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The Study of Material Handling Equipment in Industries for Safety Operation

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ABSTRACT: Safety management systems require highly qualified management and professionals who have sound Knowledge in safety procedures. Improper safety measures lead to accidents which are, uncontrollable occurrences that result in minor or major injury and damage. The construction sites are considered to be a common place of more hazards because of the higher incidence of fatal accidents. To curtail these occurrences, various elements need to be incorporated in the modern construction machinery such as equipment, resource allocation, and overall management. This paper studies and analyses safety management in the construction sites through means of safety survey, interviews with different level of employees and accident data analysis with specific reference to the material handling equipment and recommendations are suggested for enhancing the overall safety in the construction sites.

Keywords: Material handling, construction safety, safety management system.

I. INTRODUCTION

Construction is one of the principal unorganized industries in allcountries. There are about 8.5 million building and other construction workersin India as per the estimates of National Sample Survey (1987-88). Theseworkers are one of the most numerous and vulnerable segments of theunorganized sector in India. The building and other construction works arecharacterized by their inherent risk to the life and limb of the workers. Thework is also characterized by its casual nature, temporary relationship between employer and employee, uncertain working hours, lack of basicamenities and inadequacy of welfare facilities. Although the provisions ofvarious Labor Laws i.e., The Factories Act 1948 Minimum Wages Act 1948,Contract Labor (Regulation & Abolition) Act 1970 and Inter-State MigrantWorkmen (Regulation of Employment & Conditions of Services) Act 1979 etc. ,are applicable to the building and other construction workers.In India construction workers are employed through contractors ondaily wage basis. Unlike organized industries where workers are employed in semi-skilled or sometimes even in skilled job, in construction industry theyare employed only as unskilled labors. In building construction, there aremany type of construction activities like earth work, masonry work, curingwork, breaking jalli, concreting work, carrying materials etc. The tasks assigned toworkers are carrying earth /mud, begs of cement or sand, stones,bricks, concrete mixtures, cement bags etc. on their heads or back. They areconsidered unskilled &paid much less. At a construction site, loads have to be liftedand carried from one place to another. Normally the work at construction sites wascarried during day hours. But work continued till late night when roofs of the building were to be laid. In such cases, workers also work during night hours. Constructionworkers are generally from different states and migrate from one part of the country toother. Construction workers have lower status of living. The conditions of constructionworkers are worse due to ignorance and illiteracy. A high degree of risk and danger is involved in construction work, the work proceeds in dangerous situations under sun,cold, heat, rain, dust etc. The magnitude of accidents and occupational diseaseassociated with construction work are appallingly high and complex. It is because mostof the operations are labor intensive with inadequate safety measures, lowquality of materials used and lacks of training of workers on safety.The implementation of safety management systems and its procedures should be done in the supervision of people having deep knowledge about the safetyrequirements of the work site. Accidents, which occur due to improper safety measuresis an unforeseen and unplanned event or circumstance, often with lack of intentionor necessity. Some of the key elements for the occurrence of accidents are lack ofmanagement control, basic personal and task factors, sub-standard acts and conditions. Any unplanned incident leading to death, injury or property damage whichstems from inadequate control of work processes causes an accident. But, these can be prevented through an established framework of safety activities.

1.1. Principles Of Material Handling

Although there are no definite "rules" that can be followed when designing an effective MHS, the following "Ten Principles of Material Handling,"3 as compiled by the College-Industry Council on Material Handling Education (CIC-MHE) in cooperation with the Material Handling Institute (MHI), represent the distillation of many years of accumulated experience and knowledge of many practitioners and students of material handling:

1. **Planning Principle.** All MH should be the result of a deliberate plan where the needs, performance objectives, and functional specification of the proposed methods are completely defined at the outset.
2. **Standardization Principle.** MH methods, equipment, controls and software should be standardized within the limits of achieving overall performance objectives and without sacrificing needed flexibility, modularity, and throughput.
3. **Work Principle.** MH work (defined as material flow multiplied by the distance moved) should be minimized without sacrificing productivity or the level of service required of the operation.
4. **Ergonomic Principle.** Human capabilities and limitations must be recognized and respected in the design of MH tasks and equipment to ensure safe and effective operations.
5. **Unit Load Principle.** Unit loads shall be appropriately sized and configured in a way that achieves the material flow and inventory objectives at each stage in the supply chain.
6. **Space Utilization Principle.** Effective and efficient use must be made of all available (cubic) space.
7. **System Principle.** Material movement and storage activities should be fully integrated to form a coordinated, operational system which spans receiving, inspection, storage, production, assembly, packaging, unitizing, order selection, shipping, and transportation, and the handling of returns.
8. **Automation Principle.** MH operations should be mechanized and/or automated where feasible to improve operational efficiency, increase responsiveness, improve consistency and predictability, decrease operating costs, and to eliminate repetitive or potentially unsafe manual labor.
9. **Environmental Principle.** Environmental impact and energy consumption should be considered as criteria when designing or selecting alternative equipment and MHS.
10. **Life Cycle Cost Principle.** A thorough economic analysis should account for the entire life cycle of all MHE and resulting systems.

1.2. Safety management system:

A safety management system provides a systematic way to identify hazards andcontrol risks while maintaining assurance that these risk controls are effective. Florio, Stafford and Allies, expressed that it needs a systematic, explicit andcomprehensive process for managing safety risks. As with other systems, safetymanagement system at construction sites provides for a goal setting, planning, and measuring performance while it is combined with the routine activities of theorganization.

1.2.1. Safety at construction industries:

Safety in construction industries deals with various areas such as excavation,scaffolding, work at height and manual and mechanical material handling equipment (MMHE). Construction safety covers all safety aspects in a construction industry.MMHE safety is a science under research infield of construction machineries, during operation or while assembly and disassembly. The accident rate in India's construction sites is serious despite the overall downward trend of accidents in recentyears. This paper deals with the safety management of the MMHE's in the construction industries in India, highlighting the drawbacks and necessary action required to improve the present condition.

1.3. Objective:

- To protect employees, customer, and the general public from sources of harm.
- Make safety an integral part of how business is done.
- Contribute to the company's financial performance.
- It covers all aspects of the plant, facilities like equipment, human beings &procedures.

1.4. Scope of project:

Materials handling is spread over to many different industries and fields ofengineering. Construction needs proper receiving, sorting, storing and movingmaterials. In heavy construction projects, there is now a choice of special methods andequipment's of materials handling. It influences the civil engineers in project planningwith effective of material handling safety in construction site.

II. LITERATURE REVIEW

WEBSTER AND REED (1971) used optimization technique for finding a suitable minimum cost MHE for each move without initially being concerned about improving utilization, and subsequently combining several moves and assigning to some selected MHE in an attempt to improve utilization.

HASSAN (1985) proposed construction algorithm which selects a minimum cost MHE from a candidate MHE set and assigns moves to it until its utilization reaches an acceptable level, the moves assigned to the equipment are assigned to some other equipment type. One advantage of this method over Webster's procedure is that the method itself estimates the operating times and operating costs, however an operating cost per unit load distance per period is required for each item of equipment. Both procedures require the user to determine a feasible candidate MHE set for each move andt6he cost to performing each move by each MHE.

FARBER AND FISHER (1985) have developed MATHES, a Material Handling Equipment Selection Expert System. To arrive at a decision, the values of four main parameters viz. path, volume of flow, size of load and distance between facilities are determined. Fisher et al. (1988) have improved MATHES by taking into account both technological and economic considerations using heuristic rules. The results indicate that due to technological considerations the conveyors should not be selected for material moves over a variable path, while an AGV is not selected for a low volume move. Even though an AGV is technically feasible for low volume moves, it can justify its high cost only for high volume moves.

