CRANKSHAFT ANALYSIS DESIGN

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ABSTRACT -Crank shaft is a long shaft that is commonly used for multi cylinder engine to connect various cranks. The firing of this multi cylinder engine should be in particular order. In general, for a 4-stroke I.C engine the firing order will be 1-4-3-2 This is because of balancing. If this order is not followed, it will lead to the stress development in one side of the crankshaft and it will eventually bend. To avoid this firing order is necessary. One of the most critically loaded components in the engine is the crankshaft, as it experiences cyclic loads in the form of bending and torsion during its service life. Its disappointment will bring about genuine harm to the engine, so its unwavering quality check must be performed. The aim of this project is to design a two- wheeler four stroke petrol engine crankshaft using SOLIDWORKS and perform structural analysis for three different materials using ANSYS.

Key words: crankshaft, firing order, composites

Introduction:

Crankshaft is a massive part with a complicated design within the engine, that converts the linear displacement of the piston to a rotary movement with a four-link mechanism. Since the crankshaft experiences an out sized range of load cycles throughout its service life, fatigue performance and sturdiness of this part has got to be thought-about in the design stage. Design developments have perpetually been a crucial issue within the crankshaft production business, so as to manufacture a more cost-effective part with the minimum weight attainable and correct fatigue strength and alternative practical needs. These enhancements lead to lighter and smaller engines with higher fuel potency and better power output. The finite element analysis was performed in four static steps for every crankshaft. Stresses from these analyses were used for superposition with regards to dynamic load applied to the crankshaft.

Function of Crankshafts in IC Engines

The crankshaft, connecting rod, and piston constitute a four-bar slider-crank mechanism, which converts the sliding motion of the piston (slider in the mechanism) to a rotary motion. Since the rotation output is more practical and applicable for input to other devices, the concept design of an engine is that the output would be rotation. In addition, the linear displacement of an engine is not smooth, as the displacement is caused by the combustion of gas in the combustion chamber. Therefore, the displacement has sudden shocks and using this input for another device may cause damage to it. The concept of using crankshaft is to change these sudden displacements to a smooth rotary output, which is the input to many devices such as generators, pumps, and compressors. It should also be mentioned that the use of a flywheel helps in smoothing the shocks. The crankshaft, connecting rod, and piston represent a four-bar slider-crank mechanism, that converts the linear motion of the piston (slider within the mechanism) to a rotary movement. Since the rotation output is practically sensible and is applicable for input to other devices, the innovative design of an engine is that the output would be rotation. Additionally, the linear displacement of an engine isn't frictionless, because the displacement is caused by the combustion of gas within the combustion chamber. Therefore, the displacement has sudden shocks and mistreatment, this input given for other devices could cause harm there to. The idea of crankshaft is to vary these sudden displacements to a smooth rotary output, that is that the input to several devices like generators, pumps, and compressors. It ought to even be mentioned that the employment of a regulator helps in smoothing the shocks. Crank shaft is a large component with a complex geometry in the I.C engine, which converts the reciprocating displacement of the piston to a rotary motion with a four-bar link mechanism. Crankshaft consisting of shaft parts, two journal bearings and one crankpin bearing. The Shaft parts which revolve in the main bearings, the crank pins to which the big end of the connecting rod are connected, the crank arms or webs which connect the crank pins and shaft parts. In addition, the linear displacement of an engine is not smooth; as the displacement is caused by the combustion chamber therefore the displacement has sudden shocks. The concept of using crankshaft is to change these sudden displacements to as

addition to the effects of the graphite structure on gray cast iron machinability, the metal also contains compositional elements which contribute to enhanced machinability.

STRUCTURAL STEEL

which different shapes of steel structure are produced at room temperature. Consequently, steel structure ductility is increased but its ductility is reduced. Residual stress is a stress that stays in steel element after it has been fabricated. It is necessary to consider strain rate while tensile test is conducted because it modifies steel tensile properties. If steel structure is used for dynamic loads, then high strain rate would be considered. However, normal strain rate is adopted for steel used in the construction of structure designed for static loads. The ability of steel structure to accommodate energy is called steel toughness.

Shear strength of steel structure is specified at the failure under shear stress and it is about 0.57 times yield stress of structural steel. Regarding elastic shear modulus, it is expressed as the ratio of shear stress to shear strain in elastic

Aluminum Alloys

Aluminum alloys, the most widely used lightweight alloy, have also entered into many industrial fields for its SPF applications. At present, the commonly used aluminum alloys for SPF are mainly aluminum lithium alloy, 7475 aluminum alloy, 2024 aluminum alloy and 5083 aluminum alloy. Among them, the strength of 7475 aluminum alloy is the highest, which has the maximum strength after T76 heat treatment combining with aging. But it needs special treatment to be superplastic. 2024 is a superplastic aluminum alloy specially developed by the United Kingdom, which has high strength after T62 heat treatment combing with aging. 5083 aluminum alloy also requires special treatment to reach superplastic state. It has the lowest strength given that it cannot be strengthened by heattreatment after forming.

