IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 01-05
www.iosrjournals.org

"Vibration characterization of different pipe joint using finite element method (ANSYS)"

Shaik Imran Behmad[1], Ashwani Kumar[1], Pravin P Patil[2]
[1]*Research Scholar, Department of Mechanical Engineering, Graphic Era University, Dehradun-248002, India*
[2]*Professor, Department of Mechanical Engineering, Graphic Era University, Dehradun-248002, India*

ABSTRACT: *In this paper we design and study of the five different joint pipes with same dimensions with different angles and shape. The vibration of pipes is studied here using the Ansys software and modelling in Solid edge software. The vibrational response is described numerically with the Finite element method (FEM).The problem is how to reduced the vibration in the pipe with same dimensions with different angles. The first pipe we considered as 60 cm and second one as 20 cm with zero, 15 degree and 45 degree. We concluded as the pipe design joint is good with which angle and size of the pipe joints. The joint of pipe is very important factor in chemical and as well as oil industries for supply the liquid and gas with very less time and fast. Here in this paper we find out which joint will be the best for the fast supply with low vibration.*

Keywords: *FEA, Pipe joint, Vibration, Ansys.*

I. INTRODUCTION

In chemical and oil industries, pipe is very important for the flow of gas or oil through the pipe line if u observed in any home or office, water connection of the pipe line of motor to water tank. We can see easily the pipe joints with different joints type. The vibration is the most important for the design of the pipe line joints in every industries. In this paper we design different pipe joints using the solid edge software and analysis in the Ansys software for the study of the vibration behaviour in five different pipe line joints. In this paper we considered as the five different pipe joints with same dimensions with different angle.

Modal analysis has become a major technology in the quest for determining, improving and optimizing dynamic characteristics of engineering structures. Not only has it been recognized in mechanical and chemical engineering and many engineering field Dynamic behaviour of engineering structures is better appreciated, it becomes important to design them with proper consideration of dynamics. Finite element analysis as a computer modelling approach has provided engineers with a versatile design tool, especially when dynamic properties need to be perused.

The vibration is the study of the behaviour of the total deformation of the pipe elasticity. In the Ansys software we have to apply the boundary condition very carefully, if you done small mistake then the hole answer of the problem will be wrong.

II. FEM MODELS

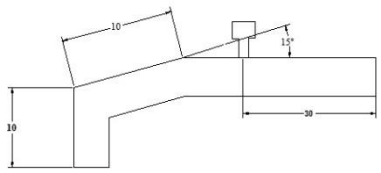
Finite element analysis as a computer modelling approach has provided engineers with a versatile design tool, especially when dynamic properties need to be perused. Modal analysis has become a major technology in the quest for determining, improving and optimizing dynamic characteristics of engineering structures. Not only has it been recognized in mechanical and chemical engineering but other engineering fields also. Study of the Dynamic behaviour of engineering structures is better appreciated, it becomes important to design them with proper consideration.

The pipes design in solid edge software and imported into the ansys software in the form of igs file format and converting into discretization model (mesh). The meshing of the pipe contents the element and nodes. The model contain the total elements as 12,030 and number of Nodes as 23721.

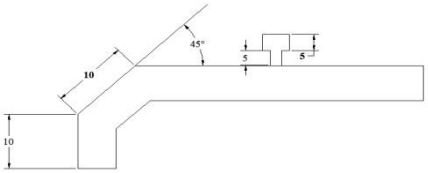
We considered five different pipe designs with 00, 150, 450 and the length of the pipe as 60 cm and joint pipe is 20 cm. we design pipes in solid edge software and analysis of the vibration in ANSYS software. as shown in figure. After the design of the pipes we imported in to ANSYS software as *.igs file format. As shown in figure.

III. PIPES DESIGN AND MATERIALS

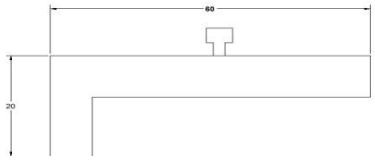
In this paper we considered five different pipe designs with 00 C, 150 C, 450 C and the length of the pipe as 60 cm and joint pipe is 20 cm. we design pipes in solid edge software and analysis of the vibration in ansys software. As shown in figure [1]. After the design of the pipes we imported in to ansys software as *.igs file format. The first pipe is 20 cm length small one and big pipe length is 60 cm with 150. The materials we used as the density 1490 kg m-3, young modulus 1 X 108 N m-2 and Poisson ratio 0.29 we considered in this research paper.



