



Experimental Study on Ratnagiri Kolhapur Highways Project

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ABSTRACT

In a National Highway Project, the engineer has to plan, design and construct either a network of new roads or road link. Once a highway is constructed, development takes along the adjoining land and subsequent changes in alignment highway is not a source of potential traffic hazard, but also causes a considerable increase in transportation cost and strain on drivers and the passengers. The Government of India had entrusted to the Authority the development, maintenance and management of Four / Six Laning of Ambaghat to Pajjarwadi section of NH- 166 from Ch 67+140(existing km 69+072) to Ch. 112+340 (existing km 115+540),Length 45.200 Km in the state of Maharashtra under NH(O) on Hybrid annuity mode (the "Project") on design, build, operate and transfer (the "DBOT Annuity" or "Hybrid Annuity") basis, which shall be partly financed by Concessionaire who shall recover its investment and costs through payment made by Authority, in accordance with the terms and conditions to be set forth in concession agreement.

Keyword- Bottom Slab, Side Wall Construction, Top Slab.

1. Introduction

The **National Highways Authority of India** was established by the **National Highways Authority of India Act, 1988 16(1)** of the Act states that the function of NHAI is to develop, maintain, and manage the National Highways and any other highways vested in, or entrusted to, it by the Government of India.

In 1988 India launched a massive program of highway upgrades, called **National Highways Development Project (NHDP)**, in which the main north-south and east-west corridors and highways connecting the four metropolitan cities (Delhi, Mumbai, Chennai, and Kolkata) have been fully paved and widened into four lane or six-lane limited-access highways.

National Highways and Infrastructure Development Corporation Limited started functioning w.e.f. 18 July 2014. It is a fully owned company of Government of India under Ministry of Road Transport and

Highway sand was created to develop, maintain and manage the national highways, strategic roads and other infrastructure of India.

1.1. About the company

Established in 1974 under the name **M/s. S. C. Thakur & Bros**, and subsequently changed to **Thakur Infra Projects Pvt. Ltd.** We have become one of the renowned infrastructure development contractors in Maharashtra. We have our registered office at Panvel Dist. – Raigad. In last three decades of its operation the company has grown at a pace to position itself as a leading company in the field of Infrastructure & earthmoving in Raigad, with a sole motto of Successful Project Executions within Time limit & Client satisfaction.

1.1.1. Main Activities

Ready Mix Concrete -Production & Supply, Asphalt Concrete -Production & Supply, Sand & Aggregates - Production & Supply.

TIPL was the first agency to initiate first Land Development work for CIDCO and is still among CIDCO's most preferred Contractors, TIPL in its 30 successful years of operations has contributed significantly to the infrastructure growth and development requirements in Maharashtra, Gujrat & Kerala. In its more than 30years of operation TIPL has successfully completed more than 100 projects. We have been fully conversant with local conditions and through the qualified Project Managers & Engineers has grown to a formidable position in the area.

TIPL has a capability of providing end to end solution to infrastructure requirements. TIPL own almost every type of machinery & equipment required to undertake infrastructure projects. This also takes care of complete raw material & back-end logistic requirement which enable the right material & resource at right time. All this has assisted the company in cementing its place amongst the leading infrastructure development contractors in Maharashtra.

The company is anchored by more than 2500 employees. Most of the Top officials of the company have contributed & witnessed the growth of the company since its initial phase.

1.2. Execution of project

- i) Planning
- ii) Surveying
- iii) Analysis and Design of Construction
- iv) Construction sequence on site (Highway)
 - a) Cleaning and Grading (C & G)
 - b) Original Ground level
 - c) Embankment (Earthwork)
 - d) Subgrade
 - e) Granular Subbase
 - f) DLC (Dry Lean Concrete)
 - g) PQC (Pavement Quality Concrete)
 - h) Road Marking and Sign Boards Instalment

- v) Construction sequence on site (Structure)
 - a) Excavation
 - b) Setting out
 - c) Foundation construction
 - d) Substructure construction
 - e) Superstructure construction
 - f) Quality control and Inspection

1.3. Project Overview

- Company name -Thakur Infraprojects Pvt. Ltd.
- Client -National Highway of Authority (NHAI)
- Independent Engineer -TPF Engineer
- Concessionaire -M/s Kolhapur Ratnagiri Highways Pvt. Ltd.
- EPC Contractor
 - 1. M/s JM Mhatre Infra Pvt. Ltd.
 - 2. M/s Thakur Infra Projects Pvt. Ltd.
- Mode of Execution - Hybrid Annuity Model
- Project Length -45.200 Km
- Award Cost of Civil Work (in Cr.) -839 Cr.

