



ROAD INFRASTRUCTURE GETTING SMARTER

Roads, both in number and quality, have been an important driver for economic development and social inclusion. In the recent three decades, the emphasis has been more on quality, leading to better speeds and all-weather connectivity. Various organisational innovations and technologies have enabled this.

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India's road infrastructure is classified into six categories. The road length in kilometres (kms) of each of the categories and its compounded annual growth rate (CAGR) in percentage over 1991, available most recently as of 31 March 2019, as per the 2022-23 annual report of the Ministry of Road Transport and Highways (MoRTH) is shown in Figure-1.

India has the second-longest road length among all countries (the USA has the longest road length). The CAGR of total road length since 1991 to 2019 has been 3.64%. The CAGR between 1951 and 1991 was 4.50% on a much lower base. The total road length in 1951 was about 4 lakh km, and in 1991 it was about 23 lakh km. In absolute terms, we have added about 40 lakh km in the last 28 years, compared to adding

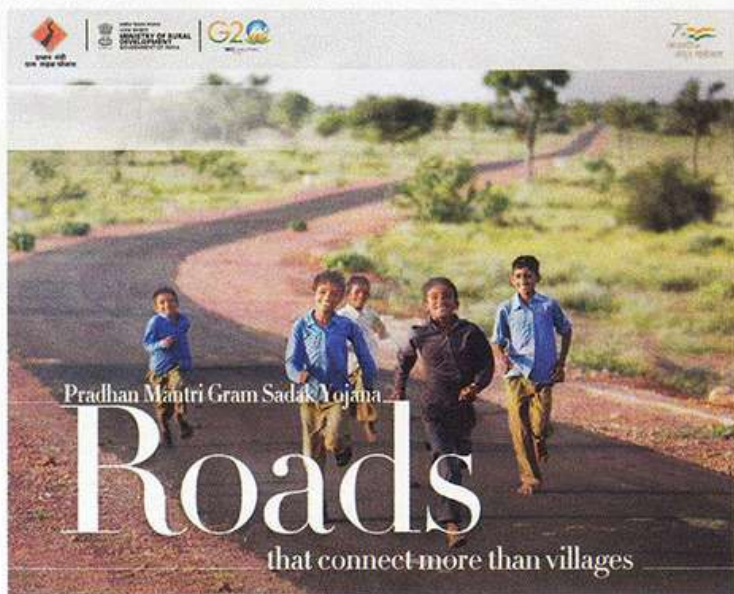
about 19 lakh km in the earlier 40 years. The growth in road infrastructure has been quite transformational.

The CAGR of National Highways (NH) has been the highest since 1991 at 5.02%, followed by rural roads at 4.67%. After 2019, more roads, especially State Highways (SH), have been reclassified as NH for upgradation. The current figure as of 31 March 2023 is 1,44,955 km of NH and 1,67,079 km of SH.

At the other end of the spectrum, there has been attention to penetrative connectivity by providing all-weather roads in rural areas through the *Pradhan Mantri Gram Sadak Yojana* (PMGSY). This project was initiated in 2001 and has played a major role in improving access and consequent development. Rural roads constitute over 70% of the total road length in India.

| National Highways (NH) | State Highways (SH) | District Roads | Rural Roads | Urban Roads | Project Roads | Total |
|------------------------|---------------------|----------------|-------------|-------------|---------------|-----------|
| 1,32,499 | 1,79,535 | 6,12,778 | 45,22,228 | 5,41,544 | 3,43,163 | 63,31,757 |
| 5.02 | 1.24 | 0.66 | 4.67 | 3.87 | 1.77 | 3.64 |

Figure-1



Thus, roads, both in number and quality, have been an important driver for economic development and social inclusion. In the recent three decades, the emphasis has been more on quality, leading to better speeds and all-weather connectivity. Various organisational innovations and technologies have enabled this.

- **Delinking Road Development and Direct Employment:** In the period until liberalisation, while there was planned focus on road development. [Nagpur Plan (1943-1963), Bombay Plan (1961-81), Lucknow Plan (1981-2001)], it was also connected with direct employment generation. This resulted in labour intensive means of construction, putting a cap on the quality of roads. It was only in the late 90s when this mindset changed and the use of capital-intensive high-tech road making equipment was brought in.
- **Creation of National Highways Authority of India (NHAI):** The NHAI became operational in February 1995, to directly drive the development of NH. It was always said that 2% of India's

roads (essentially the NHs) carried 40% of the traffic. Prior to NHAI, the NH development and maintenance was the responsibility of the state with funding from the Centre.

