Comparative study of frequency for a slab panel of an existing textile industry

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***Abstract* – Textile Industries were developed during the Historical Era in India. Surat is well-known for its textile industries and weaving technology. In older days Shuttle Looms machines were directly installed on a slab panel with same sort of foundation isolation. So the major cause which was established with the heap of this machine is VIBRATION. So as Frequency for a slab panel is being calculated by changing various parameters. The whole analysis procedure is being done using STAAD Pro. Software.**

***Index Terms* – Textile Industry, Vibration, Frequency, STAAD Pro**

I. INTRODUCTION

The Indian textile industry has a great legacy, which is perhaps unmatched in the history of India's industrial development. India's textile industry evolved and developed at a very early stage and its manufacturing technology was amongst the best. Prior to colonization, India's manually operated textile machines were among the best in the world, and served as a model for production of the first textile machines in newly industrialized Britain and Germany. An apparatus which is hand operated or power driven for weaving fabrics, which contains harnesses, lay, reed, shuttles, treadle etc., is called Looms. The basic purpose of it is to wrap threads under the tension to facilitate the interweaving of the weft threads.

The modern looms machines have transformed the entire scenario of Textile production. It enables easy and faster production rate of textile manufacturing. These machines have proved to be a boon to Textile manufacturers in terms of economy and time. However, they come with an unseen drawback of "Vibrations" due to their high operating speed. The parameters normally used to assess the vibration are the amplitude and frequency. In order to completely define a vibration, the amplitude and frequency of motion are measured in three orthogonal directions, generally in terms of displacement which is considered to be the best description for assessing the potential damage response of a structure. These vibrations may cause varying degree of damage to the building components. Minor damage is seen in the building to non-structural components such as cracking of masonry walls, de-bonding of aggregate and cements gel, etc. However, if the amplitude of vibration increases, it may cause serious damage to structural components such as excessive deformation of beams, columns, fatigue failure and settlements; which may cause serious damage to life and property.

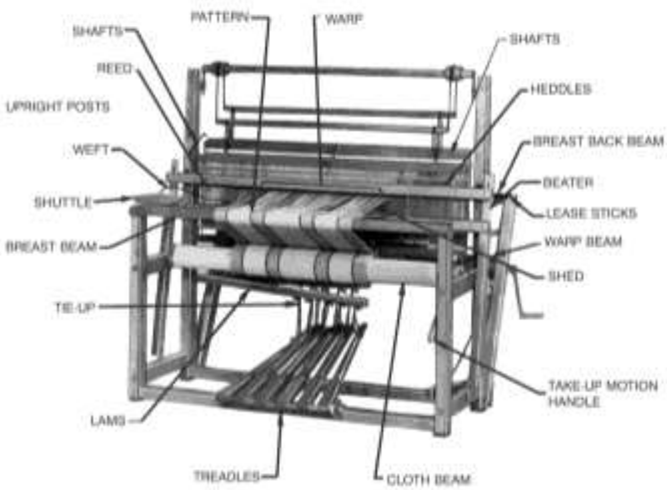

Figure 1. Shuttle Looms Machine

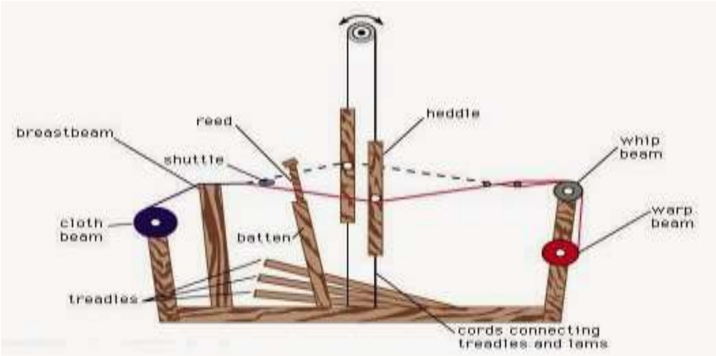

Figure 2. Basic components of looms machine

II. THEORY OF DYNAMICS

Dynamic Analysis:

Structural dynamics is a type of structural analysis which covers the Behaviour of structures subjected to dynamic (actions having high acceleration) loading. Dynamic loads include people, wind, waves, traffic, earthquakes, and blasts. Any structure can be subjected to dynamic loading. Dynamic analysis can be used to find dynamic displacements, time history, and modal analysis.

