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Design & Structural Analysis of Single Throw Crankshaft

Gayathri Devi P
PG Scholar, Mechanical Engineering,
Siddharth Institute of Engineering & Technology
Puttur-517583, INDIA

S. Suresh
Associate Professor, Mechanical Engineering,
Siddharth Institute of Engineering & Technology,
Puttur-517583, INDIA

***Abstract* -In this paper aim of the project deals with the analysis of a Single-throw crankshaft, Theoretical Design is Done & modeled in PRO/E and analyzed using CAE software ANSYS. The analysis is carried out in one stage, Static analysis, and the results of the finite element analysis.**

Keywords*— *Single Throw Crankshaft, PRO/E, Von-misses-Stress, Strain & Deformation.

I. INTRODUCTION

Crankshaft is the part of an internal combustion engine which translates reciprocating linear piston motion into rotation. To convert the reciprocating motion into rotation, the crankshaft has "crank throws" or "crankpins", additional bearing surfaces whose axis is offset from that of the crank, to which the "big ends" of the connecting rods from each cylinder attach. The arrangements of throws determine the firing order of the engine.

TABLE I: DESCRIPTION OF CRANKSHAFT

S.NO	DESCRIPTION
1	Piston
2	Piston Ring Set
3	Gudgeon Pin
4	Gudgeon Clip
5	Upper Bearing
6	Crankshaft Assembly
7	Connecting Rod
8	Crank Pin
9	Crankshaft Right
10	Crankshaft Left
11	Roller Bearing
12	Left Crankshaft Space
13	Crankshaft Bearing
14	Crankshaft Seals

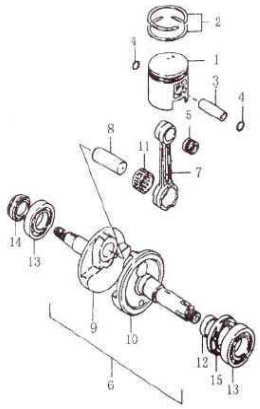

Fig.1. Crankshaft Representation

II. PROPERTIES OF CRANKSHAFT MATERIALS

Carbon steel made up of mainly Iron & carbon but still other elements do exists in this alloy as shown in figure.

TABLE II: CARBON STEEL COMPOSITION

S.NO	Elements	Maximum Weight%
1	Carbon	1
2	Copper	1.60
3	Manganese	1.65
4	Phosphorous	0.40
5	Silicon	0.60
6	Sulphur	0.05

III. DESIGN CALCULATIONS

A. *Engine Specifications:*

Speed	N=1800 r.p.m
Diameter of the piston	d=100mm
Mass of the reciprocating parts	m=1.2 k.g
Gas pressure	P_m=650KNm^{-}
Length of the connecting rod	l=270mm
Crank radius	r=60mm

