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Design and Strength Analysis of Automobile Door Processing Skid

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Abstract - *The paper represents work carried out in automobile door processing skid. Accordingly, we have done the project work in automobiles because there is a lot of demand for automobile in the world. The automobiles are more required for day to day transaction and carrying the goods. The people are very hurry to look after their business. Therefore, work load on manufacturers to manufacture automobiles in time. The automobiles require doors. The doors before going to paint application, electro-deposition process is to be carried out. For the skid, it required to dip the doors in the solution and after drying the doors are come out and sealant need to be applied on doors. For this application the skid is designed.*

***Key Words*: Skid, C Channel, Hinges, Electro-Deposition process, Sealant.**

1. INTRODUCTION

Automotive coatings and the process used to coat automobile surfaces exemplify the pioneers of technology that are capable of producing durable automobile surfaces exceeding customer hopes for appearance, maximizing efficiency and meeting environmental rules.[1]. The critical performance factors driving the developed use of advanced automotive coatings are aesthetic characteristics, corrosion protection, mass production, cost and environmental requirements appearance and durability. Novel developments in paint dyes have been skilled with improved processing and paint chemistries. Today in automobiles, series of stages in painting are more standardized. Automotive coatings continue to evolve as the appearance and looks forward to meet customer expectations and environmental regulations for lowering fabricating and ownership costs.

1.1 Design of Skid

The material used is mild steel. The C channel made up of mild steel of dimensions 75X40X4.8 mm is used. The hinges are provided in the skid to hold the 8 doors. For each door 2 hinges are provided. The designing is done based on the requirement for processing 8 doors for electro-deposition process. The lifting lug of 16 mm thickness is used. The modeling is done in CATIA software. The information in the modeling must be such that manufactures should able to understand the model. The model should able to describe parts, assemblies, raw materials should be used and the manufacturing requirements. Another importance of the model is it helps to visualize part in actual service condition.

From parallel axis theorem, the moment of inertia of C channel is 585.70X 10^3 mm^4.

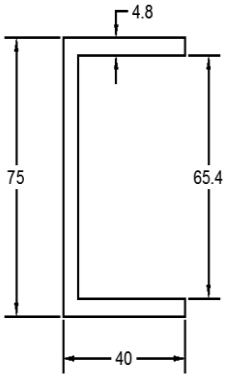

Figure 1 Diagram of C Channel

In the CATIA software, the design changes can also be made. The length of one C channel used is 2280 mm. The column height is 1906 mm.

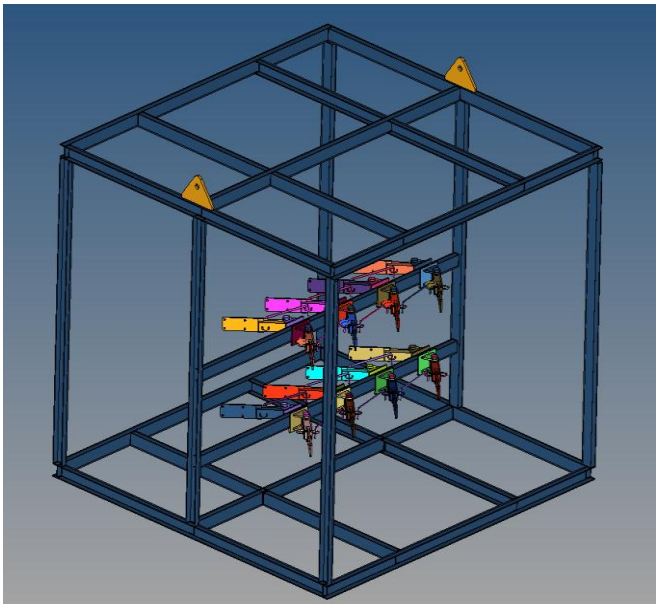

Figure 2 Isometric View of Skid

1.2 Design of Column for Buckling

The column used is long and slender in nature. It is a compression member, the mode of failure is depends upon material of the column, c/s area, and the end conditions of the column. In this case it is loaded axially.

