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# IMPROVING SMED IN THE AUTOMOTIVE INDUSTRY: A CASE STUDY

**P.Laxmi Naga Prasad[1] , D.Srinivas[2] , P.Shashidar[3]**

[1]*Asst.professor in Mechanical Engineering, Sri Venkateswara Engineering College*

[2]*Asst.professor in Mechanical Engineering, KITS*

[3]*Asst.professor in Mechanical Engineering, MGIT*

***ABSTRACT***

*A glass crusher provides for pulverization of glass to a yield size of 2" or less. Recycling operations may range from simple, manually-fed, self-contained machines to extravagant crushing systems complete with screens, conveyors, crushers and separators. All non-glass contaminants must generally be removed from the glass prior to recycling. The processes used in glass crushing for recycling involves the same methods used by the aggregate industry for crushing bottles into small pieces of glass (glass crusher).*

***Keywords: pulverization, extravagant, industry***

### 1.1 Benefits of the Bottle cycler / Crusher

**» Space**

Reduce glass bottle volume by an amazing 80%! And create more space in your venue. All crushed glass is stored inside our specially designed mini wheelie bins.

Fact: just one of our compact 60 liter wheelie bins, placed inside the crusher holds 300 crushed stubbies (or 200 wine bottles!) Eliminate the need for multiple bottle bins behind bar areas as you no longer need to bin your empties first - they now go straight through the machine. The convenient size of our mini wheelie bins allows for the option to reallocate the space usually reserved for storing your empties for more viable things like an extra car park, extra tables in your outdoor areas or extra room for stock/deliveries. Reduce the flow of your collection frequency.

## CHAPTER – II

## BACKGROUND ON GLASS RECYCLING

Glass recycling rates have increased in line with annual targets set by the Government for all packaging materials - including glass. However, the proportion of this recycled glass directed into closed loop use in container manufacture has declined in absolute terms over the past few years. In September 2011, WRAP commissioned this project to investigate the current market for glass compactor units (a.k.a. 'bottle crushers') within the hospitality sector and to investigate the possibilities for redesigning crushers so that cullet (crushed glass) produced could be used in the manufacture of new glass bottles (re-melt).

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For hospitality outlets the volume reduction leads to lower collection cost, savings in storage space, less handling, less noise problems, a significant reduction in OH&S risks and a tidier workplace. For larger hotels the savings can amount to $30,000 per year, measured in opportunity cost of $25 per hour. Up to 50% of the monthly fee for the crusher and service is usually already recouped by the reduction in collection cost or by crusher and service is usually already recouped by the reduction in collection cost or by saving 15 minutes daily on labor costs.

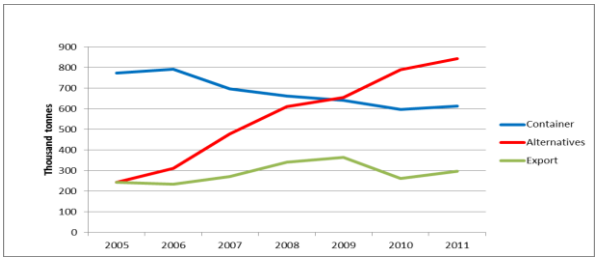


**Fig: 2.1: Volumes of glass by end use**

### 3.1 Glass Crusher Machine

Glass Crusher Machine is to use the high rotation speed hammers to crush the waste glass coming into the crushing chamber of the glass crusher machine.

***Fig: 3.1: glass crusher machine***

**The principle of small glass crusher machine is as follows:**

- In the crushing chamber of the glass crusher machine, there are many hammers which are installed on the center shaft t. The motor make the center shaft rotate in high speed. Thus, the hammers on the center shaft also rotates in high speed.

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### 3.2 Working Principle of Jaw Crusher

The structure of jaw crusher: main frame, eccentric shaft, a large belt pulley, fly wheel, swing jaw, side guard plate, toggle plate, Rear bracket, adjust gap screw, reset spring, and fixed jaw and swing jaw board etc., and the toggle plate also plays a role of protection.

