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Railways of India. An important stage of modernization is completed — unification of track width

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ABSTRACT India, the Republic of India is a country of one of the world's oldest civilizations, the largest state in the world by population — 1.42 billion people (end of 2022), occupying an area of over 3 million square kilometers. India, which has accelerated the pace of its socio-economic development in recent decades, is playing an increasingly important role in the international arena every year, including as one of the BRICS organizers. The state railways of India are managed by the Ministry of Railways of India represented by Indian Railways (99 % of the country's railway network) and are, despite the dominance of motor transport, remain one of the main modes of transport. During the year, the railways of India transport more than 8 billion passengers (2nd place in the world after Japan), the staff of the railways of India will amount to 1.2 million people (the 7th employer in the world). Railway transport in India is developing intensively, in recent years, work has been intensified on the organization of high–speed traffic on a number of lines of existing railways, the first high-speed railway line Mumbai — Ahmedabad is being built with a normal gauge of 1435 mm with a length of 508 km, designed for a maximum train speed of 350 km/h. The authors of the article have repeatedly visited India, visited various railway enterprises, railway educational institutions — universities and institutes, met with industry leaders at the Ministry of Railways of India, traveled along the country's railways along a number of routes with a total length of about six thousand km.

KEYWORDS: railway transport of India; history of transport; narrow-gauge; standard; broad-gauge railways; modernization; electrification; high-speed railways

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Обзорная статья

Железные дороги Индии. Завершается важный этап модернизации — унификация ширины колеи

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АННОТАЦИЯ Республика Индия — страна одной из древнейших мировых цивилизаций, крупнейшее по населению государство мира — 1,42 млрд человек (конец 2022 г.), занимающее территорию свыше 3 млн км^2. Индия, ускорившая в последние десятилетия темпы социально-экономического развития, с каждым годом играет все большую роль на международной арене, в том числе и как один из организаторов БРИКС. Государственные железные до-

роги управляются Министерством железных дорог Индии в лице компании Indian Railways (99 % железнодорожной сети страны) и, несмотря на доминирование автомобильного транспорта, остаются одними из основных перевозчиков. За год железные дороги Индии транспортируют более 8 млрд пассажиров (второе место в мире после Японии), персонал железных дорог Индии составляет 1,2 млн человек (седьмой работодатель в мире). Железнодорожный транспорт Индии развивается, в последние годы активизированы работы по организации скоростного движения на ряде линий существующих железных дорог, строится первая высокоскоростная железнодорожная магистраль Мумбаи (*Mumbai*) – Ахмедабад (*Ahmedabad*) нормальной колеи 1435 мм длиной 508 км, рассчитанная на максимальную скорость движения поездов 350 км/ч.

Авторы неоднократно бывали в Индии, посещали различные железнодорожные предприятия, железнодорожные учебные заведения — университеты и институты, встречались в Министерстве железных дорог Индии с руководителями отрасли, совершили поездки по железным дорогам страны по ряду маршрутов общей протяженностью около 6000 км.

КЛЮЧЕВЫЕ СЛОВА: железнодорожный транспорт Индии; история транспорта; узкоколейные; стандартные; ширококолейные железные дороги; модернизация; электрификация; высокоскоростные железные дороги

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THE BIRTH OF RAILWAY TRANSPORT IN INDIA

The first railway projects in India, then a British colonial possession, appeared early by world standards — in 1832. It was rather about creating industrial railways to transport construction materials and minerals. In 1837 the first industrial railway, the Red Hill Railroad, 25 km long, was opened in Madras [1] built by an English engineer and entrepreneur Sir Arthur Thomas Cotton (1803–1899)[1]. Arthur Cotton built canals, dams and railways and was interested in railways as a means of facilitating the delivery of construction materials to sites. To this end he built another Godavari Dam Construction Railway in 1845 to build a dam on the Godavari River [2].

In the 1840s several attempts are made to build public railways. In 1845 the Madras and East India Railway Companies are set up. The former failed and failed to start construction, was dissolved and re-established in the 1850s. The East India Railway Company was more successful and in 1851 a survey from Calcutta to Raniganj Raniganj began, which identified a crossing point for the Son River, the largest tributary of the Ganges River [2].

