Automobile Pickup Lift For Material Handling Purpose Of Light Motor Vehicle

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***Abstract*—** Packing and logistics is major field of interest in automobile industries, concerning carriers. In the major concerns, keeping up with time is very difficult and loading & unloading time is the pivot to reduce the logistic time. The pick-up lift, which we have designed, will be useful to resolve the problem of loading and unloading of cargo from the vehicle without help of anyone.There are lot of load handing vehicle is available in the market, The Pick-up Lift is the ultimate in material handling. It eliminates manual loading and positioning of heavy and cumbersome cargo, reducing the chance of injuries, and pick-up lift can get the job done quickly, safely, and efficiently. Lift, load, and place cargo exactly where you want it, while standing back safely out of the way. The main aim of the project is to develop a handy pick up lifting equipment to reduce manpower and time to delivery.

Keywords: Pick-up lift, Lloading and unload time, Material handling

1.INTRODUCTION

Material handling cannot be avoided in logistics, but can certainly be reduced to minimum levels. The productivity potential of logistics can be exploited by selecting the right type of handling equipment. The selection of material handling equipment cannot be done in isolation, without considering the storage system. Investment in the material handling system will be sheer waste if it is not compatible to the warehouse layout plan. The layout will create Obstacles for free movement of equipment and goods, resulting in poor equipment productivity. Recent trends indicate preference for automated system with higher logistics productivity to enhance the effectiveness of human energy in material movement. Everyone wants more control. The more control you have, the better you perform. Similarly good material handling systems give you control on productivity. Distribution, manufacturing, and warehousing are the areas where material handling plays a major role. To do these things well, you need control of processes, of equipment, of personnel, of space and also of time. Everyone wants more control. The more control you have, the better you perform. Similarly good material handling systems give you control on productivity. Distribution, manufacturing, and warehousing are the areas where material handling plays a major role. To do these things well, you need control of processes, of equipment, of personnel, of space and also of time.

In fact material handling systems power today's efficient distribution and manufacturing facilities. It is the secret weapon in logistics operations for improving system productivity. Enhancing customer service and speeding up throughputs. By gaining control of your warehouse, you gain control of your profitability. Effective material handling systems create savings that helps directly to improve your bottom line. If your business relies heavily on manufacturing, warehousing, storage or distribution, the potential savings are perhaps your greatest opportunity. If your suffer from damaged products, slow pick rates, a lack of space, disorganization, or bottlenecks, don't think throwing more people at it will solve the problem—that's short term help at best, and you'll be stuck with on-going costs which you cannot eliminate.

1.1.LITERATURE SURVEY

Robot manipulator is an essential motion subsystem component of robotic system for positioning, orientating object so that robot can perform useful task. The main objectives of this project are to design and implement a 4-DOF pick and place robotic arm [1-2]. There are numerous dimensions over which robotic arms can be evaluated, such as torque, payload, speed, range, repeatability and cost, to name a few. Robot manipulators are designed to execute required movements. The handling of materials and mechanisms to pick and place of objects from lower plane to higher plane and are widely found in factories and industrial manufacturing. There are number of pneumatic arms are available which consists of so many mechanisms hence becomes expensive. The designed pneumatic arm consists of two cylinders, a shaft works with lead screw mechanism capable of converting motion of piston to rotational motion of arm with help of using compressed air. The designed processes are carried out based on integrated information of kinematics dynamics and structural analysis of the desired robot configuration as whole. The highly dynamic pneumatic arm model can be easily set at intermediate positions by regulating the pressure using the flow control valve. It can be used in loading and unloading of goods in a shipping harbor as the movement of goods is done from lower plane to higher plane [4-6]. Automation has become the core of modern manufacturing so much so that, no company is able to survive in a competitive market without automating its operations. In fact the term automation basically refers to the use of computer and other automated machinery for the execution of tasks that human labour would otherwise perform. Automation is used to manage systems and to control processes, thus leading to reduce the necessity of human intervention [3].

The theoretical analysis of the flexator actuator using the non-steady flow energy equation gave a simple equation relating angular displacement to the pressure and volume of the flexator, its load torque and efficiency. The limiting conditions of this equation have been stated. Since the efficiency of the flexator was found to be variable (0 to 67%) and was related to the flexator size and load torque, the usefulness and accuracy of this equation as applied generally was questioned [7-8].