### 3.3 Advantages. Especially Cost Friendly

Different sizes of Cogelme crushers can process from 4 to 24$^{th}$ of glass bottles.

Thanks to high efficiency and low operating costs, for many years Cogelme glass crusher has been chosen and used by the main European glass bottles recyclers and glass factories.

**Main Advantages are:**

- Glass bottles are crashed to optimal dimensions required by glass workers
- 80% of energy savings (compared to hammer crushers) due to installed motorization, which is only 8 KW in the biggest model during crushing, metal caps are detached and can be easily separated with metal separators.

### 3.4 Application, Crushes to Optimal Sizes

Also know n as Glass Crusher, Cogelme Cylinder Mill optimally grinds high volumes of glass bottles after they have been separated from other materials: wood, metals, plastic, etc., and efficiently destroys glass bottles or jars with the products inside.


## CHAPTER – IV
## DESIGN METHODLOGY OF AUTOMATIC GLASS CRUSHING MACHINE

### 4.1 Introduction to CATIA

CATIA (Computer Aided Three-dimensional Interactive Application) is a multi-platform CAD/CAM/CAE commercial software suite developed by the French company Dassault Systems. Written in the C++ programming language, CATIA is the cornerstone of the Dassault Systems product lifecycle management software suite. CATIA competes in the high-end CAD/CAM/CAE market with Cero Elements/Pro and NX (Unigraphics).

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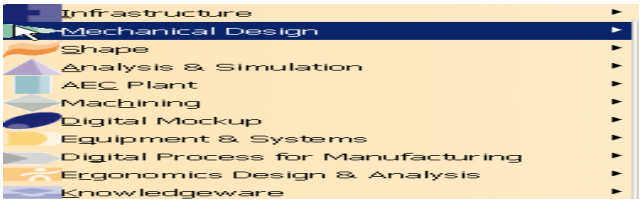


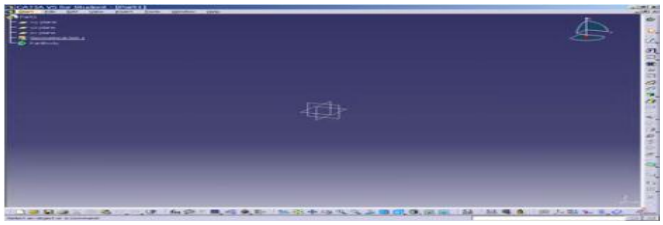

**Fig: 4.1: Home Page of CatiaV5**

### 4.2 History

CATIA started as an in-house development in 1977 by French aircraft manufacturer Avions Marcel Dassault, at that time customer of the CAD/CAM CAD software to develop Dassault's Mirage fighter jet, and then was adopted in the aerospace, automotive, shipbuilding, and other industries. Initially named CATIA (Conception Assisted Tridimensional Interactive — French for Interactive Aided Three-dimensional Design) — it was renamed CATIA in 1981,

### 4.3 Scope of Application

Commonly referred to as 3D Product Lifecycle Management software suite, CATIA supports multiple stages of product development (CAx), from conceptualization, design (CAD), manufacturing (CAM), and engineering (CAE). CATIA facilitates collaborative engineering across disciplines, including surfacing & shape design, mechanical engineering, equipment and systems engineering

### 4.4 Modeling of Automatic Glass Crushing Machine in CATIA V5

This **AUTOMATIC GLASS CRUSHING MACHINE** is designed using CATIA V5 software. This software used in automobile, aerospace, consumer goods, heavy engineering etc. it is very powerful software for designing complicated 3d models, applications of CATIA Version 5 like part design, assembly design.

