

Archive of **RAILWAY TECHNICAL WEB PAGES**

MULTI-DECK TRAINS

Introduction

This page looks at railways which use vehicles with more than one level and show some examples of how they have evolved. Both passenger and freight examples are included, with diagrams and links to photos.

Background

In an effort to improve capacity, some railways have introduced double-deck or even triple-deck trains. Triple-deck trains are usually restricted to car carrying freight trains but some double-deck trains have been built for both passenger and freight operations. In designing vehicles with more than one level, there are some restrictions which have to be taken into account. Of course, the first of these is the size. Will the vehicle fit inside the "loading gauge" or "kinematic envelope" of the lines over which it is to operate. The efforts to ensure the size requirements have led to some interesting designs.

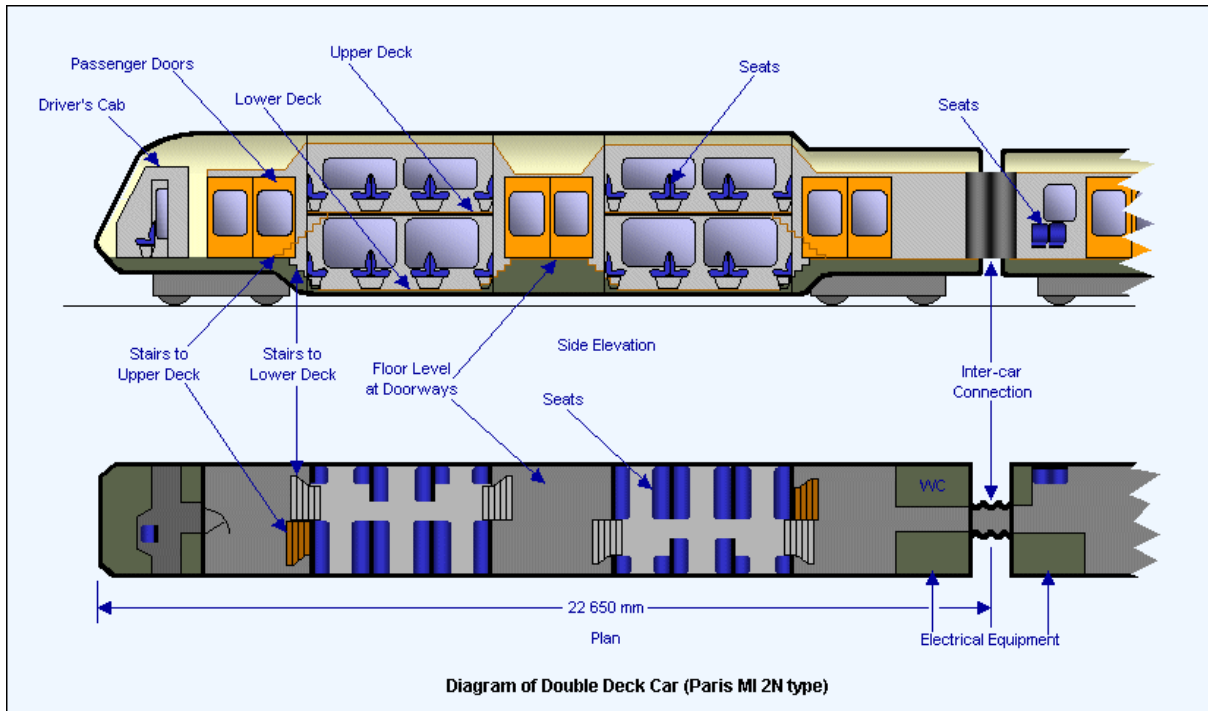
There is also the question of weight. Railways are limited by the weight limits of the structures along the line. These are usually called "civil engineering limits" or some form of shortened version of this phrase. The limits imposed by the civil engineer are usually expressed in terms of "axle load" as tons. Many lines in Europe, for example, are limited to an axle load of 22.5 tonnes, whereas, in the UK, the upper limit is generally 25 tonnes. In the US, some heavy haul lines allow axle loads of up to 40 US tons or just over 35 UK tons.