1.4. Scope of Project

Construction of the project on the site set forth in schedule –A, and as described in Schedule- B, together with provision of project facilities in Schedule–c, and in conformity with the specifications and standards set forth in Schedule-D

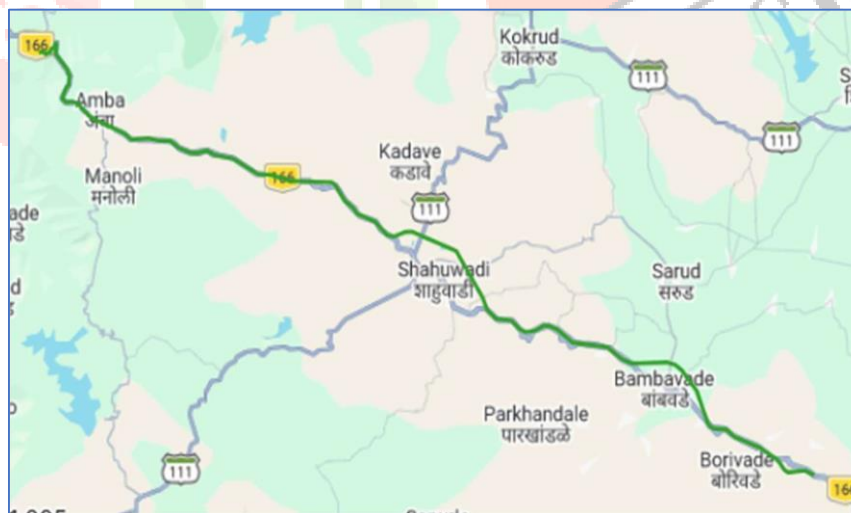


Fig 1.1 Scope of Project

Operation and maintenance of the project in accordance with the provisions of this agreement and Performance and fulfillment of all other obligations of the Concessionaire in accordance with the provision of the agreement and matters incidental there to or necessary for the performance of any or all of the obligations of the concessionaire under this agreement.

2. Construction Methodology

2.1. Site Preparation and Survey

- Clearing and grubbing the site.
- Setting out the structure centre lines using total stations based on design coordinates.
- Establishing permanent reference pillars.

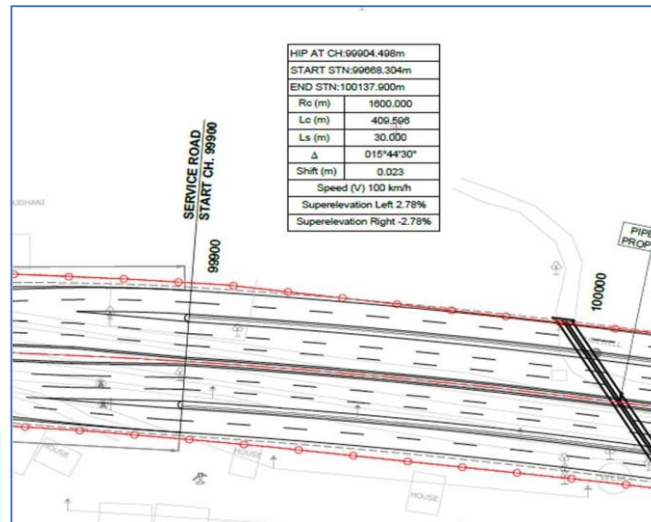


Fig. 2.1 Plan and Profile

2.2. Excavation and PCC work

- Excavation to the required depth, ensuring proper slope stability.



Fig. 2.2 Excavation work

- Levelling and compacting the ground, followed by pouring Plain Cement Concrete (PCC) for the foundation base.

2.3. Foundation and Bottom Slab Construction

- Fixing reinforcement for the bottom slab (typically Grade Fe 550 steel) with the help of Bar Bending Schedule (BBS).
- Casting the RCC bottom slab (typically Grade M35 or higher).



Fig. 2.3 Raft foundation Concrete work

2.4. Side Wall Construction

- Fixing vertical reinforcement for side walls and anchoring them to the bottom slab.
- Installing formwork (shuttering) for the walls.



Fig.2.4.1 Shuttering of Side wall

- Bar Specifications: Typically uses high-yield strength deformed (HYSD) bars, Grade Fe 500.
- Main Reinforcement: Frequently utilizes 20mm diameter bars at 170mm centre-to- centre spacing, with 27mm diameter bars used as main reinforcements in specific segments.
- Components: Formwork consists of shuttering plates, soldiers (vertical supports), beams, and angle supports.
- Casting the side walls.



