ANALYZING AND DESIGNING CONNECTING ROD OPTIMIZING METHOD FOR FOUR STROKE SINGLE CYLINDER ENGINE

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ABSTRACT

The interfacing post is the widely appealing part between the chamber and the driving bar. Its basic limit is to send the push and pull from the chamber pin to the wrench pin and accordingly convert the reacting development of the chamber into rotational development of the wrench.

In our venture we plan an interfacing bar for a four stroke single chamber motor for two unique materials Carbon Steel and Aluminum compound. Both the plans are demonstrated in 3D displaying programming Pro/Engineer.

Auxiliary investigation is done on the interfacing pole to check the quality of the associating pole by utilizing two materials Carbon Steel and Aluminum combination by applying the weight created in the motor. Modular examination is done to decide the common frequencies when burdens are applied. The examination is done to confirm the better material for interfacing pole to lessen the expense

1. INTRODUCTION

The interior ignition motor is a motor where the burning of a fuel (typically a petroleum derivative) happens with an oxidizer (generally air) in a burning chamber. In an inward burning motor, the development of the high-temperature and high - pressure gases delivered by ignition apply direct power to some segment of the motor. This force is applied normally to chambers, turbine edges, or a spout. This force moves the section over a partition, changing compound essentialness into important mechanical imperativeness. The essential internal start engine was made by Etienne Lenoir.

The term internal copying engine typically suggests an engine wherein start is intermittent, for instance, the more conspicuous four-stroke and two-stroke chamber engines, close by varieties, for instance, the six-stroke chamber engine and the Wankel turning engine. A beneath normal of inward start engines use endless consuming: gas turbines, fly engines and most rocket engines, all of which are inside consuming engines on a comparable norm as heretofore described.[1][2][3][4]

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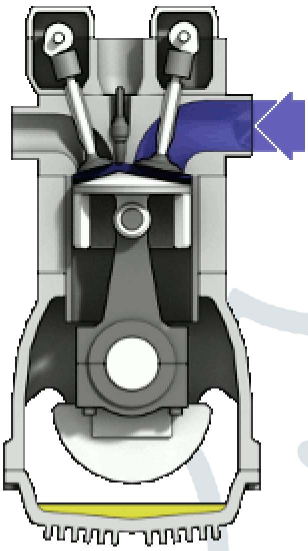
1.1 Stroke Engine

1



2. LITERATURE REVIEW

Steel is conventionally used for advancement of vehicle interfacing bars taking into account its quality, robustness, and lower cost. Regardless, steel with its high mass thickness applies unnecessary loads on the driving pole of a quick engine. This consequently requires a heavier driving bar for passing on the piles and, likewise, the best RPM of the engine is confined. Additionally, higher idleness loads, for instance, those achieved by steel partner posts and heavier driving poles decreases the speeding up or introduction movements of engine speed. Thusly, light mixture metals, for instance, aluminum and titanium are at present being used in quick engine interfacing bars to avoid the recently referenced issues. Titanium has best mechanical properties over aluminum, to the weakness of higher thickness and cost. This higher thickness and cost have made aluminum interfacing bars more popular and charming. In any case, they experience the evil impacts of modestly bad quality and depletion life.