GABBERT AND BROWN (1988) have developed MAHDE (Material Handling Design), a hierarchical frame structured KB system. The MAHDE initially selects the equipment for an MHS design based on the physical capacities of the equipment size, payload and throughput. The equipment, which does not meet the initial parameters are removed from the subsequent searches to narrow down the search space. The MAHDE system combines formal and Expert System (ES) methodologies to address the complexity of the problem and is able to select an equipment type based on optimal cost, an availability measure, lead time, a feasibility measure and a security measure.

HOSNI (1989) has presented an ES for material handling method and equipment selection. The Material Handling Equipment Selection (MHES) provides suggestion for an MHS configured to meet a particular purpose and limited by some constraints such as cost, area, material type, material weight and move characteristics and frequency. The MHES is basically based on the famous material handling equation: MATERIAL +MOVE = METHOD devised by Apple (1976). For theselection of an equipment type, a set of questions guide the user through the variousframes leading to one or more equipment's.

NOBEL AND TANCHOCO (1993) have presented a framework for an MHSdesign justification. Design justification refers to a design procedure where theeconomic ramifications of design decisions are considered simultaneously with designdevelopment. The goal of design justification is to guide the designer to a design thatis justifiable from both a performance and economic perspective. The MHS designjustification framework consists of system designer, design interface, design inferencemodel, model generator, rule base and database. The comparison between systemalternatives is facilitated through graphs showing total system cost, total systemflexibility or unit flexibility cost.

RUBINOVITZ AND KARNI (1994) have presented a detailed description ofthe use of ES for the selection of material handling and transfer equipment type. TheES compares a set of attributes of the intended operating environment with a set ofattributes of the Material Handling Transport (MHT) equipment. After comparison,the system selects the most appropriate equipment type and model.

RAMZAN YAMAN (1999) used a knowledge-based approach for selectionof Material Handling Equipment and Material Handling System. This approach speedup the design process and to extends personal abilities. In this approach, MHSequipment selection is defined as a matching problem between product, processhandling requirements and equipment specifications using rule sets.

HUSSAIN et al. (2006) used a hybrid (production rules, fuzzy logic andanalytical approaches). KB part selects MHE with certain confidence level and theanalytical part calculates the cost factors of the selected MHE in detail and practicalmanner. Some of the cost factors (such as intangible) that are difficult to estimate arecalculated using fuzzy logic. Once the adjusted costs of the selected MHE are calculated, then various moves between the departments are assigned to the mostfeasible (within the selected MHE) MHE based on minimum cost.

III. SAFETY MANAGEMENT OF MMHE

MMHE at work safety covers the assembly, disassembly, testing,transportation and other associated activities which could result in the operator injury.A safety improvement programmed at two companies and studied the awareness ofsafety among the workers after improvement programmed. Safety of machinery relatedto that of workers, businesses and properties, is an important component of sustainabledevelopment. India's MMHE safety rates are good, despite the overall downward trendin recent years, but the situation is still serious and problems still prevail. Therefore,implementation and strengthening of the science of safety management of MMHE is abig challenge.

3.1. Analysis of safety management in equipment and machineries:

With the increasing use of various types of MMHE in the constructionindustries, security issues become highly prominent causing problem that include;Imperfect safety management system, unable to strictly enforce the state and industryregulations, existence of long-term and outdated safety supervision administration,poor management of MMHE operators, imperfect MMHE technical file, mismanagement of equipment and machineries at the construction site, appallingconditions of equipment and machineries.

3.2 Safety Analysis in Material Handling:

Implementation and strengthening of the safety management of MHE are atough task and MHE being used in construction sites requires continuous and extensivestudies to improve its operation safety. Construction sites are classified as threetypes: small scale, medium scale, and large scale. Each of these types has a uniquesafety management system peculiar to its own construction sites. The first part of thisresearch work has been carried out considering two segments of the construction sites:small and medium scale sites. Construction sites employing less than 50 workers are termed small scale and those which employ between 50 and 100 workers are termed medium scale construction sites. Since most of the large scale sites follow all necessary safety procedures, they are not considered for this study.

