

3rd edition, March 2003

*Translation*

# OR

## **Static loading diagrams to be taken into consideration for the design of rail carrying structures on lines used by international services**

*Modèles de charge à prendre en considération dans le calcul des ouvrages sous rail sur les lignes  
internationales*

*Ruhende Lastbilder für die Berechnung der Tragwerke internationaler Strecken*



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

## **Leaflet to be classified in Volume :**

Chapter VII - Way and Works

## **Application :**

With effect from 1 January 2003

All members of the International Union of Railways

## **Record of updates**

### **1st edition, January 1967**

First issue under the title: "Loading diagram for the calculation of rail carrying structures on lines used by international services"

### **2nd edition, January 1974**

### **3rd edition, March 2003**

Addition of the Load Model 2000  
Retyped in FrameMaker  
New lay-out

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

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# Contents

Summary .....	1
1 - Load Models 71 and SW/0 .....	2
2 - Load Model 2000 .....	4
Appendix A - Rules for application of LM71and LM SW/0 .....	5
Appendix B - Rules for application of LM2000.....	7
Glossary .....	9
Bibliography .....	10

## Summary

*UIC Leaflet 702* contains rules governing vertical static rail traffic loads (characteristic values) required for the calculation of rail structures on international lines.

Section 1 lists two load models, **Load Model 71** and **Load Model SW/O** which are obligatory for member railway companies.

Section two contains the recommended **Load Model 2000**, designed to take on board the future trend towards higher axle and metric loads (rail freight network).

Reference is made to the theoretical principles underpinning the load models in order to create a link with rolling stock and its load. The leaflet also specifies how the load models should be taken into account during calculations.

Other information required for the calculation of rail structures in connection with Load Models 71 and SW/O, such as effects (e.g. heavy haul, dynamic effects, centrifugal force, braking, starting, etc.) load combinations and  $\gamma$  and  $\psi$  values should be taken from *UIC Leaflet 776*.

Rules governing the permissible axle and metric loads in traffic are set out in *UIC Leaflet 700*.

## 1 - Load Models 71 and SW/0

1.1 - Rail carrying structures on international routes shall be designed to carry the vertical static loads shown in the following diagrams (the loads are nominal values that may be used as characteristic values with appropriate safety factors):

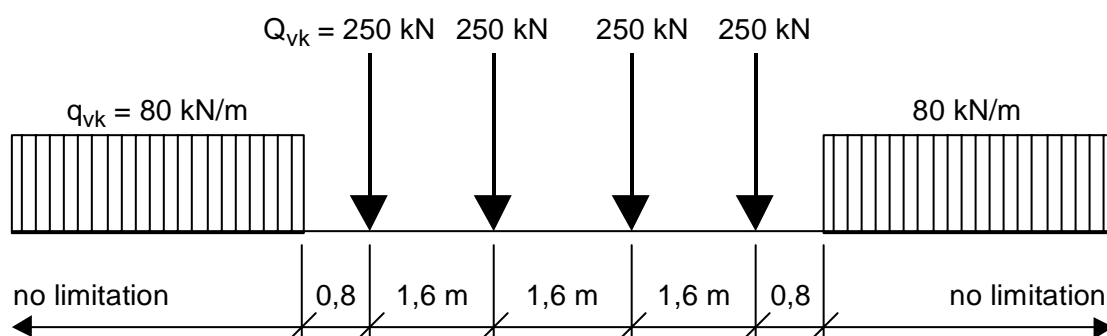


Fig. 1 - Load Model 71

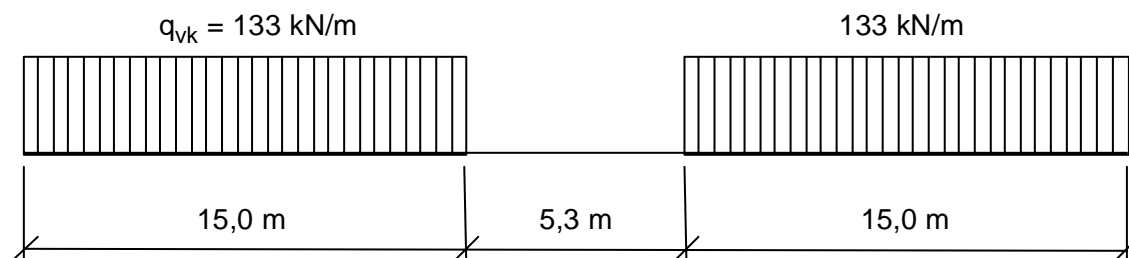


Fig. 2 - Load Model SW/0

1.2 - All continuous beams and similar constructions designed for Load Model 71 shall be checked additionally for Load Model SW/0.

