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Determination of drive cone safety due to overhang effects of the engine drive gear on the drive cone of the camshaft

[1]T.John Paul, [2]S.Ganesan
[1]Post Graduate Student, [2]Assistant Professor
Department of Mechanical & Production Engineering, Sathyabama University, Chennai-600119.
[1]t johnpaul@rocketmail.com ,[2]gansuma@gmail.com

***Abstract* -A camshaft is a shaft to which a cam is fastened or of which a cam forms an integral part, which gives the predetermined specified motion to another element called the follower. In automotive field, camshaft and its follower take important roles to run the engine. Since the system deals with high load and high speed, many analysis have been carried out on the failure of the components. The analysis is done either by experimental or finite element analysis. The result from the finite element analysis is an approximate of the component failure. The aim of the project is to determine the drive cone safety due to overhang effects of the engine drive gear on the drive cone of the shaft.Pro-E and Abaqus are used to determine the stress concentration on the components. The forces and the drive torque that are transmitted from the engine drive gear are used for the calculations. The result from the finite element analysis showed the maximum stress concentration occurring at the outermost fiber of the drive cone of the camshaft leading to failure.**

***Index Terms*-Drive cone safety, overhang length**

I. INTRODUCTION

One of the major concerns observed in the camshaft is the drive cone failure. A considerable amount of cone breakages were observed due to overhang effects of engine drive gear assembly on the drive cone of the camshaft. Various values of overhang lengths and an injection pressure of 900bar were used as limiting conditions to analyze the stresses and factors of safety in the drive cone region of the camshaft. The overhang lengths considered were 20, 40 and 60mm respectively.

II. OBJECTIVE

Analysis of camshaft by changing overhang position. Analysis of results and select the best result**.**

III. MODELING AND ANALYSIS

Force Analysis

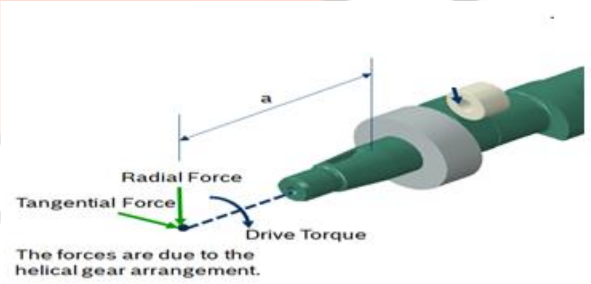

Figure 1:Position of Engine gear assembly

The forces from the engine drive gear are used to calculate the bending and Torsional stresses in the Drive cone region of the camshaft.

Bending stress in any section is given by

$\sigma_{b=}$ Mc/I - (1)

M is the bending moment in the plane of symmetry of the camshaft in N-mm

c is distance from the centre of the section to the outermost fibre.ie d/2.

I is the second moment of area and resists the bending moment.(mm^4)

M is given by

$\vec{M}=\vec{r}*\vec{W}$

Where

$\vec{W}$ is the force the helical gear arrangement

$\vec{r}$ is the distance from the large cone dia to the helical gear arrangement

c=d/2 - (2)

$I=(\pi d^4)/64$ for a solid circular section - (3)

Torsional stress in any section of the shaft

τ= Tr/J - (4)

Where

T is the internal twisting moment in the section under consideration.

r is the distance from the centre of the section to to the outermost fiber .
J is the polar moment of inertia and it resists the twisting torque

$$r = d/2 \qquad (5)$$

$$J = \pi d^4/32 \qquad (6)$$

Calculation of Equivalent stress
The stresses obtained are to be combined to an equivalent stress The Von Mises hypothesis has been adopted.
For a 2D state of stress equivalent stress is given as

$$\sigma_{eq} = \sqrt{(\sigma_b^2 + 3\,\tau^2)} \qquad (7)$$

Calculation of Permissible stress
The permissible stress is based on the strength of the material under consideration .The material considered is steel. The permissible stress considered was around to be 220 MPa.

Stress Analysis

A 3D geometry of the camshaft was created in Pro-E.The analysis were carried out using Abaqus CAE.

IV. RESULTS

Following results are obtained by applying all the parameters on the CAD model in Abaqus software.

Table 1: Theoritical results

Case no	Dimension "a" (mm)	Equivalent Stress $\frac{N}{mm^2}$	Permissible Stress $\frac{N}{mm^2}$	FOS (static)
Case1	20	94.58	220	2.32
Case2	40	115.42	220	1.90
Case3	60	141.5	220	1.55

Table 2: FEA results

Case no	Dimension "a" (mm)	Equivalent Stress $\frac{N}{mm^2}$	Permissible Stress $\frac{N}{mm^2}$	FOS (static)
Case1	20	131.4	220	1.67
Case2	40	136.9	220	1.60
Case3	60	160.7	220	1.36

V. CONCLUSION

From the design consideration a FOS of 1.6 and above is considered to be safe.

Table 3: Result summary for stress analysis

Case no	Dimension "a" (mm)	Permissible FOS	Theoretical FOS	FEA FOS	Remarks
Case1	20	1.6	2.32	1.67	Safe
Case2	40	1.6	1.82	1.60	Safe
Case3	60	1.6	1.5	1.36	Not safe

From the results obtained we observe that the FOS for the 20mm and 44mm is above 1.6.However considering various uncertainties in the load calculation, overstressing and deficiencies in material processing, the FOS for overhang length 44mm may further dip below 1.6.Hence the configuration with 20mm overhang length is considered safe. The FOS for the of case of overhang length (62 mm) is below 1.6 and clearly not acceptable

VI. REFERENCES

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