

MODELING OF WANKLE ENGINE AND STEADY STATE THERMAL ANALYSIS ON CYLINDER

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Abstract - This project is aims to design of wankle engine and steady state thermal analysis on cylinder. This is invented by German engineer Felix wankle, is a type of internal combustion engine which uses a rotary design to convert pressure energy into a rotary motion instead of using reciprocating pistons. Its four-stroke cycle takes place in a space between the inside of an oval-like epitrochoid-shaped housing and a rotor that is similar in shape to a Reuleaux triangle but with sides that are somewhat flatter. This design delivers smooth high-rpm power from a compact size. Since its introduction the engine has been commonly referred to as the rotary engine, though this name is also applied to several completely different designs.

The CAD modeling software CATIA V5R19 is used to visualize the models for the chosen design in addition, the finite element modules is used to obtain results of mechanical analysis in order to determine the wankle engine cylinder deformation, and how much heat bearing capacity of the engine cylinder. These are determined by using ansys15.

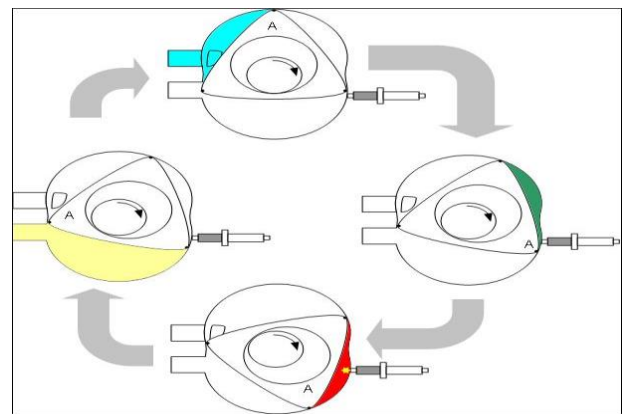
Key Words: Ansys15, CATIA V5R19, Epitrochoid, wankle engine

1. INTRODUCTION

In the Wankel engine, the four strokes of a typical Otto cycle occur in the space between a three-sided symmetric rotor and the inside of housing. The expansion phase of the Wankel cycle is much longer than that of the Otto cycle. In the basic single-rotor Wankel engine, the oval-like epitrochoid-shaped housing surrounds a rotor which is triangular with bow-shaped flanks. The theoretical shape of the rotor between the fixed corners is the result of a minimization of the volume of the geometric combustion chamber and a maximization of the compression ratio, respectively. The symmetric curve connecting two arbitrary apexes of the rotor is maximized in the direction of the inner housing shape with the constraint that it doesn't touch the housing at any angle of rotation (an arc is not a solution of this optimization problem).

The central drive shaft, called the eccentric shaft or E-shaft, passes through the center of the rotor and is supported by fixed bearings. The rotors ride on eccentrics (analogous to cranks) integral to the eccentric shaft (analogous to a crankshaft). The rotors both rotate around the eccentrics and make orbital revolutions around the eccentric shaft.

Seals at the corners of the rotor seal against the periphery of the housing, dividing it into three moving combustion chambers. The rotation of each rotor on its own axis is caused and controlled by a pair of synchronizing gears. A fixed gear mounted on one side of the rotor housing engages a ring gear attached to the rotor and ensures the rotor moves exactly 1/3 turn for each turn of the eccentric shaft. The power output of the engine is not transmitted through the synchronizing gears. The force of gas pressure on the rotor goes directly to the centre of the eccentric, part of the output shaft.



1.1 Working of wankle engine.

As the rotor rotates and orbitally revolves, each side of the rotor is brought closer to and then away from the wall of the housing, compressing and expanding the combustion chamber like the strokes of a piston in a reciprocating engine. The power vector of the combustion stage goes through the center of the offset lobe.

2. WORKING OF WANKLE ENGINE

While a four-stroke piston engine makes one combustion stroke per cylinder for every two rotations of the crankshaft (that is, one-half power stroke per crankshaft rotation per cylinder), each combustion chamber in the Wankel generates one combustion stroke per each driveshaft rotation, i.e. one power stroke per rotor orbital revolution and three power strokes per rotor rotation. Thus, power output of a Wankel engine is generally higher than that of a four-stroke piston engine of similar engine displacement in a similar state of tune; and higher than that of a four-stroke piston engine of similar physical dimensions and weight.