1.3 - The loads shall be placed in the most unfavourable position for the part of the structure in question. Loads which produce a relieving effect shall be neglected.

1.4 - Rules for application see appendix A - page 5 and UIC Leaflet 776-1 (see Bibliography - page 10).

1.5 - Railway companies may use, if they consider this advisable for their internal traffic, heavier loading than LM71 and SW/0 on international lines, or lighter loading on other lines.

For international lines Load Models 71 and SW/0 (individual loads and loads per linear metre) may be classified by a factor 1,10 - 1,21 - 1,33 or 1,46.

For other lines Load Models 71 and SW/0 may be classified by a factor 0,75 - 0,83 or 0,91.

**1.6** - In the design of new hauled vehicles and motive power units to be used in international traffic, the limits resulting from the static and dynamic effects of the six service trains (*UIC Leaflet 776-1*) (see [Bibliography - page 10](#)) must not be exceeded (for simply supported and continuous girders). The running conditions in international traffic of hauled vehicles and motive power units, on various categories of lines are to be in accordance with the regulations of *UIC Leaflet 700* (see [Bibliography - page 10](#)).

**1.7** - The running of special vehicles carrying exceptional loads on international lines shall form the subject of special agreements between Railway companies.

**1.8** - On lines where high speed passenger trains operate ( $V > 200$  km/h), the dynamic loading shall be taken into account in accordance with *UIC Leaflet 776-2* (see [Bibliography - page 10](#)).

**1.9** - For the future constructions of the international rail freight network, see also point [2.6 - page 4](#).

## R 2 - Load Model 2000

2.1 - To take account of the future development of vertical rail traffic loads, rail carrying structures on international lines may be designed to carry the loads shown in the following diagram (the loads are nominal values that may be used as characteristic values with appropriate safety factors):

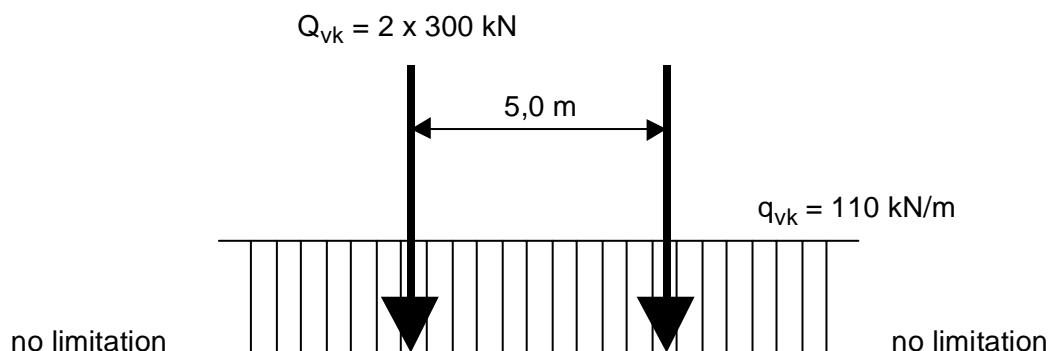


Fig. 3 - Load Model 2000

Load Model 2000 covers Load Models 71 and SW/0 (see fig. 1 and fig. 2 - page 2) (with classification factor of 1,0).

2.2 - The loads shall be placed in the most unfavourable position for the part of the structure in question. Loads which produce a relieving effect shall be neglected.

2.3 - Rules for application see Appendix B - page 7.

2.4 - Railway companies may use, if they consider this advisable for their international traffic, heavier loading than LM2000 on international lines, or lighter loading on other lines.

The concentrated loads and the loads per metre may be multiplied by a classification factor 1,10 - 1,21 or 1,33.

