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ANALYSIS AND OPTIMIZATON OF CLAMSHELL CARRIER FOR ASSEMBLY LINE CONVEYOR

N.Ramakrishnan[1], R.Ramanathan[2], G.Karthikeyan[3]

Assistant professor, Mechanical Engg, M.A.M School of Engineering, Trichy, India [1]
Associate professor, Mechanical Engg, M.A.M School of Engineering, Trichy, India [2]
Assistant professor, Mechanical Engg, M.A.M School of Engineering, Trichy, India [3]

***Abstract*—** Conveyors and automation equipment are part of material handling system in any automotive industry. Carriers are used for handling car/LCV body right from the start of manufacturing process sequence up to roll out. Clamshell carriers are one of the commonly used carriers in handling bodies and it has a provision to open and close its arms for loading/unloading of vehicle bodies. The number of carriers used in a system depends upon the throughput rate and the storage capacity requirements. In this context, it is essential to optimize the carrier design in order to be cost effective and to prevent unnecessary load on support structures. In this project, a clamshell carrier being used in an assembly line of a mini commercial vehicle is taken up for analysis and optimization. In this project, the maximum weight handled is evenly distributed over the four resting points. The clamshell actuation is done by cam arrangements at loading and unloading points. The carrier is hung from a 5-trolley load bar arrangement of a power & free conveyor system. A 3-D model of the carrier is developed using Pro-E and analysis is carried out using Ansys. Several alternate design arrangements are tried for arriving at the optimal design. It is proposed that with the modified design, the overall weight of the carrier is reduced by x% and a cost saving of Rs.xxxx.xx/carrier.

Key words: conveyors, vehicle, clamshell. Etc.

1. INTRODUCTION

1.1 OVERVIEW OF THE PROJECT

Conveyors and automation equipment are part of material handling system in any automotive industry. Carriers are used in conjunction with conveying system for handling vehicle bodies right from the start to end of manufacturing process. Clamshell carriers are one of the commonly used carriers in handling bodies and it has a provision to open and close its arms for loading/unloading of vehicle bodies. Loading and unloading are done using automation equipment and therefore no impacts need to be considered. The main aim of the project is to determine the Von Misses stresses and Total Deformation. Stress analysis and Optimization in the existing clamshell carrier. If the existing design increasing production cost, then suggest the minimum design changes in the existing clamshell carrier. In this project, only the static FEA of the clamshell carrier has been performed by the use of the software. This work can be extended to study the effect of loads on the clamshell carrier with alternate design modifications. Using standard sizes of structural members, design modifications are tried and finally comparing with them. Then the combination of finite element technique with the aspects of weight reduction is to be made to obtain the required design of clamshell carrier.

FIGURE 1

1.2 OBJECTIVE

Comparison of existing clamshell carrier with Modified clamshell carrier. Stress Analysis, Deformation Study the effect of loads on the clamshell carrier with alternate design modifications. Suggest the minimum design changes in the existing clamshell carrier Combination of finite element technique with the aspects of weight reduction is to be made to obtain the required design of clamshell carrier

2.1 PROBLEM DEFINITION:

Clamshell carriers are used in large numbers in the automotive industry. In order to minimize the overall cost of project, it is necessary that all possible avenues are explored. In this project, the clamshell carrier has been taken up for weight optimization for reducing cost of manufacture.

2.2 GENERAL

Conveyors are running in various process shops in Automobile Industries. The Clamshell carrier has two arms, the right and the left arm. The arms are welded construction from hollow sections to minimize weight. Each arm has a pair of front and rear resting arrangement. Resting points are the locations where the vehicle body rests on the carrier. They are constructed in such a way that the body does not move during carrier motion. Provisions are available in vehicle body for convenient resting and prevent movement during travel. The arm arrangement has a hollow shaft with solid stubs at the ends to enable mounting on bearings. Actuations of the arms are done at desired locations with an external actuating arrangement, generally pneumatic.

