"REDUCE VIBRATION IN HIGH SPEED WARPING MACHINE"

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ABSTRACT

Machine systems consist of a various rotating element which are rotating at different speed. Due to unexpected operating conditions, various faults such as unbalance, looseness and misalignment may occur during their service life which cause machine vibration. In this project experimental studies have perform on a high speed warping machine to predict the machine vibration due to warp beam unbalance. The machine vibration were measured at different warp beam speeds using vibration meter and compare to the data of machine vibration after reducing it by the balancing of warp beam.

Keyword: *vibration, unbalance, vibration meter*

1. INTRODUCTION:

The parallel winding of warp ends from many winding packages (cone) on to a common package (warp beam) is called warping**.**

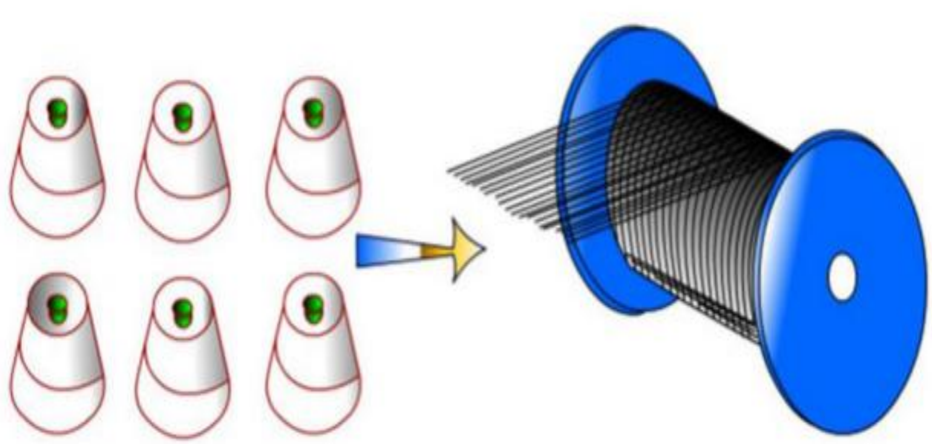

Figure 1: principle of warping process

1.1 High speed warping:

High speed warping also called Beam warping/Direct warping. In high speed warping the yarn is wound parallel on the warping beam. All the yarns are wound at once and simple flanged beam is used. It is a very high speed process and is used for making fabric of single color.

1.1.1 Flow Chart of High Speed Warping

Creel

↓

Beam of sizing

↓

Weaver's beam

1.1.2 Feature of high speed warping

1. It is used to make common fabrics in large quantities
2. It is used to produce weavers beam from single yarn
3. The production is high
4. Large amount of yarn is required to produce a weavers beam
5. Sizing is done
6. Simple flanged beam is used and drums are not required