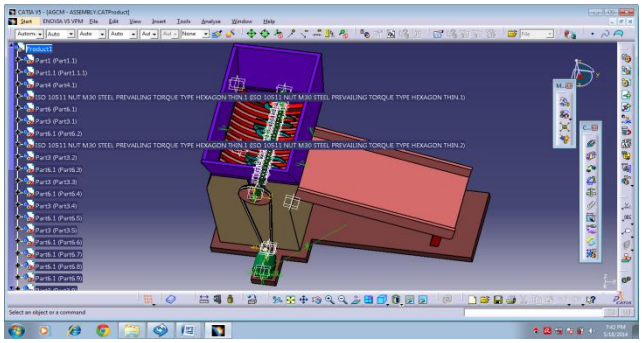

**Fig: 4.2: Model design of AGCM in CATIA-V5**

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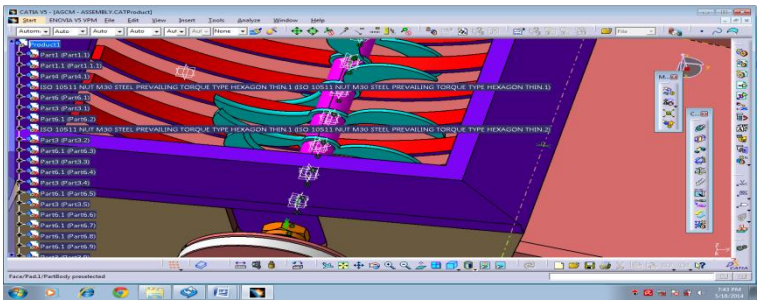


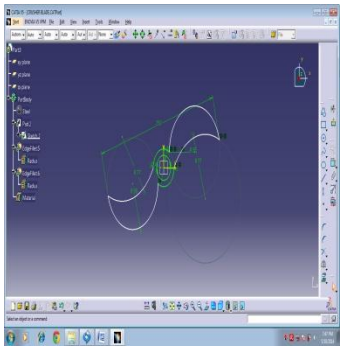
*Fig: 4.3: Model arrangement of blades in CATIA-V5*

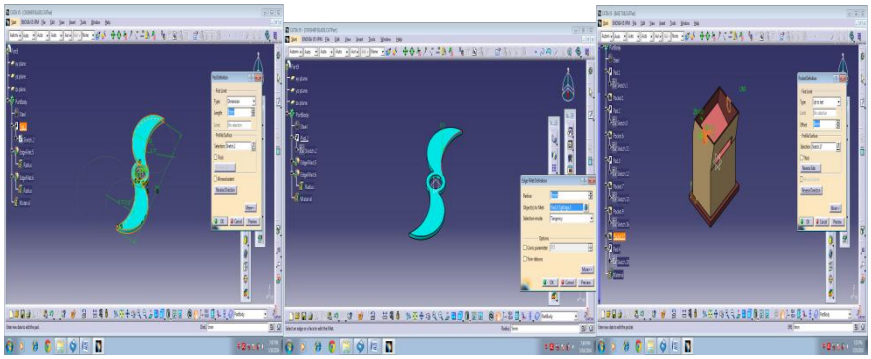
### 4.4.1Design Procedure of Automatic Glass Crushing Machine

The Automatic Glass Crushing Machine is designed in the Catia V5 software by both the part modeling and Assembly modeling. This modeling is being done by following steps:

**Part Modeling of Automatic Glass Crushing Machine**

**Sketch:** It gives the profile of the gear, like outer diameter and inner diameter by intended means of circle command.





**Using Sketch Command for outer profile of the blade**

**Pad:** It gives the required thickness to the gear component .After the sketch, click on the close workbench icon and then the pad command appears, on clicking on it, the dialog box opens; the required value can be entered.

**Fillet:** It gives the profile of the gear teeth, like a inner tooth or outer layer by intended means of circle, or surface arc, trim, reference line commands.