The vehicle engine interfacing bar is a high volume creation, fundamental part. It interfaces reacting chamber to rotating driving pole, sending the push of the chamber to the driving bar. Every vehicle that uses an internal start engine requires at any rate one partner bar dependent upon the amount of chambers in the engine. Associating poles for car applications are commonly produced by manufacturing from either fashioned steel or powdered metal. They could likewise be projected. Nonetheless, castings could have blow-gaps which are negative from strength and weakness perspectives. The way that forgings produce blow-opening free and better poles gives them a bit of leeway over cast bars. Between the fashioning measures, powder manufactured or drop produced, each cycle has its own upsides and downsides. Powder metal produced spaces have the upside of being close to net shape, lessening material waste. Notwithstanding, the expense of the clear is high because of the high material expense and advanced assembling procedures. With steel fashioning, the material is modest and the unpleasant part producing measure is financially savvy. Carrying the part to definite measurements under close resistance brings about high consumption for machining, as the clear generally contains more abundance material. The primary viewpoint was to research and analyze weariness quality of steel produced interfacing poles with that of the powder manufactured associating poles. The subsequent viewpoint was to improve the weight and assembling cost of the steel manufactured interfacing pole. The principal part of this examination program has been managed in an ace's theory named "Weakness Behavior and Life forecasts of Forged Steel and PM Connecting Rods. This current proposition manages the second part of the investigation, the advancement part. Because of its huge volume creation, it is just consistent that advancement of the interfacing bar for its weight or volume will bring about enormous scope investment funds. It can likewise accomplish the goal of lessening the heaviness of the motor segment, consequently diminishing latency loads, decreasing motor weight and improving motor execution and efficiency.

3. CALCULATIONS:

3.1 PRESSURE CALCULATIONS FOR 150CC PETROL ENGINE

Suzuki GS 150 R specifications
Engine type : air cooled 4-stroke SOHC
Bore × stroke(mm) = 57 × 58.6
Displacement =149.5CC
Maximum power = 13.8bhp @8500rpm
Maximum torque = 13.4Nm @ 6000 rpm
Compression ratio =9.35/1

Density of petrol $C_8H_{18} = 737.22 \frac{kg}{m^3}$ at 60F
$= 0.00073722\ kg/cm^3$
$= 0.00000073722\ kg/mm^3$

T = 60F =288.855K =15.55°C
Mass = density × volume
m = 0.00000073722 × 149500
m = 0.11kg
molecular Wt. for petrol = 144.2285 g/mole
PV = mRT

$$P = \frac{mRT}{V} = \frac{0.11 \times 8.3143 \times 288.555}{0.11422 \times 0.0001495} = \frac{263.9}{0.00001707}$$

P = 15454538.533 j/m^3 = n/m^2
P =15.454 N/mm^2

3.2 DESIGN CALCULATIONS OF CONNECTING ROD

Thickness of flange & web of the section = t
Width of section B= 4t
Height of section H=5t
Area of section A= 2(4t×t)+3t×t
$A=11t^2$
MI of section about x axis
$I_{xx}=1\backslash12\,(4t(5t)^3-3t(3t)^3)=419\backslash12t^4$
MI of section about y axis
$I_{YY}=(2+1\backslash12t(4t)^3+1\backslash12(3t)t^3) = 131\backslash12\,t^4$
$I_{XX}\backslash I_{YY}$- 3.2
Length of connecting rod = 2 times the stroke
L= 2×58.6 =117.2mm
Buckling load w_B = maximum gas force × F.O.S
W_B =6569.148×6 =39414.88611

$$W_B - \frac{\sigma_C \times A}{1+a(L\backslash K_{xx})^2}$$

σ_C = compressive yield stress= 172 MPa

$$k_{xx}=I_{xx}\backslash A= \frac{419\backslash12t^4}{11t^2}$$

$= 3.17t^2$
$k_{xx} = 1.78t$
f_c= maximum load
f_c= p= 39414.88611
$a= f_c \backslash\pi^2E$

$$a= \frac{39414.88611}{\pi^2 \times 80000}$$

a = 0.05

$$39414.88611 = \frac{172 \times 11t^2}{1+0.05(117.2\backslash1.78t)^2}$$

$$39414.88611 = \frac{1892t^2}{1+(4334.9\backslash t)^2 0.05}$$

$$39414.88611 = \frac{1892t^2 * 3.168t^2}{3.168t^2+686.79}$$

$5993.856t^4-124866.36t^2-27069749.63=0$

$$t^2 = \frac{124866.36 \pm \sqrt{((124866.36)^2+4\times5993.856\times27069749.63}}{2\times5993.856}$$

$$t^2 = \frac{124866.36 \pm 815230.23}{11987.712}$$

$$t^2 = \frac{94009656}{11987.712}$$

$t^2 = 78.42168$
t = 8.85
t = 9mm

Width of section B = 4t =36mm
Height of section H = 5t = 45mm
Area A = 11t^2 = 891mm^2
Height at the big end (crank end) = H_2 . 1.1H to 1.25H
H_2 =56.25 mm
Height at the small end (piston end) = 0.9H
H_1 =40.5mm