Many difficulties arose during the organisation of the construction. The delivery of nearly all necessary materials, including rails, fasteners and rolling stock was carried out from England by sailing ships. It was a long voyage around the Cape of Good Hope and the Suez Canal was not opened until 1869. Wood for sleepers was sourced from Nepal and some spruce sleepers were brought from the Baltic Sea coast, with sleepers being treated with creosote in England. The first section from Howrah to Benares, 37 km long, was opened on 15 August 1854[2].

The beginning of the modern public railway network is associated with the construction of a 33.8 km long railway between Bori Bunder (Bombay, now Mumbai) and Thane [3, 4], on which the first passenger train passed on 16 April 1853. This was a section of the future Great Indian Peninsula Railway (GIPR). The railway was built with a track gauge of 5ft and 6in (1676 mm).

The country's largest railway station, Chhatrapati Shivaji Maharaj Terminus (Chhatrapati Shivaji Terminus, CSMT)[3] which is located on the site of the former Bori Bunder station in Bombay (now Mumbai), is a reminder of that momentous occasion. The building was built between 1878 and 1888 by the British architect Frederick William Stevens[4] (1847–1900), High Victorian Gothic design based on late medieval Italian models [5]. The terminal has become one of the symbols

[1] Arthur Cotton is the builder of many hydraulic structures — irrigation canals and dams in India — has earned the grateful memory of Indians, which is kept in the states of Andhra Pradesh and Tamil Nadu. A museum dedicated to his work has been opened in Rajamahendravaram. Arthur Cotton was persecuted and harassed by the British administration, which did not maintain his loyal relationship with the locals. In recognition of Cotton's contribution, a new dam on the Godavari River, built in 1982, was named after him by the decision of Indian Prime Minister Indira Gandhi.

[2] East Indian Railway Company. URL: https://en.wikipedia.org/wiki/East_Indian_Railway_Company

[3] Formerly Victoria Terminus, the name was changed in 1996.

[4] Frederick William Stevens (1847–1900) is the author of other famous architectural creations: The former Royal Alfred Sailors' Home, Bombay (1872–1876), Municipal Corporation Buildings, Bombay (1888–1893), The Flora Fountain, Bombay (1869) together with Scottish sculptor James Forsyth (1827–1910) etc. URL: https://victorianweb.org/art/architecture/stevens/index.html

Fig. 1. Chhatrapati Shivaji Terminus Railway Station (CSMT)), Mumbai. Photo by the authors. 2016

of Bombay-Mumbai and was inscribed on the UNESCO World Heritage List in 2004[5] (*Fig. 1–4*).

The railway station is being carefully preserved and renovated to improve the passenger experience, while preserving all the important historical architectural and planning features. In recent years, air-conditioned waiting rooms, modern ticket offices and an expanded list of additional services provided to passengers have been built.

The station houses the Chhatrapati Shivaji Terminus Heritage gallery (*Fig. 5–9*). Visitors can explore the preserved state rooms of the station and the numerous stands and exhibits relating to the history of the station and the Indian Railways from the 1930s to the present day.

In 2009, a memorial was unveiled at Chhatrapati Shivaji station, which is sacred to the people of India (*Fig. 10*) to commemorate the tragic events of November 26, 2008, when a number of Mumbai facilities, including this station, were attacked in a terrorist attack that resulted in numerous casualties.

THE KEY ISSUE IN CREATING RAIL TRANSPORT: THE CHOICE OF TRACK GAUGE

To understand how entrepreneurs, engineers, planners and builders who built the first railways in India and then formed its railway network came to the decision to use the 1676 mm gauge as the main gauge in the country, while several narrow-gauge railways were also built, it is necessary to make a brief excursus into the history of the first decades of railway transport in Great Britain. The early days of railway construction in this country, the technical solutions adopted, the construction and operational parameters have had a major influence on the creation of railway transport in almost every country in the world. They influenced the

Fig. 2. CSMT. Distribution hall. Photo by the authors. 2016

[5] World Heritage — natural or man-made sites that UNESCO considers a priority for conservation and promotion because of their special cultural, historical or ecological significance.

Fig. 3. CSMT. Common waiting room. Photo by the authors. 2016

establishment and development of railways in India, which had been under colonial dependence on Britain for a long period of time. The country's railways, built for the most part by British entrepreneurs and engineers, were a reflection of the situation in the metropolis, a "crooked mirror" that in many cases exaggerated negative phenomena.

