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A FEASIBILITY STUDY OF SIX STROKE ENGINE BY ANALYSIS THROUGH AVAILABLE RESEARCH DESIGN

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Abstract — *Considering the climate change and the shortage of nonrenewable energy resources, the interests in waste heat recovery has been growing remarkably. Waste heat recovery from internal combustion engine is one of the opportunities for economizing of energy consumption. In internal combustion engine, a great amount of fuel energy is wasted in the form of heat due to thermal limitations. A concept adding two strokes to the Otto or Diesel engine cycle to increase fuel efficiency. The engine captures the waste heat from the four stroke Otto cycle or Diesel cycle and uses it to get an additional power and exhaust stroke of the piston. Waste heat from two sources is effectively converted into usable work: engine coolant and exhaust gas.*

Keywords- FEA, CFD Analysis, Structural Analysis, ANSYS, CREO.

I. INTRODUCTION

The 6 stroke internal combustion engine is advancement over the existing 4 stroke internal combustion engine which employs the same principle as that of the 4 stroke internal combustion engine. The 5th stroke or the second power stroke uses the heat evolved in the exhaust stroke (directly or indirectly) as heat required for the sudden expansion of the secondary fuel (air or water) which pushes the piston downward for the 2nd power stroke thereby rotating the crankshaft for another half cycle. As heat evolved in the 4th stroke is not wasted, the requirement for a cooling system is eliminated. Here fuel is injected once in every 3 complete cycles of the crankshaft which is any time better than a 4 stroke internal combustion engine where fuel is injected once in 2 complete cycles of the crankshaft.

II. WORKING OF SIX STROKE INTERNAL COMBUSTION ENGINE

First Stroke (Suction Stroke): During the first stroke, the inlet valve opens and air-fuel mixture from carburettor is sucked into the cylinder through the inlet manifold.

Second Stroke (Compression Stroke): During the second stroke, piston moves from Bottom Dead Centre to Top Dead Centre, both the inlet valve and exhaust valves are closed and air-fuel mixture is compressed.

Third Stroke (Fuel Power Stroke): During the third stroke, power is obtained from the engine by igniting the air-fuel mixture using a spark plug. Both valves remain closed. Piston moves from Top Dead Centre to Bottom Dead Centre.

Fourth Stroke (Re-Compression Stroke): During the third stroke, piston moves from Bottom Dead Centre to Top Dead Centre. Both the inlet and the exhaust valves are closed. By the time piston reaches Top Dead Centre, water injector injects water which is then converted to steam.

Fifth Stroke (Steam Power Stroke): During the fifth stroke, the steam initiates the second power stroke. Both valves remain closed. Piston moves from Top Dead Centre to Bottom Dead Centre.

Sixth Stroke (Exhaust Stroke): During the sixth stroke, piston moves from Bottom Dead Centre to Top Dead Centre. The inlet valve remains closed. The exhaust valve opens and the exhaust gases are released.

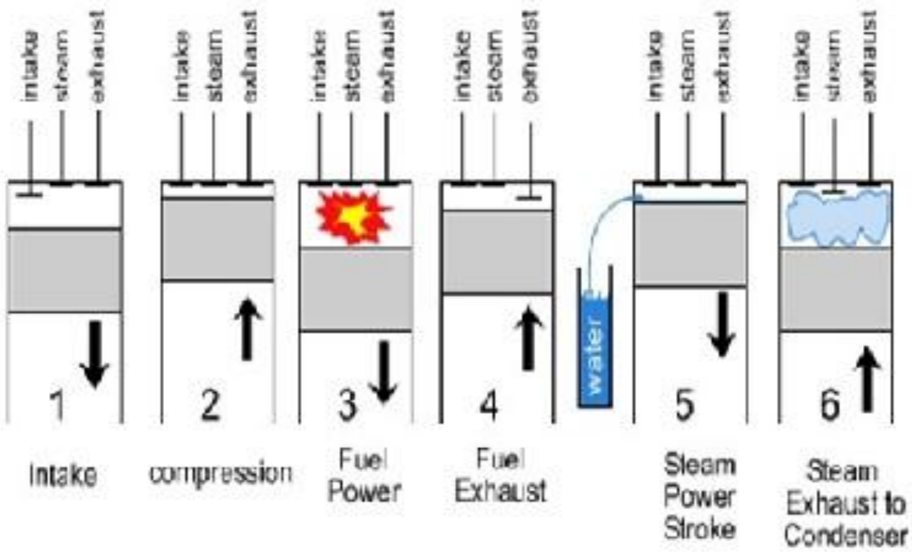

Figure 1: working of six stroke engine

III. MODELING OF SIX STROKE ENGINE

3.1 BASIC CONCEPT OF CREO

CREO is a computer graphics system for modeling various mechanical designs for performing related design and manufacturing operations. The system uses a 3D solid modeling system as the core, and applies the feature base parametric modeling method. In short CREO is a feature based parametric solid modeling system with many extended design and manufacturing applications. The main parts in six stroke engine are cylinder, piston, connecting rod and crankshaft. The assembly of all parts is performed in CREO software.