3.2.1. Elements of Safety,

For this study, the MHE safety management system of small and medium scalesites has been divided into twelve separate elements constituted in two parts:administrative management system and technical management system. The elementsof safety were derived from the literature and general risk assessments in constructionsites. Each of the elements had a questionnaire in its related field with ten questionsfor each element totaling to 120 questions overall. The first six elements come undersafety management system which include general working standards, health andhygiene, personal protective equipment, hazard and risk identification, inspection ofcranes, and worker behavioral safety and the other six elements come under technicalmanagement system which are tower crane and hydra crane inspection, operation ofindustrial trucks and dumpers, safety of passenger and builder hoist, safetyduring storage and material handling, safety of earth moving equipment, andprevention of fire and fire protection. The questionnaire was sent to thirty small and medium scale construction sites at different parts of India out of which twenty-eightsites from small scale and twenty-nine sites from medium scale sites answered for thequestionnaires. One set of answers from the medium scale site have been neglecteddue to irrelevance in answers. The questions were a "yes" or "no" type and the number of questions answered "yes" was counted and considered for this analysis.

3.2.2. Safety Education Program for MHE.

The implementation of safety education program was done through a methodof acclaimed safety procedures, in which the workers were given self-instructionalmodules containing materials for the education program. Based on the analysis of ourstudy, the knowledge level of safety among workers is less than required. This can beseen with the mean values and mostly negative correlation coefficient. Hence, for thepurpose of educating the workers on safety with MHE, three modules considered to beclosely relevant for the effective improvement of worker safety were developed. The modules are general worker safety, inspection and operation of MHE, and safety of MHE environment. These three modules of safety were considered to be effective forthe education program and typical for enhancing the awareness on safety amongindustrial workers. Two construction sites, one from small scale and the other frommedium scale, which received the lowest score were taken

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up and about nineteen workers from each of the construction sites were selected for the education program.The objective of the education program is to inculcate knowledge of safety to theworkers while they work with the MHE.

3.2.3. Effectiveness of the Program.

A different set of questionnaire was once again issued to the workers beforeand after the program to find out its effectiveness. The questionnaire consisted of threeparts: general worker safety, inspection and operation of MHE, and safety of MHEenvironment with 40 questions for each part totaling to 120 questions and each "yes"contributes to 0.25 points. Then, the points acquired by each worker before and afterthe test were compared to find out the improvement in the knowledge level of theworkers. Results of the points obtained by the workers for the questionnaire before the program. It shows the pointsobtained by workers before training.

3.3. Reforms for safety management in MMHE:

Several issues regarding safety in constructions sites need strict reformationsso as to overcome the disadvantages of the present system. We propose fewsuggestions for improving the current norms and regulations for the MMHE atconstruction sites.

3.3.1. Suggestions for improvements in norms and regulations:

To establish critical on-site safety procedures of equipment and machineries,the construction sites must strictly implement the following suggestions along with the existing standards and norms. In the field, machine management should develop aneffective on-site management system which;

i) The construction site has be equipped with all the equipment, materialsand tools required for construction site safety management.

ii) Strict safety management regulations should be established andfollowed for each machinery and equipment being used at the site.

iii) The implementation of statutory measures for the machinery andequipment, and personnel, will be the responsibility the management ofthe construction site.

iv) The mechanical, electrical and construction equipment operationshould be well maintained and in good operating condition.

v) Proper use of equipment and machineries is necessary for safe operation of equipment and machine overloads must be strictly prohibited.

vi) With the progress of building at construction site, the various classes ofMMHE used should be dynamically tracked for performance.

vii) Technical files of the process safety management procedures should beupdated from time to time in order to establish the complete safety ofMMHE.

