

# Interface between Rail Vehicle Weights and Underline Bridges

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## Synopsis

This document sets out the requirements for managing the risk of overloading of underline bridges by rail vehicles

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# Interface between Rail Vehicle Weights and Underline Bridges

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## Part A

### Issue Record

This Standard will be updated when necessary by distribution of a complete replacement.

Issue	Date	Comments
One	December 2000	Original Document but replaces GC/TT0138 Route Availability System

### Technical Content

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### Responsibilities

Railway Group Standards are mandatory on all members of the Railway Group \* and apply to all relevant activities that fall into the scope of each individual's Railway Safety Case. If any of those activities are performed by a contractor, the contractor's obligation in respect of Railway Group Standards is determined by the terms of the contract between the respective parties. Where a contractor is a duty holder of a Railway Safety Case then Railway Group Standards apply directly to the activities described in the Safety Case.

\* The Railway Group comprises Railtrack and the duty holders of the Railway Safety Cases accepted by Railtrack.

### Compliance

Compliance with section 4 is required by April 2001 for new and reconstructed underline bridges brought into use after 1 February 2001.

For the derivation of route capacity or capacities, action plans for meeting the requirements of section 5 of this document shall be in place by June 2001 with a target date for achieving compliance by December 2006.

Compliance with section 6 is required by April 2001 for all vehicles for which a design scrutiny certificate is signed after 1 February 2001.

Compliance is required for the classification of vehicles by December 2001 where no RA classification is currently recorded (section 6).

Any Railway Group member deviating from the requirements set out in this document shall ensure that the situation is regularised in accordance with the requirements of GA/RT6001, GA/RT6004, or GA/RT6006.

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## Health and Safety Responsibilities

In issuing this Standard, Railtrack PLC makes no warranties, express or implied, that compliance with all or any Railway Group Standards is sufficient on its own to ensure safe systems of work or operation. Each user is reminded of its own responsibilities to ensure health and safety at work and its individual duties under health and safety legislation.

## Supply

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## Part B

### 1 Purpose

The purpose of this document is to manage the risk of overloading of underline bridges by rail vehicles.

### 2 Scope

The overall scope of Railway Group Standards is as specified in Appendix A of GA/RT6001.

Specifically the contents of this document apply to all underline bridges on Railtrack controlled infrastructure and all rail vehicles running or proposed to run on Railtrack controlled infrastructure, with the limitations set out below.

The scope is limited to:

- a) maximum speeds up to and including 125mph for all rail vehicles except freight vehicles, but including non-passenger carrying coaching stock (for example vehicles used for carrying parcels and / or mail);
- b) maximum speeds up to and including 75mph for freight vehicles;
- c) on-track machines in travelling mode (on-track machines operating within a track possession are excluded).

This document contains requirements applicable to the duty holder of the following categories of Railway Safety Cases:

- a) Infrastructure Controller;
- b) Train Operator.

### 3 Definitions

#### Assessed Capacity

The safe load capacity of a bridge (including appropriate dynamic effects) as determined by assessment in accordance with GC/RT5100.

#### Bridge

A structure of one or more spans whose prime purpose is to carry traffic or services across an obstruction or gap.

#### Bridge Related Speed Restriction

A speed restriction less than the permissible speed imposed on certain types of rail vehicles at an underline bridge location because of the assessed capacity of the underline bridge.

#### Loaded Length

The loaded length for the structural member under consideration is the length of the appropriate influence line within which the loads produce adverse effects.

#### Long Span Underline Bridge

For the purposes of this document, an underline bridge of which one or more spans exceeds 50 metres in length. Where an underline bridge is supported on bearings the span is measured by reference to the length of track supported between bearings. For arch underline bridges, the span is measured between springings.

#### Maximum Rail Vehicle Speed

The maximum speed at which a rail vehicle is permitted to run as determined by the characteristics of the rail vehicle and as set out in the mandatory data for rail vehicles in GM/RT2211.

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## Maximum Train Speed

The maximum speed at which a train is permitted to run as determined by the lowest maximum speed of any rail vehicle which is included in the formation of the train.

## Permissible Speed

The maximum permitted speed as shown in the Sectional Appendix.

## Route Availability Classification

Route Availability (RA) Classification is a term used (but not defined) in Appendix A of GM/RT2211 and taken for the purposes of this document as having the same meaning as RA Number.