Fig. 2.4.2 Concrete of side wall

2.5. Top Slab Construction

- Installing staging and formwork for the top slab.
- Fixing reinforcement and casting the top slab.
- Concrete Cover: Typically, 40-50 mm for deck slab.
- Slab Thickness: Typically, 225mm to 250mm uniform thickness.
- Main Reinforcement: 16mm or 20mm diameter HYSD bars, often spaced at 120mm to 170mm centre-to-centre (c/c) at the bottom and top.
- Distribution Reinforcement: 10mm or 12mm diameter bars, commonly placed at 150mm to 200mm c/c.
- Clear Cover: Typically, 45mm to 50mm, unless otherwise specified, to ensure durability against environmental factors.
- Bottom Mesh: Carries positive bending moment (tension at the bottom). Generally, includes longitudinal and transverse bars.
- Top Mesh: Carries negative bending moment, especially over girder supports or within cantilevered portions.
- Lap Length: Typically, 54d to 76d (where 'd' is bar diameter) depending on the percentage of steel lapped at a section, with staggered laps required.
- Development Length: As per IRC standards, often 36d to 42d.



Fig. 2.5.1 Reinforcement of Deck Slab (LVUP)

- **Concrete Grade:** M30 to M45 grade concrete is typically specified for deck slabs.
- **Preparation and Pre-Pour Inspection:** Before pouring, formwork gaps are sealed (often with sponge or sealant), formwork supports are checked for integrity, and reinforcements are inspected for proper size, spacing, and concrete cover.
- **Concrete Placement and Consolidation:** Concrete is typically pumped. A slump test (e.g., $125 \pm 25\text{mm}$) ensures proper workability. Proper vibration is crucial, especially near the edges and construction joints to prevent air pockets.
- **Safety and Quality Control:** Key checks include deflection monitoring, checking concrete thickness (e.g., 650mm), and ensuring reinforcement is correctly placed.
- **Composite Deck Slab:** Uses corrugated, galvanized steel sheeting (0.8-1.2 mm thick) as permanent formwork, which bonds with the concrete to form a strong slab, allowing spans up to 8 meters.



Fig. 2.5.2 Deck Slab Concrete work

2.6. Expansion Joint Fixing

- **Structural Separation:** Expansion joints must completely separate the structural members (e.g., walls, floors, roofs) to function properly.
- **Location and Continuity:** Joints should extend throughout the entire structure, from the foundation to the top floor or slab.
- **Alignment:** Floor joints should align perfectly with wall joints without offsets.
- **Filler Material:** The gap is filled with compressible, watertight materials such as bitumen, cellular materials, cork strips, or rubber to allow for movement while preventing water ingress.
- **Installation Method:** One side of the joint is constructed first, after which the filler board (e.g., fibreboard) is placed, and then the other side is cast.
- **Watertight Sealing:** Joints, particularly in decking and floors, must be sealed using sealants (e.g., silicone gel) to prevent dirt and moisture accumulation.
- **Cover Plates:** Walls are often covered with material like aluminium or AC sheets to protect the joint, with screws on one side and oval slots on the other to accommodate movement.