Length of column, L = 948 + 497 + 461 = 1906 mm

For column 1, reactions R = 661.45 N

For another C section, R= 661.45 N

Total reaction, R = 1322.9 N

The stress is calculated at load 1322.9 N and the cross sectional area is 697.2 mm^2. The stress obtained is,

σ = 1.895 N/ mm^2

σ_{allow} = 250 MPa

The allowable stress is greater than induced stress. Therefore design is safe.

1.2 Meshing of the Geometry

For FEM analysis of the model, first the model needs to be meshed. Meshing is the process of dividing the physical domain into sub-domains to facilitate the approximate solution. One dimensional domain can be sub divided into smaller line segments. Two dimensional elements (planes or surfaces) are divided into quadrilateral or triangular shapes, three dimensional elements can be sub divided into tetrahedron and hexahedron shapes. The more the finer meshing, the more accurate is the result.

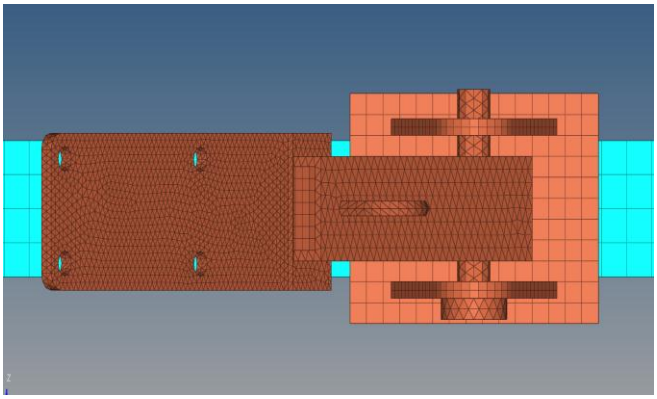

Figure 3 meshed parts namely hinge plate, stud, cover plate and C channel

Quad mesh is used for C channel. Tetra mesh for hinge plate and hex mesh for plate is meshed using HYPERMESH software.

Like welding, RB connections (yellow color) connect two parts. All DOFs are fixed in this case. These RBC will not deform and helps in load transfer. The main aim is to transfer load between grid points. RBC transfers the load in such a way that, after the load application the grids have zero relative deformation.

