COST EFFECTIVNESS OF JUMP FORM SYSTEM OVER CONVECTTIONAL FORMWORK

[1]*Sule Sachin Laxman, Kurla, Mumbai, India*
[2]*Prof. R.S.Ambekar, BSCOER, Narhe, Pune, India*

Abstract: - Formwork is mould used to shape and support the concrete until it attains sufficient strength to carry its own weight. Jump form system is advance type of technique which overcomes conventional system. Since this type of system is not suitable for small structures but in case of tall structures like towers it is very useful for all factors such as economy, labour requirement and more no. of repetitions as compared to conventional formwork system. In the project work functioning of Jump Form system and detailing of all the parts of jump form system is studied. Estimation of conventional formwork system for site which is carried out as Jump Form system. Comparison is made for cost, quality of work, workmanship, speed of work, loading effect, etc.

Keywords: *Conventional Formwork, High rise building, Jump form system, Time and Cost, Suitability.*

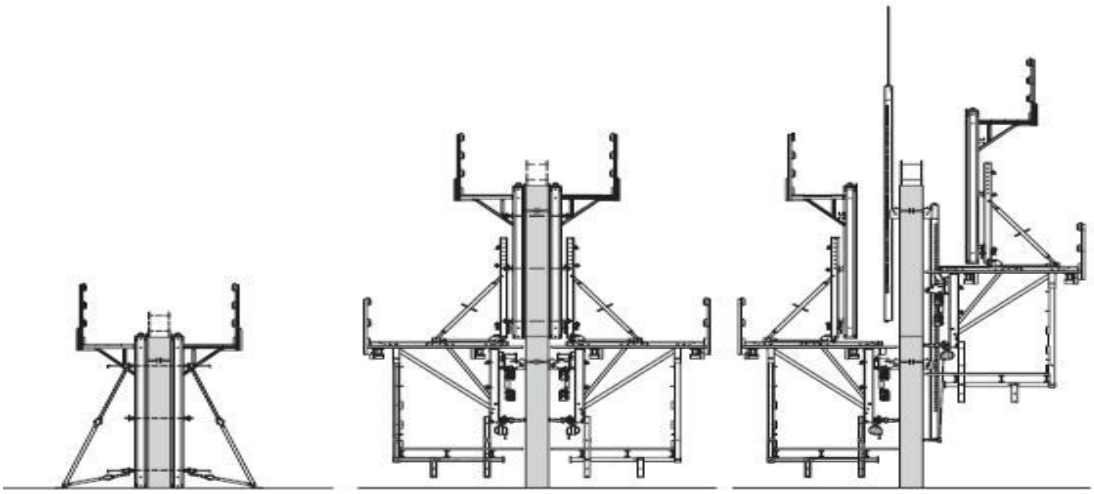
I. INTRODUCTION:

Jump Form System to Construct Concrete Core Walls of High Rise / Mid Rise Buildings The use of a climbing formwork systems to construct the core walls of tall buildings has been successful in different countries in reducing construction times, primarily because the process become repetitive through the whole height of the building. Basically it consists of a frame constructed from structural steel members over the score wall. Steel formwork panels are hung from this frame, some supported on rollers. After the concrete walls are poured, the formwork is released and rolled back from the concrete face. Jacks then lift or climb the whole frame up one level. All the formwork panels are attached to the frame. This process takes approximately one and a half hours. The moulds are cleaned after being lifted out of the finished unit and then re-assembled. A thin layer of a steel mould-releasing agent is then applied by spraying it onto the surface of the steel mould in contact with concrete prior to reinforcing bar placement. Inspection of the moulds is then carried out. Once the climbing formwork is in its approved position, the next concrete wall is poured. The cycle continues, which is normally four days. Faster times have been achieved. However, the limiting factor to faster times is usually the construction of floor slabs, which usually are done as a separate process. Formwork is the term given to either temporary or permanent molds into which concrete or similar materials are poured. In the context of concrete construction, the false work supports the shuttering moulds. The most notable concrete structure is the Pantheon in Rome. To mould this structure, temporary scaffolding and formwork or false work was built in the future shape of the structure. These building techniques were not isolated to pouring concrete, but were and are widely used in masonry. Because of the complexity and the limited production capacity of the building material, concrete's rise as a favored building material did not occur until the invention of Portland cement and reinforced concrete. The expenditure on formwork is occupying a major part in the total cost of construction. Therefore the selection and proper planning the system of form work will reduce the cost of construction, time of construction, the wastages and labor requirement which reduces the total cost of construction. Formwork systems are among the key factors determining the success of a construction project in terms of speed, quality, cost and safety of the works. Construction industry is seen to be able to play a bigger role into a sustainable society by offering sustainable construction. Formwork system is one of the important construction methods in building construction.

