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Translation

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Recommendations for the consideration of fatigue in the design of steel railway bridges, especially with orthotropic decks

Recommandations relatives aux facteurs de fatigue à considérer lors du dimensionnement des ponts ferroviaires en acier, notamment des dalles orthotropes

Empfehlungen zur Berücksichtigung der Ermüdung bei der Bemessung stählerner Eisenbahnbrücken, insbesondere mit orthotropen Platten



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Contents

Summary	1
1 - Introduction	2
1.1 - Advantages of orthotropic decks	2
1.2 - Disadvantages of orthotropic decks.....	2
1.3 - Purpose of the leaflet.....	3
2 - Design of railway bridges with orthotropic decks	4
2.1 - Static design	4
2.2 - Fatigue design	5
3 - Constructional details	6
4 - Technology	7
Appendix A - Fatigue strength at various details of orthotropic decks	8
Appendix B - Construction details	10
Bibliography	13

Summary

Fatigue-related factors to be considered in the design of steel railway bridges are henceforth addressed in *Eurocode 3, Part 2, Chapter 9* (see Bibliography).

UIC Leaflet 778-1 is the result of studies undertaken as part of the ERRI D 191 research programme and the European Union research programme. The leaflet sets out additional information on fatigue assessment of metallic railway bridges with orthotropic decks, particularly relating to the way in which the European standard should be applied to constructions of this type.

The orthotropic deck of a railway bridge serves as a deck plate, distributing load and ballast, supported by main and cross girders and, frequently, stiffened by longitudinal ribs. The ribs pass through the web of the cross girder.

The deck displays different static characteristics in two orthogonal directions.

UIC Leaflet 778-1 classifies the details of the deck into several weld categories. It gives instructions for designing the deck so as to avoid fatigue failure.

1 - Introduction

A steel railway bridge with an orthotropic deck represents an integral spatial structure in which the orthotropic deck serves as a deck plate, distributing load and ballast, supported by main and cross girders and, frequently, stiffened by longitudinal ribs. The ribs pass through the web of the cross girder. Today, non-continuous ribs are hardly ever used on railway bridges and the deck displays different static characteristics in two orthogonal directions (orthotropic = orthogonally anisotropic).

Different forms of longitudinal rib are used; box ribs with closed cross section (trapezoidal or triangular form) and open ribs or ribs of rolled steel (I-form).

1.1 - Advantages of orthotropic decks

- Low construction depth enabling correct track layout even where space is limited (in towns).
- Low-weight steel structure.
- Continuous ballast bed, allowing mechanisation of track maintenance, and keeping the noise level down to that of the track.
- Symmetrical welds on the open ribs, ensuring good penetration.
- The flat ribs contain no un-maintainable closed spaces where water, condensation, moisture and dirt could accumulate.
- Rounded edges of stringers with closed cross-section enable a complete covering of anti-corrosion paint to be applied.

1.2 - Disadvantages of orthotropic decks

- Being fully welded, orthotropic decks are sensitive to fatigue under dynamic loads.
- Asymmetrical welds on closed ribs do not allow full penetration.
- Water, humidity, moisture and dirt could accumulate in the closed cross sections of longitudinal ribs and cause corrosion if the design and welding process are not correct.

1.3 - Purpose of the leaflet

The leaflet is based on *Eurocode 3, Part 2, Chapter 9* (see Bibliography - page 13) and focuses on those aspects of the problem that are important for railway bridges. It is based on the studies carried out as part of the *ERRI D 191* research programme and that of the European Union.

The leaflet shows the application of *Eurocode 3* to the fatigue assessment of steel railway bridges with orthotropic decks and classifies the details of the deck into several weld categories. It gives instructions for designing the deck so as to avoid fatigue failure.