

2025

**Curriculum
Master of Technology (M.Tech.)
Bridge and Tunnel Engineering
(for Working Professionals)**



SCHOOL OF TECHNOLOGY

GATI SHAKTI VISHWAVIDYALAYA

**Central University, Sponsored by Ministry of Railways
Lalbaug, Vadodara - 390 004, Gujarat, India**

M.Tech Program in Bridge and Tunnel Engineering
(for Working Professionals)
(Program Duration: 03 Years)

Bridges are lifelines for India's vast geography. They catalyze economic growth by boosting trade, industry, and agriculture. Social benefits include improved connectivity, access to essential services, and disaster response. Bridges are crucial for infrastructure development, enhancing transportation and tourism. Railway bridges have unique engineering features which connects India's vast expanse. These iron giants span rivers, valleys, and terrains, enabling efficient transportation of people and goods. They are crucial for the nation's economy, trade, and development. India boasts some of the world's longest and most iconic railway bridges, showcasing the country's engineering prowess. Overcoming challenges like funding and technology is essential for India to harness the full potential of bridge construction.

Bridge engineering plays a crucial role in connecting communities, facilitating transportation, and supporting economic development. It requires a deep understanding of engineering principles, materials science, and construction techniques to create safe, efficient, and durable structures that can withstand the test of time. Tunnel engineering is a fascinating and challenging branch of civil engineering that deals with the design, construction, and maintenance of underground passages. These passages, known as tunnels, serve various crucial purposes, from transportation and utility conveyance to mining and resource extraction.

Bridge engineering is a specialized field within civil engineering that focuses on the design, construction, inspection, and maintenance of bridges. It involves the application of engineering principles and knowledge of various disciplines to ensure the safety, functionality, and durability of these vital structures.

Tunnel engineering plays a vital role in modern infrastructure, enabling efficient transportation, providing access to resources, and supporting urban development. It requires a multidisciplinary approach, combining expertise in geology, geotechnical engineering, structural engineering, and construction management.

India's bridge infrastructure faces a significant challenge. A study spanning 1977 to 2017 revealed over 2130 bridge failures, with an average lifespan of just 34.5 years, far below design expectations. Floods accounted for 52% of collapses, emphasizing the impact of India's monsoon climate. Other contributing factors include subpar construction, material deterioration, and overloading. The Morbi bridge collapse in 2022 is a stark reminder of the human cost of these failures. These statistics underscore the urgent need for robust bridge maintenance, inspection, and construction standards in India.

This proposal outlines the key features of Master of Technology (M.Tech) program in Bridge and Tunnel Engineering to be offered at Gati Shakti Vishwavidyalaya (GSV). This program aims to equip graduates with advanced knowledge and practical skills to become leaders in designing, constructing, maintaining, and ensuring the safety of modern bridges and road networks.

M.Tech in Bridge and Tunnel Engineering intends to equip the students with the essential skills desired for design, construct, and operations of Bridges and Tunnels. The program will broadly focus on critical dimensions such as:

- **Bridge Engineering:** Bridge design, analysis, materials, and construction methods for various bridge types.
- **Tunnel Engineering:** Excavation techniques, rock mechanics, tunnel lining design, and safety considerations.
- **Advanced Construction Techniques:** Learn about cutting-edge technologies used in bridge and tunnel construction.
- **Project Management:** Gain the skills to manage complex bridge and tunnel projects efficiently.

M.Tech in Bridge and Tunnel Engineering intends to enable the graduates for developing essential skills needed for design, planning and operational aspects related to bridges, tunnels, subways, and other underground structures. The graduates will acquire deep knowledge on principles behind bridge design, analysis, construction methods, and materials for diverse bridge types. The program will help students to acquire deep understanding on Tunnel engineering aspects such as excavation techniques, rock mechanics, tunnel lining design, and crucial safety considerations for underground construction. The students will explore advanced construction techniques used in modern bridge and tunnel projects.

