

# Performance Analysis of Three Phase Induction Motor Under Balance & Unbalance Voltage Condition

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**Abstract:-** A three phase induction motor are very commonly employed in power system because of their feature. It can perform the best when operated using a balance three phase supply of the correct frequency .A three phase Induction motor are very commonly employed in power system because of their features like good self starting, capability ,offers users ,simple ,rugged ,construction, easy maintained ,low cost and reliability .Due to extensive use of induction motor in Industry ,motor can be exposed to different hostile environment ,miss-operation ,manufacturing defects etc .One of the most common type of external fault is abnormal supply condition such as loss of supply voltage ,unbalance supply, over voltage ,under voltage. This paper ,present the negative effect of unbalance voltage on performance ,parameter of 5 hp induction motor such as current ,efficiency, temperature rise ,speed, torque, and comparison between different voltage condition.

**Keywords:** Induction motor, simulation, slip, speed ,torque.

## I. INTRODUCTION

A Three phase Induction Motor is an important class of electric machine which is widely used in industrial and commercial and domestic application. excellent operating characteristic induction motor became very popular in industrial uses .The three phase induction motor are designed to work under three phase balance voltage condition, but a small amount of voltage unbalance that is caused by the introduction of a negative sequence voltage may increase the current.An induction motor supplied by unbalanced three phase system has been investigate to obtain its quantities by resolving into the balanced three phase components ..The proposed set up of an induction motor has been simulated as well known MATLAB/SIMULINK software.

MATLAB result are analyzed to see the performance parameter of a three phase induction motor of rating 5hp, 415V,7.8A,1440rpm induction motor as current ,efficiency, temperature rise ,speed etc.

## VOLTAGE UNBALANCE -

In three phase power system , the generated voltage are sinusoidal and balance but they will be unbalanced commonly at the distributions end and the point of utilizations for several reason .In a balance sinusoidal supply system the three line – neutral voltage are equal in

magnitude and are phase displaced from each other by 120 degree.

## VARIOUS POSSIBLE CASE OF VOLTAGE UNBALANCE

.An induction motor supplied by unbalance three phase power system has been investigated to obtain its quantities by resolving into the balance three phase components .This is called as symmetrical components method .The induction motor fed from unbalance three phase system cannot be determined by classical method ,whereas the symmetrical components method should be used. This machine simulation method .Their voltage current and power parameter are subsequently measured with their harmonic value .The comparison has been also made for both analysis techniques.

## CASE OF UNBALANCE VOLTAGE

**TWO PHASE UNDER VOLTAGE UNBALANCE-** This type of situation arises when the load of three phase heavy load and don't have enough compensation .In this situation those two phase will have higher voltage drop than the third phase

**THREE PHASE UNDER VOLTAGE UNBALANCE-**This type of situation arises when the load of three phase are too heavy and not balance in the situation the three phase under voltage unbalance.

**SINGLE PHASE OVER VOLTAGE UNBALANCE-**Capacitors are normally used to compensate system reactive power .In order to maintain a system voltage at rated value. If one of the three phase voltage has been over compensated ,the voltage of this phase will be higher than the rated value.

**TWO PHASE OVER VOLTA** If two of the three phase has been over compensated ,then the volt of these two Phase will be higher than the rated value.

**FORMULA=**Torque=( $S_1 - S_2$ )\* $r$ \*D.constant  
Slip =  $N_s \cdot N_r / N_s$

**THREE PHASE OVER VOLTAGE UNBALANCE**-If the three phase voltage over compensated to different degree, than all these three phase voltage will be higher than the rated value and not equal. This type of situation usually occurs at the line when a factory is shut down but capacitor are still connected to the system.