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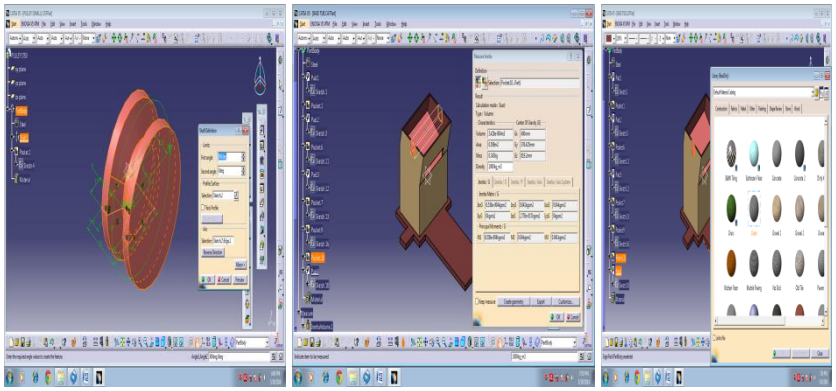
**Pocket:** It gives the required pocket / groove / hole to the gear component .After the sketch, click on the close workbench icon and then the pocket command appears, on clicking on it, the dialog box opens; the required value can be entered.

**Shaft definition:** giving all the material according to the revolved angle from 0 – 360 degrees.



**Applying Shaft definition**

**Applying Material properties:** Selection of Component and type of material

**Measure Inertia:** Here we get all the values of the material by which the properties were applied; like Mass, Area, Moment of Inertia, Young's Modulus, etc.

### 4.4.4. Bill of Material

| S.NO | COMPONENT | MATERIAL | NO.'s USED | MASS | DENSITY | AREA | VOLUME | POSSIONS RATIO |
|---|---|---|---|---|---|---|---|---|
| 01 | Base Tub | M.S | 01 | 1949.6 | 7860 | 4.895 | 0.248 | 0.27 |
| 02 | Bush | Brass | 01 | 0.094 | 8216 | 0.01 | 1.149e-005 | 0.27 |
| 03 | Crusher Blade | M.S | 12 | 0.306 | 7860 | 0.019 | 3.888e-005 | 0.27 |
| 04 | Crusher Blade Axle | M.S | 01 | 4.556 | 7860 | 0.079 | 5.796e-004 | 0.27 |
| 05 | Material Collector | M.S | 01 | 141.56 | 7860 | 1.633 | 0.018 | 0.27 |
| 06 | Mid Bushes | Brass | 11 | 0.094 | 8216 | 0.01 | 1.149e-005 | 0.27 |
| 07 | Motor | Copper | 01 | 14.039 | 7860 | 0.104 | 0.002 | 0.27 |
| 08 | Pulley – Large | M.S | 01 | 5.452 | 7860 | 0.093 | 6.937e-004 | 0.27 |
| 09 | Pulley – | M.S | 01 | 0.248 | 7860 | 0.01 | 3.15e-005 | 0.27 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Small | | | | | | | |
| 10 | Hexagon Nut | M.S | 02 | 0.213 | 7860 | 0.008 | 2.707e-005 | 0.27 |
| 11 | Upper Tub | M.S | 01 | 170.06 | 7860 | 2.554 | 0.022 | 0.27 |
| 12 | V-Belt | Fabric | 01 | 0.037 | 200 | 0.074 | 1.858e-004 | 0.27 |
| 13 | Assembly | M.S | - | 2290.7 | 7860 | 7.823 | 0.291 | 0.27 |

## CHAPTER-V

## ANALYSIS OF AUTOMATIC GLASS CRUSHING MACHINE

### 5.1 Procedure for FE Analysis Using ANSYS:

The analysis of the Crusher blade, bushes, Tubs, & shafts are done using ANSYS. For compete assembly is not required, motor and attached pulley system is to carried out by applying moments at the rotation location along which axis we need to mention. Fixing location is bottom legs of rod assembly machine.