2.5 - In the design of new hauled vehicles and motive power units to be used in international traffic, the limits resulting from the static and dynamic effect of the 124 service trains (*ERRI D192 RP1*) (see [Bibliography - page 10](#)) must not be exceeded (for simply supported and continuous girders). The running conditions in international traffic of hauled vehicles and motive power units, on various categories of lines are to be in accordance with the regulations of *UIC Leaflet 700* (see [Bibliography - page 10](#)).

2.6 - As an alternative to LM2000,  $1,33 \times \text{LM71}$  is recommended for the future constructions of the international freight network.

## Appendix A - Rules for application of LM 71 and LM SW/0

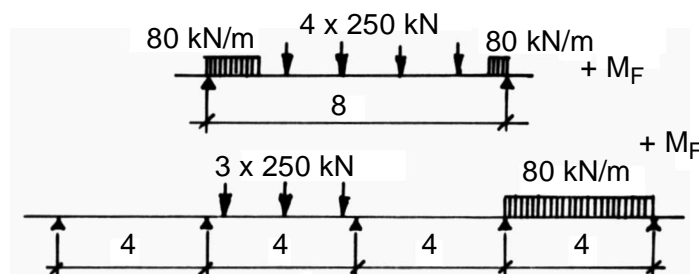
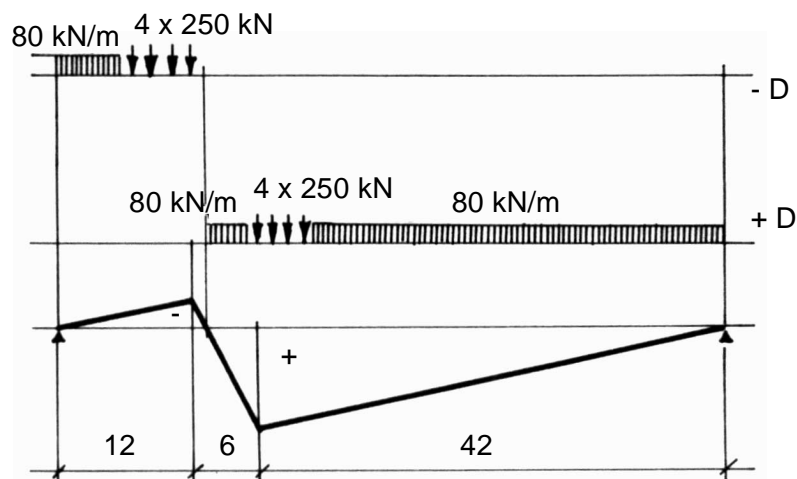
**A.1** - For the determination of the most adverse load effects from the application of Load Model 71:

- any number of lengths of the uniformly distributed load  $q_{vk}$  shall be applied to a track and up to four of the individual concentrated loads  $Q_{vk}$  shall be applied once per track,
- for elements carrying two tracks, Load Model 71 shall be applied to either track or both tracks,
- for bridges carrying three or more tracks, Load Model 71 shall be applied to any one track, any two tracks or 0,75 times Load Model 71 to three or more of the tracks.

