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Optimization of Crankshaft Performance using ANSYS & CATIA

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A B S T R A C T

The Engine Crankshaft are one of the most important components of an automobile which is subjected to high rotational and structural stresses. The material of Crankshaft should have high strength to density ratio and high thermal conductivity so as to dissipate heat and prevent crankshaft wear and tear also engine damage. The current research investigates the application of MMC (Metal Matrix Material) compo site material for engine crankshaft subjected to Heavy loading conditions. The CAD model of crankshaft is developed ANSYS FEA software. optimize designed crankshaft by changing or modifying dimension for right balancing and also different grades of steel to study the variation properly In this experiment it was revealed that in addition to the AISI 4041 material.

Keywords: AISI 4014, GGG70, FEM, Crankshaft.

1.Introduction

Crankshaft is a substantial part with a mind-boggling geometry in the motor, which changes over the responding relocation of the cylinder into a rotational movement. This examination was directed on a four-chamber petroleum motor. It must be sufficiently solid to take the descending power amid control stroke without unnecessary twisting. Due to the continued bowing and winding burden the crankshaft bombs as splits shape in filet region and expectation of weakness life is vital to guarantee wellbeing of segments. The crankshaft which changes over the responding demonstration of cylinder inside chamber to the rotational demonstration of flywheel. This Conversion of the movement is finished by utilization of the counterbalance inside crankshaft.

2 .Proposed Work

The general goal of this investigation was to assess and look at the weariness execution of two contending producing advancements for car crankshafts, namely ASTM A536 100-70-03 (EN-GJS-700-2, GGG70, Ductile Iron, SG Iron) and AISI-4140 alloy steel(EN 19C). Moreover, weight and cost decrease for enhancement of the produced steel crankshaft were likewise researched.Subtle elements of the writing audit led, test program and results, and investigations preformed on the crankshaft consider are introduced in two broad reports and a few different productions. These reports and productions were examined. This official outline gives a concise foundation and result for the examination, and in extent of the investigation.

3 Methodology

In this stage the CAD model is developed using Catia design software using extrude, revolve and pattern tools. Crankshafts typically have either necessary or connectable stabilizers. These stabilizers balance the outward power made by every individual crankpin and its networks as the entire crankshaft is pivoted about the fundamental diary hub. Without the stabilizers, the crankpin masses tend to twist and twist the crankshaft causing intemperate edge-stacking in the principle heading. In this manner, every half wrench web is by and large reached out the other way to that of the crankpin, to offset the impacts of the crankpin.

Dimensions of crankshaft

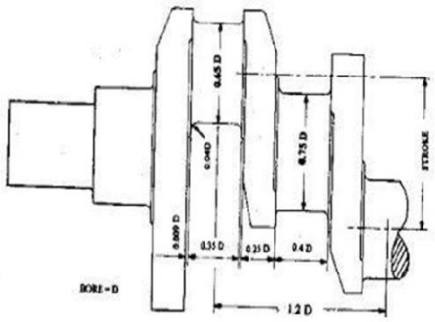

Figure 2: Dimensions of crankshaft

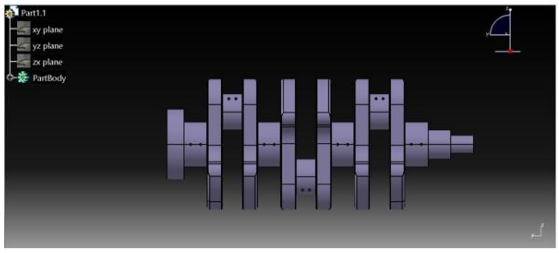

Figure 6.2 shows description of crankshaft from side view.

CATIA stands for Computer Aided Three-dimensional Interactive Application. It's a CAD software used for physical modelling in various industries including Mechanical and Aerospace. It was developed by Dassault Systems in early 80's mainly for aerospace industry.