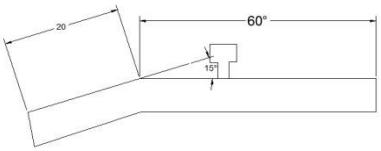
Pipe Design ‘A’



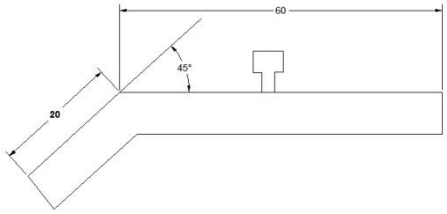
Pipe Design ‘B’



Pipe Design ‘C’



Pipe Design ‘D’



Pipe Design ‘E’

Figure 1. Five Different Pipe joints design (A, B, C, D, E Pipes)

IV. PROBLEM STATEMENT

The joint of pipe is very important factor in chemical and as well as oil industries for supply the liquid and gas with very less time and fast. Here in this paper we find out which joint will be the best for the fast supply with low vibration.

V. BOUNDARY CONDITIONS EFFECTS

The pipes model in chemical industries subjected to different boundary conditions we can applied. The boundary condition applies on the pipes as fixed support to two sides. We take in to the account 5 modes of natural frequency of the pipes with different angles like 0, 15, 45 degrees as shown in figure [1].

VI. RESULT AND DISCUSSION

The design is the very important parameters in to the pipe design. The pipe 3D solid model design based on Solid edge software is used to design the pipe with different design structure shown in figure 1. and imported in to the mechanical based finite element analysis commercial software ANSYS 14.0 is used for modal analysis. The analysis is a 3D modal analysis.

Once imported in to the Ansys 14.0 software, pipe is divided into small pieces called elements used in this study which includes over Nodes 23721, Elements 12030. All five different pipe joints have same nodes and Elements with different angles.

We study of the different five pipes design with the different angles to satisfy the dynamic design and analysis for the low vibration produced and satisfies the dynamic condition in chemical industries as well as the oil industries.

In this paper we have taken in to the account as the first bend is 10 cm and second bend 10 cm with 150 degree as shown in figure [1]. And length of the pipe from the second bend is 60 cm.

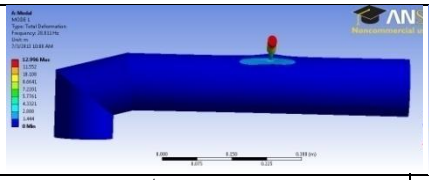


Figure .1. 1st Mode shape of the 'A'

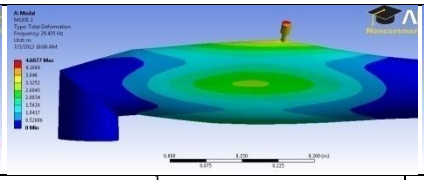


Figure .2. 2nd Mode shape of the 'A'

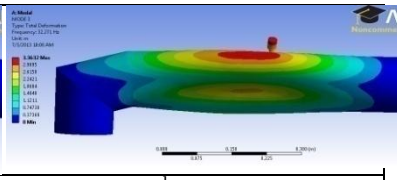


Figure .3. 3rd Mode shape of the 'A'

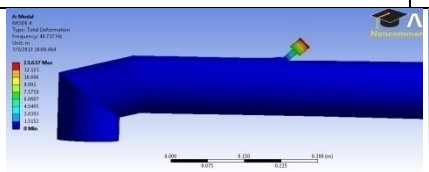


Figure .4. 4th Mode shape of the 'A'

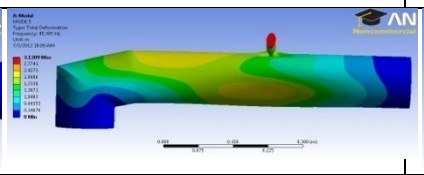
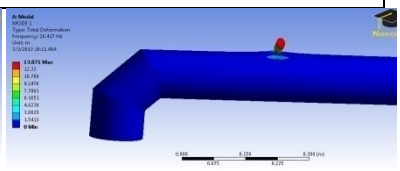
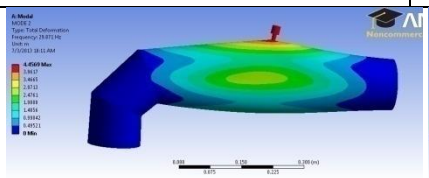