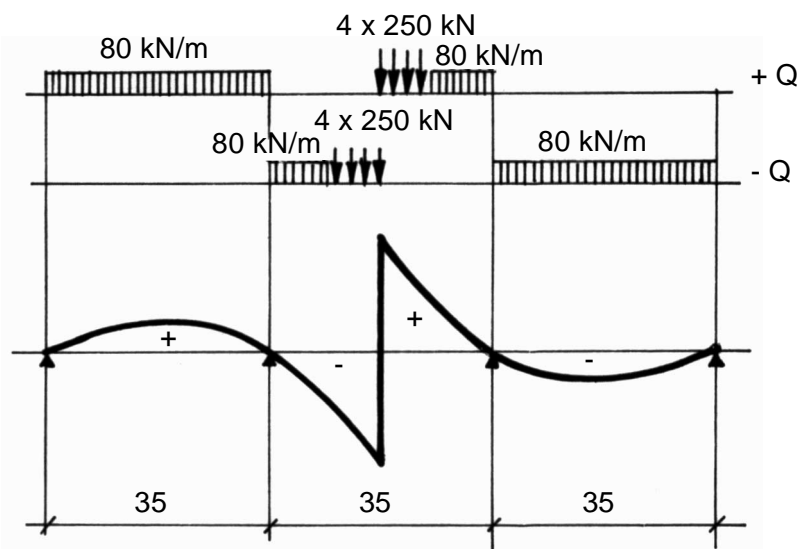
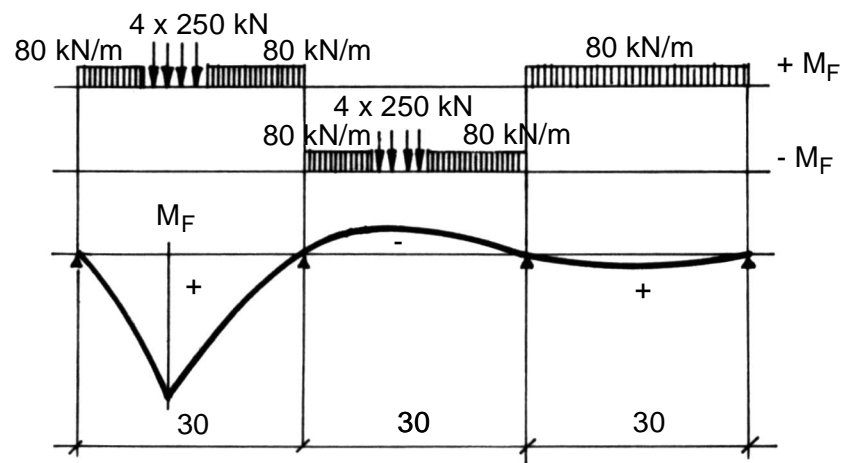
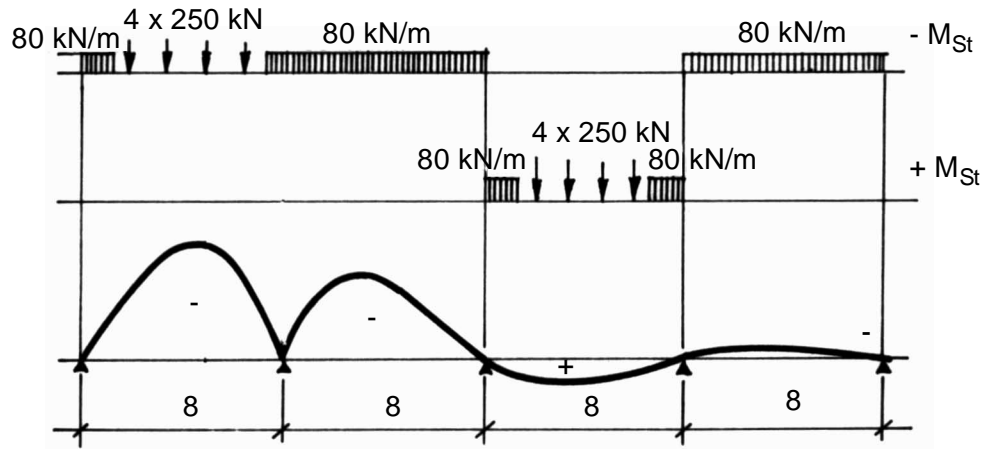
**A.2** - For the determination of the most adverse load effects from the application of Load Model SW/0:

- Load Model SW/0 shall be applied once to a track,
- for elements carrying two tracks, Load Model SW/0 shall be applied to either track or both tracks,
- for bridges carrying three or more tracks, Load Model SW/0 shall be applied to any one track, any two tracks or 0,75 times Load Model SW/0 to three or more of the tracks.