The entire weight of the vehicle body is distributed evenly on the front and rear resting points. Load distribution may vary slightly at the front and rear where the carrier negotiates a vertical curve on the conveyor. The weight of the vehicle body and self weight of carrier arms are transferred to top structure at bearing points. The entire carrier and body loads are transferred to the Power and Free trolley through kingpin arrangement. The figure shows clamshell carriers moves on a power and free conveyor. The tata ace body is manufacture in various workstation, after a particular work is completed they have to move
another station for further work. The arms of the conveyors free to move and pick up the body of the vehicle.

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FIGURE 2

3.1PROBLEM SOLVING METHODOLOGY

The Clamshell Carrier is designed and analyzed using Pro E and Ansys software. The Carrier is modeled as a three dimensional and modeling to be done using by commercially available software Pro E. The model is export to the Ansys and the analysis is to be done. The next stage is to selecting various parameters and the each node in structure is analyzed using Ansys. From the modified carrier results show that the carrier is structurally safe.

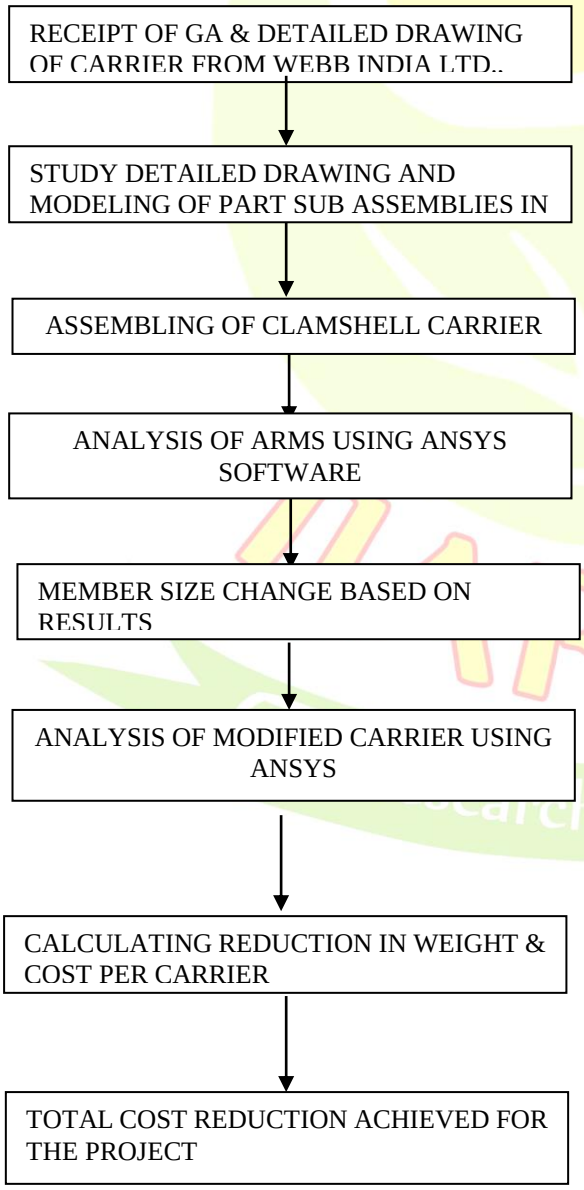

FIGURE 3

CLAMSHELL CARRIER

GENERAL

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another station for further work. The arms of the conveyors free to move and pick up the body of the vehicle.

4.1BASIS FOR STUCTURAL ANALYSIS

Loads are evenly distributed on all four resting points. No impact loads are encountered. 10% excess load is considered for dynamic conditions. The four bearing points on the top structure is considered as load transfer locations. Operation of carrier under normal ambient conditions.

4.2MODELING OF CLAMSHELL CARRIER

GENERAL

Clamshell carrier has two arms that is right hand and left hand arms. Both the arms are fitted on the top frame of the carrier. The arms are free to move with the help of bearing. Assemble of the top frame right hand and left hand are hanged on the Power and Free conveyor. Clamshell carriers are moved one by one in a line for carrying the vehicle body to various stations for end of manufacturing process. Carrier right hand arm has been taken for analysis and optimizing weight. First, existing model of right hand arm has taken and each part of arm modeled with the help of PRO/E Wildfire 5.0 software.