## Rolling Stock Library

Rolling Stock Library (RSL) is the national central database of rail vehicle design, and operational data, which is maintained by the Infrastructure Controller's authorised agent (currently Sema Group for Railtrack).

## Route

A section of track bounded by identified limits such as junctions, terminals.

## Route Availability Number

Route Availability (RA) Number is the number derived in accordance with the provisions of this Railway Group Standard to express either of the following:

- a) the assessed capacity of an underline bridge or route in terms of its capacity to carry the vertical static and dynamic loads due to different types of rail vehicle;
- b) the static load characteristics of a rail vehicle type.

For on-track machines, the static load characteristics of the rail vehicle are those applicable to the rail vehicle when in travelling mode.

## Rail Vehicle

A single locomotive, on-track machine (including cranes), freight wagon or passenger coach or a number of wagons or coaches which normally operate coupled together in fixed formation (eg, passenger multiple-units or cranes).

## Underline Bridge

A bridge carrying one or more operational railway tracks.

## 4 Derivation, Recording and Review of Assessed Capacity or Capacities of an Underline Bridge

### 4.1 Assessment of Underline Bridges

GC/RT5100 gives general requirements for assessment of bridges including underline bridges.

### 4.2 Derivation of RA Number(s) of an Underline Bridge except Long Span Underline Bridges

The assessed capacity of an underline bridge in terms of the RA Number shall be derived in accordance with the provisions of Appendix A.

For each underline bridge (except as given below for long span underline bridges), the Infrastructure Controller shall determine the assessed capacity in terms of the RA Number at the permissible speed.

In addition, the Infrastructure Controller shall determine the assessed capacity of each underline bridge at speeds of 60mph, 75mph and 90mph where these speeds are less than the permissible speed and where the RA Number of the relevant route at the permissible speed is less than RA10.

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It is permissible for the Infrastructure Controller to determine the assessed capacity of underline bridges in terms of the RA Number at other speeds.

Where no assessed capacity of an underline bridge exists, it is permissible for the Infrastructure Controller to assign an RA Number or RA Numbers to an underline bridge based on current knowledge of its condition, use and behaviour. The justification for the RA Number assigned shall be recorded. The assigned RA Number(s) shall be reviewed when an assessment of the underline bridge in accordance with GC/RT5100 has been carried out.

### 4.3 Recording of RA Number(s) and Associated speeds of Underline Bridges except Long Span Underline Bridges

The Infrastructure Controller shall record the RA Number of each underline bridge in a form that clearly identifies the RA Number of the route at the permissible speed and at other speeds as identified in section 4.2 (for example in tabular form).

### 4.4 Derivation of RA Number(s) of a Long Span Underline Bridge

In the case of long span underline bridges, the assessed capacity shall be determined as in section 4.2 except that the assessed capacity shall be determined in terms of the rail vehicles that are permitted to cross the underline bridge and not in terms of the load model set out in Appendix A.

### 4.5 Recording of Assessed Capacity or Capacities and Associated Speed(s) of Long Span Underline Bridges

The assessed capacity of a long span underline bridge shall be recorded in terms of a train of the heaviest rail vehicle type(s) that is permitted to cross the long span underline bridge.

The rail vehicles shall be positioned so as to give the most severe effect for the underline bridge element being considered.

It is permissible for the static load effects of rail vehicles to be assessed using an envelope representing the static load effects of a class or category of rail vehicles so long as the envelope has been validated by the Infrastructure Controller for all relevant spans. In all cases however the assessed capacity of the long span underline bridge shall include the dynamic effects of the rail vehicles.

For such underline bridges the assessed capacity shall be recorded in the form "RA(LS)", where (LS) indicates that the assessed capacity has been derived in terms of rail vehicles and not in terms of the RA Number.

The record shall set out the details of the rail vehicle type(s) and speeds, and/or rail vehicle envelope(s) and speed(s) to which the assessed capacity relates.

### 4.6 Review of the Assessed Capacity of an Underline Bridge

The Infrastructure Controller shall review the assessed capacity of an underline bridge as derived in accordance with sections 4.2 and 4.4 and amend it if necessary in the following circumstances:

- a) whenever it is proposed to change the permissible speed at the underline bridge location;
- b) whenever the assessed or assigned capacity of the underline bridge has changed.



