A SCHEMATIC DESIGN AND ANALYSIS OF A FLYWHEEL UNDER STATIC LOADS SUBJECTED TO SOME DEFORMED LOADS

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ABSTRACT

A flywheel is an inertial energy-storage device which is utilized to stores vitality and vitality is more than the necessity discharges the prerequisite of vitality is more than supply. A Flywheel is situated toward one side of the crankshaft and its dormancy it decreases the vibration which outs the power stroke in every chamber fires. The Flywheel is outlined in 3D demonstrating CATIA. The investigation of the will be finished by the model of Flywheel is finished by utilizing Cast Iron and aluminum composite A360. The examination should be possible with the materials and the best material after the investigation is Flywheel aluminum combination A360.

Ke ywords: *Flywheel, CATIA, Alloy.*

INTRODUCTION:

A flywheel is a rotating mechanical device that is used to store Rotational Energy. Flywheels have a significant moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by applying torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing its rotational speed.

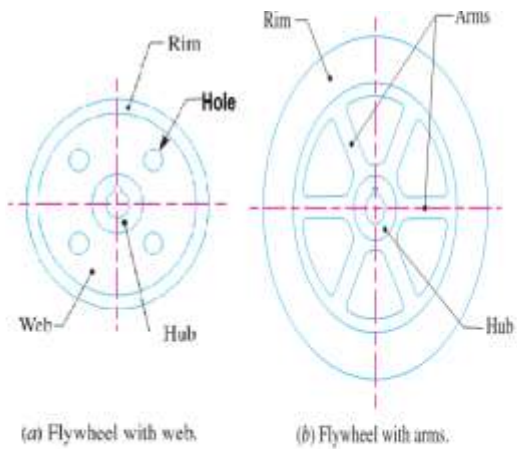


Figure Shows Types of Flywheel

Common uses of a flywheel include:

Providing continuous energy when the energy source is discontinuous For example, flywheels are used in reciprocating engines because the energy source, torque from the engine, is intermittent.

Delivering energy at rates beyond the ability of a continuous energy source. This is achieved by collecting energy in the flywheel over time and then releasing the energy quickly, at rates that exceed the abilities of the energy source.

Controlling the orientation of a mechanical system. In such applications, the angular momentum of a flywheel is purposely transferred to a load when energy is transferred to or from the flywheel.

Flywheels are typically made of steel and rotate on conventional bearings; these are generally limited to a revolution rate of a few thousand RPM. Some modern flywheels are made of carbon fiber materials and employ magnetic bearings, enabling them to revolve at speeds up to 60,000 RPM.

Carbon-composite flywheel batteries have recently been manufactured and are proving to be viable in real-world tests on mainstream cars. Additionally, they are more eco-friendly, as it is not necessary to take special measures in the disposal of them.

HISTORY:

The principle of the flywheel is found in the Neolithic Spindle and the potter's wheel.

The flywheel as a general mechanical device for equalizing the speed of rotation is, according to the American medievalist Lynn White, recorded in the *De* diversibus artibus (On various arts) of the German artisan Theophilus Presbyter (ca. 1070–1125) who records applying the device in several of his machines.

In the Industrial Revolution, James Watt contributed to the development of the flywheel in the steam engine, and his contemporary James Pickard used a flywheel combined with a crank to transform reciprocating into rotary motion.

GRID ENERGY STORAGE:

Beacon power opened a 5MWh, (20 MW over 15mins) flywheel energy storage plant in Stephentown, New York in 2011. Lower carbon emissions, faster response times and ability to buy power at off-peak hours are among some advantages of using flywheels instead of traditional sources of energy for peaking power plants.

WIND TURBINES:

Flywheels may be used to store energy generated by wind turbines during off-peak periods or during high wind speeds.

Beacon power began testing of their Smart Energy 25 (Gen 4) flywheel energy storage system at a wind farm in Tehachapi, California. The system is part of a wind power/flywheel demonstration project being carried out for the California Energy Commission (Beacon Power Press Release March 2010).

TOYS:

Friction motors used to power many toy cars, trucks, trains, action toys and such, are simple flywheel motors.