Recent advances have seen the influx of highly advanced control systems for construction equipment which are improving quality and safety while reducing labor costs. Control schemes that have been developed range from resolved motion and teach/learn capability to tele-operated and even automated systems [9-10]. The development and examination of semi-autonomous operation with shared control between the human operator and computer control system of a large-scale kinematically redundant manipulator for gripping and lifting heavy objects in unstructured dynamical environments [11-12].

2.DESIGN AND PROPOSED METHODOLOGY

2.1.PROPOSED METHODOLOGY .

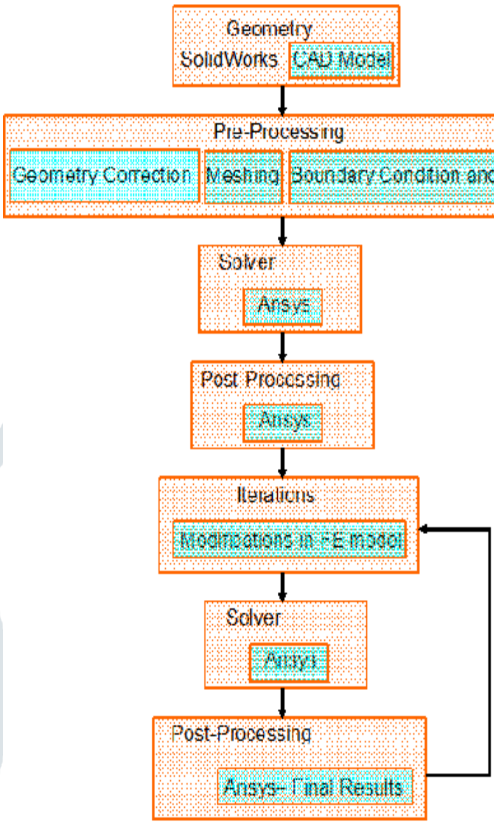

Figure-1. Proposed Metodology

2.2.PRINCIPLE AND DESIGN

Proposed Methodology refer in Fig. 1. A 4-bar linkage has four links and four joints. One of the links is grounded and two of the joints are fixed joints which means what you actually see moving are three links. A generic 4-bar is shown below in Fig.2. Link “a” is the driver crank and is attached to the motor. Link “b” is the coupler and link “c” is the output crank. The tip of link “c” traces the desired output. The fourth link “d” is the ground link which does not move and is represented by the distance “d” between the two ground joints. By changing the lengths of a, b, c and the distance between the ground joints, an infinite set of motions for the driven tip can be achieved. Area of selection with the dimensions refers in Fig.3.

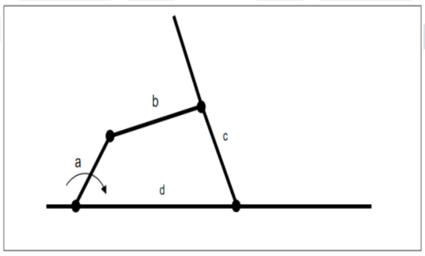

Figure-2. Four bar mechanism

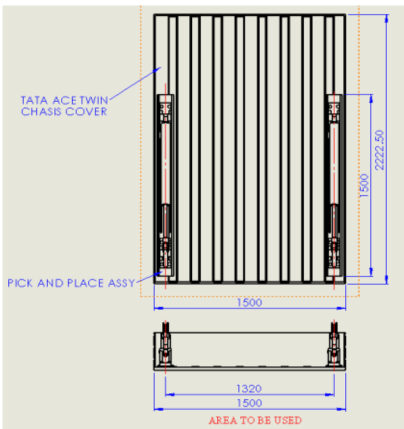

Figure-3. Selection of area

2.2.DESIGN OF FRAME

The frame for this project is the movable type that closely resembles the human arm. Shoulder that mounted on base can move the arm through 180 degrees, from horizontal to vertical on each side. The frame use main arm used in different material and size. All are ISO standards square tubes and I beam different type of machining. The standard covers the nominal dimensions, mass and sectional properties of hot rolled sloping flange beam and column sections, sloping and parallel flange channel sections and equal and unequal leg angle sections.The requirements for hot and cold formed square and rectangular hollow steel sections for structural use.For the purpose of the standard, the weights are calculated on the basis that steel weighs 0.785 kg/cm* per metre run. For calculating cross- 1 IS 4923: 1997 sectional area and weight per unit length, corner radii have taken into consideration refers to Annexure A.