2. Dimensions of crank pin

Load on the crank pin = projected area × bearing pressure
$F_L = d_c \times l_c \times p_{bc}$
$l_c = 1.25\ d_c$ to $1.5d_c$
$F_L = 1.5\ d_c^2 \times p_{bc}$
p_{bc}= allowable bearing pressure at the crank pin bearing
p_{bc}= 12.5N\mm^2
$F_L = (\pi D^2\backslash4) \times P = 39414.88611$
39414.88611 = 1.5 d_c^2 × 12.5
39414.88611 = 18.75d_c^2
d_c^2 = 2102.12 = 45.84
l_c = 1.5d_c = 68.77mm

3. Piston pin (gudgeon pin (or) wrist pin)

d_o=outside dia of the piston pin
l_1=length of the piston pin in the bush of the small end of the connecting rod in mm
l_1=0.45D=0.45×57=25.65mm
load on the piston due to gas pressure

$$P_{gas}=p\times\frac{\pi D^2}{4}=30090.38N$$

Load on the piston pin due to bearing pressure (or)
Bearing load=bearing pressure×bearing area
Load = $P_{b1} \times d_o \times l_1$
P_{b1}=bearing pressure at the small end of the connecting rod bushing
P_{b1}=77.28N/mm^2
30090.38=77.28× d_o×25.65

$$d_o = \frac{30090.38}{841.25} = 15.16mm$$

d_i=0.6 d_o=9.1mm

$$\text{length between the supports } l_2 = \frac{l_{1+D}}{2}$$

l_2=41.325mm

4. 2D sketching and 3D Modeling of CONNECTING ROD

Master/ENGINEER Wildfire is the standard in 3D thing arrangement, featuring industry-driving proficiency instruments that advance endorsed techniques in plan while ensuring consistence with your industry and companions standards. Facilitated Pro/ENGINEER CAD/CAM/CAE courses of action license you to design snappier than whenever in ongoing memory, while extending progression and quality to finally make magnificent things.

Customer essentials may change and time loads may continue mounting, yet your thing setup needs proceed as in the past - paying little psyche to your endeavor's degree, you need the earth shattering, easy to-use, moderate game plan that Pro/ENGINEER gives.

Pro ENGINEER can be bundled in various adaptations to suit your necessities, from Pro/ENGINEER Foundation XE, to Advanced XE Package and Enterprise XE Package, Pro/ENGINEER Foundation XE Package unites a wide base of usefulness. From vigorous part displaying to cutting edge surfacing, incredible gathering demonstrating and reenactment, your requirements will be met with this scaleable arrangement. Flex3C and Flex Advantage Build on this base contribution broadened usefulness based on your personal preference.

