Vibration Analysis of Six Degree of Freedom of spring – Mass System Two Dimensionally

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***Abstract*- This work is aimed at using Finite Element Analysis Software (ANSYS APDL) to demonstrate the analysis of 2-D spring mass system to obtain its first six natural frequencies and mode shape. Modal analysis of dynamic properties of systems created by the vibration analysis. This study is useful to structural engineers. This results the natural frequencies of vibration and excitation response .it is very useful for analysis of bridges, buildings and dynamic systems. In this study the numerical results obtained using ANSYS 19.1 to validate the results. The material used in this study was steel.**

***Index Terms*- Modeling, Spring mass, ANSYS, Vibration.**

1. INTRODUCTION

The mode shapes, natural frequencies and vibration of a 2-D Spring mass system is characterized using modal analysis established in ANSYS 19.1. This study is very useful in the designing of structures subjected to dynamic loadings and when pre-stressing Turbine blades. This is made possible from the natural frequencies and mode shapes obtained during the Simulation process. Spring mass system is basically known for vibration analysis.

1.2 Purpose Of Study

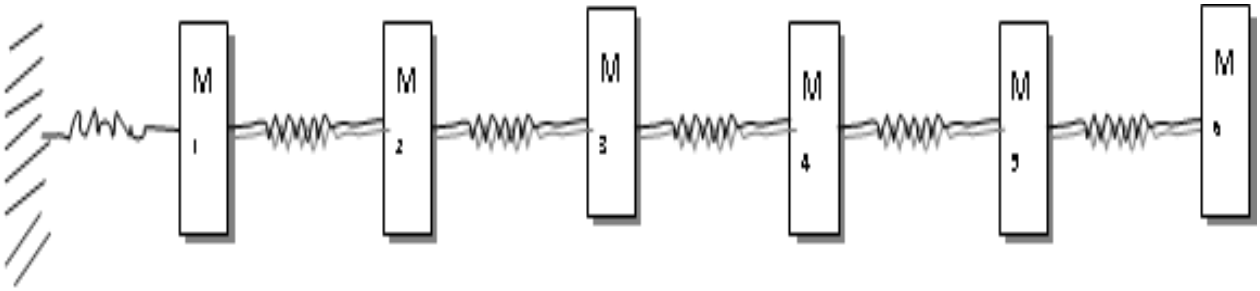
The aim of this study is to obtain the first six natural frequencies and mode shapes of a 2-D Spring mass system using ANSYS APDL.

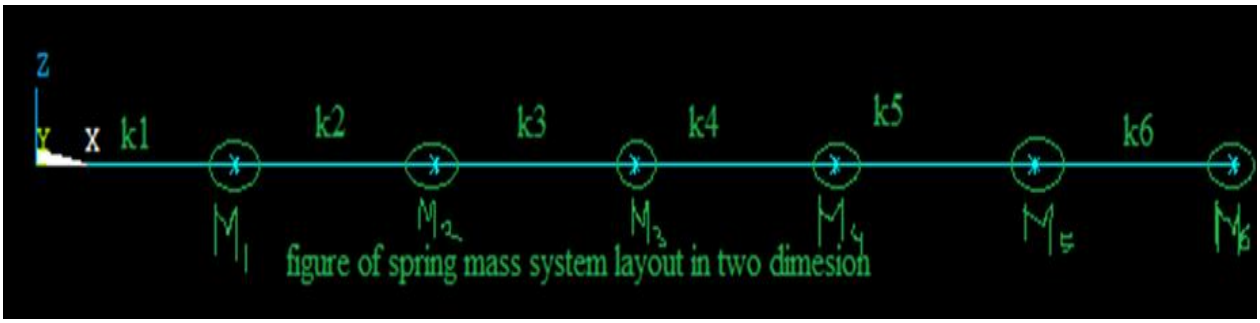
1.3 Benefit Of Study

This study is beneficial to structural engineers in predicting the natural frequencies of vibration and excitation response of bridges, building and dynamic systems.

2. METHODOLOGY

In this study, the Simulation process was done using ANSYS APDL and the results obtained from ANSYS. The methods are given below:





2.1.Theoretical :

The Figure shows six degrees of freedom (2-DOF) system that is made up of six modes of vibration which corresponds to six natural frequencies. Using Newton's second law of motion, the equation of motion for the six mass systems becomes

For mass 1

M1x1=-k1x1-k2(x1-x2)

For mass 2:

M2x2=-k2(x2-x1)-k3(x2-x3)

For mass 3:

M3x3=-k3(x3-x2)-k4(x3-x4)

For mass 4:

M4x4=-k4(x4-x3)-k5(x4-x5)

For mass 5:

M5x5=-k5(x5-x4)-k6(x5-x6)

For mass 6:

M6x6=-k6(x6-x5)

Problem—the 6 mass systems are connected by six spring of stiffness 10N/M each. The mass of each element is 30kg, 25kg, 20kg, 15kg, 10kg, 5kg.determine the mode shape and frequency of the system.