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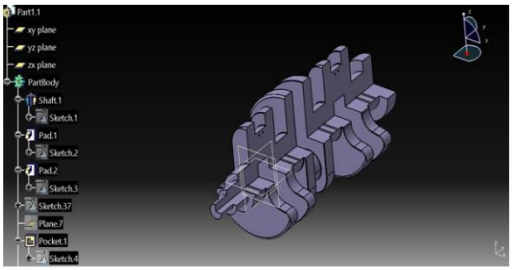


Figure 3: isometric view of crankshaft

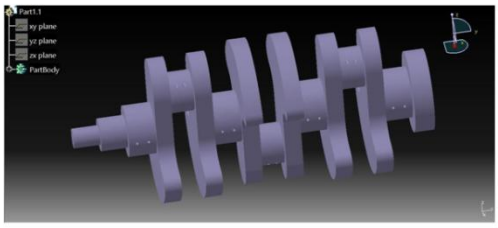


Figure 4: Views of crankshaf explained

Compression based on fillet and not fillet crankshaft is that filleted crankshaft is have more life as it is having less weight and better demission stability which in turn provided efficient working and good balancing.

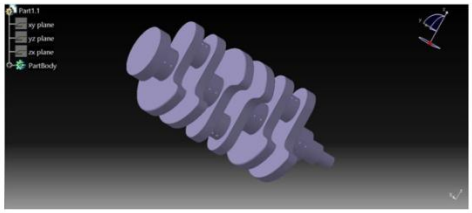


Figure 5: Crankshaft Not filleted

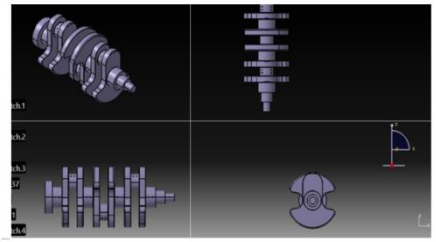


Figure 5: Crankshaft Not filleted

Both alloys steel had good machinability in form as the annealed condition as annealing diminishes inside burdens and help machining. AISI/SAE 4140 Hardness is comparatively high then GGG 70 indicates great general blends of quality, durability, wear opposition and exhaustion quality. It has high exhaustion quality, scraped area and effect opposition, durability, and torsional quality. By providing fillet the distribution of material is uniform over all edge which help in achieving better balances as reduced unbalanced or counter weight of crankshaft.

4. Results and Discussion

The first thing that is needed to be performed is the validation of the experiment. While dealing with problems of the forces excreted on the crankshaft or combination of them as in our case it is difficult to predict data theoretically and compare the results with calculators gathered data. This problem intensifies when the number of unknown increases in the experiment.

The controlled parameters in our calculations are-

1. Life (Numbers of cycles).
2. Safety Factor.
3. Equivalent Alternating Stress.
4. Shear Elastic Strain.
5. Equivalent Elastic Strain.
6. Deformation.
7. Damage.
8. Mathematical values of Equivalent Elastic

Stress.
9. Mathematical values of Shear Elastic Strain.
10. Mathematical values of Shear Stress.
11. Mathematical values of Safety Factor.
12. Mathematical values of Stress Safety Tool.
13. Graphical representation of Amplitude of the forces.
14. Graphical representation of Fatigue tools for mean stress correction theory.

Based on our readings and available data we have calculated the following parameters,

1. Calculation of the Dimensions of the crankshaft.
2. Factor of safety (N).
3. Forces exerted on the crankshaft.

Force while Rotation Life Material GGG 70

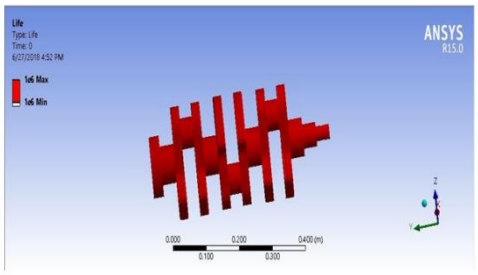


Figure 6: Life material GGG 70

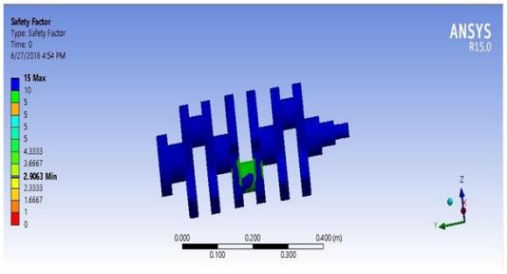


Figure 7: Safety Factor material GGG 70

To counter the problem of validation of such problems use of materials done as well as the safety of factor. Based on the type of problem various materials are proposed by scientists. Materials are characteristic number obtained by combination of different properties of metal used, forces that they can resist, and other physical specifications related with the crankshaft and the validation is done by the safety of factor of the material which was calculated by number of factors and properties of the material Here in this project we have a rotational, vertical as well as horizontal forces on a crankshaft. The force is mainly rotational in nature. It is a case of forced convection on the crankshaft which is due to piston forces, rotation due to piston, counter weight. For such a force Good man's theory is used to standardize the problem and study the characteristics of the material with the use of safety of factor which is 3.

