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A Review Paper On Design Of Special Purpose Jib Crane

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Abstract - Tech-flux Engineering Solution is known for manufacturing of air condensers. Some of the components in the company workshop are very heavy and needed to be stored at second floor. Due to lack of floor space, regular jib cranes are of no use. Column mounted jib crane is somewhat useful but has lateral space limitations. Length of the beam of the jib crane cannot be extended beyond some limit but height of the crane can be raised if required. Hence there is needed to adjust the height of the column in the column mounted jib crane. In this dissertation work, regular column mounted jib crane is modified so that it can be useful at particular location in the company workshop. Special purpose modified jib crane will be raised to required height. Available CAD tools like CATIA V5 and CAE tools like ANSYS will be used for modeling and analysis. Analytical, numerical and experimental results will be compared. The special purpose jib crane will be then manufactured, tested in the company premises and will be used for the company.

Key Words: ANSYS, CAE, CATIA V5, space limit, special purpose jib crane

1.INTRODUCTION

A jib crane is in effect a monorail that is cantilevered from its supporting members and pivoted at one end. The horizontal beam provides the track for the hoist trolley. Jib crane have three degrees of freedom. They are vertical, radial, and rotary. However they cannot reach into corners. They are usually used where activity is localized. Lifting capacity of such cranes may vary from 0.5 ton to 200 ton and outreach from a few meters to 50 meters. Such cranes find various applications in port area, construction site and other outdoor works. For handling general cargo, lifting capacities usually 1.5 ton to 5 ton with maximum out reach of 30 meter. Jib crane provided with grabbing facilities have usually a capacity ranging from 3 ton operating 50 to 100 cycles per hour. Lifting heights may be 30 meter or more. Jib cranes used in ship yards for lifting heavy machinery equipment, weighing 100 to 300 tons, are usually mounted on pontoons. Frequently, these cranes are provided with two main hoisting winches which can be employed singly or together to lift a load. For handling light loads may hand auxiliary arrangement localized, such as in machine shops. Column mounted jib cranes are commonly used in packaging industry. The size of the crane can be visualized from the height of the operator. These cranes are used for hoisting up to 1 ton loads.

Tech-Flux Engineering Solutions is an industry manufactures air condensers and water condensers. Some water condensers manufactured by Tech Flux are very heavy. Lifting these in very constrained space of the workshop is very challenging and difficult task. Moreover sometimes they are needed to be stored on the upper floor which has height of 15ft. This makes lifting these condensers more difficult. To solve this problem it is proposed that a jib crane will be used whose column would be lifted by hydraulic cylinder to match the height of the upper floor. Therefore the company has agreed to sponsor this project titled '**Design & Analysis of Special Purpose Jib Crane'**

Various papers are explored which are useful for modeling and analysing the jib crane accessories. Objective of this synopsis is to explore the literature that focuses the study on the structural strength and working of the special purpose jib crane.

2. LITRETURE REVIEW

Fuad Hadžikadunić, Nedeljko Vukojević, Senad Huseinović In their work have done a wider analysing methodology for construction and static-dynamic behavior of specific crane's type – jib crane is given. A considerate methodology is applicable also on other types of cranes, what gives a certain width and expediency of its consideration. An application of CAD technologies and calculation numerical methods to this complex structure is of a great importance, which gives modern access in the actual design and constructive diagnostics. In this work a comparative analysis of several concept solutions of jib cranes is given, with application of KOMIPS system, as well as detail analysis of a selected solution. An analysis of jib crane's design is given also by application of the I-DEAS 11 NX Series software. Results of the static-dynamic analysis of complex configuration behaviour can be of great importance for significant improvement of construction, and presented methodology is applyable for different types of crane's construction [1].

Chaitra C. Dandavatimath, Prof. H. D. Sarode have investigated the bending behavior of regular I section cantilever beam of jib crane subjected to self-weight and load at the free end. A new design is proposed in this study to tackle the bending and increase

the strength of the crane. Finite element analysis is carried out to analyze the effect of geometrical parameters of various web shapes. The thickness of the flange is constant for all specimens with length 2.54 m and tested for 500 Kg load lifting capacity. Structural analysis is done to examine the influence of the section dimension due to load at the free end on cantilever. From FEA and subsequent analysis it is observed that changing the web designs, influences load carrying capacity and resistance to bending [2].