Ans:

M1=30kg M2=25kg M3=20kg

M4=15kg M5=10kg M6=5kg

K1=K2=k3=k4=k5=k6=10N/M

2.2. Ansys analysis

The element types were selected mass 21 by combination and spring –Damper 14. The material properties for the masses and springs were clearly defined. Mapped meshed with 6 sided was used for the first part. Then creation of the node at the wall and spring elements was done. Rigid body constraints were applied to the system and solved. The natural frequencies were obtained and mode shapes displayed.

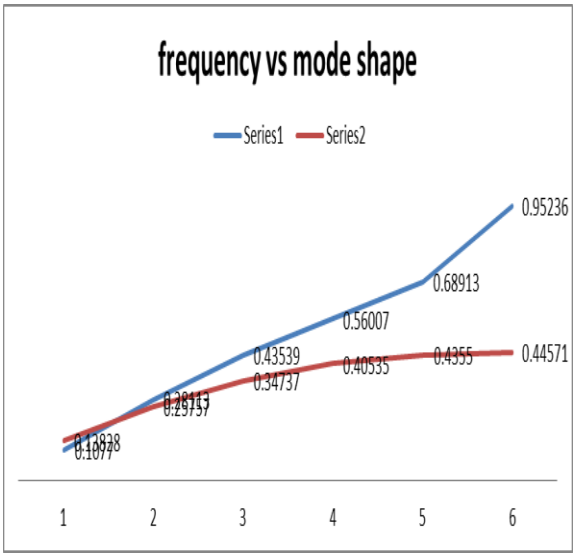
3. RESULT

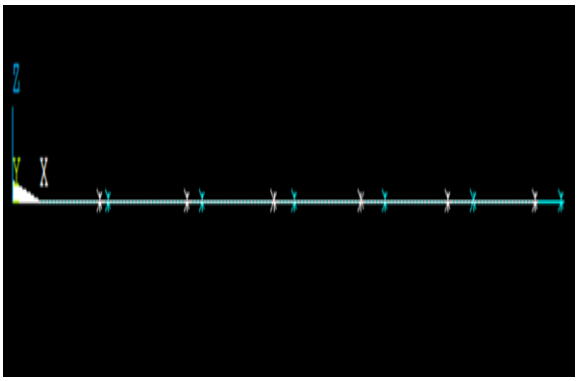
In ansys analysis the frequency of system

	ω_1	ω_2	ω_3	ω_4	ω_5	ω_6
frequency	0.10770	0.28113	0.43539	0.56007	0.68913	0.95236

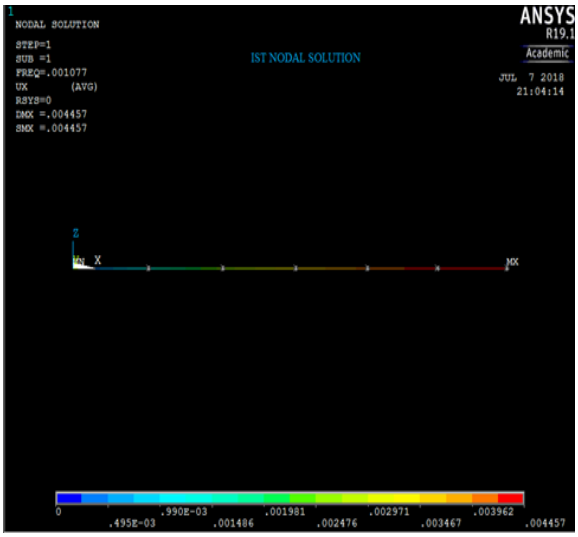
Mode shape of the system

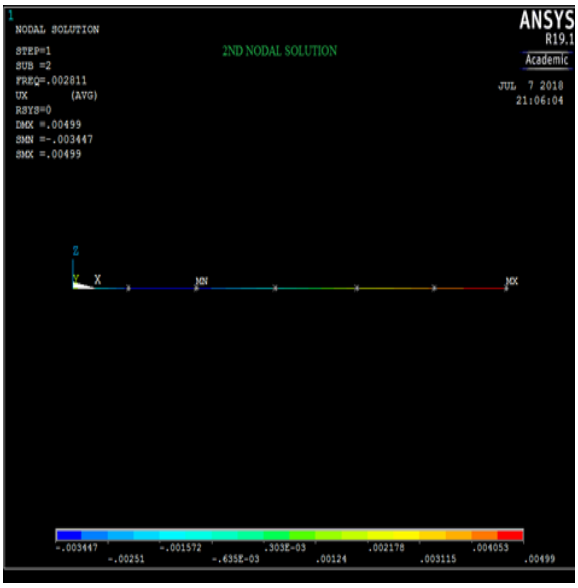
	1st mode	2nd mode	3rd mode	4th mode	5th mode	6th mode
Mode shape	0.13828	0.25757	0.34737	0.40535	0.43550	0.44571