It is well known that the choice of gauge for a railway is one of the fundamental factors determining the scope and cost of construction works and the most important parameters for future operation, including maximum speed, carrying capacity and operating costs.

In the early decades of public railways, engineers and planners in various countries, especially in the home of railways in England, experimented with gauges. As the sources of those years indicate, most of them, and practically the entire community of entrepreneurs and engineers and government officials, until the mid-1830s considered each railway project as an isolated transport enterprise, based on its specific practical and commercial purposes in a given location, in connection with other facilities — mines, mines, factories, ports. Few foresaw that road railways, especially in the initial period of construction of the first of them, would in the foreseeable future come together, much less merge into a nationwide network.

In England, for example, by the beginning of XIX century there was a well-developed network of canals to ensure national transport tasks, and the length and condition of highways were improving year by year. Railways, mostly with cast-iron rails,

Fig. 4. CSMT. Men's Lounge for 1st and 2nd class passengers. Photo by the authors. 2016

Fig. 5. CSMT. Museum of Indian Railways. Layout of the Chhatrapati Shivaji Terminus. Photo by the authors. 2016

Fig. 6. CSMT. Terminus Parade Gallery. Photo by the authors. 2016

Fig. 7. CSMT. Parade Hall for official delegations. Photo by the authors. 2016

Fig. 8. CSMT. Museum of Indian Railways. Model of a late 19th century Indian Railways mix-type passenger car. Photo by the authors. 2016

were designed for local transportation purposes of cargo delivery to ports or from ports to industrial plants, intrafactory transportation and delivery of materials to construction sites. There was practically no passenger transport on the rail tracks.

Only after Liverpool-Manchester railway (1830) and Great Western Railway (1838) were built, and titans of engineering and building such as George Stephenson (1781–1848) and Isambard Kingdom Brunel (1806–1859) and some other figures entered the field of railway transport, a wide circle of businessmen, representatives of government structures and then society as a whole, saw opportunities and prospects of new type of transport — the railway. The leading figures of the transport industry and industry began to realise the consequences of disorderly development of railways. First of all, this concerned the main and at that time defining parameter for the possibility of unit-

Fig. 9. CSMT. Museum of Indian Railways. Model of an Indian railway steam locomotive from the late 19th century. Photo by the authors. 2016

Fig. 10. CSMT. Memorial to the tragic events of 26 November 2008, Mumbai. Photo by the authors. 2016

ing the railways into a single national network — the width of the gauge[6].

In the late 1830s and early 1840s a social-economic phenomenon called British Railway Mania of the 1840s[7] broke out in Britain — the Battle of the Gauges or Gauge Wars. Among engineers, builders, railway workers and businessmen, two principled approaches to further railway construction emerged. The ideas of these engineering approaches also spread to broader social circles, with adherents of one and the other emerging amongst different sections of society, professions, journalists, politicians.

From the two different approaches to railway construction, it is possible to identify those who advocate "narrow gauge" — any gauge narrower than 4ft 8 and 1/2 inches (1435 mm) — and those who advocate "broad gauge" — broader than 1435 mm. The exponent of the technical and economic ideas of the former was the great engineer and entrepreneur George Stephenson[8]. The second line was represented by the equally great and successful engineer and entrepreneur Isambard Kingdom Brunel, who built the Great Western Road with a track gauge of 7 feet and 1/4 inch (2140 mm)[9].

Broad gauge advocates argued that they could deliver higher speeds, more comfortable travel conditions for passengers, greater capacity through larger rolling stock and, most importantly, that they were safer and more reliable.

The narrow-gauge advocates assured other people that they could provide almost the same high speed and carrying capacity on their railways, and, with figures in their hands, proved considerable savings in the construction of 1435 mm gauge railways and their rolling stock as compared with broad gauge.

In the early years of the Great Western Railway's operation its trains reached higher speeds than the Stephenson gauge, but by the end of the 1840s the speeds were virtually identical.

By this time, more than two dozen gauge sizes were in operation in the UK, ranging from 600 mm[10] and up to 2140 mm on the Great Western Railway[11] (*Fig. 11*).

In the 1840s, a paradoxical situation developed in Britain: as the length of railways in the kingdom increased, it became increasingly inconvenient for passengers and shippers. At the junctions of different rail gauges, there are obstacles to travel, to transport goods in direct services, and to ensure "Seamless Traffic".