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## 5 Derivation, Recording, Publishing and Review of Assessed Capacity or Capacities of a Route

### 5.1 Derivation of RA Number(s) of Routes where there are no Long Span Underline Bridges

For each route, except those containing long span underline bridges, the Infrastructure Controller shall determine the RA Number for the route at the permissible speed and at the speeds identified in section 4.2 where applicable.

The RA Number of the route at the permissible speed shall be the minimum RA Number of any underline bridge on the route calculated or assigned at the permissible speed.

The RA Number of the route at other speeds shall be the minimum RA Number of all underline bridges on the route calculated or assigned at the speed being considered (ie, 60mph, 75mph or 90mph as appropriate).

The Infrastructure Controller shall record the RA Number of each route in a form that clearly identifies the RA Number of the route at the permissible speed and at other speeds identified in section 4.2 (for example in tabular form).

### 5.2 Additional Derivation of Assessed Capacity or Capacities of Routes containing Long Span Underline Bridges

Where a route contains one or more long span underline bridges, the RA Number of the route shall be recorded as above except that in addition the record shall include:

- a) a reference to the presence of the long span underline bridge(s);
- b) details appropriate to each long span underline bridge of the rail vehicle type(s) or envelope(s) and speed(s) recorded in accordance with section 4.5.

### 5.3 Accessibility of RA Number(s) and Other Capacity or Capacities of a Route

The Infrastructure Controller shall publish in the Sectional Appendix, and make available to the relevant train operator(s), a register of the RA Numbers of all routes as identified in sections 5.1 and 5.2.

### 5.4 Review of the Assessed Capacity of a Route

The assessed or assigned capacity of a route as derived in sections 5.1 and 5.2 shall be reviewed and amended if necessary in either of the following circumstances:

- a) whenever it is proposed to change the permissible speed at any underline bridge location on the route;
- b) whenever the assessed or assigned capacity of any of the underline bridges on the route as derived in accordance with either section 4.2 or 4.4 has changed.

## 6 Derivation, Recording, Publishing and Review of RA Number and Speed of a Rail Vehicle

### 6.1 Derivation of RA Number of a Rail Vehicle

For each type of rail vehicle running or proposed to run on Railtrack controlled infrastructure, the relevant train operator shall ensure that the RA Number of the rail vehicle type is derived in accordance with the provisions of Appendix A.

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The train operator shall have procedures in place to establish the RA Number and the maximum speed of a rail vehicle where this information is not previously recorded.

### 6.2 Maximum Speed of a Rail Vehicle

For each type of rail vehicle running or proposed to run on Railtrack controlled infrastructure, the relevant train operator shall ensure that the maximum speed of the rail vehicle is established.

### 6.3 Vehicle Details to be Established

For each type of rail vehicle running or proposed to run on Railtrack controlled infrastructure, the relevant train operator shall ensure that the following information relating to the rail vehicle type is established when required in accordance with sections 7.1.2 and 7.2:

- a) details of spacings between the axles and distance between each end of the rail vehicle and the adjacent axle;
- b) the maximum static tare weight on each axle;
- c) the static weight on each axle when the rail vehicle is loaded to its authorised limit (as set out in the mandatory data for the vehicle required by GM/RT2453);
- d) maximum height of the centre of gravity of the loaded rail vehicle.

The end of the rail vehicle shall be taken as the face of the buffers or, for rail vehicle ends with no buffers, midway between the headstock of the rail vehicle and the headstock of a rail vehicle of the same type coupled to it (the coupling plane).

### 6.4 Accessibility of Rail Vehicle Information

The train operator shall publish and make available to the infrastructure controller the information required in sections 6.1, 6.2 and 6.3.

GM/RT2453 requires that, for all rail vehicles, the RA Classification (RA Number) and maximum speed be included in the rail vehicle data to be maintained in the Rolling Stock Library database.

### 6.5 Review of Rail Vehicle Information

GM/RT2000 sets out the requirements for reviewing rail vehicle information in the following circumstances:

- a) whenever it is proposed to change the maximum authorised axle load of the rail vehicle;
- b) whenever it is proposed to alter the maximum speed of the rail vehicle.

