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ANALYSIS OF PISTON RING FOR BAJAJ DISCOVER

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ABSTRACT

The friction at piston ring cylinder liner assembly is a major contributor in the total friction losses in the I.C. engine. The piston ring assembly is dominant sources of the engine rubbing forces. The components in Piston Ring Assembly are oil control ring, compression ring, and piston skirts are the responsible for the frictional force. The present work deals with evaluation of the friction in the piston ring cylinder liner assembly for a 4-stroke four cylinder petrol engine. The relationship between the friction force and piston tilt angle showed weak correlation at low speed and increases with the engine speed. The computer model incorporates a finite difference solution of the two-dimensional Reynolds equation with squeeze effect for fully flooded lubrication as well as a flow-continuity algorithm for 'starved' lubrication and used to evaluate the tribological performance of piston rings operating in both circular and distorted bores. The influences of factors, such as level of bore distortion, ring conformability, circumferential variation of the ring face and axial motion of the ring, and profile are taken into account. An improved method for determining oil availability in a ring pack was also developed by the effect of relative locations of rings on the piston and oil accumulation in front of the ring.

Keywords: *piston ring, Ansys14.0, Stress analysis.*

I. INTRODUCTION

The friction loss in internal combustion engine is important factor in determining the fuel economy and performance of the vehicle utilizing power of the engine. 50% of the friction losses in an internal combustion engine are due to piston/cylinder system, of which 70–80% comes from the piston rings. Piston rings are important components in the internal combustion engine. Their prime function is dynamically seal the gap between the moving piston and the cylinder liner surface in order to prevent escape of combustion gases from the combustion chamber into the crankcase and the leakage of the oil from crankcase into the combustion chamber. During operation of an I C engine, the formation of a hydrodynamic oil film at the interface between the rings and liner is encouraged. This reduces engine friction and wear. Studies of the hydrodynamic lubrication of piston rings play an important role in the evaluation and design of piston rings, since the lubrication phenomena at the interface directly impact on efficiency, durability and emission output of IC engines. In the steam engines no piston rings were used. The temperatures and steam pressures were not as high as corresponding parameters in today's internal combustion engines, need for considering thermal expansions and clearances was smaller. Increasing power demands required higher temperatures caused stronger heat expansion of piston material. This made it necessary to use a sealant between piston and the cylinder liner to allow a decrease in the clearance in cold conditions, i.e. when clearances were at their maximum. Keeping the clearance between piston and liner wall at a minimum considerably reduces combustion gas flow from combustion chamber past the piston.

II. ANALYSIS OF A PISTON RING BY USING FEA

Finite element method is a numerical analysis technique for obtaining approximate solutions to a wide variety of engineering problems. originally developed and applied to the broad field of continuum mechanics. Because of its diversity as well as flexibility as analysis tool, it is receiving much attention in engineering schools and industry. It is necessary to obtain numerical solutions to problem rather than exact closed from solutions. The resource of the analyst usually comes to the rescue and provides several alternatives to overcome this dilemma. possibility is to simplifying assumption to ignore the difficulties and reduce the problem to be handled sometimes this procedure works more often than not it leads to series inaccurate or wrong answers. Now computers are widely available, a more alternative is to retain the complexities of the problem find an approximate numerical solution. A finite element model of a problem gives a approximation to the governing equations'. The basic premise of the finite element method is that a solution region analytically modeled or approximated by replacing it with an assemblage of discrete elements since these can be put in a variety of

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ways, they can be put together in a variety of ways, and they can be used to represent complex shape.

Table 2.1 The details of the compression ring[1]

Outside diameter of the ring:	99.2mm
Inside diameter of the ring:	96mm
Width of the ring:	3.2mm
Load on the ring:	420Mpa

2.2 Modeling Of Piston Ring For Static Condition:

The finite element model is generated using solid 185 element type using sweep mesh the wheel and the connecting links are meshed platform model generated as using mapped mesh platform solid model is changed to FEA model

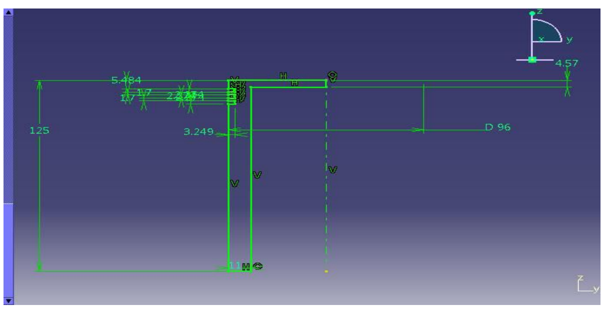

Fig.2.2.1 Piston Drawing and Dimensions

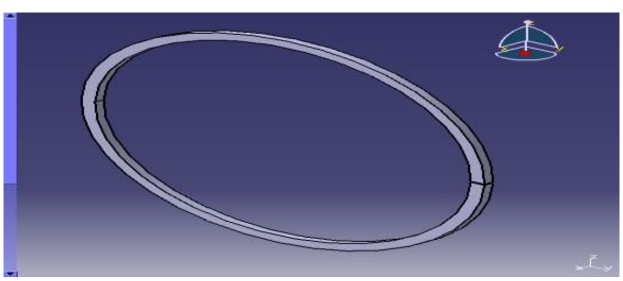

Fig. 2.2.2 Modeling of compression ring

2.3 Boundary Conditions for Structural Analysis of Piston

Combustion of gases in combustion chamber exerts pressure on head of the piston during power stroke. The pressure force will taken as boundary condition in structural analysis using ANSYS mechanical APDL. Fixed support has surface of pin hole. Because the piston will move from TDC to BDC with the help of fixed support at pin hole. The load is apply in piston due to gas explosion that force causes to failure of piston pin .Pressure acting on piston=3.3N/mm^2.