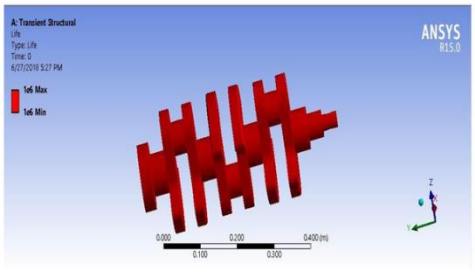


Figure 8: Life material AISI 4041

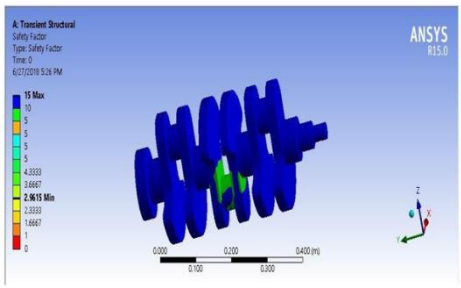


Figure 9: Safety factor material AISI 4041

In this figure we had tested for life taking consideration as force while rotational for the material GGG 70. As life is one of the most important parameters for judgement of any crankshaft is good or not.In this figure we had tested for life taking consideration as force while rotational for the material AISI 4041.

Safety Factor

Now we will discuss about safety factor as for any crankshaft factor of safety is also one of the most important parameters which need to check.For this we will take both material analysis one by one first we are taking material GGG 70 for safety parameter testing or analysis.

Material AISI 4041

Then we are taking next material into consideration which is AISI 4041 as for the material factor of safety is very important parameter which is needed to decide which material can server better factor of safety.

Equivalent Alternating Stress

Now next parameter which we are considering is Equivalent alternating stress as it is also one of the most important parameters as stress is major factor for failure of crankshaft, we need to check equivalent alternating stress for both the material first we are taking Martial GGG 70.

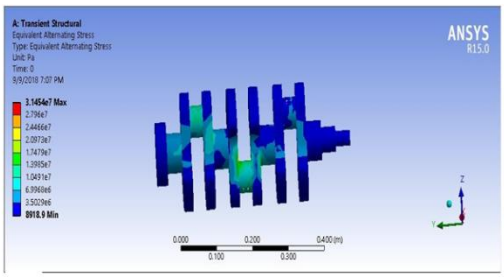


Figure:10 Equivalent alternating stress material GGG 70

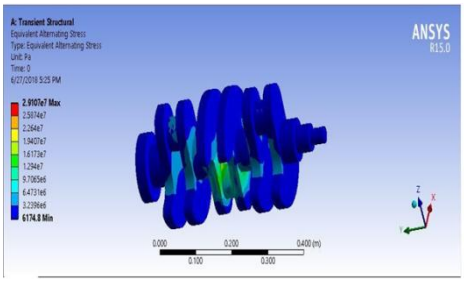


Figure:11 Equivalent alternating stress material AISI 4041

Shear Elastic Strain

Shear force which is also one of main consideration in which we are taking shear elastic strain as elasticity is also the factor which come into play which crankshaft operated. Firstly material GGG 70.

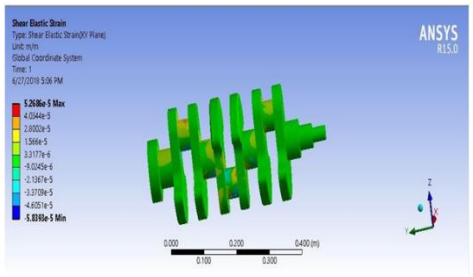


Figure: 12 Shear elastic strain material GGG 70

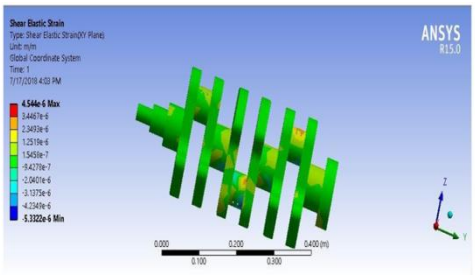


Figure: 13 Shear elastic strain material GGG 70

Deformation

Deformation of crankshaft due to several loads or forces is also need to check for a right crankshaft design as for any crank shaft material the deformation parameter is needed to check on priority basis.