[6] Nowadays, apart from this technical parameter, other parameters are important which determine the possibility to combine different railways for a single operation, besides the dimensions of the rolling stock and the proximity of the structures, such as the electrical supply system on electrified railways, the characteristics of fixed and train devices of railway automation, telemechanics and several others, but at that time the gauge was the most important.

[7] Railway mania — "financial pyramid schemes", "financial bubbles" in the stock market of the United Kingdom of Great Britain and Northern Ireland in the 1840s, associated with the construction of new railways. As the share price of the railway companies increased, speculators invested more money in them, which further increased the share price until the share price collapsed. The mania reached its peak in 1846, when 263 parliamentary acts were passed to create railway companies.

[8] The 4ft 8in1/2inch (1435 mm) track, which later became standard in many countries, was suggested by George Stephenson. It is often referred to as the "Stephenson gauge".

[9] Originally 7ft (2134 mm), later widened to 7ft and 1/4 in (2140 mm). In 1854, after merging with several other railways, the Great Western Railway was "re-stitched" to what had by this time become the standard gauge of 1435 mm.

[10] The Wells and Walsingham Light Railway in Norfolk England has the world's narrowest gauge of 10 and 1/4 inches (260 mm) of public railways in continuous commercial operation (established by an Act of Parliament in the UK) at 6.4 km.

[11] The broadest track gauge in the world is that of the currently active toothed track of the Krasnoyarsk Hydroelectric Power Station ship-lift in Russia — 9000 mm (29 ft 6 in + 5/16 in). A number of sources indicate the use of 8 ft (2439 mm) broad track in the early twentieth century on a timber road in Oregon, USA, but conclusive evidence has not yet been found.

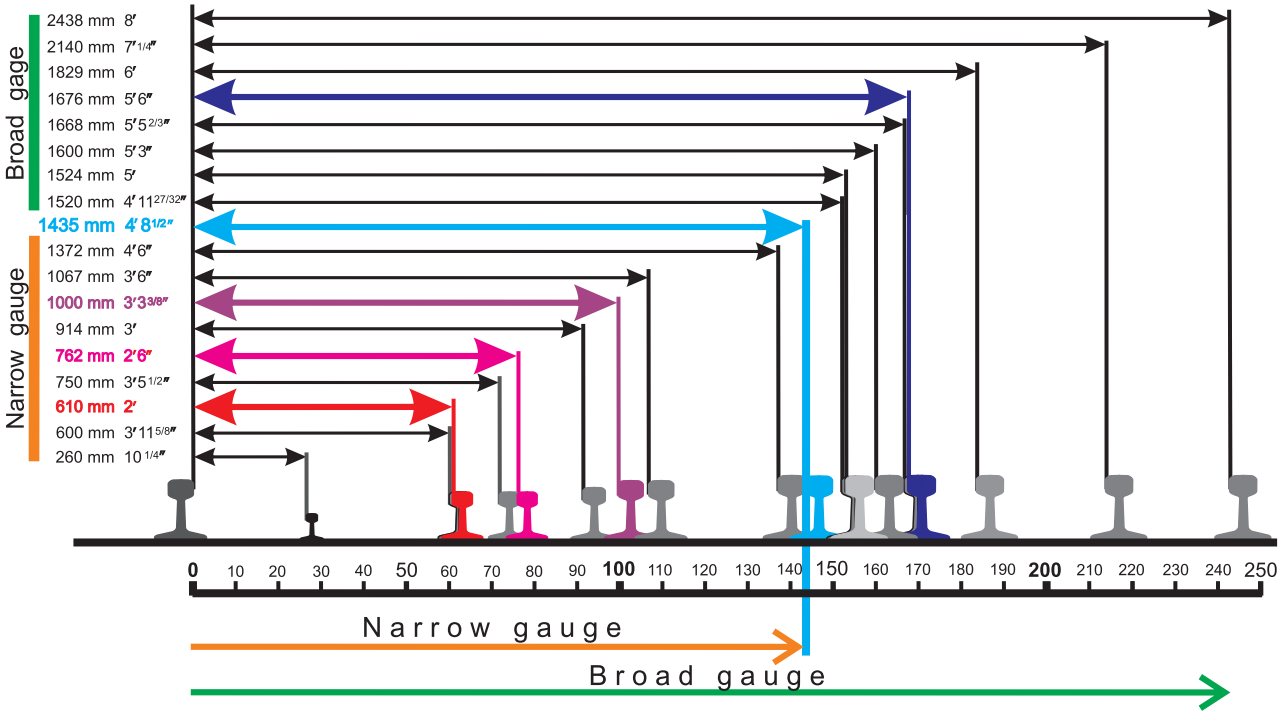

Fig. 11. Examples of different track gauges common on the world's railways. The narrowest and broadest gauge in regular commercial use are shown. Bold coloured lines indicate gauge types used in India. The rail profile is shown conventionally and does not refer to the types of specific gauge. Reconstruction by the authors from open sources. 2023