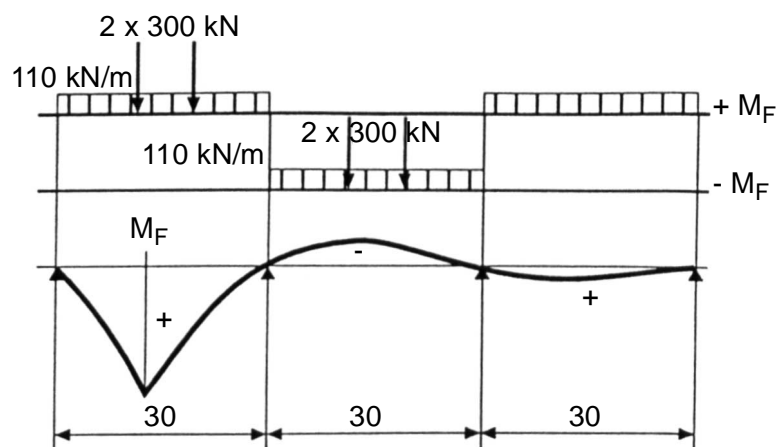
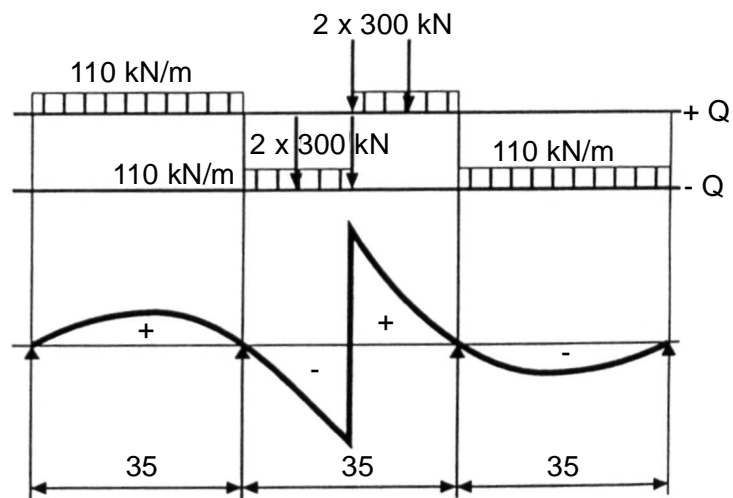
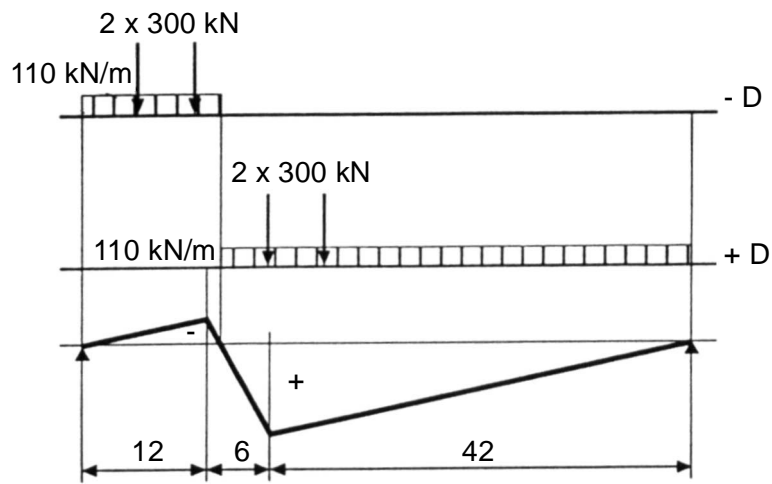
**A.3** - For the application of influence lines, the examples shown for Load Model 71 may be used as specimens:

