

2nd edition, September 2002

Original

R

Structures built over railway lines - Construction requirements in the track zone

Constructions situées au-dessus des voies ferrées - Dispositions constructives dans la zone des voies
Überbauung von Bahnanlagen - Bautechnische Maßnahmen im Gleisbereich



UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

Leaflet to be classified in Volume :

VII - Way and works

Application :

With effect from 1 January 2003

All members of the International Union of Railways

This leaflet applies to standard gauge lines

Record of updates

1st edition, January 1997

First issue

2nd edition, September 2002

This edition updates the recommendations for class B structures for speeds up to 300 km/h. It includes other minor editorial changes.

The person responsible for this leaflet is named in the UIC Code

Warning

No part of this publication may be copied, reproduced or distributed by any means whatsoever, including electronic, except for private and individual use, without the express permission of the International Union of Railways (UIC). The same applies for translation, adaptation or transformation, arrangement or reproduction by any method or procedure whatsoever. The sole exceptions - noting the author's name and the source - are "analyses and brief quotations justified by the critical, argumentative, educational, scientific or informative nature of the publication into which they are incorporated".

(Articles L 122-4 and L122-5 of the French Intellectual Property Code).

© International Union of Railways (UIC) - Paris, 2002

Printed by the International Union of Railways (UIC)
16, rue Jean Rey 75015 Paris - France, September 2002
Dépôt Légal September 2002

ISBN 2-7461-0480-6 (French version)
ISBN 2-7461-0481-4 (German version)
ISBN 2-7461-0482-2 (English version)

Contents

Summary	1
1 - General.....	2
2 - Classification of structures.....	3
2.1 - Class A structures.....	3
2.2 - Class B structures.....	3
3 - Factors influencing recommended measures.....	4
3.1 - General factors influencing risk for Class A & Class B structures	4
3.2 - Danger zones for class A structures.....	5
3.3 - Class B structures.....	5
4 - General design principles	6
5 - Class A superstructures.....	7
5.1 - Field of application.....	7
5.2 - Group allocation.....	7
5.3 - Basic provisions for all groups	7
5.4 - Design, equivalent static forces and other measures for supports in ZONE 2	8
5.5 - Measures in ZONE 3	10
6 - Class B superstructures.....	11
6.1 - Principles	11
6.2 - Scope	12
6.3 - Recommended preventative and protective measures for Class B structures...	12
6.4 - Method for determining the location of supports for new class B structures (taking into account other preventative and protective measures)	13
6.5 - Appraisal of measures for existing structures.....	14
6.6 - Supports for Class B structures.....	15
6.7 - Structure-specific risk analysis	16
7 - Additional measures - Protection arrangements	17

7.1 - Deflecting devices.....	17
7.2 - Absorbing devices	17
Appendix A - Provisions for Class A superstructures located within ZONE 2 and ZONE 3	18
Appendix B - Presentation of zones	20
Appendix C - Comments concerning ZONE 1 and ZONE 2	22
Appendix D - Provisions concerning Class A supports located in ZONE 1.....	23
Appendix E - Definition and list of influencing factors	25
Appendix F - Values of parameters that may be used in the risk assessment procedure for class B structures	27
Appendix G - Example of use of method for determining the optimum lateral clearance of supports for new class B structures	38
Bibliography	41

Summary

This leaflet sets out recommendations for managing the risk from derailed trains near structures built over railway lines. It distinguishes between structures that are generally occupied (for example, multi-storey office blocks) and those that may not be occupied (for example, bridges). Different methods are proposed for these two types of structure. The methods take into account those people most at risk and the likely speed range for rail traffic passing under these structures. It is made clear that, in assessing the risk, some parameters are the responsibility of the railway and not the engineer.

1 - General

The object of this leaflet is to recommend suitable measures to reduce as far as is reasonably practicable the effects of an accidental impact from a derailed vehicle against the supports of structures located above tracks and supports carrying superstructures. This leaflet refers to both preventative and protective measures (including static design measures).

The recommendations apply to the following:

- Class A structures over lines where trains travel at speeds up to and including 120 km/h,
- Class B structures over lines where passenger trains travel at speeds up to and including 300 km/h,
- Class B structures over lines where freight trains travel at speeds up to and including 160 km/h.

For class B structures, the recommended procedure requires input from the relevant authority.