The "Gauge War" involves railway professionals, business people, the press, politicians, and, increasingly, the general public — passengers and shippers — who experience the problems of operating stations at the junctions of different gauge railways. Newspapers have published cartoons on these subjects [6] (*Fig. 12*).

Queen Victoria was definitely not amused. Whenever she travelled from her estate on the Isle of Wight to her castle at Balmoral, she encountered the inconvenience of twice changing trains, once at Basingstoke and again at Gloucester. She had no choice: even royalty was obliged to mind the gap between railway tracks of different gauges [6].

The situation at the transfer stations threatened passengers every day with complete chaos, delayed trains, lost luggage [6] (*Fig. 13*).

However, neither Stephenson's supporters nor Brunel's supporters gave up. The construction of railways with different gauges continued in Britain. Different ways of solving the problem were proposed: using auxiliary rolling stock to carry wagons on a different gauge — Rollbock and Transporter wagon, which gained some popularity, construction of tracks with dual gauge — three or four rails (dual gauge), attempts to create rolling stock, which could switch from one gauge to another (variable gauge system). In 1845, I. Brunel suggested to carry goods in big boxes — container. The system, later called containerization, made it easier to move goods from one wagon to another. None of these proposals fundamentally solved the problem of fragmented railways.

In 1845, a Royal Commission was set up to study the question of gauge and make recommendations. After numerous surveys, technical and economic comparisons, and expert hearings, including George Stephenson and Isambard Kingdom Brunel, the Commission prepared the Railway Regulation (Gauge) Act 1846,

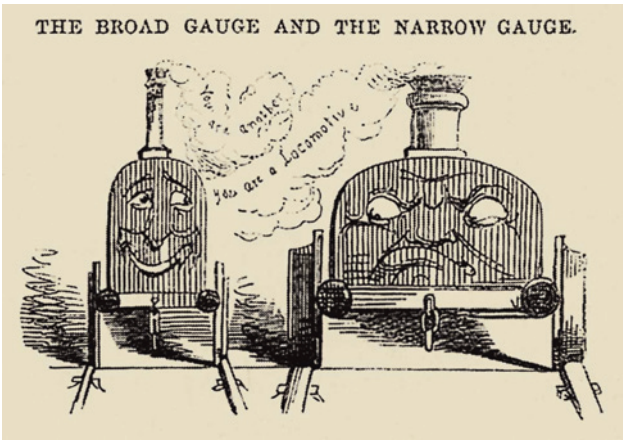

Fig. 12. A caricature in the spirit of today's Thomas the steam locomotive. The meeting of locomotives of different track gauges clearly shows: the designers of broad-gauge railway rolling stock had more scope for implementing their technical ideas. Cartoon by Angus Reach, 1845 © Lordprice Collection/Alamy

Fig. 13. J.H. Townshend, Break of Gauge at Gloucester, 1846, Illustrated London News, 6 June 1846

which was passed by the British Parliament and approved by Queen Victoria on 18 August 1846[12].

The Act further required railways in Britain to be built with gauges of 4 ft 8 and 1/2 inches (1435 mm), and in Ireland 5 ft 3 inches (1600 mm). Importantly, for the first time the Act defined "railway gauge" as "the distance between the inner surfaces of two running rails"[12]. In the UK, and elsewhere, some experts have found it useful to refer to the gauge as the distance between the axes of the rail heads, leading to confusion.

But the law did not prohibit the continued operation of the railways already built with different gauge, nor did it permit the construction of new railways with different gauge, provided that the project was approved by Parliament. In other words, the status quo of "different gauge" railways was maintained for many years. Proponents of broader or narrower gauge lobbied parliament for the decisions they wanted, and construction continued on a variety of railways, including the broad-gauge Brunel line.