2.3.DESIGN OF ACTUATOR

An actuator is a component of a machine that is responsible for moving or controlling a mechanism or system. An actuator requires a control signal and a source of energy. The control signal is relatively low energy and may be electric voltage or current, pneumatic or hydraulic pressure, or even human power.The actuator have bore diameterof 60mm, stroke length as 550mm and the pressure as 140 bar. Fig.4 refers the actuator.

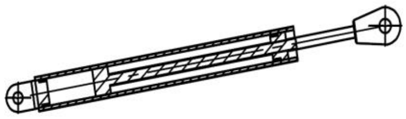

Figure-4. Actuator

2.4.DESIGN OF CRANK SUPPORT FRAME

The Automobile pick-up lift is mainly consist of Base plate, Main Hinge, C-Section, Rod holder, 90°Crank, Actuator, and Frame as shown in the Fig.5, Base plate, Actuators and Frame is acting like a links in the mechanism. The Link A is specified as distance between two pivot points of main hinges i.e. 1120mm. Link B is specified as from the actuator end to Crank pivot point is 850mm and angle between Link A and Link B is 10°. Link C is specified as from rod holder end and the Crank pivot point is 350mm, and the angle between Link A and C is 28°.

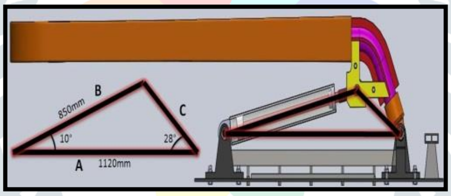

Figure-5. Crank support frame

2.5.DESIGN OF HINGE OF CRANK SUPPORT FRAME

A 4-bar linkage has four links and four joints. One of the links is grounded and two of the joints are fixed joints which means what you actually see moving are three links and it shown in Fig.6.

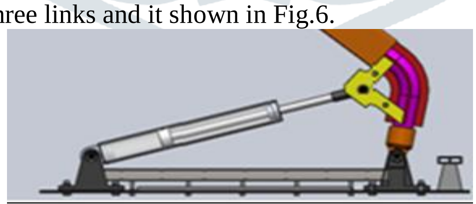

Figure-6. Hinge of Crank support frame

2.6.DESIGN OF HINGE OF CRANK SUPPORT FRAME

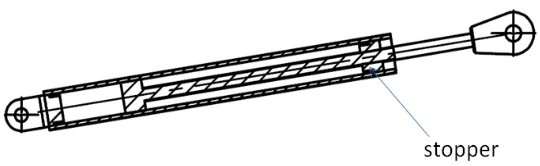

Figure-7. Stopper in actuator

The stopper used maximum stroke length reached the piston stop the stopper. And control the piston end stroke and shown in Fig.7.

3.MODELLING AND ANALYSIS

3.1. 3D MODELLING

The process methodology for pick-up lift is start form geometric modelling, which has been done using solid modelling software called Solid works. Solid works is a Para solid-based solid modeller, and utilizes a parametric feature-based approach to create models and assemblies. Parameters refer to constraints whose values determine the shape or geometry of the model or assembly. Parameters can be either numeric parameters, such as line lengths or circle diameters, or geometric parameters, such as tangent, parallel, concentric, horizontal or vertical, etc. Numeric parameters can be associated with each other through the use of a relation, which allows them to capture design intent. Features refer to the building blocks of the part. They are the shapes and operations that construct the part.Fig.7 refers the 3D Z model and Fig.8 shows the model attached in the vehicle.

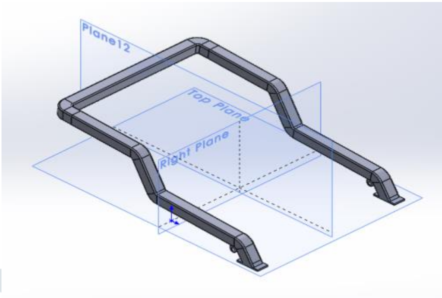

Figure-7. 3D Z model

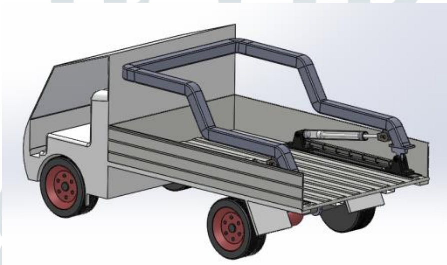

Figure-8. Model in Vehicle

3.2. MESH GENERATION

The geometry is discretized to form a mesh of elements and nodes. This means that the structure is broken down into small sub regions on which the numerical analogue of the governing equations can be developed. Structured (parametric) finite element should be used for the components involving high cycle fatigue.