IV. TYPES OF EQUIPMENT USED IN CONSTRUCTION

There are several equipment that is been used in the Construction Industry.These are used for both large and small scale purposes. Various types of Equipmentare been used for Building & structural Construction, Road construction, underwaterand other marine construction work Power projects etc. There are various operationsthat are involved in construction project, whether it's a large scale or a small scale;Excavation and digging of large quantities of earth, Placement of constructionmaterials (eg:- Bricks, concrete) Compacting and leveling, Dozing, Grading, Haulingetc…

Construction equipment can be categorized in to 4 main sections based onpurpose and use, they are:

1. Earth Moving equipment
2. Construction vehicle
3. Material Handling Equipment
4. Construction Equipment

4.1 Earth Moving Equipment:

Earthmoving equipment is heavy equipment, typically heavy-duty vehiclesdesigned for construction operations which involve earthworks. They are used to move large amounts of earth, to dig foundations for landscaping and so on. Earthmovingequipment may also be referred to as; heavy trucks, heavy machines, construction equipment, engineering equipment, heavy vehicles and heavy hydraulics. Most earthmoving equipment uses hydraulic drives as the primary source of motion.

4.1.1. Excavators:

Excavators (hydraulic) are heavy construction equipment consisting of a boom,dipper (or stick), bucket and cab on a rotating platform known as the "house". Thehouse

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sits atop an undercarriage with tracks or wheels. They are a natural progressionfrom the steam shovels and often mistakenly called power shovels. All movement andfunctions of a hydraulic excavator are accomplished through the use of hydraulic fluid,with hydraulic cylinders and hydraulic motors. Due to the linear actuation of hydrauliccylinders, their mode of operation is fundamentally different from cable-operatedexcavators which use winches and steel ropes to accomplish the movements.

4.1.2. Skid loader:

A skid loader, skid-steer loader or skid steer is a small, rigid-frame, enginepowered machine with lift arms used to attach a wide variety of labor-saving tools orattachments. Skid-steer loaders are typically four-wheel vehicles with the wheels mechanically locked in synchronization on each side, and where the left-side drivewheels can be driven independently of the right-side drive wheels. The wheelstypically have no separate steering mechanism and hold a fixed straight alignment onthe body of the machine. Turning is accomplished by differential steering, in whichthe left and right wheel pairs are operated at different speeds, and the machine turnsby skidding or dragging its fixed-orientation wheels across the ground. The extremelyrigid frame and strong wheel bearings prevent the torsional forces caused by thisdragging motion from damaging the machine. As with tracked vehicles, the highground friction produced by skid steers can rip up soft or fragile road surfaces.Theycan be converted to low ground friction by using specially designed wheels such as the Meconium wheel. Skid-steer loaders are capable of zero-radius, "pirouette"turning, which makes them extremely maneuverable and valuable for applications thatrequire a compact, agile loader. Skid-steer loaders are sometimes equipped with tracksinstead of the wheels, and such a vehicle is known as a multi-terrain loader or moresimply as a track loader.Unlike in a conventional front loader, the lift arms in these machines arealongside the driver with the pivot points behind the driver's shoulders. Because of theoperator's proximity to moving booms, early skid loaders were not as safe asconventional front loaders, particularly during entry and exit of the operator. Modern skid loaders have fully enclosed cabs and other features to protect the operator. Likeother front loaders, it can push material from one location to another, carry material in its bucket or load material into a truck or trailer.

4.3. Material Handling Equipment:

4.3.1. Crane:

A crane is a type of machine, generally equipped with a hoist rope, wire ropes or chains, and sheaves, that can be used both to lift and lower materials and tomove them horizontally. It is mainly used for lifting heavy things and transporting them to other places. The device uses one or more simple machines to create mechanical advantage and thus move loads beyond the normal capability of ahuman. Cranes are commonly employed in the transport industry for the loading and unloading of freight, in the construction industry for the movement of materials, and in the manufacturing industry for the assembling of heavy equipment.

