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Analysis and design of lifting mechanisms of computer helper EOT cranes.

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ABSTRACT

High-performance tasks in an industry or workshop are managed by several mechanical devices such as cranes, lifts, and lifts. Includes charging/loading, shipping heavy materials, lifting and replacing heavy devices. High-performance tasks such as removing engines from vehicles are complex processes that involve removing engines to repair/rebuilding and restoration, and moving heavy engine parts from one location to another. The task usually takes time depending on the lifting device you are using. Chain heating is manipulated manually by human motion and takes time as there are certain limitations on how it is defined on a structured beam or tripod. Hydraulic handle hooves, on the other hand, have a greater ability to lift motors that are more difficult than chain heating or electrical hooves. However, the electric hoist weighs around 200-250 kg, but has a better speed than other leveraged devices such as chain heating and hydraulic hoists. In this Servey, some draft concepts for lifting/lifting heavy engine modules are considered to be over 250 kg. We plan to test portable hebbere hoists by modeling the assembly of CREO parameters, analyzing them with ANSYS-WorkBench prescribed technical data, using various default stresses and analyzing load conditions to optimize other optimistic knowledge
Key Words: Engine Hoist, Crain, Hydraulic Lifting Device, Chain Hoist, Electric Hoist, Hoisting Device

1. INTRODUCTION

The hoisting process has become a very essential system for the transportation of heavy equipment as well as personnel. According to design the hoist consists of several components in which there are winders, ropes hydraulic actuators, chain, grabbing hook, electric motors, structural frame etc. The safety and reliability of the hoist depends on its design, therefore proper and accurate design of a hoist is very important. The engine hoist consists of a solid support system that typically consists of welded or aluminum steel. It includes an expanding beam from the frame that is fitted with chain connections built to link the tool to the engine anchor. It can be used manually, electrically, and pneumatically when raising a certain load from one stage to the other, using the 1 wires, fibers, or wire ropes. The load is connected with a hook to the hoisting unit. The operator can easily lift the heavy load and can drop it wherever needed.

2. LITERATURE SURVEY

In his 2008 work titled Design of Hoisting Arrangement of Electric Overhead Traveling Crane, Rajendra Parmanik explores the historical development of cranes, outlines various types and applications, and presents a conceptual design of key components of an EOT (Electric Overhead Traveling) crane. Meanwhile, R. Uddanwadiker, in the study Stress Analysis of Crane Hook and Validation by Photo-Elasticity, highlights that crane hooks are critical structural elements prone to failure due to high stress accumulation. By identifying the regions with concentrated stress, the hook's geometry can be optimized to enhance durability and minimize the likelihood of failure. A typical diagram of a Single Girder EOT Crane features essential elements such as a single girder, bus bar, and a hoisting unit, which is responsible for lifting loads vertically using mechanical or electrical mechanisms.

3 METHODOLOGY

Use a device or mechanism to lift something or a small load from the lower position to a higher position. An electric overhead hiking crane is essentially composed of carriers or carriers supported on both ends with routes that can increase solid traces. A car that is equipped with a lift or other mechanism and can cross from such a carrier or edge of a carrier. Such cranes have different lifting capabilities ranging from about 2 to 400 tons and 20 to 150 feet or more. For capacity of 10 tons or more, 1/5 to 1/3 independent auxiliary heating is often available for major relief. Computer-based design enables alternative parameters, and calculates unknown parameters that accelerate the design process. Computerization eliminates the scope of cabin offerings on the bridge, reducing costs and space. Computer-aided design with Electric Overhead Wonder Clan uses Visual Basic as the Frontend. Designing with Visual Basic requires users to enter increased loads and operating conditions, such as service type, service factor, lifting speed, and subsequent rope construction. The rope design is based on lifespan standards, strength standards can be confirmed, and vice versa based on available data. The diameter of the rope is calculated and the diameter of the disk is calculated. During calculation of rope diameter, tackle efficiency, the waste system is analyzed according to the load to select the rope diameter, the rope list, and therefore the various parameters. The tackle assembly calculates the moving windshield and hook assembly. For movable disk assemblies, the diameter of the moving window and the corresponding dimensions of the disk are calculated. Similarly, camping selection, shaving plate dimensions and check plates are calculated. For hook arrangements, the diameter of the bed is determined by the load, and the corresponding dimensions are generated by empirical relationships, giving all dimensions. Fault analysis is performed on each part. For example, if a pull error occurs in the threaded portion and a failure occurs, the dimensions are improved and the load and overall dimensions change. The drawer design continues and storage selection is complete. Finally, a cross-piece design is carried out, taking into account various design considerations. The lifting mechanism is designed with the appropriate drive unit and rope drum selected.