The Great Western Railway was "converted" to the Stephenson gauge, later to be called the standard-gauge railway, a more or less complete unification of the British railway network with a single gauge of 1435 mm only occurred in 1892 (track gauge conversion).

Railways in India were built with different gauges depending on decisions of particular entrepreneurs and design engineers, often with immediate interests of businessmen clashing with regional or national ones. The battle of the gauge in all its negative manifestations is unfolding in India.

In India, the gauge used was 2 ft (610 mm); 2 ft and 6 in (700 mm); the standard gauge was 2 ft, 8 in and 1/2 in (1435 mm); and the broad gauge was 5ft and 6 in (1667 mm). There is conflicting information in published sources about the gauge of the same railways. Apart from gauge, the British builders of India's first railways, like all other countries, experimented with track designs and other technical devices in an effort to keep construction costs as low as possible. For example, the Godavari Dam Construction Railway and a number of other early railways used peculiar rails with a wooden backing and iron strips to create a rolling surface for the wheels. To do this, they would take a 6–7 inch (15–17 cm) diameter dulled teak logs 20 feet (8.09 m) long and tap them to a narrow, flat surface, onto which a 1/2 inch wide and 1/2 inch thick iron strip would be screwed. The resulting "rail" was laid in the track on wooden sleepers. The author of one note notes that the cost of such rails was "negligible"[13].

All kinds of experiments aimed at reducing capital investment in construction, reducing the cost of construction materials, while possibly using cheap labour, have resulted in the creation of unique transport systems in India — single-rail (monorail) railways of the so-called outrigger type, known as the Ewing System[14]. In the first decade of the twentieth century, more than 10 such railways were built in India with a total length of about 500 km. One of them, Patiala State Monorail Trainways (PSMT) with a total length of several lines of about 80 km was constructed in 1907 in the city area and operated until the mid-1920s.

On the railways of this system, only one metal running rail (cast iron, iron or steel) was laid in the track, on which the grooved (dual ridge) wheels of the rolling stock were supported. To maintain equilibrium, the rolling units were equipped with a kind of outriggers with wide steel wheels, which rolled on a compacted earth track, laid parallel to the rail. The wheels on the rail carried about 70–80 % of the load of the locomotive or wagon, the rest being carried by the outrigger.

The single-rail track reduced the need for metal for the track by half. The cheap labour of local diggers kept the compacted dirt track for the outrigger wheels in good condition, and in some cases this track was paved with stone within stations.

A small section of Patiala State Monorail Trainways is now reproduced in the National Rail Museum, New Delhi (*Fig. 14*). It features a dismantling of the pre-

[12] An Act for regulating the Gauge of Railways. 18th August 1846. URL: https://www.irishstatutebook.ie/eli/1846/act/57/section/1/enacted/en/html

[13] Godavari Dam Construction Railway. URL: https://wiki.fibis.org/w/Godavari_Dam_Construction_Railway

[14] In 1895 the English entrepreneur W.J. Ewing, working in Bengal, India, patented the monorail system proposed by William Thorold of Norwich in England in 1868.

Fig. 14. Patiala State Monorail Trainways National Rail Museum, New Delhi[15]

served original monorail rolling stock, including a unique steam locomotive[15].

ESTABLISHMENT OF COMMON RAILWAYS IN INDIA

Today, India's railways are the fourth longest in the world (67.900 km) after the USA (148.7)[16], China (109.7)[17] and Russia (85.5)[16], India, meanwhile, operates the largest railway network in the world on the broadest gauge currently in operation — 5 feet and 6 inches (1.676 mm) (see table). This gauge was first used in Scotland on two small railways built in the 1830s. This was a time of many experiments in railway construction in the context of the "Battle of Gauges". The builders of the first Scottish railway chose a gauge of 1676 mm, probably out of a desire to be in the "golden mean" between Stephenson's standard 1435 mm gauge and Brunel's extra broad 2140 mm gauge[18].

In India in the 1830s and 1840s, echoes of the battle of the gauge battles that were taking place in the metropolis reached the country. In response to a variety of sentiments, entrepreneurs, engineers and local colonial authorities opted for a Scottish gauge of 1676 mm for the first main line railway in India. Railway builders in several other countries of the region — Pakistan, East Pakistan (Bangladesh), Nepal, Sri Lanka, the island of Ceylon[19].

