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Case Study on Elevating Structures by Jacking Technology.

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Abstract - *This project study gives us an idea to adopt a particular method to uplift the structure based on workability, practicability, cost-effective, and time. In this process, the house is temporarily lifted to a certain height with the help of jacking technology and a new elevated foundation is constructed below. In case your house lies below the road level and sewage water routinely streams in, Demolition and then new construction is not the best option. With the present technology you can undoubtedly raise the level of your house without any structural damage. Now here's an opportunity to save money and live in a similar house which you are accustomed to living in. Being more explicit, houses that are set up in low-lying regions frequently face a major issue. This issue is endless during the rainy seasons when there is significant precipitation and a substantial inflow of water into the low-lying lands. As an outcome, there's an answer for this issue which is house lifting.*

Key Words: (House lifting, Jacking technique, Foundation repairs, Economy)

1. INTRODUCTION

Constructing a house, repairing, renovating or rebuilding, we all know. But tinkering with a house and that too with its foundation and then lifting it to a desired height, is something not usually heard of. Every year, some areas of the country get more rain than the local rivers, canals, and storm drains can handle. Flooding poses a threat to houses and businesses in these communities. Rebuilding is not the best option as it involves huge amount of time and money.

In the field of engineering, there are different techniques used conventionally for the repair and restoration of foundations. Conventional methods used for the repair of the foundation are underpinning, soil replacement, etc. are costly, time-consuming, and also may lead to damage to the superstructure. Nowadays repair of the foundation is completed done with new techniques referred as jacking technology.

In this technique, the building is lifted with the number of hydraulic jacks or screw jacks and a new foundation is constructed. This system is economical as compared to the techniques used conventionally to repair and restoration of the structure.

This technique was first introduced in Philadelphia, Pennsylvania (USA) 1799 for the aim of moving a building. In India house lifting technique was first done by Late 'Aatma Ram Sisodia' in 1973. Now many private companies all over the world provides lifting and shifting services.

Fig. 1. Elevating house using Jacking Technology.

2. NEED FOR THE STUDY

"We should make sure that the building is protected against all forms of Natural disasters. If your house is lying in a low land area near the sea or the river, then there are a lot of chances that your house would be affected by floods." [2] Many houses in some countries were built before proper roads existed. When the houses were constructed, enough anti-flood measures were not taken to protect it from floods. This is because the required technology was not available at that point of time. Today these houses fall below the road level. In this case, house lifting is the best technology to be opted. The reason behind house lifting is to protect the foundation from water damage or the foundation which has already been damaged by groundwater and rainwater entering from the longitudinal drains of roads. This technique is widely used in the southern and north-east parts of India as these regions are affected by the high rate of rainfall.

3. NECESSITY AND OBJECTIVES

The following objectives are set to accomplish by the study are listed below.

- To repair foundation which is affected by ground water or stormwater.
- To raise the plinth level of structure above road level.
- To save huge amount of cost and time of reconstruction.

- To elevate structure without using heavy machinery.
- To add foundation or basement to existing structure.
- To divert any sewage line or pipeline which passes beneath the structure.

4. EQUIPMENTS USED IN JACKING TECHNOLOGY

4.1 Screw Jack and Hydraulic Jack.

A house jack, also called a 'screw jack' consists of a heavy-duty vertical screw with a load table mounted on its top, which screws into a threaded hole in a stationary support frame with a wide base resting on the ground. A rotating collar on the head of the screw has holes into which the handle, a metal bar, fits. When the handle is turned clockwise, the screw moves further out of the base, lifting the load resting on the load table. Screw jack, is a mechanical device primarily used to lift buildings from their foundations for repairs or relocation. A series of jacks is used and then wood cribbing temporarily supports the structure. This process is repeated until the desired height is reached. Hydraulic jack function is based on a concept in fluid mechanics known as Pascal's Principle. Hydraulic jacks are mainly used for bigger projects, like shoring and moving/shifting of larger structures.

Fig. 2. Screw Jack.

4.2 Wooden Blocks.

Wood has been used as an artifact for thousands of years in its wild. Today, engineered wood is becoming quite common in industrialized countries. Wood is a product of tree and used for construction purposes when cut or pressed into lumber and timber, such as boards, planks, and similar materials. It is a generic artifact and is employed in building almost any type of structure in most climates. Wood is often very flexible under loads, keeping strength while bending, and is incredibly strong when compressed vertically. There are many different qualities to the various sorts of wood, even among the same tree species. These Wooden blocks are used to give support and balance the structure. They are placed between the jacks and channel beam. Mainly 150x150x150 mm cubical blocks are used. The sizes of blocks may differ concerning the conditions of the structure.

4.3 I-beam.

An I-beam, also known as H-beam is a beam with an I or H-shaped cross-section. The horizontal elements of the I are flanges, and the vertical element is the "web". I-beams are usually made of structural steel and are used in construction and civil engineering. In this technique, the I-beam is used to equally distribute a load of walls from the structure to jacks. The size selection of the channel beam is done depending upon the thickness of the walls and the plinth beam.

Fig. 3. I-Beam.

4.4 Wooden Plank.

A wooden plank is timber that is flat, elongated, and rectangular with parallel faces that are higher and longer than wide. Used primarily in carpentry, planks are critical in the construction of ships, houses, bridges, and many other structures. In house lifting technology elongated planks are used to give support to the wooden blocks and the channel beam.

4.5 Drilling machine and Core-cutter machine.

These machines are used to make holes in foundation walls. Drill machine is used to make hole in bricks foundation wall and core-cutter is used in concrete poured foundation walls. These holes are made to insert I-Beams and jacks.

5. METHODOLOGY

The methodology adopted for lifting a house using jacking technology is listed below,

5.1 Obtain necessary permits.

Before starting any work it is very much important to get the permission from governing civic body of that area.

5.2 Study of the land where structure is located.

The plot where structure is located should be free from live leakages. If water is present then it should be pumped out.

5.3 Study of the structure.

The structure's height should be G+2 or below. The super structure to be lifted should not be affected by an earthquake in the past. It should be free from any structural damage like cracks. The study of weak members should be done precisely and more support should be given to that member.

Evaluate whether the current foundation will take additional load. Load-bearing houses are more difficult to lift, mainly due to their design, construction, and weight, but lifting these homes is possible.

5.4 Study of surrounding area.

The offset required for working should be at least 4 to 5 feet from the structure to boundary wall.

5.5 Level of the structure to be lifted.

The amount of elevation required is determined by the DFE (Design flood elevation) you have chosen. For example, if your DFE (Design flood elevation) is equal to the BFE (Base flood elevation), you will need to elevate your home so that the top of the lowest floor is at or above that elevation. In case your house is situated below street level then the height to be lifted is taken with respect to road level.

5.6 Numbers of Jacks required.

Load calculation of the structure is done using plans or surveying. In load calculations Dead load, live load, and area of the structure is calculated also the load carrying capacity of one jack is required in calculation.

No. of jacks required is calculated by given equation,
Jack required per m^2 = Total load/Capacity of one jack.

6. PROCEDURE

Step by step procedure of jacking technology is listed below,

6.1 Turn off utility services.

Before starting the work remove all furniture from the house. Disconnect water lines, sewage lines, etc.

6.2 Excavation around the foundation wall.

Excavate around foundation walls from both the side i.e., from inside and outside of the house.

Fig. 4. Excavation around foundation.

6.3 Cut holes in foundation walls.

"First, holes are made at intervals in the foundation wall so that a series of steel I-beams can be installed at critical points under the floor framing. If the foundation walls are made of concrete blocks, the lifting contractor can remove individual blocks to create the required holes to insert jacks. If the walls are made of poured concrete, the holes will be cut out. The I-beams are placed so that they run perpendicular to the plinth beam. Then jacks are placed from the edges of the house as shown in figure below." [1]

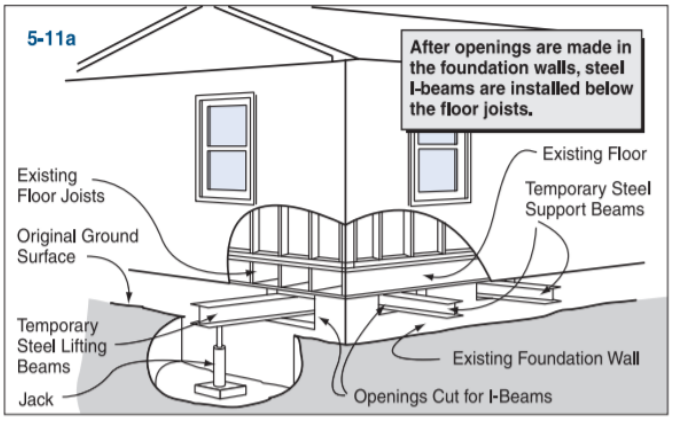

Fig. 5. Cutting holes and inserting I-Beams in foundation walls.

"In some houses, however, the foundation walls are not high. To lift such a house, the contractor first dig trenches at intervals around the foundation. The I-beams are then lowered into the trenches and inserted below the floor framing. The contractor may also have to dig holes for the lifting jacks. The number of jacks needed will depend on the size, shape, and type of house to be lifted." [1]

6.4 Raise house with jacks and Extend walls.

"Once the beams and jacks are in place, the elevation process begins. The jacks will extend only so high; so at intervals during the process, the house and jacks are supported temporarily on I-Beam while the jacks are raised. After the house is elevated high enough, it is again supported on I-Beams and wooden planks while the foundation walls are extended to the desired height with concrete blocks or poured concrete. Before raising a new foundation wall, water-proofing is done and some ground improvement techniques are also used to avoid further seepage of groundwater." [1]

Fig. 6. Raising house by jacks.

6.5 Lower house to elevated foundation.

"The house is then lowered onto the extended foundation walls, the I-beams are removed, and the holes where the beams passed through are filled. An important part of the project is installing flood openings in the foundation walls to so that floodwaters can enter and equalize the internal and external hydrostatic pressures. If any cracks are developed then cementing grouting is done on that particular member." [1]

6.6 Re-connect utility lines.

Connect all sewer lines and water lines. Then the backfilling of soil should be done with good compaction. Floor finish work is done and the house is ready for living.

7. ADVANTAGES

- House is protected from disasters like floodwater and stormwater.
- A damaged foundation can be repaired without demolishing the whole structure.
- Basement repair work can be done efficiently and effectively.
- Saves construction materials of reconstruction which is an environmentally friendly process.
- Huge Machines are not used is lifting, Hence cost-effective process.
- The owner can stay at the same place, No need for relocation.

8. DISADVANTAGES

- Expert supervision is highly needed at the time of lifting and it is a labor-intensive process.
- Not applicable to the structure which is already affected by an earthquake.
- Not applicable to the structure above G+3.
- About 3-4 feet offset between the house and boundary wall is required for this process.
- Additional stairs are required to construct after lifting and Elevation may affect the appearance of the structure.

9. CONCLUSIONS

The following conclusions are drawn from the study of jacking technology.

- This study will help to raise the house up to the street level without damaging the structure with the help of jacks.
- The building is protected against all forms of Natural Disaster.
- A damaged foundation or basement can be repaired without demolishing or reconstructing the structure.
- House jacking technology is cheap and saves valuable time.
- House jacking technology is a labor-intensive task where skill and perfection are highly required, but this saves construction materials hence its environmentally friendly process.

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