1.2 Yarn path diagram of high speed warping machine

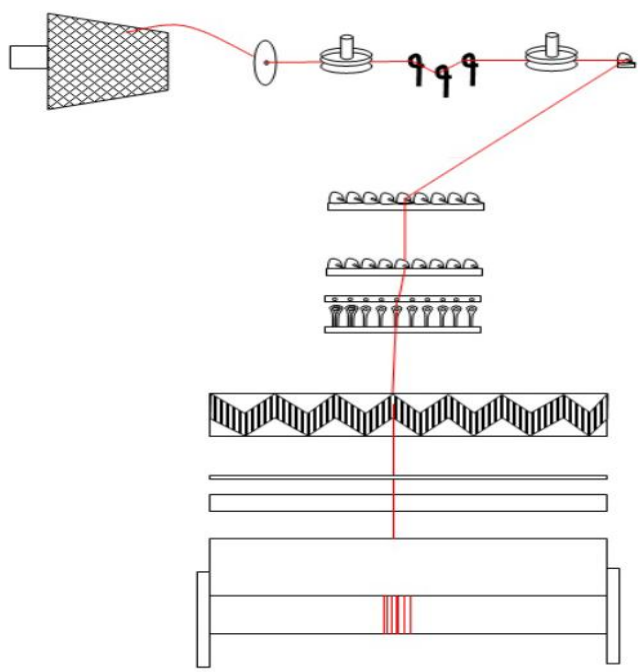

Figure 2: yarn path diagram of high speed warping machine

1.3 Components Of High Speed Warping Machine

1 creel
2 head stock
3 control device

1.3.1 Function of components of creel

1 **Cone or cheese:** Spindle for high speed warping
2 **Thread guide:** To pass the yarn in the require way.
3 **Tensioner:** To keep the yarn always in a uniform tension.
4 **Yarn cleaner:** To remove various faults of yarn like slubs, naps etc.
5 **Suction fan or blower:** To remove the dirt & dust from the yarn.
6 **Breakage indicator:** To indicate breakage in package.
7 **Stop device:** To stop the machine when yarn will be broken.

1.3.2 Function of components of headstock

1 **Adjustable or variable v-reed or wraith:** To control the width of the warping beam.
2 **Measuring & making device:** Measure the amount of warp yarn on the beam & marks yarn.
3 **Yarn speed controlling device**: To control the speed of yarn.
4 **Pneumatic pressure unit:** To press the warp beam with the surface contact driving drum**.**
5 **Break assembly:** It stop the machine after read length is wound on beam.
6 **Driving drum**: Beam is in contact & control with driving drum.
7 **Stop Motion:** Used for separation of yarn individually.
8 **Beam bracket:** To support & hold the yarn individually.
9 **Lease rod:** Used for separation of yarn individually.

1.3.3 Control device:

Similar to winding, warp yarns are threaded through tension device, stop motion, leasing rods and the reed. The stop motion electrically links each warp end to the warper braking system when a warp end break, the warper stop a light indicates the location of the broken end, the warping process is generally irreversible , unwinding of the beam would cause yarn entanglement. The stop motion device which can be mechanical or electronic for quick response is usually located near the creel.fan are used to prevent lint accumation when warping staple yarns.

2. LITERATURE REVIEW:

Amit. M. Umbrajkaar and A.Krishnamoorthy: In all kind of rotating machinery application misalignment is the major concern with machinery healthmonitoring. Usually, misalignment effects are seen at coupling, bearing and at support. The lateral responses along with torsional vibrations of misalignment have considered for modeling the equations. The general equation of motions are derived using Lagrangian approach. The misalignment magnitude is derived using frequency and transient responses in dimensionless form.Newton – Raphson method is used to obtain from dimensionless form. The analysis of signal using FFT is possible up to single level of decomposition as it loses time domain information. Therefore, to analyze vibration signals at different level of decomposition in both time and frequency domain Discrete Wavelet Transform (DWT) is proposed in this paper. Different mother wavelets are available in DWT which shows different result of analysis for same signals. In this work, under healthy and misalignment conditions vibration signals are collected to extract features using suitable mother wavelet. It is observed that selected mother wavelet, level of decomposition and extracted features are most useful for prediction of misalignment. [1]

Guilherme Kenji Yamamoto, Cesar da Costa, João Sinohara da Silva Sousa: Rotor imbalance is the most common cause of machine vibration. In practice, rotors can never be balanced perfectly owing to manufacturing errors such as porosity in casting, non-uniform density of materials, manufacturing tolerances, and gain or loss of material during operation. Mass imbalance leads to the generation of a centrifugal force, which must be counteracted by bearings and support structures. A full spectrum analysis is presented for vibration signal to reveal the fault specific whirl signatures. The results clearly indicate the potential and feasibility of the discussed approach for the rotor imbalance diagnosis in a rotor shaft system coupled with a three phase induction motor. This paper presents a smart experimental method for vibration measurement and imbalance fault detection in rotating machinery. [2]

Kushal N. Vashi, Mox C. Patel, Mayur C. Patel: The present study was conducted to determine the number of yarn breaks in the Warping Process on Warping Machine. Warping is the process which involves preparing the weaver's beam for the weaving process with a predetermined number of spools or creel to the warp's beam. The research encloses the basic problem of the number of breakage rate of cotton yarns during the warping process during the production process which results in increment of waste and poor quality of product. The approach to control this and to get the best optimum solution is based on the proper experimental design and analysis of the process parameters for effective machining. [3]