In the metropolitan area, not much time had passed since the Gauge Act was passed in 1846 and, as shown above, there was in fact still considerable confusion about how to determine the optimum gauge in practice. Similar processes have taken place in other countries. In the North American United States (USA), no fewer than a dozen different gauge sizes were being built, with the Stephenson gauge of 1435 mm and the five-foot gauge of 1524 mm dominating. Russia, a future great railway power, experimented with a broad gauge of 6 feet on its first public railway, the Tsarskoselskaya. The American five-foot gauge (1524 mm) was adopted when the construction of the main line between Saint Petersburg and Moscow was decided, and later became the standard gauge in Russia, later to be called the Russian gauge.

With the establishment of the Great Indian Peninsula Railway in India in 1849, it was decided that the Indian railway network would develop with a track gauge of 1676 mm. Many historical publications have pointed out that the choice of a broader track (1435 mm) in India was based on the belief of many experts at the time that a broader track would be more resistant to possible damage under the harsh conditions of the Indian peninsula, especially the long monsoon rains and the hot climate.

Despite the decision to build 1676 mm broad gauge mainline railways in India, numerous metre gauge railways and smaller gauges — 762 mm and 610 mm — were constructed throughout the 19th century and early 20th century[20] [7]. Entrepreneurs tried in every way to reduce the cost of building railways. At the same time, even the construction of one-metre gauge railways seemed to many of them to be too expensive. As has already been noted, often projects to build narrow-gauge railways, for which powerful lobbyists had per-

[15] Delhi: India's oldest monorail comes back to life, to chug every Thursday. URL: https://www.hindustantimes.com/delhi-news/delhi-india-s-oldest-monorail-comes-back-to-life-to-chug-every-thursday/story-pRQRDdKcFDCaLXP8uhY8DO.html
[16] International Union of Railways data, which we consider to be the most trustworthy / Railway Statistics Synopsis 2022 edition. Paris: UIC, 2022. URL: https://uic.org/IMG/pdf/uic-railway-statistics-synopsis-2022.pdf
[17] US and Chinese railways use a standard gauge of 1,435 mm for almost their entire length, while the Russian Federation's railways use a gauge of 1,520 mm, established in the 1970s.
[18] Today it is difficult to establish the true reasons why the Dundee and Arbroath Railway (1836–1947) and the Arbroath and Forfar Railway were built with a gauge of 1667 mm. Subsequently they were "converted" to a standard gauge of 1435 mm.
[19] The 1676 mm gauge is currently used in Argentina, Chile, on the Bay Area Rapid Transit (BART) urban passenger rail line in San Francisco. In the past, railways with this track gauge, further "converted" to a standard of 1435 mm, were operated in Canada and the USA.
[20] The 1000 mm broad track was first used in Belgium and France and in cities in Germany and other European countries. Subsequently, in most European countries it was "re-stitched" to a standard gauge. However, the one-metre gauge has survived and is in use in many countries in Africa and Asia. According to various estimates, the length of railways with such track in the world is about 80 thousand km, it is also used as a tramway in more than 50 cities around the world.

Table

Operational length of railways in India

Years	Track gauge, mm								Total operational length
	1676		1000		762		610		
	1 – operational length, km, *2* – percentage of the operational length of the network								
	1	*2*	*1*	*2*	*1*	*2*	*1*	*2*	
1956–1957 [8]	25 842	47.0	24 654	44.9	3 886	7.0	577	1.0	54 959
2022*	65 093	95.7	1655	2.5	Narrow gauge 762 + 610 mm				68 193 According to UIC – 67 956[16]
					1	*2*			
					1294	1.91			

* India Brand Equity Foundation (IBEF). URL: https://www.ibef.org/industry/railways-presentation

suaded both the local authorities and London to grant permission, conflicted with the transport needs of the country. By the end of the 19th century India's railway network, like Britain before it, had numerous junctions where goods and passengers had to be reloaded and interchanged. The Indian railway network at the beginning of the twentieth century was a patchwork of different gauges: broad (1676 mm), one-meter and narrow gauges, with numerous junctions and transfer platforms.

