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Design and Optimization of Jib Crane Boom

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Abstract –Jib cranes are most popular and used mostly. Jib crane design procedures are designs for standardization and develop their own jib crane automation modules for entire jib crane design applications. Starting from the fact that components of jib cranes are generally composed of similar electrical and mechanical sub-components independent of the crane type, a general component tree of jib cranes are developed for automation purpose. From time and main effort for implementation of the jib crane design procedures are generally spent for explanation and interpretation of the available jib crane design standards, a computer-automated access by using parametric modeling to the available standards may improve reliability, quality and speed of the design procedures.

Independent Design Procedures are defined as atomic design modules of the jib crane design procedures by considering computational approaches and rules in the "F.E.M. Rules" for each jib crane component. Design Modules of cranes are defined from the developed component tree of the cranes based on the available design procedures. Access to the "F. E. M. Rules" from any design procedure is fully automated by using a systematic approach of parametric modeling. The "Finite Element Method rules" is selected for this purpose because of its wide spread use and established popularity among the jib crane manufacturers. The parametric model can be used for various further for optimization as well as.

Jib crane design cases

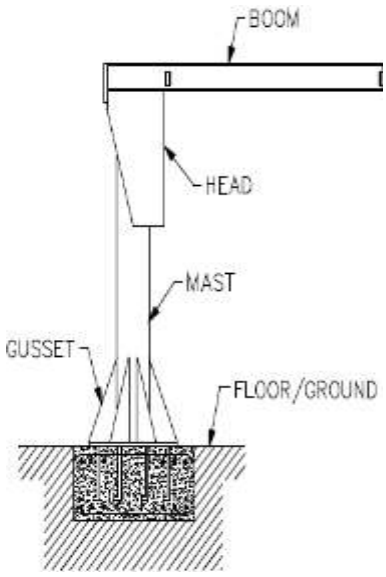
1. INTRODUCTION

Jib crane have three degrees of freedom. They are vertical, radial, and rotary and its effect is in a monorail that is cantilevered from its supporting members and pivoted at one end. The horizontal beam provides the track for the hoist trolley. However jib crane cannot reach into corners. They are usually used where activity is localized. From 0.5 ton to 200 ton Lifting capacity of such cranes may vary and they outreach from a few meters to 50 meters. Such cranes find various applications in port area or costal or beach area, also used 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 for lifting heavy machinery equipment near ship yard, usually weighing 100 to 300 tons are mounted on pontoons. Commonly, these cranes are provided with two main hoisting winches which can be employed singly or together to lift a load. As well as for handling light loads may hand auxiliary arrangement localized, such as in machine shops. Column mounted jib cranes uses are commonly in packaging industry. From the height of the operator the size of the operator visualized. These cranes are used for hoisting up to 1 ton loads.

