DESIGN OPTIMIZATION AND ANALYSIS OF 4 STROKE IC ENGINE FLYWHEELS

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Abstract

A flywheel applied as part of machines fills in as a repository which shops power amid the length whilst the supply of vitality is greater than the necessity and discharges it amid the length while the prerequisite of energy is extra than supply. In I.C. Automobiles, the vitality is created simply inside the power stroke that is substantially more than motor load, and no energy is being produced amid the suction, pressure and fumes strokes in the event of 4 stroke motors. The overabundance energy is created amid manipulate stroke is consumed by using the flywheel and discharges it's to the wrench shaft amid trade strokes wherein no vitality is produced, subsequently pivoting the crankshaft at a uniform velocity. The flywheel is located in the direction of one aspect of the crankshaft and fills two desires. To begin with, through its inactivity, it lessens vibration by way of smoothing out the electricity stroke as every barrel fires. Second, it is the mounting floor used to jolt the motor as much as its heap. The factor of the venture is to devise a flywheel for a multi barrel oil motor flywheel utilising the special speeds and to break down to show symptoms of development comes approximately. A 2D drawing is drafted using the estimations. Examination is improved the scenario two substances Aluminum and Cast Iron to think about the results. CATIA is the standard in 3D item configuration, such as industry-using profitability contraptions that strengthen prescribed strategies in plan. ANSYS is extensively useful confined component exam (FEA) programming package deal. Limited Element Analysis is a numerical approach for deconstructing an complex framework into little pieces (of customer assigned size) known as additives. A parametric model of the flywheel is planned utilizing 3-D displaying programming CATIA. The powers following up at the flywheel are additionally computed. The pleasant of the flywheel is approved by applying the powers at the flywheel in examination programming Ansys.

Keywords:-Structural Analysis, engine flywheel, Dynamic Analysis.

INTRODUCTION

The flywheel is a stable metal, aluminum, or zinc plate that is mounted towards one facet of the crankshaft to give state of no activity to the motor. Dormancy is the assets of issue by way of which any physical body holds on in its situation of rest or uniform movement until observed up on via an outer strength. Idleness is not a electricity, it is a property of problem. Amid the hobby of a responding motor, burning occurs at unique interims. The flywheel elements the dormancy required to counteract loss of motor pace and

potential stoppage of crankshaft turn between burning interims. Amid each stroke of an inward ignition motor, the flywheel, crankshaft, and different motor components are inspired by variances in speed and energy. Amid the electricity occasion in a 4-stroke cycle motor, the crankshaft is quickened speedy by the unexpected motion of the cylinder and interfacing bar get together. The flywheel clean's out a part of the rpm and electricity deviation via its safety from growing velocity. The state of being inactive of the flywheel offers a hosing effect on the motor normal to attempt to out outspread increasing velocity powers and rpm deviations created inside the motor. **1.4 Function of Flywheel in engine**

The flywheel is set up on the one aspect of a crankshaft of the transmission line, to reduce the unevenness of the rotational power on the crankshaft. On account of the four-stroke motor, in every chamber, one strength stroke is created in line with upsets of the crankshaft. The flywheel shops this power as active energy and offers the same in trade strokes (stress, admission, and fumes) for a ceaseless motor run. Along these traces, with out a flywheel, the flip of the crankshaft has moved towards turning into throbbing; and when the intervening time of the strength stroke turns out to be lengthy as within the lingering kingdom, the motor receives ceased.

The flywheel collected on a crankshaft more likely than no longer been progressively adjusted. Progressively unequal gathering causes vibration of the crankshaft and similarly a huge load on the crankshaft and bearing.

Calculation of ic engine flywheel

The approach predicted to play out an examination rely on the investigation write. You finish an exam by means of playing out the accompanying advances:

• Create an exam characterizing its research compose and alternatives. If important, represent parameters of your exam.

• A parameter may be a model dimension, cloth assets, compel esteem, or some different information.

• Define material properties.

• Specify regulations and burdens.

• The software therefore makes a mixed paintings when various geometries (robust, shell, auxiliary individuals and so forth.) exist inside the model.

• Define section touch and call units.

• Mesh the model to split the version into severa little portions called additives.