## 7 Procedure for Permitting a Train to Operate

### 7.1 Procedure for Routes where there are no Long Span Underline Bridges

#### 7.1.1

Provided that there are no long span underline bridges on the proposed route of a train and provided that either or both of the following conditions apply:

- a) the maximum RA Number of every rail vehicle in the train is equal to or less than the RA Number of the route at the permissible speed;

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- b) the maximum RA Number of every rail vehicle in the train is equal to or less than the RA Number of the route quoted at a particular speed and the maximum speed of the train is equal to or less than this particular speed;

it is permissible for the train to run as regards the assessed or assigned capacity of underline bridges.

### 7.1.2

Where the conditions set out in section 7.1.1 are not met, the train operator shall supply the Infrastructure Controller with the information identified in section 6.3 and apply to the Infrastructure Controller for an assessment to be made of whether the rail vehicle(s) is/are permitted to pass over the route as regards the assessed or assigned capacity of underline bridges.

When the Infrastructure Controller receives a request from a train operator for such an assessment to be made the following shall be taken into account:

- a) any bridge related speed restrictions that are necessarily imposed at certain underline bridges in order to reduce dynamic loading effects;
- b) any limitations on the loading of the rail vehicles which are necessarily imposed;
- c) any other operating restrictions (for example, the use of barrier vehicles).

For the train to be permitted to run as regards the assessed or assigned capacity of underline bridges, the following conditions shall apply:

- a) the assessed or assigned capacity of every underline bridge on the route shall equal or exceed the loading (including dynamic effects as appropriate) due to the rail vehicles making up the proposed train;
- b) an exceptional load form in accordance with GO/RT3407 shall be issued by the Infrastructure Controller to the train operator and shall identify any restrictions in speed, limitations on the loading of the rail vehicles or other requirements that apply;
- c) the train operator shall communicate any relevant restrictions to the driver as set out in section 8.1.

## 7.2 Additional Procedure for Routes where there are Long span Underline Bridges

### 7.2.1

Where the proposed route of a train contains one or more long span underline bridges, the train operator shall supply the Infrastructure Controller with the information identified in section 6.3 to enable an assessment to be made of whether the rail vehicle(s) is/are permitted to pass over the long span underline bridge(s).

Provided that either or both of the following conditions apply:

- a) the maximum load effect of every rail vehicle in the train is equal to or less than the load effect of the rail vehicle or rail vehicle envelope that has been recorded in accordance with in section 4.5 at the permissible speed;
- b) the maximum load effect of every rail vehicle in the train is equal to or less than the load effect of the rail vehicle or rail vehicle envelope that has been recorded in accordance in section 4.5 quoted at a particular speed and the maximum speed of the train is equal to or less than this particular speed;

it is permissible for the train to run as regards the assessed or assigned capacity of long span underline bridges.

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### 7.2.2

Where the conditions set out in section 7.2.1 are not met, the procedure set out in section 7.1.2 shall be applied.

### 7.3 Action when the Conditions in Section 7.1 or 7.2 are not Met

If the assessed or assigned capacity of any underline bridge on the route is less than the load effects (taking into account dynamic effects as appropriate and any limitations identified in section 7.1.2) due to the rail vehicles making up the proposed train, the Infrastructure Controller shall not permit the train to run.

### 7.4 Requirements of GO/RT3270

GO/RT3270 sets out requirements in respect of information to be recorded regarding the route acceptance of rail vehicles, including "the equipment configuration, operational requirements and limitations and route constraints".

## 8 Communication of Restrictions and Changes

### 8.1 Requirements on Infrastructure Controller

GO/RT3407 sets out the requirements for the Infrastructure Controller (Railtrack) to determine route availability conditions and the supply to the train operator of conditions of travel.

### 8.2 Requirements of Train Operator

GO/RT3407 sets out the requirements for the train operator to apply conditions of travel imposed by the Infrastructure Controller (Railtrack) with advice to its train crews.

GO/RT3253 sets out the requirements for the train operator to check the speed of trains.

GM/RT2453 sets out the requirements for changes to the rail vehicle information as identified in section 6.5 to be recorded in the RSL.

# Interface between Rail Vehicle Weights and Underline Bridges

## Appendix A Derivation of RA Numbers

### A.1 Derivation of RA Number of an Underline Bridge

The load model shown in Figure A (or its metric conversion shown in Figure B) shall be applied to the underline bridge and positioned such as to give the most severe effect for the underline bridge element being considered.

Unless otherwise justified, for continuous bridges, the load model shown in Figure A shall be applied separately and simultaneously to the parts of the spans that produce unfavourable effects only. The load model shall be positioned to give the most severe effects on each loaded length.