- **Bringing in Public-Private Partnerships (PPP):** Discussions around this began as early as 1996, during the early days of NHAI. The initial concession agreements (CAs) were loaded in favour of the Government, making it unattractive for private parties to enter this domain for financing, building, and operations and maintenance (O&M). PPPs, if at all, happened in short segments like bypasses and road over bridges, where traffic risks were low.
- **Creation of State-Level Road Development Corporations:** As the NHAI got active, many states started thinking of better organisational forms than the Public Works Department for road development under its charge. Maharashtra was the first state to set up the Maharashtra State Road Development Corporation Limited (MSRDCL) in August 1996. The Mumbai-Pune Expressway was developed by the MSRDCL. Other states followed over the next decade. These corporations also promoted PPPs where possible. Some states are also developing Expressway-standard roads. Uttar Pradesh is a leader in this.
- **Starting the National Highways Development Project (NHDP):** This project was started under NHAI in 1998 and consequently grew to seven phases involving a total length of 49,260 km, focusing on almost the entire NH system as it existed then. Phase 1 consisted of four-laned the Golden Quadrilateral (GQ), connecting the four major metro cities. Phase 2 was four-laned, connecting the north-south and east-west corridors, connecting the extreme points of the country. There is an interesting story about how both phases 1 and 2 came to be announced simultaneously, while the original plan was only to announce the first phase. Atal Bihari Vajpayee, the then Prime Minister, while announcing the project, in his poetic style, said that the NHDP would enable connectivity from "Kashmir to Kanyakumari and Saurashtra to Silchar", while the initial focus was to be on the GQ, which had higher traffic. Thus, phase 2 was also announced. In 2018, with most of the NHDP having been completed, the remaining works were subsumed

| Year (as on 31 March) | NH length (kms) | Year (as on 31 March) | NH length (kms) |
|-----------------------|-----------------|-----------------------|-----------------|
| 2011 | 70,934 | 2017 | 1,14,158 |
| 2012 | 76,818 | 2018 | 1,26,350 |
| 2013 | 79,116 | 2019 | 1,32,500 |
| 2014 | 91,287 | 2020 | 1,32,500 |
| 2015 | 97,991 | 2021 | 1,38,376 |
| 2016 | 1,01,011 | 2022 | 1,41,345 |
| | | 2023 | 1,44,955 |

under the larger *Bharatmala Pariyojana*.

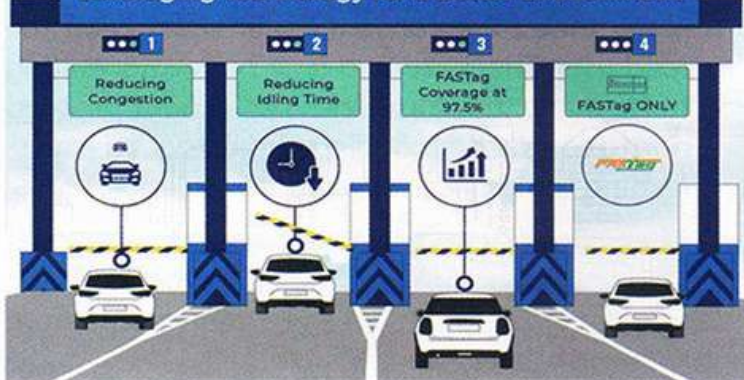
- **Focus on Rural Roads through PMGSY:** This has been one of the more successful projects in India. It can be attributed to three reasons: (i) selection of villages for connectivity based on objective criteria; (ii) overseeing from independent agencies, including the World Bank; and (iii) housing the project under the Ministry of Rural Development (demand side) rather than the MoRTH (supply side). The PMGSY has also spun off projects like the *Mukhya Mantri Gram Sadak Yojana* (MMGSY) in many states that want faster development of rural roads. The PMGSY has also brought in state involvement for the maintenance of the roads. Given the interest in rural roads, the earlier classification of 'Other District Roads (ODR)' has been merged with rural roads since 2016.
- **Providing Viability Gap Funding (VGF):** The approach to the initial phases of NHDP was to leverage PPPs. However, PPPs were hardly forthcoming for the GQ as phase 1 got started due to high risk perceptions. The NHAI decided to do the bulk of the work through traditional contract means, with support from a road cess. In the meantime, based on discussions with stakeholders, including contractors who could be PPP players, the idea of mitigating risks by providing a VGF came up. In fact, this was the bidding criteria with a cap of 40% of the project cost. This created interest for the bidders and many projects after phase 1 were done through the PPP route. The idea of VGF has since been used by other infrastructure sectors.