MODERNISING INDIA'S RAILWAYS WITH INDEPENDENCE

Great Britain had left India with a dire railway legacy of a network of backward infrastructure and scattered sections of railways of various gauges. While the metropolis had a unified network of standard gauge mainlines by the early 1890s, the situation in India at the time of India's independence in 1947 was dire in terms of nationwide operations. The length of India's railways by the 1950s was about 55.000 km [8], placing it seventh in the world after the USA (350.000 km)[21], USSR (120), France (40.9), Great Britain (30.60), and Germany (30.5) [8]. Technical armament of Indian railways was one of the lowest in the world for a network of such length, in the vast expanses of India railway stations of different gauges were comparable with rapids on navigable rivers. Of the 54,500 km operational length, 47 % had 1667 mm broad track gauge; 44 % had meter track gauge and about 9 % had narrow gauge (762 mm and 610 mm gauge railways)[22] [8].

For several decades in the second half of the twentieth century, the process of interconnecting India's network on the basis of 1676 mm broad gauge railways, important for improving railway operations, developed very slowly. Both the country's leadership and the railway community were well aware of the need for it. However, the stated objective required enormous expenditures at the national scale for reconstruction, and sometimes practically new construction of railways when they were converted from the narrow gauge to the standard broad gauge accepted in the country. In many cases it was a question of constructing a new earthwork, artificial structures, laying new track structure and replacing rolling stock compatible with a broad track gauge of 1676 mm. This landmark reconstruction required political will and a unified approach at various levels of government, as well as unity in dealing with the many tasks of various social groups, associations of businessmen, industrialists, builders.

Ten years after independence, the task of creating a single "seamless" railway network was far from being achieved. Within a decade, many new metre gauge railways had been built and some of the narrower gauge roads had been reconstructed to metre gauge.

The revolutionary decision to carry out systematic work to unify the Indian railway network on the basis of converting ("re-building") railways with a gauge of already 1676 mm (meter gauge, 762 mm and 610 mm) into 1676 mm gauge mainlines was taken on April 1, 1992 by a program called Unigauge[23] [7], A timetable was approved for the transformation of individual railway lines, railway sections and railway junctions into

[21] The maximum operational length of the US railways reached 409,100 km in 1916, after which they steadily declined.
[22] Figures published in 2023 by the Ministry of Railways of India differ slightly from the above, but within 1–2 percent (Project Unigauge. URL: https://en.wikipedia.org/wiki/Project_Unigauge; What is project Unigauge. URL: https://www.railnewscenter.com/what-is-project-unigauge/railway-employee/
[23] What is project Unigauge. URL: https://www.railnewscenter.com/what-is-project-unigauge/railway-employee/

a unified network of 1676 mm gauge. Several narrow-gauge railways are to be eliminated and their freight and passenger flows transferred to the new broad-gauge lines.

The progress of the Unigauge programme to date is significant. In 2022, the operational length of the broad-gauge railway network in India was 65.094 km or 95.7 % of its total length.

Under the Unigauge programme, a specific list of metre and narrower gauge railways with a total length of about 500 km has been drawn up and approved as a national historical and cultural heritage as well as a UNESCO World Heritage Site in India. They and the rolling stock for them, as well as railway buildings of various industrial uses and railway stations, are not subject to alterations and conversions and are preserved and maintained in their historical form.

CONCLUSION

Railway transport in India, from the construction of the first railways in the 1830s until the country's independence in 1947, developed as part of the colonial policy of the metropolis to enslave the country and plunder its national wealth. The British colonisers did this in the cheapest way possible, without creating high-tech national enterprises and without taking into account the interests of the colonial territories.

In the development of rail transport in India, this was evident in the construction of railways by the colonial authorities in the cheapest way possible, almost universally to the detriment of national interests, without any aspiration to create a unified railway network, with the 1676 mm broad gauge adopted as standard in the country.

The result of this policy was the formation of a fragmented agglomeration of railway lines by the mid-20th century. In India, a fragmented agglomeration of railway lines and local sections of railways of different gauges with numerous junctions and reloading stations, which hindered freight and passenger transportation at a significant cost of transport operations.

Only after national independence did the modernisation of the railways begin. Preparatory work was carried out over several decades, and the national Unigauge programme, adopted in 1992, brought the first phase of rail modernisation closer to completion. Today, more than 95% of the total length of India's railways is a unified gauge system with a gauge of 1667 mm.

This opens broad prospects for a technological renewal of all railways, based on the completion of electrification, the unfolding construction of high-speed railways and the digitalisation of rail transport.

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