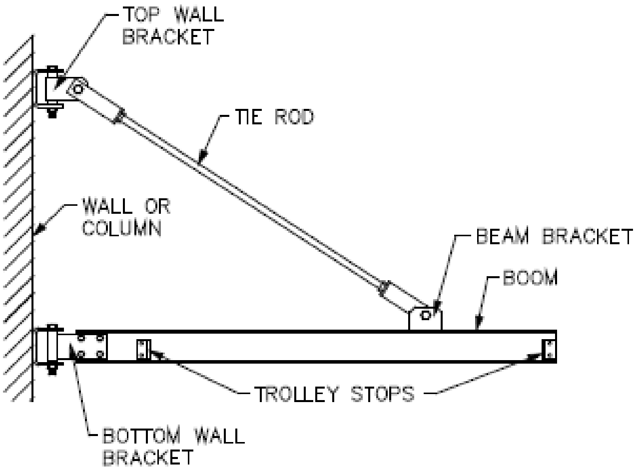
Fig:- Jib Crane

1.1 Types of JibCranes:

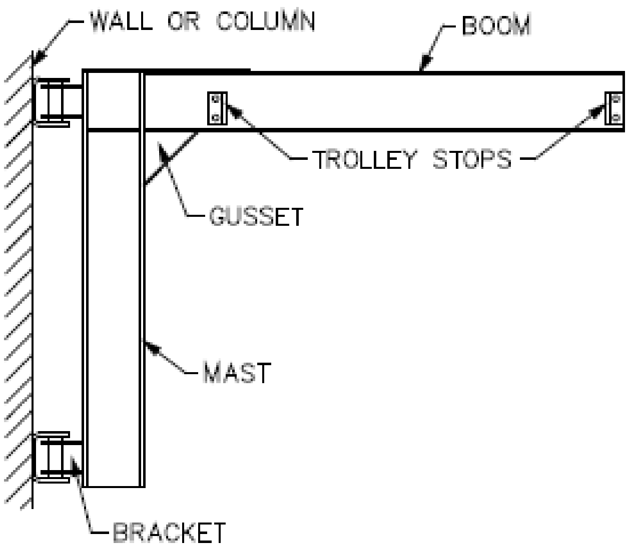
1. Free Standing Jib Cranes



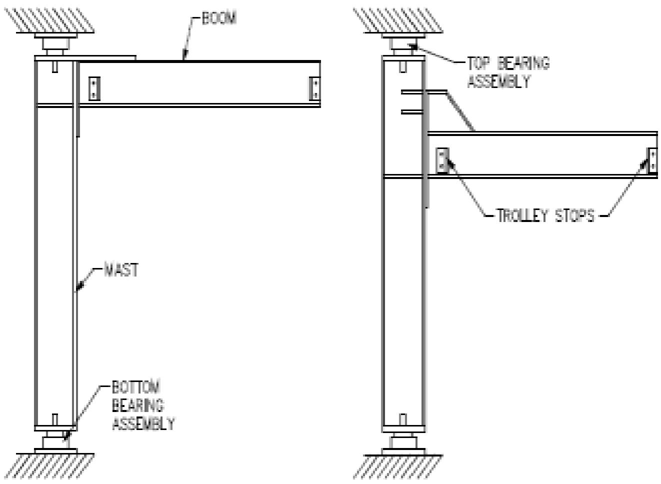
2. Wall bracket jib crane



3. Wall cantilever jib crane



4. Mast type jib crane



5. Wall Bracket & Wall Cantilever Motorized Jib Cranes:

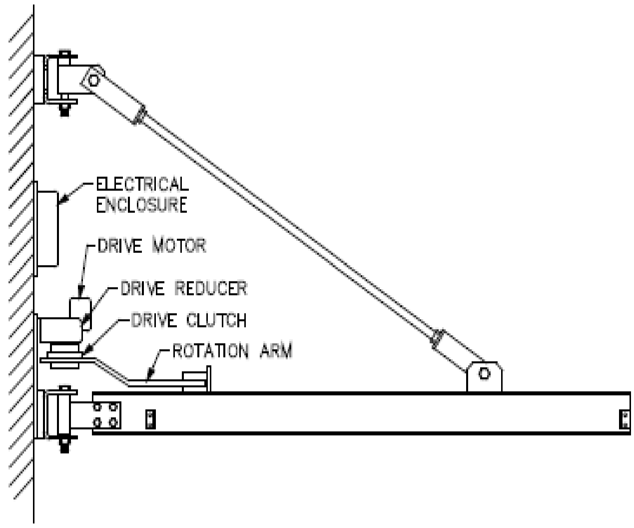


Fig:- Wall bracket motorized jib crane

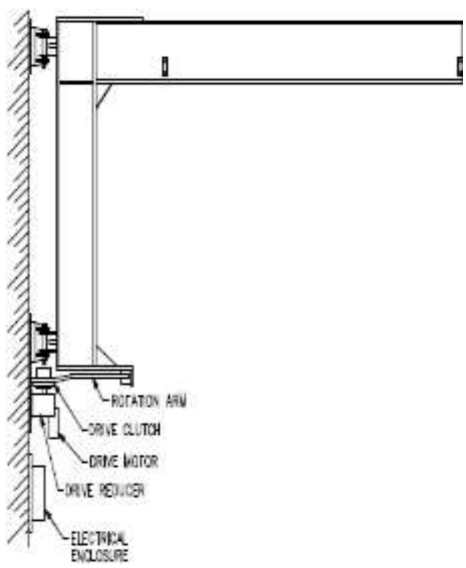


Fig:-wall cantilever motorized Jib crane

2. LITERATURE REVIEW

Mr. FaudHadzikadunic, Mr. Omer Jukic, (1) published a paper on "AN ANALYSIS OF JIB CRANE CONSTRUCTIVE SOLUTION IN EXPLOATATION",

In this paper a wider analyzing methodology for construction and static-dynamic behaviour of specific crane's type – given here is a jib crane. This methodology is applicable on other types of cranes, an application of calculation numerical methods and CAD technologies to these complex structures is of a big importance, which gives latest modern access in the actual design and constructive diagnostics. . In this paper an effective methodology of calculation and design of real model of jib crane construction, with final goal of local and global structure optimization using CAD technologies are presented. In this paper jib cranes are given, with application on KOMIPS system as well as detail analysis of a selected solution gives a comparative analysis of several concept solutions of,. An analysis of jib crane's design is given also by application of the I-DEAS 11 NX Series software. Results of the dynamic-static analysis of complex configuration behaviour can be of great importance for significantly improvement this methodology resulted with new structural conception of same domain of jib crane with better static and dynamic parameters. With modification of structure geometry several goals are achieved.

Gerdemeli I., K. Kurt S., Tasdemir B. "DESIGN AND ANALYSIS WITHFINITE ELEMENT METHOD OF JIBCRANE". (2)

