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COMPUTER AIDED DESIGN AND ANALYSIS OF SWING JAW PLATE USING COMPOSITE MATERIAL

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***Abstract*— Jaw crusher is a mechanical device which is use rough and massive work reduction of large solid into small piece. The performance of jaw crusher is depending on material to be crush and capacity of the crusher. Swing jaw plate strong enough to crush hardest material without any failure on other hand it have consume less power in short light weighted. Generally swing jaw plate assembly (plate and holder) made of martensite steel which is heavy and consume more power. Aim of this work is reduce weight of swing jaw plate assembly by using different composite material and compare with previous material and choose best suitable composite material for jaw plate holder. For this CAD modeling of jaw plate assembly is done in CREO and structural analysis in ANSYS for using different composite material. Static analysis result shows composite material more safe than martensite steel. Equivalent stress and total deformation of fiber reinforced aluminum less than the martensite steel. Hence for swing plate holder fiber reinforced aluminum is replace the martensite steel as a material and light weighted also because density of fiber reinforced aluminum is less than martensite steel.**

***Index Terms*-Swing jaw plate, Composite material, Static analysis, Equivalent stress and total deformation.**

I. INTRODUCTION

Jaw crusher is a device which is use crush the large material convert into small piece by using the power deliver by the motor. In jaw crusher feed is trapped within the two jaws where it can crush by using the compressive force applied by jaw plate. In jaw crusher two set of jaw plate first is fixed and other one is movable which is hinged to the shaft. Swing jaw plate provides to and fro motion with respect to fixed plate and crushes the material. The crusher crushes the feed by some moving units against a stationary unit or against another moving unit by the applied pressure, impact, and shearing or combine action on them. Crushing plate is strong enough to crush hardest material hence this study based on crusher plate and its strength. By using composite material as holder material for decrease the weight of the plate assembly.

II. MATERIAL AND METHOD

The material which is composed of two or more different kind of composite which are insoluble in each other and maintain their physical and chemically separated by clear cut interface called composite.

- Low density
- High specific strength
- High specific modulus
- High thermal conductivity
- Good fatigue modulus
- Control of thermal expansion

For this work choose three types of composite material which is near to the martensite steel in physical and mechanical prosperities.

- Epoxy carbon fiber reinforced composite
- Epoxy fiber glass composite
- Fiber reinforced aluminum composite

III. CAD MODELING OF JAW PLATE ASSEMBLY

First we creating jaw plate in CREO, using part file and unit setup were in metric system, the length of plate is 1200mm, width of the plate is 900 mm and thickness is 140 mm in fig 3.1

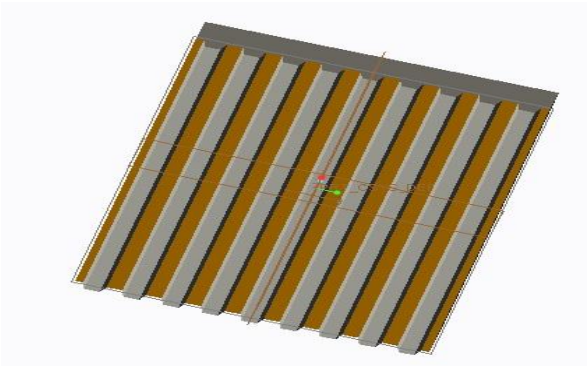

Fig 3.1 Jaw plate

Creating swing jaw holder using part file. The dimension for swing jaw plate are defined as per the measurement of actual model used in industry in fig 3.2