2 - Classification of structures

Depending on their utilisation, structures built above tracks are divided into two classes:

2.1 - Class A structures

Superstructures supporting elevated structures that are permanently occupied (such as offices, lodgings, business premises) or serve as a temporary gathering place for people (such as theatres and cinemas) as well as all the multi-storey structures which are only subject to short-term occupancy (such as multi-storey car parks and warehouses).

2.2 - Class B structures

Superstructures not supporting elevated structures, such as roadways, road bridges, railway bridges, footbridges and similar structures. Single-storey structures not providing long-term occupancy (e.g. parking areas, warehouses) should be allocated to this class.

The provisions of this leaflet do not apply to any type of roof construction or platform awnings.

3 - Factors influencing recommended measures

3.1 - General factors influencing risk for Class A & Class B structures

3.1.1 - Class A structures

The risk from derailed trains to Class A structures built over tracks and to people affected by these structures depends upon the following:

- the number of people occupying the structure,
- the permissible speed of trains using the line,
- the number of tracks,
- the structural configuration of the structure,
- the presence of switches and crossings in the vicinity of the structure.

The following factors also affect the risk but to a lesser extent:

- the type of train using the line (passenger, freight),
- the curvature of the track.

3.1.2 - Class B structures

The risk from derailed trains to Class B structures built over the tracks and to people affected by these structures depends mainly upon the following:

- the number of people travelling in the train,
- the presence of switches and crossings,
- the permissible speed of trains using the line,
- the number of trains using the line,
- the number of tracks,
- the structural configuration of the structure.

The following factors also affect the risk but to a lesser extent:

- the number of people using the structure,
- the curvature of the track.

3.2 - Danger zones for class A structures

For Class A structures, three danger zones require consideration:

- ZONE 1: The distance from the nearest track centre line is less than 3,0 m (Appendix B, Fig. 1 - page 20)
- ZONE 2: The distance from the nearest track centre line is 3,0 and 5,0 m (Appendix B, Fig. 2 - page 20)
- ZONE 3: The area behind track ends (Appendix B, Fig. 3 - page 21)

3.3 - Class B structures

For new Class B structures, the risk from derailed trains should take into account the following factors:

- the predicted rate of derailed trains on the approach to the structure,
- the permissible speed of trains using the line,
- the predicted deceleration of derailed trains on the approach to the structure,
- the lateral distance a derailed train is predicted to travel,
- whether the line is single or not in the vicinity of the structure,
- the type of train (passenger / freight) passing under the structure,
- the predicted number of passengers in the train passing under the structure,
- the frequency of trains passing under the structure,
- the presence of switches and crossings on the approach to the structure,
- the static system (structural configuration) of the structure and the robustness of the supports,
- the location of the supports to the structure relative to the tracks.

The following factors also affect the risk from derailed trains, but to a lesser extent:

- the curvature of the track in the vicinity of the structure,
- the number of tracks, where there are more than two.

The effect that any preventative and protective measures proposed have on other parts or other users of the adjacent infrastructures should also be taken into account. This includes for example the effects on signal sighting distances, authorised access, and other safety considerations relating to the layout of the track.

4 - General design principles

The design of the structure should also take into account the factors influencing the risk as set out in point 3 - page 4.

When designing structures that are to be built over tracks, the reasonably foreseeable development of railway infrastructure, particularly the track layout and the structural clearances, should be taken into consideration.

For class A structures covering large areas and characterised by a large number of supports, the areas under the construction which are unobstructed by supports should be as large as possible in order for subsequent modifications of the track to be carried out. A plan with a description and graphical representation of all supports, detailing the allocated zone and group, should be produced for acceptance by the relevant authority.

The structure (including the supports) should also be designed so that the installation of temporary structures required during the construction phase and future maintenance can be carried out as far as possible without interfering with traffic operations.

5 - Class A superstructures

5.1 - Field of application

The following provisions apply to the design and construction of supports (walls, wall-type sections and columns) which have to carry loads from the elevated structures and are located within Zones 2 and 3. For supports situated within Zone 1 separate provisions should be laid down by the railway. The provisions laid down in Appendix D - page 23 may be used as a basis for these.

5.2 - Group allocation

Supports situated within ZONE 2 are allocated to the following groups depending on track utilisation (type of traffic, maximum permissible speed) of each track running alongside them. The track with the highest occupancy rate or the greater maximum speed will determine the group classification.