Parameters of Basic Structural Dynamics:

1. **Amplitude**

   It is define as maximum displacement of a vibrating body from the mean position.
2. **Frequency**

   Frequency may be defined as the number of complete cycles of oscillations which occur per unit of time.
3. **Mode Shape**

   A mode shape is a specific pattern of vibration executed by a mechanical system at a specific frequency. Different mode shapes will be associated with different frequencies. The experimental technique of modal analysis discovers these mode shapes and the frequencies.
4. **Vibration**

   A magnitude (displacement, force, or acceleration) which oscillates about some specified reference where the magnitude of the force, or acceleration is alternately smaller and greater than the reference. Vibration is commonly expressed in terms of frequency (cycles per second or Hz) and amplitude, which is the magnitude of the force, displacement, or acceleration.
   If the motion of the body is oscillating or reciprocating in character, it is called vibration if it involves deformation of the body. In case the reciprocating involves only the rigid body movement without its deformation, then it is called oscillation.
   E.g. Motion of a multi-storey building during earthquake is vibration as there is deformation of the building.
   There are mainly two types of vibration:
   - **Free Vibration**
     Free vibration occurs under the influence of forces inherent in the system itself, space without any external forces. However, to start free vibration, some external force or natural disturbance is required.
   - **Forced Vibration**
     Forced vibration occurs under the influence of external existing force

III. ANALYSIS CRATERIA

The slab panel of a typical floor plan of an existing looms industrial building is to be considered as a problem on which the various properties are assigned and a machine by a beam element.

The Loads assigned to the given slab panel is listed below.

- Dead Load; which includes Self-Weight, Masonry Load and Floor Finish load.
- Live Load
- Harmonic Load(Time History)
- Dead Load + Live Load + Harmonic Load

The various parameters which are studied for the behavior of structure are;

- By Various Support Condition
- By Changing the phase angles of the looms Machine
- By Adding different Girder Pattern
- By Changing Different Beam Sections for the Girder Pattern

IV. MODELLING PROCESS

Here the Slab Panel of and existing textile industry is being constructed using STAAD Pro software. Various support condition, various girder patterns and various beam section for that particular pattern is being used for the comparison. All the parameters and loads are being assigned to the constructed slab panel and the analysis is being carried out for various models developed in the STTS Pro.