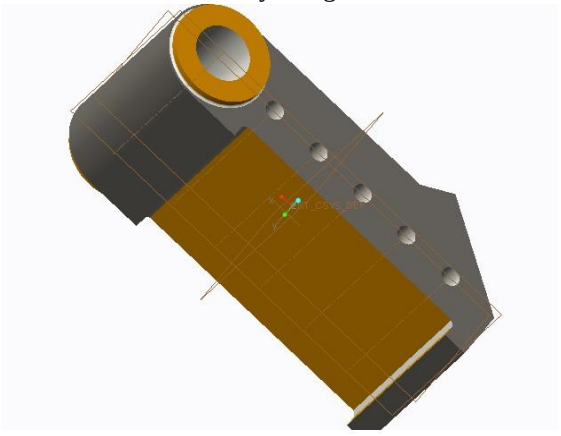

Fig 3.2 Jaw holder

First importing swing jaw holder part in assembly

environment and set as to default constraint. The default constrained made the swing jaw holder part fixed in all direction, importing jaw plate in assembly environment and fixed with clamp part on centre axis and aligned with its plane, assembly is showing in fig 3.3.

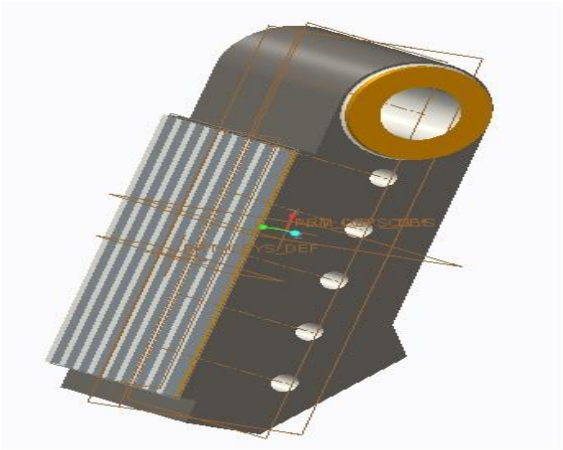

Fig 3.3 Swing jaw plate assembly

IV. STRUCTURAL ANALYSIS OF SWING JAW PLATE ASSEMBLY

A. First import the geometry from the file folder saved in IGES format.

B. Second assign the material of each of the component in this plate as a martensite steel and holder is composite material.

C. Meshing- Meshing of the jaw crusher model is done after defining the material properties and assigning each material to each of the component. Tetrahedral element is used for all the components of jaw crusher. Tetrahedral element better approximate the shape with minimum error as compared to brick element shown in fig 3.4.

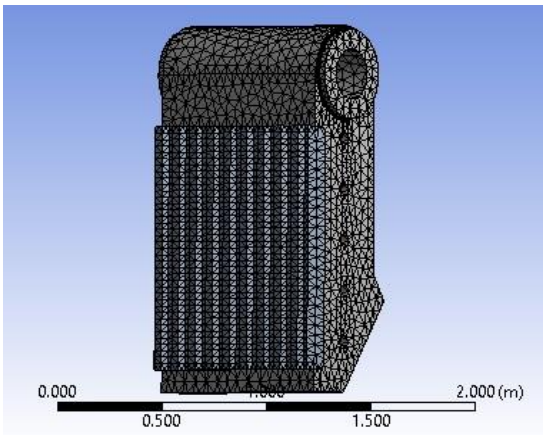

Fig 3.4

D. Boundary Condition- Hinged support at upper face of the assembly, force is applied in the jaw assembly model. 8700 N in the face of the plate and toggle force applied in the back side of the holder shown in fig 3.5.

