Design And Analysis of Cylinder Block using ANSYS
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I. Introduction:
Cylinder block is the important part of engine. It is also called engine heart because there is having piston movement inside the cylinder. The cylinder block is having number of cylinder. The cylinder block have coolant path. It is made by single material. There is no adding part. Total part of cylinder block is made by one single large material. Other important part also mounted on the cylinder block.
Cylinder block is the 3-4% weight of vehicle. It is made by normally iron and substitute material is aluminium. The application of aluminum engine comes on later period of 1970. During technical requirements substitute materials required.

II. Static Analysis:
The linear is relationship between load and deformation must be linear. The static is load acting depends upon time. Displacements are varying very small range. Stiffness values are must be constant

III. Transient Thermal Analysis:
Transient thermal analyses determine temperatures and other thermal quantities that vary over time. The variation of temperature distribution over time is of interest in many applications such as with cooling of electronic packages or a quenching analysis for heat treatment. Also of interest are the temperature distribution results in thermal stresses that can cause failure. In such cases the temperatures from a transient thermal analysis are used as inputs to a structural analysis for thermal stress evaluations. Many heat transfer
applications such as heat treatment problems, electronic package design, nozzles, engine blocks, pressure vessels, fluid-structure interaction problems, and so on involve transient thermal analyses. A transient thermal analysis can be either linear or nonlinear. Temperature dependent material properties (thermal conductivity, specific heat or density), or temperature dependent convection coefficients or radiation effects can result in nonlinear analyses that require an iterative procedure to achieve accurate solutions. The thermal properties of most materials do vary with temperature, so the analysis usually is nonlinear.

IV. Fatigue Analysis:
Fatigue failure is defined as the tendency of a material to fracture by means of progressive brittle cracking under repeated alternating or cyclic stresses of an intensity considerably below the normal strength.

V. Software:
CATIA:
Cylinder block design is done by CATIA software.

ANSYS:
It is the engineering simulation software. This software founded in 1970. There are many versions comes to market. This software used for simulating computer models of structures, electronics, machine components for analysis. Here we are used version 14.5 for this project. We are used version called ANSYS workbench 14.5. Here we are using analysis on static structural, transient thermal analysis. We are analysis on static, thermal and fatigue.

Static analysis and fatigue analysis done by static structural. Thermal analysis based on time varying done by transient thermal.

VI. Methodology

Design the part of cylinder block
Material selection
Static analysis 1
Transient Thermal analysis 1
Fatigue analysis 1
Changing material
Static analysis 2
Transient thermal analysis 2
Fatigue analysis 2
Find out the result from the analysis
Compare the result from the analysis

VII. Materials:
There are two type of materials available. The materials are ferrous and non-ferrous. Ferrous materials are having iron content. Non-ferrous materials are having no iron content. Ferrous is having good magnetic property. Ferrous are weight more. Non-ferrous materials are weight less. Ferrous are less expensive. Non-ferrous are more expensive. Ferrous are does not recycling. Non-ferrous are recycling and reusable.

In this analysis taken materials are AL7475, NICKEL BRONZE ALLOY, GRAPHITE CAST IRON, SAND CAST
MAGNESIUM ALLOY. These are materials available on various countries. These materials are taken into account for analysis process. In this four materials we finding suitable material for future use. Mostly material selections are iron and aluminum for cylinder block. In this analysis we are introduced to new kind of material.

Al7475- it is non-ferrous material. It is weight less. It is available at north America. The cost of this material is 200 per kg.

NICKEL ALUMINIUM BRONZE ALLOY- It is non-ferrous material. It is having high load capacity. The cost of this material is 1200 per kg.

GRAPHITE CAST IRON – It is ferrous material. It is weight more. It is having great strength concentration. The cost of this material is 75 per kg.

In this criteria we taken and move with one material. Our concentration is reduce the weight of the vehicle. The above mentioned material properties we choose material non-ferrous material. The materials are AL7475 and NICKEL ALUMINIUM BRONZE ALLOY. But here we are taken into account of cost of material. Because reduce the total cost of vehicle. So, we consider the theory of these materials suitable for our analysis is Al7475.

