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DesignandanalysisOf3phaseinductionmotorusingAnsysMaxwell

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Abstract:

It is evident that an induction motor is very reliable, robust and efficient machine usedfor various industrial applications under various loading conditions. Induction motors arecheaperincost,ruggedinconstructionandrequireverylittlemaintenance.Thispaperfocuses on performance aspects and censorious fields in the design of such a machine. Similar reference laboratory motors have been taken into account for designing of a motor.Therefore by using ANSYS, a three phase 50 Hz 430V 1.1KW motor has been designed.Once the designing of a 2 pole motor is done; its behavior has been studied. The tools usedfor this design and analysis are ANSYS Maxwell 2D and RMxprt. It is an instrumental innot only giving classical motor performance parameters, but also spawns an outright transferof the3D or 2Dgeometry in conjunction withall electrical as well as electromagneticproperties.Theconclusionsretrievedareconferredand presumptionsaredrawn.

KeyWordsandPhrases: *Inductionmotordesign,analysis, RMxprt,Maxwell2D,Ansys*

1. Introduction

This study describes and investigates the design and analysis of a three-phase induction drive. A conventional squirrel cage motor with two poles is used in the proposed induction machine. The proposed drive offers benefits such as increased dependability and greater flexibility in manipulating the motor's torque-speed curve. Split-wound and self-cascaded dual stator machines are the two most common kinds. Previously, the split-wound machine was widely used as a begetter to boost the total power capacity of big synchronous generators [1]. Since then, they've been used in a wide range of applications, from synchronous machines to massive pumps and compressors. Split-wound motors are responsible for extending the power range of solid state based drives beyond the capability of a single inverter, and novel multilayer topologies have also been created recently

[2]. It is also claimed that the system has a higher level of authenticity as a result of the implicit recurrence [3] [4] [5]. The stator of a split-wound machine is made up of two complimentary but separate three-phase windings wound for the same number of poles. The rotor is a conventional squirrel cage, and both stators have the same frequency.

2. Maxwell2DandAnsys:

ANSYS For engineers working on 3D and 2D electro-magnetic and electro-mechanical equipment such as drives, actuators, transformers, sensors, and coils, Maxwell is a cost-effective electromagnetic field modeling tool. Maxwell 2D is a high-performance bilateral software package that solves problems involving electric, magneto static, eddy current, and transients using finite element analysis (FEA).

The following are the differential versions of Maxwell's equations:

1. FaradayslawofinductionΔ xE= -∂B/∂t
2. Gauss'slawfor magnesiumΔxB=0
3. Ampere'slaw ΔxH=J+∂D/∂t
4. Gauss's lawfor electricityΔxD=P

RMxprt:

In addition to ANSYS Maxwell, engineers who develop electrical devices and generators may now use ANSYS RMxprt, a template-based design tool. In order to fulfil market demand for greater efficiency and lower cost machines, Maxwell and RMxprt partnered to develop a truly bespoke machine design pipeline.RMxprt uses classic analytical motor theory and analogous magnetic circuit techniques to compute machine performance, make initial sizing decisions, and carry out hundreds of "what-if" studies in a theme of seconds. A critical aspect of RMxprt is its ability to routinelyproduce a full Maxwell project (2D/3D), including geometry, materials, and boundary circumstances. For thorough electromagnetic transient analysis, the setup comprises the necessary symmetries and excitations, as well as coupling circuit architecture.RMxprt creates a reduced order model automatically, taking into account nonlinearities and eddy effects, and sends it to Simplorer for additional electric drive study. In Implorer, RMxprt can also effectively create a custom-made driving circuit topology that can be linked to the necessary electric machine reduced order model as a stand-alone component.

SquirrelCagemotordesignusingRMxprt:

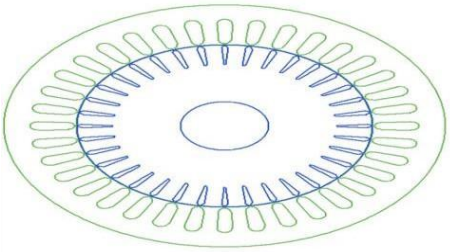

Fig. 2: RMxprt user Interface (2-pole)

Squirrel cage rotors are used in the majority of AC motors. Between the iron laminates of the rotor, the motor symbolically cast Al or Cu. The bars and varnished lamination carry a significant portion of the rotor currents. D21-50 is the laminated steel designated to the rotor and stator. Copper windings have been assigned. Figure 2 depicts the user interface for a 2-pole RMxprt.The time required for investigation was in seconds because the RMxprt is a template-based tool.