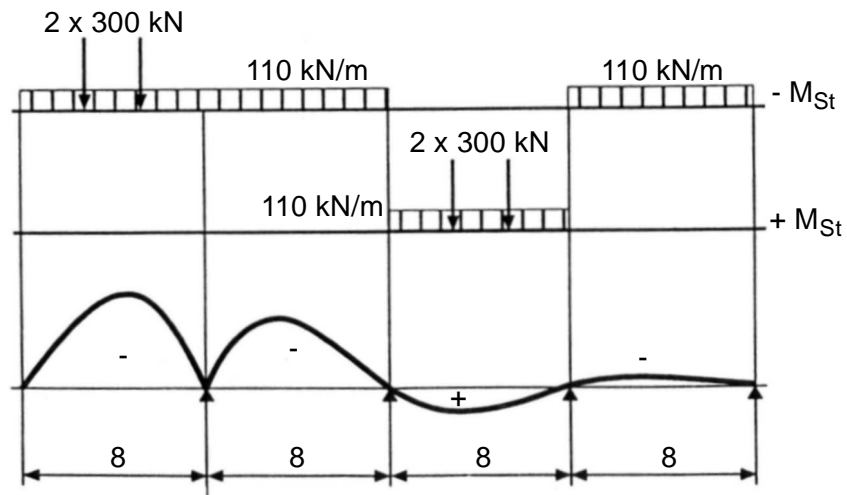
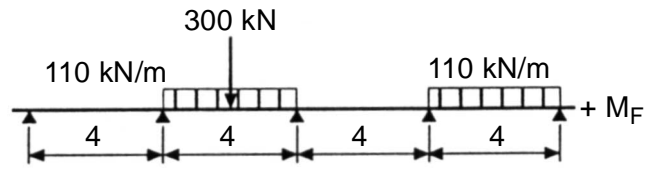






## Appendix B - Rules for application of LM 2000





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## Glossary

**TSI**

Technical specification for interoperability

# Bibliography

## 1. UIC leaflets

### International Union of Railways

*Leaflet no. 700: Classification of lines and resulting load limits for wagons, 9th edition of 1.7.87 and 2 Amendments*

*Leaflet no. 776-1: Loads to be considered in railway bridge design, 4th edition of 1.7.94*

*Leaflet no. 776-2: Bridges for high and very high speeds, 1st edition of 1.7.76*

## 2. Minutes of meetings

### International Union of Railways

*5th-7th Committees (Preparation of a universal test train of the future for international lines), May 1963*

*5th-7th Committees (Preparation of a universal test train of the future for international lines), May 1964*

*5th-7th Committees (Preparation of a future load distribution diagram for international lines), May 1965*

*5th-7th Committees (Preparation of a future load distribution diagram for international lines), May 1966*

*Way and Works Committee (Preparation of rules for applying the UIC loading diagram), May 1967*

*Way and Works Committee (New loading diagram to be taken into consideration in the calculation of rail carrying structures on international lines - Revision of Leaflet no. 702), June 1973*

*Infrastructure Commission (Plenary session - Conclusions), June 2002*

## 3. ERRI reports

### European Railway Research Institute

*D192/RP1: Theoretical basis for verifying the present UIC 71 loading, 1.3.93*

*D192/RP2: Comparison of present and future rail traffic on international lines with UIC 71 loading based on deterministic calculation, 1.4.94*

*D192/RP3: Comparison of the effects of current and future rail traffic on international lines with the effects from UIC 71 loading on a probabilistic basis, 1.12.94*

*D192/RP4: Study of the construction costs of railway bridges with consideration of the live load diagram, 1.5.96*

*D192/RP5: Loading diagram to be taken into consideration for the calculation of rail-carrying structures on lines used by international services, 1.11.96*

*D214/RP1: Literature Summary - Dynamic behaviour of railway bridges, 1.11.99*

*D214/RP2: Recommendations for calculation of bridge deck stiffness, 1.12.99*

*D214/RP3: Recommendations for calculating damping in rail bridge decks, 1.11.99*

*D214/RP4: Train-bridge interaction, 1.12.99*

*D214/RP5: Numerical investigation of the effect of track irregularities at bridge resonance, 1.12.99*

*D214/RP6: Calculation for bridges with simply-supported beams during the passage of a train, 1.12.99*

*D214/RP7: Calculation of bridges with a complex structure for the passage of traffic - Computer programs for dynamic calculations, 1.12.99*

*D214/RP8: Confirmation of values against experimental data.*

*Part A: Rig tests to investigate ballast behaviour on bridges due to high acceleration levels - Confirmation of the acceleration limit for the ballast.*

*Part B: Comparison of calculations and measurements using simplified models of rail bridges - Confirmation of the validity of the calculated values, 1.12.99*

*D214/RP9: Final Report.*

*Part A: Synthesis of the results of D 214 research.*

*Part B: Proposed UIC Leaflet, 1.12.99*

## **4. European standards**

### **European Committee for Norms**

*EN 1991-2: Traffic loads on bridges, 2003*

*EN 1990: Basis of structural design, 2002*

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