The UK Experiment

Many of the routes in the extensive suburban network south of London had reached capacity by the end of the second world war in 1945 and ways were sought to improve them without expensive platform lengthening to allow longer trains. The answer was thought to be the double-deck train and an experimental 8-car electric multiple unit was introduced in November 1949. It was built according to the traditional Southern Railway pattern with "slam" doors provided for each seating bay on the lower level. The seat bays of the upper level were reached by a set of stairs at each lower bay. It was not possible for a level upper deck floor to be provided within the small British structure gauge. Loading of the train was slow and this was the main reason for it not being generally adopted. You can see photos of this train at the [Southern E-Group](#) web site.

Europe

Most routes in Europe have a larger structure gauge than is available in the UK and various railways have introduced double-deck rolling stock over the more densely used lines. In France, there are a number of double-deck designs, the latest of which is shown in the diagram below.

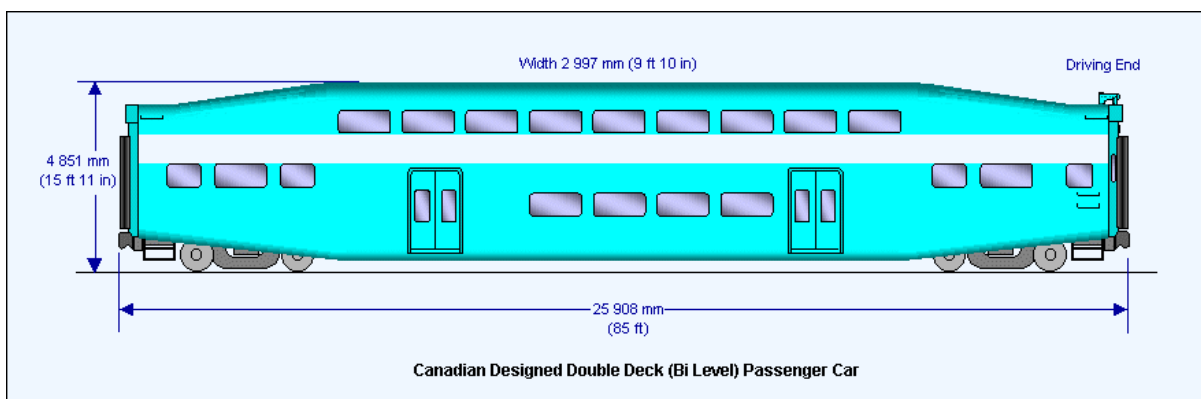


This example is typical of the designs used on suburban lines around Paris and other large cities in Europe. The passenger area is located between the bogies so that the lower deck floor can be sunk and thus give the height required for the upper deck. Entrance doors are provided over the bogies and in the centre of the car to allow rapid loading and unloading.

Although popular for suburban lines, the French have introduced a double-deck TGV (high speed train) design. This was the "Duplex" TGV, as it is called.

North America

The benefits of a large loading gauge have given North American railroads the scope to employ double deck coaches, or bi-level cars as they call them, on a much wider scale than in Europe. A popular design, first introduced in Toronto, Canada in 1977, is now in use on a number of suburban and interurban routes in the US and Canada. The car looks like this:

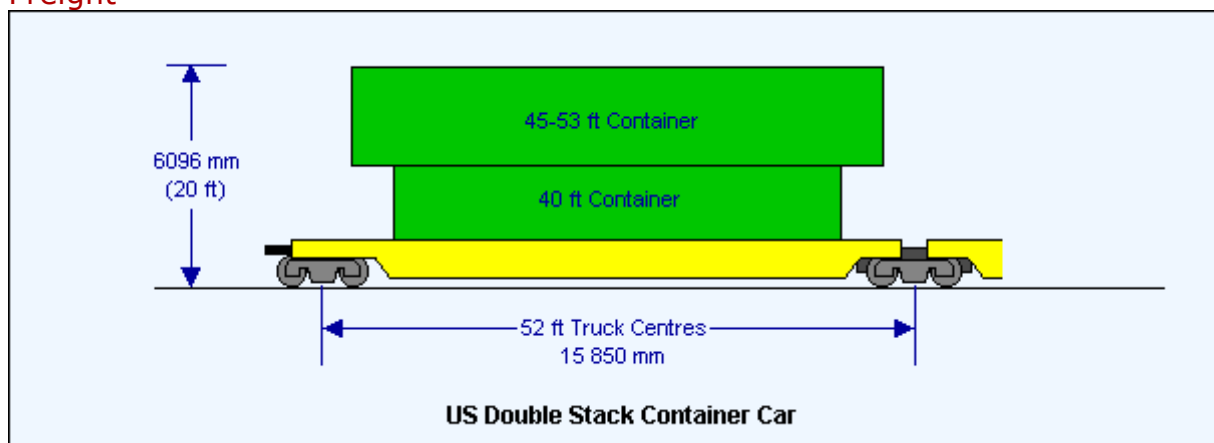


The design differs from the French model described above in that there are three seating levels. The lowest is between the two side entrance doorways, the intermediate level is over the trucks at each end of the car and the highest is directly above the lowest in the centre of the car. The highest level has the most seating space.