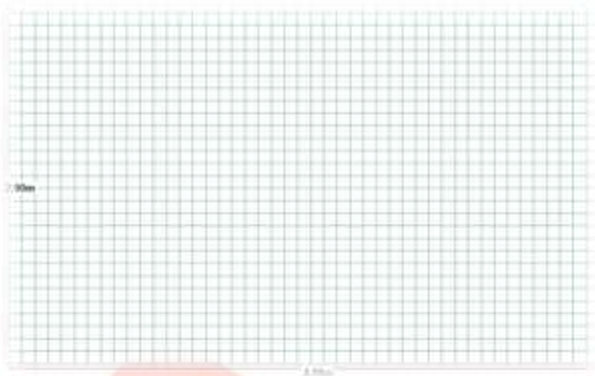

Figure 3. Construction of initial Slab panel

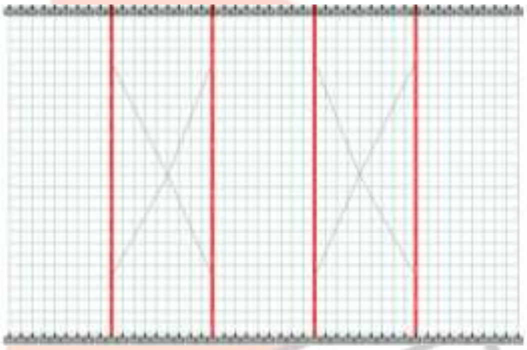

Figure 4. Girder Pattern 1

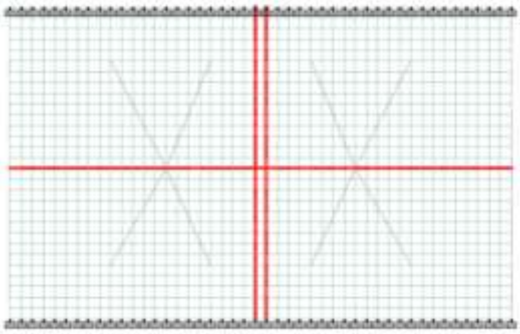

Figure 5. Girder Pattern 2

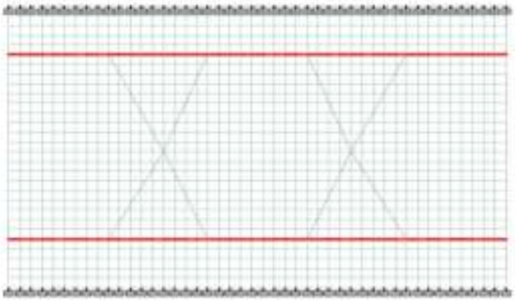

Figure 6. Girder Pattern 3

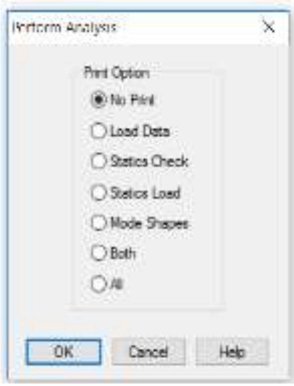

Figure 7. Analysis Command

V. RESULTS

Here the models are being developed for the various phase angles of the machine and by that for a one support condition i.e. for both end fixed support condition and a basic slab panels, frequency for various mode shapes in various phase angle conditions are being carried away in a table.

Table 1: Frequency of slab panel for fixed end support condition without any Girder for various phase angle condition

P-1	P-2	SUPPORT	Frequency(CPS)					
			MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6
0	0	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252
0	30	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252
0	90	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252
0	120	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252
0	180	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252
0	210	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252
0	240	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252
0	270	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252
0	330	BOTH END FIXED	38.761	44.202	47.879	59.049	81.579	95.252

As shown in table 1, it seems that by making various changes in phase angle on machines frequency was not being changed for a same support condition and a same girder pattern with various cross beam section.

Part 1-Without any Girder

Table 2: Frequency of slab panel for various support condition without any Girder

Support	Frequency(CPS)					
	Mode 1	Mode 2	Mode 3	Mode 4	Mode 5	Mode 6
Both End Fixed	38.761	44.202	47.879	59.049	81.579	95.252
Both End Hinged	20.61	22.216	28.065	44.565	65.468	68.121
One Fixed-One Hinged	29.207	32.52	36.838	50.786	74.564	79.271

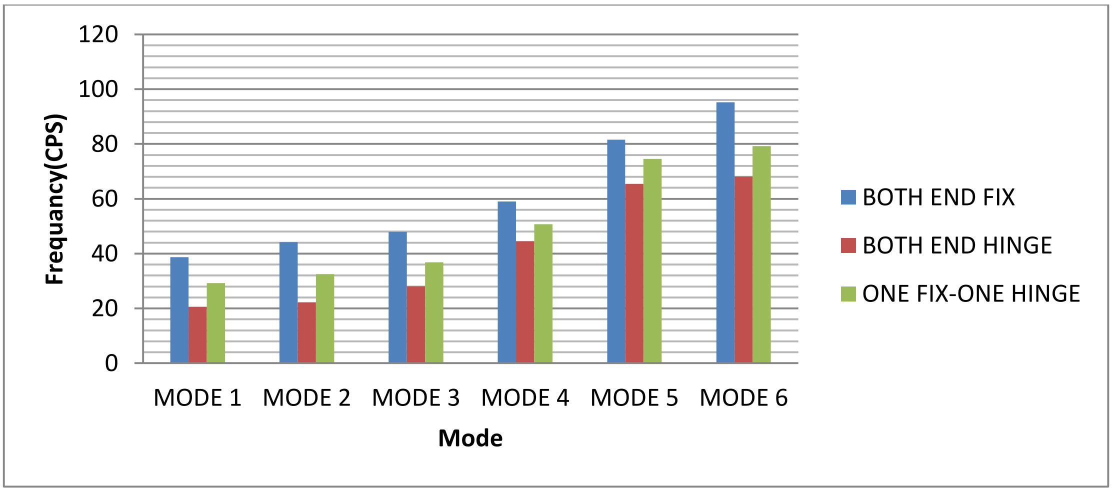

Figure 8. Frequency Vs Mode Number for Part 1

From the above **Table 2** and **Fig 8** it seems that for both fixed end support; frequency increases to 153.67%, for both hinged end support; frequency increases to 230.68% and for one end fixed and one end hinged support condition; frequency increases to 171.47% from mode shape 1 to 6.