4.3CARRIER- INPUT & OUTPUT DETAILS

The Exisiting design increasing the manufacturing cost, then suggest the minimum design changes in the existing clamshell carrier. After that the work is carried out for safe design. Modelling made by using Pro E software and it is imported in ansys software. Various parts of carrier has to be made minimum design changes and analysed. Finally Item I, part name of seamless pipe has taken and analysed.

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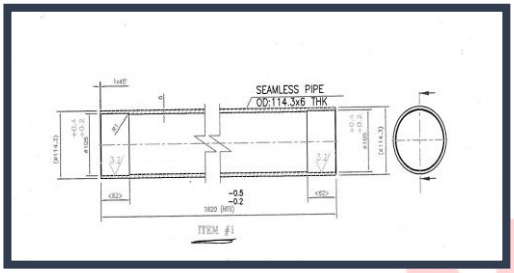

FIGURE 4

The pipe made as slight modification in diameter. It has a original diameter of114.3mm and 6mm thickness. After changes in minimum modification that is diameter 88.9mm and 5.5mm thickness

Clamshell Carrier arm assembly – RH has taken as Analysis and weight reduction.
Total weight of existing clamshell carrier is 177.08kg.
After the minimum design changes in the existing clamshell carrier, total weight be reduced 168.85kg.
In the analysis carried out, values for stress analysis and deformation within the limit
Von mises for existing Clamshell carrier – 90.352Mpa
Deformation for existing Clamshell carrier – 1.967mm
Von mises for Modified Clamshell carrier – 87.506Mpa
Deformation for existing Clamshell carrier – 1.8517mm
Combination of finite element technique with the aspects of weight reduction is to be made the required design of Clamshell carrier. The results also used to carry out for safe design.

5.1CARRIER- ANALYSIS RESULTS

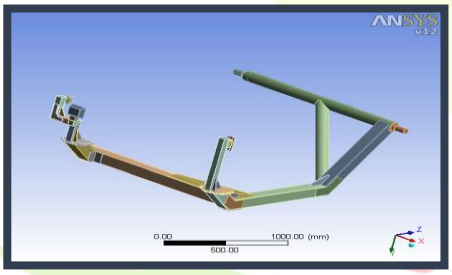

FIGURE 6

Existing Model of Clamshell Carrier Imported in Ansys software
Then the 3-D existing model analysed by the help of Ansys 12.0 software. Stress and deformation of existing model of carrier arm has been taken. Various design modification has been made with standard sizes of available material. Comparing existing result with modified design. Finally, seamless pipe design result is better than existing model.

5.2Modified Model

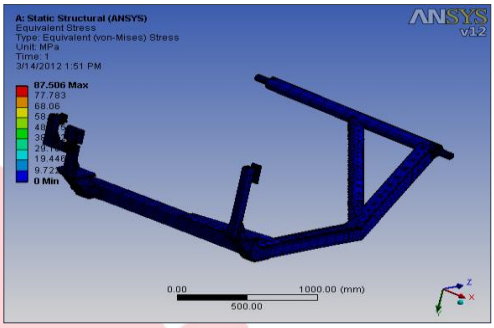

FIGURE 7

6.1 CONCLUSION:

The analysis result of the existing clamshell carrier reveals scope of weight reduction. Some of the member sizes were modified based on the Ansys results where it shows stresses much lower than allowable limit. The modified carrier was analysed using Ansys software and results shows that the carrier is structurally safe. Consequent to the member size changes, a weight reduction of 16% has been achieved and the cost reduction per carrier is Rs.1600/unit. Objective of the optimization task is to minimize the weight of the clamshell carrier under the effect of a load range comprising the extreme loads. The stresses and deformation are within the allowable limits. The production cost of the clamshell carrier was also to be minimized.

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