FINITE ELEMENT ANALYSIS OF BEARING HOUSING USING ANSYS

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Abstract— In today’s competitive age foundries are required to be more active and efficient. They need to respond fast. For that casting simulation has become a powerful tool to visualize mould filling, solidification and cooling and to predict the location of the internal defects such as shrinkage, porosity, sand inclusion and cold shut. It can be used for existing casting process or for developing new casting without shop-floor trials. In present finite element analysis is done for knowing the temperature distribution after material is poured. This gives information about how the temperature varies at different portion of the bearing housing

I. INTRODUCTION

Since the evolution of mankind, man has used his intelligence and creative instinct to develop things that will reduce his labor. He shaped bowls, tools and weapons out of stones and wood which was naturally found in nature. With the passage of time he discovered other element in nature like gold, silver and copper which were readily available in nature in the form of nuggets. He melted and shaped this metal according to his desires. He probably discovered gold pebbles with stone and copper from the copper bearing ores that line the fire pits. He found it easy to melt the iron, copper and gold using the fire woods and charcoal, and hence in different ages cast-iron and copper became the most profusely used natural materials.

A metal casting can be defined as a metal object formed when molten metal is poured into a mold which contains a cavity of the desired shape and is allowed to solidify.

The casting process is used most often to create complex shapes that would otherwise be difficult or impossible to make using conventional manufacturing practices. Casing has certain characteristic metallurgical, physical and economical advantages over other methods of metal processing. It is by far the cheapest method to produce different shapes in metals. The size of the casting may vary from a few grams to several tones. They may also vary in composition and properties depending upon the material of the mold, type of metal charged, alloying elements added in the charge or in laddel and the rate and method of cooling.

Casting can be divided into six general classes commercially known as plain gray cast iron, alloy cast iron, malleable iron, steel, alloy steel and nonferrous casting. It is rare that a foundry attempts at making all the six types. Castability of metals depend on many factors and castability index is high if the material has high fluidity, low shrinkage, low affinity for absorbing gas, low stress and uniform strength. Material which are considered exceptionally good for casting include casting iron, copper base alloy zinc, aluminum, nickel and magnesium. Some of typical casting includes pulleys, flywheel, engine and machine blocks, machine tool beds, gear blank turbine, blades, C.I pipes etc.

A. Classification of casting process
   - Die casting
   - Continuous casting
   - Sand casting
   - Centrifugal casting
   - Investment casting

B. Casting Defects
   - Cold Shuts and Misruns
   - Porosity
   - Pipe shrinkage
   - Hot Tearing and Cracks
   - Open Blows and Blow holes
   - Hot spots

II. MODELLING AND FINITE ELEMENT ANALYSIS

A. Details of bearing housing
Name of the Product: Bearing Housing
Material: A216WCB
Unit weight: 133.5 kg
Size of the casting box:
   - Cope: 609.5mm × 609.5mm × 355.6mm
   - Drag: 609.5mm × 609.5mm × 355.6mm
   - Cheek: 609.5mm × 609.5mm × 355.6mm
Shape of the Casting box: rectangular
Type of the gating system used: pressurized gating system used
Pattern material: wooden
Type of pattern: multi piece pattern
Type of moulding: Hand moulding
Moulding sand: silica sand
No. of cores used: 1
Pouring temperature: 1610 °C

B. Material Properties of A216WCB

<table>
<thead>
<tr>
<th>ASTM No.</th>
<th>C</th>
<th>Mn</th>
<th>P</th>
<th>S</th>
<th>Cr</th>
<th>Ni</th>
<th>Mo</th>
<th>Si</th>
<th>Enthalpy</th>
<th>Yield Strength</th>
<th>Elongation in %</th>
<th>Reduction in area</th>
<th>Hardness HBN</th>
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</thead>
<tbody>
<tr>
<td>A216</td>
<td>0.3</td>
<td>1</td>
<td>0.04</td>
<td>0.02</td>
<td>0.6</td>
<td>0.5</td>
<td>0.2</td>
<td>0.5</td>
<td>450</td>
<td>250</td>
<td>22</td>
<td>35</td>
<td>185</td>
</tr>
</tbody>
</table>

Table 1: Material Properties of A216WCB

C. Properties of sand

<table>
<thead>
<tr>
<th>Conductivity</th>
<th>0.519 W/m K</th>
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<tbody>
<tr>
<td>Specific Heat</td>
<td>1172.304 J/kg K</td>
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Finite Element Analysis of Bearing Housing Using ANSYS

III. Modeling of Bearing Housing in Pro E

<table>
<thead>
<tr>
<th>Density</th>
<th>1495 kg/m³</th>
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Table 2: properties of sand

Fig. 1: wire frame model of bearing housing

Fig. 2: solid model of bearing housing

IV. Thermal Analysis of Bearing Housing in ANSYS

This is a transient heat transfer analysis of a casting process. The objective is to track the temperature distribution in the steel casting and mold during solidification process. Steps involve in this software as given below.

A. Creating 2D element of bearing housing with mold

Fig. 3: 2D element of bearing housing with mold

B. Assign material and give different material properties to mold & cast product

Material properties (like specific heat, enthalpy, and thermal conductivity)

C. Meshing the mold & cast product

Meshing size fine course=1 is used for cast product & meshing size fine course=6 for mold

Fig. 4: Temp Vs enthalpy

Fig. 5: Temp Vs thermal conductivity

Fig. 6: Meshing of mould

Fig. 7: Selection of material
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1. Click on node numbers button which separate nodes of mold & cast product

Fig. 8 Meshing of bearing housing

D. Click on node numbers button which separate nodes of mold & cast product

Fig. 9: Meshing with node number

E. Apply convection loads on the exposed boundary lines. Apply the convection to the lines of the model. Loads applied to solid modeling entities are automatically transferred to the finite element model during solidification.

Fig. 10: Apply loading condition

F. Find out nodal solution

Stepped boundary condition simulates the sudden contact of molten metal at definite temperature with the mould at ambient temperature. The program will choose automatic time stepping that will enable the time step size to be modified depending on the severity of nonlinearities in the system.

Fig. 11: Nodal solution

G. Find out simulation result

It gives the temperature distribution in bearing housing under loading condition.

Fig. 12: Time Vs. Temp. Graph

Fig. 13: Simulation result

V. CONCLUSION

Based on the above result we come to know about temperature distribution in bearing housing using sand casting process. Temperature at the middle portion of the model is very high and get reduce at the outer portion.

REFERENCES

Bibliographies


[16]Sarojirani Pattnaik,ion , “ The investigations made to enhance the strength, surface finish, etc. of ceramic shell for ferrous alloys/non-ferrous alloys as well as super alloys in investment casting”, Transactions of the AFS,98,353-357, 1990.


Websites
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