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OPTIMIZATION AND ANALYSIS OF FLYWHEEL

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Abstract

In present investigation, a flywheel is designed, optimized and analysed. By using optimization technique various parameter like material, cost for flywheel can be optimized and by applying an approach for modification of various working parameter like efficiency, output, energy storing capacity by applying various materials and loads on the basic design with constraints and boundary conditions and hence we can compare the result with existing flywheel result. Based on the dynamic functions, specifications of the system the main features of the flywheel are initially determined, the detail design study of flywheel is done.The three-dimensional body of our design would be done on CATIA software and would be analysed with all the parameters using ANSYS software. Then FEA ANALYSIS for more designs in diverse areas of engineering are being analysed through the software. FEA provides the ability to analysed the stresses and displacements of a part or assembly, total deformations, life, and damages as well as the reaction forces other elements are to be imposed. This thesis guides the path through 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. At last, the design objective could be simply to minimize cost of flywheel by reducing material and understand the life of a flywheel.

Key words: Flywheel, Optimization design, Analysis, Finite Element Analysis (FEA)

1. INTRODUCTION

A flywheel is a mechanical gadget particularly intended to effectively store rotational vitality. Flywheels oppose changes in rotational speed by their snapshot of dormancy. The measure of vitality put away in a flywheel is relative to the square of its rotational speed. The best approach to change a flywheel's put away vitality is by expanding or diminishing its rotational speed applying a torque lined up with its hub of symmetry,Basic employments of a flywheel include:

Smoothing the power yield of a vitality source. For instance flywheels are utilized as a part of responding motors in light of the fact that the dynamic torque from the individual cylinders is irregular. Energy stockpiling frameworks Flywheel vitality stockpiling Delivering vitality at rates past the capacity of a vitality source. This is accomplished by gathering vitality in a flywheel after some time and afterward discharging it rapidly, at rates that surpass the capacities of the vitality source. Controlling the introduction of a mechanical framework, spinner and response wheel Flywheels are normally made of steel and turn on customary orientation; these are by and large constrained to a greatest upheaval rate of a couple of thousand RPM. High vitality thickness flywheels can be made of carbon fiber composites and utilize attractive course, empowering them to rotate at speeds up to 60,000 RPM (1 kHz).Carbon-composite flywheel batteries have as of late been made and are ended up being suitable in genuine tests on standard autos. Moreover, their transfer is more eco-accommodating.

Figure 1 Flywheel To Even Out The Power Of Its Single Cylinder.

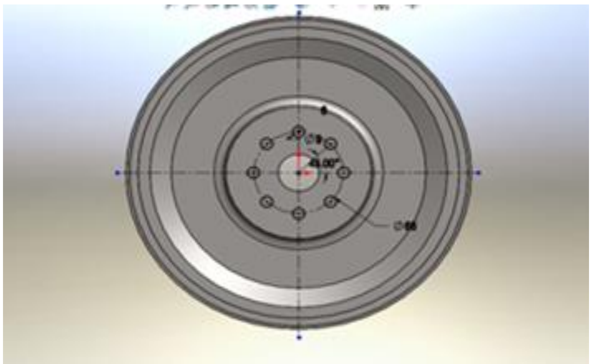


Figure 2 Pocket Cut

- ❖ After sketch. Go to features and select Pocket cut boss/base .
- ❖ In Pocket cut boss, sketch above profile as a object to depth and specify direction
- ❖ Then click ok or click on right mark.

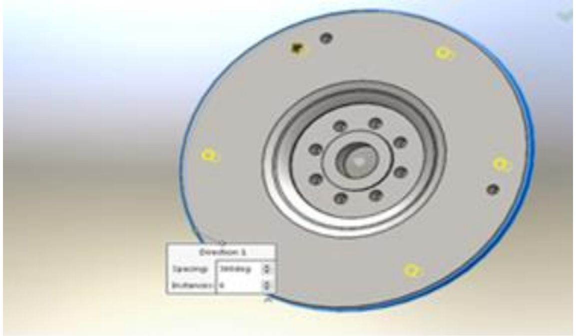


Figure 3 pocket Cut And Circular Pattern

- ❖ After pocket cut, go to plane in reference and select front plane as a reference and specify offset distance 0.45metre.