The maximum number of units of such loading which the underline bridge has the assessed or assigned capacity to carry shall be determined (taking into account the dynamic effects of such loading at the selected speed). This number shall be rounded down to the next smaller integer and ten shall be subtracted. The resulting integer shall be called the RA Number of the underline bridge at that speed.

(Example: if the maximum number of load model units which the underline bridge has the assessed capacity to carry at a given speed is 18.7, the RA Number of the underline bridge for that speed is  $18 - 10 = 8$ .)

### A.2 Derivation of RA Number of a Rail Vehicle

Rail vehicles of the type being considered shall be taken as coupled together into trains at least 50 metres long. In the case of rail vehicles with asymmetric axle spacing or axle loads and in the case of fixed-formation multiple-unit trains including cranes, rail vehicles and multiple-units shall be taken as coupled together in the orientation giving the most severe effect for the underline bridge span length under consideration.

The maximum bending moment and end shear shall be determined for the static train loading acting on simply-supported underline bridge spans varying in length from 1 to 50 metres.

Using these values, an Equivalent Uniformly Distributed Load (EUDL) shall be determined for each span from 1 to 50 metres using the same units as those used to define the load model set out in Figure A or B.

Similarly the maximum bending moment and end shear force shall be determined for the static load model shown in Figure A or B acting on simply supported spans varying in length from 1 to 50 metres.

Using these values, an EUDL shall be determined for each span from 1 to 50 metres. This EUDL represents 1 unit of the load model set out in Figure A or B.

For each span length, the EUDL values derived from applying the rail vehicle shall be divided by the EUDL values for 1 unit of the load model specified in Figure A or B to derive the number of load model units which the train represents.

The maximum number of load model units thus derived shall be rounded up to the next larger integer and ten shall be subtracted. The resulting integer shall be called the RA Number of the rail vehicle type (or multiple-unit type).

(Example: if the rail vehicle train represents 18.3 load model units, the RA Number of the rail vehicle type is  $19 - 10 = 9$ .)