TOGGLE ACTION PRESSES:

In industry, toggle action presses are still popular. The usual arrangement involves a very strong crankshaft and a heavy duty connecting rod which drives the top. Large and heavy flywheels are driven by electric motors but the flywheels only turn the crankshaft when clutches are activated.

2.0 LITRATURE REVIEW

Literature review is an assignment of previous task done by some authors and collection of information or data from research papers published in journals to progress our task. It is a way through which we can find new ideas, concept. There are lots of literatures published before on the same task; some papers are taken into consideration from which idea of the project is taken.

In 2005 JohnA.Akpobi & ImafidonA.Lawani have proposed, a computer-aided-designs of software for flywheels using object-oriented programming approach of Visual Basic. The various configurations of flywheels (rimmed or solid) formed the basis for the development of the software. The software's graphical features were used to give a visual interpretation of the solutions. The software's effectiveness was tested on a number of numerical examples, some of which are outlined in this work.

In 2012 Sushama G Bawane, A P Ninawe and S K Choudhary had proposed flywheel design, and analysis the material selection process. The FEA model is described to achieve a better understanding of the mesh type, mesh size and boundary conditions applied to complete an effective FEA model.

Saeed Shojaei , Seyyed Mostafa Hossein Ali Pour Mehdi Tajdari Hamid Reza Chamani have proposed algorithms based on dynamic analysis of crank shaft for designing flywheel for I.C.engine , torsional vibration analysis result by

AVL\EXCITE is compared with the angular displacement of a desire free head of crank shaft ,also consideration of fatigue for fatigue analysis of flywheel are given.

Sudipta Saha, Abhik Bose, G. SaiTejesh, S.P. Srikanth have propose the importance of the flywheel geometry design selection and its contribution in the energy storage performance. This contribution is demonstrated on example cross-sections using computer aided analysis and optimization procedure. Proposed Computer aided analysis and optimization procedure results show that smart design of flywheel geometry could both have a significant effect on the Specific Energy performance and reduce the operational loads exerted on the shaft/bearings due to reduced mass at high rotational speeds.

Bedier B. EL-Naggar and Ismail A. Kholeif had is suggested the disk-rim flywheel for light weight. The mass of the flywheel is minimized subject to constraints of required moment of inertia and admissible stresses. The theory of the rotating disks of uniform thickness and density is applied to each the disk and the rim independently with suitable matching condition at the junction. Suitable boundary conditions on the centrifugal stresses are applied and the dimensional ratios are obtained for minimum weight. It is proved that the required design is very close to the disk with uniform thickness.

3.0INTRODUCTION 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 Creo Elements/Pro and NX (Uni-graphics).

HISTORY:

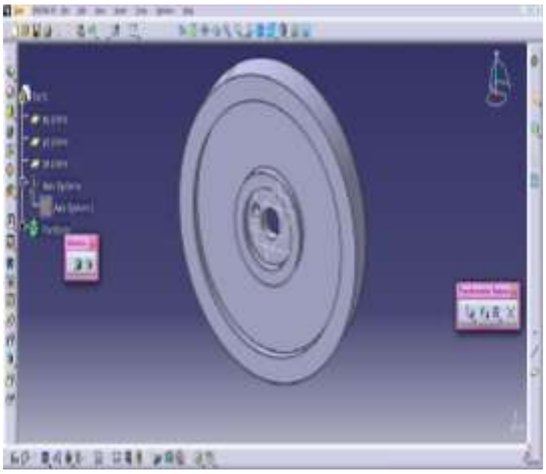
CATIA (Computer Aided Three-Dimensional Interactive Application) started as an in-house development in 1977 by French aircraft manufacturer Avions Marcel Dassault, at that time customer of the CAD/CAM/CAE software to develop Dassault's Mirage fighter jet. It was later adopted in the aerospace, automotive, shipbuilding, and other industries.

Initially named CATI (Conception Assistée Tridimensionnelle Interactive – French for Interactive Aided Three-dimensional Design), it was renamed CATIA in 1981 when Dassault created a subsidiary to develop and sell the software and signed a non-exclusive distribution agreement with IBM.

