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MODELING AND SIMULATION OF TEMPERATURE VARIATION OF BEARINGS IN A HYDROPOWER GENERATION UNIT

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ABSTRACT

Hydroelectric power contributes around 20% to the world electricity supply and is considered as the most important, clean, emission free and an economical renewable energy source. Hydroelectric power plants operating all over the world has been built in the 20th century in many countries and running at a higher plant-factor. This is achieved by minimizing the failures and operating the plants continuously for a longer period at a higher load. However, continuous operation of old plants have constrained with the failures due to bearing overheating. The aim of this research is to model and simulate the dynamic variation of temperatures of bearing temperature of a hydro electric generating unit. Multi-input, multi-output (MIMO) system with complex nonlinear characteristics of this nature is difficult to model using conventional modeling methods. Hence, in this research neural network (NN) technique has been used for modeling the system.

Keywords— Hydroelectricity, Bearing Temperature, Plant factor, neural network, Simulation

Chapter -1

INTRODUCTION

BEARING HOUSING:

Housing is one of the accurate components to keep the bearing reliability and safety. A new generation of bearing protectors is now available that can help maintain lubricant cleanliness, prevent loss of lubricants, and prolong the life of your rotating equipment.

Depending upon the design of a shaft or housing, the shaft may be influenced by an unbalanced load or other factors which can then cause large fluctuations in bearing efficiency.

For this reason, it is necessary to pay attention to the following when designing shaft and housing:

- Bearing arrangement selection; most effective fixing method for bearing arrangement
- Selection of shoulder height and fillet radius of housing and shaft.
- Shape precision and dimensions of fitting; area run out tolerance of shoulder.

Machining precision and mounting error of housing and shaft suitable for allowable alignment angle and inclination of bearing.

SAND CASTING: Sand casting, also known as sand moulded casting, is a metal casting process characterized by using sand as the mould material. It is relatively cheap and sufficiently refractory even for steel foundry use. A suitable bonding agent (usually clay) is mixed or occurs with the sand. The mixture is moistened with water to develop strength and

plasticity of the clay and to make the aggregate suitable for moulding. The term "sand casting" can also refer to a casting produced via the sand casting process. Sand castings are produced in specialized factories called foundries. Over 70% of all metal castings are produced via a sand casting process.

BASIC STEPS IN MAKING SAND CASTINGS:

The basic steps involved in making sand castings are:

1. Patternmaking: Patterns are required to make moulds. The mould is made by packing moulding sand around the pattern. The mould is usually made in two parts so that the pattern can be withdrawn.

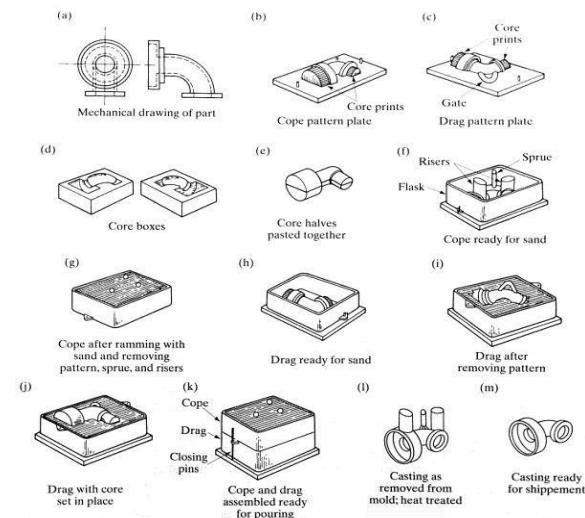
- In horizontal moulding, the top half is called the cope, and the bottom half is called the drag.
- In vertical moulding, the leading half of the mould is called the swing, and the back half is called the ram.
- When the patterns withdrawn from the moulding material (sand or other), the imprint of the pattern provides the cavity when the mould parts are brought together. The mould cavity, together with any internal cores as required, is ultimately filled with molten metal to form the casting.

2. If the casting is to be hollow, additional patterns, referred to as core boxes, are needed to shape the sand forms, or cores, that are placed in the mould cavity to form the interior surfaces and sometimes the external surfaces as well of the casting. Thus the void between the mould and core eventually becomes the casting.

3. Moulding: is the operation necessary to prepare a mould for receiving the metal. It consists of ramming sand around the pattern placed in support, or flask, removing the pattern, setting cores in place, and creating the gating/feeding system to direct the metal into the mould cavity created by the pattern, either

by cutting it into the mould by hand or by including it on the pattern, which is most commonly used.

4. Melting and pouring are the processes of preparing molten metal of the proper composition and temperature and pouring this into the mould from transfer ladles.



1.1 Schematic showing steps of the sand casting process

OBJECTIVES

1. Study about the castings.
2. Study about bearing housing.
3. Verification of design process.
4. Machining simulation about CNC programming.

CHAPTER-2 LITERATURE SURVEY

Casting methods: Metal casting process begins by creating a mould, which is the 'reverse' shape of the part we need. The mould is made from a refractory material, for example, sand. The metal is heated in an oven until it melts, and the molten metal is poured into the mould cavity. The liquid takes the shape of cavity, which is the shape of the part. It is cooled until it solidifies. Finally, the solidified metal part is removed from the mould.