In this study paper; JIB cranes, which generally used in ship maintenance and manufacturing processes, have been analyzed. Results of the analytical calculation and the results that were obtained by finite element method have been compared. In this way, it has been investigated the reliability of the finite element method for JIB crane design. As a result, it has been seen that, F.E.M is the most reliable and practical method which can be applicable during JIB crane design process.

At the end of the study paper, results of the analytical calculation is that the results that were obtained by finite element method have been compared. And according to these comparison results, it has been observed that, the error margins were obtained between the acceptable boundaries.

Chirag A. Vakani, Shivang S. Jani (3) "Analysis and Optimization of 270° Jib Crane Deflection",

Jib cranes are hugely used in industrial facilities all over the world. A typical jib crane consists of a top beam which is rotating around a fixed column. This configuration may be referred to as an L-shaped structure. Current material handling systems exhibit anisotropic behaviour. That is, their two planar degrees of freedom require different amounts of forces input from the operator. These devices Movement of correspondingly is not easy. One of the three most prevalent material handling devices, the jib crane, is selected for research into creating isotropic motion. Deflection occurs of T-section as a span of Jib crane which is mention in this paper, to optimization of deflection to increase modulus of elasticity. Analysis showed that a T-section will withstand large transverse deflection without in-plane ply failure; the predominant failure mechanism is delaminating in the fillet region. Most of time Jib Crane used for circular material handling, that menace radial work.

Through the literature review jib crane utilization where required radius type work. That is, there are different amounts of forces input from the operator require for two planar degrees of freedom. Movement of these devices is correspondingly not easy. Fibers are elasticity Furthermore some additional load cases not contemplated in the norm have been established and they have a great interest for a correct design of the mechanical set, principally because the simulate some maneuvers that, although they are discussed.