2. Program Objectives

- Develop a comprehensive understanding of advanced construction techniques and materials for bridge constructions and road pavements.
- Develop strong analytical skills for load assessment, structural behavior analysis, and bridge stability evaluation.
- Integrate knowledge of construction materials, geotechnical engineering, and project management specific to bridges.
- Impart knowledge on pavement design, analysis, and evaluation methods.
- Equip students with skills for effective bridge and tunnel maintenance and rehabilitation strategies.
- Foster expertise in implementing bridge and tunnel safety principles and accident prevention measures.
- Inculcate a sense of environmental sustainability in bridge and tunnel construction and maintenance practices.

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Year 1

Semester	Course Name	Description	Credits
1	Structural Analysis and Design	Bridge engineers analyze the forces acting on a bridge, such as gravity, wind, and traffic loads, and design the structure to withstand these forces.	4
1	Material Selection	Choosing appropriate materials is crucial in bridge engineering. Engineers consider factors like strength, durability, cost, and environmental impact when selecting materials such as steel, concrete, and composites.	4
1	Construction Techniques	Bridge engineers oversee the construction process, ensuring that the bridge is built according to the design specifications and safety standards. They are familiar with various construction methods, including cast-in-place, precast, and segmental construction.	4
2	Inspection and Maintenance	Regular inspection and maintenance are essential to ensure the long-term safety and functionality of bridges. Bridge engineers conduct inspections to identify any signs of deterioration or damage and recommend appropriate repairs or maintenance measures.	4
2	Environmental Considerations	Bridge engineers also consider the environmental impact of bridge construction and design. They strive to minimize the environmental footprint of bridges by using sustainable materials and construction practices and by considering the impact on local ecosystems.	4
2	Research Methodology	Appreciate the concepts of scientific research and a systematic methodology to implement research in practice	3

Summer Internship (6 Weeks)

Year 2

Semester	Course Name	Description	Credits
3	Ventilation and Safety	Proper ventilation is crucial in tunnels to ensure air quality and remove exhaust fumes. Tunnel engineers also design safety systems, including fire suppression, emergency exits, and communication systems.	4
3	Geotechnical Investigation	Understanding the ground conditions is paramount in tunnel engineering.	4
3	Elective 1	To be selected from the given list of electives	3
4	Tunnel Design	Tunnel design involves determining the optimal tunnel alignment, shape, and size, considering factors like ground conditions, intended use, and construction methods. Engineers use advanced software and analysis techniques to ensure the stability and safety of the tunnel.	4
4	Construction Methods	Tunnel engineers employ various construction methods depending on the ground conditions and project requirements. Common methods include: ○ Cut-and-cover: This method involves excavating a trench, constructing the tunnel within it, and then backfilling the trench. ○ Tunnel boring machines (TBMs): These massive machines excavate tunnels through various ground conditions, providing support as they advance. ○ Drill and blast: This method involves drilling holes into the rock, filling them with explosives, and then detonating the explosives to break the rock. ○ New Austrian Tunneling Method (NATM): This method utilizes the surrounding ground to support the tunnel, minimizing the need for extensive artificial support.	4
4	Elective 2	To be selected from the given list of electives	3

Summer Internship (6 Weeks)

Year 3

Semester	Course Name	Description	Credits
5	Support Systems	Tunnels require support systems to prevent collapse and ensure long-term stability. These systems can include: ○ Linings: Concrete, steel, or shotcrete linings provide structural support and prevent water infiltration. ○ Rock bolts: These steel anchors reinforce the surrounding rock mass. ○ Ground improvement techniques: Techniques like grouting and ground freezing can improve the stability of the ground.	3
5	Environmental Considerations	Tunnel engineers consider the environmental impact of tunnel construction and operation. They strive to minimize disruption to ecosystems, manage groundwater, and control noise and vibration.	3
5		Graduation Thesis Project (Part I)	4
5	Elective 3	To be selected from the given list of electives	3
6		Graduation Thesis Project (Part II)	8

List of Electives:

- Advanced Design and Analysis of Bridges
- Construction Management and Innovation for Bridges
- Bridge Aerodynamics
- Bridge Aesthetics and Design
- Bridge-Geotechnical Interaction
- Smart Bridges and Bridge Instrumentation
- Bridge Management Systems and Bridge Information Modelling (BIM)
- Advanced Tunnel design and construction methods