	YOUNGS MODULES	POSISON'S RATIO	DENSITIY	ULTIMAT TENSILE STRENGTH
GRAYCAST IRON	1.1E11 pa	0.28	7200kg /m^3	240MPa
STRUCTURAL STEEL	2E11pa	0.3	7850kg /m^3	460MPa
ALUMINIUM ALLOY	7.1E10 pa	0.33	2700kg /m^3	310MPa

MODELLING

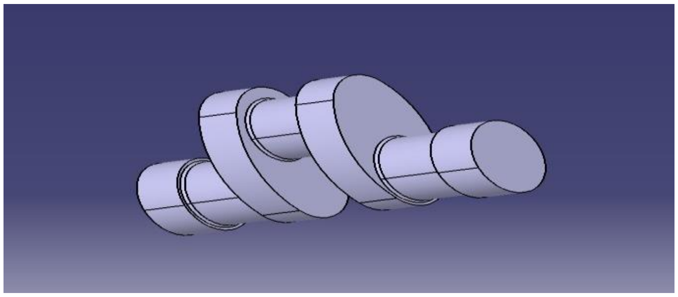
The first step in this project was to construct a 3-D model of the crankshaft, which was then analyzed with ANSYS. The 3-D model was made in SolidWorks according to the requirements specified in

PARAMETERS	VALUES(M.M)
Diameter of crank pin	40
Length pin	37
Web thickness	26
Web width	70
Bore Diameters	93
Shaft diameter	174
Max cylinder pressure	45 bar

Big-end journals diameter = 0.65 D Main-end journal diameter = 0.75 D Big-end journal width = 0.35 D Main-end journal width = 0.40 D Web thickness = 0.25 D

Fillet radius of journal and webs = 0.04 DModelling:

Crankshaft is designed from and it is selected for research work. The dimensions of the crankshaft are carryout by using drafting in software. Crankshaft was modeled with the



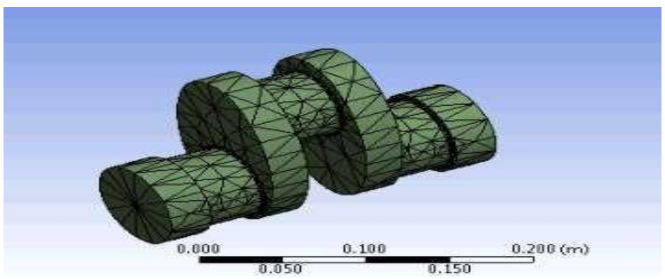
help of SOLIDWORKS.

Meshing:

The crankshaft is fixed at both side with cylindrical support which is shown below in Blue color in all the degree of freedom and the load of 40KN is applied to at crankpin in vertical downward direction.

Analysis:

1. LOAD TEST

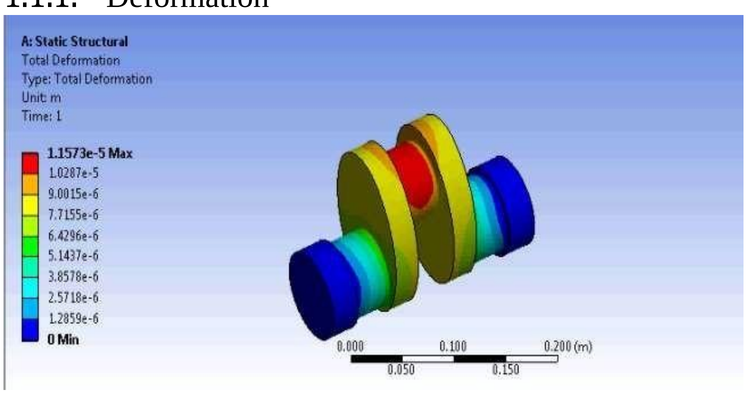


I have chosen tetrahedral mesh because the tetrahedral meshing methodology is utilized strong district geometry cross section and meshing delivers a good support for boundaryrepresentation of solid auxiliary model.

Meshing of solid is as below.