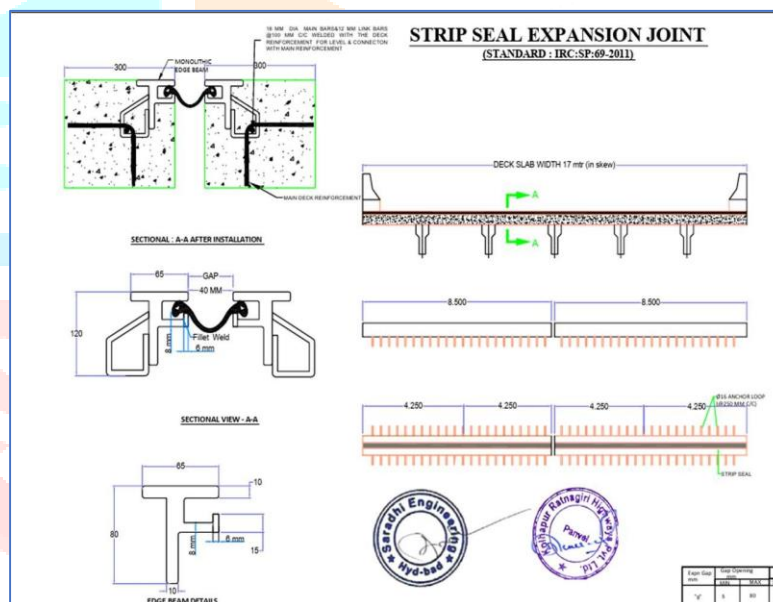


Fig. 2.6 Expansion Joint

3. Typical Technical Specifications for LVUP

- **Structure type-** RCC Box
- **Typical Dimensions-** 3.75 m to 5.5 m width (often designed as 1x12x4.75 m or similar configuration).
- **Vertical Clearance-** Usually around 3 to 4.5 meters.
- **Concrete Grade-** Often M35 grade of concrete.
- **Steel Grade-** Fe 550 Steel.
- **Design Standards-** IRC 6:2017 (Loads), IRC 112:2019 (Concrete)

4. Cube Filling, Slump Cone Test and Strength Achieve Test

4.1. Cube Filling Test

- To determine the compressive strength of concrete, ensuring it meets structural design specifications and quality standards.



Fig. 4.1 Cube Filling Test

4.2. Slump Cone Test

- A quick, on site or laboratory test used to determine the consistency and workability of fresh concrete.
- It measures the vertical subsidence of concrete after a moulded conical specimen is lifted, indicating its flowability.
- A higher slump indicates more workable, fluid.



Fig.4.2 Slump Cone Test

4.3. Strength Achieve Test

- Compression Testing Machine- The primary, high- capacity (often 3000 KN) hydraulic apparatus used to apply gradual, axial loads to concrete cubes or cylinders until failure.



Fig. 4.3.1 Compression Testing Machine (CTM)

➤ Curing-

- The number of days the specimen was cured (standard intervals are 7 and 28 days).
- 7-Day Test: Expected to achieve approximately 65% to 75% of the target characteristic strength. This is an early indicator of quality.
- 28-Day Test: The official benchmark for acceptance; the concrete must meet 100% of the specified characteristic strength.

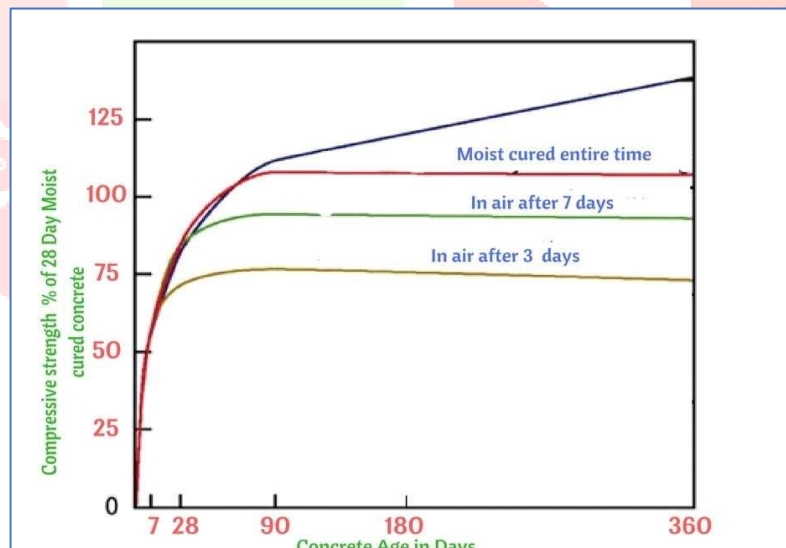


Fig. 4.3.2 Curing Period

5. Conclusion & Future Scope

In addition to taking into account potential environmental effects and the requirement for continuous maintenance to ensure its long-term functionality, the completion of a highway project denotes the successful completion of construction, leading to a new or improved transportation corridor that improves connectivity between regions, facilitates the efficient movement of goods and people, boosts economic growth, and generally improves the quality of life within the affected areas.

I Need to only say one thing that practical knowledge is almost all for execution of any work.

5.1. Future Scope

The future scope of highway projects is expected to focus heavily on sustainable construction practices, advanced technology integration, improved safety features, smart highway management systems, and a shift towards developing high-speed corridors and connecting remote areas, aiming to not only build new roads but also enhance the overall transportation efficiency and economic development potential of regions served by these highways.

Vision

- To be a highly Preferred Infrastructure Developer.
- Innovative infrastructure to connect regions and drive economic growth.
- Enhancing user safety and connectivity isolated regions to urban centre

Mission

- Timely completion with Enviabale Quality.
- To design and develop.
- Maintain safe and efficient.
- Sustainable road infrastructure that connects communities.

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8. Using Schedule D for conformity with the specifications and standards.
9. IRC 6:2017 for loads.
10. IRC 112:2019 for concrete.