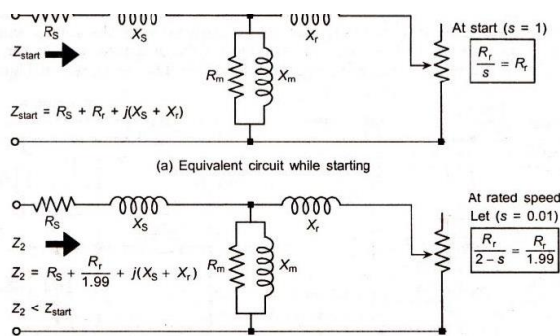
#### COMPARISON OF VARIOUS DEFINITIONS OF VOLTAGE UNBALANCE

The following definitions of the voltage unbalance have been given according to different standard.

**NEMA definitions**-The NEMA definitions of voltage also known as the line voltage unbalance rated (LVR), is given by max. voltage deviation from the average line voltage magnitude.

%LVUR = Average line voltage magnitude.

**IEEE definitions**-The IEEE definitions of voltage unbalance, also known as phase voltage unbalance rated is given by max. voltage magnitude circuit of three phase induction motor



A simple laboratory setup was made in which a three phase induction motor connected to 415 volt, three phase supply through a star delta starter and a dc generator coupled to it was used as a load on the machine. Investigated to analyse the performance of the motor under unbalance & balance. It is clear that during no load condition an unbalance and balance in the supply voltage causes the speed to reduce gradually. During loaded condition, it is observed that an unbalance in the stator voltage causes a drastic reduction in the speed of the motor.

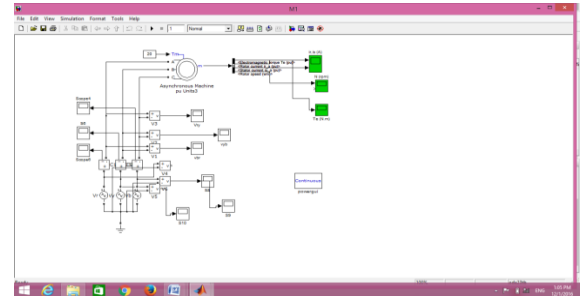
#### SIMULATION AND ANALYSIS OF THE UNBALANCE AND BALANCE OF AN INDUCTION MOTOR

Semolina is an extremely powerful tool of MATLAB. Semolina is an environment for multi domain simulation and Model Based Design for dynamic and embedded system. It provides an interactive graphical environment and a customizable set of block libraries that let you design, simulate, implement, and test a variety of time varying systems, including controls, signal processing,

**SIMULINK MODEL MACHINE SPECIFICATION** Squirrel cage Induction motor, 5HP, 200V, 50HZ, 1440rpm, Mutual Inductance ; 0.2037H

Rotor resistance & Inductance = 1.00ohm, 5.974mh

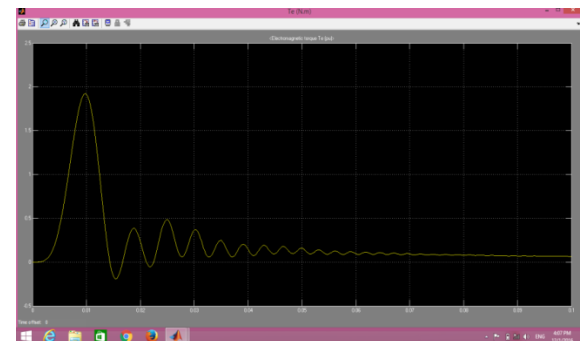
Stator resistance & inductance = 1.115ohm, 5.974mh



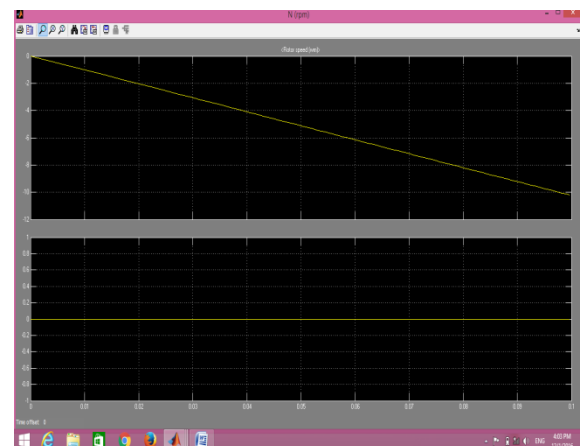
Initially the machine is supplied three phase balanced supply & the results are observed in the form of balance torque, voltage, speed.