Part 2-With Girder Pattern 1 of beam section ISMB 150

Table 3: Frequency of slab panel for various support condition with Girder Pattern 1 of beam section ISMB 150

Support	Frequency(CPS)					
	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6
Both End Fixed	44.97	46.083	50.137	63.011	84.721	111.278
Both End Hinged	22.96	23.183	31.972	47.204	69.536	77.117
One Fixed-One Hinged	33.114	33.759	40.147	54.122	77.149	92.782

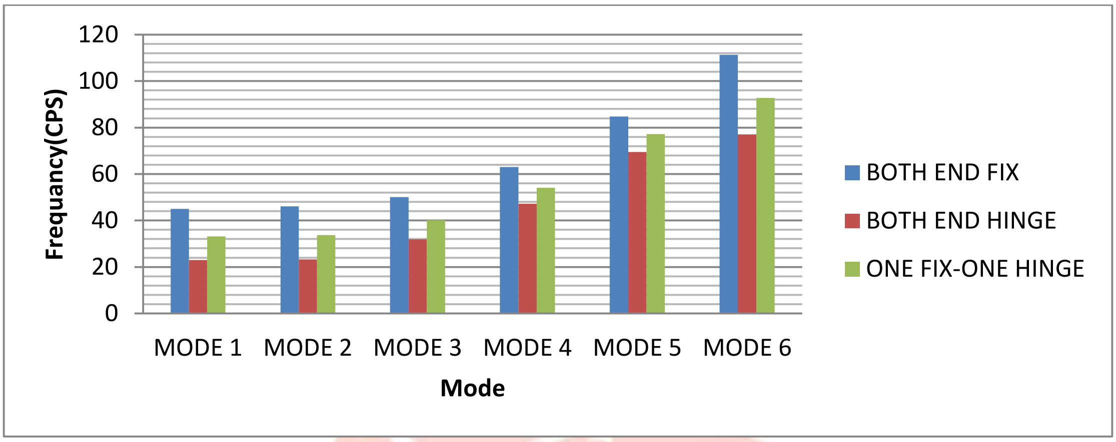

Figure 9: Frequency Vs Mode Number for Part 2

From the above **Table 3** and **Fig 9** it seems that for both fixed end support; frequency increases to 147.44%, for both hinged end support; frequency increases to 235.875% and for one end fixed and one end hinged support condition; frequency increases to 180.189% from mode shape 1 to 6.

Part 3-With Girder Pattern 2 of beam section ISMB 150

Table 4: Frequency of slab panel for various support condition with Girder Pattern 2 of beam section ISMB 150

Support	Frequency(CPS)					
	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6
Both End Fixed	41.112	44.165	49.158	60.708	86.666	101.236
Both End Hinged	20.925	22.183	28.998	46.153	69.265	71.611
One Fixed-One Hinged	30.244	32.477	38.038	52.306	78.899	84.081

