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"Modification of Engine Crankshaft Performance Using Different Materials"

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A B S T R A C T

All automobile companies are trying to modify their vehicle, in which the automobile engine becomes powerful and at the same time becomes compact, which takes less space.The requirement is that the engine should produce a large amount of power without any wear and tear. The main part of the power generation assembly is the crank shaft which produces torque to the entire engine. As we know these days off road driving is in trend among more and more youth which due to excessive power requirement leads to crankshaft break Due to the increasing power requirement due to the crankshaft steel being made of metal and the limited available space in commonly used vehicles, increasing the efficiency and thickness of the vehicle results in increasing the weight of the crankshaft. which is not as suitable as it should be. We here in this study try to study the effect of various materials on the overall crankshaft and the performance of an Ashok Leyland's Hino engine. Here we have designed a test crankshaft of Ashok Leyland's hino v8 engine rig for evaluation performance. These materials offer low weight and deformation. With the advancement of study in material, In today's modern era, new generations of new materials are coming out all the time with new discoveries and researchers also found that these materials are less weight than traditional materials but also exhibit greater amount of strength.

Keywords: AISI 4014, GGG70, FEM, Crankshaft, Engine.

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. 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. Each counterbalance some portion of the crankshaft has an orientation surface known as a wrench stick to which the interfacing bar is appended Crank-through is the balanced cylinder is controlled by the toss of the crankshaft. The burning power is exchanged to the from the crankshaft focus line. The stroke of the wrench toss after the crankshaft has moved past best perfectly focused to deliver turning exertion or torque, which pivots the crankshaft. Hence all the motor power is conveyed through the crankshaft.

2 .Proposed Work

Material are as essential as the crankshaft choice. We initially expected to contemplate distinctive kinds of material accessible and some other new elective material if accessible. We went over various distinctive material beginning with various properties, for example, Tensile Strength, Yield Strength, and so forth Elongation. One intriguing group of material found was AISI-4140 alloy steel .This a material which havea marginally more weight however a definitely less measure of strain were found to have great positive effect.Regardless the work of G.H. Farrahi, F. Hemmati, S.M. H-Gangaraj. M. Sakhaei, S. Abolhassani has been the most helpful thus it is taken has a reference for the project for validation too

Crankshafts materials ought to be promptly formed, machined and warm treated, and have satisfactory quality, sturdiness, hardness, and high weariness quality. The crankshaft are made from steel either by producing or throwing. The principle bearing and associating bar bearing liners made up of babbitt, tin and lead combinations. Fashioned crankshafts are more grounded than the cast crankshafts yet are costlier. Produced crankshafts are produced using sae 1045 or comparative write steel. Fashioning influences an extremely thick, intense to shaft with a grain running parallel to the central pressure bearing. Crankshafts are thrown in steel, measured iron or modulable iron.

Chemistry of Crankshaft Alloys
Nominal Percentages of Alloying Elements

Material	AMS	C	Mn	Cr	Ni	Mo	Si	V
4340	6414	0.40	0.75	0.82	1.85	0.25		
EN-30B		0.30	0.55	1.20	4.15	0.30	0.22	
4330-M	6427	0.30	0.85	0.90	1.80	0.45	0.30	0.07
32-CrMoV-13	6481	0.34	0.55	3.00	<0.30	0.90	0.25	0.28
300-M	6419	0.43	0.75	0.82	1.85	0.40	1.70	0.07
Key:	C = Carbon		Mn = Manganese			Cr = Chromium		
	Ni = Nickel		Mo = Molybdenum			Si = Silicon		
	V = Vanadium			AMS = Aircraft Material Spec Number				

The determination of crankshaft materials and warmth medicines for different applications are as per the following.