S. R. Algule, D. P. Hujare: Rotor unbalance and shaft misalignment are major concerns in rotating machinery. In order to understand the dynamic characteristics of these machinery faults a model of complete motor flexible coupling rotor system capable of describing these failures was developed. Unbalance is the most cause of machine vibration, an unbalanced rotor always cause more vibration and generates excessive force in the bearing area and reduces the life of the machine. Experimental studies were performed on a rotor to predict the unbalance in rotor. The vibrations were measured at different speeds using FFT [Fast Fourier Transform], detection of the various effects of vibration signature such as unbalance, misalignment, and crack that may lead to downtime. Vibration analysis therefore helps in monitoring the health of a rotating component. Vibration signature also helps to alert equipment operators of engine health condition. It could be useful to prevent the breakdown resonance. [4]

Ms Prajakta M. Patil, Prof A. U. Gandigude: Condition Monitoring is an advanced and very useful tool of predictive maintenance techniques.When a machine fails or break down, the consequences can range from annoyance to the financial disaster or personal injury and possible loose of life. For this reason early detection, identification and correction of machinery problems is paramount to anyone involved in the maintenance of industrial machinery to insure continued, safe and productive operation. In order to run the machines efficiently condition monitoring of machines is important.Vibrations are found almost everywhere in rotating shaft. shaft vibrates due to unbalances, misalignments and imperfect bearings. .Here in this project condition monitoring of rotating shaft is done using vibration analysis and also crack detection analysis, accelerometeris used along with a device called as Fast Fourier Transform (F.F.T.) Analyzer. [5]

Kundan Kumar, Prof.K.H.Munde: Condition Monitoring is an advanced and very useful tool of predictive maintenance techniques. When a machine fails or break down results in catastrophic failure, For this reason early detection, identification and correction of machinery problems is paramount to anyone involved in the maintenance of industrial machinery to insure continued, safe and productive operation. In order to run the machines efficiently condition monitoring of machines is important. Vibrations are found almost everywhere in rotating shaft. Shaft vibrates due to unbalances, misalignments and default in Shaft. The disturbance in shaft will be vibrated using actuator and then the vibratory motion in the shaft is sensed by accelerometer. The accelerometer will send the sensed vibration data to F.F.T Analyser which can change the sensed data by accelerometer to meaningful data shown in the PC, such as; frequency, Amplitude, displacement due to misalignment, defects are compared, so that pre-maintenance can be done. so in this paper shows the behaviour of shaft under normal & defects condition & its effects on its performance is shown.[6]

M Chandra Sekhar, M.Sailaja, K.Satyanarayana, T.V. Hanumanta Rao, S.V.Umamaheswara Rao: Condition monitoring is an important machine maintenance technique which predicts the condition of machine for preventing the unexpected failure. It involves with continuous analysis of operational equipment and the identification of problem before component breakage or machine failure. High level of structural reliability is achieved with minimum maintenance cost with condition monitoring. Unbalance is a common source of vibration, unequal distribution of weight of a rotor about its rotating centerline is unbalance. Experimental procedure was carried out for determining the intensity of vibration and its source, using vibration analyzers and trending software. The experimental readings were taken periodically. Variations of these readings were used to determine the amount of balancing to be provided [7]

A.C. Babar, A.A. Utpat: Mechanical systems such as motors, pumps, engines, and turbines are operating on shafts which arerotating at different speed. Due to unexpected operating conditions, various faults such as cross-sectional cracks, looseness and misalignment may occur during their service life. In this paper experimental studies have performed on a rotor bearing system to predict the vibration spectrum for shaft misalignment. Here accelerometer is used along with a device called as Fast Fourier Transform (F.F.T.) Analyzer. Initially case of perfect aligned shaft is considered for measurement of vibration and then case of misaligned shaft is considered. The misaligned shaft vibrates and then the vibratory motion in the shaft is sensed by accelerometer at the ball bearing housing. The accelerometer sends the sensed vibration data to F.F.T. Analyzer which can change the sensed data by accelerometer to meaningful data shown in the PC, such as; frequency, Amplitude, displacement and so on. The obtained experimental predictions are in agreement with the ANSYS results. Both the measured and ANSYS results spectra shows that degrees of shaft misalignment. [8]