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A large number of metal components in designs we use every day are made by casting. The reasons for this include:

- (a) Casting can produce very complex geometry parts with internal cavities and hollow sections.
- (b) It can be used to make small to very large size parts
- (c) It is economical, with very little wastage: the extra metal in each casting is re-melted and re used
- (d) Cast metal is isotropic – it has the same physical/mechanical properties along any direction.

Common examples: door handles, locks, the outer casing or housing for motors, pumps, etc., wheels of many cars. Casting is also heavily used in the toy industry to make parts, e.g. toy cars, planes,

TYPES OF CASTINGS:

Summarizes different types of castings, their advantages, disadvantages and examples

Process	Advantages	Disadvantages	Examples
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Sand	Wide range material sizes, shapes, low cost	Poor finishing, wide tolerance	Engine blocks and cylinder heads
Shell mould	Better accuracy, higher production rate	Limited part size	Connect rods, gear housings
Expandable patterns	Wide range of metals	Pattern have low strength	Cylinder heads, break components

Plaster mould	Complex shapes, high accuracy, good finishing	Non-ferrous metals low production rate	Prototype of mechanical components
Ceramic mould	Complex shape, high accuracy	Small sizes	Impellers, induction mould tooling
Permanent mould	Good finishing, low porosity, high production rate	Costly moulds, simpler shapes only	Gears, gear housings
Die	Excellent dimensional, high production rate	Costly moulds, small parts, non ferrous metals	Precision gears, camera bodies, car wheels
Centrifugal	Large cylindrical parts, good quality	Expensive or limited shapes	Pipes, boilers, fly wheels

CHAPTER-3 DESIGN SPECIFICATIONS AND METHODOLOGY

PATTERN MODEL DESIGN:

Starting NX

Toolbars and tools

The tools bars are generally used the co axial alignment of the parameters given to the system to which the required shape must be desired and should be obtained with accurate results.

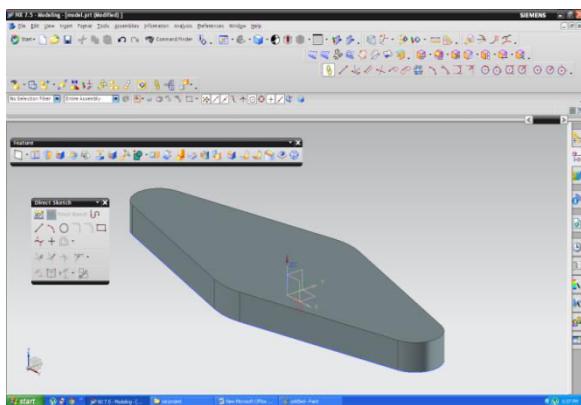


Figure 3.1 bottom view

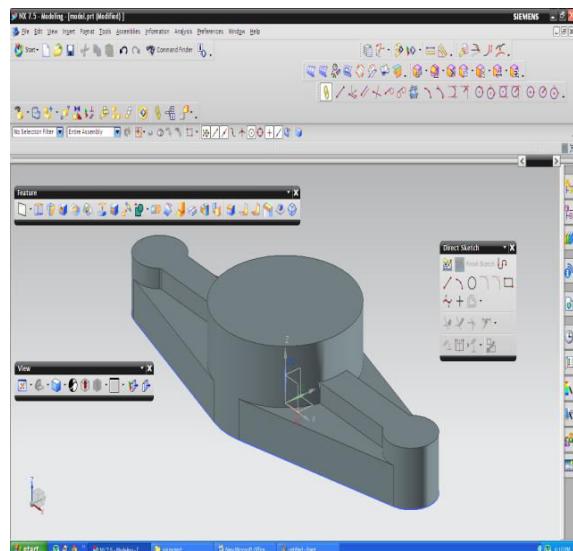


Figure 3.2 part modelling

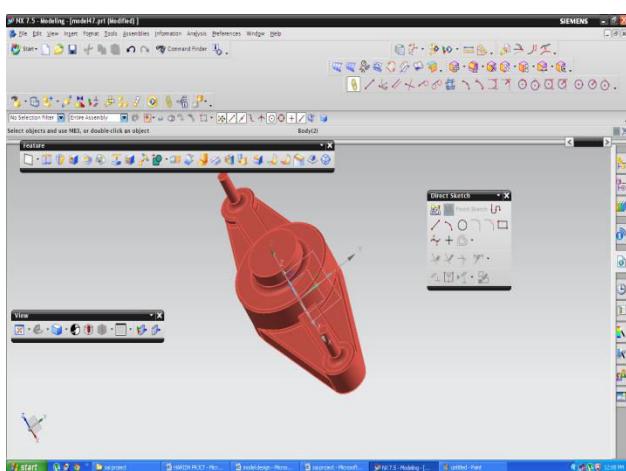
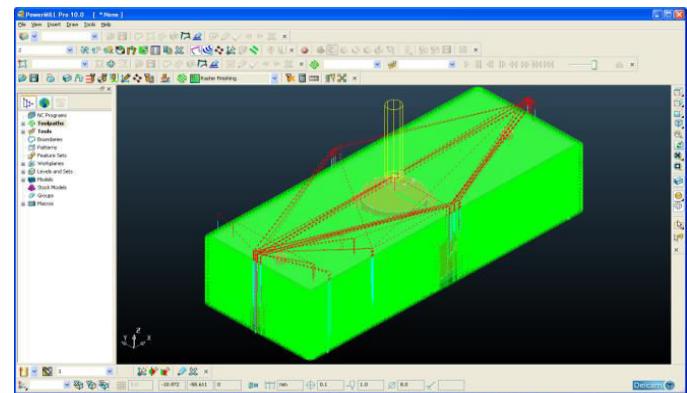