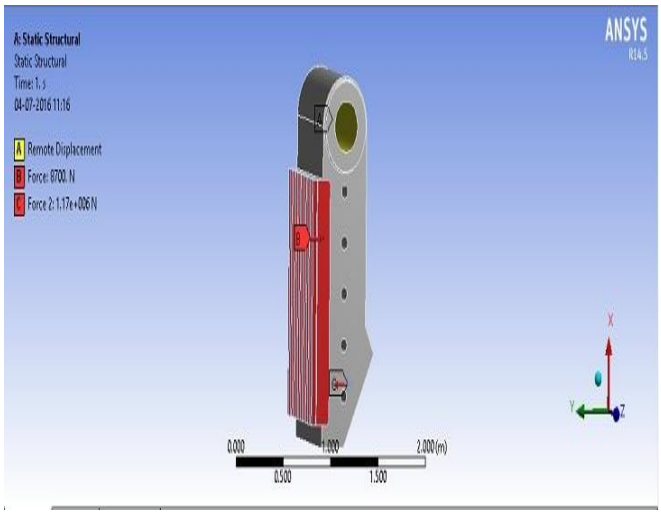

Fig 3.5

E. Equivalent stress and Total deformation

1.Both plate and holder is made of **Martensite steel**

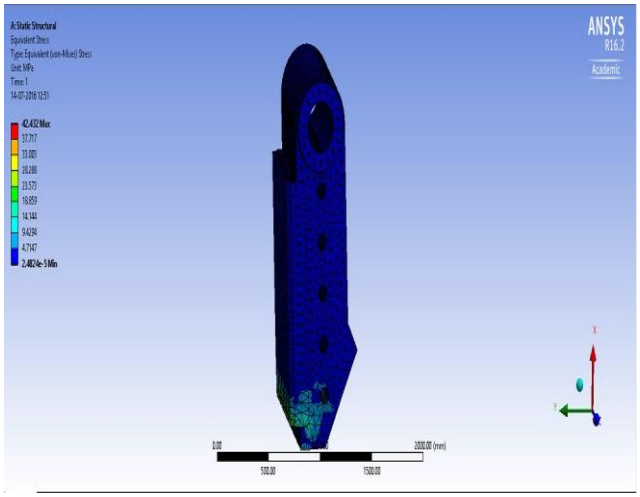

Fig 3.6 Equivalent stress for martensite steel

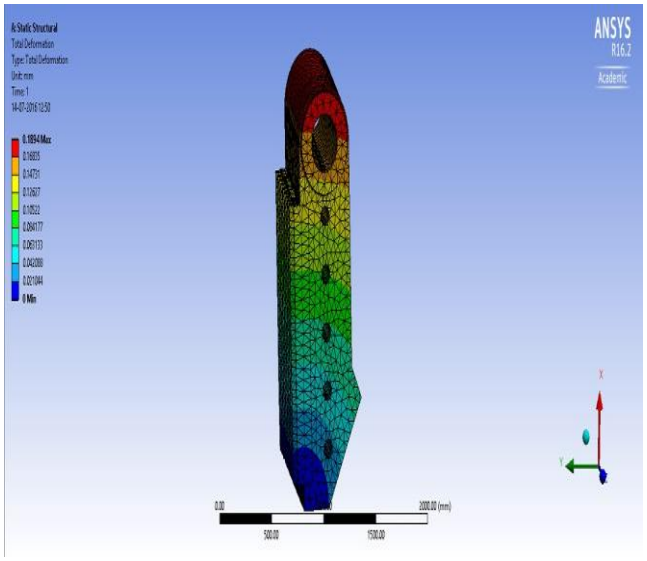

Fig 3.7 Total Deformation for martensite steel

2. Holder made of **Epoxy fiber glass composite**

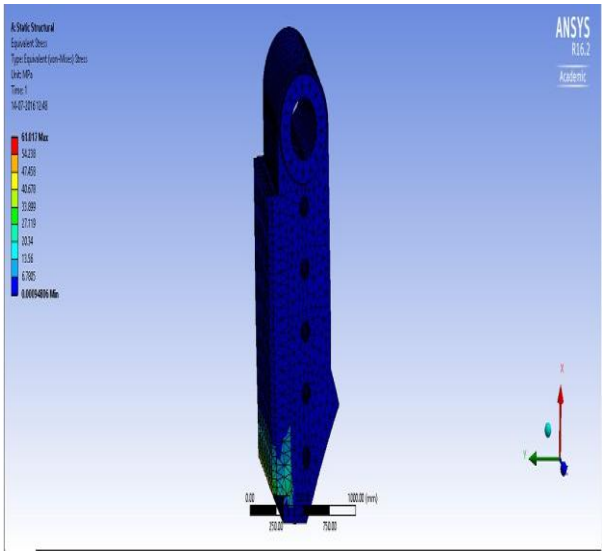

Fig 3.8 equivalent stress for epoxy carbon fiber glass

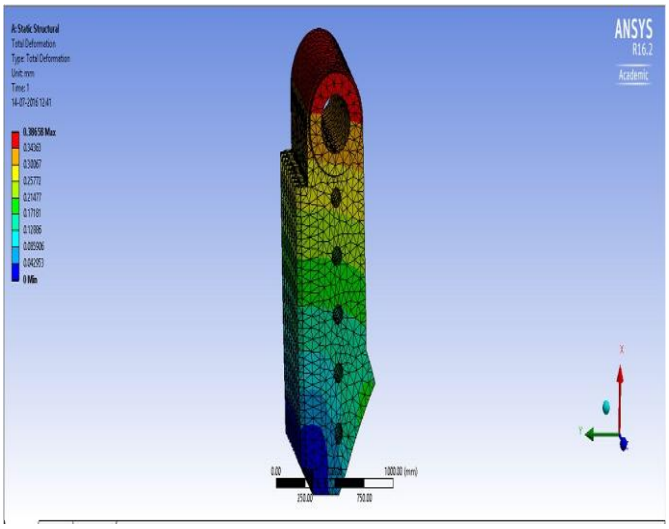

Fig 3.11 total deformation for epoxy carbon fiber

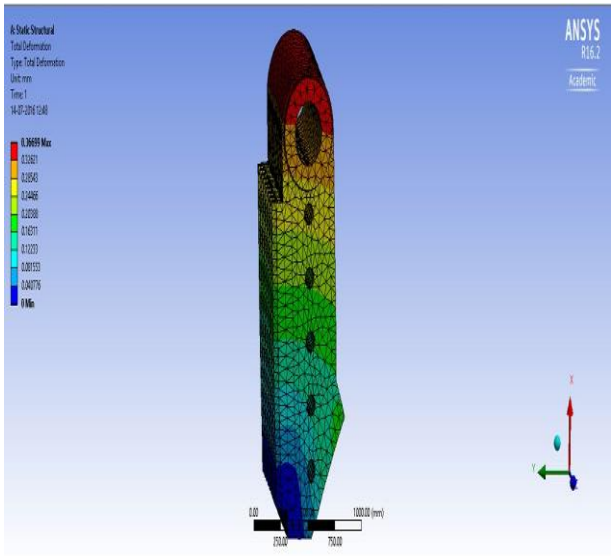

Fig 3.9 total deformation epoxy carbon fiber glass composite

4. Holder made of **Fiber reinforced aluminum**

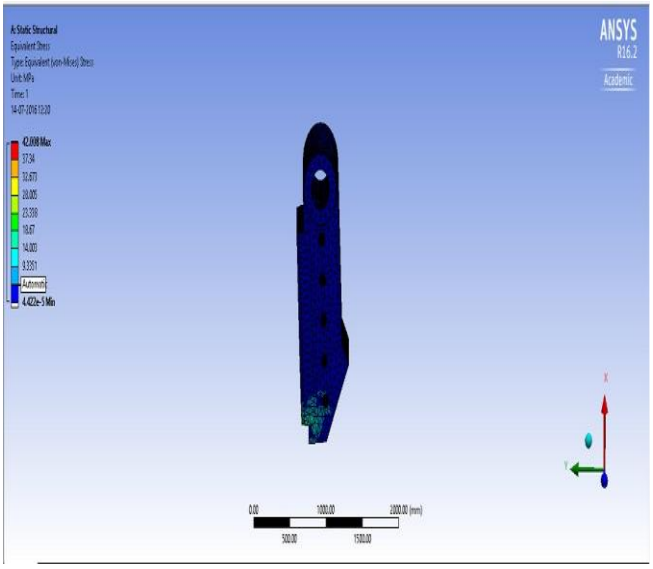

