

# Advanced Tunnel Form Construction Technique, Case Study of “Rohan-Abhilasha, Wagholi”

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**Abstract**—This paper gives a brief introduction about the uses and advantages of tunnel form in the Indian construction industry. Tunnel form is a type of formwork that allows the casting of the walls and slabs on a daily cycle. It combines faster speed and great quality with the flexibility of in-situ construction.

## I. INTRODUCTION

Tunnel form formwork has turned out to be one of the most efficient means for the construction of high, medium or low rise mass housing projects. Tunnel form is considered to be suitable for Indian condition for mass housing projects, where time and quality are two major constraints. Tunnel form is a fast-track method suited to repetitive projects such as -  
Large commercial hotels  
Social housing - Large/mass scale housing  
Student hostels  
Residential projects

If properly planned a 1-day repeat cycle can be achieved, a 12 story building can be constructed within 40 days with half set of formwork. As it gives a smooth finish, it saves on usage of finishing material like plaster and saves cost.

## II. WORKING OF TUNNEL FORM

*Step-1:* Detailed drawings of the mock up shuttering must be made. It must be made sure that the building’s architectural and structural drawings are finalized before the manufacturing /fabrication of the tunnel form. Any revision in the drawings will lead to delay and increase in cost of the project.



Fig. 1. Layout plan of F2 Bldg. (FL. No. 3,5,7,9).



Fig. 2. Layout plan of F2 Bldg. (FL. No. 2,5,6,8).

*Step-2:* The surveyor provides marking for the concrete starter (Kickers), after which the reinforcement work starts followed by the placing of the tunnel formwork.



Fig. 3. Reinforcement and conduit work for wall Slab.

*Step-3:* Once the tunnel form is in place, the reinforcement work for the slab is done along with the electrical conduit work and column reinforcement for the upper slab.



Fig. 4. Placing the Tunnel formwork with the help of tower crane.

*Step-4:* Monolithic concrete pouring is done for the walls and slab.



Fig. 5. Concreting of the slab during the night.

### III. FEATURES OF TUNNEL FORM FORMWORK

#### Panel size

- Standard size of panels (Inverted L): 6000x1500, 4000x1500.
- Door openings: 1000x2000.
- Window openings: 1500x1000.

#### Cycle time

- 1 days repeat cycle is possible with proper ancillary machineries and infrastructure provisions.
- A 12 story buildings R.C.C. works can be completed in about 40 days.
- Faster speed of work.

#### Pouring method

- Monolithic pouring of wall and slab.

#### De-shuttering time

- Within 12 hours of casting or when the concrete strength has reached 12 MPA.

#### Durability

- More than 500 repetitions can be achieved while using Tunnel form formwork.

#### Machinery requirement

- Require 10 ton capacity Crane
- A 60 to 80 m<sup>3</sup> batching plant
- Mesh Welding Machine
- Gas heaters (for cold climate)
- Hydra

### IV. ADVANTAGES OF TUNNEL FORM FORMWORK

- A 1 day repeat casting cycle can be achieved.
- Monolithic structure eliminates leakages problem at the joints.
- Flexibility in Final design of the building: Cantilever balconies, facades or any walling system can be adapted.

- Smooth surfaces for the walls with very few panel joint lines.
- High level precision in slab units and wall production.
- No/Minimal additional finishes work is required due to the smooth surfaces of the walls and slab of the tunnel form system.
- Faster completion of the project provides opportunity for early recovery of investment cost.
- The repetitive nature of the work aids in minimization of labour-cost and effectiveness in workmanship.

### V. LIMITATIONS OF TUNNEL FORM FORMWORK

- It is not suitable where the size of the project is small and there is a lot of variation in the design.
- The cost of equipment is relatively high as compared to traditional formwork systems.
- Initial cost of investment is very high.
- A wall thickness of 200 mm must be maintained throughout as offsets for column beams are not possible.
- Separate provision of a workshop is required for the production of Pre-cast staircase, Lobbies and cladding panels.
- Complete dependency on the supplier for any change or modification in the design.
- Due to high speed of construction, timely management of high cash-flow is a must.
- Requirement of cranes causes a substantial difficulties due to some topographical conditions.

### VI. CASE STUDY

1. Name of organization: Rohan Builders and Developers Pvt. Ltd.
2. Name of project: Rohan-Abhilasha.
3. Location: Wagholi, Pune.
4. Type of project: Real estate.
5. Scope of work considered:
  - I. Rohan Abhilasha 'F- Block'. F block consist of three 14 (U.B. +L.B. +12) storied towers.
  - II. Play Area.
6. Area of project: 13, 00,291Sq.Ft
7. Built-up area: 3,200 Sq.Ft.
8. Target completion date: 31<sup>st</sup> March 2018.
8. Type of formwork used:
  - I. Up to 2nd parking level: Conventional formwork
  - II. 3rd to 14th floor: Tunnel formwork.
9. Contractor hired for tunnel form: BUYUK ISKENDER, Ankara, Turkey.
10. Architectural consultant: Mindspace architects, Bangalore.
11. RCC consultants: JW Consultants, Pune.

### VII. CONSTRUCTION PERIOD ANALYSIS FOR SHUTTERING WORKS

Timely completion of work depends upon availability of workforce and materials onsite.

Here we consider only one tower of F-Block i.e. Tower F2. With half a set of tunnel form.

TABLE I.

	Tunnel form	Conventional formwork
Slab 1(Conventional)	14 Days	14 Days
Slab 2(Conventional)	14 Days	14 Days
Floor 1(Tunnel form)	7 Days	14 Days
Floor 2(Tunnel form)	4 Days	14 Days
Floor 3 to Floor 12	40 days. (Taking 4 days per floor)	140 Days. (Taking 14 days per floor)
Total	3 Months considering 26 working days a month.	7 Months considering 26 working days a month.

form, not only has reduced the time of construction but has resulted in reduced consumption of finishing materials. Only requiring a high initial investment cost, tunnel form proves to be economical for large scale projects. The early completion of the projects helped the developer recover his investment cost in time, as well as provide housing to low-income group. Tunnel form technology has helped Rohan Builders provide housing for the middle income people in this recession period. We can hereby conclude that tunnel form is capable of providing high quality construction at a reasonable price and quicker speed.

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Fig. 6. F2 Building during tunnel casting.

VIII. CONCLUSION

The construction industry in India has gone through significant changes in past couple of years, one the major changes being the formwork system used. The use of tunnel