
Use of Hydraulic System in Construction Industry

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ABSTRACT

This paper mostly comes under the use of hydraulic fluid i.e. water in construction industry to develop the new technique and machineries to help the construction field. This paper is generally a comparative analysis of conventional instruments used in construction industry and new hydraulically operated instruments used in construction industry. The reason behind this study is to provide a new, cheaper and more efficient machinery to help for construction work. In this paper we have design a proto-type model which can be effectively used in large scale construction work. Here we used the concept of fluid mechanics like Pascal's Law and other basic concepts of fluid mechanics.

1. Introduction:-

Hydraulics is a topic in applied science and engineering dealing with the mechanical properties of liquids or fluids. At a very basic level, hydraulics is the liquid version of pneumatics. Fluid mechanics provides the theoretical foundation for hydraulics, which focuses on the engineering uses of fluid properties. In fluid power, hydraulics is used for the generation, control, and transmission of power by the use of pressurized liquids. Hydraulic topics range through some part of science and most of engineering modules, and cover concepts such as pipe flow, dam design, fluidics and fluid control circuitry, pumps, turbines, hydropower, computational fluid dynamics, flow measurement, river channel behavior and erosion. Free surface hydraulics is the branch of hydraulics dealing with free surface flow, such as occurring in rivers, canals, lakes, estuaries and seas. Its sub-field open channel flow studies the flow in open channels. Fluid power is the use of fluids under pressure to generate, control, and transmit power. Fluid power is subdivided into hydraulics using a liquid such as mineral oil or water, and pneumatics using a gas such as air or other gases. Compressed-air and water-pressure systems were once used to transmit power from a central source to industrial users over extended geographic areas; fluid power systems today are usually within a single building or mobile machine. Hydraulic systems use a incompressible fluid, such as oil or water, to transmit forces from one location to another within the fluid. Most aircraft use hydraulics in the braking systems and landing gear. Pneumatic systems use compressible fluid, such as air, in their operation. Some aircraft utilize pneumatic systems for their brakes, landing gear and movement of flaps.

Pascal's law states that when there is an increase in pressure at any point in a confined fluid, there is an equal increase at every other point in the container. All the hydraulic pressure based system is based on the Pascal's law. Hydraulic machines are machinery and tools that use liquid fluid power to do simple work. Heavy equipment is a common example. In this type of machine, hydraulic fluid is transmitted throughout the machine to various hydraulic motors and hydraulic cylinders and becomes pressurized according to the resistance present. The fluid is controlled directly or automatically by control valves and distributed through hoses and tubes. The popularity of hydraulic machinery is due to the very large amount of power that can be transferred through small tubes and flexible hoses, and the high power density and wide array of actuators that can make use of this power. Hydraulic machinery is operated by the use of hydraulics, where a liquid is the powering medium. It is an undisputed fact that shelter is one of the basic human necessities. However, irrespective of the importance of shelter, most people do not have access to good shelter, most especially in developing countries. In fact there is an estimated deficit of between 17 and 18 million housing units in Nigeria in 2012. The poor are most adversely affected by this housing shortage. The most important building materials for low-cost housing are blocks/bricks but conventional quality concrete blocks are too expensive

for low-income communities. Due to high cost of Portland cement, a lot of block producer's use less than the recommended amount in the concrete mix making the blocks to be substandard. This is one of the most important contributing factors for the frequent building collapse in the country recently. Bricks / Blocks are solid pieces of hard substances, usually with flat sides, used as construction units.

The full operation of system concrete pumping, concrete placing is done with the help of hydraulically operated system, repairing of foundation of building due to the occurrence of settlement or due to the earthquake forces acting on foundation of building.

2. Objectives:-

1. To study the operation of hydraulic machineries
2. Design and fabrication of small scale by hydraulic model.
3. Comparative study of use of hydraulic equipments over conventional equipments.
4. To effective use of hydraulic models in construction industries.

3. Literature Review:-

1. Author Name:- S. O. Yakubu and M. B. Umar

Title:- Design, Construction and Testing of Multipurpose Brick / Block Moulding Machine.

Published:- 2015.

They do the research on the machines which are hydraulically operated for design, construction and testing of a multipurpose brick/block. This machine is plays very important roles for improving the quality of bricks/blocks. They designed the hydraulically operated equipment of moulding in which hydraulic oil is used. In other world, bricks or blocks produced by using this machine are relatively cheap and affordable for those in rural areas and for low income earners. This machine is based on the compaction pressure control. So, it is good as civil engineering point of view.

2. Author Name:- S. S. Kamaruddin, M. F. Mohammad and R. Mahbub

Title:- Barriers and impact of Mechanization and Automation in construction to achieve better quality products.

Published:- 2015.

The major concern to the construction industry in general, would be the decreasing quality and productivity of end products; labour shortages; occupational health and safety; and allowing work to be performed where people cannot do. This paper discusses how the quality of life may be achieved by tackling the barriers and their impact to this initiative which could improve the industry in terms of productivity, safety and quality. This will also ensures the harmony between environment and energy management with productivity enhancement for better quality products that could lead to better quality of life for the end users.

3. Author Name:- S. S. Kamaruddin, M. F. Mohammad, R. Mahbub and K. Ahmad

Title:- Mechanization and Automation of the IBS construction approach: A Malaysian Experience.

Published:- 2013.

The objective of the main research is to investigate the current state of implementation of mechanization and automation in the Industrialized Building System (IBS). The aim of this paper however, is to provide an overview on the implementation of mechanization and automation in the IBS construction approach. Questionnaire survey and semi structured interviews were conducted to collect viewpoints among contactors and manufacturers of IBS to ensure the richness of the data collected. The results illustrated that although most respondents have agreed on most critical issues in the implementation of mechanization and automation; they were not ready to move forward. These responses were quite consistent across the professions.

4. Author Name:- Michael G. Kay

Title:- Material Handling Equipment.

Published:- 12th January, 2012.

He had written the journal paper on material handling equipment. He has also given the information about the conveyor which can be operated mechanically or hydraulically. He has given there are two types of conveyors which may operated hydraulically which are Reciprocating vertical conveyor & sorting conveyor. He has explained the all the types of conveyor.

5. **Author Name:- Okolie Izunna Jude**

Title:- Design and construction of hydraulic scissors lift

Published:- 2011-2012.

In this paper, he has given the information about the scissor lift. He has also given the information about the hydraulic pressure may be used for lifting materials, civil engineering applications like the scaffolding. He has also stated that for getting to a height encounter a lot of limitations(time and energy consumption, comfortability, amount of load that can be carried etc.),which hydraulic scissors lift is set out to achieve. He has given the importance and significance of the study such as The design and construction of a hydraulic scissors lift is to lift a worker together with the working equipment comfortably and safely to a required working height not easily accessible. It may be used without a necessary external assistance or assistance from a second party due to the concept of the design. This project will be an important engineering tool or device used in maintenance jobs. Changing of street lights, painting of high buildings and walls around the school environment.

6. **Author Name:- Tianliang Lin, Qingfeng Wang, Baozan Hu, Wen Gong.**

Title:- Development of hybrid powered hydraulic construction machinery.

Published:- 2009.

Facing the environment problems, the improvement on the efficiency of the construction machinery such as the excavator and wheel loader is highly demanded. The hybrid power systems used in automobiles have been adapted into the construction machinery. This paper first analyzes the difference between the hybrid powered automobile vehicle and the hybrid powered construction machinery. The research and development of the hybrid power systems and energy regeneration systems of construction machinery are reviewed, and the applications of hybrid systems in construction machinery are presented. Finally, the challenges facing the researchers and the construction machinery manufacturers are discussed.

7. **Author Name:- Neil R. Guptill.**

Title:- Placing Concrete by Pumping Methods.

Published:- 1996.