4. DESIGN COMPONENTS OF WANKLE ENGINE IN CATIA

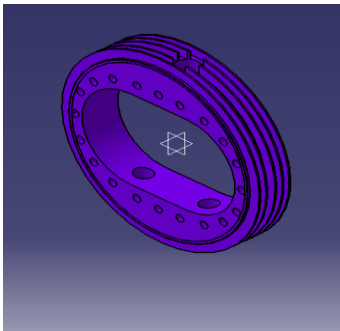


Fig4.1 Cylinder

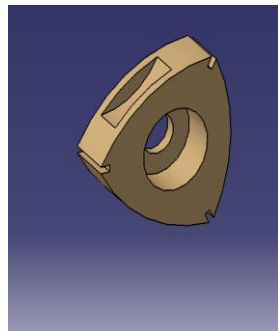


Fig4.2 rotor

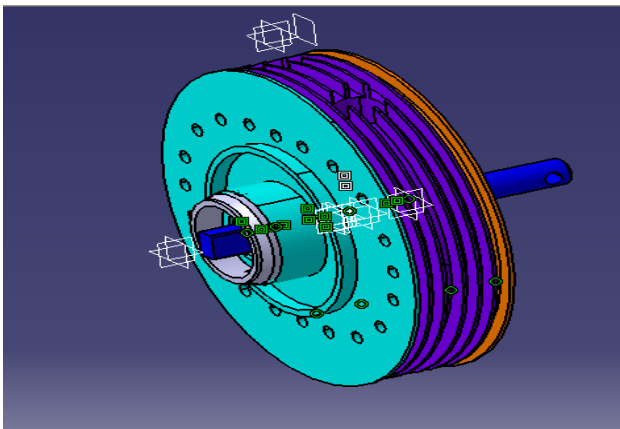
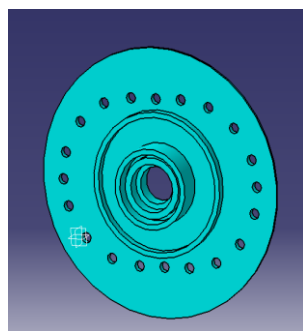
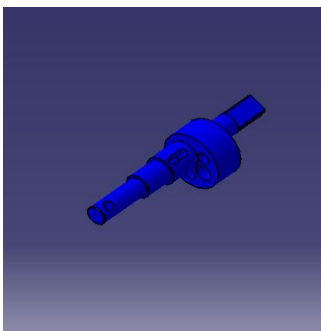