### 5.2 Preprocessor

In this stage the following steps were executed:

- **Import file in ANSYS window**

File Menu > Import> STEP > Click ok for the popped up dialog box > Click Browse" and choose the file saved from CATIAV5R19 > Click ok to import the file

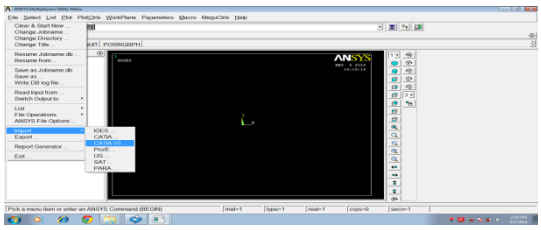

**Fig.5.1: Import panel in Ansys.**

### 5.2.1 Meshing:

Mesh generation is the practice of generating a polygonal or polyhedral mesh that approximates a geometric domain. The term "grid generation" is often used interchangeably. Typical uses are for rendering to a computer screen as finite element analysis or computational fluid dynamics. The input model form can vary greatly but common sources are CAD, NURBS, B-rep and STL (file format). The field is highly interdisciplinary, with contributions found in mathematics, computer science, and engineering.

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### 5.2.3 History of FEM:

In 1909 Ritz developed an effective method for the approximate solution of problems in the mechanics of deformable solids. It includes an approximation of energy functional by the known functions with unknown coefficients. Minimization of functional in relation to each unknown leads to the system of equations from which the unknown coefficients may be determined. One from the main restrictions in the Ritz method is that functions used should satisfy to the boundary conditions of the problem.

### 5.3 Analysis Procedure of Automatic Glass Crushing Machine:

Tetrahedral element that has a quadratic displacement behavior and is well suited to model irregular meshes (such as produced from various CAD/CAM systems). The element is defined by ten nodes having three degrees of freedom at each node: translations in the nodal x, y, and z directions. The element also has plasticity, creep, swelling, stress stiffening, large deflection, and large strain capabilities.

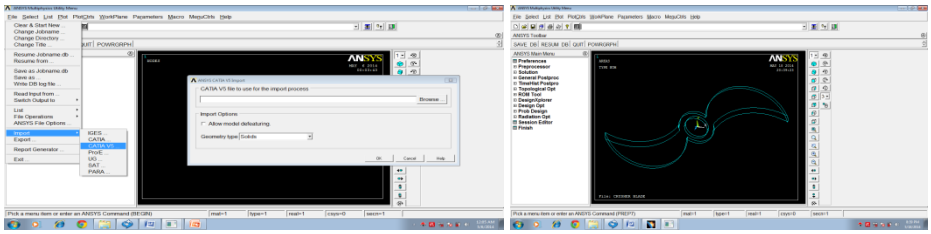

**Fig.5.2: Importing Crusher Blade file in Ansys.**

**Fig.5.3: Imported file in Ansys from the system / directory**

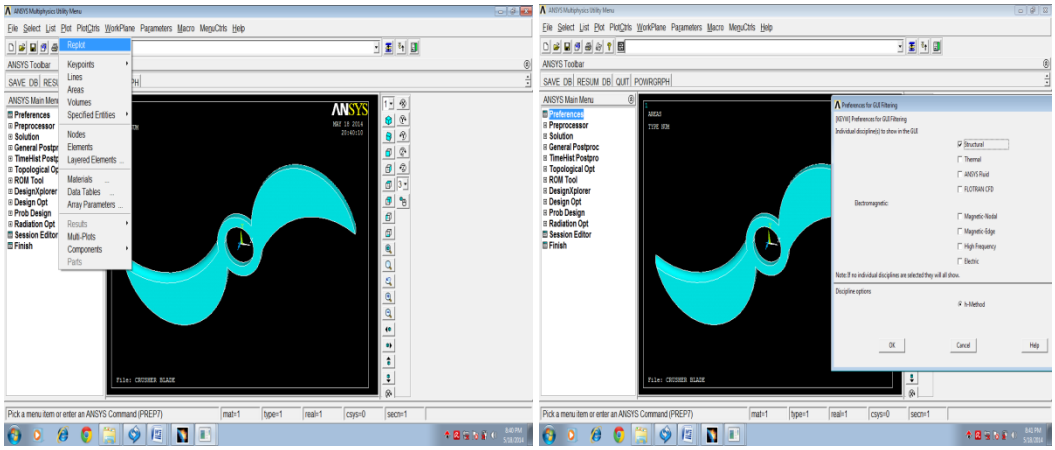

**Fig.5.4: Replotting (Refresh) the component from the menu bar.**

**Fig.5.5: Giving Preferences to the solid component – Structural – ok**

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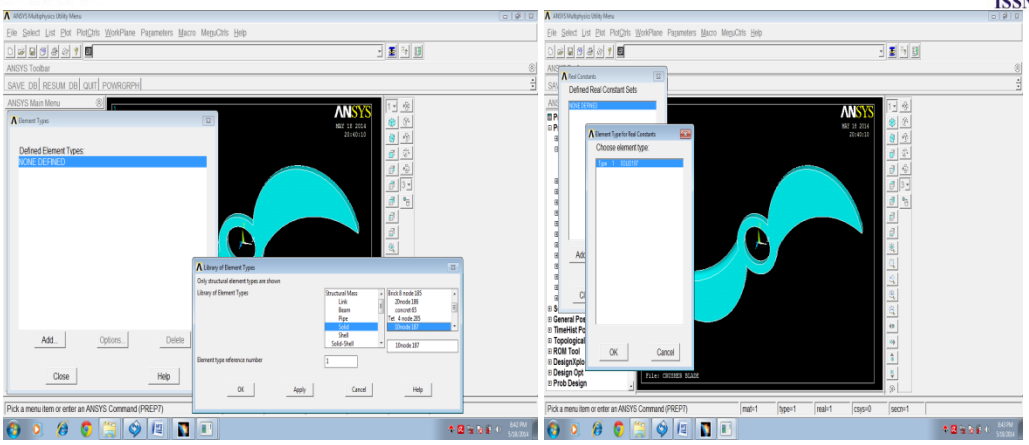