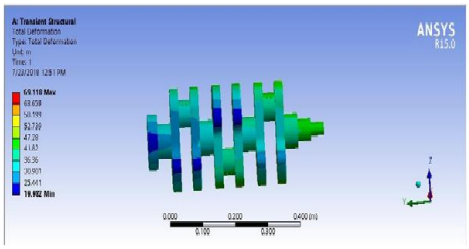


Figure: 14 Deformation material GGG 70

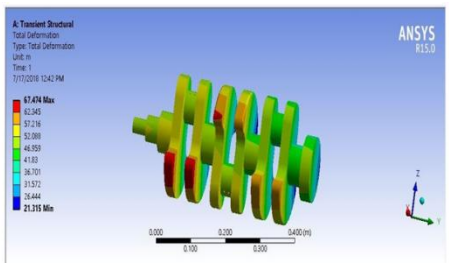


Figure: 15 Deformation material AISI 4041

Deformation for material AISI is shown in above figure by which we get details about deformation which certain about of force or load is applied.

Damage Material GGG 70

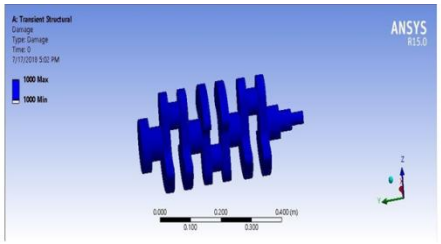


Figure:16 Damage material GGG 70

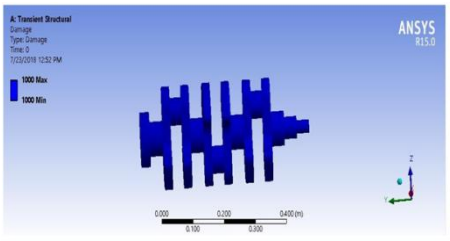


Figure:17 Damage material AISI 4041

Above two figures respectively figure 7.13 for material GGG70 and material AISI 4041 showed the effect of load or force on crankshaft material

which is need to check from perfect working of crankshaft

Results in tabular form Material GGG 70

Table 7.1 difference several factors of material GGG 70

Object Name	Equivalent Elastic Strain	Shear Elastic Strain	Shear Stress
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Definition			
Type	Equivalent Elastic Strain	Shear Elastic Strain	Shear Stress
Results			
Minimum	7.6672e-008 m/m	-5.5354e-005 m/m	-3.888e+006 Pa
Maximum	1.652e-004 m/m	5.2433e-005 m/m	3.6828e+006 Pa
Minimum Value Over Time			
Minimum	7.6672e-008 m/m	-5.5354e-005 m/m	-3.888e+006 Pa
Maximum	7.6672e-008 m/m	-5.5354e-005 m/m	-3.888e+006 Pa
Maximum Value Over Time			
Minimum	1.652e-004 m/m	5.2433e-005 m/m	3.6828e+006 Pa
Maximum	1.652e-004 m/m	5.2433e-005 m/m	3.6828e+006 Pa
Information			

In above table there is compression between factor like equivalent elastic strain, shear elastic strain and shear stress for crankshaft.

Material AISI 4140

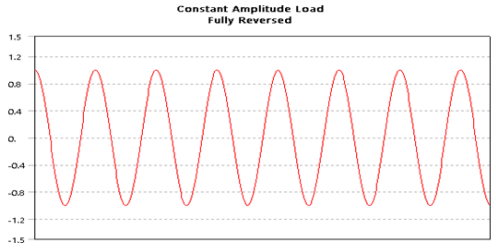
Table 7.2 difference several factors of material AISI-4140

