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DESIGN AND ANALYSIS OF PLENUM BRACKET

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ABSTRACT

Conceptual design is a crucial activity in the product development process. The design freedom must consider a trade-off analysis among several aspects such as assembly, manufacturing, and costs. The goal of this approach is to define a multi-objective design approach for the determination of feasible design options. This proposes a link between void coalescence and growth, ductile damage, crack opening modes and fracture toughness in sheet metal forming. This new integrated view is based on an analytical framework that allows estimating the location of the fracture loci in the principal strain space directly from material stress-strain response and from fracture toughness and thickness at fracture obtained in forming 2 process. In order to get rid from crack we are going to design and analysis in Ansys the reason of obtaining crack and redefining the load propagation through the model.

Keywords: Conceptual design, sheet metal forming, fracture loci, fracture toughness, forming etc.

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1. INTRODUCTION

Until recently, the formability limits by fracture have not been of interest to sheet metal forming because once a neck appears and spreads sideways under subsequent deformation, thinning will progress very fast under decreasing loads or pressures until the sheet cracks. As a result of this, research has been focused on the formability limits at the onset of plastic instability (also known as the forming limit curves, FLC's). Nowadays, the experimental methods and procedures for determining the FLC's of metal sheets at room temperature are well established in the international standard ISO 12004-2 (ISO, 2008) and involve carrying out Nakazima and Marciniak sheet formability tests.

The widespread utilization of finite element analysis in sheet metal forming relaunched the discussion on the utilization of ductile damage mechanics for predicting the onset of failure by fracture and on the experimental methods and procedures for determining the fracture loci in the principal strain space and in the space of effective strain vs. stress triaxiality. Some authors

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combine data retrieved from sheet and bulk formability tests (Wierzbicki et al., 2005) while others consider that the differences in plastic flow resulting from the plane stress conditions of sheet metal forming and the three dimensional stress conditions of bulk metal forming that are commonly used as a rationale to classify metal forming processes into two different groups must be treated differently, in order to distinguish the circumstances under which different processes fail by fracture (Isik et al., 2014).

The commonly accepted fact that FLC's are not material properties and that its determination is greatly influenced by strain loading paths, by combination of in-plane loading and bending effects and by difficulties in measuring the onset of necking (Centeno, 2014) further contribute to the growing interest in the formability limits by fracture

2. LITERATURE REVIEW

A detailed literature survey has been carried out on sheet metal operations and some of the important concepts from different journal were studied and they are summarized below

Indian standard (2006) Indian standard COLD REDUCED LOW CARBON STEEL SHEET AND STRIP Indian
Standard for Cold reduced carbon sheet for commercial and drawing qualities

Claudio Favia, Michele Germania, Marco Mandolinia(2016)A multi-objective design approach to include material, manufacturing and assembly costs in the early design phase**.** The goal of this paper is to define a multiobjective design approach for the determination of feasible design options

M.B. Silva K. Isik A.E. Tekkaya A.G. Atkins P.A.F. Martins(2016**)**FRACTURE TOUGHNESS AND FAILURE LIMITS IN SHEET METAL FORMING This paper proposes a link between plastic flow, void coalescence and growth, ductile damage, crack opening modes and fracture toughness in sheet metal forming.

Daniel R. Cooper, Kathleen E. Rossie, Timothy G. Gutowski(2017)The energy requirements and environmental impacts of sheet metal forming: An analysis of five forming processes This paper concluded that researchers interested in reducing the environmental impacts of sheet metal forming concentrate on innovations that would reduce sheet metal blanking and post-forming trimming losses.

3. PROBLEM DEFINATION

- The Plenum Bracket is the part which is used for the outer bracketing of the vehicle frame.

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- As the report we got from the industry, the production of this part is about 4 to 5k parts/batch but in the part when the sheet metal operations are performed at the last stage of the manufacturing the cracks are produced one or more of the 4 corners.
- The client has a requirement of a good yield strength so as to have an upper hand in the market.
- So we have to design and analyze the part so as to eliminate the crack.

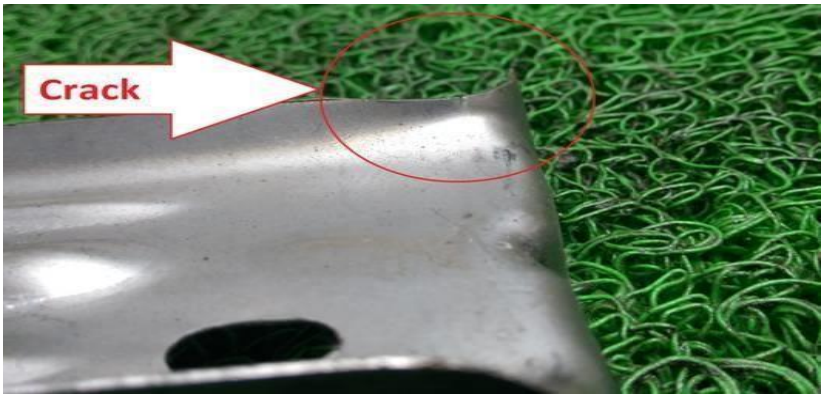

Fig. 1: Crack observed in the component

To compensate crack problem, company just using solution of grinding the crack area to remove crack obtained. It is time consuming process as 90% part are getting crack. As we know time is money for any industry. So we will work on that problem.