The primary modules are

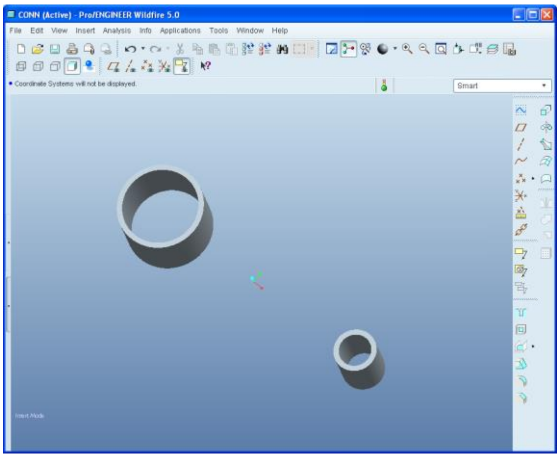
Part Design

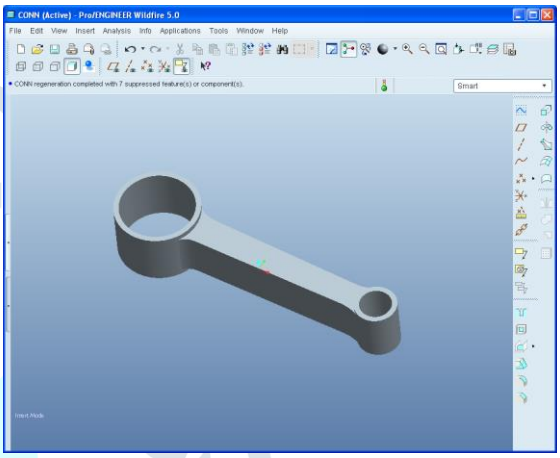
Assembly

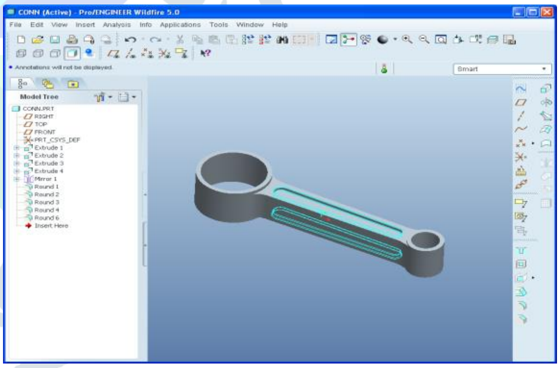
Drawing

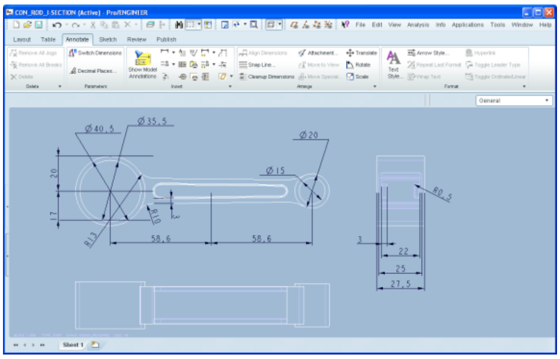
Sheet Metal

4.1 3D MODEL OF I – SECTION

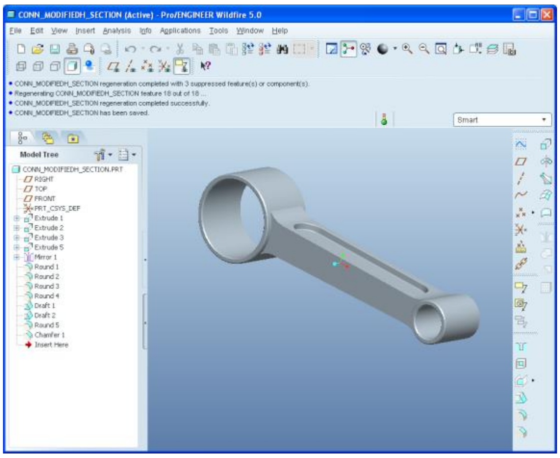




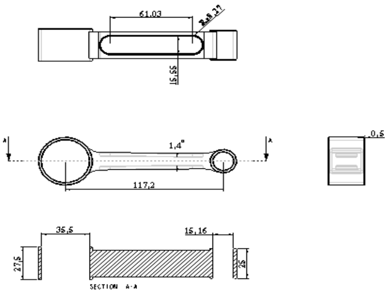




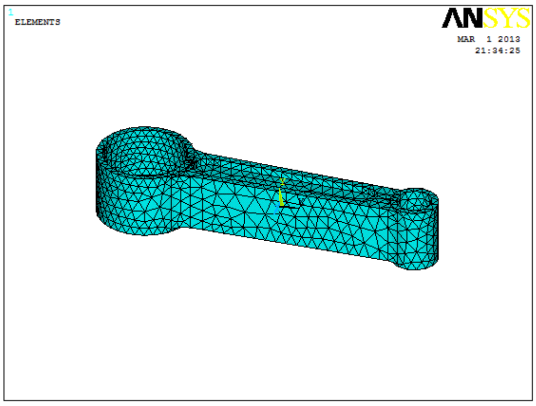