Figure 3.3 Final pattern

RESULTS:



4.6 Tool Path generation

The above figure describes the initial tool path generation of model having a specific flow of stresses and strains.

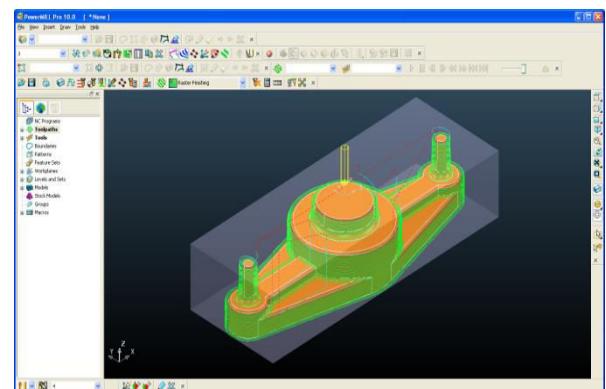


Figure 4.2 Surfacing tool paths

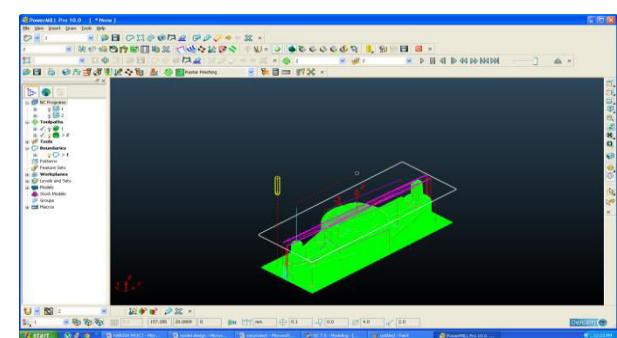


Figure 4.3 final molded cavities of paths

CHAPTER-6

PROBLEM DEFINITION

In the present thesis the study of molten metal flow and the temperature variation along the path of flow from the inlet and the final component has been carried out for four symmetrically placed components .In this problem the material consider is

Aluminum 6061 .

Density(ρ) = $2.7\text{e-}0$ tonnes/mm 3 .

Viscosity (ν) = $1.7\text{N}\cdot\text{m}/\text{S}^2$.

Thermal conductivity(k) = $0.173\text{W}/\text{mm}^0\text{k}$.

The meshing is done for the fluid flow along the path using 2d-flotran 141

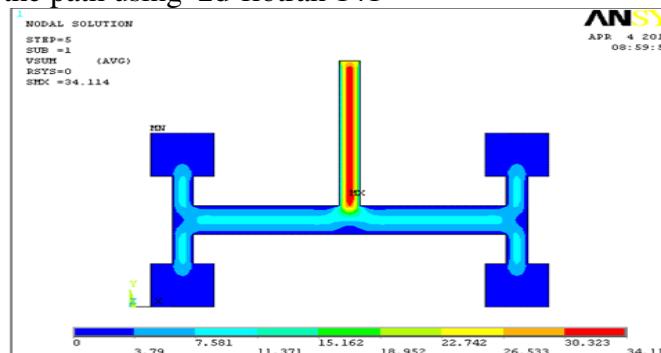


Fig.6.4velocity vector along the path

After performing the analysis the following results of fluid flow distribution and temperature variation along the path are obtained as shown below.

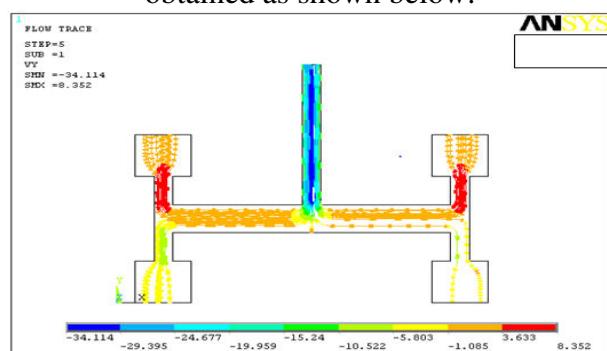


Figure 6.5 velocity flows in y

CONCLUSIONS:

1. The material HE30 used for making pattern plays an important role for high production rate.
2. Designing techniques are presented for sand casting patterns.
3. CNC programming also introduced to get high accuracy in pattern making.
4. The flow is laminar and temperature distribution is varying uniformly in the path

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