**Fig.5.6: Entering into preprocessor for selection of Element Type.**

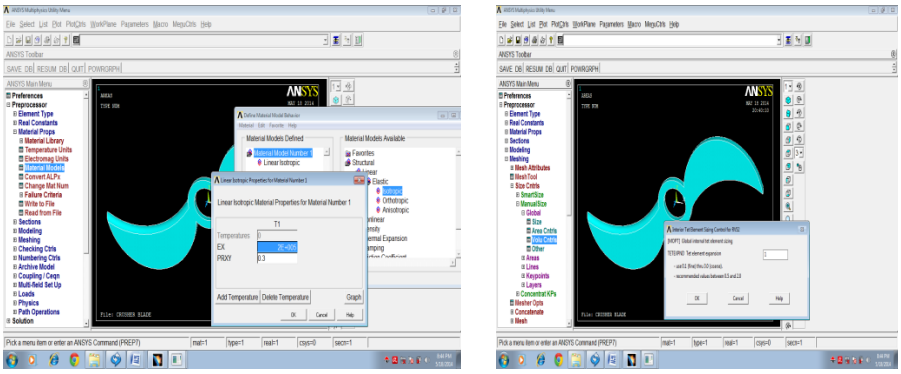

**Fig.5.7: Entering into preprocessor for selection of Real Constraints.**

**Fig.5.8: Entering into preprocessor for selection of Material Model properties.**

**Fig.5.9: Entering into preprocessor for Volume controls values for mesh element size.**

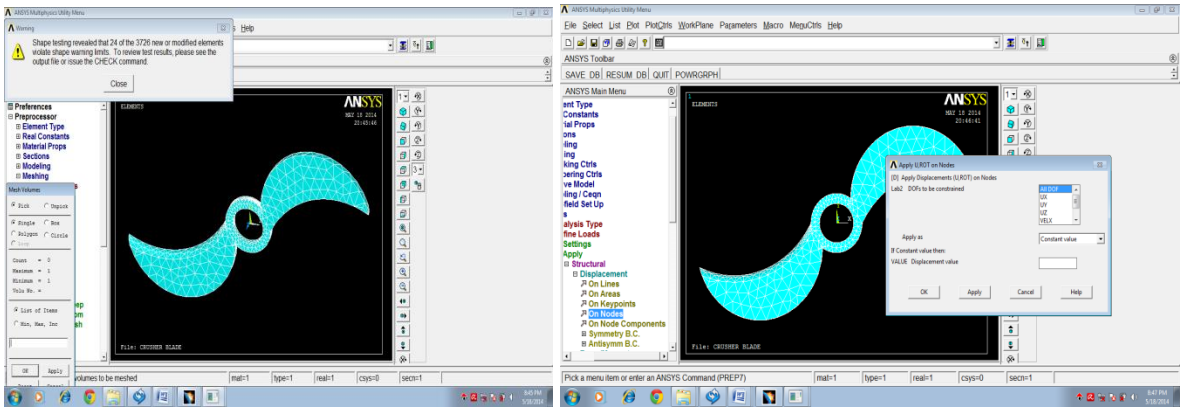

**Fig.5.10: Entering into preprocessor for Meshing.**

**Fig.5.11: Entering into preprocessor for displacement of element.**

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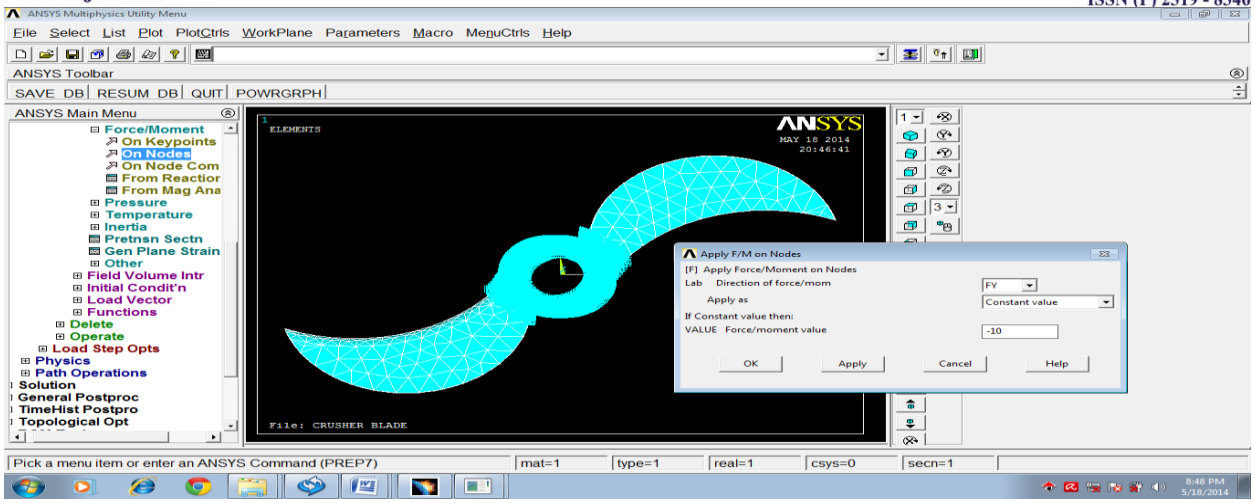


**Fig.5.12: Entering into preprocessor for Force / Moment of element.**

## CHAPTER – VII

## CONCLUSION

Most conventional glass recycling machines crushes glass only into cullet. The resulting cullet is used for making glass again if it is transparent or brown.

As shown above figures the displacement, stresses and strains of the complete assembly is meshed and solved using Ansys and displacement is very less. This is showing us that clearly each component in gear assembly is having minor displacement.

Stress is at the fixing location (Minimum Stress which is acceptable). The value is 0.021 MPa which is very less compared to yield value of Mild steel; this is below the yield point.

The maximum stress is coming, this solution solving with the help of Ansys software so that the maximum stress is less .so we can conclude our design parameters are approximately correct.

The final result positive manner .There is no problems while the design of the machine. Final assembly is designed and it can go without failure. For proving that above analysis is carried out.

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