When the unbalance is introduced in the unbalance voltage of phase and torque, speed.

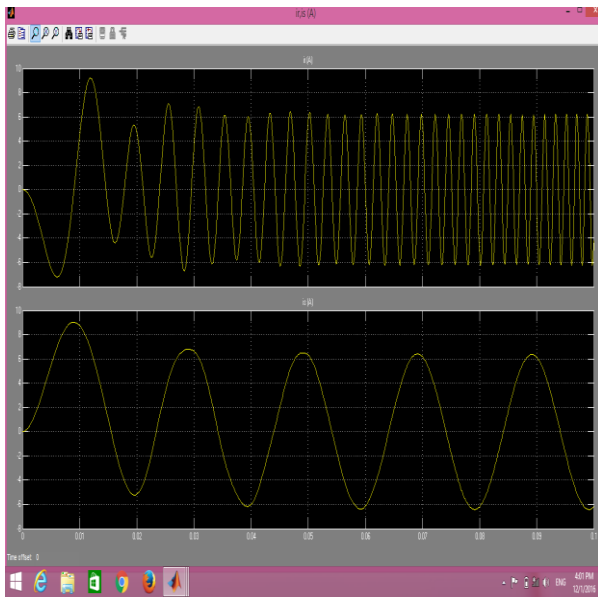
The results of it can be observed in the form of unbalance parameter of stator current, speed, torque of the motor.



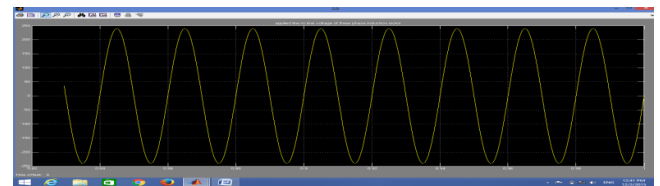
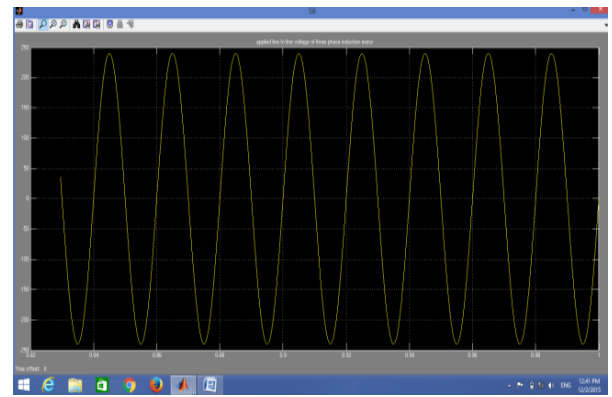
Unbalance torque