Figure-9. Meshed model of frame

Fig. 9 shows the meshed model of the frame.Control of mesh transition in areas of stress gradient is possible with better convergence in results using structured elements such as brick with 8(or) 20 nodes. Convergence of finite elements model using brick elements is monatomic. Brick element by manual meshing quality of structured meshed parts with geometric transition control is possible.

3.2. STRUCTURAL ANALYSIS

The stress analysis has been done by using Ansys as the solver and the pre-processing has been done in HyperMesh.A Finite Element Analysis is required to be done on the frame subjected to a load of 1.5 ton to identify the weak spots.The meshed model of Frame consists of 27,338 elements and 27,288 nodes. As per length versus thickness ratio is very small, we modeled with shell element for higher accuracy and to reduce the computational time. Frame has been modeled using structural shell element i.e. shell 63.

3.3 I SECTION FRAME

3.3.1 I FRAME TYPE 1

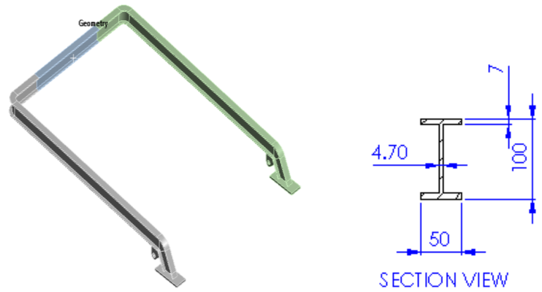

Figure-8. I frame type I geometry

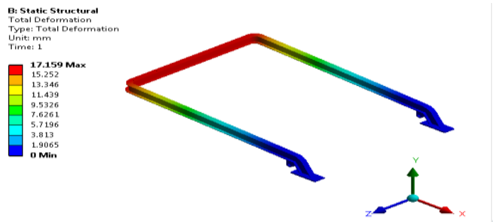

Figure-9. I frame type I deformation results

3.3.1 I FRAME TYPE 2

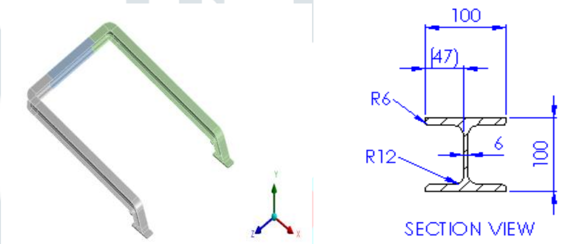

Figure-10. I frame type II geometry

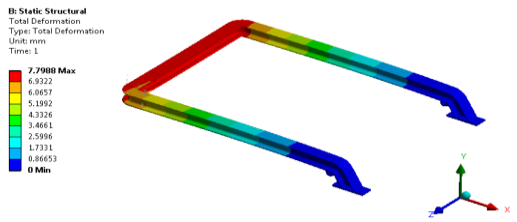

Figure-10. I frame type II deformation results

3.4 SQUARE SECTION FRAME

3.4.1 SQUARE FRAME TYPE 1

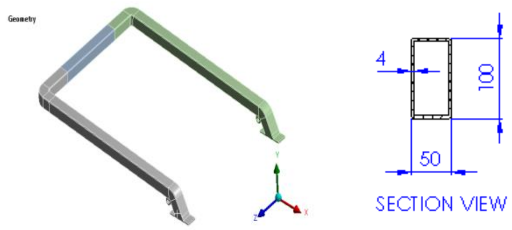

Figure-11. Square frame type I geometry

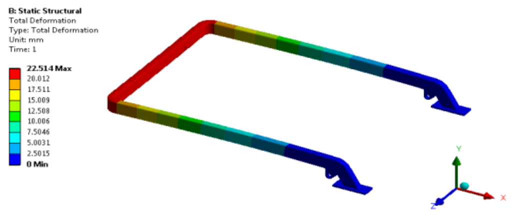

Figure-12. Square frame type I deformation results

3.4.2 SQUARE FRAME TYPE 2

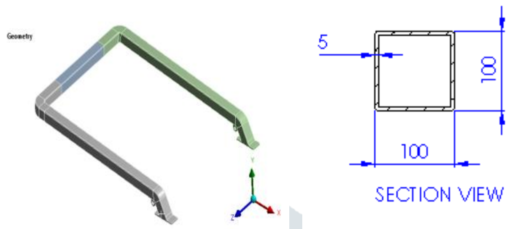

Figure-13. Square frame type II geometry

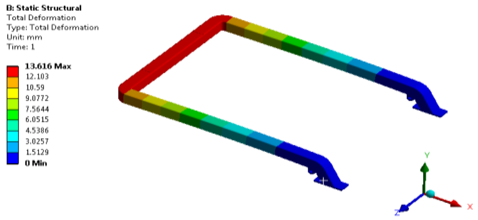

Figure-14. Square frame type II deformation results

3.4.3 SQUARE FRAME TYPE 3

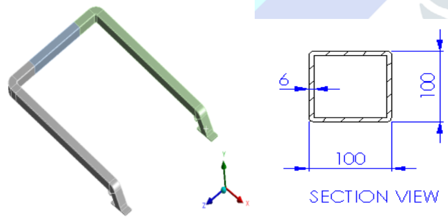

Figure-15. Square frame type III geometry

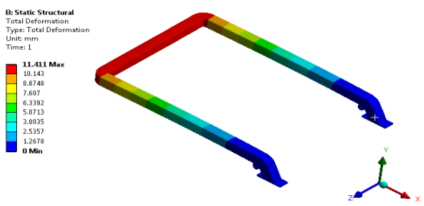

Figure-16. Square frame type II deformation results