1. **Manganese-molybdenum Steel:** This is a generally shoddy producing steel and is utilized for direct obligation oil motor crankshafts. This compound has the piece for 0.38% Carbon, 1.5% Manganese, 0.3% Molybdenum with rest
2. **1%-Chromium-molybdenum Steel:** This manufacturing steel is utilized for medium-to rock solid petroleum and diesel-motor crankshafts.
3. **2.5%-Nickel-chromium-molybdenum Steel:** These steels is picked uncompromising diesel-motor applications. The structure of this composite is 0.31%C, 2.5% Ni, 0.65% Cr, 0.55%Mo and rest.
4. **3%-Cr-molybdenum and/or 1.5%-Cr-Al-modybdenum Steel:** These produced steels are utilized for diesel-motor crankshafts reasonable for heading of hard high weariness quality materials. The alloying pieces are 0.15% carbon to 3% chromium, with 0.5% molybdenum and/or 0.3% carbon and 1.5%-Cr with 1.1% Al, as 0.2% molybdenum
5. **Nodular Cast Irons:** These cast irons are otherwise called spheroidal-graphite irons or pliable irons. These dim cast irons have 3 to 4% carbon and 1.8 to 2.8% silicon,

3 **Methodology**

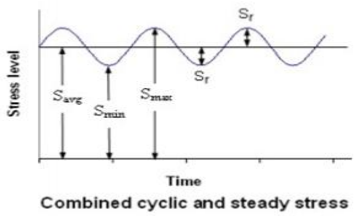
A vital viewpoint towards investigate is the need of the exploration. We first take a glance at the present situation of the world and afterward focus our emphasis on a specific point. Here for this situation we are taking a shot at crankshaft execution of a vehicle. Plan advancements have dependably been a critical issue in the crankshaft creation industry, so as to produce a more affordable segment with the base weight conceivable and legitimate exhaustion quality and other practical prerequisites.These upgrades result in lighter and littler motors with better fuel proficiency and higher power yield. This task was an augmentation of a finished undertaking on contending producing advances utilizing directing knuckles. It underpins the activities point by point in both the Forging Industry Technology Roadmap to the Steel Industry Technology Roadmap

Mechanical Properties

Tensile strength psi (min):100,000 , Yield strength psi (min):70,000 , Elongation (min) :3%

Forces of the crankshaft

The fatigue caused by cyclic pressure is called fatigue failure. The fatigue failure begins from a miniaturized scale break (fragile fatigue) because of stress fixation impact at surface inconsistencies. Minute anomalies, for example, granulating scratches, device marks, review stamping, stamped part numbers or then again surface scales may create a high incentive for the worry because of stress fixation and fill in as the beginning stage for the smaller scale split, which dynamically increments until the point that the part breaks into two pieces like a weak crack. No plastic twisting is seen in the fatigue surface.



Graph 01 Crankshaft Stress level vs Time

The generalized stress form condition, can be defined as we combine purely reversing stress-Sr superimposed on the steady stress-Savg .Following stress-time graph shows that this combined reversing and a steady stress condition. If the stress is fluctuating between the Smax & Smin, then

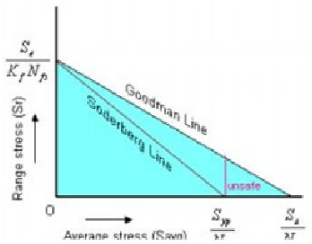
$$\text{Steady stress} = S_{avg} = \frac{S_{\max} + S_{\min}}{2}$$

$$\text{Reversing stress} = S_r = \frac{S_{\max} - S_{\min}}{2}$$

Because of brittle nature of failure, Goodman proposed the design stress for steady stress to Su/Nfs instead of Syp/Nfs in Soderberg's equation itself . This resulted in the safe design

$$S_{avg} + S_r K_f \left(\frac{S_u}{S_e}\right) \leq \frac{S_u}{N_{fs}}.$$

The part may fail from yielding from plastic deformation. The area here shown as the unsafe region.



Graph: 02 Crankshaft Range Stress level vs Average stress

This amount however, has undergone some modifications according to equation in order to be applicable for the crankshaft's geometry ,loading, and the surface finish.