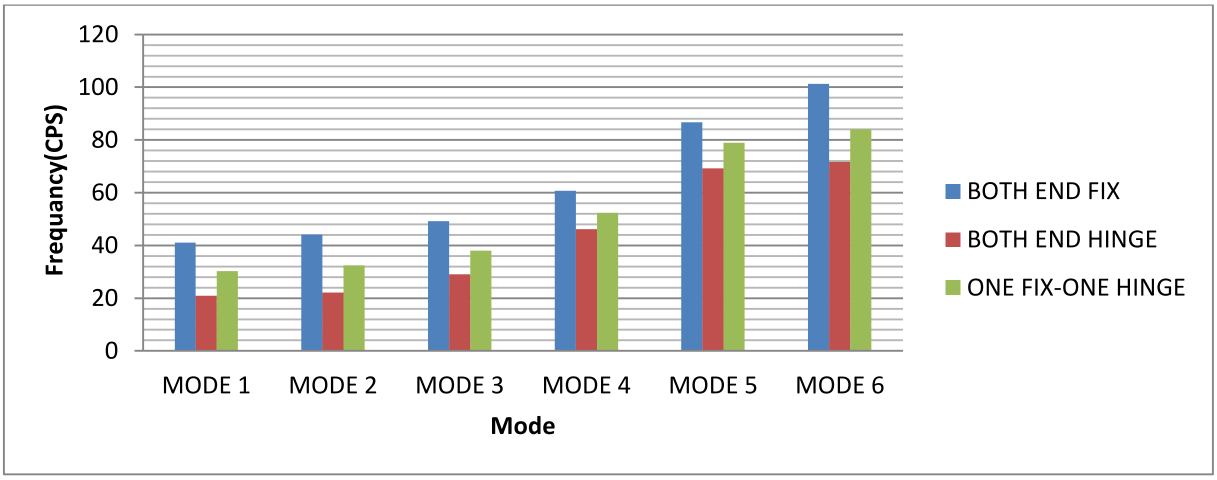

Figure 10. Frequency Vs Mode Number for Part 3

From the above **Table 4** and **Fig 10** it seems that for both fixed end support; frequency increases to 146.244%, for both hinged end support; frequency increases to 242.227% and for one end fixed and one end hinged support condition; frequency increases to 178.008% from mode shape 1 to 6.

Part 4-With Girder Pattern 3 of beam section ISMB 150

Table 5: Frequency of slab panel for various support condition with Girder Pattern 3 of beam section ISMB 150

Support	Frequency(CPS)					
	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6
Both End Fix	40.012	44.625	48.074	59.5	82.056	97.257
Both End Hinge	21.457	22.527	28.705	44.979	66.85	68.586
One Fix-One Hinge	30.255	32.832	37.193	51.169	74.983	80.734

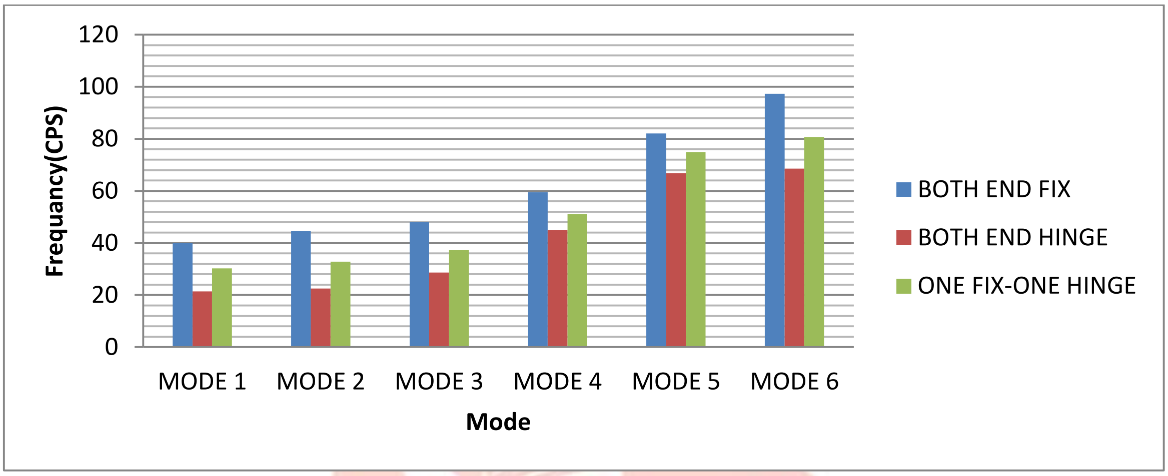

Figure 11. Frequency Vs Mode Number for Part 4

From the above **Table 5** and **Fig 11** it seems that for both fixed end support; frequency increases to 143.069%, for both hinged end support; frequency increases to 219.643% and for one end fixed and one end hinged support condition; frequency increases to 166.845% from mode shape 1 to 6.

Part 5-With Girder Pattern 1 of beam section ISMB 250

Table 6: Frequency of slab panel for various support condition with Girder Pattern 1 of beam section ISMB 250

Support	Frequency(CPS)					
	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6
Both End Fix	48.295	48.316	64.946	75.119	93.492	120.187
Both End Hinge	24.557	24.626	41.086	53.279	73.302	86.04
One Fix-One Hinge	35.451	35.481	52.089	63.112	83.315	102.957