3.4.4 SQUARE FRAME WITH 2 RIBS

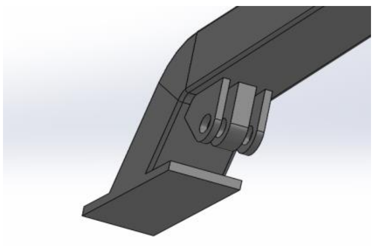

Figure-17. Square frame type with 2 ribs

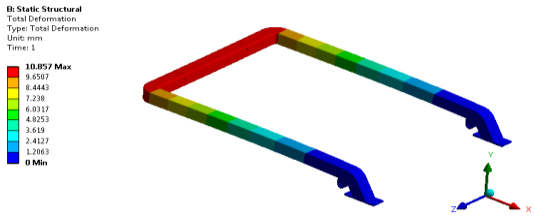

Figure-17. Square frame with 2 ribs deformation results

3.4.5 Z TYPE FRAME

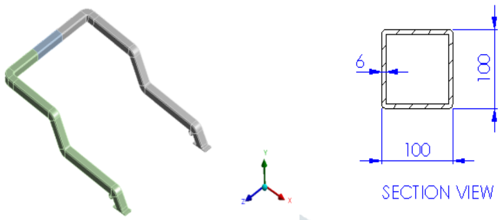

Figure-18. Z frame geometry

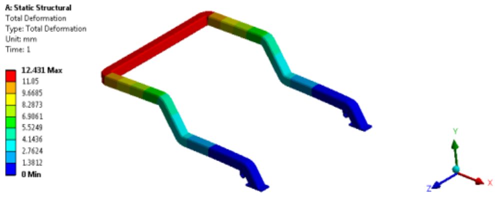

Figure-19. Z frame deformation results

4.CONCLUSIONS

The transportation of finished goods from the manufacturing unit to the storage place or to the delivery area is the final and important part in the production field.

In transportation phase, the handling of finished goods in a safe and proper manner is the major problem faced in industries if the materials are handled by humans, there is lot of chances for damaging the material as well as hurting themselves. So an automatic material handling machine may be boon to handle materials in a proper and safe way. For this purpose a frame with different cross section is designed using SOLIDWORKS and it is fitted with the vehicle to handle the material safely.

Three different types of frames namely I Frame,SQUARE Frame and Z Frame are designed as per standards and tested for various load condition at the rangeupto 500 kg and analyzed using ansys software to know the total deformations in the frame. Based on the efficiency of the above mentioned frame, Z frame has more efficiency in handling the materials in a effective way. The total deformation and equivalent stress in the frame is noted and tabulated below in Table 1

Table. 1. Total deformation and stress for frames

Item No	Cases	Deformation (mm)	Equivalent stress (MPa)
1	I BEAM (100 x 50 x 7)	17.159	298.88
2	I BEAM (100 x 100 x 6)	7.79	137.52
3	SQ, TUBE (100 x 50 x 4)	22.51	403.55
4	SQ, TUBE (100 x 100 x 5)	13.61	356.96
5	SQ, TUBE (100 x 100 x 6)	11.41	332.33
6	SQ, TUBE (100 x 100 x 6) WITH ADDED RIBS	10.85	179.15
7	SQ, TUBE (100 x 100 x 6) Z- TYPE	12.43	150.7

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