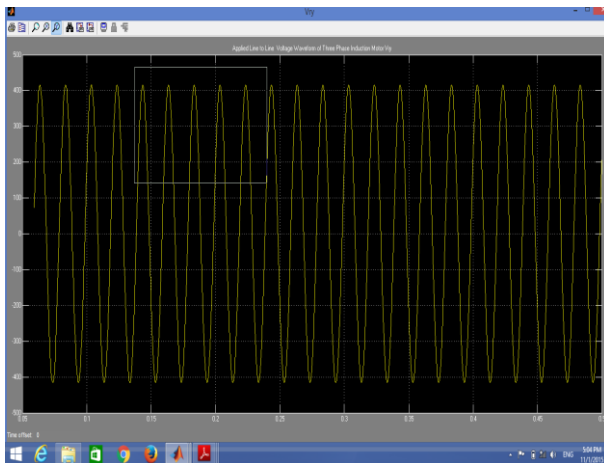
Speed under voltage unbalance condition



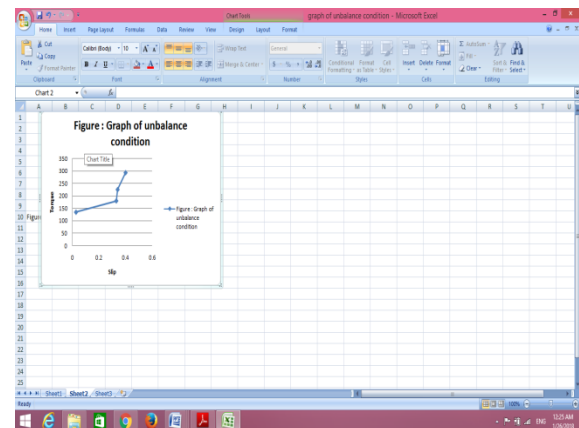
Result of balance condition voltage



GRAPH PLOT LOAD BETWEEN SLIP UNDER BALANCE CONDITION

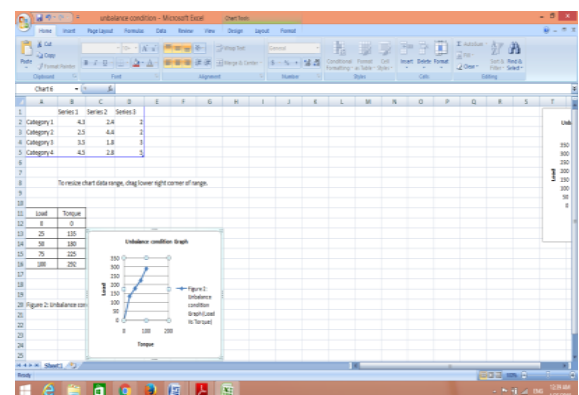
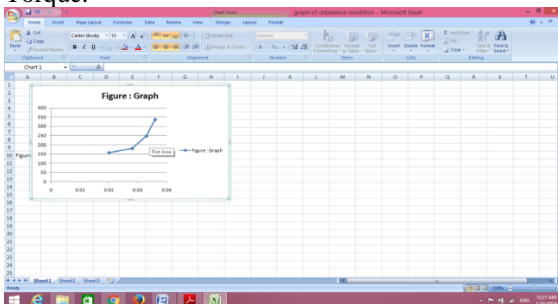


Result of balance voltage condition

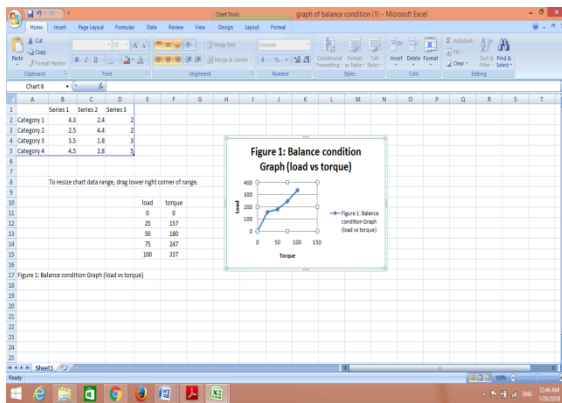


Graph Plot Between Load & Slip Under Unbalance Condition

So, the result are obtained from the unbalance & Balance Voltage conditions justifies the abnormality of the motor performance in the form of speed, Torque.



Graph plot between load & torque unbalance condition



Graph plot between load & torque under balance condition

### CONCLUSION& FUTURE SCOPE

An attempt is made to explain the basic abnormality concerned with the three phase induction motor by conducting experimental analysis and simulation.

Using sufficient number of reading and extra variation the single phasing condition can truly be considered .As the unbalancing in the voltage source can cause excessive losses ,heating, noise ,vibration ,torsional pulsations ,slip ,torque, detecting of unbalancing in the voltage applied is important .In the case of unbalance voltage the efficiency and average output torque of the machine would decrease and the ripple would increase significantly destructing the motor application .Hence it is extremely essential to analyze the unbalance condition of Induction machine.

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