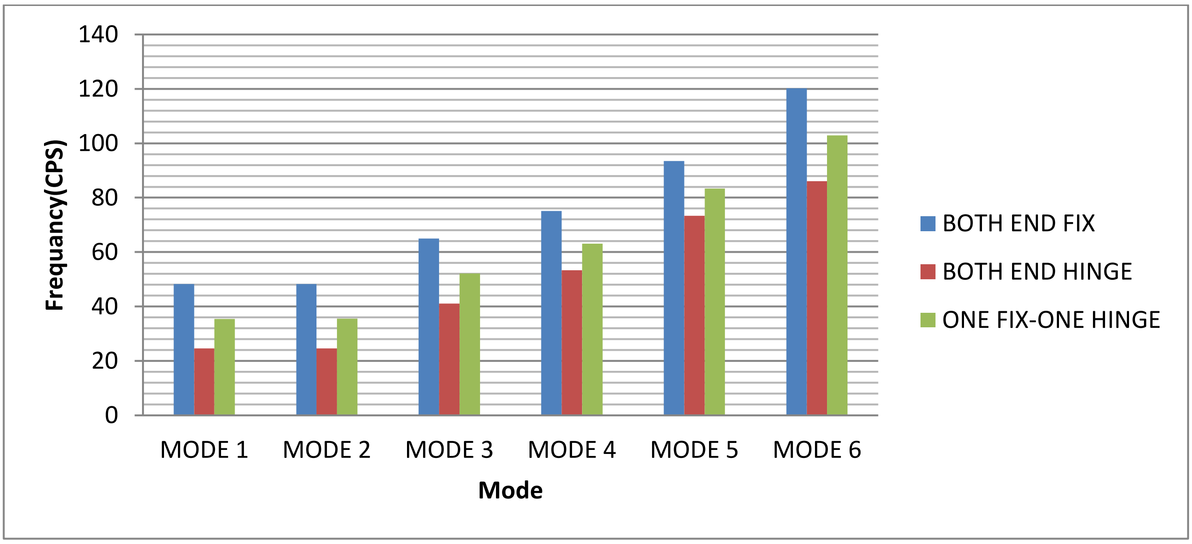

Figure 12: Frequency Vs Mode Number for Part 5

From the above **Table 6** and **Fig 12** it seems that for both fixed end support; frequency increases to 148.86%, for both hinged end support; frequency increases to 250.368% and for one end fixed and one end hinged support condition; frequency increases to 190.420% from mode shape 1 to 6.

Part 6-With Girder Pattern 2 of beam section ISMB 250

Table 7: Frequency of slab panel for various support condition with Girder Pattern 2 of beam section ISMB 250

Support	Frequency(CPS)					
	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6
Both End Fix	44.4	44.822	58.782	68.695	106.044	106.847
Both End Hinge	22.117	22.168	34.69	53.89	77.297	77.495
One Fix-One Hinge	32.518	32.549	45.629	59.539	91.629	91.866

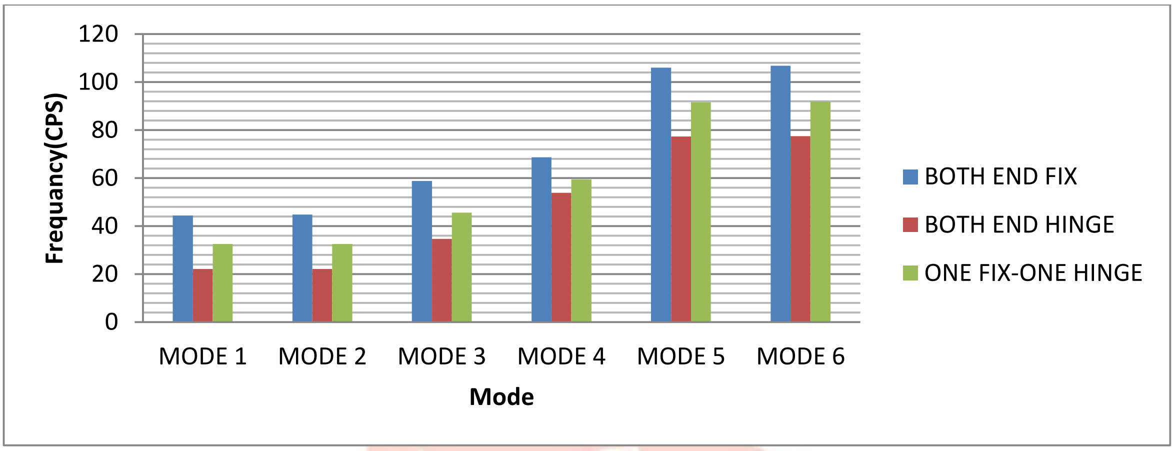

Figure 13. Frequency Vs Mode Number for Part 6

From the above **Table 7** and **Fig 13** it seems that for both fixed end support; frequency increases to 140.64%, for both hinged end support; frequency increases to 250.386% and for one end fixed and one end hinged support condition; frequency increases to 182.508% from mode shape 1 to 6.