Object Name	Equivalent Elastic Strain	Shear Elastic Strain	Shear Stress
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Results			
Minimum	6.8837e-009 m/m	-5.3322e-006 m/m	-4.2658e+006 Pa
Maximum	1.4805e-005 m/m	4.544e-006 m/m	3.6352e+006 Pa
Minimum Value Over Time			
Minimum	6.8837e-009 m/m	-5.3322e-006 m/m	-4.2658e+006 Pa
Maximum	6.8837e-009 m/m	-5.3322e-006 m/m	-4.2658e+006 Pa
Maximum Value Over Time			
Minimum	1.4805e-005 m/m	4.544e-006 m/m	3.6352e+006 Pa
Maximum	1.4805e-005 m/m	4.544e-006 m/m	3.6352e+006 Pa
Information			

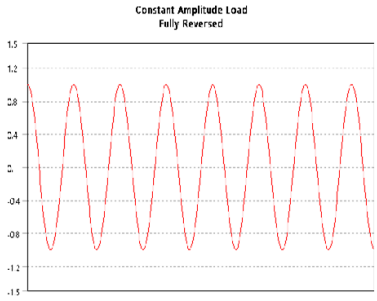
AISI 4140 is a chromium-molybdenum alloy steel. The chromium content provides good hardness penetration, and the molybdenum content ensures uniform hardness and high strength. AISI 4140 chrome-molybdenum steel can be oil hardened to a relatively high level of hardness. The desirable properties of the AISI 4140 include superior toughness, good ductility and good wear resistance in the quenched and tempered condition.

Amplitude of the forces Material GGG 70 Amplitude of the forces

It is quite often to have the metallurgical problems such as segregation, formation of inter- metallic compounds that tend to alter the mechanical properties of the weld interface and weld zone associated with the dissimilar combinations of low alloy steel and austenitic stainless steels. It is reported that segregation within the dendritic structure results in deterioration of the mechanical properties and corrosion resistance of the joints.



Graph 01 Amplitude of the force Material GGG 70



Graph 02 Amplitude of the force 1 Material AISI 4140

Mean stress is equal to the average of the maximum and minimum stress during a fatigue load cycle. Much of fatigue data is generated assuming a zero-mean stress, which means that the load cycle is completely reversed. The stress ratio, also referred to as R or R-ratio, is defined as the minimum stress over the maximum stress and is used to quantify the mean stress. A stress ratio of -1 represents a fully reversed loading.

5.Conclusion

The work in place is made using AISI-4140 alloy steel (EN 19C) steel specific and diesel motor camshaft material as compared to ASTM A536 100-70- 03 (GGG7O) material High ductile. And the material is heavier than ASTM A536 100-70-03 (GGG70), but possesses higher crankshaft properties and has a higher degree of stress, thus achieving higher administration life. These metals have high shear force and, high hardness, pile condition, yield strength = 70000 and tensile strength = 100000 psi, Working on Ansys, we find that the material on ASTM A536 100- 70-03 (GGG7O) is sheared at high tensile strength, more solid than AISI-4140 alloy steel (EN 19C). Impact testing reveals that AISI-4140 Alloy Steel (EN 19C) weighs 3 kg more than ASTM A536 100-70-03 (GGG7O).In addition, the results of work done in France have shown that AISI-4140 alloy steel (EN 19C) crankshafts also reduce dislocation compared to ASTM A536 100-70-03 (GGG7O) camshafts for all stack positions It can be seen from these results that AISI-4140 alloy steel (EN 19C) camshafts give better results when used. This study will help to find the most suitable crank shaft material of the future design parameters for crankshaft can reduce time and cost and can help in increasing quantity and quality products which in turn huge benefits to automobile industries.

6. References :

[1] Farzin H. Montazersadgh and Ali Fatemi], The examination to explore weight and cost for a fashioned steel crankshaft "Technology of crankshaft In Science & Engineering (IJAFRSE)."

[2] Mahesh L. Raotole ,D. B. Sadaphale ,J. R. "The weariness life of crankshaft" is rely upon the correct filet span.

[3] Seema S. Shinde ,C. S. Pathak and Manoj "Recognize and enhance the exhaustion life of the crankshaft by performing parametric investigation", Colorado state university, 2004 formula SAE platform

[4] Ms.Shweta Ambadas Naik "Function of crankshaft and reciprocating displacement of the piston" (October 2008) An innovative crankshaft designing

[5] Ktari et al "Examination of the disappointment of three unique crankshafts of 12 chambers V-12 outline motor utilized in trains". Volume 1 Issue 1, MAT Journals 2017.