Fig 4.3 ASSEMBLY OF WANKLE ENGINE

5. STEADY STATE THERMAL ANALYSIS OF WANKLE ENGINE CYLINDER BY USING ANSYS 15.0

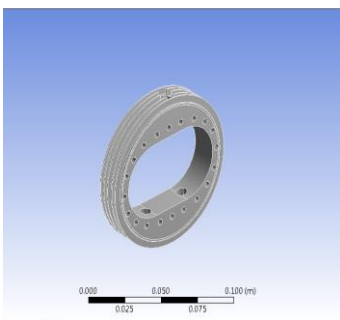


Fig5.1 GEOMETRY OF CYLINDER

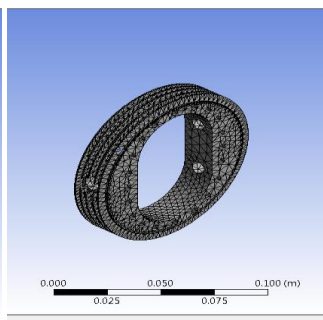


Fig5.2 MESHING

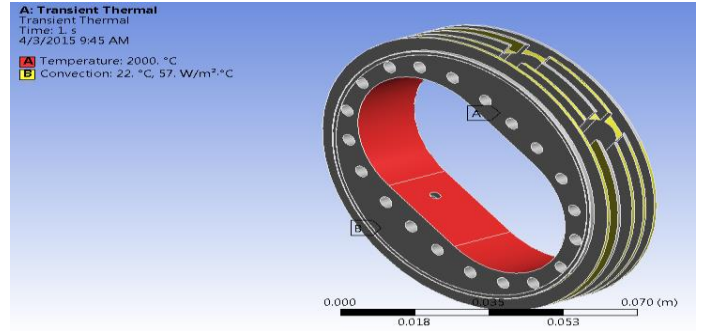


Fig 5.3 BOUNDARY CONDITIONS

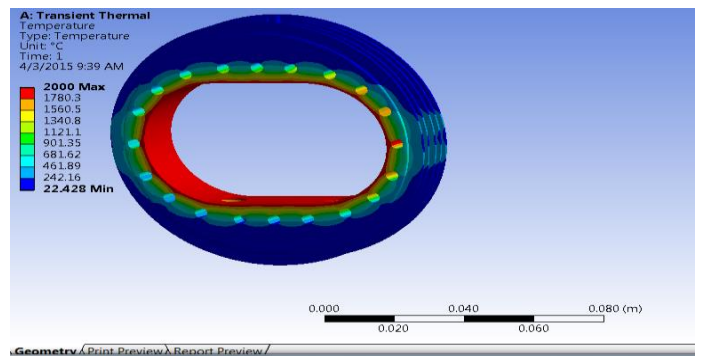


Fig 5.4 TEMPERATURE DISTRIBUTION

5.1 STRUCTURAL ANALYSIS OF CYLINDER WITH STRUCTURAL STEEL

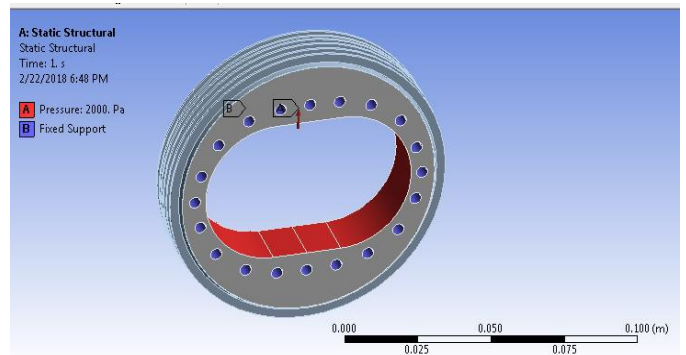


Fig5.5 BOUNDARY CONDITIONS

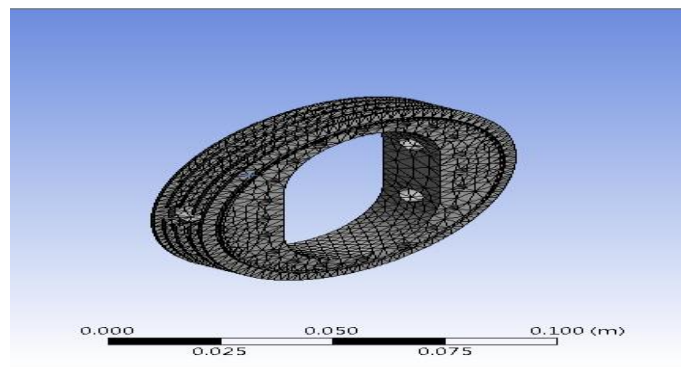


Fig5.6 MESHING

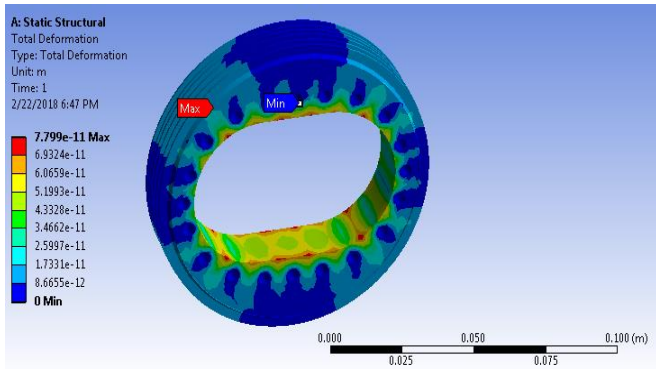


Fig5.7 TOTAL DEFORMATION

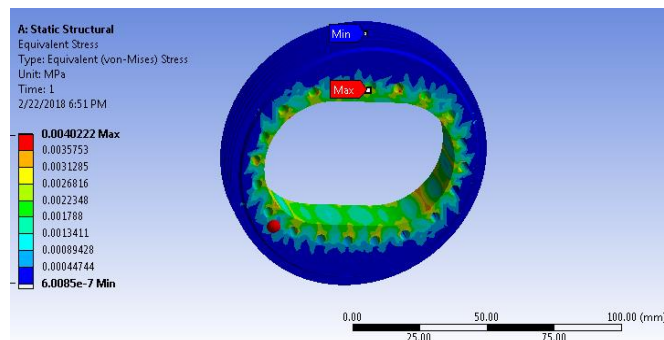


Fig5.8 EQUIVALENT STRESSES

5.2 STRUCTURAL ANALYSIS OF CYLINDER WITH GRAY CAST IRON

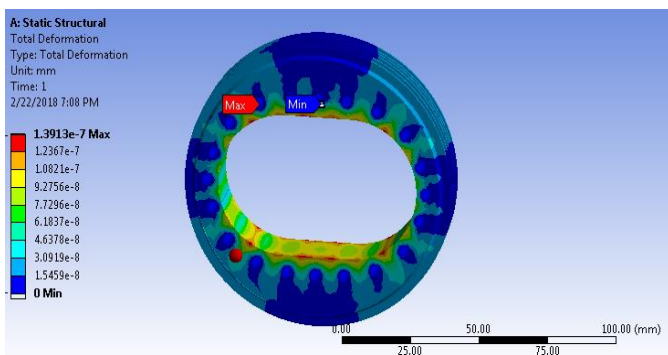


Fig5.9 TOTAL DEFORMATION

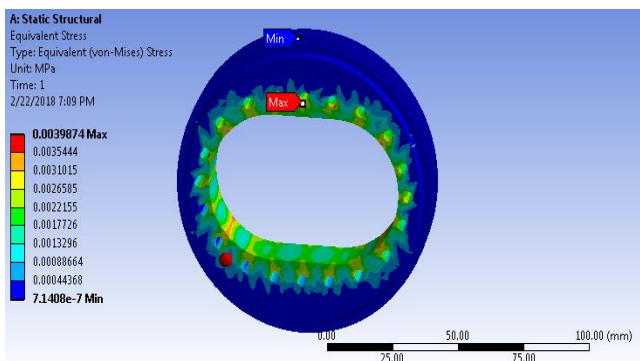


Fig 5.10 EQUIVALENT STRESSES

6. RESULTS

6.1 Finite element analysis:

The cylinder block is analyzed in ANSYS 15.0 by importing the system in to the work bench.

Both thermal and structural analysis are done on the wankle engine cylinder block

6.1 Table shows the temperature distribution of structural steel material

THERMAL ANALYSIS		
S.NO	MATERIAL	TEMPERATURE DISTRIBUTION
1	STRUCTURAL STEEL	2000-22.428 ⁰

6.2 table shows the stresses developed in the cylinder with structural steel and gray cast iron material

S.NO	MATERIAL	STRESS (MPA)	DEFORMATION (MM)
1	STRUCTURAL STEEL	0.004022	7.799X10 ⁻¹¹
2	GRAY CAST IRON	0.003987	1.39X10 ⁻⁷

7. CONCLUSIONS