# Interface between Rail Vehicle Weights and Underline Bridges

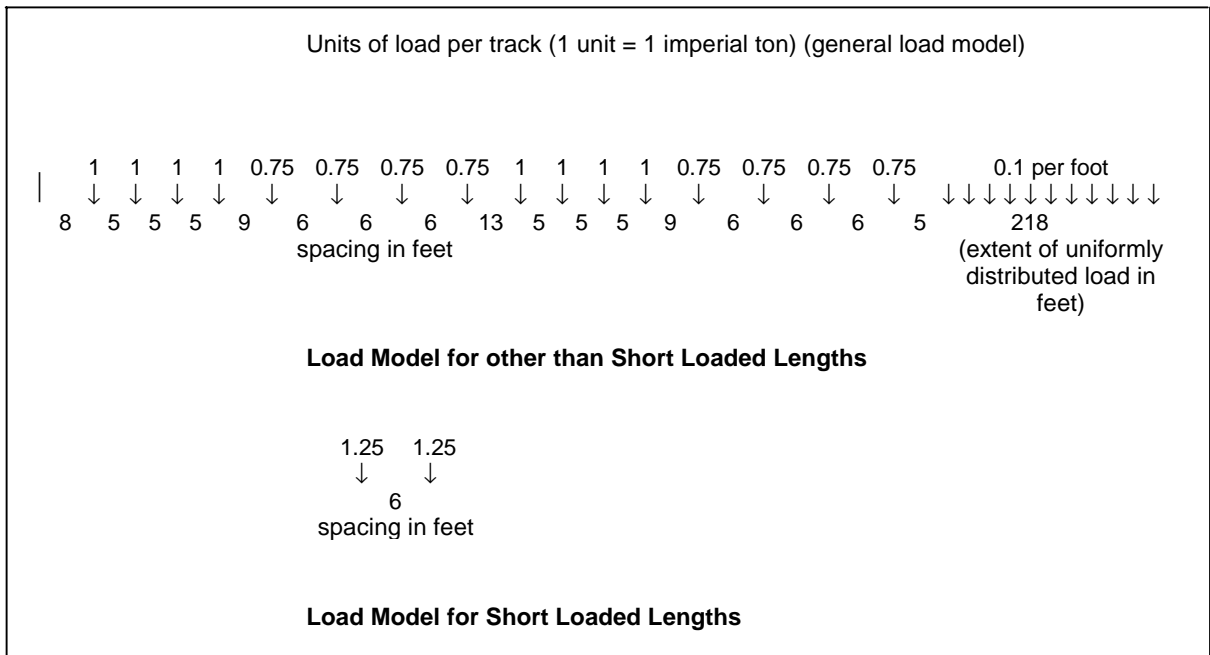


Figure A Load Model