4.3.2 Hoists:

Also known as a Man-Lift, Buck hoist, temporary elevator, builder hoist, passenger hoist or construction elevator, this type of hoist is commonly used on large scale construction projects, such as high-rise buildings or major hospitals. There are many other uses for the construction elevator. Many other industries use the buck hoist for full-time operations, the purpose being to carry personnel, materials, and equipment quickly between the ground and higher floors, or between floors in the middle of a structure. There

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are three types: Utility to move material, personnel to move personnel, and dual-rated, which can do both. The construction hoist is madeup of either one or two cars (cages) which travel vertically along stacked mast tower sections. The mast sections are attached to the structure or building every 25 feet (7.62 m) for added stability. For precisely controlled travel along the mast sections, modern construction hoists use a motorized rack-andpinion system that climbs the mast sections at various speeds. While hoists have been predominantly produced in Europe and the United States, China is emerging as a manufacturer of hoists to be used in Asia. In the United States and abroad, General Contractors and various other industrial markets rent or lease hoists for a specific projects. Rental or leasing companies provide erection, dismantling, and repair services to their hoists to provide General Contractors with turnkey services. Also, the rental and leasing companies can provide parts and service for the elevators that are under contract.

4.4. Construction Equipment:

4.4.1 Concrete Mixture:

A concrete mixer (often colloquially called a cement mixer) is a device that homogeneously combines cement, aggregate such as sand or gravel, and water to form concrete. A typical concrete mixer uses a revolving drum to mix the components. For smaller volume works, portable concrete mixers are often used so that the concrete can be made at the construction site, giving the workers ample time to use the concrete before it hardens. An alternative to a machine is mixing concrete by hand. This is usually done in a wheelbarrow; however, several companies have recently begun to sell modified tarps for this purpose.

4.4.3 Pavers:

A paver (paver finisher, asphalt finisher, paving machine) is a piece of construction equipment used to lay asphalt on roads, bridges, parking lots and other such places. It lays the asphalt flat and provides minor compaction before it is compacted by a roller.

V. HAZARDS AND SAFETY MEASURES

It is a fact that the accidents can be eliminated by providing safe working placeand establishing safe ways of working at the construction site. A brief description of different types of construction activities, their associated hazards and safety measuresto be taken for prevention of accidents are highlighted here. In this monograph, those type of construction activities have been discussed where the rate of fatalities/injuriesare high in DAE units. AERB's stipulations through notifications wherever issued areprovided for reference in this monograph.

5.1 Rock blasting

The blasting works involve risks related to storage, transportation, handlingand use of explosives, blasting accessories and agents. The hazard sinvolved during blasting are fly rock, dust, fumes, ground vibration etc. from an explosion that maycause personal injuries, damage to adjacent property etc. Major safety measures to be taken during blasting are

- The blaster should be a qualified and competent person for carrying outblasting work. He should know about the dangers involved.
- Before blasting, sufficient warning should be given to enable the peopleworking in the area to get off the danger zone at least 10 minutes before the blasting starts. The danger zone should be suitably cordoned off and flag menposted at important points.

5.2 Excavation

Excavation is among the most hazardous construction operations. Excavations are needed for the foundation of structures, installation and repair of utility lines,replacement of water and sewer lines etc. An excavation may be defined as any manmade cut, trench, or depression in the earth's surface formed by earth removal. Cave-ins pose the greatest risk and are much more likely than other excavation relatedaccidents to result in worker fatalities. Other hazards to be considered include accidental contact with utility lines, crushing and striking hazards posed bymechanized equipment, and hazardous atmospheres. Working in excavations is anextremely dangerous operation which can be made safe by an awareness of the hazardsand the precautions to be taken and careful management of the process. Minimumsafety requirements stipulated by AERB during excavation work are as follows:

- Means for rapid access and egress should be provided. All trenches 120 cm or more in depth should at all times be supplied with at least one ladder for every30 m along the trench. Ladder should be extended from bottom of the trench to at least 1 m above the surface of the ground.
- Workers should not be exposed to dangers of being buried by excavatedmaterial or collapse of shoring. Measures to prevent dislodgment of looseor unstable earth, rock or other material from falling into the excavation by propershoring should be ensured.
- Measures should be taken to prevent persons who are not engaged inex cavation work, from approaching excavation areas by placing warning signals, barricades etc. near the site of the excavation.

5.3 Work at Height

Majority of the accidents at construction sites are related to fall of personsworking at a higher elevation.