3D MODEL OF H – SECTION



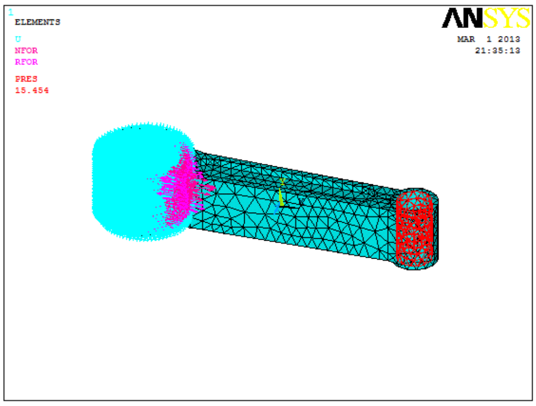
4.2 2D DRAWING

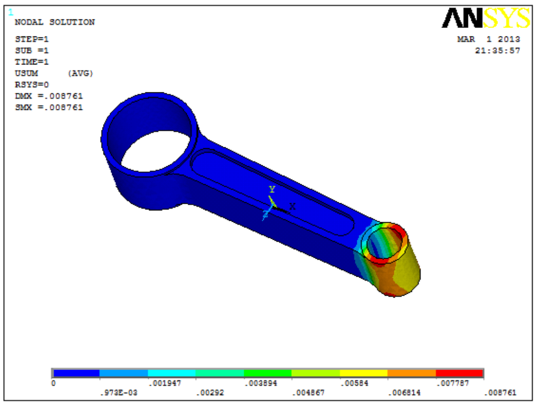


4.3 STRUCTURAL ANALYSIS OF CONNECTING ROD I-SECTION ALUMINUM ALLOY A360



Meshed Model





Auxiliary Analysis of Connecting Rod I-Section Aluminum Alloy A360

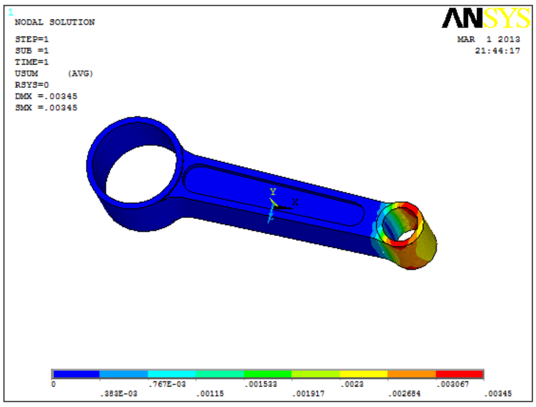
4.4 STRUCTURAL ANALYSIS OF CONNECTING ROD I-SECTION