The cars are usually produced in two types, a driving trailer, called a "cab car" in the US, and a trailer car. They are normally used in push-pull formation with a locomotive at one end and the "cab car" at the other. The distinctive tapering shape of these cars makes them instantly recognisable. There are now over 500 of them in use in North America. Other designs are also used but these lack the tapered ends and some versions have only a single door in the centre of each side of the car. Many of these cars are designed as gallery cars, where the upper deck consists (as the name implies) of a gallery above the main (lower) deck. Some, such as Amtrak Superliners and Swiss intercity stock, have inter-vehicle connections at upper-deck level, effectively making that the main deck.

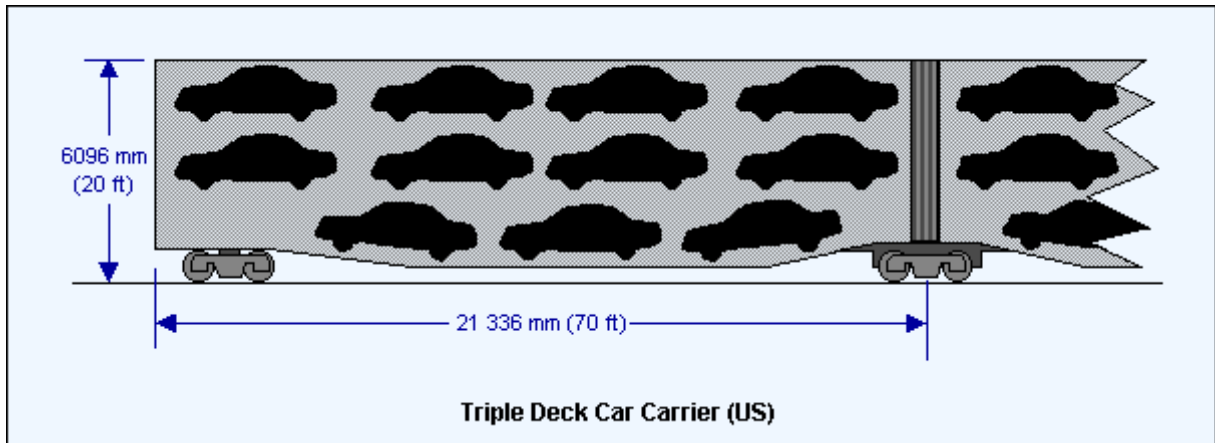
A word ought to be mentioned about Asia where the Japanese have a number of modern double-deck passenger train designs and in Hong Kong where a new double-deck train has been introduced between Kowloon and Guangzhou. Also, the extensive suburban network in Sydney, Australia is operated entirely by double-deck electric multiple units - all vehicles bought since 1964 have been double-deck.

Freight



Freight railways have also developed multi-deck operations, most particularly in North America, where they are now common for container traffic. Purpose-built sets of container cars are now standard equipment on many lines and these can carry containers as shown in the diagram left.

The car itself is a well wagon which can carry two 20 ft containers or one 40 ft container at the lower level. A second container can be carried on top and may overlap the lower one due to its length, which can be up to 53 ft. Containers are secured to each other and on the wagon. Wagons can be individual bogie vehicles or articulated (as shown above) in 3-car or 5-car sets. The weight carried by the containers has to be limited to restrict the weight on the vehicle. After all, a 40 ft container packed with marble blocks will weigh a lot more than one carrying ladies underwear. The limit currently set is 125 tons (i.e. US short tons or 2,000 lbs.) for a 4-wheeled car, which is based on an axle load limit of 40 tons.



For new car shipping trains, the vehicle design has been developed to permit three levels of cars to be shipped inside an enclosed wagon as shown left.

The railroad cars are formed into articulated sets and are enclosed to prevent damage and pilfering. The articulated train sets are designed to allow a car to be driven across the coupling between one wagon and the next.