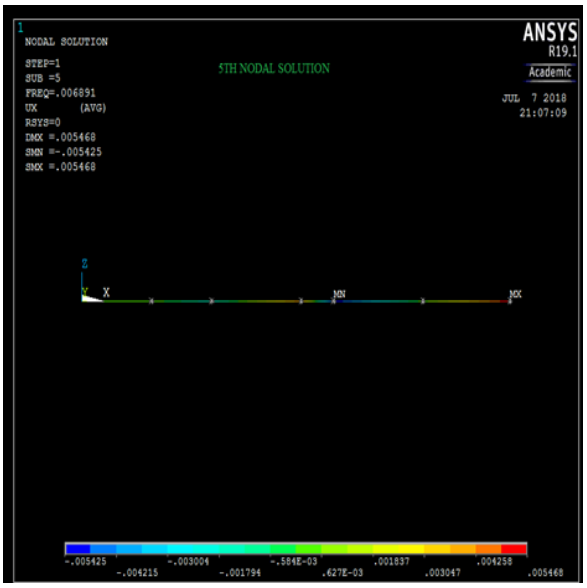


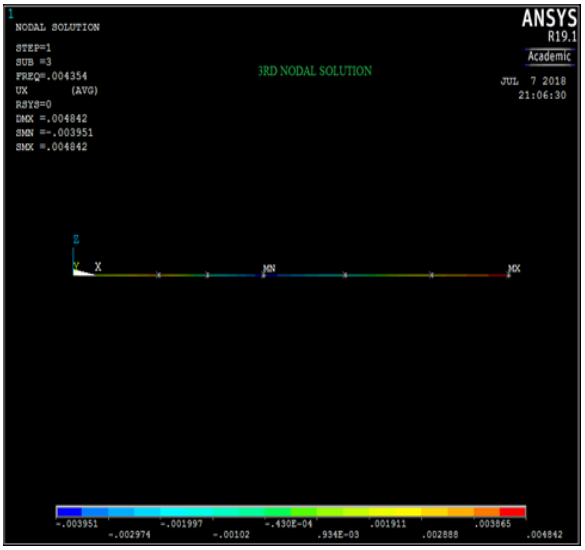


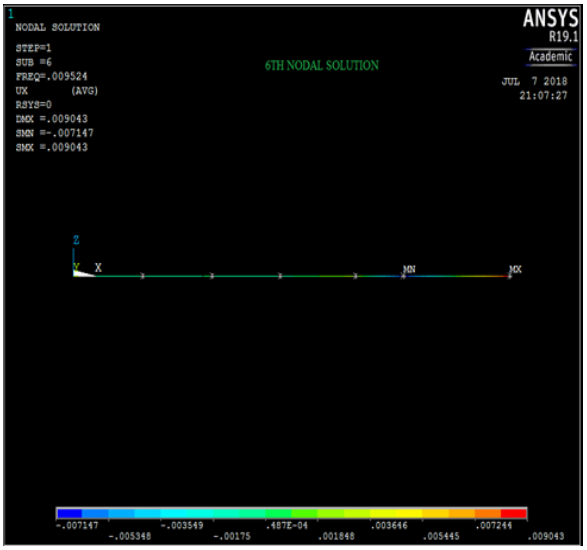
The figure of the mode shape are given below

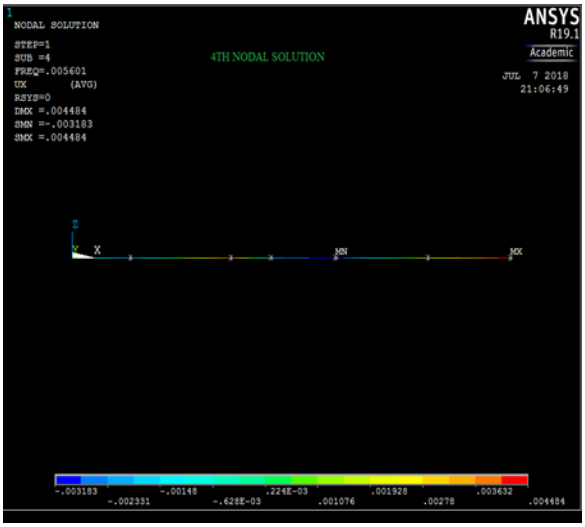












4 .RESULT AND DISCUSSION

In this analysis cleary find when spring stiffness is same and mass of the system increase the frequency of the system increases. when mass of the system is less the mode shape of the system is high value.The ANSYS results is therefore acceptable and valid to be used for the prediction of natural frequencies and excitation response of structures and dynamics systems. it is very useful for construction many storey building, bridge etc.

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