Deepak Desai, Amol N Patil The existing Jib cranes have high deflections which are not suitable for machine shop applications. The Jib is standardized for certain heights, however in actual the heights are altered suitable to different site conditions and applications. Under such conditions the existing deflection values change and generate lower natural frequency. Due to this the dampening time of the load during acceleration and deceleration increase and creates operational problems. The attempts in the research problem is to generate algorithm to find out the deflection and s tress of complete pillar mounted crane under various slewing angles and load position by using limit state method. The limit state method is different to general allowable state method where the partial duty factors are multiplied on load side is and t he permissible stress is closer to yield or ultimate stress. This method is adopted by ISO 12100 and European standards EN 13100 and latest state of the art methods [3].

Adem Candaş, Serpil Kurt, İsmail Gerdemeli, Eren Kayaoğlu have proposed in their paper that Jib cranes are a kind of material handling machines using in the industry such as factories, shipyards, construction areas, and storages. Standards and regulations about them are published by API (American Petroleum Institute), FEM (The Federation Europeen de la Manutention) et al. In this study a jib crane designed by an engineering work group, were examined in terms of static structural test analysis before put it into use according to the API Spec 2. Firstly, critical areas, which have the highest stress values, were determined by finite element method in a commercial analysis program. The next step is the application of strain gages on the structure and initial reference test values are obtained just before the assembling. Two tests were done after the jib crane was assembled under circumstances with no load and test load. Finally, strain and stress values were calculated and the resulting stress obtained from tests and finite element method analysis results were compared with each other.

K Suresh Bollimpelli, V Ravi Kumar In their work have observed that a static, modal and harmonic analysis of column mounted jib crane using ANASYS software is presented. A column mounted jib crane of 1.5 Ton capacity is modeled using CATIA which is imported into ANASYS where calculations are performed. The detailed drawing of various parts of the crane is obtained from TATA Advanced systems Ltd (TASL) Adibhatta village, Hyderabad. The deflection values, Von Misses stress etc are obtained using the static analysis. The hand calculations of the column mounted jib crane have been done using simple strength of material expressions. The deflection is obtained as 3.709mm, when the load applied is 1.5 tons. The maximum stress obtained is 147.8Mpa which is less than the allowable stress. The static stress was found to be within the limits of safety. The model analysis shows the natural frequencies of the crane to be in the lower range 0-10Hz. The fundamental frequency is found out to be 0.323589 Hz. All the other higher frequencies are also found to be very low making the jib crane less stiff and highly stable for any transient loading. The harmonic analysis is performed with a view to predict the performance of the crane if a cycle time dependent load is allowed to act at the trolley. For this hypothetical situation, the Von-Mises stress and displacement along the z-directions were obtained using ANSYS. The maximum Von-Mises stressof 60Mpa occurs at fundamental frequency of 1Hz. The maximum z-direction displacement of 5mm was observed. These values indicate that the column mounted jib crane is safe to operate under the load of1.5 Tons under static and cyclic time dependent loads also [5].

Amreeta R. K, Dr. V. Singh have presented work that ensures the smooth functioning of the jib crane in various areas. In general the jib crane requires at least two times maintenance in a year. The present work has been taken to reduce the servicing required and to ensure smooth functioning without any breakdown through analyzing of various parameters on beam sections MB150, MB125, MB100 and 140*80 rectangular sections. Comparative analysis is carried out by using analytical and FEM approaches on the beam. It has been found that the I section beam MB150 is most suitable and safe in the working load range of 1000kg.This study aims at stress analysis of single girder wall mounted jib crane of following specification [6]:

a. load carrying capacity 1000 kg,

b. span length 2.5 m

c. swing range 180 degrees

M.Dhanoosha, V.Gowtham Reddy have suggested that jib crane is a type of crane having cantilevered beam with hoist and trolley and it is either attached to a building column or cantilever vertically from an independent floor mounted column. This paper will mainly concentrates floor mounted jib cranes here the trolley hoist moves along the length of the boom and the boom spin allowing the lifted load to be skillfully about in a relatively circular area. While designing a jib crane several factors have to be considered in these most important factors are own

weight of the crane, the weight of the goods. The aim of this thesis to carry out detailed design &analysis of jib crane. This project investigates the stress regions in the jib crane with different materials and the work is carried out by designing reinforcement to overcome those stresses in the component. With the analytical design dimensions models are prepared in modeling software and the analysis is performed on the models by finite element solver with suitable conditions and results are compared [7].

Goran Pavlovic, Milomir Gasic, et al, has observed that Column-mounted jib cranes belong to the group of cranes which are the most widespread in plants. The increased development of industry requires shorter deadlines for the manufacturing and assembly of these cranes and, consequently, shorter design time. Deflection of these cranes often represents the main limiting factor in design. The paper presents the comparative analysis of expressions for analytical calculation of deflection of the jib tip defined by a lot of authors. The obtained results were compared by using the finite element method, as well as by experimental values. The recommendations for the selection of an adequate expression for calculation of deflection of the jib tip were given based on the comparison of results. The recommendation for the use of appropriate analytical expressions, which can considerably shorten the time of preliminary calculation in design of this type of cranes, was given based on the conclusions [8].