For the mentioned engine specifications,

Angular velocity (ω) = (2π N)/60 = 188.5 rads^{-1}

Gas force (F) =5105 N

Inertia force (F_B) = 2840 N

Net piston force (F_P) = F – F_B +*mg*

F_P = 5105 – 2840 + (1.2 x 9.8) = 2276.8 N

Net load on the gudgeon pin = force in the connecting

$$F_C = \frac{F}{\cos\beta} = 2283.44 \text{ N}$$

IV. MODELLING OF CRANKSHAFT

A. *2D DRAWINGS*

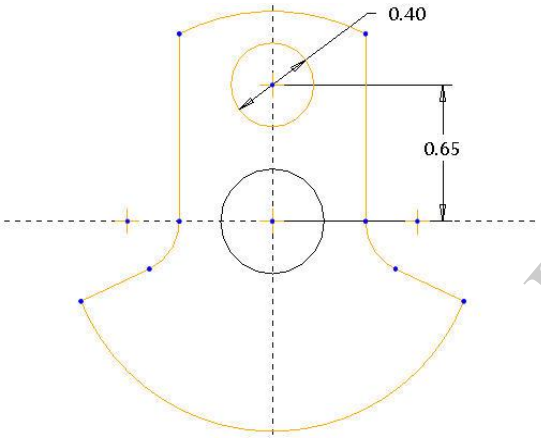

Fig.2. Crankshaft sketcher

B. *3D MODELLING*

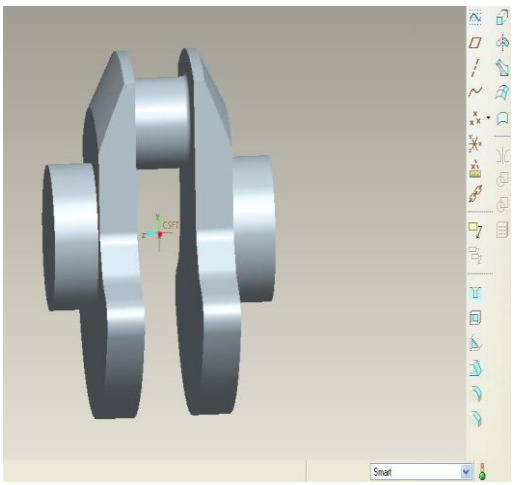

Fig.3. Modeling of crankshaft in PRO-E

V. FINITE ELEMENT ANALYSIS OF CRANKSHAFT

Finite Element Analysis is carried out in ANSYS Classic The Analysis is carried out in Three Stages they are Pre- Processor in which Preferences, Element Model, Material Properties and Meshing is done for the product, Processor in which Boundary Conditions and Loads are Applied for the Product & Post-Processor in which Results are plotted for the Product and Results are also Read in ANSYS at Different Nodes and Elements.

A. *MESHING OF CRANKSHAFT*

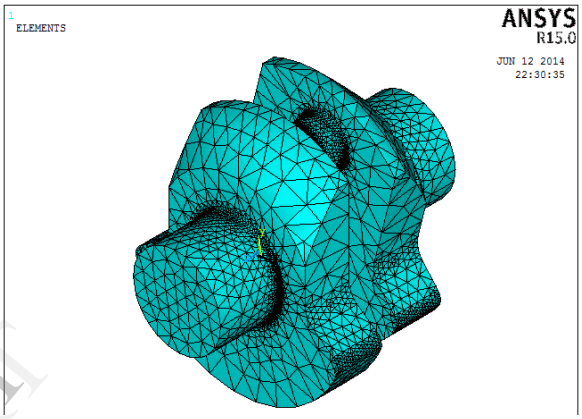

Fig.4. Meshing of Crankshaft in ANSYS

B. *BOUNDARY CONDITIONS & LOADS IN ANSYS*

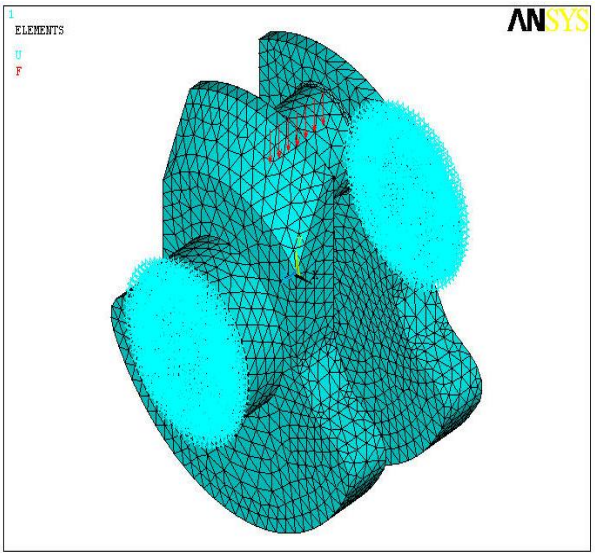

Fig.5. Boundary Conditions & Loads applying on Crankshaft

C. MATERIAL PROPERTIES OF CARBON STEEL

TABLE IIII: MECHANICAL PROPERTIES OF CARBON STEEL

S.NO	Material	Carbon Steel
1	Young's Modulus	$2*10^5$ N/mm^2
2	Poisson´s Ratio	0.3
3	Density(ρ)	7850 Kg/m^3

VI. RESULTS & DISCUSSIONS

A. STRUCTURAL ANALYSIS:

In Structural Analysis we are Find out The Strength of the Crankshaft, Vonmises Stress, Vonmises Strain and Displacement in X-Component and Y-Component is Find out.