3.2 MODEL OF SIX STROKE ENGINE

Figure 2: Assembly model of six stroke engine

IV. COMPUTATIONAL FLUID DYNAMICS (CFD) ANALYSIS ON VARIOUS PARTS OF SIX STROKE ENGINE

IC engines involve complex fluid dynamic interactions between air flow, fuel injection, moving geometries, and combustion. Fluid dynamics phenomena like jet formation, wall impingement with swirl and tumble, and turbulence production are critical for high efficiency engine performance and meeting emissions criteria.

4.1 TYPES OF CFD ANALYSIS

4.1.1 COLD FLOW SIMULATION:

This simulation is related to air and fuel velocities and effect of turbulence in piston cylinder geometry.

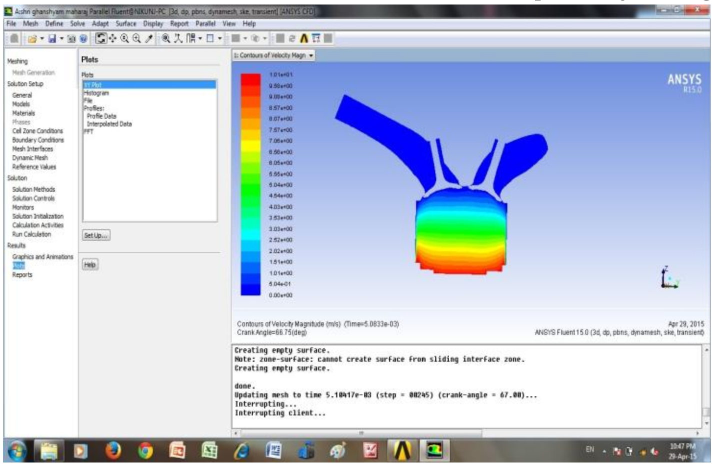

Figure 3: cold flow analysis

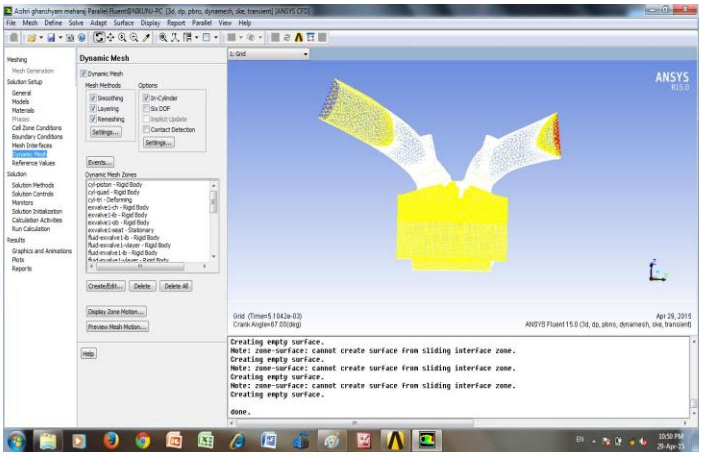

Figure 4: Dynamic mesh on piston

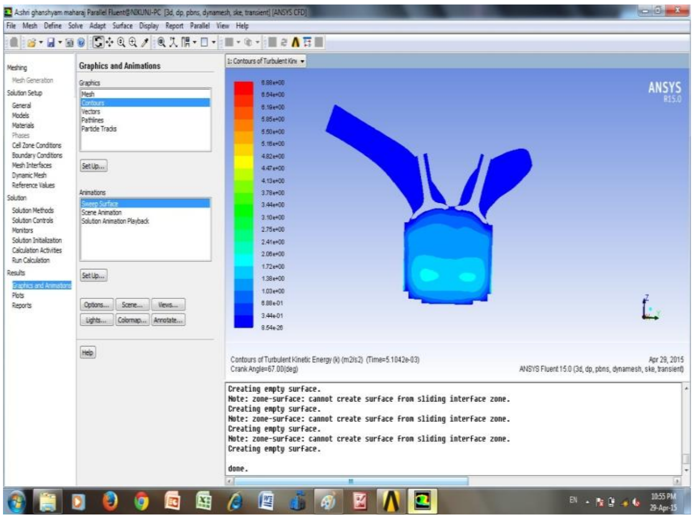

Figure 5: turbulence on piston

4.1.2 PORT FLOW SIMULATION

This simulation is related to temperature and velocity effect at the ports of engines.

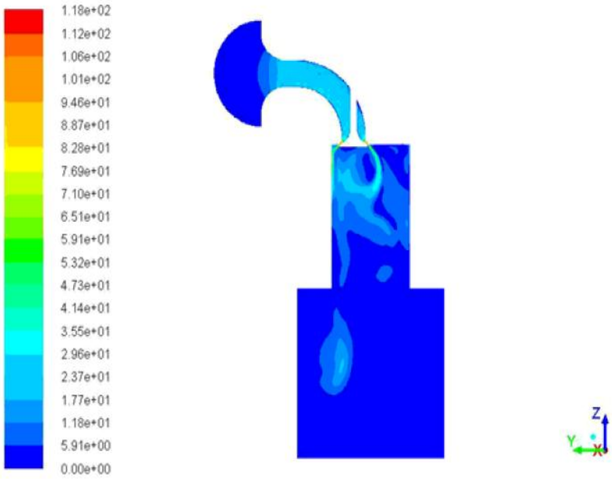

Figure 6: Velocity magnitude on piston

4.1.3 IN CYLINDER COMBUSTION SIMULATION

This simulation is related to distribution to temperature and velocity magnitude contours in combustion chamber**.**

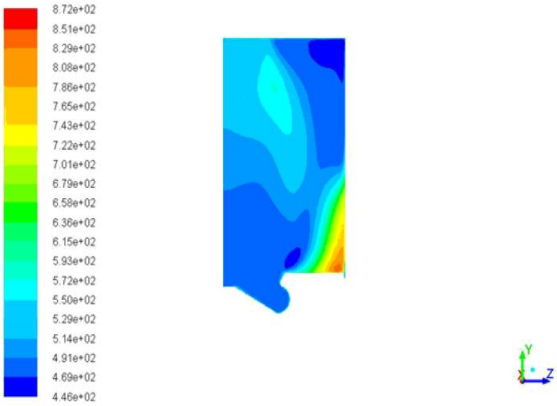

Figure 7: temperature distribution on cut plane

V. STRUCTURAL ANALYSIS OF SIX STROKE INTERNAL STROKE ENGINE

5.1 INTRODUCTION

In finite element analysis, the design is subdivided into a series of elements that are connected by nodes. Material properties and element properties are specified to represent the physical properties of the model. Boundary conditions and applied loads are then define to represent the operating environment for which the design is to be subjected and its simulation tool that enables engineers to simulate the behavior of an entire structure.

In addition, ANSYS Mechanical offers thermal analysis and coupled-physics capabilities involving acoustic, piezoelectric, thermal–structural and thermo-electric analysis. It enables organizations to confidently predict how their products will operate in the real world.

5.2 STRUCTURAL ANALYSIS OF CYLINDER

The function of a cylinder is to retain the working fluid and to guide the piston. The cylinders are usually made of cast iron or cast steel.

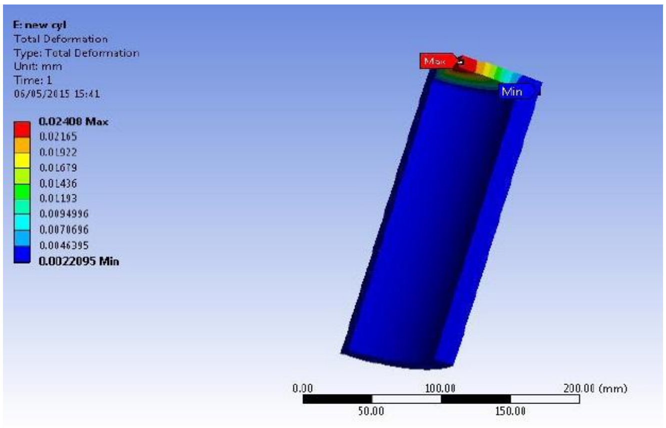

Figure 8: Total deformation in cylinder

5.3 STRUCTURAL ANALYSIS OF PISTON

The main function of the piston of an internal combustion engine is to receive the impulse from the expanding gas and to transmit the energy to the crankshaft through the connecting rod.

