# TRANSIENTS THERMAL EFFECT ON THE DESIGN ANALYSIS OF 3- PHASE INDUCTION MOTOR

Ajay Anand[1], Alka Thakur[2]
[1]Research Scholar, Department of Electrical Engineering, School of Engineering sssutmssehore
[2]Assistant Professor, Department of Electrical Engineering, School of Engineering sssutmssehore

***Abstract: Induction motor is singly excited motor, which is very simple and compact. In this paper a model was developed in the 2d and 3d Maxwell program by which the transient process at the motor start-up was calculated for different features especially temperature. For detailed and accurate analysis of motor performance in faulty conditions, an accurate model for the motor in which all conditions can be considered is of extreme importance. Thermal analysis is achieved based on a precise knowledge of the test motor geometry, materials, and heat sources (losses). This work will help the induction motor designer in prediction the thermal state of induction motor .In this work the model of induction motor is presented in 2d and its designing is understood with the variation of currents and various characteristics curves have been studied.***
***Keywords:Design, Induction Motor,2d, transients***

## I. INTRODUCTION

The effect of the thermal aging may cause the induction motors defenseless to the other factors which cause failure in the insulation structure. If the insulation system loses its physical integrity, it cannot resist to dielectric, mechanical and environmental effects. Stators winding faults may arise from thermal aging and thermal overloading. The insulation life decreases to half for each increase of 10 °C in temperature. The effect of the temperature on thermal aging can be minimized by decreasing the operating temperature or using high-quality insulation material. Thermal overload may appear depending on the applied voltage [1], [2]. Thermal monitoring technique has been used for bearing and stator fault detection. But it offers limited fault diagnosis capability as it is too slow to detect the fault before it spreads into more severe faults [3]. Thermally, the insulation is by far the weakest component in any motor [4].

## II. MACHINE DESIGN WORKFLOW

It providing user with very fast solutions, complete set of design information including load and no load and even short circuit parameters. RMxprt host a wide variety of machine types in the form ofc/3D ready to run models automatically.

### *2.1 Machine Interfacing:*

The machine selection interface includes all the possible AC and DC rotating machines with the RMxprt mainframe, with each module having its own predefined dimensions and properties.Upon selecting any of the machine the system opens up a user interface based on that particular machine having different tool bars and various functions. Using these functions and windows like the project window and detailed window user can easily modify or input the desired values to generate the machine.Among the different properties lie the Stator Property Window, Slot Design, The End/Insulation and the Rotor Property Window etc.. The general properties like Outer & Inner Diameter along with Length are user defined fields. The software describes various Steel Types and also has the option for user defined additions.

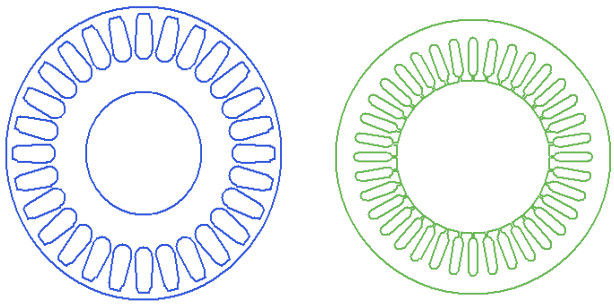


Fig:1 Rotor Design (a) (b) Stator slots Design

Figure 1 (a) and (b) shows the design of rotor and stator in 2d.

## III. DESIGN CONFIGURATION

In this paper the Simulation of 1100 W 380 V 1450 RPM @ 50 Hz Induction Motor using Ansys Maxwell and Ansys Transient Thermal Analysis at 50 A current has been performed. Detailed table has been shown in figure below.

Properties: MaxwellProject - RMxprtDesign1 - Machine

Machine

| | Name | Value | Unit | Evaluated V... | Description | Read-only |
|---|---|---|---|---|---|---|
| | Machine Type | Three Phase Inductio... | | | | ☑ |
| | Number of Poles | 2 | | | Number of poles o... | ☐ |
| | Stray Loss Factor | 0.01 | | 0.01 | Stray Loss Factor | ☐ |
| | Frictional Loss | 11 | W | 11W | The frictional loss ... | ☐ |
| | Windage Loss | 11 | W | 11W | The windage loss ... | ☐ |
| | Reference Speed | 1450 | rpm | | The reference spe... | ☐ |