for Deriving RA Number using Imperial Units

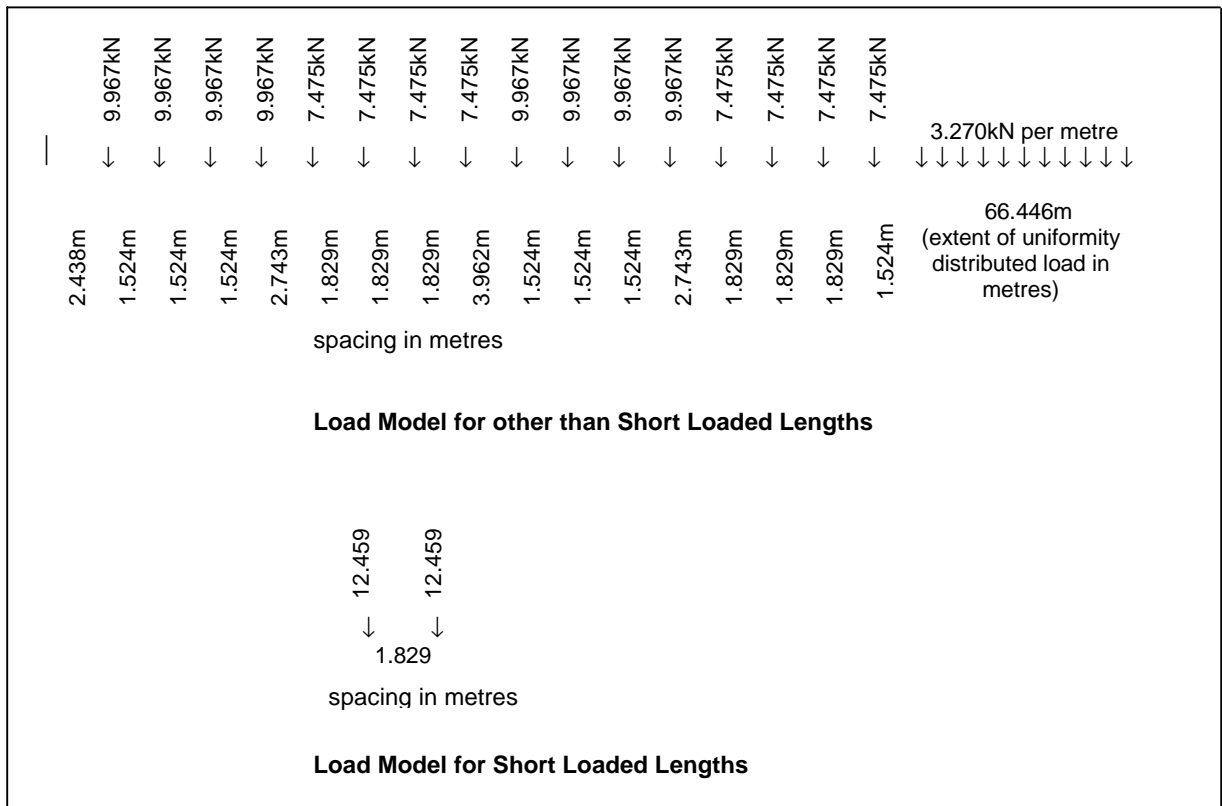
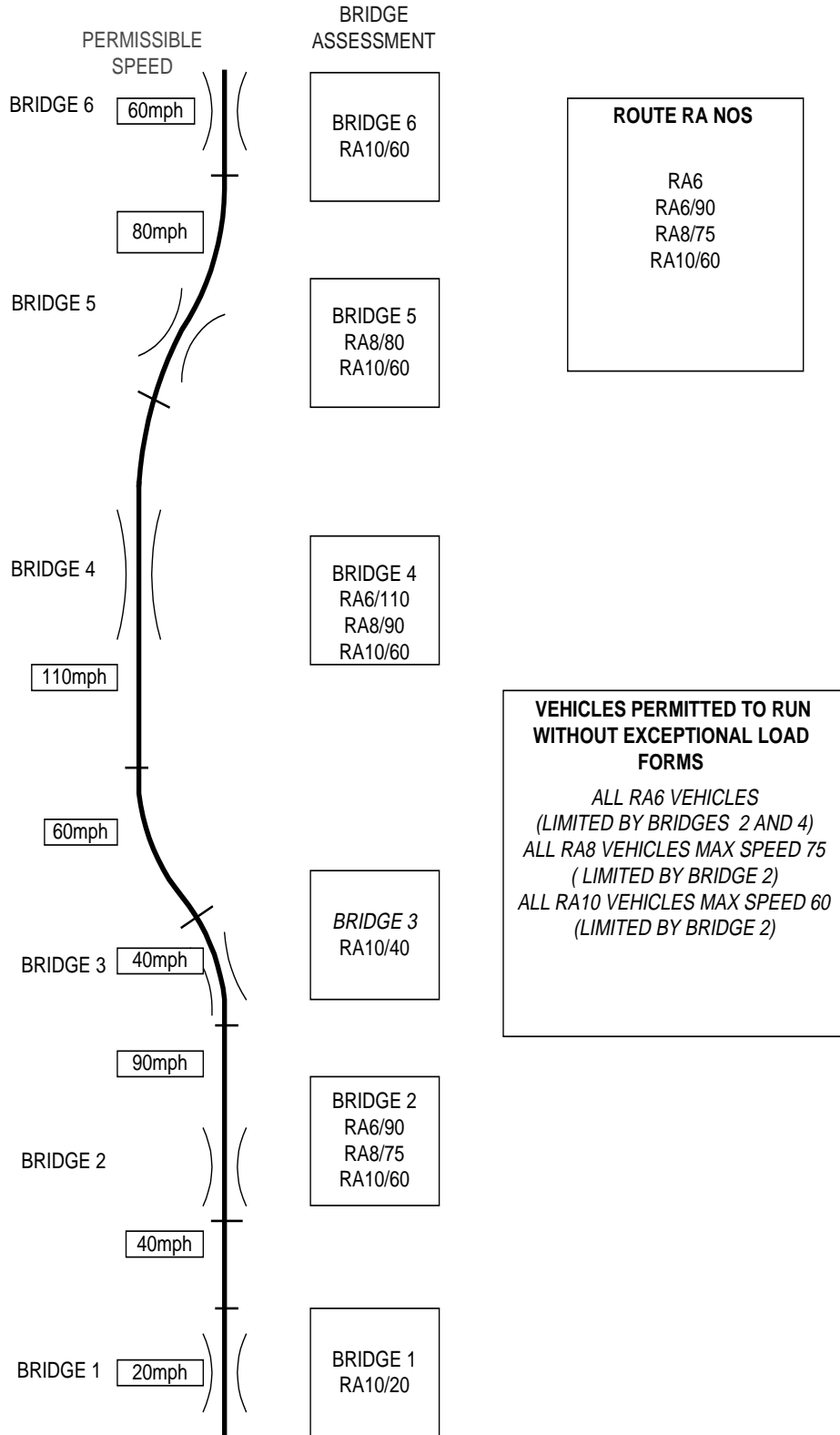