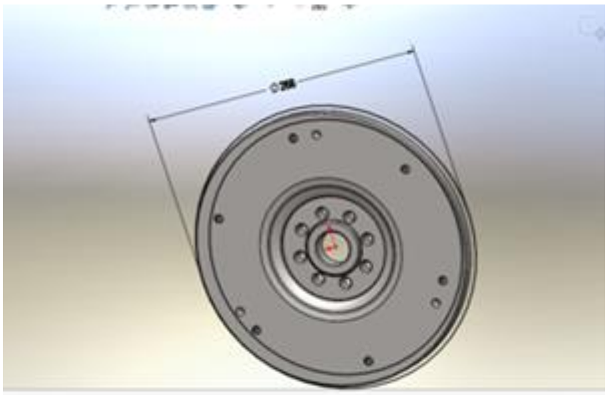


Figure 4 Sketch For Teethes

- On part module go to sketch. And select sketch, then create sketch as shown in figure in below
- Later select on exit sketcher

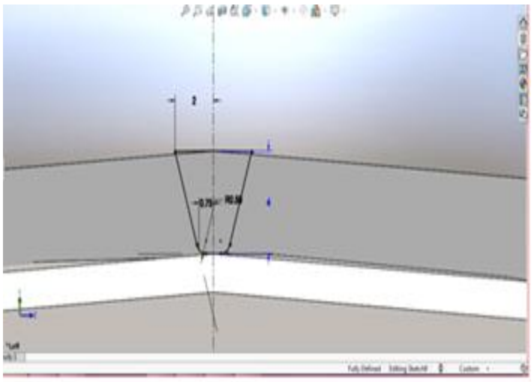


Figure 5 Sketch For Teeth

- After sketch. Go to features and select extrude cut boss/base .
- In extrude cut boss, sketch above profile as a object to depth and specify direction
- Then click ok or click on right mark.

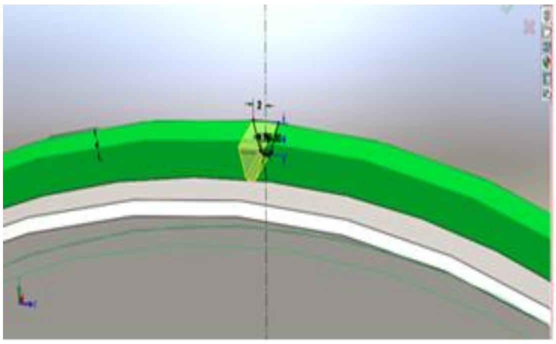


Figure 6 pocket Cut

- final modal with 152 teethes as shown in figure 3.10.

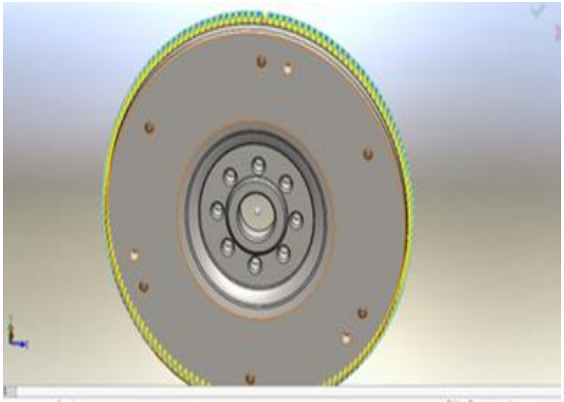


Figure 7 Model 1 With 152 Teethes

- similarly I also create 146 teethes fly wheel as shown in figure 3.11.

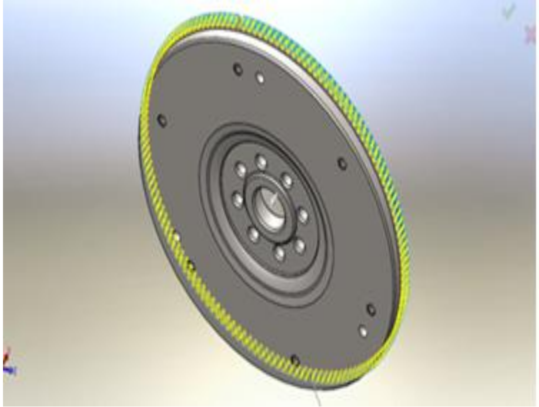


Figure 8 Modal 2 with 146 Teethes

Pre-processor

The pre-processor is a phase that process input data to produce an output which is used as input in the subsequent phase (solution). Following are the input data that need to be given to the pre-processor.

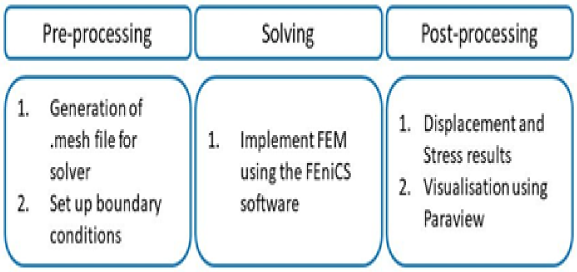


Figure 9 FEA Through Software

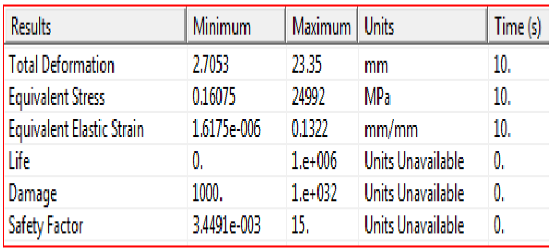
Types of analysis (structural or thermal, static or dynamics, and linear or non-linear).