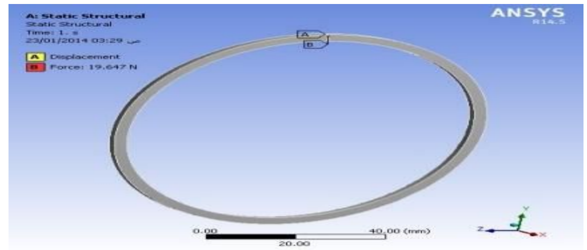

Fig.2.3 boundary condition for structural analysis

2.4 Boundary Condition for Thermal Analysis of Piston Ring

The thermal boundary conditions consist of applying a convection heat transfer coefficient and the bulk temperature, and they are applied to the piston crown, landsides, piston skirt shown in Fig.4. Maximum piston head temperature= 859.70C, Bulk temperature= 250C, Heat transfer coefficient piston surface=3200W/m2K,Maximum temperature at edges piston=482.70 C, Heat transfer coefficient on edge piston = 2400 W/m2K, Heat transfer coefficient on lands rings=1600W/m2K, Heat transfer coefficient on piston skirt=1000W/m2K.

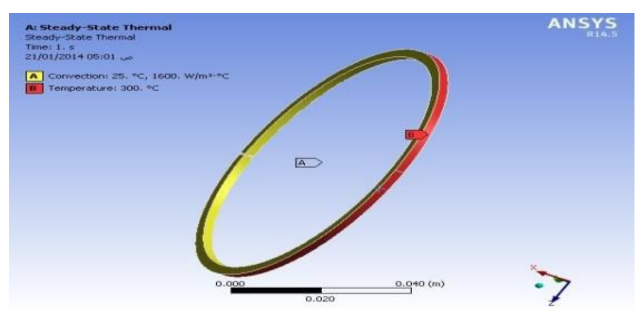

Fig.2.4boundary condition for thermal analysis

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III. CASE STUDY

3.1 FEA Analysis of Piston Ring For Various Materials

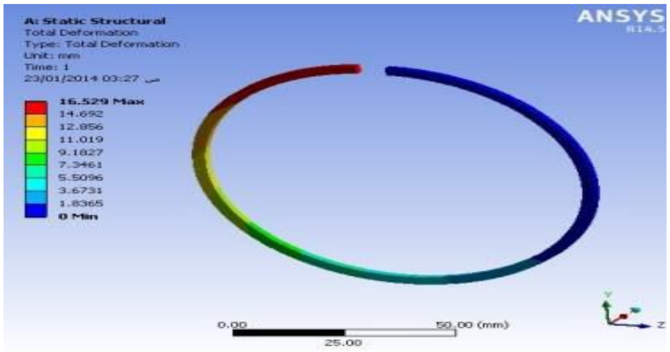

Fig.3.1 total deformation for Nodular Spheroidal cast iron

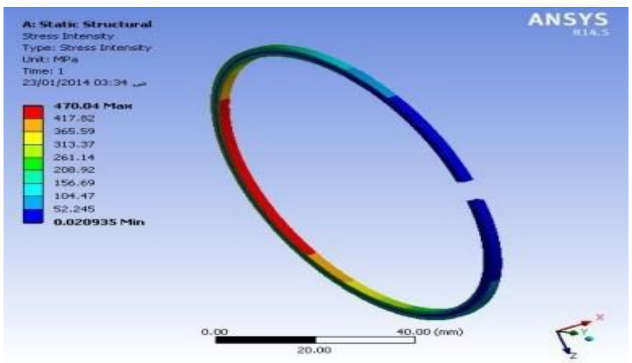

Fig.3.2 Stress intensity for Nodular Spheroidal cast iron

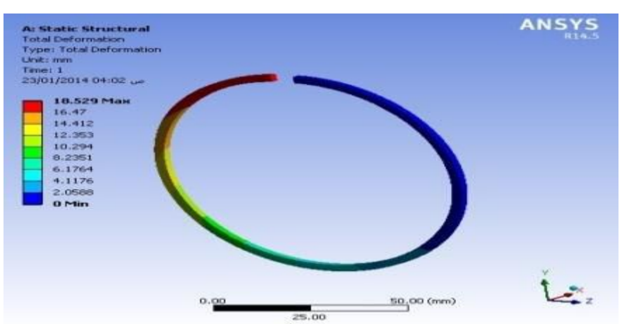

Fig.3.3 total deformation for grey cast iron

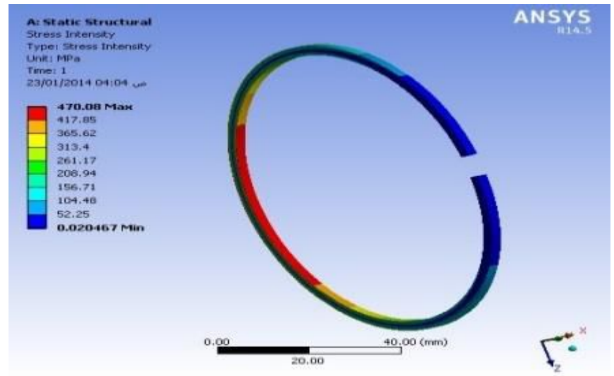

Fig.3.4 Stress intensity for grey cast iron

IV.RESULT AND DISCUSSION

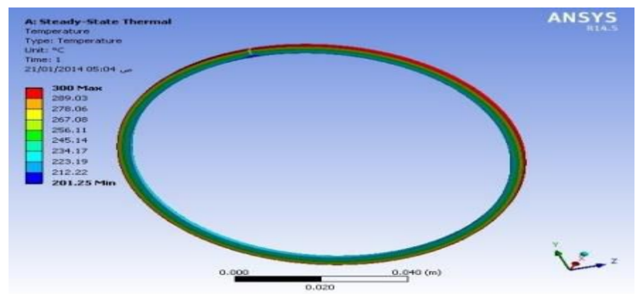

Fig.4.1 Temperature for Nodular Spheroidal cast iron