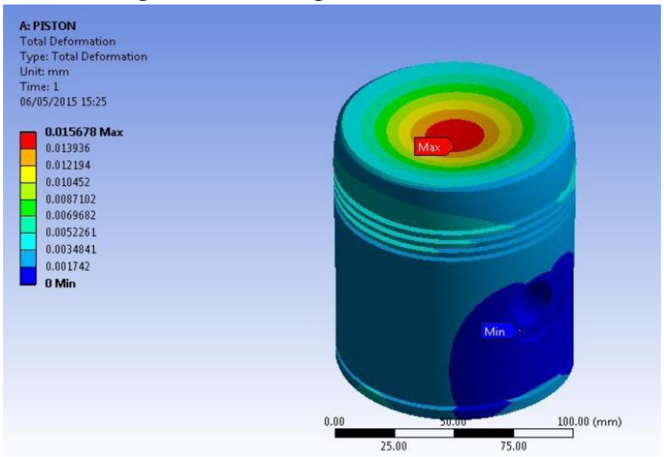

Figure 9: Total deformation of piston

5.4 STRUCTURAL ANALYSIS OF CONNECTING ROD:

The connecting rod is the intermediate member between the piston and the crankshaft. Its primary function is to transmit the push and pull from the piston pin to the crankpin and thus convert the reciprocating motion of the piston into the rotary motion of the crank.

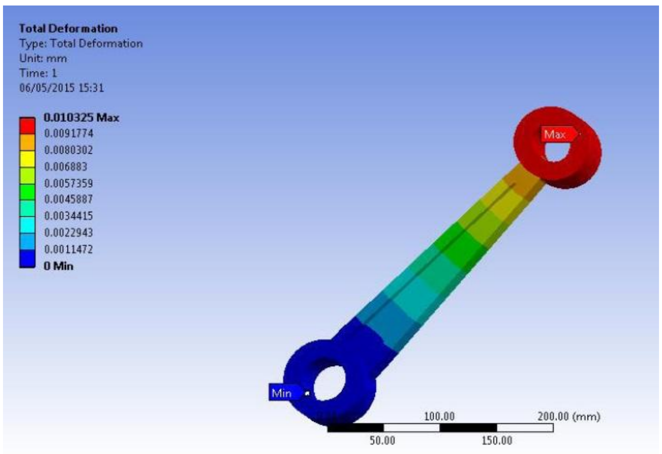

Figure 10: Total deformation in connecting rod

5.5 STRUCTURAL ANALYSIS OF CRANKSHAFT

A crankshaft (i.e. a shaft with a crank) is used to convert reciprocating motion of the piston into rotary motion or vice versa.

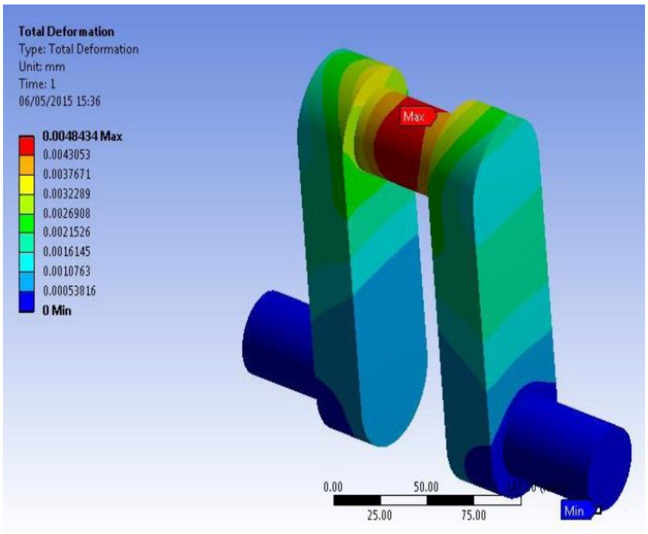

Figure 11: Total deformation of crankshaft

VI. COMPARISON OF RESULTS:

- Six stroke internal combustion engine improve the engine efficiency than four stroke internal combustion engine by using heat energy of exhaust gases.
- Also six stroke internal combustion engine required lesser amount of fuel than four stroke internal combustion engine for same capacity of engine.
- In six stroke internal combustion engine brake thermal efficiency is higher than four stroke internal combustion engine.
- In six stroke internal combustion engine we can extract more work per cycle than four stroke internal combustion engine.
- Better scavenging is possible in six stroke internal combustion engine than four stroke internal combustion engine.
- Six stroke internal combustion engine also reduce pollution level and protect environment than four stroke internal combustion engine.

VII. CONCLUSION

By working on this topic in dissertation I conclude that stroke engine is feasible according to design and analysis point of view. But significant amount of resources required for running this engine practically.
By performing analysis on various parts of six stroke engine I conclude that design of all parts is safe against the stresses acting on them and life of parts is highly reliable.

VIII. SCOPE OF FUTURE WORK

In future this topic is helpful to researcher to develop highly efficient engine with less power consumption and better scavenging is also possible. This type of engine is also helps society and environment for reduction in pollution level.

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