3. RESULTS:

Table no1: Datasets

Poweroutput (kW)	1.1
Voltage(V)	430
Windingbond	Wye
QuantityofPoles	2
Speed(rpm)	1450
Frequency(Hz)	50

Table no 2: MaterialConsumption

Current of RotorPhase(A)	2.02238
Stator Winding CopperLoss(W)	121.897
RotorWinding Copper Loss (W)	46.2453
FrictionandWind ageLoss(W)	108.966
driftLoss(W)	11
entireLoss(W)	361.918
enterPower(kW)	1.46198
yieldPower(kW)	1.10006
reflexstreamTorque(N-m)	3.63553
Competence(%)	75.2446
PowerFactor	0.656958
rateSlip	0.0368409
ratestreamvelocity(rpm)	2889.48

Table no 3:RMxprtResults(2-pole)

Ratedshaftspeed	2889.48rpm
MechanicalshaftTorque	3.63553NM
Totallosses	361.918W
Powerfactor	0.656958
Efficiency	75.2446%
Output power	1.10006 KW

SquirrelcagemotordesignusingMaxwell:

With a direct channel, the above-mentioned motor is moved from RMxprt to Maxwell.. The motor's parameters are same, as given in Table 1 for a two-pole motor.Meshing is done using Maxwell-2D's automated flexible meshing method. The magnetic flux density at the time of peak current, current v/s time, torque v/s time, & graphics for the defined motor with 2-pole were derived and given in Fig. 5 (a), (b), and (c), respectively, as a result of the study.

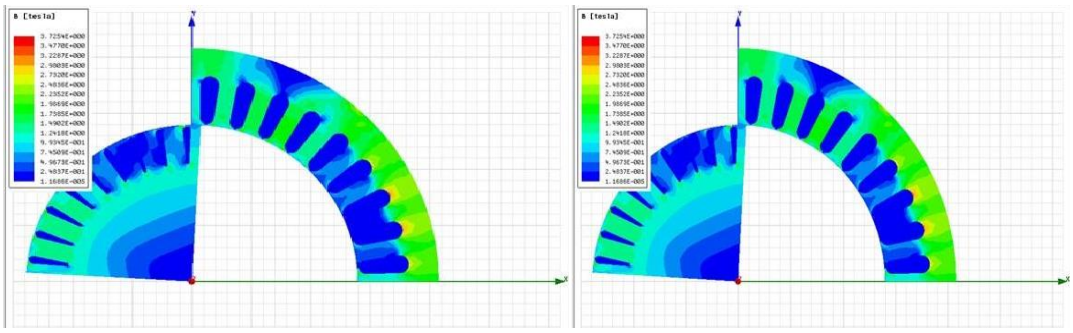

Figure no 5(a):Magneticfluxdensity Figure no 5(b):Phasecurrentv/sTime

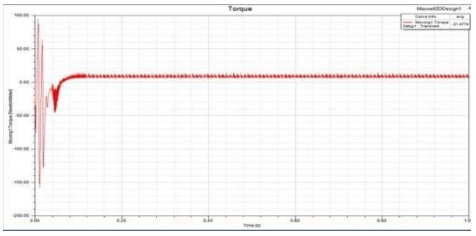

Fig.5(c):Torquev/s Time

4. Conclusion:

In this article, the ANSYS Maxwell 2D and RMxprt program instrument are utilised to build and analyze a squirrel cage motor. In terms of field computation and investigation findings, the motor parameter and characteristics may be properly estimated & anticipated. It is also clear that as computer technology advances and computation times decrease, FEM techniques become increasingly useful for motor analysis. A conventional squirrel cage rotor and two stator windings wound for different numbers of poles are used in the proposed DSIM. The drive's major advantage is its increased operating capabilities.This property is very beneficial for implementing speed sensor-free systems, and it offers a new level of flexibility to traditional AC motor control approaches. We've also seen how the torque and power curves of single and multi stator winding induction motors differ in this study.

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