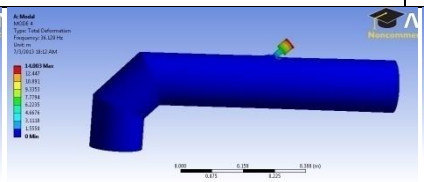
Figure .5. Pipe 5th Mode shape of the 'A



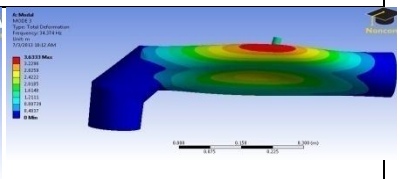
1st Mode shape of the 'B'



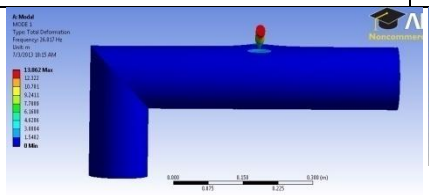
2nd Mode shape of the 'B'



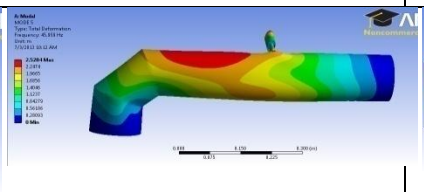
3rd Mode shape of the 'B'