4. MECHANICS AND OPERATION

Cranes and hoists used during the medieval period, much like those from ancient civilizations such as Greece and Rome, were mainly capable of lifting materials in a straight vertical direction. Unlike modern cranes, they lacked the ability to transport loads horizontally over significant distances. Because of this limitation, construction activities were arranged differently than they are today. For example, in masonry work, stones were either hoisted directly from the ground into their final position or raised from a central point to supply workers positioned at either side of a wall.

To make slight adjustments in direction, the crane operator—positioned outside the wheel mechanism—would maneuver the load using a rope. By around 1340, cranes with rotating capabilities, known as slewing cranes, started to be used. These were particularly effective in shipyards and other waterfront areas, where turning a load was crucial.

For lifting heavy stone blocks such as ashlar, builders used tools like slings, Lewis irons, or a gripping device called the "devil's claw" (or Teufelskralle in German). Other types of cargo were placed in containers such as wooden boxes, barrels, baskets, or pallets before being lifted. Interestingly, most medieval cranes did not include ratchets or braking systems. This was likely because the high friction within the treadwheel mechanism itself acted as a natural brake, making additional safety devices unnecessary.

5 .PLAN OF ACTION

In the proposed hoist design, the trapezoidal cross-section initially showed lower stress levels. However, when the area was reduced in a modified version, the stress unexpectedly increased due to the smaller load-bearing surface. To address load distribution, increasing the number of rope falls can be effective—it reduces the tension in each rope and enhances the lifting speed. For example, employing four rope falls means the same lifting task can be accomplished with one-fourth the effort. However, more rope falls also mean longer ropes, which raises costs and influences the design of the drum. Since the rope length directly affects drum size, a larger drum may be needed, increasing the system's volume. To mitigate this, a double-layer winding technique on the drum can be adopted to conserve space.

The power requirement of the motor is influenced by both the weight of the load and the speed at which it needs to be lifted. Because the rotational speeds of the motor and the drum differ, a gearbox is essential to ensure proper torque transmission. To validate the design and analyze mechanical behavior, several methods are used: theoretical analysis of curved beam bending, mathematical and empirical approaches, 3D modeling, and simulation through ANSYS for evaluating stress distribution and deformation.

6. CRANE AND HOIST SAFETY DESIGN REQUIREMENTS

The following are the design requirements for cranes and hoists and their components

- The design of all commercial cranes and hoists shall comply with the requirements of ASME/ANSI B30 standards and Crane Manufacturer's Association of America standards (CMAA-70 and CMAA-74).
- All crane and hoist hooks shall have safety latches.
- Hooks shall not be painted (or re-painted) if the paint previously applied by the manufacturer is worn.

• Crane pendants shall have an electrical disconnect switch or button to open the main-line control circuit.
• Cranes and hoists shall have a main electrical disconnect switch. This switch shall be in a separate box that is labelled with lockout capability.
• Crane bridges and hoist monorails shall be labelled on both sides with the maximum capacity.
• Each hoist-hook block shall be labelled with the maximum hook capacity.
• Directional signs indicating N-W-S-E shall be displayed on the bridge underside, anda corresponding directional label shall beplaced on the pendant.
• A device such as an upper-limit switch or slip clutch shall be installed on all building cranes and hoists. A lower-limit switch may be required when there is insufficient hoist rope on the drum to reach the lowest point.
• All newly installed cranes and hoists, or those that have been extensively repaired or rebuilt structurally, shall be load tested at 125% capacity prior to being placed into service.
• If an overload device is installed, a load test to the adjusted setting is required.
• Personnel baskets and platforms suspended from any crane shall be designed in accordance with the specifications in 29 CFR 1926.550 (g) and COMAR 09.12.38.
• All cranes used for personnel lifting, shall have anti-two blocking devices installed and operational.
• Cranes taken out of service, for extended periods, shall be clearly tagged/labeled "Out of Service;" OOS labels shall be signed and dated. Cranes that are out of service shall have the power physically disconnected or locked out.