• Fatigue and advancement examines utilize the go sections in referenced investigations.

• Run the examination and View comes approximately.

Analysis Properties (1):

S.No	Properties	Values
1	Young's Modulus (MPa)	2×10^5
2	Poison's ratio	0.3
3	Analysis Type	Structural
4	Elements	Solid – 10 node 187

Analysis Properties (2):

S.No	Properties	Values
1	Young's Modulus (MPa)	2×10^5
2	Poison's ratio	0.3
3	Analysis Type	Dynamic
4	Elements	Solid – LS Dyna Explict

Materials properties for Aluminum:

S.No	Material	Aluminum
1	Young's Modulus (MPa)	7.1×10^5
2	Poison's ratio	0.33
3	Yield strength (N/mm^2)	240
4	Density (kg/m^3)	2710

Materials properties for Cast Iron:

S.No	Material	Cast Iron
1	Young's Modulus (MPa)	2.1×10^5
2	Poison's ratio	0.30
3	Yield strength (N/mm^2)	200
4	Density (kg/m^3)	7870

DESIGN METHODLOGY OF IC ENGINE FLYWHEEL

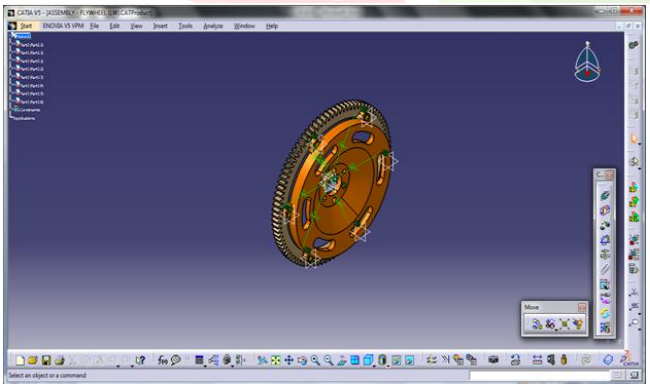

Fig:-1 Model design of IC Engine Flywheel in CATIA-V5

Multi View: This is the command in which all the views of the component / model can be displayed on the screen at a same time, they can be edited under the workbench.

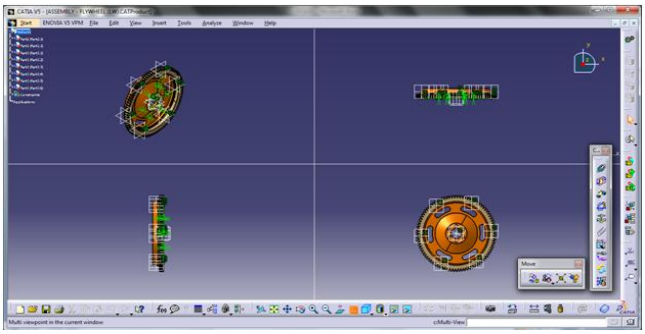

Fig: 2 Using Multi View Command

Bill of material

S.No	Component Name	Material	Qty	Density (Kg/m^3)	Mass	Area (m^2)
01	Ring Gear Pin	CI	06	7870	0.012	$9.6*10^{-4}$
02	Flywheel Ring Gear	CI	01	7870	2.056	0.084
03	Flywheel – CI	CI	01	7870	3.553	0.128
04	Flywheel – A1	Aluminum	01	2710	1.224	0.128

DISCUSSION ON ANALYSYS RESULT

Results of Displacement Analysis:

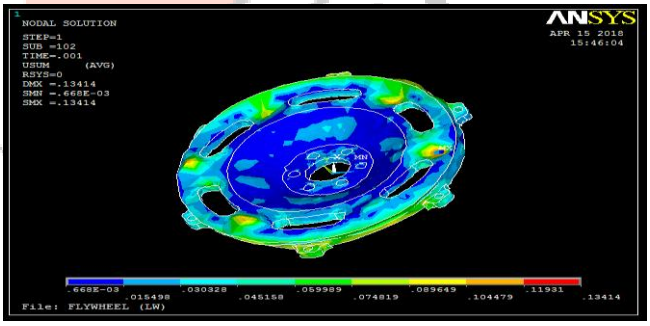

Fig:- 3 Displacement of FLYWHEEL

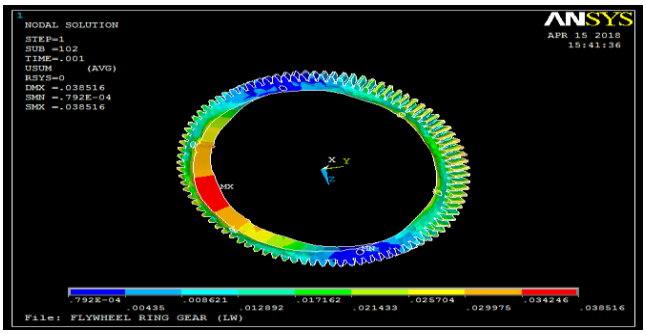

Fig:-4 Displacement of FLYWHEEL RING GEAR

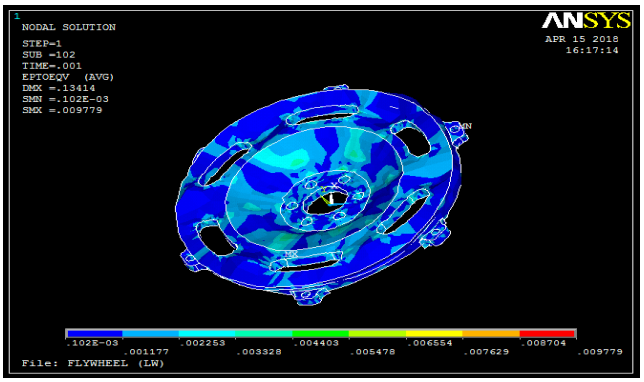

Fig:-5 Von Mises Strain Analysis AL – 10000

CONCLUSION

It seen from the above result that, our objective to find out after the loads falling on the flywheel in the IC Engine with variable speeds. The design has been successful. As shown above figures the displacement of the complete design assembly is meshed and solved using Ansys and displacement is 0.059 mm which is very less. This is showing us that clearly each component in assembly is having minor displacement.

Structural Analysis

Stress is at the fixing location (Minimum Stress which is acceptable). The value is 1.356 MPa which is very less compared to yield value; 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 788.31 MPa which is very less.

S.No	Results	Flywheel Assembly
01	Displacement (in mm)	0.059
02	Stress (Mpa)	788.31
03	Strain (Mpa)	0.0051

So we can conclude our design parameters are approximately correct. Strain acting by the designed model is at the fixing location. The value is 0.0051 MPa.

Dynamic Analysis

It seen from the above result that, our objective to find out after the loads falling on the flywheel in the IC Engine with variable speeds by dynamic analysis. The design has been successful.

Dynamic Analysis – 3500 RPM

S.No	Results	Al – 3500	CI – 3500
01	Displacement (in mm)	0.0462	0.0645
02	Rotational (in mm)	0.0899	0.0699
03	Von Misses Stress (Mpa)	518.96	657.47
04	Von Misses Strain (Mpa)	0.0033	0.0037

Dynamic Analysis – 10000 RPM

S.No	Results	Al – 10000	CI – 10000
01	Displacement (in mm)	0.1341	0.0921
02	Rotational (in mm)	0.1767	0.0999
03	Von Misses Stress (Mpa)	937.91	1504.49
04	Von Misses Strain (Mpa)	0.0097	0.0053

According to the above results, where design we have imported it into the Ansys and structural and dynamic analysis is done on it using the materials Cast Iron and Aluminum. By using these materials the results are obtained and when they are compared with each other.We can conclude that Aluminum is lighter in weight and can be stable than Cast Iron has the best ability to rotate at the analyzed rpm which can be brought into effect.The design of the flywheel in the IC Engine with variable speeds mechanism worked flawlessly in analysis as well. All these facts point to the completion of our objective in high esteem.

FUTURE SCOPE

Although the flywheel is one of the earliest forms of energy storage, compact, reliable, low maintenance flywheels have only become available relatively recently. The numbers produced have been small, and the use of more exotic materials and their processing, such as carbon fiber composites. New, innovative designs based on steel overcome the concern about safety for highly stressed rotors, which can now operate at much higher tip speeds than must considered safe.

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