- Group 1: Supports alongside tracks with a regular service of trains running at speeds of between 50 km/h and 120 km/h, and trains with rolling stock that does not meet the latest standards and running at a maximum speed of 100 km/h.
- Group 2: Supports alongside tracks with a regular service of trains running at a maximum speed of 50 km/h.
- Group 3: Supports alongside tracks used only for shunting or marshalling (maximum speed of 20 km/h).

When allocating supports to one of the 3 groups, attention should be given, if possible not only to current track utilisation but also to the anticipated future alterations in the pattern of utilisation.

5.3 - Basic provisions for all groups

5.3.1 - Equivalent loads for derailments

When dimensioning the supports, the impact forces exerted by derailed vehicles on the supports should be taken into account in the form of horizontal equivalent loads acting at a height of 1,80 m above the top of the rail in the direction stipulated under the following paragraphs.

In addition to these equivalent loads, all permanent loads together with the applied traffic loads should be taken into consideration.

Also, the effect of the equivalent loads on the immediately - adjacent structural member of the superstructure above the relevant supports and on the foundations below should be taken into consideration if these are immediately under the relevant supports.

5.3.2 - Supports situated on platforms

For supports situated on platforms or loading ramps with a minimum height of 38 cm above the top of the rail, the equivalent loads allocated to the respective groups may be reduced by half.

The total loss of individual supports does not have to be considered.

5.3.3 - Check of residual cross selection in the case of an accident

A check should be made on all supports designed to resist equivalent loads to see that half the cross section can support all anticipated loads from the superstructure.

5.4 - Design, equivalent static forces and other measures for supports in ZONE 2

5.4.1 - Group 1 supports

5.4.1.1 - Design

1. In principle, supports should be designed as continuous walls. The provision of non-continuous walls, in other words walls constructed from individual wall-type sections, is permissible.
2. If the wall is built up from a number of wall-type sections, collapse of the superstructure due to impact from derailed railway vehicles should be prevented by choosing adequate dimensions for the individual sections. The dimensions, particularly the length of the sections parallel to the track, should be chosen in such a way that total loss of load-bearing capacity due to the impact of a derailed train cannot be expected.

Minimum dimensions:

$$L:W = 4:1 \quad W \geq 0,8 \text{ m} \quad L \geq H/2$$

Where

L =	length of support
W =	width of support
H =	height of support (measured from ground level)

3. If platforms or elevated foundations with a height of 55 cm or preferably 76 cm above the top of the rail are provided, supports do not have to be designed as walls.

5.4.1.2 - Equivalent loads

All walls and wall-type sections should be designed for an equivalent load of:

1. 4 000 kN parallel to the track axis and,
2. 1 500 kN at right angles to the track axis.

The design should be checked for each load case separately

5.4.1.3 - Other measures

If, in individual cases, the minimum dimensions cannot be chosen in compliance with point 5.4.1.1, total loss of these supports should be assumed when designing the superstructures. Such supports should not be used as the first in a row of columns or located one after another.

5.4.2 - Group 2 supports

5.4.2.1 - Design

1. Supports should be designed in accordance with point 5.4.1.1 - page 8.
2. If this is not possible due to technical reasons, they may be designed as individual columns.

A crash barrier should be provided in front of the first column in a row or in front of any column that is located in an area where there is a high risk of derailment. These crash barriers should be designed in such a way as to provide for the deflection function and should be easily replaceable.

3. To protect supports subject to an impact risk, a platform or an elevated foundation with a minimum height of 55 cm above the top of the rail should be provided.

5.4.2.2 - Equivalent loads

The supports as well as the crash barriers should be designed to withstand an equivalent load of:

1. 2 000 kN parallel to the track axis and,
2. 750 kN at right angles to the track axis.

The design should be checked for each load case separately.

5.4.2.3 - Other measures

The design should allow for the loss of one column following an accident. The loss of several columns arranged one after the other in the track direction does not have to be considered.

5.4.3 - Group 3 supports

5.4.3.1 - Design

1. If required for operational reasons (to give better visibility for shunting operations), supports should, in general be designed as individual columns, otherwise the wall-type sections should be preferred to individual columns.
2. Crash barriers in accordance with the provisions of point 5.4.2.1 (2) should be arranged in front of the first column in a row or in front of columns which are at risk because they are located within switching zones. In addition to crash barriers, the provision of a check rail is recommended if this is technically possible.
3. If a check rail is provided, it should be installed over a minimum length of 30 m before approaching the support.

5.4.3.2 - Equivalent loads

1. All columns and crash barriers should be dimensioned for an equivalent load of:
 - a. 2 000 kN parallel to the track axis and