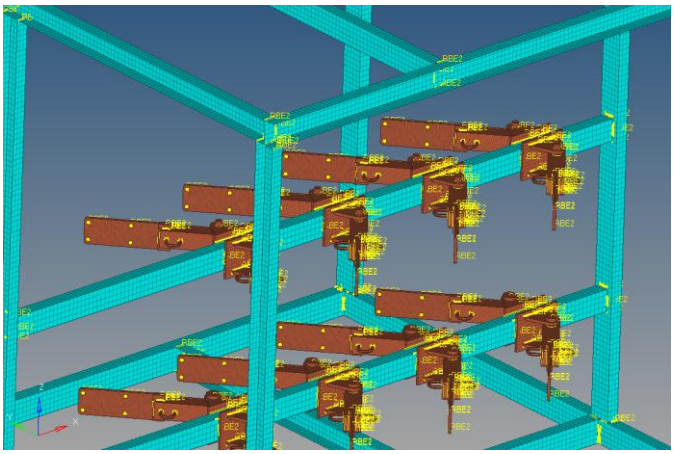

Figure 4 rigid body connections

2. Loading Condition for Skid

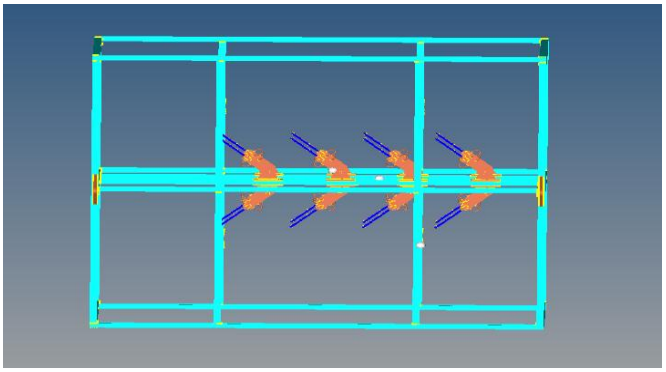

Figure 5 skid under loading condition

Each automobile door weighs 30 kg. There are such 8 doors are there whose total mass is 240 kg. For each hinge half of weight of one door is applied that is 15 kg as shown in the figure by blue lines. This is the meshed geometry in HYPERMESH software and loads are applied.

2.1 Boundary Condition Applied to Skid

The boundary conditions are those which fixes the structure at its position rigidly that no movement is occurred in the fixed condition. There are two boundary condition for the skid under which static strength analysis is carried out in HYPERMESH software.

The skid needs to move from workplace in the industry to the conveyor line. In this condition, the skid needs to be lifted by crane at the eyes of the two lifting lug of the skid. For this in software, the two lifting lugs are constrained. This acts as skid in lifted condition is the analysis software.

During electro- deposition process, the skid needs to be fixed at 4 locations on the fixture. This fixture holds the skid during the operation. The skid dips in the solution at an angle 30 degree. The strength analysis is carried out in skid at 30 degree. Therefore 4 locations at the base frame of the skid are constrained. This acts like the skid in tilted condition.

The boundary conditions are applied after the meshing is done to the skid. Under both these conditions, the skid is holding 8 doors with total 240 kg are applied on skid.

In real manufacturing, the C channel joints are fixed by welding. The hinge plate is also fixed by welding. But in analysis, the rigid body connections are used which acts like weld joint.

The skid is dip into the solution tank with doors attached to it. The whole structure is going through the solution. The doors are fixed in the skid such that it reduces the thrust force acting on the doors. The arrangement of doors in skid is like an arrow resembling shape.

2.2 Strength Analysis Results of the Skid in Lifted Condition

After carrying out the static strength analysis, the maximum Von-Mises stress comes out is 70 MPa and deflection is 4.654 mm.