Subhash N. Khetre, S. P. Chaphalkar, Arun Meshram "MODELLING AND STRESS ANALYSIS OF COLUMN BRACKET FOR ROTARY JIB CRANE", (4) in this paper, the method of final designing of column Bracket and boom for Material handling jib crane system. The basic functions are determined for certain parameters of jib cranes as yield deflection of column Bracket, strength, and boom using stress analysis and displacement analysis. Its requirement for movement of heavy loads which are correspondingly not easy. They are free standing Jib crane, Tower jib crane with trusses. Among them the higher strength, best design and greater life span crane has to be designed for future work. During the column Bracket and Boom analysis, the Solid Works and COSMOS is used with the analysis is carried out in two load steps. Jib crane is design, analyze and develop from three most prevalent material handling devices the total analysis time is approximately twenty two hours taken by the software.

Ajinkya Karpe, Sainath Karpe, AjaykumarChawrai (5) "VALIDATION OF USE OF FEM (ANSYS) FOR STRUCTURAL ANALYSIS OF TOWER CRANE JIB AND STATIC AND DYNAMIC ANALYSIS OF TOWER CRANE JIB USING ANSYS",

In this paper, author has selected jib for analysis since we wanted to validate the use of ANSYS (FEM method) for structural design of Tower Crane Jib. Jib model was generated in ANSYS 14.5 workbench and further analyzed in the same. Two models of Tower Crane jib were compared initially for axial force and deformation developed in members of the jib and the better model was selected for further analysis. Throughout the analysis, the load has been applied at the end of the jib of the tower crane to generate maximum moment and stresses in the jib. Initially the results of ANSYS 14.5 were validated using analytical method for the jib (Method of sections for trusses). After that, the results for dynamic as well as static analysis are obtained. In acceleration, braking, and angular velocity are considered in dynamic analysis and in wind loading, static analysis, crane's self-weight, payload, hook weight, trolley weight are considered whereas. In wind loading was observed to be major criteria in the design of structure for the Tower Crane. As the allowable stress of Material (Structural Steel) of the components are greater than computed stress values in the jib. The allowable stress of Material (Structural Steel) of the components is observed that the jib crane is safe according to I.S norms. The analytical and FEA (ANSYS) results are very close. The results show that the boundary conditions have been chosen correctly. Use of FEM method for structural analysis of Tower Crane Jib is validated and hence a lot of time saving.

3. PROBLEM SPECIFICATION

A boom of jib crane experiences a maximum load when the load is acting at the maximum span of the crane. In this case the boom of jib crane which is made of I-section beam tends to bending. Eventually this may cause a severe failure of the jib crane. Hence we must focus on increasing the load carrying capacity of the boom under maximum possible loading condition.

3.1 Objectives of Project:

The main objective of the project is to propose an optimized structure of boom for a selected jib crane.

Another objective is to design and analysis optimized boom of jib crane to increase its load carrying capacity.

Thus we will be carrying a linear static analysis under these circumstances and boundary condition.

3.2 Scope:

It is proposed to do FEA analysis on Jib Crane Boom, as per the following.

Theoretical Analysis: Running the problem in any FEA software and comparing the results with the experimental analysis.

Iterative approach on various shapes of web of the I-beam through FEAtechnique.

Experimental Analysis: Testing the Jib Crane Boom under actual conditions and carrying out the calculation.