- **Evolution of the Model Concession Agreement (MCA):** The first MCA for the road sector was brought out in 2000. Beyond the VGF, many other aspects of better allocation of risk between the PPP player and the authority were addressed over the past 10 years in a spirit of continuous improvement. These included issues such as (i) Revenue share over negative grant, (ii) Site handover to the extent of 80% of the requirement, (iii) Omnibus bipartite State Support Agreement over a case-by-case approach, (iv) Specifications and standards beyond the Indian Roads Congress (IRC) guidelines, (v) Security to lenders through an escrow account, (vi) Supervision by an Independent Engineer, (vii) Change of scope during the concession period, (viii) Change in ownership with a moratorium period, (ix) Breach of maintenance obligations, (x) Variations in traffic growth addressing both upside and downside, (xi) Overloading regulation and (xii) Termination conditions.
- **Focus on Expressways:** The first access-controlled expressway for fast and streamlined movement was opened between Mumbai and Pune in 2002. While the construction of expressways had a slow start, it has picked up in the past 10 years. As of August 2023, India has about 5000 km of operational expressways, with another 9000 km under construction. There are proposals for a further 20,000 km of expressways.
- **New Contracting Models and Asset Monetisation:** Apart from the classical tendering through the Engineering, Procurement, and Construction (EPC) or the PPP through the Build, Operate, and Transfer (BOT), the Hybrid Annuity Model (HAM) and Toll, Operate, and Transfer (TOT) have emerged as acceptable operating models over the past decade. In the HAM, there is better risk allocation to the private player, who must build and operate the road, without being vulnerable to toll revenues. Further, 40% of the capital cost is provided by the authority. The remaining 60% is paid to the private player over 30 years in biannual installments. In the TOT model, a built road is offered to the private player for toll collection and maintenance over the concession period. To enable asset monetisation of built roads, the idea of Infrastructure Investment Trusts (InVIT) has been operationalised.



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- **Focussed Organisations:** Apart from the NHAI, organisations have been created for specific objectives. In December 2012, the Indian Highways Management Company Limited (IHMCL) was set up to carry out electronic tolling. This was followed by the National Highways and Infrastructure Development Corporation Limited (NHIDCL) to carry out road development projects in the border states. The National Highways Logistics Management Limited (NHLML) was set up in 2020 for developing Multi Modal Logistics Parks (MMLPs) and the first/last mile port connectivity projects.
- **Road-Making Technologies:** As the NHDP was rolled out, the import of road-making equipment was brought under the open general licence to make it easy for procurement. The manufacture of such equipment through technology transfer was also encouraged. The bidders for the GQ tenders had to be a consortium of an Indian and a foreign player, so that there could be learning from other countries. This has since not been mandatory. Over the years, we have learned to increase the rate of road surface construction (including setting records in the Samruddhi expressway), construct better bridges at a lower cost, and tunnel through mountains and environmentally sensitive areas. New and environmentally sustainable materials are being experimented with and used where they are found acceptable.
- **Electronic Toll Collection (ETC):** With the increasing number of toll plazas across the country, it became imperative to bring in ETC to reduce the toll collection time and consequent waiting. This had a slow start in the initial years, with 5% penetration by 31 March 2017, and then going up to 96% by 31 March 2022. The average daily ETC during 2021-22 was Rs 90 crore through 55 lakh transactions, at an average of a little over Rs 160 per transaction. This technology must further evolve, like in developed countries, to the point where vehicles need not slow down for the electronic payment but can have it done while travelling at the maximum speed.

While the above have facilitated road development in the country, there still are challenges.

- **Better Focus on Safety:** Road design and construction practices are the biggest causes

of our unsafe roads, which kill the maximum number of people in a country. While we aspire for higher speeds on the road, the design and practices have not kept up. For example, there is rarely a buffer lane for a right turn to enable traffic to wait for the opposing traffic. Exits and entrances do not have buffer lanes, which could ensure streamlined turns. Crash barriers need improvement and immediate replacement when damaged. Roads for traffic diversion during construction are of poor quality, leading to congestion due to low speeds. Signages are not provided with scientific considerations of visibility to prepare the road user for a change in rhythm of their driving speed. Roadside parking is not provided as per user expectations and consequently is not regulated.

- **Urban Roads:** While long haul and even rural roads are getting attention, urban roads are not getting their due. This results in low speeds in urban areas, leading to significant wastage of time and poor first/last mile connectivity. Further, urban goods movement is treated poorly. Parking is a significant issue. There are co-ordination issues with urban public transport.
- **Lane Kilometres versus Road Kilometres:** As more and more multiple-lane roads get constructed, it is important to focus on the measure of lane kilometres rather than road kilometres. This will capture not only access but also capacity. Maps must also be fed with information on the number of lanes to enable road users to make better choices.
- **Origin to Destination (OD) Data:** For future planning of development of the road network, and even if required for traffic regulation, it is important to have OD traffic flow data. Such data collection can be integrated with ETC.
- **Better Co-ordination with PPP Players:** Significant time and energy is wasted in disputes between the PPP players and the authority. Many times, the consequential effect is on the road user. There are two-lane highways waiting to be made into four-lanes but cannot proceed due to contractual conflicts. Projects get delayed, leading to significant user inconvenience.

Given the traction that the country has built on road infrastructure, we would hope that the challenges are addressed and the momentum enhanced for development. □