Part 7-With Girder Pattern 3 of beam section ISMB 250

Table 8: Frequency of slab panel for various support condition with Girder Pattern 3 of beam section ISMB 250

Support	Frequency(CPS)					
	MODE 1	MODE 2	MODE 3	MODE 4	MODE 5	MODE 6
Both End Fix	40.219	44.681	48.112	59.705	82.66	96.882
Both End Hinge	21.557	22.558	28.817	45.245	66.456	69.409
One Fix-One Hinge	30.384	32.87	37.275	51.435	75.705	80.38

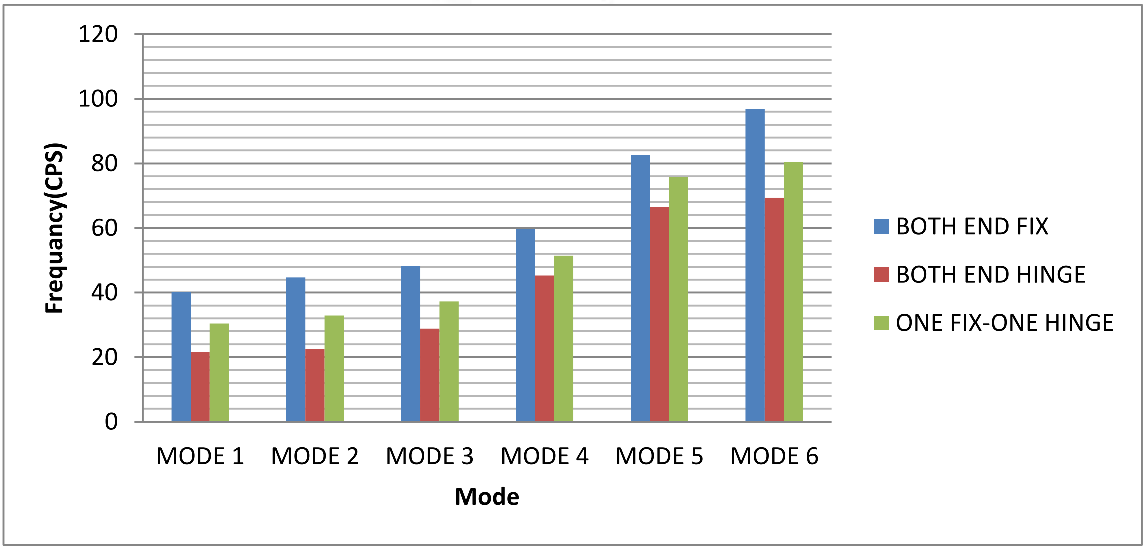

Figure 14: Frequency Vs Mode Number for Part 7

From the above **Table 8** and **Fig 14** it seems that for both fixed end support; frequency increases to 140.886%, for both hinged end support; frequency increases to 221.978% and for one end fixed and one end hinged support condition; frequency increases to 164.547% from mode shape 1 to 6.

VI. CONCLUSION

- Frequency of a vibration does not depend on the various phase angle condition that is in any direction of movement of power looms machine frequency of that slab panel will not change for the particular mode shape.
- Frequency of a vibration is purely depends on the Support Condition. For Both end Hinge Condition the Frequency is minimum and for Both End Fixed Condition the Frequency is maximum for the particular slab panel and mode shape i.e. stiffer the slab panel frequency will increases.
- By adding the different girder pattern with different beam section the frequency of the slab panel would likely to increase for a particular pattern.
- Frequency for mode shape 1 in no girder pattern condition is 38.761 CPS, for pattern 1 with beam section ISMB 150 is 44.97 CPS and for pattern 1 with beam section ISMB 250 is 48.295 CPS. It seems that by adding any girder beam section, the frequency of the structure will increase i.e. slab panel becomes stiffer by adding girders with various beam section.
- A case of a slab panel when both ends are fixed and machine are running with same phase angle, in no girder condition frequency increases to 153.67%; in girder pattern 1 with beam section ISMB 150 condition frequency increases to 147.44% and in girder pattern 1 with beam section ISMB 250 condition frequency increases to 148.86% from mode 1 to 6. So it concludes that by adding girders the percentage in increment of frequency is decreased.
- In this parametric study various stresses and moment values are being generated from plate stress contours using software STAAD Pro. To check the increment or decrement in the values of them for various cases taken in this study.

VII. ACKNOWLEDGMENT

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