In this paper he describes hydraulic pumps for transporting and placing concrete. He also discussed about rigid and flexible pipe lines and all other accessories required. He gives recommendations for proportioning pumpable concrete suggest optimum gradation of aggregates; outline water, cement and admixture requirements and emphasize the need for evaluation of trial mixes for pumpability. He described the importance of saturating lightweight aggregates. He also gave suggestions regarding layout of lines; for manufacturing uniform delivery rate, as well as uniform quality of concrete at the end of line; and for cleaning out pipelines.

4. Methodology:-

1. Study of different Hydraulically Operated Devices:-

1.1 Backhoe for Excavation Purpose:-

A backhoe loader, also called a loader backhoe, digger in layman's terms, or colloquially shortened to backhoe within the industry, is a heavy equipment vehicle that consists of a tractor like unit fitted with a loader-style shovel/bucket on the front and a backhoe on the back. Due to its (relatively) small size and versatility, backhoe loaders are very common in urban engineering and small construction projects (such as building a small house, fixing urban roads, etc.) as well as developing countries. This type of machine is similar to and derived from what is now known as a TLB (Tractor-Loader-Backhoe), which is to say, an agricultural tractor fitted with a front loader and rear backhoe attachment.

The true development of the backhoe actually began in 1947 by the inventors that started the Wain-Roy Corporation of Hubbardston, Massachusetts. In 1947 Wain-Roy Corporation developed and tested the first actual backhoes. In April 1948 Wain-Roy Corporation sold the very first all hydraulic backhoes, mounted to a Ford Model 8N tractor, to the Connecticut Light and Power Company for the sum of \$705.



Figure:- 1.1 Backhoe

1.2 Brick Moulding Machine:-

The production of the bricks was carried out following the steps below.

1. The hydraulic oil tank was checked to ensure adequate oil level.
2. The oil supply valve to the hydraulic pump was fully opened.
3. The electric motor was then powered.
4. Feeder was positioned directly under the hopper.
5. Using shovel, the mix was fed to the hopper.
6. Holding the feeder handle, the feeder was moved to a position above the mould and then the feeder was shaken back and forth to make sure that the mould was well filled.
7. By depressing the lever of the directional control valve, the rammer was lowered into the mould and therefore compressing the soil to its final density.
8. Using the same lever but this time upward, the compressed soil block is now ejected.
9. Using palms of both hands the Green Block was removed from the machine to curing area.
10. The cycle was repeated for other blocks.



Figure:- 1.2 Brick Moulding Machine

1.3 Hydraulic Props for Slab Formwork:-

Hydraulic props consist of a sealed working cylinder with two valves, one for intake (setting valve) and the other for discharge (release valve, working valve) of hydraulic fluid. For increased stability the hydraulic props are equipped with a claw at the upper head-end and a base at the bottom. The function of the props is to stabilize incompetent roof or hanging wall. The positioned prop is telescopically extended by highly-pressurized hydraulic fluid injected by means of a setting gun and wedged into place with a specific setting load adjusted according to the respective compressive rock load. When the rated load is reached during installation or by subsequent strata movement, the working valve engages and opens the cylinder. This

yielding prevents damage to the support from increasing compressive loading. The optimal support is attained when the props are installed in combination with articulated bars which distribute the forces over a wider hanging-wall or roof surface. During prop recovery, the release valve is opened with a key, allowing the hydraulic fluid to escape and the prop, equipped with a spring, to recede. The prop is then available for reuse. Use of hydraulic single prop supports is only practical and economic where incompetent roof or hanging wall requires a support method which can be adjusted to meet rapidly changing conditions. Hydraulic prop supports are appropriate for short-term installations involving frequent changes of location due to rapid face advance, or where high prop-setting loads are desirable. Such conditions arise in coal mining with roof caving or backfilling, in long wall mining, in room and pillar mining, as well as in ore mining by overhand stopping. In addition, single hydraulic props are suitable for support of all special mining activities such as support of fault-zones or roof-fall areas, machine rooms, and face-roadway intersections.