Suggested Instruction to Improve Safety in Mobile Cranes:

- A mobile crane is inherently unstable and is liable to overturn if used on uncompact ground or on a slope. Rain can soften the ground and sites which are not level impose strains on the crane which may lead to unintentional overloading.
- Operator should understand the advantages and limitations of outrigger settings and be aware of the dangers of failing to use them.
- Lifting outdoors may be made more difficult or hazardous by the wind. Make sure that there is adequate clearance for the crane's jib or boom and counterweight from traffic and fixed structures such as buildings and that no part of the crane or the crane load will be closer to live overhead power lines.
- Safe lifting depends on three key elements, which
  require that the operation must be:
- properly planned by a competent person appropriately supervised by a crane supervisor and
  carried out in a safe manner
- No lift is small enough to be left to chance. Every lift should be planned and carried out by trained, competent people. If no one has the expertise, contract out the work to someone whodoes.If alift is going to be carried out, accidents can be avoided by appointing someone (not the crane operator) with the expertise to take charge and control the lifting operation.
- The crane is positioned to ensure adequate clearance
  between the wall and the counterweight. The slings
  are protected by packing around the load.
- The supervisor should be someone other than the
  crane operator.
- Supervisors should have sufficient training and be
  competent to supervise the operation.
- A supervisor should:
- Direct and supervise the work.
- Be fully briefed on the safe system of work described in the lift plan.
- Be able to identify any problems either arising from
  changed site conditions or occurring while the lifting
  operation is in progress and have the authority to
  stop the operation until guidance can be provided by
  the person who planned the lift.

Suggested Instruction to Improve Safety in Hoists:

- Only authorized employees may use hoists to move heavy objects and equipment. When using
  hoists.
- Never walk, stand, or work beneath a hoist.
- Isolate hoisting area with barriers, guards and signs,as appropriate.
- Never exceed the capacity limits of your hoist.

- Wear gloves and other personal protective equipment, as appropriate, when working with hoistsand cables.
- Ensure that hoists are inspected regularly.
- Always hold tension on the cable when reeling it in or out.
- When the work is complete, always rig the hoist down and secure it.
- When the load block or hook is at floor level or its lowest point of travel, ensure that at least two turns of rope remain on the drum.
- Be prepared to stop operations immediately if signaled by the safety watch or another person.
- Ensure that the hoist is directly above a load before
  picking it up. This keeps the hoist from becoming stressed. Picking up loads at odd angles may result in injury to people or damage to the hoist.
- Do not pick up loads by running the cable through,over, or around obstructions. These obstructions can foul the cable or catch on the load and cause an accident.
- Do not hoist loads when any portion of the hoisting
  equipment or suspended load can come within 6 feet of high-voltage electrical lines or equipment.
- If you need to hoist near high-voltage electrical lines or equipment, obtain clearance from your supervisor first.
- The hooks on all blocks, including snatch blocks,must have properly working safety latches.
- All hooks on hoisting equipment should be free of cracks and damage.
- The maximum load capacity for the hoist must be noted on the equipment.
- Cables and wiring should be intact and free of damage.
- Properly constructed of sound materials and capable
  of lifting the required loads.
- Properly marked as to use either for equipment and
  materials only, or for passengers in addition to goods and the number that can be carried, together with a safe working load notice. Never allow passenger storide on a goods-only hoist.

VI. CONCLUSION

Material handling problems in construction sites contribute to themaximum number of accidents. And MMHE's play a critical role for thesafety management process in these construction sites. The selection and procurement of construction and material handling equipment is importantand should be done carefully as it is the base for safer operation and easiermaintenance. The outcome of this research reveals that small scaleconstruction industries have lesser equipped safety systems when compared to that of medium construction industries. Hence, properregularization needs to be done in the small scale industries. Further, themedium scale industries require technological improvement and upgradation of their safety management system. Implementation of effectivesafety measures is necessary on a continual basis for the construction sites,which will greatly enhance the safety system and protect the constructionworkers from injuries and fatalities.

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