Md. Abdul Saleem, G. Diwakar, Dr. M.R.S. Satyanarayana : Vibrations are found almost everywhere in rotating machines. Vibrations in rotating machinery are commonly the result of mechanical faults including mass unbalance, coupling misalignment, mechanical looseness, and many other causes. Unbalance is the most cause of machine vibration, an unbalanced rotor always cause more vibration and generates excessive force in the bearing area and reduces the life of the machine. In this paper ‘Deflected Shape of Shaft’ (DSS) of a rotating machine was found for detecting unbalance in its rotating components. The change in deflection shape gives the presence of unbalance in the shaft. Experiment reveals that a significant change in the DSS as an early warning indicator of unbalance in the rotating components. Tests were performed on a machinery fault simulator under various conditions of unbalance. Vibration data in terms of displacement was simultaneously acquired using a FFT (Fast Fourier Transform). The rotor shaft displacements were measured at different speeds using FFT at both unbalanced and balanced condition. The experimental frequency spectra were taken for both balanced and unbalanced condition. The presence of unbalance produces a change in the DSS at the rotor running speed and this data was extracted by conducting the experiments. A comparison was then performed with the theoretical calculation and also the vibration data acquired from FFT, at different running speeds. The results of this work provide a new method for detecting machinery unbalance, and offer a simplified approach for on-line fault detection in operating machinery. [9]

B. Kiran Kumar, G. Diwakar, Dr. M. R. S. Satynarayana: Vibrations are found almost everywhere in rotating machines. Rotating machinery vibrates due to unbalances, misalignments and imperfect bearings. Vibrational analysis of rotating machinery is able to identify a large number of system ills. Shaft bow, shaft unbalance and coupling misalignments make up the major portion of the observed vibrational frequency spectra of rotating machinery. These vibrational spectra can be used to determine the type of rotating system abnormality. Unbalance is the most cause of machine vibration, an unbalanced rotor always cause more vibration and generates excessive force in the bearing area and reduces the life of the machine. In this paper, experimental studies were performed on a rotor to predict the unbalance in rotor. The vibration velocities were measured at five different speeds using FFT (Fast Fourier Transform) at initial condition. Based on vibration readings spectrum analysis and phase analysis was carried out to determine the cause of high vibrations. By observing the spectrum unbalance was identified. Then Rotor was balanced and found that vibrations were reduced.. The experimental frequency spectra were obtained for both balanced and unbalanced condition under different unbalanced forces at different speed conditions. This paper aims at the implementation of condition based maintenance on rotating machine, by adopting Vibration spectrum analysis which is a predictive maintenance technology. It eliminates unnecessary opening of equipment with considerable savings in personnel resources [10].

V. Hariharan and PSS. Srinivasan: Experimental studies were performed on a rotor dynamic test apparatus to predict the vibrationspectrum for shaft misalignment. A self-designed simplified 3 pin type flexible coupling was used in the experiments. The rotor shaft accelerations were measured using dual channel vibration analyzer (ADASH) under the misalignment condition. The experimental and numerical (ANSYS) frequency spectra were obtained. The experimental predictions are in agreement with the ANSYS results. Both the measured and ANSYS results spectra shows that misalignment can be characterized primarily by 2X (two times) shaft running speed. However, misalignment 2X is not close enough to one of the system natural frequencies to excite the system appreciably. Therefore, there are cases where the misalignment response is hidden and does not show up in the vibration spectrum. On the other hand, if 2x shaft running speed is at or close to one of the system natural frequencies, the misalignment effect can be amplified and the speed is pronounced in the frequency spectrum. [11]

3. EXPERIMENTAL PROCEDURE:

Vibration signal at high speed warping machine were measured by using vibration meter. The vibration is measure at five different speed (200,400,600,800,1000in m/min) of warping machine for 1X frequency in unbalanced condition. After that the balancing of warp beam is done on balancing machine. Then after the vibration is measure at same speed of warping machine for 1X frequency in balanced condition.