Figure:- 1.3 Hydraulic Props

1.4 Hydraulically Operated Scissor Lift:-

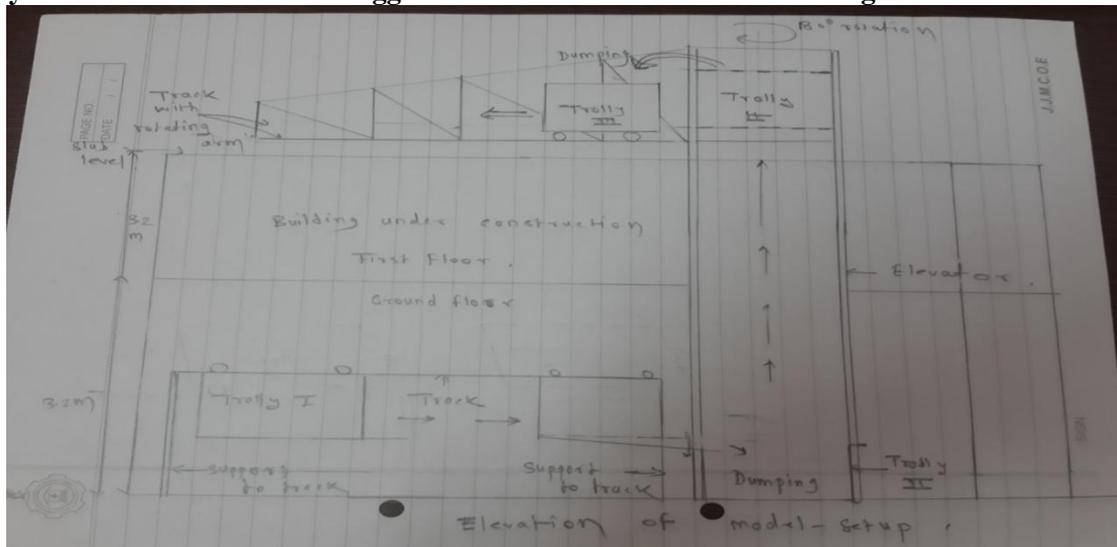
Scissor lifts owe their mechanical capability to the pantograph. A pantograph is a series of linked parallelograms with hinged intersections that allow the operator to elongate the mechanism while maintaining the integrity of the geometric figure. The structural components of the pantograph serve as opposing line segments within adjacent parallelograms; geometric changes are therefore uniform across the mechanism. True vertical lift is accomplished by using components of equal length.

Scissor lifts require linear motion to supply elevation and this force is provided by a pneumatic or hydraulic actuator, or a mechanical input such as a leads crew or rack and pinion drive. Scissor lifts under fluid power are preferred because a purge valve allows the lift to be lowered during a malfunction. Lifts with independent locomotion can integrate lifting and propulsion into a single power source, be it petrol or electric.



Figure:- 1.4 Scissor Lift

Layout of Small Scale Model suggested for Material & Concrete Lifting from Floor to Floor:-



While doing a project we have suggested a new model for construction industry which can be used by the engineers to lift the material like bricks, concrete, cement, sand from one floor to another floor.

In suggested model there is horizontal and vertical movement of trolleys containing material required for construction with the help of rail track provided for horizontal and vertical movement and the energy required for horizontal and vertical movement is provided by using hydraulic pressure. The dumping of material is also done by using hydraulic pressure. For the requirement of required intensity of pressure for pushing and dragging of trolley the piston and cylinder arrangement is designed by using the information getting from various journals available in college itself and some journals are downloaded with the help of internet.

Advantages of Model over Conventional Method:-

1. This method is cheaper than conventional method.
2. The labour cost is minimized.
3. Total Overall Cost of Project is reduced.
4. Time required for Lifting of material is reduced.
5. Materials can be safely transported from floor to floor.

5. Conclusion:-

The working of hydraulically operated instrument is easy as compared to other instruments. The working of hydraulic instruments is efficient than conventional equipments. From above study it is concluded that the model designed by us is efficient for construction industry due to its properties of time saving and labour cost is minimized by the use of this model.

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