

Fall semestre

BUILDING PRODUCTION SYSTEMS



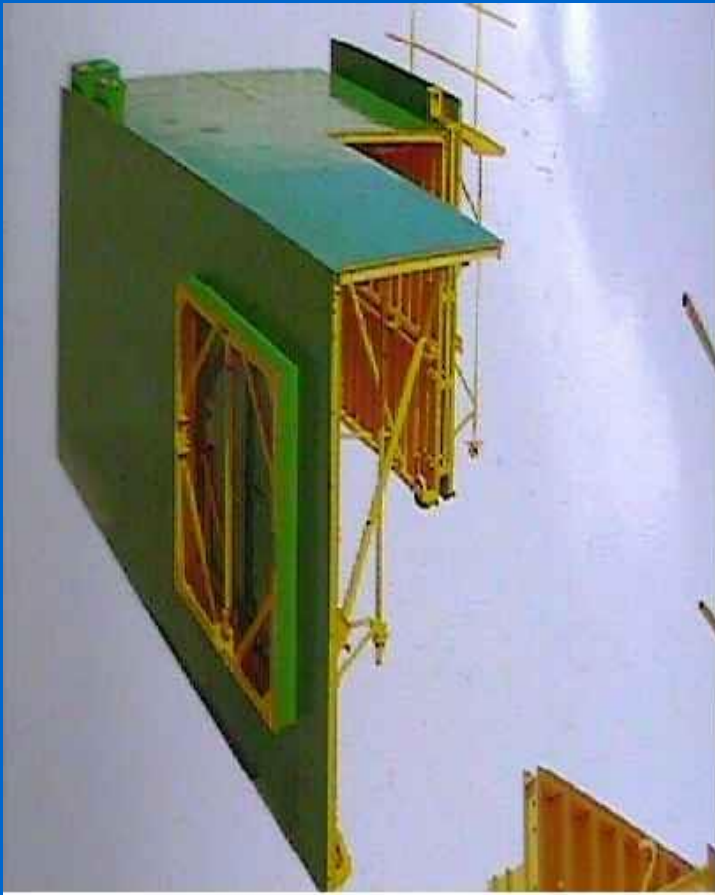
Tunnel Formwork System

by

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Horizontally Moving Formworks



Tunnel Formwork

- Tunnel Formwork is a Steel Formwork that is used during the placing of the concrete to form the floor and the wall at the same time.
- They can be in different shapes, sizes and modules.

Advantages of Tunnel FWS

Like the other advanced formwork systems tunnel formwork system provides some advantages

- Advantages related to time
- Advantages related to cost
- Advantages related to quality

Advantages of Tunnel FWS (time)

- A production cycle of 1-3 days can be achieved.
- Depending on the production speed of load bearing system succeeding production activities in the building can also be accelerated.
- The project can be completed in a short time compared to traditional construction systems.
- Due to accelerated production, effects of climatic conditions on productivity are minimized.
- Due to learning curve, laborers obtain specialization and “zero defect” production pattern.

Advantages of Tunnel FWS (quality)

- Higher precision in production of walls and slab units (1/1000 deformation is allowed and can be achieved)
- Smooth surfaces for the walls and slabs are obtained that can be covered with wallpaper right after easy and quick cleaning.
- Standard dimensions for the other components such as carpet, windows, and doors can be applicable due to strict dimensions of load-bearing system elements.

Advantages of Tunnel FWS (cost)

- Formwork cost per m² (or per housing unit) can be reduced by using formwork up to 8 hundred times.
- Due to smooth surfaces, walls and slabs do not need any additional finishing such as plaster.
- Early completion of project provides financial opportunities such as rental incomes.
- Repetitive nature of buildings provides effectiveness in production and minimization of labor costs.

Disadvantages of tunnel FWS

- Investment cost of formwork system increases formwork cost per m² if project is small sized.
- A continuous and fast cash flow that complies with the speed of production is essential.
- Due to high production speed management-related functions are vital. Coordination problems cause remarkable delays in schedule.
- Skilled labor force is needed compared to traditional systems.
- Equipment costs are relatively higher due to the cranes that are needed by each block.

Design phase limitations

- Dimensional limitations must be considered
 - Low degree of modular flexibility
 - (105 cm+1,2,3...n X 30 cm for a half tunnel formwork)
 - Min. Room size 210 cm.
 - (Appr. 12 m depth, and 6 m width since ribbed or waffle slab can not be applied)
 - Min. 20 cm thickness of wall and slabs

Design phase limitations

- Tunnel formwork system is not convenient for some building types such as music halls, theaters, etc., that contains large spans.
- Lowered slab is not allowed since it prevents the removal of formwork, suspended ceiling is required.
- Load bearing walls must be designed continuously on the same axial system due to the resistance requirements against horizontal forces.
- Basement stories can not be constructed by using tunnel formwork system, removal of formwork is not possible.

Design phase limitations

- Distances of blocks facing each other must allow removal of formwork.
- Erecting and dismantling of cranes took appr. 2 weeks. If a railway system is decided, blocks should be arranged by considering the crane circulation. This makes settlement monotonous and dull.
- Continuous footing or raft (mat) foundation is required.
- Various geometrical forms and angles are possible but these forms must not prevent removal of formwork.

Construction phase limitations

- Tower cranes are required for the erection, removal and carriage of formworks, scaffolds, and pre-cast components.
- A workshop is required for the production of pre-cast components such as stairs, parapets, and walls.
- A crane can serve max. 2 blocks at the same time
- Movement of cranes has difficulties according to some topographic conditions.