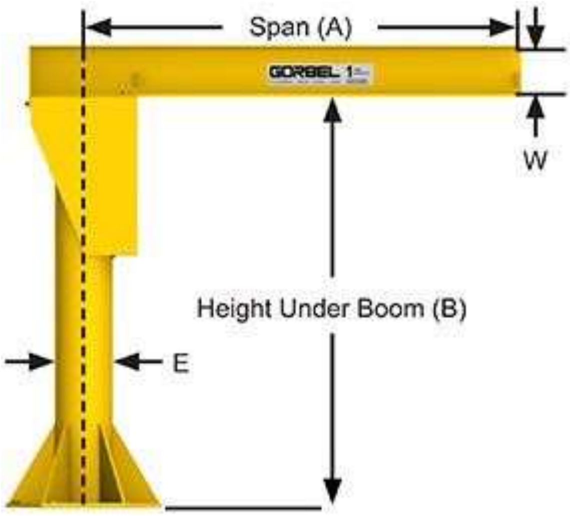
4. DESIGN AND ANALYSIS OF BOOM

The chapter Design and Analysis of boom of dissertation includes design and analysis of a boom of jib crane. Dimensions of the existing boom have been selected from catalog and references and CAD model of a boom (I-beam) have been prepared in CATIA V5. The finite element analysis is carried out by using Hypermesh and ANSYS as post-processor.

Computer-aided design (CAD):

Computer-aided design (CAD), also known as computer aided design and drafting (CADD), it is the use in design documentation and computer technology for the process of design. Computer Aided Drafting describes the process of drafting with a computer. CADD software, or environments, provides the user with input-tools for the purpose of streamlining design processes; manufacturing processes, drafting and documentation process.

CAD is mainly used for detailed engineering of 3D models and/or 2D drawings of physical components, but it is also used throughout the engineering process from conceptual design and layout of products, through strength and dynamic analysis of assemblies to definition of manufacturing



methods of components. It can also be used to design objects.

Dimensions

CAPACITY	HUB (B)	SPAN (A) 8'	10'	12'	14'	16'	18'	20'
1/4 Ton	8'	FS300-8-6	FS300-8-6	FS300-8-6	FS300-12-W8	FS300-12-W8	FS300-12-10	FS300-12-10
	10'	FS300-8-6	FS300-8-6	FS300-8-8	FS300-12-W8	FS300-12-W8	FS300-12-10	FS300-12-10
	12'	FS300-8-6	FS300-8-6	FS300-12-6	FS300-12-W8	FS300-12-W8	FS300-12-10	FS300-12-10
	14'	FS300-8-6	FS300-8-6	FS300-12-6	FS300-12-W8	FS300-12-W8	FS300-12-10	FS300-14-10
	16'	FS300-8-6	FS300-8-6	FS300-12-6	FS300-12-W8	FS300-12-W8	FS300-12-10	FS300-14-10
	18'	FS300-8-6	FS300-12-6	FS300-12-6	FS300-12-W8	FS300-14-W8	FS300-14-10	FS300-14-10
	20'	FS300-8-6	FS300-12-6	FS300-12-6	FS300-14-W8	FS300-14-W8	FS300-14-10	FS300-16-10
1/2 Ton	8'	[illegible]	FS300-8-6	FS300-12-W8	FS300-12-W8	FS300-12-10	FS300-12-10	FS300-12-12
	10'	FS300-8-6	FS300-8-6	FS300-12-W8	FS300-12-W8	FS300-12-10	FS300-12-10	FS300-14-12
	12'	FS300-8-6	FS300-12-6	FS300-12-W8	FS300-12-12	FS300-12-12	FS300-14-W10	FS300-14-W10
	14'	FS300-8-6	FS300-12-6	FS300-12-10	FS300-12-12	FS300-12-12	FS300-14-W10	FS300-14-W10
	16'	FS300-8-6	FS300-12-6	FS300-12-10	FS300-12-12	FS300-14-12	FS300-16-W10	FS300-16-W10
	18'	FS300-8-6	FS300-12-6	FS300-12-10	FS300-14-12	FS300-14-12	FS300-16-W10	FS300-16-W10
	20'	FS300-8-6	FS300-12-6	FS300-14-10	FS300-14-12	FS300-14-12	FS300-16-W10	FS300-16-W10

Fig. Frees standing Jib Crane Specifications.