- In 1984, the Boeing Company chose CATIA V3 as its main 3D CAD tool, becoming its largest customer.
- In 1988, CATIA V3 was ported from mainframe computer to UNIX.
- In 1990, General Dynamic Electric Boat Corp chose CATIA as its main 3D CAD tool to design the U.S. Navy's Virginia class Submarine. Also, Boeing was selling its CADAM CAD system worldwide through the channel of IBM since 1978.

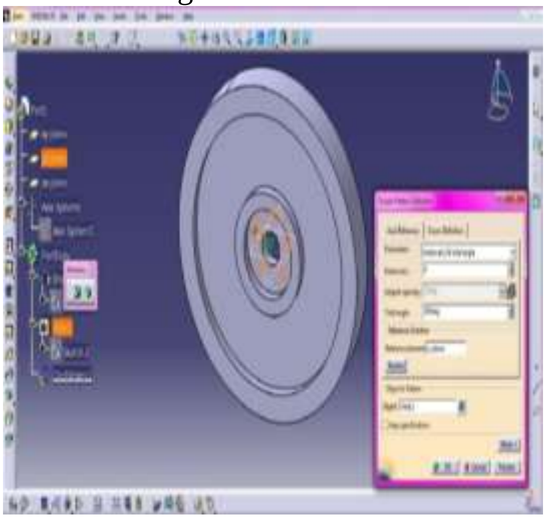
4.0 Methodology:

In sketched base features select hole. After selecting hole a new window open in that sketch a hole with 26 diameter on PCD 100 as shown in figure with a depth of 30mm.



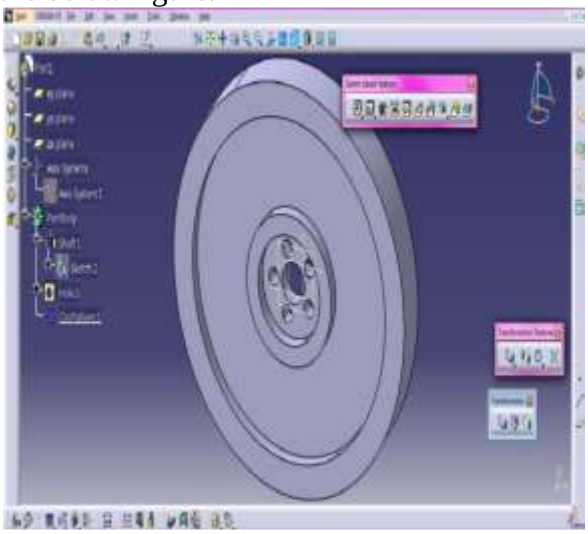
Inserting hole

After inserting hole on 100mm PCD select transformation features. It contains options like transformation, mirror, patterns and scaling. Select pattern and that select circular pattern a new window will open in that select axial reference and parameters as Instance and Total angle and number of instances as 6 and set total angle as 360 degrees. Select the 26 dia circle as current solid and reference element as front view as shown in figure

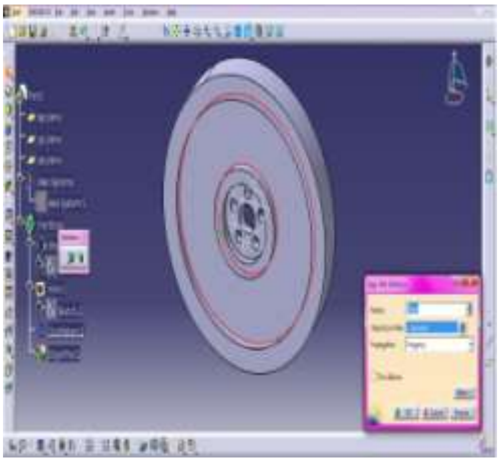


Circular pattern

After pressing the ok button at the bottom of new window the figure is as shown in the below figure.