II. MATERIAL AND METHODS

Jump form systems comprise the formwork and working platforms for cleaning/fixing of the formwork, steel fixing and concreting. The formwork supports itself on the concrete cast earlier so does not rely on support or access from other parts of the building or permanent works. This type of formwork is designed for constant floor height and layout for multi-storey buildings. The formwork is "jumped" up from one floor to the next floor above. The system is raised vertically for consecutive lifts. Anchor points or ties used near the top of the formwork are reused for the bottom of formwork when it is lifted. Jump form construction, also referred to as sliding form construction, is similar to an extrusion process. Plastic concrete is placed in the forms, and the forms act as moving die to shape the concrete. Once the form has been filled with fresh concrete and hardening has started the form is gradually raised by the lifting devices on which it is suspended. The rate of movement of the form is regulated, so that the forms leave the concrete after it is strong enough to retain its shape while supporting its own weight. Pouring of concrete, tying of reinforcement, fixing of openings/inserts etc. are performed gradually from a working platform. An average sliding speed of 200mm an hour is common, rising to 300mm an hour under the best conditions and 100 to 150mm an hour when large or complicated structures are being jump formed.

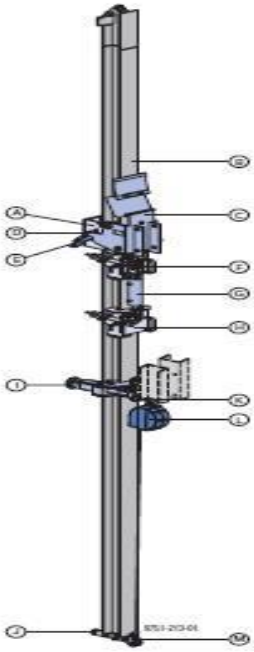
The SKE automatic climbers are "jumped" with the aid of a hydraulic ring-main system. The ring-main system is based on a stationary hydraulic unit designed to provide uniform, simultaneous drive for up to 30 automatic climbers. The number of automatic climbers that can be raised jointly in one climbing cycle must be appropriate for the structure and the construction workflow, and not so many
that it is no longer possible to "keep track" of them all.



Start-up phases		
Pouring 1st casting section	Pouring 2nd casting section	First hydraulic climb
1. Set up one side of the formwork 2. Mount the positioning-points 3. Place the reinforcement 4. Close the formwork 5. Pour this section	1. Mount the suspension shoes 2. Hang the climbing scaffold into place on the suspension shoes (if possible with the Level -1 suspended platform) 3. Place the formwork on the climbing scaffold 4. Mount the positioning-points 5. Place the reinforcement 6. Close the formwork 7. Pour this section	1. Strip the formwork 2. Clean the formwork 3. Mount the top suspension shoe - **Note:** The Main vertical profile MF 160 of the Climbing bracket must be parallel to the concrete wall. 4. Lift the Climbing profile into place by crane 5. Mount the "Profile protection SKE 50" 6. Hydraulically "climb" the entire Climbing scaffold plus formwork

Beam Components:
Beam Side Panel:- It forms the side of the beams. It is a rectangular structure and is cut according to the size of the beam
Prop Head for Soffit Beam:- It forms the soffit beam. It is a V-shaped head for easy dislodging of the formwork.
Beam Soffit Panel:- It supports the soffit beam. It is a plain rectangular structure of aluminum
Beam Soffit Bulkhead:- It is the bulkhead for beam. It carries most of the bulk load.
Deck Component:
Deck Panel:- It forms the horizontal surface for casting of slabs. It is built for proper safety of workers
Deck Prop: - It forms a V-shaped prop head. It supports the deck and bears the load coming on the deck panel.
Prop Length: - It is the length of the prop. It depends upon the length of the slab.

Deck Mid – Beam: - It supports the middle portion of the beam. It holds the concrete
Deck Beam Bar: It is the deck for the beam. This component supports the deck and beam.
Rocker: It is a supporting component of wall. It is L-shaped panel having allotment holes for stub pin.
Kicker: It forms the wall face at the top of the panels and acts as a ledge to support
Stub Pin: It helps in joining two wall panels. It helps in joining two joints



A	Suspension shoe SKE 50 rigid
B	Climbing profile SKE 50
C	Climbing carriage SKE 50
D	Safety pin SKE 50
E	Suspension pin SKE 50
F	Lifting mechanism SKE 50, top
G	Hydraulic cylinder SKE 50 RL
H	Lifting mechanism SKE 50, bottom
I	Supporting carriage SKE 50

For comparative study of advance formwork and conventional formwork. Jump form was selected as representative of advanced formwork and it is compared with timber formwork. Comparative study is then carried out by selecting a suitable working plan of a building. The plan is selected such that the shuttering area for timber formwork is 1769 sq. m. and for Jump form it is 2400 sq. m. The area calculated for both form works are the shuttering area for same floor area.

Using methods for designing formwork prescribed in chapter 5, all the quantities were calculated for plan as shown in fig 6.1 and following parameters were compared

1. Shuttering area
2. Reinforcement binding
3. Concrete with RMC
4. Brick masonry
5. Internal plaster
6. External plaster

Quantities for comparison for both formworks are calculated for all items and work which require formwork.

III. ASSUMPTIONS

Jump form we consider **35** repetitions. In conventional shuttering consider **10** repetitions.

