

A Study on a Slip Form Construction

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Abstract: Slip forming is the best techniques which carried out fast and rapid construction in an unusual structure like cooling towers, chimneys, silo and also in a roadway construction, bridge construction. Slip formwork techniques carried out with more than 16m height structure and it's very rapid and time saving erection techniques and also economical. Slip forming considers mainly 7.2m per day which is fastest erection procedure. They content various components and after the completion of curtain height concreting by the hydraulic jack it lifted up and further concreting could be done. Hence these methods are rapid, time saving, economical and less labor force is required.

KEYWORDS: Cooling towers, silo, rapid construction, slip forming, chimneys



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INTRODUCTION

Slip form is a method of construction in which concrete is poured into the top of a continuously moving formwork. As the concrete is poured, the formwork is raised vertically at a speed which allows the concrete to harden before it is free from formwork at the bottom. Slip forming is an economical, rapid and accurate form of construction that can be used to build concrete, reinforced concrete, or pre stressed concrete structures. Although slip forming is not suitable for all types of structures, it can be used to construct a wide variety of structures such as chimneys, building cores, bridge piers, and cooling towers. Slip form work used for vertical as well as horizontal continuous structure. This type of formwork is totally depends upon automatic erection techniques.



Slip form Construction Technique



Slip Form Work Construction

HISTORICAL BACKGROUND:

The slip forming technique was in use by the early 20th century for building silos and grain elevators. James MacDonald, of MacDonald Engineering of Chicago was the pioneer in utilizing slip form concrete for construction. His concept of placing circular bins in clusters was patented, with photographs and illustrations, contained in a 1907 book, "The Design of Walls, Bins, And Grain Elevators".

In 1910, MacDonald published a paper "Moving Forms for Reinforced Concrete Storage Bins," describing the use of molds for moving forms, using jacks and concrete to form a continuous structure without joints or seams. This paper details the concept and procedure for

creating slip form concrete structures. On May 24, 1917, a patent was issued to James MacDonald of Chicago, "for a device to move and elevate a concrete form in a vertical plane.



The first residential houses built with Slip forming, was erected 1950 in Västertorp.



Skylon Tower

SLIP FORM CONSTRUCTION

Slip form construction technique is an alternative for conventional formwork system which helps in continuous vertical and horizontal construction. The slip form helps to conduct continuous pouring of the concrete to the moving formwork. The process stops only when the required length of casting is completed. Slip forming is a highly efficient method of constructing long payments and tall concrete structures. Rate of construction of several meters per day of varying geometrical shapes and cross sections, containing multiple inserts and openings can be achieved within strict geometrical tolerances.

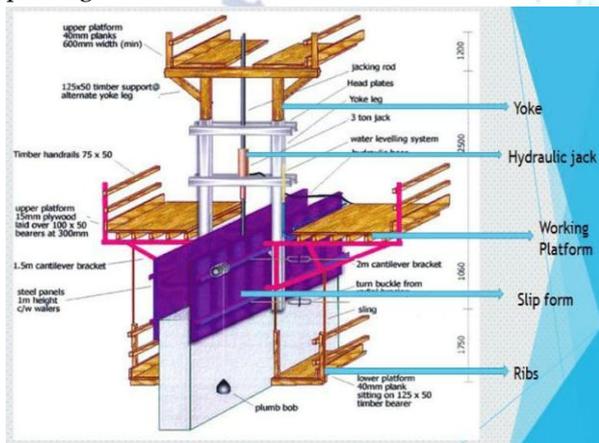
COMPONENTS OF SLIP FORM CONSTRUCTION:

Sheathing or vertical forms: Vertical forms can be wood staves, metal, plywood, glass-fibre reinforced plastic or a combination of these materials. The function of vertical forms is to shape the concrete.

Wales: Wales is also an important component of vertical slip forms supports and holds vertical forms in place. This transmits the lifting force from the yoke to the vertical forms and other elements of the form. It also supports various platforms and scaffolding.

Yokes: Yokes is the component of vertical slip formwork supports the Wales at regular interval with their legs. It transmits the lifting forces from the jacks to the Wales and resists the lateral force of plastic concrete within the form.

Jacks: Jacks is installed on the yoke's beam, it mounts on the jack rod which provides the necessary force to lift the entire slip form system. Various platforms, decks and scaffolds complete the slip form system, provides space for storage of concrete, reinforcing steel and embedding. In short, they serve as a work area for placing and finishing.