3.1 Parameter considering for experiment

- **Input parameter**

1. Warping speed

- **Output parameter**

1. Vibration amplitude in terms of velocity
2. Vibration in amplitude in terms of acceleration
3. Vibration amplitude in terms of displacement

3.2 Vibration measurement

The vibration is measure at five different speed of warping machine for 1x frequency in balanced and unbalanced by using vibration meter. The expression "1X" means vibration at the same frequency as the running speed of machine. The frequency at the different running speed of the machine is shown in below table. The warp beam speed (rpm) is found from warping speed (m/min) by using below equation.

Warping speed(m/min)=3.14*beam flange diameter*0.001*warp beam RPM

Where, Beam flange diameter=1000mm

1Hz= 60 rpm or 1 RPM = 1/60 Hz

Warping speed (m/min)	Warp beam speed(rpm)	Frequency(Hz)
200	64	1.06
400	128	2.13
600	191	3.18
800	255	4.25
1000	318	5.30

Table 1: Vibration Frequency

3.3 Warper Beam balancing

- **Specification**

1 Flange diameter-up to 1600 mm
2 Warping width-up to 2800 mm

Figure:3 warper beam

- The dynamic balancing of warper beams as per ISO :1940 standards with Residual Unbalance Quality Grade G 6.3 is done on highly sophisticated computer controlled dynamic balancing machines supplied by the manufacturer M/S ABRO.
- The balancing machine displays both left and right hand correction amounts and the angular location of the correction weights for the addition of material. Lead is use as correction weight material.

4. RESULT AND DISCUSSION:

4.1 Vibration Reading In Unbalance Condition

The vibration reading at five different warping speeds is shown in below table .This readings are measure at prism textile machinery Pvt. Ltd.

Warping speed (m/min.)	Velocity (mm/sec)	Acceleration (m/sec^2)	Displacement (mm)
200	3.54	0.023	0.528
400	4.89	0.065	0.402
600	6.34	0.126	0.317
800	8.56	0.233	0.328
1000	11.76	0.372	0.335

Table 2: Machine vibrations reading in unbalanced condition

4.3 Warper Beam Balancing

Flange /plane	Residual unbalance figures		
	Weight	**Degree**	**Distance**
Right	300gm.	120^0	420mm
Left	420gm.	168^0	430mm

Table: 3 Residual Unbalance Figures before Balancing

Flange /plane	Residual unbalance figures		
	Weight	**Degree**	**Distance**
Right	4gm.	80^0	420mm
Left	5gm.	60^0	430mm

Table: 4 Residual unbalance figures after balancing

4.4 Vibration Reading In Balanced Condition

Warping speed (m/min.)	Velocity (mm/sec)	Acceleration (m/sec^2)	Displacement (mm)
200	1.36	0.009	0.202
400	1.89	0.025	0.141
600	2.67	0.053	0.133
800	3.43	0.091	0.128
1000	4.12	0.137	0.123