3.1 PART MATERIAL DETAILS

Brand	Nextgen Steel & Alloys
Material Grade	IS513
Size (feet X feet)	15 X 15
Thickness	0-1 mm, 1-2 mm, 2-3 mm, 3-4 mm, 4-5 mm, >5 mm
Color	Grey
Quantity per pack	10 No
Approx. Price	Rs 60 / Unit

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3.2 CHEMICAL COMPOSITION

Grades	Carbon	Manganese	Sulphur	Phosphorus
Extra Deep Drawing (EDD)	0.08	0.4	0.03	0

3.3 MECHANICAL PROPERTIES

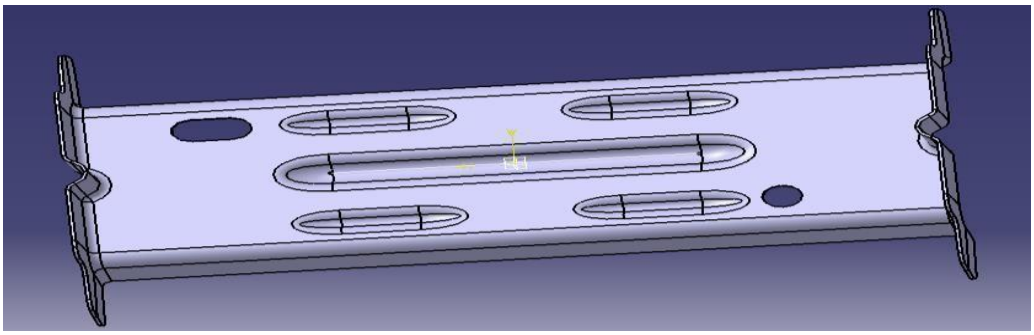
Grade	UTS Mpa	YS (MIN) Mpa	EL.% Min Lo-80 mm b-20 mm
Extra Deep Drawing (EDD)	380	190	36

4. METHODS

- To eliminate the crack formation in the part.
- To maintain the overall production cost within prescribed limit.
- To obtain desire strength of final product.
- To get the final product without fail.
- To minimize the production of faulty parts per batch.

5. MODELING

The three-dimensional model of the Plenum Bracket are designed using CAD software like CATIA V5 R20.