7.CRANE AND HOIST OPERATION RULES

7.1 Pre-Operational Test

At the start of each work shift (on a day when the crane and/or hoist will be used), operators shall do the following steps before making lifts with any crane or hoist:
• Test the upper-limit switch. Slowly raise the unloaded hook block until the limit switch trips.
• Visually inspect the hook, load lines, trolley, and bridge as much as possible from the operator's station; in most instances, this will be the floor of the building.
• If provided, test the lower-limit switch. equipment in close proximity to the limit switches.
• Test the pendant emergency stop.
• Test the hoist brake to verify there is no drift without a load.
• If provided, test the bridge movement alarm.
• Lock out and tag for repair any crane or hoist that fails any of the above tests. Do not return to service until necessary maintenance is completed

7.2 Moving a Load

• Center the hook over the load to keep the cables from slipping out of the drum grooves and overlapping, and to prevent the load from swinging when it is lifted. Inspect the drum to verify that the cable is in the grooves.
• Use a tag line when loads must traverse long distances or must otherwise be controlled.Manila rope may be used for tag lines.
• Plan and check the travel path to avoid personnel and obstructions.
• Lift the load only high enough to clear the tallest obstruction in the travel path.
• Start and stop slowly.
• Land the load when the move is finished Choose a safe landing.
• Never leave suspended loads unattended. In an emergency where the crane or hoist has become inoperative, if a load must be left suspended, barricade and post sign sin the surrounding area, under the load, and on all four sides. Lock open and tag the crane or hoist's main electrical disconnect switch

7.3 Parking a Crane or Hoist

• Remove all slings and accessories from the hook. Return the rigging device to the designated storage racks.
• Raise the hook at least 2.1 m (7 ft) above the floor.
• Store the pendant away from aisles and work areas, or raise it at least 2.1 m (7 ft) above the floor.
• Place the emergency stop switch (or push button) in the OFF position.

8.GENERAL RIGGING SAFETY REQUIREMENTS

Use only select rigging equipment that is in good condition. All rigging equipment shall be inspected at least annually. Defective equipment shall be removed from service and destroyed to prevent inadvertent reuse. The
load capacity limits shall be stamped or affixed to all rigging components. Prudent practice requires a minimum safety factor of 5 to be

9.APPLICATIONS

The most common Electric Overhead Traveling Crane use is in the steel industry.At every step of the manufacturing process,until it leaves a factory as a finished product,steel is handled by an overhead crane. Raw materials are poured into a furnace by crane,hot steel is stored for cooling by an overheadcrane, the finished coils are lifted and loaded onto trucks and trains by overhead crane,and the fabricator or stamper uses an Electric Overhead Traveling Crane to handle the steel in his factory. The automobile industry uses overhead cranes for handling of raw materials. Smaller workstation cranes handle lighter loads in a work-area, such as CNC mill or saw.Almost all papermills use bridge cranes for regular maintenance requiring removal of heavy press rolls and other equipment. The bridge cranes are used in the initial construction of paper machines because they facilitate installation of the heavy cast iron paper drying drums and other massive equipment, some weighing as much as 70 tons.In many instances the cost of a bridge crane can be largely offset with savings from not renting mobile cranes in the construction of a facility that uses a lot of heavy process equipment.

10. CONCLUSIONS

• In the designed hoist model trapezoidal section show less stress.
• The modified section should show less stress but due to reduction in area it shows more stress.
• Using more no. of rope falls divide the load and make the tension less. Also it makes the work faster. E.g., if we use 4 rope falls then using the same force 4 times work is done.
• But increase in rope fall increase the rope length by that times, which is expensive• Also the rope lengths determine the drum length.
• Increase in drum length increase the volume of setup to reduce the volume we can double winding of rope on the drum can be adopted Motor power required depends on lifting speed and load applied.
• The angular speed of drum and the motor are different so a gear box is used for power transmission.

11. REFERENCES

1. [1] N, Rudenko, Material Handling Equipment.
2. [2] Yuantal crane, “composition and working principles of lifting mechanism”.
3. [3] Indian standard Design, erection and testing (structural portion) of cranes and hoists code of practice (second revision). IS 807:2006.
4. [4] Indian standard code of practice for Electric Overhead Travelling cranes and gantry cranes other than steel work cranes (second revision). IS 3177:1999.
5. [5] Electromech FZE, “single failure proof EOT crane”.
6. [6] Laurids Porse, “single failure proof EOT crane for nuclear power plant” U.S. nuclear regulatory commission’s division Engineering of standards Washington , D. C. 20555, may 1979.
7. [7] Rajendra parmanik “Design of hoisting arrangement of EOT crane” posted on July 26, 2008.
8. [8] Dr. Frank jauch, “Care, Use & Maintenance of Wire Ropes on Cranes”, Crane Industry Council of Australia (CICA) 2012.