Table: 5 Machine vibrations reading in balanced condition

4.5 Comparison Graphs Of Vibration Reading V/S Speed

4.2.1 Vibration velocity v/s speed in balanced and unbalanced condition

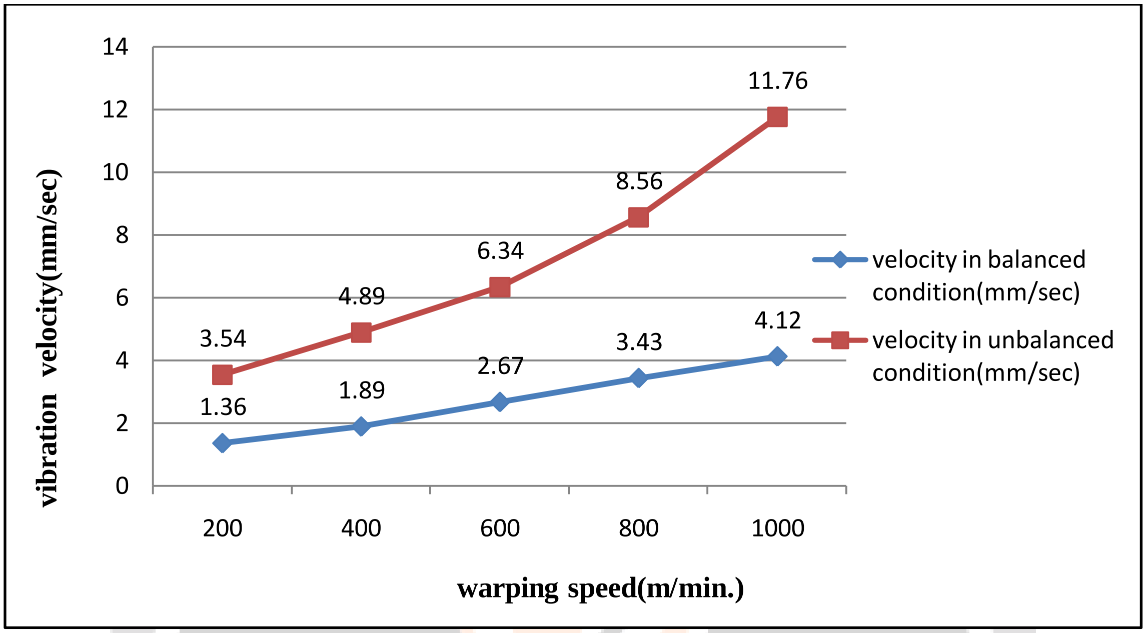

Chart-1: Vibration velocity v/s speed in balanced and unbalanced condition

4.5.2 Vibration acceleration v/s speed in balanced and unbalanced condition

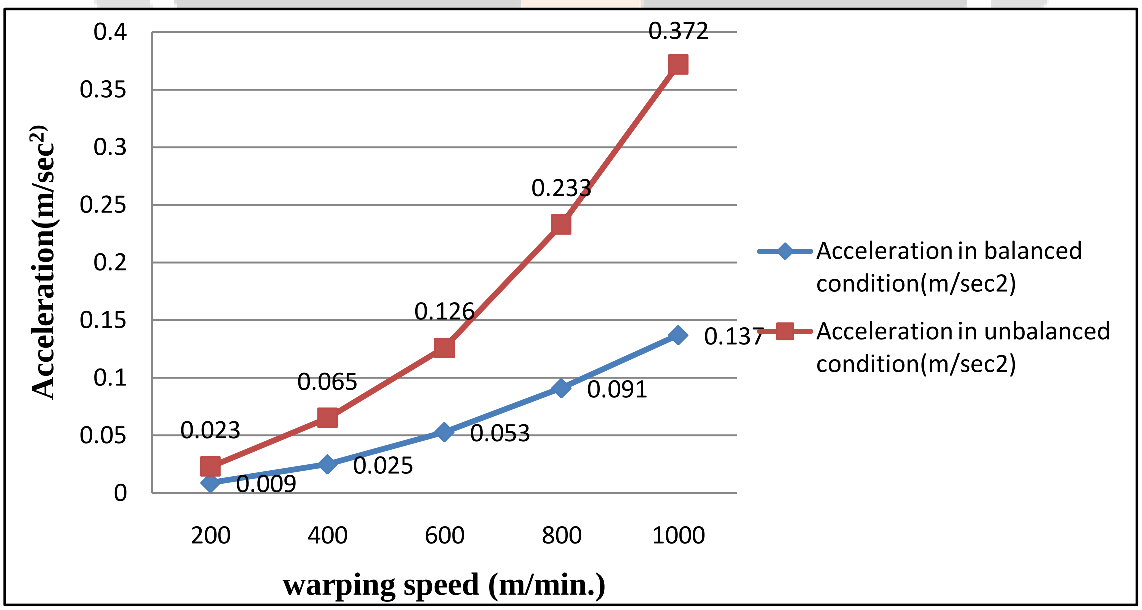

Chart-2: Vibration acceleration v/s speed in balanced and unbalanced condition

4.5.3 Vibration displacement v/s speed in balanced and unbalanced condition

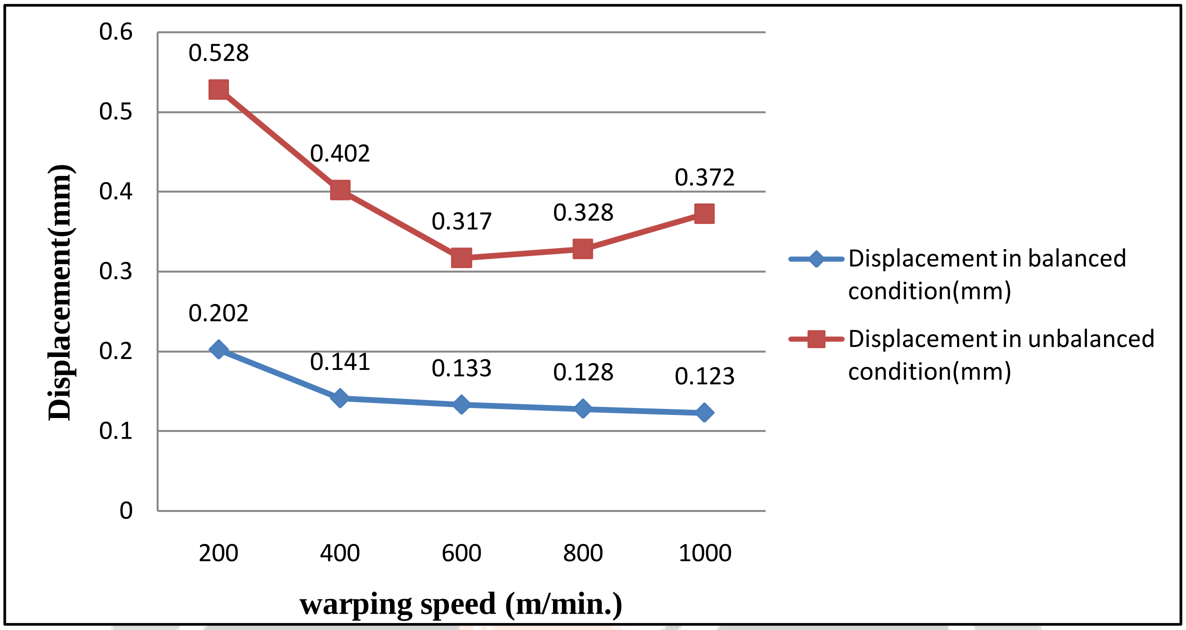

Chart-3 Vibration displacement v/s speed in balanced and unbalanced condition

5. CONCLUSIONS:

- As the speed increases the vibration velocity and vibration acceleration at 1X frequency is also increases. This increase in amplitude value is because of increase of centrifugal force.
- The displacement is decrease with increase in speed at 1X frequency. As the vibration frequency increases, the duration of time for the force to be applied in one direction is reduced. Due to the cyclical nature of vibration actuators (both ERMs and LRAs) high frequency vibrations only have a short period of time to displace the motor before it is displaced in the opposite direction. This means the peak to peak displacement is greatly reduced.
- As amplitude increases with speed an unbalance force is also increases that produce vibration which may cause a breakdown of parts of the system in future.
- By the balancing of rotating component of the machine we can reduce vibration to satisfactory level at which it will not harmful to the machine and its parts.

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"Vision without action is a dream. Action without vision is simply passing the time. Action with Vision is making a positive difference -Joel Barker"

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