ABSTRACT
This paper reports stress analysis of curved pipe with different end constraints using finite element method. The stress analysis is carried out by varying various geometric parameters of curved pipe such as diameter of pipe, r/d ratio and included angle \(\theta\).

KEYWORDS Stress analysis, FEM, Curved Pipe.

1. INTRODUCTION
A pipe is a general term used for hollow product having circular, elliptical or square cross section of any closed perimeter. A pipe is tubular product of cross section that has specific sizes and thicknesses governed by particular dimensional standards, which includes outer diameter (D_o), inner diameter (D_i), thickness and r/d ratio.

A piping component experiences two main categories of stresses. The first category of stress comes from the pressure, either internal or external. The second category of stress comes from the forces and moments generated by weight, thermal expansion, wind, earthquake, and so forth.

The main cause of curved pipe failure is the maximum Von-Mises stress induced at the bend section of curved pipe. Hence it is necessary to evaluate the stress at the bend section of curved pipe. The curved pipe has different parameters namely internal diameter, outer diameter, radius of curvature of pipe & bend angle. In the present work an analysis had been carried out only under internal pressure & FEM had been used for analysis.

The finite element analysis of curved pipe is performed by considering the following parameter.

- Variation in the radius of curvature of the pipe & its diameter (r/d ratio).
- Variation in various diameters of the pipes (D).
- Variation in the in bend angle of curved pipe (\(\theta\)).

The end constraints considered as follows:
- Both pipe ends fixed
- One end fix and other is free

2. Finite Element Analysis of Curved Pipe
The various models of curved pipe for different geometric parameters are analyzed for two types of end constraints using finite element analysis. The pressure loading is considered in the analysis. The analysis revealed the Von-Mises Stresses. The representative Von-Mises stresses contour are shown in figure 2.1, 2.2, 2.3, for both types of end constraints and comparison of results are presented in figure 2.4, 2.5, 2.6, 2.7, 2.8, 2.9 and 2.10.
3. DISCUSSION & CONCLUSION

Though the results are presented in earlier chapters, here the detailed discussions and conclusions are presented as follows:

1. It is observed that for both ends constrained, as the r/d ratio of the curved pipe increases the Von-Mises stresses at the bend portion of the pipe reduces. However, as the diameter of bend pipe increases the stresses also increases. It means that the induced stress in curved portion of the pipe is directly proportional to the r/d ratio.

2. It is observed that for one flexible end, as the r/d ratio of the curved pipe increases the Von-Mises stresses at the bend portion of the pipe also increases. However as the diameter of bend pipe increases the stresses also increases. It means that the induced stress in curved portion of the pipe is directly proportional to the r/d ratio.

3. It is concluded that as the bend angle of pipe increases, the stresses in pipe decreases for both type of constraints. It is further concluded that the behavior of stresses for both type of constraints are exactly reversed for r/d ratio. It is concluded that the bend pipe with both ends constrained lead to lower stress value as compared to bend pipe with one end flexible. It is also proposed that the present analysis need to be validated using experimental methods, for confirmation of results.

REFERENCES

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