Se= (ka×kb×kc×kd×ke) ×S'r)

This relation (Se) is fatigue limit of a standard specimen and while e S is the fatigue limit of a crankshaft.

aK,bK,cK,d K , and eK are the correcting factors of surface finish, size, loading mode, operation temperature and the reliability.

If the working stress concentration as factor for surface roughness is obtained. The effective fatigue stress concentration (Kf) can be obtained from

$$K_f = 1 + q(K_t - 1)$$

Where q= notch sensitivity

$(\bar{\rho})$ = radius of the surface texture

$$q = \frac{1}{(1 + \gamma/\bar{\rho})}$$

Where we q = 0.9 Kt = 3.3

$$\gamma = 0.025\left(\frac{2070\ \text{MPa}}{\sigma_u}\right)^{1.8}\ \text{mm} \quad (\sigma_u \geq 550\ \text{MPa})$$

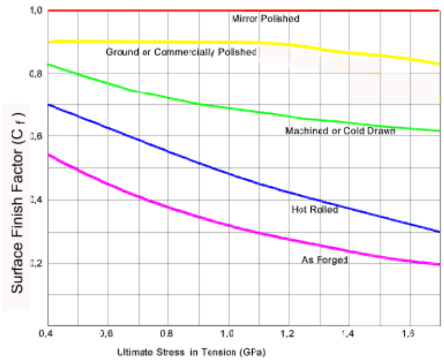
Thus, Kf = 150 ksi (15)

Kb = Size Factor

Thus, Kb = .8 (16)

K f = Surface Finish Factor

The specimens used in the laboratory to determine the fatigue strength curve or endurance limit of a particular material have a standard size and surface.



Graph 03 Crankshaft Surface factor vs Ultimate tensile strength according to the machining

Table 5.10 Reliability with Surface finish factor [27.]

Reliability	Cr
0,5	1
0,9	0,897
0,95	0,868
0,99	0,814
0,999	0,753
0,9999	0,702
0,99999	0,659
0,999999	0,620

These factors is a general to allow for the various factors which are not easily quantifiable. This factor may include influence of: corrosion and electrolytic plating (metallic coatings), metal spraying, cyclic frequency

4. Results and Discussion

After performing the test runs and verifying proper functioning of all the components actual material properties were used to perform analysis. Firstly, by keeping the same angular velocity and varying material. Record the corresponding the fatigue according to goodmans

theory and tabulate the readings. Also perform some experimental runs vertically as well as horizontal forces acting on the crankshaft.

After we have done study on performance evaluation of the crankshaft in the previous section next is to prepare results. The first step in preparation of results is validation. We compared the research Paper and experimental (analytic value) values of both the material. Here on we compare the crankshaft performance with different material for constant forces. For each of a material composition we calculate the Fatigue with help of the goodmanstheory and study the effect of varying on Fatigue crankshaft characteristics. Another thing that we calculate is the variation in materialist properties. Repeat of test and observation is done for finding better result.

5.Conclusion

In this undertaking the appropriate substitute material has been AISI-4140 alloy steel (EN 19C) Steel distinguished and examined for the diesel motor camshaft rather ASTM A536 100-70- 03 (GGG7O) high ductile than material. Since the current material requires visit substitution prompting loss of time and cash. Mechanical properties, for example, hardness, sturdiness and wear opposition of both the material were considered. What's more pressure investigation was completed utilizing ANSYS. The outcomes got from Ansys test showed that the shear for exerted on the ASTM A536 100- 70-03 (GGG7O) high ductile than material is more as compared to AISI-4140 alloy steel (EN 19C) before enlistment solidifying. Effect test demonstrated that the weight of AISI-4140 alloy steel (EN 19C) is 3kg higher than ASTM A536 100-70-03 (GGG7O). Moreover, ANSYS comes about demonstrated that AISI-4140 alloy steel (EN 19C) crankshaft endured bring down dislodging than ASTM A536 100-70-03 (GGG7O) crankshaft for all heap conditions. From these outcomes it can be watched that AISI-4140 alloy steel (EN 19C) crankshaft influenced utilizing has higher administration life.

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