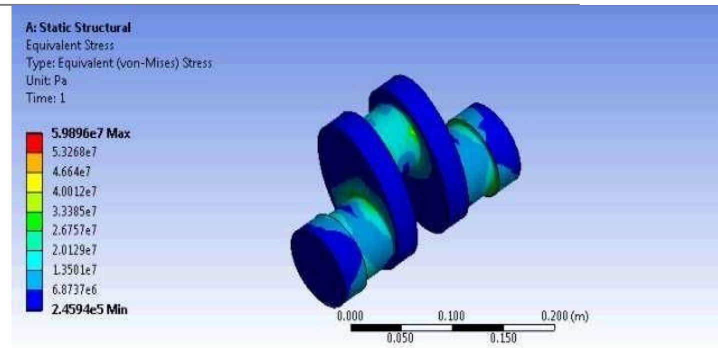
1.1. Structural Steel

1.1.1. Deformation



1.1.2. Equivalent Elastic Strain

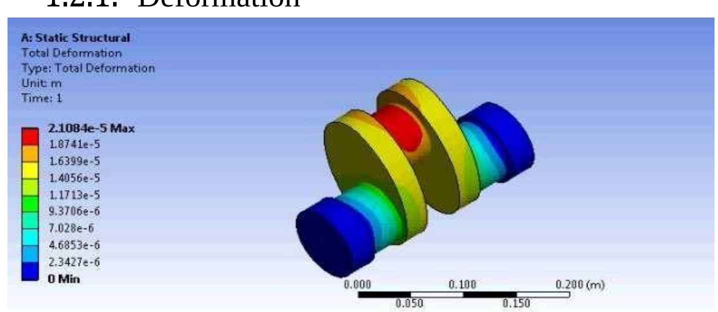
1.1.3. Equivalent Stress



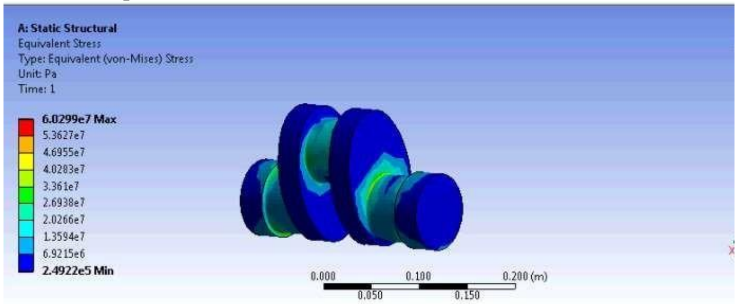
Material	Structural steel	
Load	40 KN	
	Min	Max
Deformation	0	1.58e-5
Eq elastic strain(m/m)	1.43e-6	0.0003
Eq Stress(Pa)	2.46e6	5.91e7

1.2. Gray Cast Iron

1.2.1. Deformation

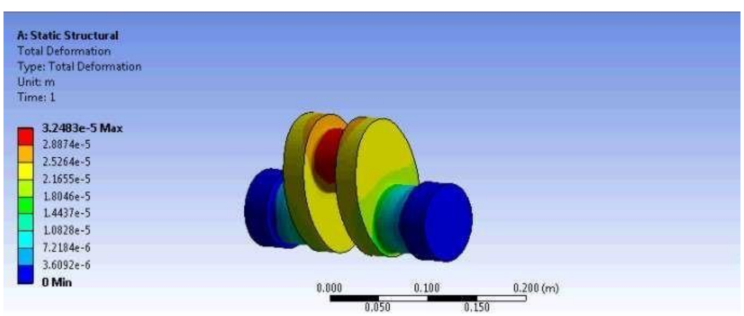


1.2.2. Equivalent Elastic Strain



Material	Grey Cast Iron	
Load	40 KN	
	min	max
Deformation(m)	0	2.11e-5
Eq. Elastic strain(m/m)	2.64e-6	0.0006
Eq. Stress(Pa)	2.49e5	6.03e7

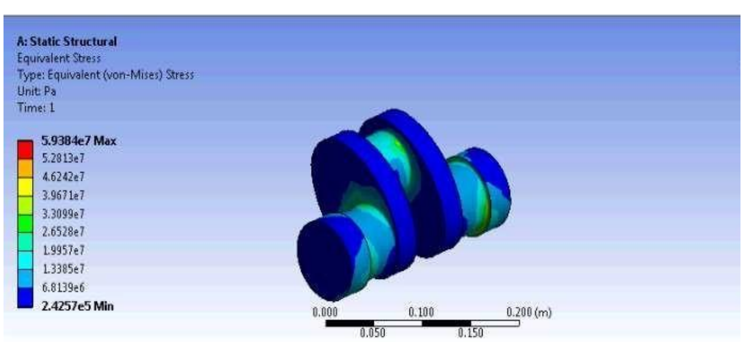
1.3. Aluminum Alloy



1.3.1. Deformation

1.3.2. Equivalent Elastic Strain

1.3.3. Equivalent Stress



Material	Aluminum	
Load	40 KN	
	min	max
Deformation(m)	0	3.25e-5
Eq. Elastic strain(m/m)	3.97e-6	0.0008
Eq. Stress(Pa)	2.43e5	5.94e7

MATERIAL	LOAD (KN)	Deformation(m)		Eq. Elastic strain(m/m)		Eq. Stress(Pa)	
		min	max	min	max	min	max
Stainless steel	40	0	1.58e-5	1.43e-6	0.00003	2.46e6	5.91e7
Grey Cast Iron	40	0	2.11e-5	2.64e-6	0.00006	2.49e5	6.03e7
Aluminum alloy	40	0	3.25e-5	3.97e-6	0.00008	2.43e5	5.94e7

Conclusion:

From the above analysis we can see that there is total three materials used for analysis and different results were obtained from that of Structural Steel, Gray Cast Iron and Aluminum Alloy steel.

The Material which was maximum deformation is found to be Structural Steel. In the case of Equivalent Strain, the material which has least maximum value is structural steel. Finally, the material which has least maximum value for

Equivalent Stress is Structural steel. Therefore, we can conclude safely that the best of the materials used in this study is Structural Steel. The falling in line in this experiment, for safe usage is Gray Cast Iron and then Aluminum Alloy.

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