a) VONMISSES STRESS

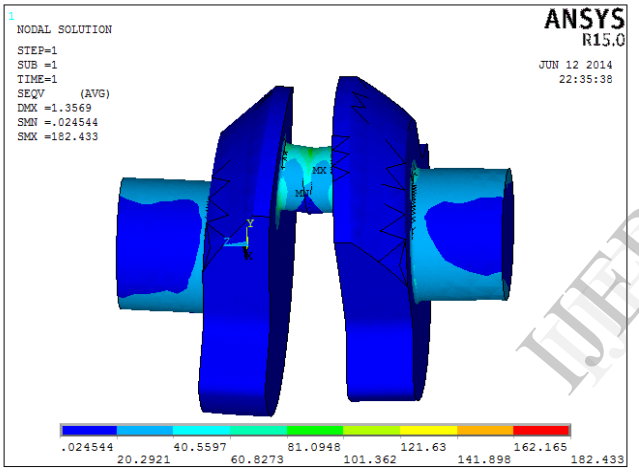

Fig.6. Von-misses Stress of Crankshaft

b) VONMISES STRAIN

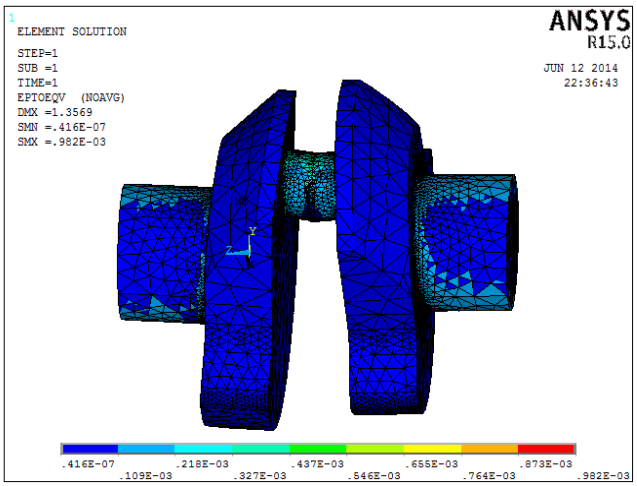

Fig.7. Von-misses Strain of Crankshaft

c) DISPLACEMENT IN X-COMPONENT

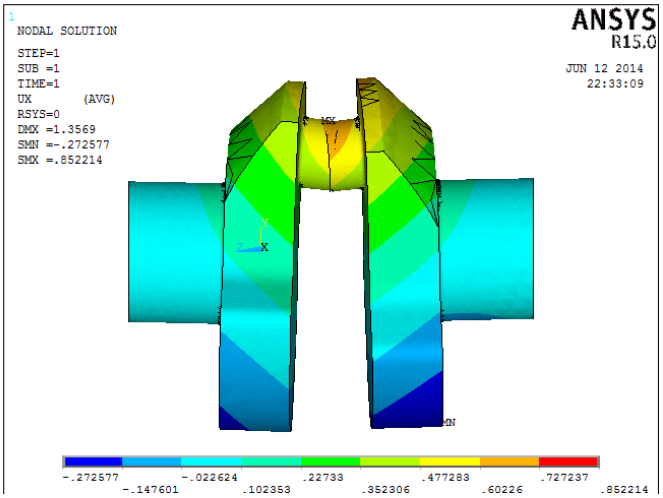

Fig.8. X-Component Displacement

d) DISPLACEMENT IN Y-COMPONENT

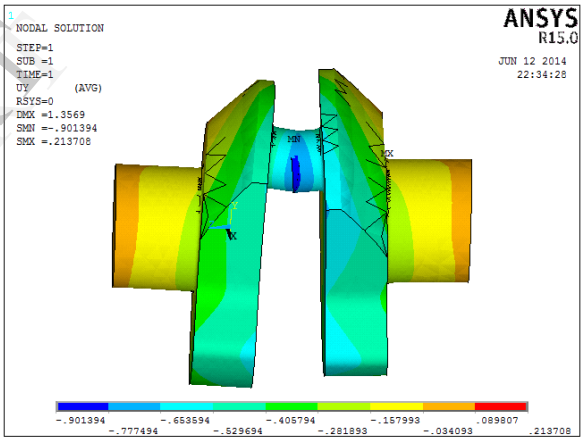

Fig.9. Y-Component Displacement

TABLE IIIV: RESULTS OF STRUCTURAL ANALYSIS

S.NO	Parameters	Maximum Deflection (mm)	Minimum Shear Stress (Mpa)	Maximum Shear Stress (Mpa)
1	Vonmises stress	1.3569	0.02454	182.433
2	Vonmises strain	1.3569	0.416e^{-07}	0.982e^{-03}
3	Displacement X-Component	1.3569	-0.2725	0.852214
4	Displacement Y-Component	1.3569	-0.9013	0.213708

VII. CONCLUSION

Theoretical Design, Modelling of Single Throw Crankshaft is completed. Carbon steel Material is used for Crankshaft. The Maximum Allowable stress with in a Material is 182.433Mpa. The crankshaft can withstand deflection up to 19.342mm.

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