Jack

rods: These are climbed up by Jacks.

TYPES OF SLIP FORM CONSTRUCTION:

- 1. Slip forming:** The concrete form may be surrounded by a platform on which workers stand, placing steel reinforcing rods into the concrete and ensuring a smooth pour. Together, the concrete form and working platform are raised by means of hydraulic jacks.



Vertical Slip Forming

- 2. Horizontal slip forming:** Horizontal slip forming for pavement and traffic separation walls concrete is laid down, vibrated, worked, and settled in place while the form itself slowly moves ahead.



Horizontal slip forming

- 3. Tapered slip forming:** It is also used in the construction of conical chimneys, cooling towers, piers and other tall concrete structures involving constant or changing thickness in walls, diameters and/or shapes. A form is used with sections which overlap so that one gradually slides over the other. This is commonly done in chimney construction but it is not satisfactory for architectural concrete because the lap shows. While the tapered slip forming process is similar to that used on the standard slip forming, it requires greater attention, contractor experience and expertise to ensure the success of such projects.



Tapered slip forming

The Cantilever forming: It is used as climbers that are independent of cranes and attached to a large area of

formwork at storey height. In this system, shuttering has already been completed, which is part of the structure between individual levels of climbers. The cantilever jump form system gives maximum protection, providing a complete self-climbing formwork system that is independent of cranes for walls, columns, supports and floor bears



Cantilever slip forming

4. Egg-shaped slip forming: It is based on the jump from principle that can be adapted to any geometric shape. Individual curvature adjustment can be obtained by adjusting the axis and vertical circumferential slope. The system can be adjusted independently on each side of the wall as well as products of optimal working condition.



Egg-shaped slip forming:

5. Conical slip forming: It is a system by which it is possible to construct structures of varying wall thicknesses and tapering walls. The conical formwork is made up of cantilever plates and overlapping plates, which are fastened to steel yoke frames.



Conical slip forming

APPLICATIONS OF SLIP FORM WORK

S.N O	Application	Picture
1.	Service cores for commercial buildings	
2.	Lift and stair shafts.	
3.	Silos.	
4.	Chimneys.	
5.	Concrete gravity structures	
6.	Bridge pylons and piers.	
7.	Mine headgear towers.	
8.	Surge shafts.	
9.	Shaft linings.	
10.	Liquid containment vessels	

ADAVANTAGES OF SLIP FORM WORK:

1. Careful construction planning processes can achieve high production rates.
2. Slip formwork doesn't require the crane to move upwards, minimizing crane use.
3. Provision of a joint less structure.
4. A saving of shuttering material both initially as well as lesser wastage of shuttering material.
5. Scaffolding is not required.

6. Very rapid concreting. It is at least four times faster.
7. Better finishing of concrete.
8. No plastering required.
9. Accuracy is more than regular formwork.
10. Strength is more than regular formwork.
11. Save formwork material.
12. Economical/reasonable for the structure above a certain size.

SAFETY FEATURES:

1. Working platforms, guard rails, ladders and wind shields are normally built into the completed system.
2. Completed formwork assembly is robust and strong enough.
3. Strengths of concrete must be checked at certain time intervals.
4. Site operatives can quickly become familiar with health and safety aspects of their job.
5. All parts should move in uniform rate. There should be no jam in form work or jack work.
6. Lateral support of forms must be provided.

ECONOMICAL CONSIDERATION:

1. This type of form works economical when the height of the structure is a minimum of 16m high.
2. The thickness of the wall should be a minimum of 15cm.
3. This system is only suitable for a structure like silo, cooling towers, chimneys, tall building and piers.

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CONCLUSION

With the invention of slip forming technique and due to speedier completion of work by the technique, there are substantial savings in cost in terms of wages and interest. This technique has no comprises against quality control and homogeneity of structure.

The cost saving will not appear automatically just because slip forming has been used. This technique has a lot of scope for improvement. But it can be adapted for tall framed structure. For slip forming work ordinary concrete of equally M20 & M25, rarely M30 Generally Portland cement is used for concreting. Fast setting

cement in special cases work during winter and slip form progress is chosen. After dismantling the slip form components it can be used for span more than 25 years

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