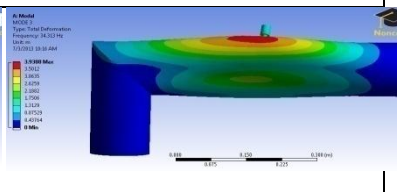
4th Mode shape of the 'B' pipe



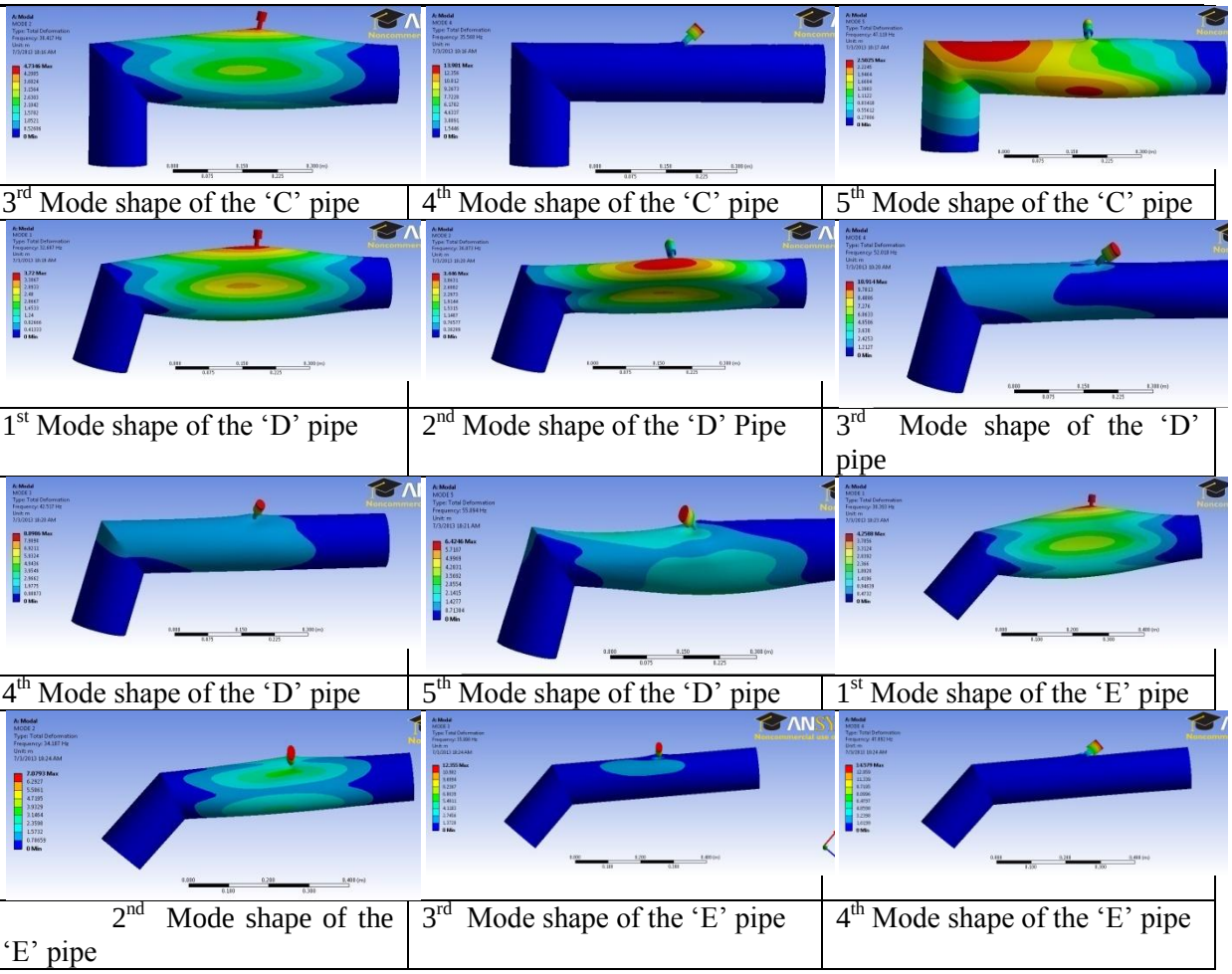
5th Mode shape of the 'B' pipe



1st Mode shape of the 'C' pipe

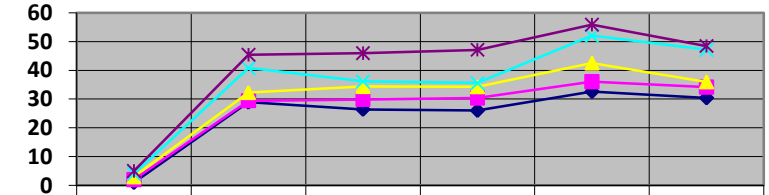


2nd Mode shape of the 'C' pipe



3rd Mode shape of the 'C' pipe	4th Mode shape of the 'C' pipe	5th Mode shape of the 'C' pipe
1st Mode shape of the 'D' pipe	2nd Mode shape of the 'D' Pipe	3rd Mode shape of the 'D' pipe
4th Mode shape of the 'D' pipe	5th Mode shape of the 'D' pipe	1st Mode shape of the 'E' pipe
2nd Mode shape of the 'E' pipe	3rd Mode shape of the 'E' pipe	4th Mode shape of the 'E' pipe

Figure .2. Different mode shapes of the A, B, C, D,E Pipes with each 5 modes shape



Mode No.	A Pipe	B Pipe	C Pipe	D Pipe	E Pipe
1	28.911	26.417	26.017	32.607	30.393
2	29.435	29.871	30.417	36.073	34.187

Graph 1. Comparison of five different pipe joints of mode and frequency

VII. CONCLUSION

This work studied for the effect of the pipe joint in chemical based industries to supply of the liquid. The main role of the pipe is to supply the liquid or gas in industries very fast and low vibration. Here we took into the account five different pipe joints with different angle. After the study and observed the result based on the FEA using the ANSYS software. We concluded as the 'A' Pipe design has the low vibration among the other four pipes joints.

The chemical industries it's very important factor to reduced the vibration with high speed supply of the liquid or gas. So in this research paper we concluded 'A' pipe design is the best joint pipe to satisfy the pipe joint design for the chemical industries.

REFERENCES

Nabeel K. Investigation into the Vibration Characteristics and Stability of a Welded Pipe Conveying Fluid. JJMIE, 378 – 387 June, 2010

Neimark Yu.I., Golumov V.I., Kogan M.M., "Mathematical models in natural science and engineering ", Springer, Berlin, 2003.

Reddy J.N. and Wang C.M., "Dynamics of fluid-conveying beams ", Centre of offshore research and engineering, National University of Singapore, August, 2004.

Hutton.V.D,2004.in "Fundamental of finite element analysis", , McGraw- Hill Publishing Company,New York ,p-11

Clough Ray W., Penzien J.,1994.in "Dynamic of Structure", McGraw-Hill, Publishing Company,New York,P-173

Giancarlo Genta. – Vibration of Structures and Machines: Practical Aspects. Springer; Softcover reprint of the original 2nd ed. 1995 edition (July 31, 2012)

Jimin He and Zhi-Fang Fu. - Modal analysis. Text book, Butterworth-Heinemann publisher. ISBN-13: 978-0750650793.