Figure B Load Model for Deriving RA Number using Load Model in Figure A converted to Metric Units (kilonewtons, metres)

# Interface between Rail Vehicle Weights and Underline Bridges

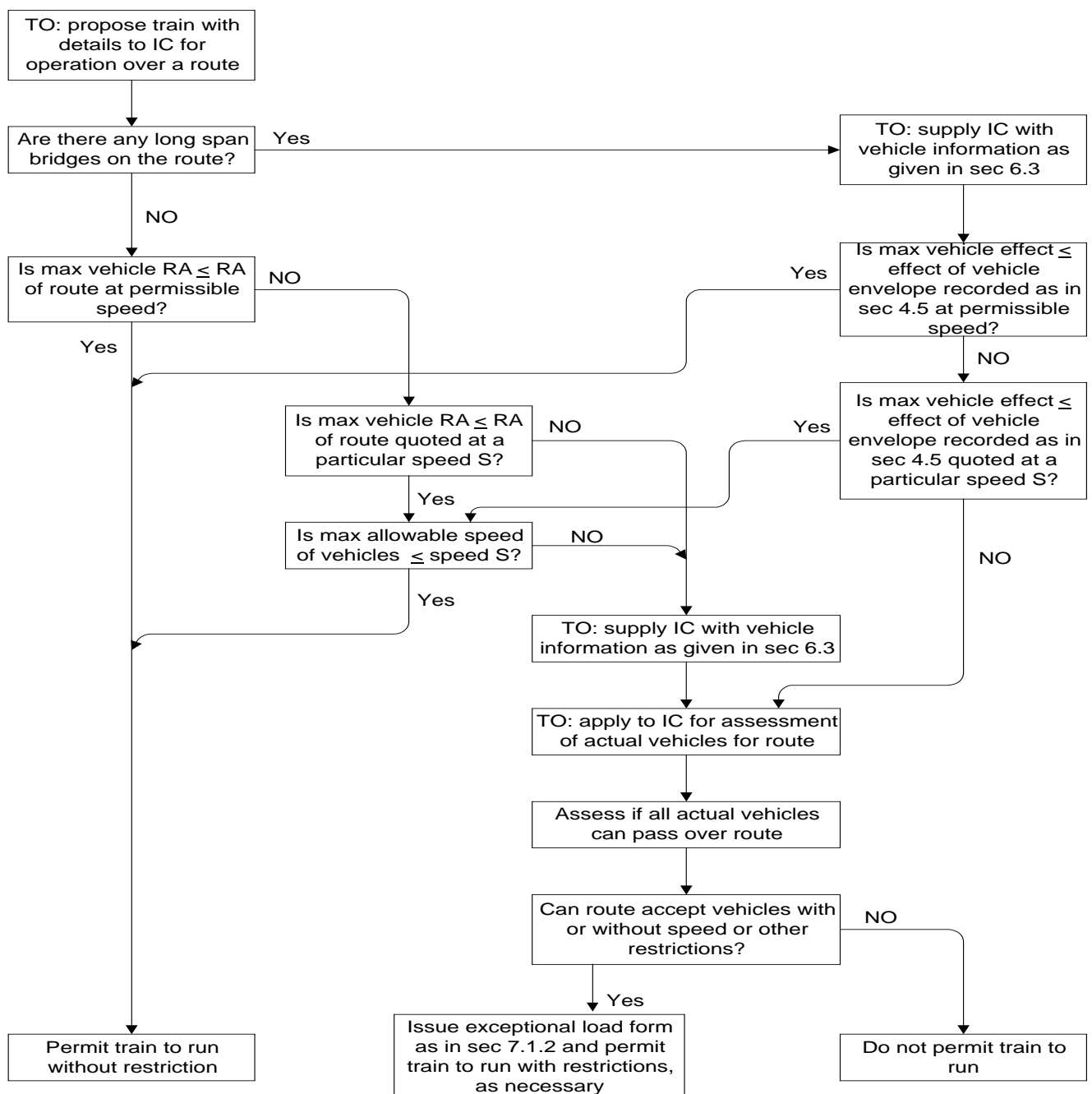
## Appendix B Example of Route Classification



# Interface between Rail Vehicle Weights and Underline Bridges

## Appendix C Flow chart of Procedure for Permitting a Train to Run

The diagram below illustrates the typical procedure for permitting a train to run over a given route as set out in sections 7.1 and 7.2. Action headed 'TO' is for the Train Operator to take; otherwise all action is for the Infrastructure Controller (IC).





# Interface between Rail Vehicle Weights and Underline Bridges

## References

<b>GA/RT6001</b>	Railway Group Standards Change Procedures
<b>GC/RT5100</b>	Safe Management of Structures
<b>GM/RT2000</b>	Engineering Acceptance of Rail Vehicles
<b>GM/RT2211</b>	Mandatory Data for Rail Vehicles
<b>GM/RT2453</b>	Registration of Rail Vehicles and Mandatory Data Requirements
<b>GO/RT3206</b>	Format and Content of the Sectional Appendix
<b>GO/RT3253</b>	Checking the Speed of Trains
<b>GO/RT3270</b>	Route Acceptance of Rail Vehicles
<b>GO/RT3407</b>	Train Operation – Exceptional Load Documentation

The Catalogue of Railway Group Standards and the Railway Group Standards CD-ROM give the current issue number and status of documents published by the Safety & Standards Directorate.