For both systems concreting is done with RMC using concrete pump and Tower crane. No external plaster is required for jump form system. Take same plan of floor for Jump form and conventional system

IV. CALCULATION FOR CONVENTIONAL SHUTTERING The surface area of timber formwork is **1769** sq. m.

Consider 100 sq. m. of Timber Formwork

PARTICULARS	UNIT	QUANTITY	RATE (RS)	AMOUNT (RS)
PLYWOOD	NO.	38	2560	97280
WOODEN PATTI	SQ.FT.	0.85	485	412.25
WOODEN CHABI	SQ.FT.	0.34	530	180.2
OTHERS	UNIT	255.5	280	71540
				TOTAL=169420

Hence for 1 sq. m. the cost of formwork is Rs.1694.20 Calculation for Jump form system

The surface area for Jump form system is 2400 sq. m. Consider 100 sq. m. of Jump form shuttering

PARTICULARS	UNIT	QUANTITY	RATE (RS)	AMOUNT (RS)
PLYWOOD	NO.	38	3676	95580
CLIMBING BRACKET	NO.	24	6000	144000
SUSPENDED PLATFORM	NO.	8	12000	96000
CLIMBING CONE	NO.	96	300	28800
ANCHOR CONE	NO.	50	574	28700
OTHERS	NO.	350.8	280	98224
				TOTAL=491304

Hence for 1 sq. m. the cost of formwork is Rs. 4913.04

V. RESULTS AND ANALYSIS

CALCULATION FOR 1 FLOOR,

A) CONVENTIONAL FORMWORK Cost for 1 sq.m. is Rs.1694.20

The total surface area is 1769 sq.m.

Hence cost of conventional formwork for 1 floor

= 1769*1694.20

=Rs.2997039.8

Since the no. of repetitions for conventional formwork is 10, Hence Cost of conventional formwork system is Rs.299703.98

B)JUMP FORM FORMWORK

= 4913.04*2400

=Rs.11791296

Since the no. of repetitions for JUMP FORM formwork is 35, Hence Cost of JUMP FORM formwork system is Rs.336894.1714

RESULT

Results obtained from comparative study of conventional and aluminum formwork is presented below,

PERTICULARS	Cost (Rs)	
	CONVENTIONAL	JUMP FORM
PLYWOOD	97280	95580
COMPONENTS	600	297500
OTHER	71540	98224
TOTAL for 100 sq.m.	169420	491304
TOTAL for 1 sq.m.	1694.2	4913.04

4. CONCLUSIONS

From the above project data we concluded the following points,

- Since the initial cost of jump form system is more but due to more number of repetitions it is economical than conventional type.
- Jump form system is time saving process.
- Jump form system gives good finishing and aesthetic view.
- Due to all above factors jump form system is more advisable for high rise construction.

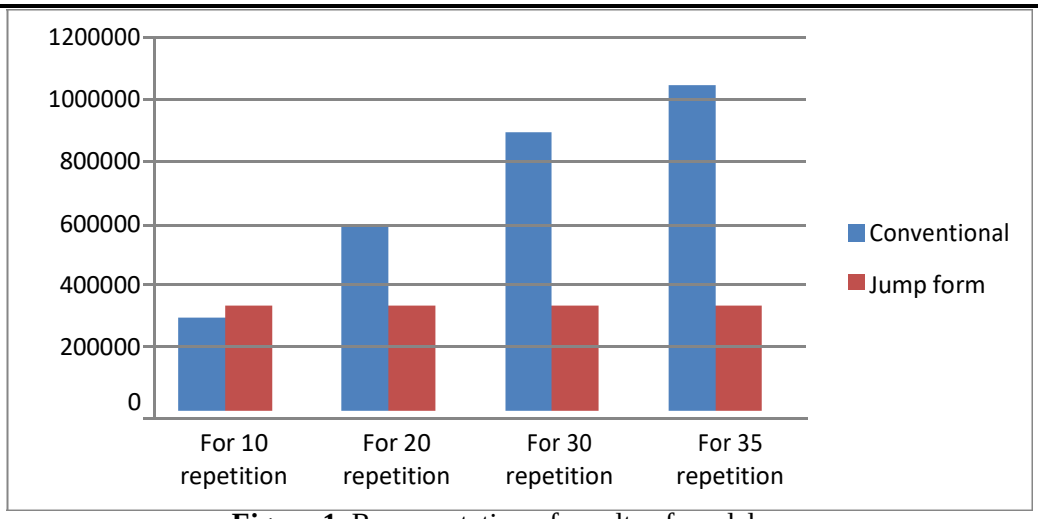


Figure 1. Representation of results of model

REFERENCES:

Robert L. Peurifoy, "Formwork for Concrete Structures",fourth edition, 2011, McGraw Hill. David W. Johnson,"Design and Construction of Concrete Formwork'',fifth edition, 2010,McGraw Hill.M.K. Hurd,''Formwork for Concrete'',7th edition, 2005, American Concrete Institute, Farmington Hills.Patrick H. McDonald,'' Fundamentals of Infrastructure Engineering: Civil Engineering Systems'', Second Edition, 2007, McGraw Hill.