Fig 3.12 equivalent stress for fiber reinforced aluminum

3. Holder made of **Epoxy carbon fiber composites**

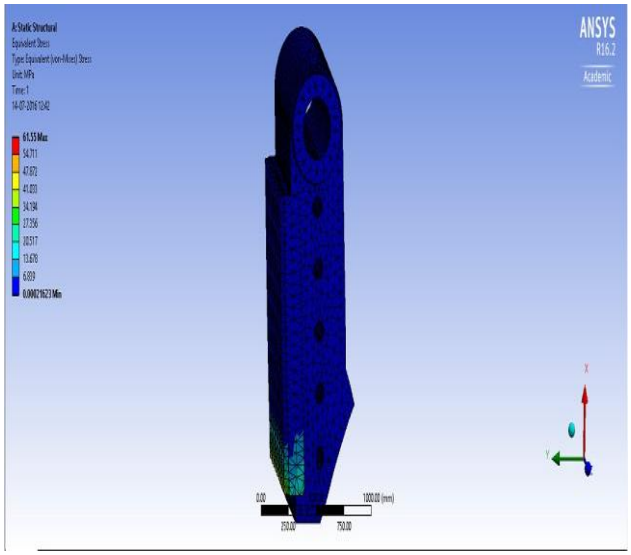

Fig 3.10 equivalent stress for epoxy carbon fiber

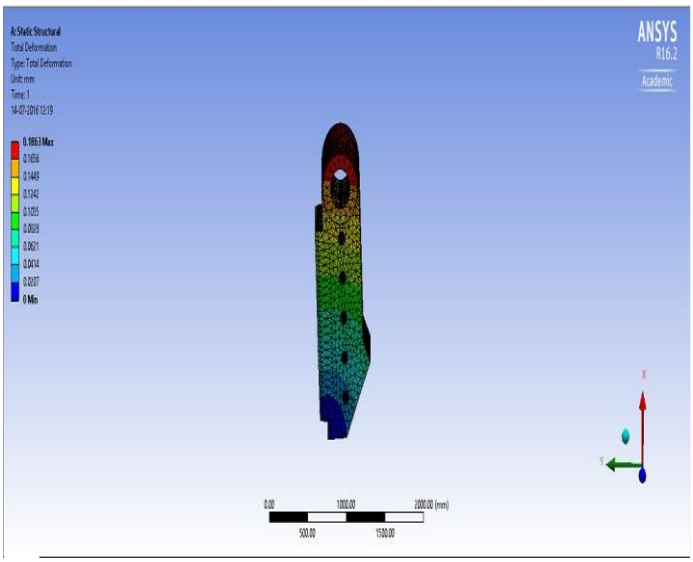

Fig 3.13 total deformation for fiber reinforced aluminum

V. RESULT AND DISCUSSION

After taking of all possible material result shows martensite steel as a holder material generate more stress compare to composite material and deformation also more than the composite material. Analysis shows the result that Fiber reinforced aluminum deformation and equivalent stress both are less than Martensite steel and also other composite material (Epoxy fiber glass and Epoxy carbon fiber)

Table 5.1 Static analysis result

S.NO	Material	Load (N) Jaw plate	Total Deformation (mm)	Equivalent stress (MPa)
1	Martensite steel	8700	0.1894	42 .43
2	Epoxy fiber glass composites	8700	0.3669	61.01
3	Epoxy carbon fiber composites	8700	0.3865	61.55
4	Fiber reinforced aluminum composite	8700	0.1863	42.008

VI. CONCLUSION

The static analysis is performed for several composite material like epoxy fiber glass, epoxy carbon fiber and fiber reinforced aluminum. These materials which can replace the martensite steel as a holder material of jaw crusher. Suggested material is fiber reinforced aluminum because the value of von mises is same as martensite but the deformation is less than the martensite steel.

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