Components Type :

- Real constants for components (cross-sectional zone, snapshots of idleness, shell thickness and soon)
- Material properties (young's modulus, poisons proportion, spring consistent, warm conductivity, coefficient of warm development, and soon)
- Geometry show (either made in FEA programming or imported from miscreant bundle)
- FEA display (disparaging the geometric model into little components)
- Loading and limit conditions (characterizing loads, weights, minutes, temperature, conductivity, convection, imperatives (settled, stuck or frictionless/symmetrical), et cetera.
- The input information are preprocessed for the yield information and the preprocessor creates the information documents consequently with help of employments.

2. ANSYS WORKBENCH

The modal analysis is used to calculate the vibration characteristics such as natural frequency and mode shape (deformed shapes) of a structure or a machine component. The output of the modal analysis can be further used as input for the harmonic and transient analyses.For example , a beam, attached to a system vibrating at a certain frequency. It is important for the designer to find out whether the beam will sustain the vibrations induced by the machine to which it is connected.hen the vibrates, various shapes are attained at certain frequencies. The shape of the component corresponding to a frequency is known as mode shape. The mode shape is a graphical representations of the deformation attained due to vibration. The main aim of the modal analysis is to find whether the natural frequency of the component is closer to the vibrations induced in the component. In this example, with this , the maximum number of modes found is six. Through display the various mode shapes of first, second, 3rd, and 4th modes, respectively.If the natural frequency of a system is very close to the excitation frequency, the component can get into resonance and fail. Therefore, to avoid the resonance, you need to strengthen the component on die basis of the mode shape. However, sometimes strengthening the component may not be possible due to the design limitations. Also, in actual practice, the displacement produced at resonance may not be infinite due to the presence of damping. Therefore, you need to calculate the response of a system under the time/frequency based loads. If the stress/strain/displacement response is less than the permissible limit, the component will not be required to strengthen or redesign.



Results	Minimum	Maximum	Units	Time (s)
Total Deformation	2.7053	23.35	mm	10.
Equivalent Stress	0.16075	24992	MPa	10.
Equivalent Elastic Strain	1.6175e-006	0.1322	mm/mm	10.
Life	0.	1.e+006	Units Unavailable	0.
Damage	1000.	1.e+032	Units Unavailable	0.
Safety Factor	3.4491e-003	15.	Units Unavailable	0.

Figure 10 Summary From Workbench

- ❖ Close the existing mechanical window; the workbench window is displayed.

3. RESULTS

Total Deformation FOR MODAL ANALYSIS:

	Model 1		Model 2	
Modes	Total Deformations Mm	Frequency Hz	Total Deformations Mm	Frequency Hz
1	26.403	532.39	26.37	531.78
2	26.435	534.09	26.412	533.09
3	18.595	782.16	18.568	781.42
4	17.531	1081.7	17.519	1081
5	28.835	1099.3	28.807	1098.2
6	28.82	1099.4	28.806	1098.3
7	21.12	2594.1	31.089	2591.7
8	31.348	2604.6	31.331	2602.2

Table 1 Resultant Deformations

TOTAL DEFROMATION OF STATIC STRUCTURAL

Modal 1		
Types	Units	Maximum
Total Deformation	Mm	23.352
Equivalent Stress	Mpa	27948
Equivalent Strain	Mm/Mm	0.14823
Life	Hours	1000000
Damage	Positions	1000
Safety Factor		0.0003084

Modal 2		
Types	Units	Maximum
Total Deformation	Mm	23.35
Equivalent Stress	Mpa	24992
Equivalent Strain	Mm/Mm	0.1322
Life	Hours	1000000
Damage	Positions	1000
Safety Factor		0.0003449

Table 8.2 Total Deformation, Stress, strain and life

4. CONCLUSION

We have successfully made a change in flywheel design by reducing the teethes of 152 to 146 teethes. We compared the results of two models of flywheels which are having 152 teethes and 146 teethes in terms of total deformations, equivalent stress, strain, life of flywheel and damages occurred during applying loads. The results shows that the flywheel which having of 146 teethes and 152 teethes are same, yet a slight change in stress and life of fly wheel. Consequently I can state that quality and life do fly wheel is relies upon speed and no of teethes.

The static auxiliary and modular investigation is done in the ANSYS 16 programming for low head FLY WHEEL sprinter. The anxiety (von-misses) and most extreme anxiety created at the sprinter cutting edges are greatest at joints between the centre point and sprinter sharp edge whoever their valves are less a definitive rigidity of the sprinter edge material. Most extreme rule push is likewise in as far as possible. Henceforth every one of the burdens created at the FLY WHEEL sprinter are sheltered and no real disappointment is recorded amid the static basic investigation. The modular investigation demonstrates no reverberation in any of the four mode shapes. The regular recurrence of all mode shape does not coordinate with the common recurrence of the sprinter sharp edge. Henceforth no reverberation delivered amid the modular examination. The cutting edge goes about as a settled cantilever shaft amid the modular investigation where the relocation is high however in safe points of confinement at the edges of the sprinter sharp edge for all mode shapes.

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