

## **MINI CLIMBING CRANE – AN APPROPRIATE INTERMEDIATE TECHNOLOGY FOR MATERIAL HANDLING AT CONSTRUCTION SITES**

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### **ABSTRACT**

For construction of multistoried buildings, choice of material handling equipment becomes critical for reasons of both economy and safety. To bridge the existing technological gap between age-old traditional methods of material handling and modern sophisticated cranes, the Central Building Research Institute (CBRI) Roorkee has developed Mini Climbing Crane with a lifting capacity of 1000 kg-m. The crane has registered considerable saving in construction time besides a large saving in labour. This machine has been awarded the best technology NRDC Award.

### **KEY WORDS**

Mini Climbing Crane, chain pulley blocks, hoisting, diversified application, sophisticated cranes and primitive methods of material handling.

### **INTRODUCTION**

Time is of paramount importance in any construction activity as material handling an important ingredient at construction sites needs a serious planning in execution with a view to achieving proper blending of speed, economy, efficiency and safety. Since most of construction activities are still performed manually by using mechanical equipments ensures these advantages. Chain pulley blocks and hoists are often used to lift the loads vertically and industrial sophisticated cranes are put to use in factory for lifting the loads.

However, construction cranes are not easily available for material handling at different building sites. Construction cranes mostly tower cranes have also been manufactured but in small numbers. Owing to their high price the private builders cannot afford to use them. These builders though not being fairly well to do, have the credit to undertake maximum construction work in the country. In addition to it, the tower cranes are too big and heavy to use so their lifting capacity exceeds normal capacity required at most construction sites.

On one hand, the available sophisticated material handling devices like tower crane, portal crane etc. are highly capital intensive, energy consuming and labour-saving technologies making lavish use of scarce and expensive resources of the country while failing to utilize much of the India's most abundant asset-people and on the other hand, builders are using primitive devices like chain pulley blocks and other similar aids for lifting materials.

A technological gap, therefore, exists between the modern sophisticated cranes and the on-going age-old traditional methods of material handling. Under the circumstances, there had been a long felt need for an appropriate material handling device which should be simple, inexpensive and fast in operation and at the same time should be suitable for Indian sites.

## MINI CLIMBING CRANE

The Mini Climbing Crane (Fig. 01) developed by Central Building Research Institute (CBRI) Roorkee has a 3.6 metres high mast and self weight of the crane as 650 kg. The innovative machine has been successfully utilized in the field for construction of buildings up to eight storeys (Fig. 02). Loads up to 500 kg have been lifted at a speed of 20 metres per minute and 10 metres per minute. Motorized slewing of the lifted loads all-round in horizontal plane is carried out at a speed of 1.3 revolutions per minute. Safety to the crane and the workers is ensured with the help of overload protection device and over hoisting protection device. The total power required for operating the crane is 3.5 kW. Although the normal height of the mast of the mini climbing crane is 3.6 metres but it can be increased to 6.5 metres by adding more sections of the mast. In that position the crane can be used for mass construction of two storeyed buildings.

During construction of multi-storied buildings the Mini Climbing Crane is used for placing it at the roof of lower storey. This involves frequent disassembling and reassembling of the crane. To help accomplishing these operations more speedily, the components of the crane have been made very light in weight and compact in size. No component of the crane is longer than 2 metres and heavier than 50 kg. Two persons easily carry the components through doors, staircases and other restricted path encountered at site. Use of bolts and nuts for assembling the components has been minimized to affect saving in the assembling time. Tapered locating pins and cam operated clamps have been used for quick alignment and assembling of mating parts. Safety and strength of the assembled components have been checked and satisfactorily established through rigorous testing and field trials of the crane.

For transferring the crane loads to the strongest section of roof, the two base beams of

leg-assemblies of the crane are always positioned on the roof at sections which are close to the walls since bending moment in a roof is the minimum at those sections. For achieving this condition, the two leg assemblies are wide opened such that the gap between their base beams could be set at any of the four dimensions of 2.4 metres, 2.95 metres, 3.3 metres or 3.6 metres. This has been done to cover the common range of roof-spans of residential building which varies between 2.4 metres to 3.6 metres. The Mini Climbing Crane is a self-sufficient type of component in its use as it needs no anchorage with buildings or structure for its stability. However, if the base dimensions of the crane are less than 2.3 metres x 2.4 metres, the mast of the crane has to be rigidly anchored with some nearby structure for purpose of stability. The crane needs no props below the roof on which it is placed. The Mini Climbing Crane has been designed and satisfactorily tested according to the available relevant I.S. Codes of Practice [1,2,3,4].