Fig: 2(a) data of motor

Properties: MaxwellProject - RMxprtDesign1

General | IndM3

| | Name | Value | Unit | Evaluated V... | Description | Read-only |
|---|---|---|---|---|---|---|
| | Name | Setup1 | | | | ☐ |
| | Enabled | ☑ | | | | ☐ |
| | Operation Type | Motor | | | Motor or generator | ☑ |
| | Load Type | Const Power | | | Mechanical load t... | ☐ |
| | Rated Output Power | 1100 | W | 1100W | Rated mechanical... | ☐ |
| | Rated Voltage | 380 | V | 380V | Applied or output r... | ☐ |
| | Rated Speed | 1450 | rpm | 1450rpm | Given rated speed | ☐ |
| | Operating Temperat... | 75 | cel | 75cel | Operating temper... | ☐ |

Fig: 2(b) Design Specification of Motor

The Design Configuration of the Induction motor is analysed by the software for it working condition under various data. And results were opted and examined for the different rated output and available efficiency for this particular configuration.

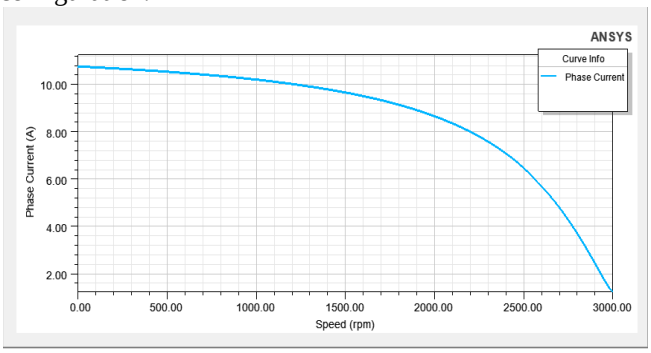



Fig 3(a) phase current vs speed

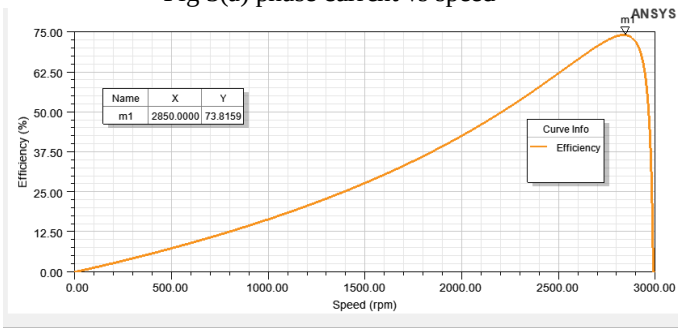



Fig 3 (b) efficiency vs speed

The Transient Solver computes the time varying magnetic fields in time domain and solves for instantaneous magnetic fields at each time step. Mesh plays an important role in the accuracy of the computed results and thus require higher mesh resolution in the regions where fields are of interest. Initial Mesh is automatically created by the Maxwell software without any instruction from the user prior to performing field calculations.

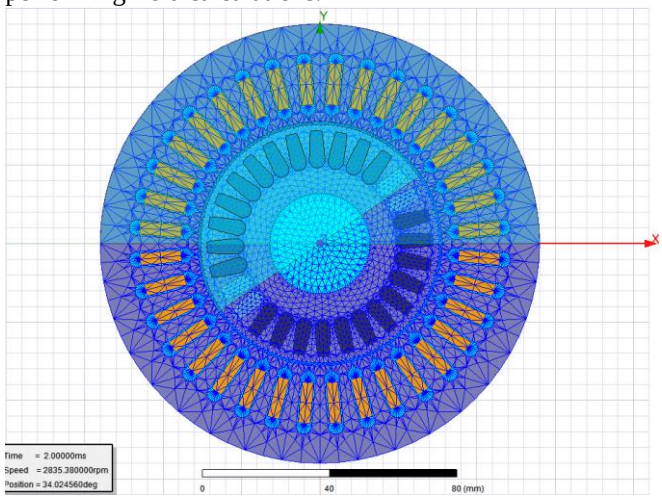
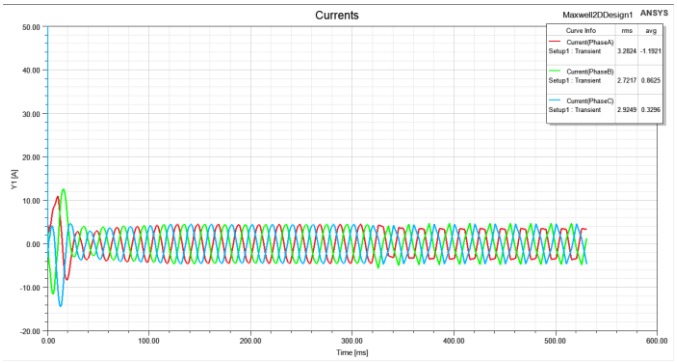