In this research paper the wankle engine is modelled according to the german drawings in CATIAV5R19 parametric software environment. The thermal and structural analysis is done on ANSYS 15.0 workbench. In this analysis was done on wankle engine cylinder by changing the materials of the cylinder material. The present used material for the wankle engine cylinder is cast iron. In this paper other material structural steel is used to analyse the engine cylinder.

From the above observations of wankle engine cylinder thermal and structural analysis was done by using gray cast iron and structural steel. Depends on the stress and deformations we concluded that gray cast iron is the best suitable material

REFERENCES.

- [1] Chol-Bum M. Kweon, A Review of Heavy-Fueled Rotary Engine Combustion Technologies, Army Research laboratory, ARL-TR-5546, may 2011
- [2] Froede, W. G. The NSU-Wankel Rotating Combustion Engine. Society of Automotive Engineers International (SAE), SAE 610017,1961.

[3] Mazda. The Mazda RX-8; Mazda media report, 2002.

[4] Ohkubo, M.; Tashima, S.; Shimizu, R.; Fuse, S.; Ebino, H. Developed Technologies of the New Rotary Engine (RENESES). Society of Automotive Engineers International (SAE), SAE 2004-01-1790, 2004.

[5] Peter A.J. Achten, Johan P.J. van den Oever, Jeroen Potma, Georges E.M. Vael Horsepower with brains: The design of the CHIRON Free Piston Engine, 2000-01

[6] Peter A.J. Achten Ph.D., Joop H.E. Somhorst, Robert F. van Kuilenburg, Johan P.J. van den Oever, Jeroen Potma, CPR for the hydraulic industry: The new design of the innas free piston engine.

[7] C.R. Ferguson, Internal combustion engines, applied thermosciences, New York: John Wiley and Sons, 1986

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