CHAPTER
2

Railway Track Gauge

Introduction

Gauge is defined as the minimum distance between two rails. Indian Railways follows this standard practice and the gauge is measured as the clear minimum distance between the running faces of the two rails as shown in Fig. 2.1.

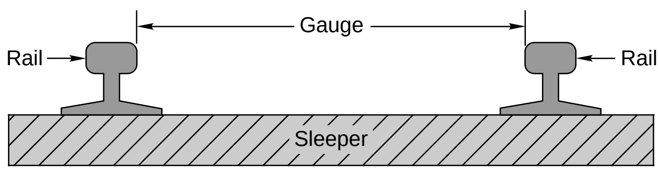

Fig. 2.1 Gauge

In European countries, the gauge is measured between the inner faces of the two rails at a point 14 mm below the top of the rail. This chapter describes the different gauge widths prevalent in India and other countries. It also discusses the problems and implications of a multiple-gauge system as adopted in India.

2.1 Gauges on World Railways

Various gauges have been adopted by different railways in the world due to historical and other considerations. In British Railways, a gauge of 1525 mm (5 feet) was initially adopted, but the wheel flanges at that time were on the outside of the rails. Subsequently, in order to guide the wheels better, the flanges were made inside the rails. The gauge then became 1435 mm (4′ 8.5″), as at that time the width of the rail at the top was 45 mm (1.75″). The 1435-mm gauge became the standard gauge in most European Railways. The approximate proportions of various gauges on world railways are given in Table 2.1.

Table 2.1 Various gauges on world railways

Type of gauge	*Gauge (mm)*	*Gauge (feet)*	*% of total length*	*Countries*
Standard gauge	1435	4′ 8.5″	62	England, USA, Canada, Turkey, Persia, and China

(*contd*)

Table 2.1 (*contd*)

Type of gauge	*Gauge (mm)*	*Gauge (feet)*	*% of total length*	*Countries*
Broad gauge	1676	5′6″	6	India, Pakistan, Ceylon, Brazil, Argentina
Broad gauge	1524	5′0″	9	Russia, Finland
Cape gauge	1067	3′6″	8	Africa, Japan, Java, Australia, and New Zealand
Metre gauge	1000	3′3.5″	9	India, France, Switzerland, and Argentina
23 various other gauges	Different gauges	Different gauges	6	Various countries

2.2 Different Gauges on Indian Railways

The East India Company intended to adopt the standard gauge of 1435 mm in India also. This proposal was, however, challenged by Mr W. Simms, Consulting Engineer to the Government of India, who recommended a wider gauge of 1676 mm (5′6″). The Court of Directors of the East India Company decided to adopt Mr Simms's recommendation and 5′6″ finally became the Indian standard gauge. In 1871, the Government of India wanted to construct cheaper railways for the development of the country and the 1000-mm metre gauge was introduced. In due course of time, two more gauges with widths of 762 mm (2′6″) and 610 mm (2′0″) were introduced for thinly populated areas, mountain railways, and other miscellaneous purposes.

The details of the various gauges existing on Indian Railways are given in Table 2.2.

Table 2.2 Various gauges on Indian Railways

Name of gauge	*Width (mm)*	*Width (feet)*	*Route kilometres*	*% of route kilometres*
Broad gauge (BG)	1676	5′6″	39,612	63.2
Metre gauge (MG)	1000	3′3.37″	19,210	30.7
Narrow gauge (NG)	762	2′6″	3838	6.1
	610	2′0″		
Total	–	–	62,660	100

2.3 Choice of Gauge

The choice of gauge is very limited, as each country has a fixed gauge and all new railway lines are constructed to adhere to the standard gauge. However, the following factors theoretically influence the choice of the gauge.

Cost Considerations

There is only a marginal increase in the cost of the track if a wider gauge is adopted. In this connection, the following points are important.

(a) There is a proportional increase in the cost of acquisition of land, earthwork, rails, sleepers, ballast, and other track items when constructing a wider gauge.

(b) The cost of building bridges, culverts, and tunnels increases only marginally due to a wider gauge.

(c) The cost of constructing station buildings, platforms, staff quarters, level crossings, signals, etc. associated with the railway network is more or less the same for all gauges.

(d) The cost of rolling stock is independent of the gauge of the track for carrying the same volume of traffic.

Traffic Considerations

The volume of traffic depends upon the size of wagons and the speed and hauling capacity of the train.

(a) As a wider gauge can carry larger wagons and coaches, it can theoretically carry more traffic.

(b) A wider gauge has a greater potential at higher speeds, because speed is a function of the diameter of the wheel, which in turn is limited by the width of the gauge.

(c) The type of traction and signalling equipment required are independent of the gauge.

Physical Features of the Country

It is possible to adopt steeper gradients and sharper curves for a narrow gauge as compared to a wider gauge.

Uniformity of Gauge

The existence of a uniform gauge in a country enables smooth, speedy, and efficient operation of trains. Therefore a single gauge should be adopted irrespective of the minor advantages of a wider gauge and the few limitations of a narrower gauge.

2.4 Problems Caused by Change of Gauge

The need for uniformity of gauge has been recognized by all the advanced countries of the world. A number of problems have cropped up in the operation of Indian Railways because of the use of three gauges. The ill effects of change of gauge (more popularly known as *break of gauge*) are numerous; some of these are enumerated here.

Inconvenience to Passengers

Due to change of gauge, passengers have to change trains mid-journey alongwith their luggage, which causes inconvenience such as the following.

(a) Climbing stairs and crossing bridges

(b) Finding seats in the compartments of the later trains
(c) Missing connections with the later trains in case the earlier train is late
(d) Harassment caused by porters
(e) Transporting luggage
(f) Uncertainty and delay in reaching the destination

Difficulty in Trans-shipment of Goods

Goods have to be trans-shipped at the point where the change of gauge takes place. This causes the following problems.

(a) Damage to goods during trans-shipment.
(b) Considerable delay in receipt of goods at the destination.
(c) Theft or misplacement of goods during trans-shipment and the subsequent claims.
(d) Non-availability of adequate and specialized trans-shipment labour and staff, particularly during strikes.

Inefficient Use of Rolling Stock

As wagons have to move empty in the direction of the trans-shipment point, they are not fully utilized. Similarly, idle wagons of one gauge cannot be moved on another gauge.

Hindrance to Fast Movement of Goods and Passenger Traffic

Due to change in the gauge, traffic cannot move fast which becomes a major problem particularly during emergencies such as war, floods, and accidents.

Additional Facilities at Stations and Yards

(a) Costly sheds and additional facilities need to be provided for handling the large volume of goods at trans-shipment points.
(b) Duplicate equipment and facilities such as yards and platforms need to be provided for both gauges at trans-shipment points.

Difficulties in Balanced Economic Growth

The difference in gauge also leads unbalanced economic growth. This happens because industries set up near MG/NG stations cannot send their goods economically and efficiently to areas being served by BG stations.

Difficulties in Future Gauge Conversion Projects

Gauge conversion is quite difficult, as it requires enormous effort to widen existing tracks. Widening the gauge involves heavy civil engineering work such as widening of the embankment, the bridges and tunnels, as well as the tracks; additionally, a wider rolling stock is also required. During the gauge conversion period, there are operational problems as well since the traffic has to be slowed down and even suspended for a certain period is order to execute the work.

2.5 Uni-gauge Policy of Indian Railways

The problems caused by a multi-gauge system in a country have been discussed in the previous section. The multi-gauge system is not only costly and cumbersome but also causes serious bottlenecks in the operation of the Railways and hinders the balanced development of the country. Indian Railways therefore took the bold decision in 1992 of getting rid of the multi-gauge system and following the uni-gauge policy of adopting the broad gauge (1676 mm) uniformly.

2.5.1 Benefits of Adopting BG (1676 mm) as the Uniform Gauge

The uni-gauge system will be highly beneficial to rail users, the railway administration, as well as to the nation as described below.

No Transport Bottlenecks

There will be no transport bottlenecks after a uniform gauge is adopted and this will lead to improved operational efficiency resulting in fast movement of goods and passengers.

No Trans-shipment Hazards

There will no hazards of trans-shipment and as such no delays, no damage to goods, no inconvenience to passengers of transfer from one train to another train.

Provisions of Alternate Routes

Through a uni-gauge policy, alternate routes will be available for free movement of traffic and there will be less pressure on the existing BG network. This is expected to result in long-haul road traffic reverting to the railways.

Better Turnround

There will be a better turnround of wagons and locomotives, and their usage will improve the operating ratio of the railway system as a whole. As a result the community will be benefited immensely.

Improved Utilization of Track

There will be improved utilization of tracks and reduction in the operating expenses of the railway.

Balanced Economic Growth

The areas presently served by the MG will receive an additional fillip, leading to the removal of regional disparities and balancing economic growth.

No Multiple Tracking Works

The uni-gauge project will eliminate the need for certain traffic facilities and multiple tracking works, which will offset the cost of gauge conversions to a certain extent.

Better Transport Infrastructure

Some of the areas served by the MG have the potential of becoming highly industrialized; skilled manpower is also available. The uni-gauge policy will help in providing these areas a better transportation infrastructure.

Boosting Investor's Confidence

With the liberalization of the economic policy, the uni-gauge projects of the Indian Railways have come to play a significant role. This will help in boosting the investors' confidence that their goods will be distributed throughout the country in time and without any hindrance. This will also help in setting up industries in areas not yet exploited because of the lack of infrastructure facilities.

2.5.2 Planning of Uni-gauge Projects

The gauge-conversion programme has been accelerated in Indian Railways since 1992. In the eight Plan (1993–97) itself, the progress achieved in gauge-conversion projects in 5 years was more than the total progress made in the last 45 years. The progress of gauge-conversion projects is briefly given in Table 2.3.

Table 2.3 Gauge-conversion projects in India

Year	*Progress in gauge conversion (km)*	*Remarks*
1947–1992	2500	Approx. figure
1993–1997	6897	Actual
1997–1998	847	Actual
1998–1999	693	Actual
1999–2000	260	Actual
2000–2001	92	Actual
2001–2002	211	Actual
2002–2003	830	Actual
2003–2004	854	Actual

2.6 Loading Gauge

The loading gauge represents the maximum width and height to which a rolling stock, namely, a locomotive, coach, or wagon, can be built or loaded. Sometimes, a loading gauge is also used for testing loaded and empty vehicles as per the maximum moving dimensions prescribed for the section. In Indian Railways, the maximum height and width of rolling stock prescribed as per the loading gauge are given in Table 2.4.

Table 2.4 Maximum dimensions of rolling stock on Indian Railways

Gauge	*Maximum height of rolling stock*	*Maximum width of rolling stock*
BG	4140 mm (13′7″)	3250 mm (10′8″)
MG	3455 mm (11′4″)	2745 mm (9′0″)

In order to ensure that the wagons are not overloaded, a physical barrier is made by constructing a structure as per the profile of the loading gauge (see Fig. 2.2). This structure consists of a vertical post with an arm from which a steel arc is suspended from the top. The function of this structure is to ensure that the topmost and the widest portion of the load will clear all structures such as bridges and tunnels, etc. along the route.

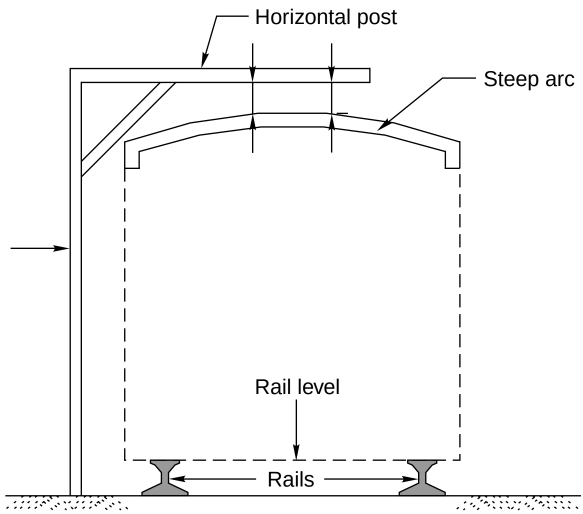

Fig. 2.2 Loading gauge

2.7 Construction Gauge

The construction gauge is decided by adding the necessary clearance to the loading gauge so that vehicles can move safely at the prescribed speed without any infringement. The various fixed structures on railway lines such as bridges, tunnels, and platform sheds are built in accordance with the construction gauge so that the sides and top remain clear of the loading gauge.

Summary

Three types of track gauges have been adopted in Indian Railways. The basic consideration behind the adoption of the metre gauge and narrow gauge was to provide access to undeveloped areas with low cost of construction. The multiple-gauge system has caused many problems and caused serious bottlenecks in the operation of the Railways. The work of gauge conversion has been accelerated on Indian Railways since 1992. The uni-gauge system will be highly beneficial to rail users, the railway administration, and the nation.

Review Questions

1. Define gauge problems with special reference to Indian Railways and bring out the effects of variations in the width of the gauge.

2. Why is it desirable to have, as far as possible, a uniform gauge for the railway network of a country?
3. What is the standard gauge in Indian Railways? State the disadvantages of having a multiple gauge system.
4. List out the various gauges prevailing in India with their gauge widths. What factors govern the selection of a suitable gauge? Discuss.
5. What is the uni-gauge policy of Indian Railways? Describe the benefits of the uni-gauge system.
6. What do you understand by loading gauge? How is it different from the construction gauge?
7. How many gauges exist in Indian Railways? Give their widths and route kilometres.
8. Write short notes on the following.
   (a) Break of gauge
   (b) Standard gauge
   (c) Cape gauge
   (d) Metre gauge