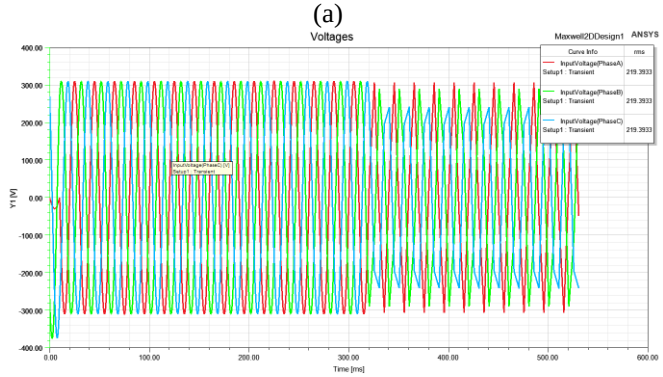
Fig 4 Mesh of the 2D Induction Motor

The solution setupdefines the parameters used for solving the simulation. It contains different tabs for various commands like time steps, stop time, end time etc. In this simulation we have given the time of solution equal to 1 Seconds and the time step is = 0.005s.

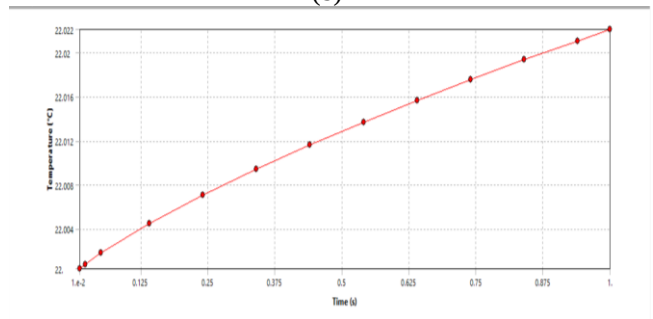
## III. RESULTS AND DISCUSSION




(a)




(b)




(c)

Fig 5 (a),(b),(c) Variation of current voltage and temperature vs time

## IV. CONCLUSION

The final conclusion of the proposed work is while the current load is kept at 50 A as an input and the motor is run for a small time of 1 second the rise in temperature from initial 22 degree Celsius to 22.022 degree Celsius which is a significant increase looking at the run time.

## REFERENCES

[1] Zhongming, Y. A. " Review of induction motor fault diagnosis" The Third International Electrical Power System and Motion Control Conference, 2000, Pp No.1353–1358.

[2] S. Karmakar, S. Chattopadhyay, M. Mitra, and S. Sengupta, Induction Motor Fault Diagnosis. 2016.

[3] Snehal O. Gulhane ,M. R. Salodkar "Review of Detection of Faults in Induction Motor", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 08 | Aug -2016.

[4] Stajić, Z., et al., Induction Machines (in Serbian), Faculty of Electronic Engineering, Nis, Serbia, 2012
[5] Eck, B., Fans-Design and Operation of Centrifugal, Axial-Flow, and Cross-Flow Fans, Pergamon Press, Oxford, UK, 1973
[6] Spasić, Ž. T., et al., Variation of Operation of Low-Pressure Reversible Axial Fans Driven by Induction Motor from Start to the Steady-State, Proceedings, 15th Symposium on Thermal Science and Engineering of Serbia, Sokobanja, Serbia, 2011, pp. 586-595
[7] P Niu, Q G Sun and H B Lv, Simulation Analysis of Oil-gas Two-phase Jet Flow Based on Fluent. Machine Building & Automation, 2013,41(2): 91-93.
[8] Dableh J H and Findlay RD, Szabados B, Belmans R. Investigation of the Air Gap Influence on the Performance and Cost Optimization of a Squirrel Cage Induction Motor.International Conference on Electrical Machines & Drives,1993:31-37.
[9] Optimum Design Criteria for Maximum Torque and Efficiency of a Line-Start Permanent-Magnet Motor Using Response Surface Methodology and Finite Element Method