For efficient use of material handling device, the most important factor to be considered is the rapidity in which it can be put to work on its arrival at site. Features like telescopic mast and chair unit, hinged boom, foldable counter weight frame and quick fastening devices in place of slow operating bolts and nuts, made the mini climbing a versatile machine. For quickly collapsing down its mast to a low height to two metres, the mini climbing crane (Fig. 03) is easily moved on its wheels from one place to another at the site and this way the working of the crane is usually started within an hour after its arrival at the new site. When Mini Climbing Crane (Fig. 04) is mounted on a mobile chassis, it may be used effectively for Taxi Service in Material Handling at different work sites without losing much time in reaching from one site to another.



FIG.01 : MINI CLIMBING CRANE AT WORK IN A YARD



FIG.02 : EIGHT STOREYED POONAM TOWER UNDER CONSTRUCTION AT NAGPUR AND MINI CLIMBING CRANE HELPING IN LIFTING CONCRETE FROM THE MIXER PLACED ON THE GROUND.



FIG.05 MINNI CLIMBING CRANE UNDER ERECTION. THE ASSEMBLY OF RING GEAR AND PLATFORM CHASIS (WEIGHING ABOUT 170 Kg.) IS BEING LIFTED UP WITH THE HELP OF PIVOTED POLE HOISTING GADGET.



FIG.06 : HELPING BASE CONCRETING OF WALL FOUNDATION FOR COAL HANDLING PLANT AT SUPER THERMAL POWER STATION, CHANDARPUR (MS).



FIG.03 : WHEELED UNDER CARRIAGE FOR MOBILITY OF MINI CLIMBING CRANE AT SITE.



FIG.07 : MINI CLIMBING CRANE HOISTING LOAD WHILE STANDING ON THE ROOF OF THIRD STOREY.



FIG.04 : MINI CLIMBING CRANE MOUNTED ON TRUCK CHASSIS FOR TAXI SERVICE IN MATERIAL HANDLING AT DIFFERENT NEARBY SITES.



FIG.08 : MINI CLIMBING CRANE AT EXCAVATION WORK NEAR PADRA RAILWAY STATION (GUJARAT).



## SALIENT FEATURES

- Lifting Capacity : 500 kg at 2 m radius  
250 kg at 4 m radius
- Hoisting speed : 10m/min and 20 m/min
- Power requirement:3.5kW
- Light structure : Four persons can erect the crane in about 4 hours
- Cost much less in comparison to available sophisticated cranes
- Can be split in sub-assemblies for ease in shifting from one floor/site to another
- Simple in operation and maintenance
- Operation of hoisting and slewing the loads are done independently with the help of two separate motor, which are remote controlled with a push button low voltage system
- Heavier components/sub-assemblies of the crane are erected with a pivoted lifting pole built with the crane (Fig. 05)

## COMMERCIALIZATION AND FIELD APPLICATIONS

After Mini Climbing Cranes were introduced, know how for its commercial production was given to seven parties and the cranes have been available in the market. Firms of international repute like M/S Larson & Tubro Limited, Mumbai and Simplex Concrete Piles (India) Ltd., Kolkata collaborated in the construction of Super Thermal Power Station at Chandarpur for Maharashtra State Electricity Board . The Mini Climbing Crane was put to diversified use. One such typical use of the crane is exhibited in Fig. 06. Here crane assisted in handling of concrete during the construction of coal handling plant. The crane was put to another alarming use by mounting it on the roof of a building to help the construction of the next higher storey (Fig.07). These cranes helped to lift materials like concrete, prefab door and window sections and

several other items. This application of crane was reported to be putting up satisfactory performance and it saved 40% both of energy (labour) and time. M/S Ravi Builders of Padra put the crane to the novel use of land excavation and laying foundation at Padra Railway Station (Fig.08). M/S Parawati Construction (Maharashtra) also used the crane and they also reported a saving of time and labour from 50% to 60% respectively. The crane could lift the load up to a height of about 40 metres.

## CONCLUSIONS

In Contrast to highly mechanized and elaborate devices like tower cranes and portal cranes, the Mini Climbing Crane developed has amply demonstrated its potential as an appropriate device for handling materials in the weight range of 50 to 500 kg. Being light in weight and compact in size, it has been successfully used for multistory constructions. The Mini Climbing Crane fills up the gap that existed for a long time between sophisticated cranes and primitive methods of material handling. Due to exceedingly low initial cost, the Mini Climbing Crane is well within the resources of small to medium capacity builders with inbuilt extreme flexibility in the design of components and ease of adaption to diversified site conditions, the Mini Climbing Crane has been recognized as a highly versatile and inexpensive tool for the construction of building up to ten stories. The crane has been equally useful for both the traditional and the prefab systems of construction.

## REFERENCES

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