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DESIGN OF MATERIAL HANDLING SYSTEM FOR TRANSPORTATION AND INSTALLATION OF HEAVY MACHINERY

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Abstract
With the growth in technologies and increasing global competition, the industries are frequently changing their manufacturing strategies by installing newer machines with better capabilities. Installation of heavy machinery in itself is a complete project. Setting up a new plant requires large number of such machineries to be installed at a given location. Also any given organization is always in a hurry to install machines in the quickest possible time to reduce idle period and start manufacturing at the earliest for making profits. As such onus of starting machinery rests on the entity installing the machines. This paper discusses one such case wherein 3.5Ton of a machine was moved to a level of 7.5 meter above ground level and installed with time and space constraints.

Keywords: *Installation of machine, heavy machine installation.*

1. Introduction

Advancement in manufacturing technologies and integration of computing power and robotics have increased production rate to an unprecedented level. Product life cycles have decreased. New innovations need to be capitalized as early as possible to overcome stiff competition. In such a scenario a manufacturing organization is always on its toes to sustain its products in the market.

An organization always wants to install machineries as soon as it is received to minimize losses. Handling and installation of a machine is a sensitive process. Every step should be planned carefully to avoid any mishap.
Since there could be different types of constraints for installation of even same type of machines in different locations of a factory, one has to look into various issues separately. First planning is to be done based on size and weight of the machine as each type of machine need to be moved at exact location of installation.

Next planning is for the equipment's needed for handling machinery within constraints of time and space. Use of material handling equipment's like crane, forklift, rail guides, hoists etc. is decided based on the size, weights and constraints. Once machine reaches its desired location installation work starts.

Most of the companies dealing in material handling and installation of machineries have a design team to help in designing the equipment for special cases. Few companies have specialised items for the purpose. Design teams use them to quickly make equipment for material handling.

Polyurethanewheels (PU wheels) are readily available based on different type of load requirements [1-4]. Design teams use them for quick design of machine handling system.

Polyurethane elastomers used for making PU wheels are set of engineering materials that combine the advantages of rigid plastics, metals and ceramics with the flexibility and elasticity of rubber. It is known for its versatility and can be used for its properties like:

- High in versatility and performance to materials like metal, plastic & rubber
- Excellent resilience (high or low)
- Extra toughness and durability
- High tear strength and cut resistance
- Low compression set
- Very good impact resistance
- Outstanding abrasion resistance
- Good machinability
- Easy to mold, great to fabricate
- Possess very strong bonding properties with materials like steel, aluminum, plastic, stainless steel, etc.

- Resistance to radiation & ozone
- Resistance to oil, water, grease, chemicals & solvents
- High Abrasive, Cut & Tear Strength with Excellent Tensile Properties
- Very high load bearing capacity
- Does not damage the epoxy coating of floor

Cantilever platform was used with PU roller for movement of machines inside the plant.

2. Installation Process

The biggest machine to be moved and installed on second floor of the factory weighed 3500 kg. Fig 1 shows the opening on the second floor through which machine was to be hauled and moved inside. The opening was 3 meter wide and 3.6 meter high. Since the dimension of the biggest machine was 4 x 2.8 x 3 meters (L x B x H), it became impossible for a crane to move machine inside. This prompted another solution of moving machine inside using rail guides and PU rollers.

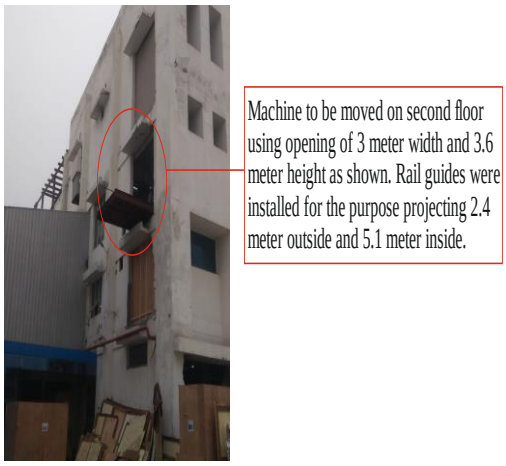

Fig 1. Opening for moving machine inside the factory for installation

I-section rail guides having size of 250mm were placed, 2.4 meter projected outside and 5.1 meter inside; gap between two beams center top plate on the top steel plate supported by rollers for load bearing as well as movement. I-section rail guides having size of 250mm were placed, 2.4 meter projected outside and 5.1 meter inside; gap between two beams center to center was 2.4 meter.

The platform was made up of 100x100x4mm thick square pipe with 4 mm thick M.S plate on top supported by rollers for load bearing as well as movement.

The platform was load tested for 4800kg, to be more precise for moment of 4800kg x 2.5meter = 12000 kgm

Max moment due to machine load 3500kg x 1.25m = 4375 kgm.

The rollers should be selected based on following parameters:

- Type of usage
- Severity in the operation
- Type of load
- Speed of movement
- Operating Temperature
- Lubrication of rollers

Fig 2. Inside view of the setup of rail guides for moving machine

Four rollers each having four PU wheels (which does not damage the epoxy coating of the shop floor)were used beneath platform for balancing and moving machine to its required place. Fig 3(a) shows the four wheels used in one roller while Fig 3(b) shows the top view of the roller.

Fig 3(a) Bottom side of the roller showing four PU wheels *Fig 3(b) Top view of roller*

Each roller has 4 PU wheels of diameter 70mm and length 80mm.Each wheel designed for load carrying capacity of 750kg. Thus, Total Load carrying capacity of roller = 750kgx4=3000kgper roller.

The overall size of the roller is250x210x100mm(LxWxH). The top round plate of the roller is movable, have M16 thread, where the machine base can be clamped.

A schematic diagram of rollers beneath platform is shown in Fig 4.

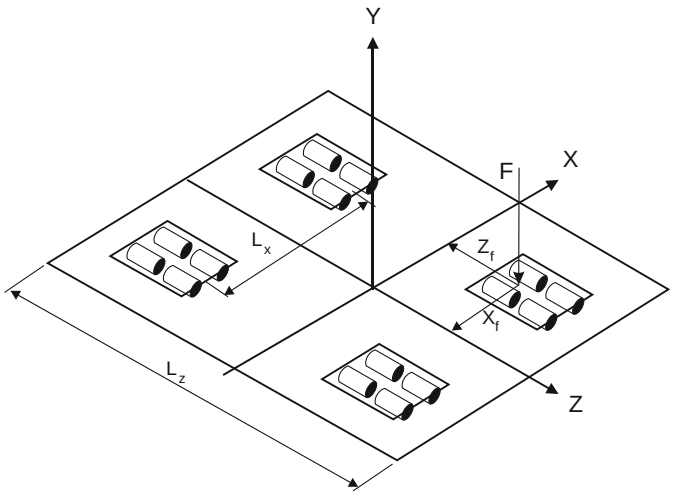

Fig 4. Schematic diagram of rollers on platform

In the given case study, following values were considered
F = 4800 kg
X_f = 500 mm
Z_f = 1000 mm
L_x = 1000 mm
L_z = 2500 mm

The 'Maximum Load capacity' given for each roller is the maximum load it will carry in intermittent use (a maximum of 1 hour running followed by a minimum of 1 hour at rest) under the following conditions[4]:
a) the wheel is free-wheeling (not driving)
d) the surface on which the wheel runs is flat and smooth (i.e steel or smooth concrete)
b) the ambient temperature is below 45 degrees C and above -20 degrees C
e) that the wheel is not steering or subjected to axial loads
c) the surface speed does not exceed 6 KM/h
f) no chemical is present which will attack polyurethane

The maximum load on a roller can be calculated as
Allowable load per roller = 3000kg x 0.75 (continuous running factor) x 0.8 (speed factor) x 0.7 (driving factor)
= 1260kg.

Total Load on four rollers = 1260 x 4 = 5040 kg

Since, total load carrying capacity is more than the design load considered i.e. 4800 kg, therefore given rollers can be used for material handling system for transportation and installation of heavy machinery.

3. Conclusion

Transportation and installation of heavy machinery is a crucial job as it requires proper handling of the machine. Design of material handling equipment in such special cases is generally non-standard. They need to be designed as per requirement.

In this particular case, the machine to be shifted was of 3000 kg which could have been easily moved and installed in a normal situation using cranes. The problem arose when installation was to be done on second floor having limited opening as well as space for movement.

The material handling system designed for the purpose is unique and may be replicated in similar situation.

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