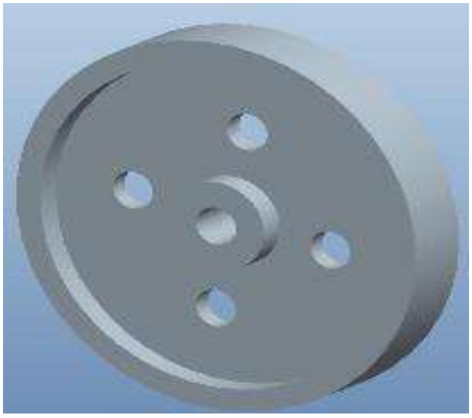
Flywheel with holes



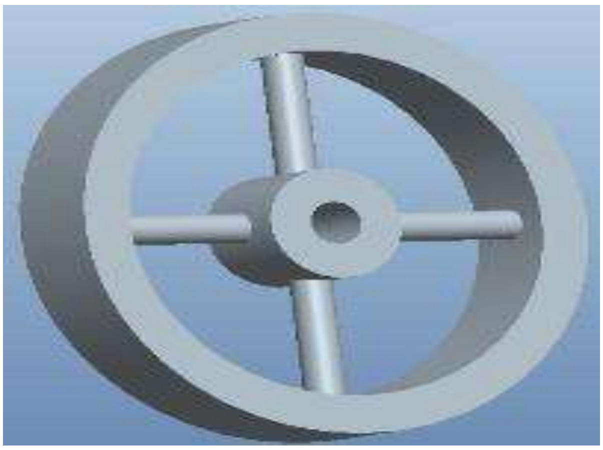
Edge fillet

After filleting the edges on both sides the required fly wheel is obtained as shown in figure .After that save the file as CATpart or Stp format for importing it into the ANSYS for analyzation purpose. CATpart format is used to import in to the A.P.D.L and Stp format into ANSYS workbench.

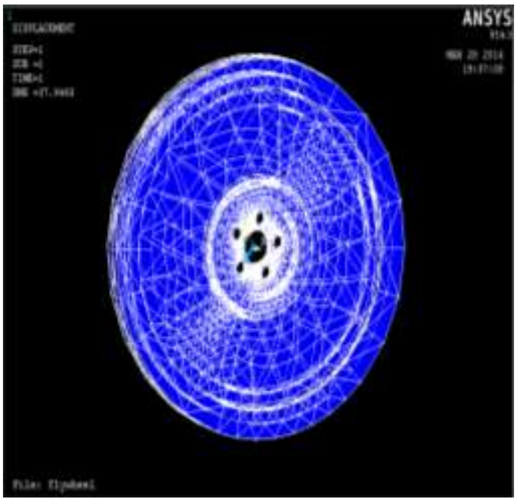
GEOMETRY PROFILE OF WEB TYPE FLY WHEEL



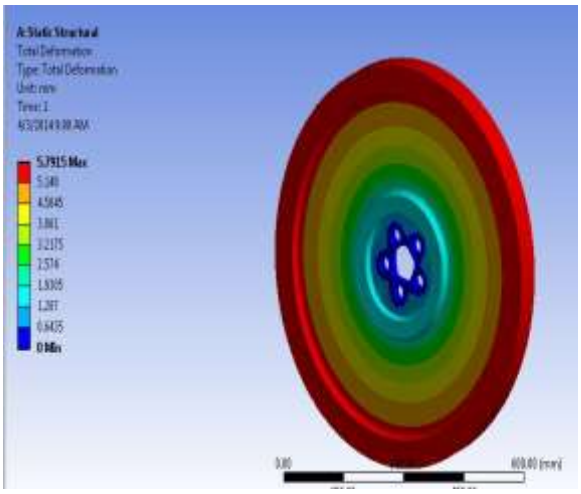
GEOMETRY PROFILE OF SPOKED TYPE FLY WHEEL



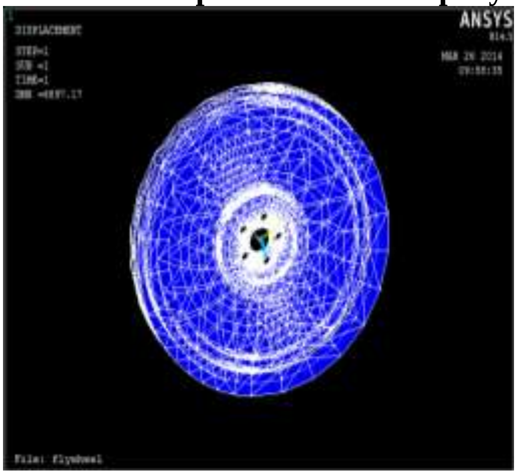
5.0 RESULTS:



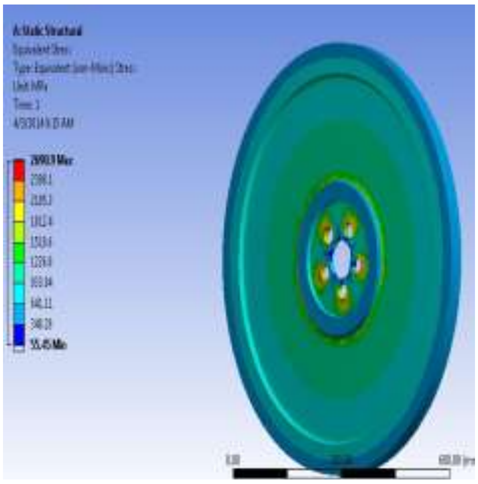
deformed shape for S – Glass Epoxy



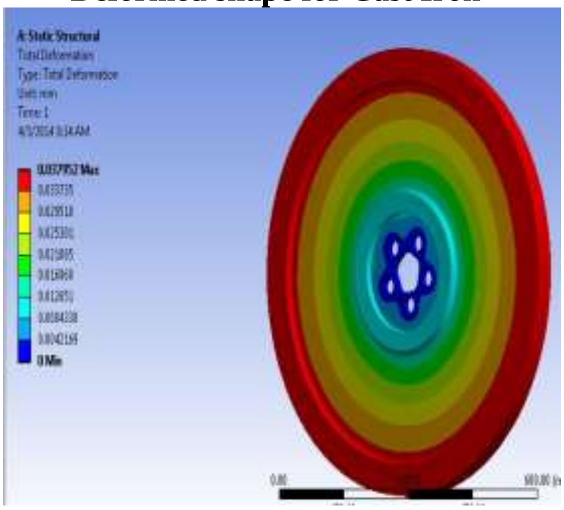
Total Deformation for Cast Iron



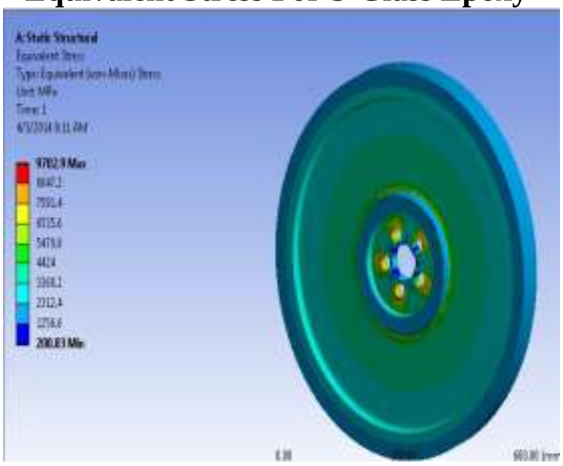
Deformed shape for Cast Iron



Equivalent Stress For S-Glass Epoxy

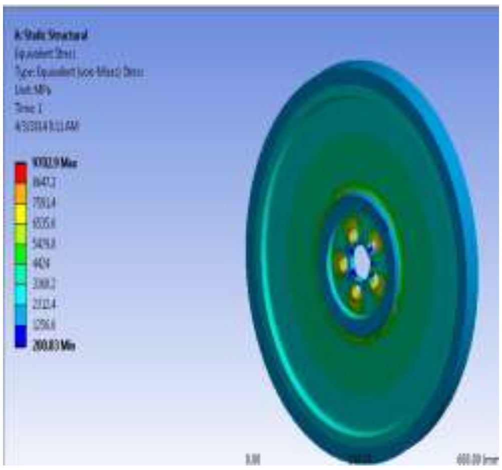


Total Deformation for S-Glass Epoxy

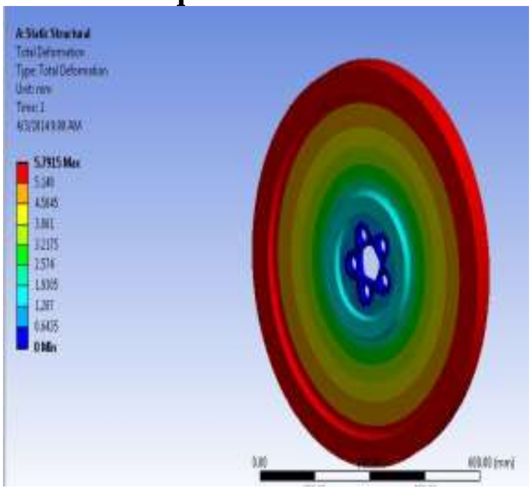


Equivalent Stress for Cast Iron

5.1 RESULTS AND COMPARISON RESULTS FOR SOLID TYPE WHEEL BY USING CAST IRON:



Equivalent stress

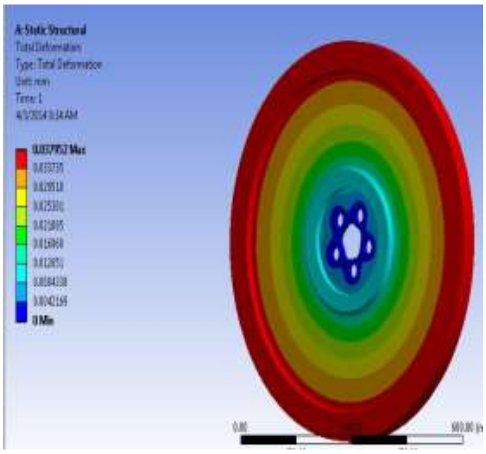


Total Deformation

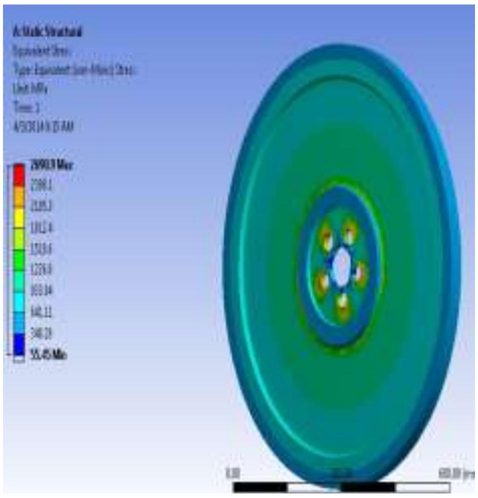
	Total deformation (mm)	Equivalent Stresses (Mpa)
Maximum	5.7915	9702.9
Minimum	0	200.83

Results for Cast Iron

RESULTS FOR S-GLASS EPOXY:



Total Deformation



Equivalent Stress

	Total Deformation (mm)	Equivalent Stress (MPa)
Maximum	0.03795	2690.9
Minimum	0	55.5

Results for S-glass Epoxy

COMPARISON TABLE:

	Cast Iron	S-glass Epoxy
Total Deformation (mm)	5.7595	9702.9
Equivalent Stress (MPa)	0.03795	2690.9

Comparison between Cast Iron and S-glass Epoxy

6.0 CONCLUSION

The subject of the flywheel is very extensive and is difficult to explain in few pages. This attempt is to summarize some important results by conducting the structural analysis on flywheel with Cast Iron and S-glass Epoxy.

Conducted the structural analysis on flywheel stresses and deformation are founded and observed. By observed results concluded that the most effective material is S-glass Epoxy because S-glass Epoxy has less deformation and less Equivalent Stress when compared to the Cast Iron.

FUTURE SCOPE

It is suggested that the analysis approach could be successful approach applied to Cast Iron and S-glass Epoxy under different loads.

The results show that the analysis of flywheel with different materials can be a simple way to find out the stress and deformation.

The stress and deformation obtained by this method are for future use for more elaborate for structural analysis with different materials.

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