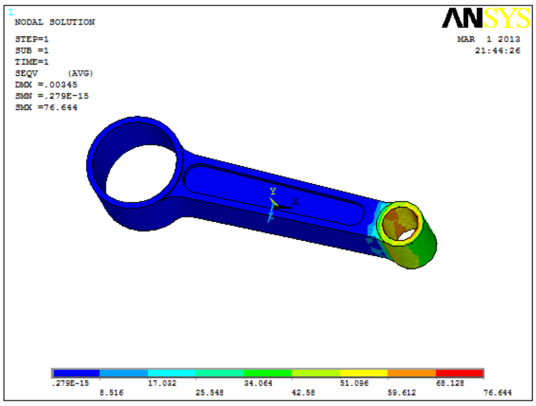
CARBON STEEL

Young’s modulus – 200000MPa

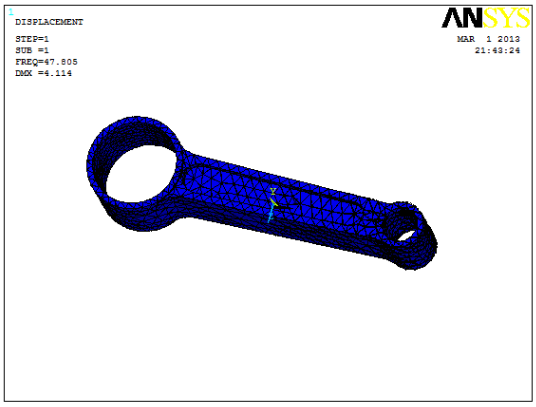
Poisson ratio - 0.295

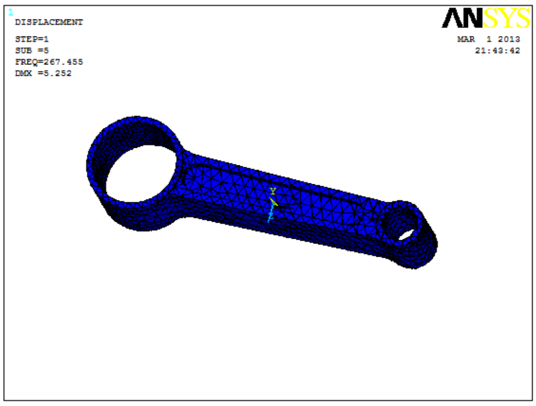
Density – 0.000007872kg/mm^3





MODAL ANALYSIS





5. RESULTS AND DISCUSSION

RESULTS TABLE

I-SECTION

		ALUMINUM	CARBON STEEL
	STRESS (N/mm^2)	76.702	76.644
	DISPLACEMENT (mm)	0.008761	0.00345
MODE	FREQUENCY (HZ)	52.694	47.805
	DISPLACEMENT (mm)	7.158	4.114
	FREQUENCY (HZ)	59.346	53.893
	DISPLACEMENT (mm)	7.093	4.076
	FREQUENCY (HZ)	211.289	194.488
	DISPLACEMENT (mm)	9.429	5.42
	FREQUENCY (HZ)	242.591	220.275
	DISPLACEMENT (mm)	9.516	5.5
	FREQUENCY (HZ)	293.855	267.455
	DISPLACEMENT (mm)	9.124	5.252

H-SECTION

		ALUMINUM	CARBON STEEL
	STRESS (N/mm^2)	47.73	47.761
	DISPLACEMENT (mm)	0.05383	0.02125
MODE	FREQUENCY (HZ)	30.109	27.33
	DISPLACEMENT (mm)	6.751	3.88
	FREQUENCY (HZ)	50.47	45.809
	DISPLACEMENT (mm)	6.652	3.823
	FREQUENCY (HZ)	136.825	125.827
	DISPLACEMENT (mm)	9.278	5.332
	FREQUENCY (HZ)	176.617	160.362
	DISPLACEMENT (mm)	6.133	3.53
	FREQUENCY (HZ)	272.79	248.324
	DISPLACEMENT (mm)	7.395	4.255

6. Conclusion

In our task we have planned an interfacing pole for a 150cc motor and demonstrated in 3D displaying programming Pro/Engineer.

Genuine cross area interfacing pole is I – segment, we have changed the cross segment to H – segment. By changing the cross segment, the heaviness of associating bar is decreased by 10gms.

Present utilized material for associating bar is carbon steel. We are supplanting with Aluminum compound A360. By supplanting it with Aluminum composite A360, the heaviness of the interfacing bar decreases around multiple times than utilizing Carbon steel since thickness of Aluminum amalgam A360 is less as contrasted and Carbon Steel.

We have done auxiliary and modular examination on the interfacing pole utilizing two materials Carbon steel and Aluminum compound A360.

By watching the auxiliary examination results, the pressure esteems acquired for the two materials are not exactly their separate yield pressure esteems. So utilizing Aluminum composite A360 is protected.

By looking at the pressure esteems for the two materials, it is marginally less for Aluminum amalgam A360 than carbon steel.

By watching the modular examination results, we decided regular frequencies.

So we can presume that Aluminum combination A360 is better for associating bar.

7. References

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