Material Properties:

AL 7475
Density: 2.81g/cc
Young’s Modulus: 70.3GPa
Poisson’s Ratio: 0.33
Thermal Conductivity: 163 W/m-K
Specific Heat Capacity: 0.88 J/g-°C

Nickel Aluminium Bronze Alloy
Density: 7.53g/cc
Young’s Modulus: 110GPa
Poisson’s Ratio: 0.32
Thermal Conductivity: 41.9 W/mK
Specific Heat Capacity: 419.0 J/kg

Graphite Cast Iron
Density: 7.91g/cc
Young’s Modulus: 99GPa
Poisson’s Ratio: 0.21
Thermal Conductivity: 46 W/mK
Specific Heat: 490 J/kg

Sand Cast Magnesium Alloy
Density: 1.81g/cc
Young’s Modulus: 45GPa
Poisson’s Ratio: 0.35
Thermal Conductivity: 62 W/m.K
Composition:
Aluminium 10.7%
Magnesium 90%
Zinc 0.3%

VIII. DESIGN/IMPLEMENTATION:
Here we designed V8 Engine for analysis. This design is taken and made by CATIA Software. This is the base of this project. The design made by calculation and assumption of basic information of the engine. After finishing design of cylinder block we move to ANSYS Workbench for making analysis. Static analysis Load applied near 11.6 Mpa Pressure applied each cylinder of engine block. Bottom of the cylinder block fixed. Result of this analysis like stress, strain, total deformation. There is cylinder block divided into two models. One is half model. Another one is full model. In half model only four are cylinder considerable for analysis. In full model total
block is considerable for analysis. The second analysis is Transient thermal Analysis. In this analysis 250 sec time was taken. In that time taken applied temperature near 800 degree centigrade. The result of this analysis is stress, strain, temperature, heat flux. The final analysis are known Fatigue Analysis. This is only refer for safety factor.

Fig. No. 1 Design of cylinder Block

Fig. No. 2 Pressure Applied on Cylinder

Fig. No. 3 Static Analysis

Fig. No. 4 Transient thermal Analysis
Here above the table is result of static structural analysis of Half model. In this analysis highest stress material is Graphite cast iron. Minimum strain value contain material is Sand Cast Magnesium Alloy. Minimum Deformation material is Nickel Aluminium Bronze alloy.

2. Static Structural

Table No II Static Structural Full Model

<table>
<thead>
<tr>
<th>Type of material</th>
<th>Equivalent Stress Mpa</th>
<th>Equivalent Strain</th>
<th>Total Deformation mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al 7475</td>
<td>81.994 to 0.81309</td>
<td>0.0011849 to 1.1566e-5</td>
<td>0.087633</td>
</tr>
<tr>
<td>Nickel Aluminium Bronze Alloy</td>
<td>82.168 to 0.813</td>
<td>0.0007612 to 7.3951e-6</td>
<td>0.0561</td>
</tr>
<tr>
<td>Graphite Cast Iron</td>
<td>86.751 to 0.84328</td>
<td>0.0080909 to 8.518e-6</td>
<td>0.062426</td>
</tr>
<tr>
<td>Sand Cast Magnesium Alloy</td>
<td>81.32 to 0.1426</td>
<td>0.0018316 to 1.8095e-5</td>
<td>0.13597</td>
</tr>
</tbody>
</table>

Here above the table is result of static structural analysis of Full model. In this Analysis highest stress material is Graphite cast iron. Minimum strain value contain material is Nickel Aluminium Bronze alloy. Minimum Deformation material is Nickel Aluminium Bronze alloy.
3. Transient Thermal
Table No III Transient Thermal

<table>
<thead>
<tr>
<th>Types Of Materials</th>
<th>Temperature</th>
<th>Heat Flux</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al 7475</td>
<td>812.35 to 9.1606</td>
<td>3.043 to 7 0.001 7651</td>
</tr>
<tr>
<td>Nickel Aluminum</td>
<td>816.45 to 15.679</td>
<td>1.385 to 6 0.000 5823 4</td>
</tr>
<tr>
<td>Bronze Alloy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphite Cast Iron</td>
<td>814.29 to 16.28</td>
<td>1.499 to 6 0.000 8038</td>
</tr>
<tr>
<td>Sand Cast Magnesium</td>
<td>811.57 to 9.0526</td>
<td>1.177 to 0.000 7251 9</td>
</tr>
<tr>
<td>Magnesium Alloy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Here Above table highest temperature conduct material is Nickel aluminum Bronze alloy.

IX. CONCLUSION
From this paper we are conclude that design of cylinder block materials are Al7475 and Graphite cast iron. Here Al 7475 stress and temperature values suitable for engine environment.

REFERENCES: