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Significance of Selection of Material Handling System Design in Industry – A Review

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Abstract— In this paper an attempt is made to review the considerations for material flow design problems (i.e. material handling equipment selection, flow path design, facility layout design, routing, etc.) for related product design in the Industry. A concise study on developing material Handling technology has been explained in the literature.

Keywords— transit, facility design ,automaton, manufacturing, material Handling equipment selection ,analysis, simulation model.

INTRODUCTION

A material-handling system can be defined as movement, handling, storage and controlling of materials throughout the manufacturing process. The main purpose of using a material handling system is to ensure that the material in the right amount is carefully delivered to the desired destination at the right time at minimum cost. Material handling as such is not a production process and hence does not add to the value of the product but it costs 30-75% of the total product cost. An efficiently designed material handling system ensures the reduction in operation cost, manufacturing cycle time, MH cost, delay and damage. It promotes productivity, flexibility, better utilization of manpower, increases material flow and automation in handling. This paper discusses the research carried out on material handling system design, MH equipment Selection, Analysis and simulation from last decades to get the best solution for implementing the design of MH system in the existing facilities. The constraints and challenges in designing material handling system, solutions are identified and discussed.

1.1 Significance of Material handling system in Industry

Material handling is an essential and significant component of any productive activity. It is something that goes on in every plant all the time. It is simply picking up, moving, and lying down of materials through manufacture. It applies to the movement of raw materials, parts in process, finished goods, packing materials, and disposal of scraps. In general, hundreds and thousands tons of materials are handled daily requiring the use of large amount of manpower while the movement of materials takes place from one processing area to another or from one department to another department of the plant. The cost of material handling contributes significantly to the total cost of manufacturing.

In the recent period of competition, this has acquired greater magnitude due to growing need for reducing the manufacturing cost. The significance of material handling function is greater in those industries where the ratio of handling cost to the processing cost is large. Today material handling is rightly considered as one of the most potentially lucrative areas for reduction of costs.

1.2 Factors and considerations for Design of MHS

It is usually difficult to identify and quantify the benefits associated with MH; it is much easier to identify and quantify the costs of MH (e.g., the cost of MH equipment, the cost of indirect MH labor, etc.). MHS cost as the sole criterion to select a MHS design depends on the degree to which the other aspects of the production process are able to be changed. If a completely new facility and production process is being designed, then the total cost of production is the most appropriate criterion to use in selecting a MHS—the lowest cost MHS may not result in the lowest total cost of production. In actual practice, it is difficult to consider all of the components of total production cost simultaneously. If it is too costly to even consider changing the basic layout of a facility and the production process, then MHS cost is the only criterion that need be considered.

The movement of material from the place where it is to the place where it is needed can be time consuming, expensive, and troublesome. The material can be damaged or lost in transit. It is important, therefore, that it be done smoothly, directly, with the proper equipment and so that it is under control at all times. The several factors that must be known when a material handling system is designed include:

1. Form of material at point of origin, e.g., liquid, granular, sheets, etc.
2. Flow demands, e.g., amount needed, continuous or intermittent, timing, etc.
3. Handling equipment available, e.g., devices, prices, reliability, maintenance needs, etc.

1.3 Other factors to be considered include:

1. Labor skills available
2. Degree of mechanization desired
3. Capital available
4. Return on investment
5. Expected life of installation

Since material handling adds expense so it should be reduced as much as possible with respect to time, distance, frequency, and overall cost. A straight steady flow of material is usually most efficient. The use of mechanical equipment rather than humans is usually, but not always, desirable—depending upon the duration of the job, frequency of trips, load factors, and characteristics of the material. When equipment is used, maximizing its utilization, using the correct equipment, proper maintenance, and safety are important considerations. The proper material handling equipment can be selected by analyzing the material, the route it must take from point of origin to destination, and knowing what equipment is available.

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2. Literature Review

J. S. Noble and C. M. Klein, A. Mid ha [1] have examined several aspects of the integrated material flow system design problem. ; However, as problem complexity has increased the ability to obtain solutions to the more integrated problem formulations has become more difficult. They present a model which integrates material handling equipment selection and specification (including interface equipment between different types of equipment), and path/load dependent unit load size and variable unit load size. The formulation is solved using the meta-heuristic procedure of tabu search to find a "good" solution to a more integrated formulation

Ramazan YAMAN [2] develop a knowledge-based system for material handling equipment selection and pre-design of these equipments in the facility layout is discussed. The study comprises two sections. In first section author explained the selection of material handling equipment for related product requirements and in second section decision making for equipment between departments. However, it is defined more comprehensively as using the right method to provide the right amount of material, at the right place, at the right time, in the right sequence, in the right position, in the right condition, and at the right cost (White and Apple, 1985). Author compared the selection of equipment and design of MHS by means of traditional selection and using analytical method with knowledge based approaches. In traditional selection, the designer relies principally on handbooks and experience and also may not be cost-effective because of the limitation of personnel experience. Only consulting agencies and large companies are likely to have a specialized planner with full-time facility planning responsibilities. In medium and small size companies, facility layout forms a part of the responsibilities of an industrial or plant engineer's activities. He also explained the Analytical models have not often been applied in industry, because they generally consider only quantifiable factors such as cost and utilization and are often difficult to implement (Matson et al., 1992). Thus he prefers a knowledge-based approach which involves the use of expert guidelines and 'rules of thumb' and allows extensive matching of equipment characteristics to application requirements. Practically, this expertise needs to be established over a period of time, based on operational experience.

A Suratkar, V. Shukla [5] represents a design optimization method for the over head crane using computer modeling procedure. The researches that use for the majority of the test cases different strain measurement stern out to be quite hard and expensive for the real experimental studies to take into consideration the influence of the connections between the main beams and the rest parts of the construction, the influence of the longitudinal and transverse ribbings as well as the influence of the supports on the overall stressed state of the construction. All these problems could be solved successfully by the use of computer modeling procedures. They present a 3D model that could satisfy all the requirements for examining the general stressed state of the carrying metal construction while 2D computer studies give idea of the planar behavior of the construction and lack the opportunity of showing the influence of supports. For research they created of 3-D models crane design and analyzed its behavior. They have also done calculations of Conventional design proposed by Indian Standard Rules were performed. They applied the load, assign material and define boundary conditions to and Finite Element meshes to the solid model. A four-node tetrahedral element was used for finite element analysis, using the girder solid model generated by means of Inventor software 2012. After a comparison of the finite element analyses, and the conventional calculations, the analysis was found to give the most realistic results.

J. D. Tew, S. Manivannan, D. A. Sadowski, and A. F. Seila [4] were illustrate the simulation methodologies used in the design of Automated Material Handling Systems (AMHS) at Intel wafer fabs for semiconductor manufacturing. The models used in AMHS design has categorized as AMHS models and production models. The AMHS models support the design of Interbay and Intrabay systems. The Inter bay systems handle the material flow between different bays (production centers). The Intrabay systems handle the material flow within the bays. The production models compliment the AMHS models. In modeling framework, they approaches AMHS and the production process models use a consistent set of assumptions. This de-coupling approach typifies the general philosophy to using simulation in design. Authors review the general model structures and simulation examples under these categories used in actual system implementations. In this paper the main purpose of using simulation is to ensure that the material handling system design meets material storage and transport requirements.

Prasad Karande and Shankar Chakraborty[5] have carried out the selection method for suitable MH equipment . They had proceed with multicriteria decision-making (MCDM) problem. As wide range of MH equipment is available today, for this complicated task they applied a multicriteria decision-making (MCDM) tool to select the most suitable MH equipment. They implement weighted utility additive (WUTA) method to solve an MH equipment selection problem. They have also observed a comparison of ranking obtained with the past researchers and found its potentiality, applicability, and accuracy to solve complex decision-making problems. They have explained that the WUTA method has a strong mathematical base and proficient of deriving more precise ranking of the considered alternatives. They have also concluded that it can also be useful for any decision-making problem with any number of selection criteria and feasible alternatives.

3. Conclusion:

From the above study it is observed that the material handling is important activity in manufacturing industry. The selection of the most appropriate MH equipment for any particular application can be influence the profit of any manufacturing company. The literature review has shown that researchers have consider the design problems in material flow system and overcome with adequate knowledge base approach, properly design, 3d modeling ,analyzing and using simulation model to validate the system performance for acquiring the MH equipment selection. Thus it concludes that MH system plays a major role in productivity. Distribution, manufacturing, and warehousing and helps to give the best optimization to increase the productivity, reduced cost and idle time, proper utilization of labour, product quality and safety.

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