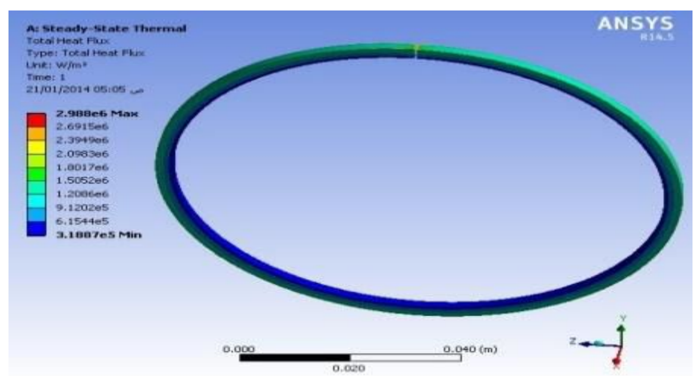

Fig4.2 Total heat flux for NSCI

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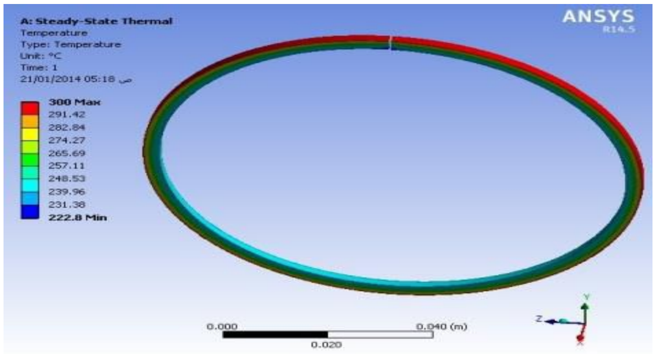

Fig.4.3 Temperature for grey cast iron

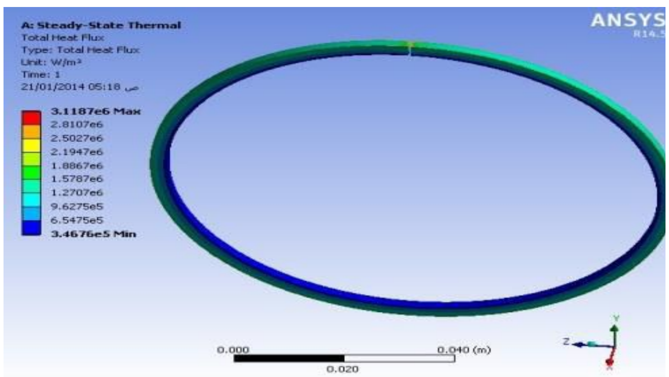

Fig.4.4 Total heat flux for grey cast iron

IV. CONCLUSION

As engine speed increases the friction force also increases. The power loss due to the friction at the interface of the piston ring and the cylinder liner is significant and is the major contributor to the total frictional. Power losses in I.C. engine. The friction power loss at piston ring assembly seems to increase with engine speed. It is seen that the maximum values of the frictional force are higher for the lubricant SAE30W which may cause higher wear the rings. Piston rings are made of Nodular Spheroidal Cast Iron and Grey Cast Iron. GCI Piston Rings show more deformation than in NSCI. Stress intensity is equal in both. Maximum temperature is equal both materials, where minimum temperature is higher in GCI, which is 222.8 ^{o} C. Here, Maximum total heat flux is observed in GCI piston rings and minimum value in NSCI piston rings. Hence, NSCI material shows better heat dissipation capabilities than GCI therefore for manufacturing of piston rings NSCI material should be a better option.

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