Gorbel Jib Crane Manufacturer the specifiications of selected jib crane are as follows:

Model Number = FS300-8-6

Capacity = □Ton

Hieght under Boom (HUB) = 8’ = 2438.4 mm

Span of crane (A) = 8’ = 2438.4

Model Number Explanation: FS300-8-6

FS300 = Base plate mount style

8 = Mast diameter in inches (E)

6 = Beam size in inches (W) = 152.4 mm

Dimensions of beam cross section:

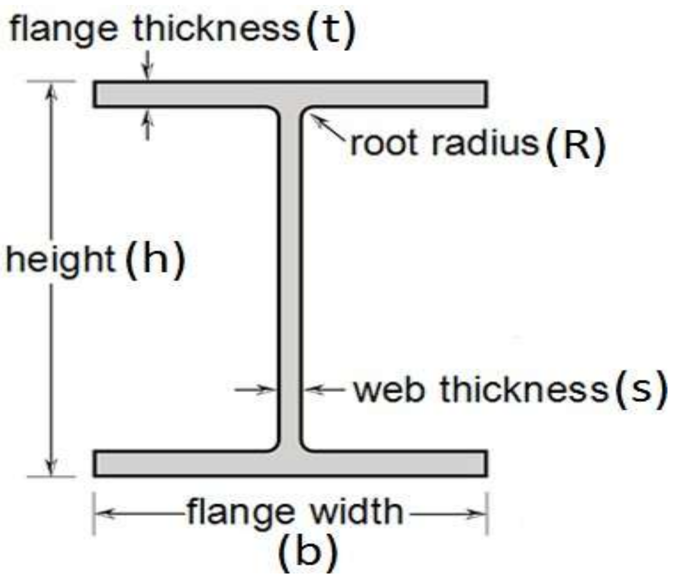


Fig. I-Beam section specifications

5. Analysis

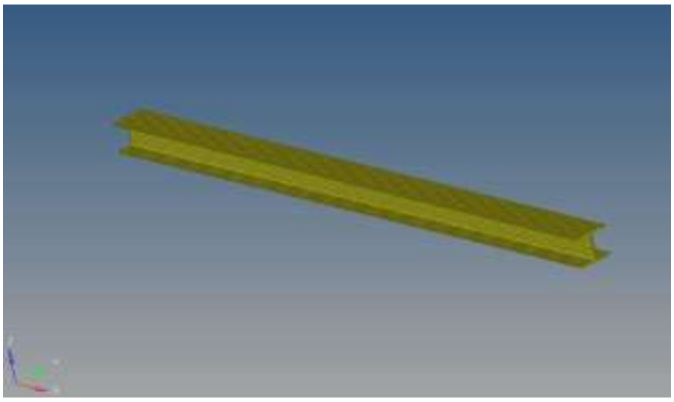


Fig:- Meshed I beam in hypermesh

Following are the results displayed for stress and deformation

Von mises stress for boom

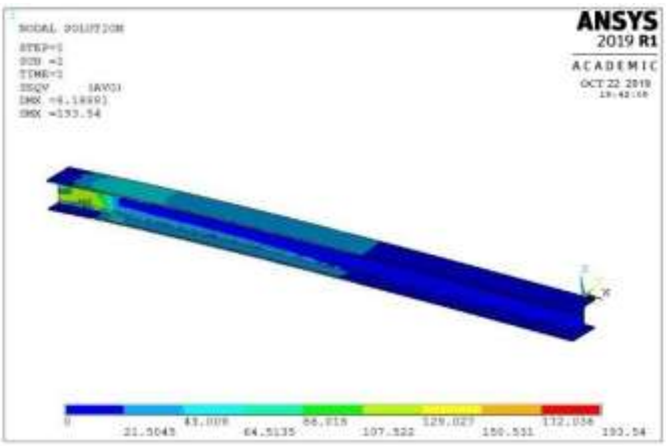


Fig:- von mises stress for boom

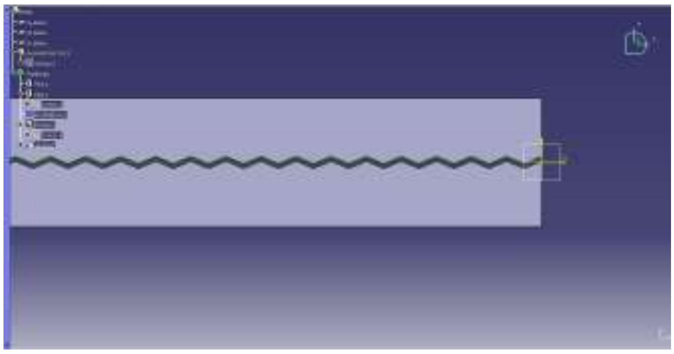
Stress value for boom is 193.54 N/mm^2 which is well below the critical value. Hence, design is safe.

6. RESULTS

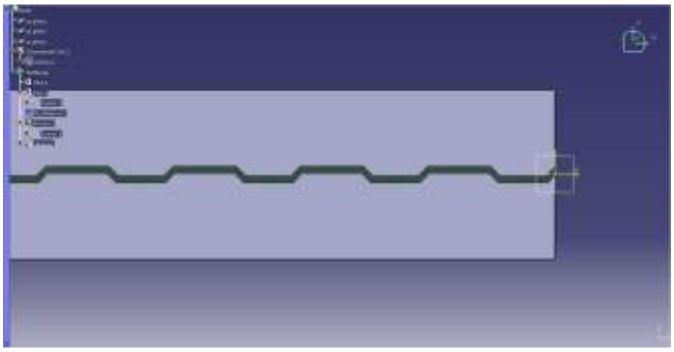
For the dissertation work this chapter is very important, because it gives the relevant information about existing boom of jib crane. The maximum stress value is coming out to be 193. 54 N/mm^2 which is within the safety limit. We have scope for optimizing its topology without effecting its structural behaviour rather increasing its load bearing capacity. The maximum displacement value is 8.188 mm which we must reduce.

Proposed Topological changes in Web section of the I-beam:

Proposal 1



Proposal 2



Likewise we will do an iterative approach for FEA on various web sections and the one having higher strength will be selected for fabrication and testing

7. CONCLUSION