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6.1ANLYSIS OF PLENUM MODEL

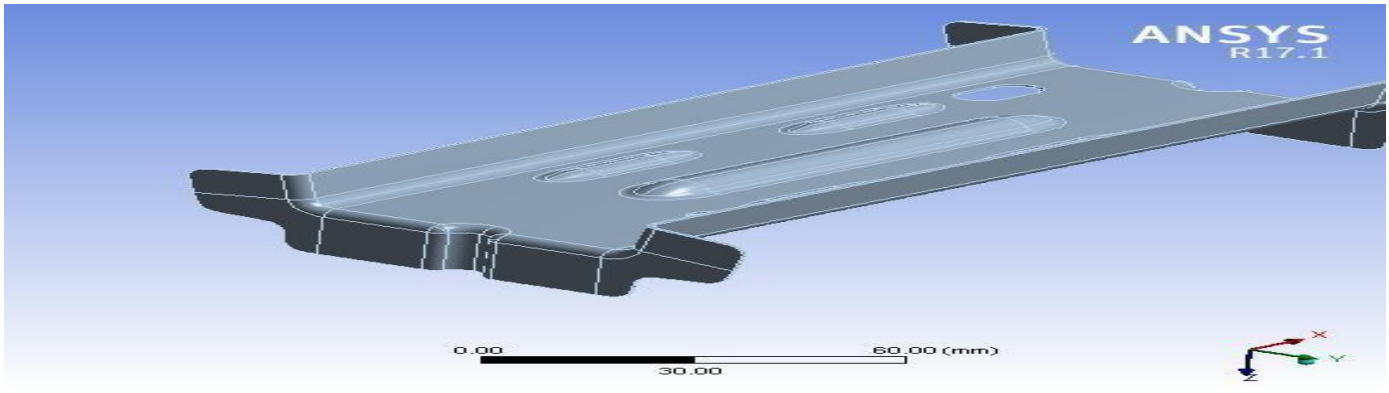

Fig 6.1: Design of Plenum Bracket

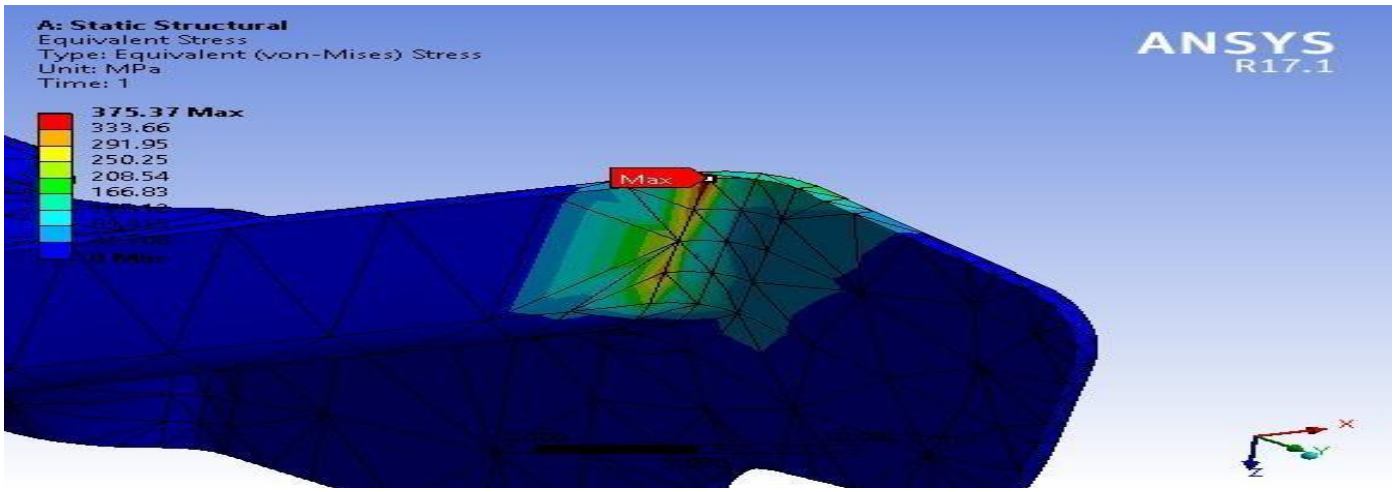

Fig 6.2: Zoomed view of Deformation area

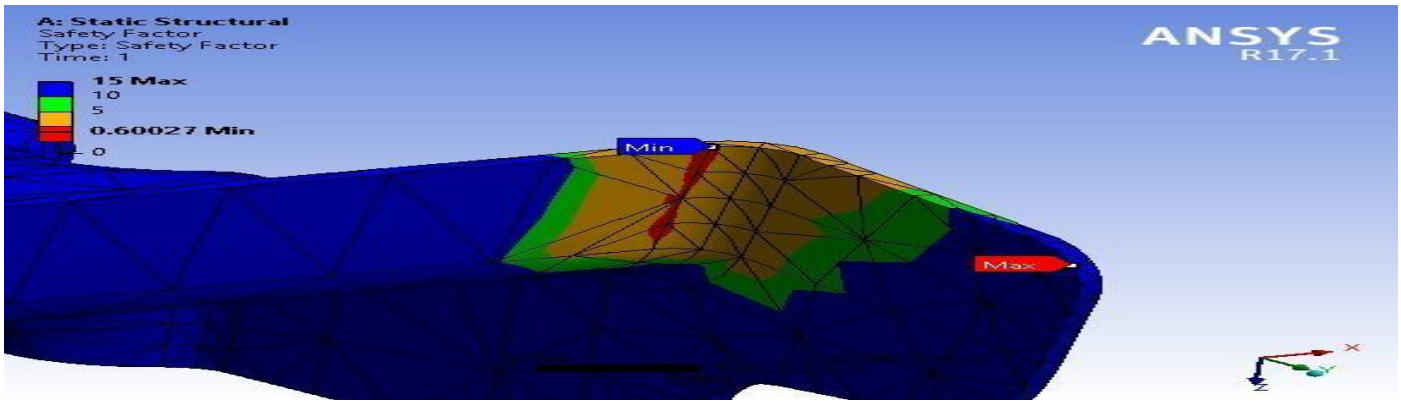

Fig 6.3: Minimum safety factor obtained.

7. CONCLUSION

The results good shows the Equivalent stresses and Damage area. The analyzed area perfectly shows the stresses developed due to which crack occurs. And to get rid of crack as per analysis

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did makes sure that the tool design needed to be modified. Due to Explicit Dynamics Analysis which makes Tool as rigid part of Analysis it is must to analyze the tool which tends to change the shape of edges of tool punch making it U shaped.

8. REFERENCES

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