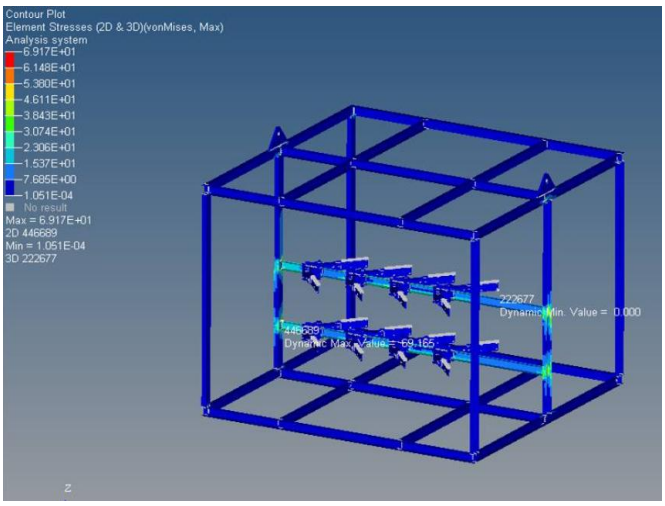

Figure 6 Von- Mises Stress of Skid, Max at Joint of Value 69.17 MPa

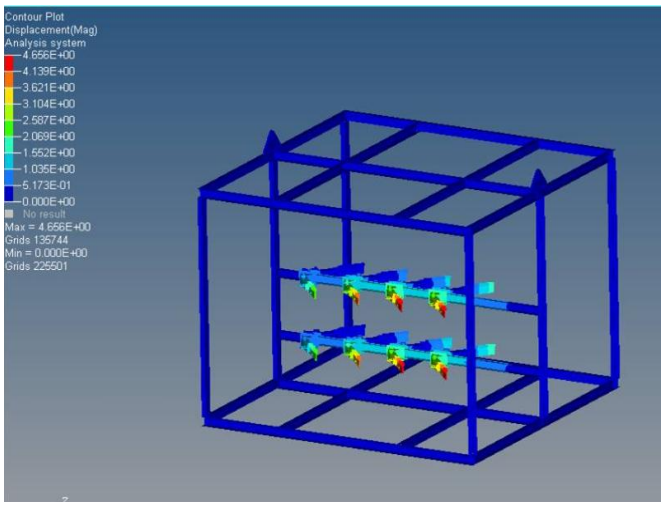

Figure 7 Deflection at Hinges observed, Max. Of value 4.65 mm

The maximum deflection is showing red color in HYPERVIEW results as shown in the figure which is at the ends of the hinges because the load is acting there only due to doors resting on the hinges. The maximum stress is at the ends of the C channel.

2.3 Strength Analysis Results of Skid at 30 Degree Tilted Condition

After carrying out the static strength analysis for 30 degree tilted condition of the skid, the maximum stress is found is 151 MPa and deflection obtained is 6 mm.

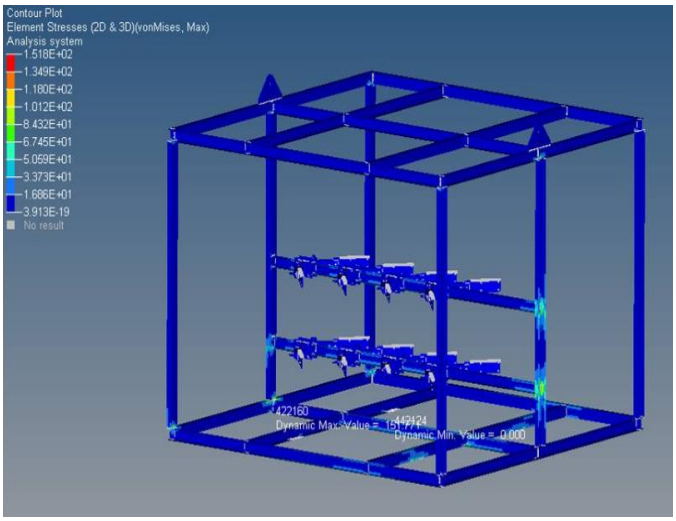

Figure 8 Von-Mises Stress for Skid at 30 Degrees, Max. Value of 151 MPa

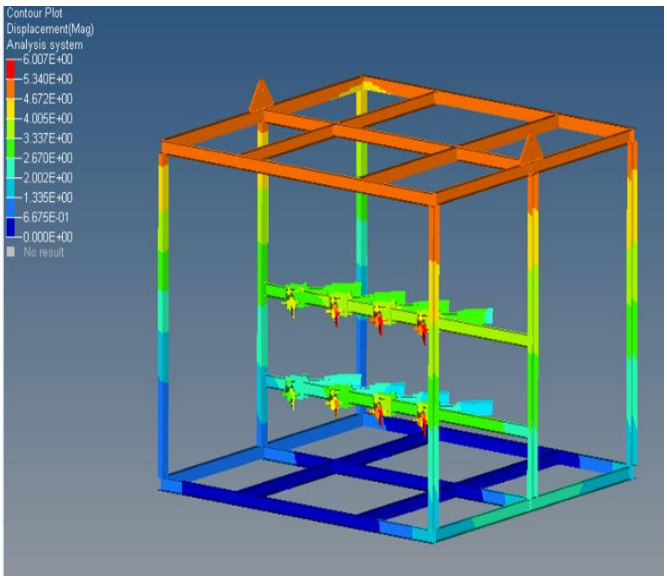

Figure 9 Deflection at Top of the Frame observed, Max. Value of 6 mm

As can be seen from the results above, the deflections and stress values are within allowable limits, therefore the design is considered as safe.

3. Results

After carrying out the analysis in HYPERMESH software following results are obtained.