New proposed topological changes reflects in the FEA design, The 6mm rectangular rib section provides good results than that of I section beam model. 8 mm rectangular section offers very lesser deflection to the applied loads and provides good strength

REFERENCES

1. Mr.FaudHadzikadunic, Mr. Omer Jukic, "An analysis of jib crane constructive solution in exploitation", 12th International Research/Expert Conference ''Trends in the Development of Machinery and Associated Technology'' TMT 2008, Istanbul, Turkey, 26–30 August,2008V.B. Bhandari, "Machine Design" McGrowth Hill 2012

2. Gerdemeli I., K. Kurt S., Tasdemir B. "Design and analysis withfinite element method of jib crane", Faculty of Mechanical Engineering Istanbul Technical University, Turkey.

3. Chirag A. Vakani, Shivang S. Jani " Analysis and Optimization of 270° Jib Crane Deflection", International Journal for Scientific Research & Development, Vol. 2, Issue 10, 2014, ISSN (online):2321-0613

4. Subhash N. Khetre, S. P. Chaphalkar, Arun Meshram "Modelling and stress analysis of column bracket for rotary jib crane", International Journal of Mechanical Engineering and Technology (IJMET), ISSN 0976 – 6340(Print), ISSN 0976 – 6359(Online), Volume 5, Issue 11, November (2014), pp. 130-139

5. Ajinkya Karpe, Sainath Karpe, AjaykumarChawrai "validation of use of fem (ansys) for structural analysis of tower crane jib and static and dynamic analysis of tower crane jib using ansys", International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163, Volume 1 Issue 4 (May2014).

6. Boris Visocnik, Stojan K.Ravanja, "slewing port jib cranes", Technology and Management of Traffic Review, Vol. 14, 2002, No.5,251-257.

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