3. GAP IDENTIFICATION

In all the papers above, authors have mainly focused on the design and analysis of simple column mounted jib crane or wall mounted jib crane according to the load carrying capacity. But none of above has worked on the special purpose jib crane whose column height can be adjusted and raised. Raising the height of the column is must because floor space is very limited. So for the dissertation work, it is decided to design and analyze the special purpose column mounted jib crane that can fulfill requirements of Tech-Flux Engineering Solution.

4. PROBLEM STATEMENT

From the aforementioned reasons it is clear that there is need of work to be done on Special purpose jib crane. This dissertation needs to suggest a sustainable design for special purpose column mounted jib crane. The crane must not fail in bucking when column is raised to its highest limit. The analysis will be mainly focused on the design of the column, cantilever beam and not on the other standard parts in the jib crane assembly. Suitable materials can be chosen as per company requirements and given parameters.

5. AIM

- **a.** To minimize the floor space utilization for jib crane.
- **b.** To design a special purpose jib crane that will sustain to given buckling load.
- **c.** To design a special purpose jib crane that can carry given load to the second floor.

6. OBJECTIVE

- **a.** Design of 3D model of special purpose jib crane using Computer Aided Design softwares like CATIA V5.
- **b.** Choosing suitable materials and sizes for jib crane column and beam.
- **c.** Analyzing the 3D model analytically for various loads.
- **d.** Analyzing the 3D model numerically using Computer Aided Engineering softwares like ANSYS for various loads.
- **e.** Design of experimental set-up to compare the results obtained in analytical and numerical method.
- **f.** Suggesting design with dimensions and sizes for special purpose jib crane for given capacity loads to the company.

7. METHOLOGY

A 3D model will be designed using CAD Software to get an idea of the construction of the special purpose jib crane. Analytical calculations are done for the column and beam used for jib crane considering the loads and available dimensions given by the company. Parameters like deformation, bending stress and buckling stress will be then obtained from analytical calculations as well as CAE software. The analysis will be focused on column, beam and machine parts that undergo considerable load in the assembly. Other standard parts will not be designed. Based on results obtained from both the methods, Experimental set up will be made and again it is tested to compare the outputs. This process will be followed until all parts in the assembly of special purpose jib crane are sustainable and up to the mark according to the company.

8. DETAILS OF IMPLEMENTATION

The special purpose jib crane machine will work as same as other column mounted jib cranes but due to lack of floor space length of the beam is short. As material must be stored on the second floor, height of the column must be high. When column is higher than beam, material cannot be hung properly on the beam. To counter this problem such a column is proposed to design whose height will be adjustable. This will be done by using vertical double operated hydraulic cylinder and its power pack. This dissertation is focused to prevent failure due to bucking caused by raised

height. Other important components will also be analyzed. Proposed set up will be as follows.

H = Adjustable height of jib crane.

h = maximum height of the hoist

L = maximum length of the beam.

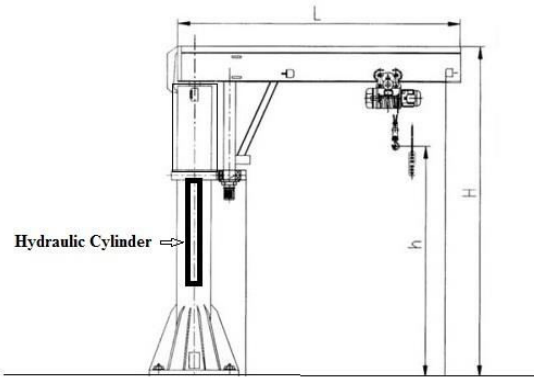

Fig 1: Proposed special purpose jib crane

9. RESULT AND DISCUSSION

Analysis will be done considering this a static problem. Results obtained in Analytical, Numerical and experimental methods will be compared. Number of iterations of analysis will be done until results are within factor of safety. Thus most suitable size of column and beam that works satisfactorily as per the company requirements will be suggested.

10. CONCLUSION

From literature review it is clear that **Design & Analysis of Special Purpose Jib Crane** can be done as discussed above. Based on results and discussion there will be a optimized solution that will fulfill the problem definition given by the company. Likewise one can design and change the basic construction of the jib cranes and explore the future scope

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