Table 1 comparison of stresses

Sl. No.	cases	Von- mises stress, MPa	Yield strength, MPa	remarks
1	Skid under lifted condition	69	250	SAFE
2	Skid under 30 degree tilted condition	151	250	SAFE

4. Conclusion

In lifted condition, the strength analysis of the skid is carried out. The maximum induced stress of 70 MPa is within yield strength of the material and deformation is within permissible limits.

For skid at 30 degree tilted condition, the strength analysis is carried out and the maximum stress induced for this condition is 151 MPa which is less than the yield strength.

The column is checked for buckling stress. The result comes out that column wont buckle.

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REFERENCES

[1] Nelson k. Akafuah, Sadegh Poozesh, Ahmad Salaimeh, Gabriela Parick, Kevin Lawer and Kozo Saito, Evolution of Automotive Body Coating Process- A review, coatings, 2016, 6, 24; doi: 10.3390/ coatings60200024.

[2] Pandhare A. P., Chaskar S. T., Patil J. N., Jagapat A. S., Bangal P. M., Design Analysis and Optimization of Skid Base Frame, International Journal of Technology Enhancements and Emerging Engineering Research, VOL 2, ISSUE 7 ISSN 2347-4289.

[3] Shailesh S. Pachbhai, Laukik P. Raut, A Review on Design on Fixtures. International Journal on Engineering Research and General Science, volume 2, issue 2, Feb. – mar 2014 ISSN 2091-2730.

[4] Chris harper, P. Eng, Honfa Wu, Ph. D., P. Eng., Optimized Skid Design of Compressor Packages, Presented at: Gas Machinery Conference 2013, October 7 – 10, 2013, Albuquerque, NM.

[5] Naveena m., Naceen Kumar, Manjunath T V, Sudhakar k, Design and Analysis of Skid Frame for Pumping Station, International Journal on Engineering Research volume no.5 Issue: special 6, pp: 1129 – 1254.

[6] Marek bures, Efficient Education of Ergonomics in Industrial Engineering Study Program, Procedia – Social and Behavioral Sciences 174 (2015) 3204- 3209.

[7] Maria – Elena Boatca, Biania Cirjaliu, A Proposed Approach for an Efficient Ergonomics Intervention in Organization, Procedia Economics and Finance 23 (2015) 54-62.

[8] Christian Johanson, Tobias Larsson, Sravan Tatipala, Product- Service System for Functional Offering of Automotive Fixtures: Using Design Automation as Enabler, Procedia CIRP 64 (2017) 411 – 416.

[9] R. forstmann, j. Wager, k. Kreiskother, a. Kampker, d. Busch, Design for Automation: The Rapid Fixture Approach, Procedia Manufacturing 11 (2017) 633 – 640.

[10]. Retfalvi Attika, Michel Stampfer, Szegh Imre, Fixture and Setup Planning and Fixture Configuration System, Procedia CIRP 7 (2013) 228 – 233.

[11] Tristan Carrier Baudouin, Jean-Francois Remacle, Emile Merchandise, Francoise Henrotte and Christope Guzaine. A Frontal Approach to Hex-Dominant Mesh Generation, Carrier Baudouin et al. Advanced Modeling and Simulation Engineering Sciences 2014, 1:8.

[12] Tae - Hyu Ha, Bong Ho Cho, Hongjin Kim, and Dae-Jin Kim, Development of an Efficient Steel Beam Section for Modular Construction Based on Six Sigma, Hindawi Publishing Corporation, Advances in Materials Sciences and Engineering, Volume 2016, Article ID 9687078, 13 pages.

[13] CAD / CAM principles & application, P. N. RAO, third edition, McGraw Hill, 2017.

[14] The Finite Element Method in Engineering, S. S. Rao, Fifth edition, Butterworth Heinemann, 2011.

[15] Strength of materials, R. Subramanian, Oxford University Press, 2016.

[16] MACHINE DESIGN, DATA HANDBOOK (S. I. METRIC), H. G. PATIL, International Publishing House Pvt. Ltd, 2011.