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Design & Analysis of Piping System for Optimization of Pipe Wall Thickness

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***Abstract*—one of the major tasks in any process industry is to transportation of fluid from one place to another. The most convenient method for the same is to transfer the fluid through piping system. The piping system is the interconnected piping subject to the same set of design conditions. The piping system involves not only pipes but also the fittings, valves, flanges, Gaskets, bolting and other specialties. The main objective of this thesis is to design the piping system and then to analyze its main components. Wall thicknesses are calculate for all pipes which shall be safe for the given three types of load cases such as operating conditions, sustained conditions and expansion conditions. Also pipe system is design as per standard piping design codes. The results obtain from analysis will be compared with ASME Power Piping Code B31.1. Also the system is validated based on the experimental results**

In the present research, piping system is design & analyse based on the process piping code ANSI B31.1 & wall thickness is calculated for critical piping loop i.e High pressure pump delivery piping.

Keywords*— *Piping Stress analysis, Ansys Analysis; Reverse osmosis, ProcessOptimization

I. INTRODUCTION

Piping System design and analysis is a very important field in any process and power industry. Piping system is analogous to blood circulating system in human body and is necessary for the life of the plant. The water treatment piping system, mentioned in thesis will be used for supplying the water to Reverse Osmosis system at given temperature and pressure. Mainly piping system designing is done in two parts; one is during the pre-bid stage of the project and second is at detail engineering designing stage after finalization of project. As during the post-order stage it is not possible to check the entire technical specification requirement regarding to the piping system. So it is necessary to develop optimized system for reverse osmosis unit. This reverse osmosis piping system is one of the major requirements of the water treatment plant to be installed. [2]

Reverse osmosis system piping is one of the critical piping for the water treatment plant due to the following reasons:-

1) Since the RO system having the high pressure water piping at around 300 psi to 600 psi which is higher than other plant piping.
2) RO system flow rate is high & therefore piping material & schedule required for these systems will be of high quality.
3) RO System having the large number of instrument mounting over the piping and various instruments tapping are required due to which higher pressure drop observed during these operation.

Therefore RO system is one of the critical systems in the water treatment plant in terms of high pressure & high flow application & it is necessary to optimize such a system to reduce its various designing parameters such as piping system. Basically the sizing of RO piping has already done at pre-bid stage by process designing stage and contained nearly on 5x10m² areas, including various pipes, fittings and junctions. The process flow diagram for the RO piping system is shown in Figure 1-1. The following parameters are considered for designing the piping system:-

1) Inlet Water pressure :- 20 mWc
2) Inlet Water Flow Rate:- 72 m3/hr
3) Inlet water velocity:- 1.2 m/sec

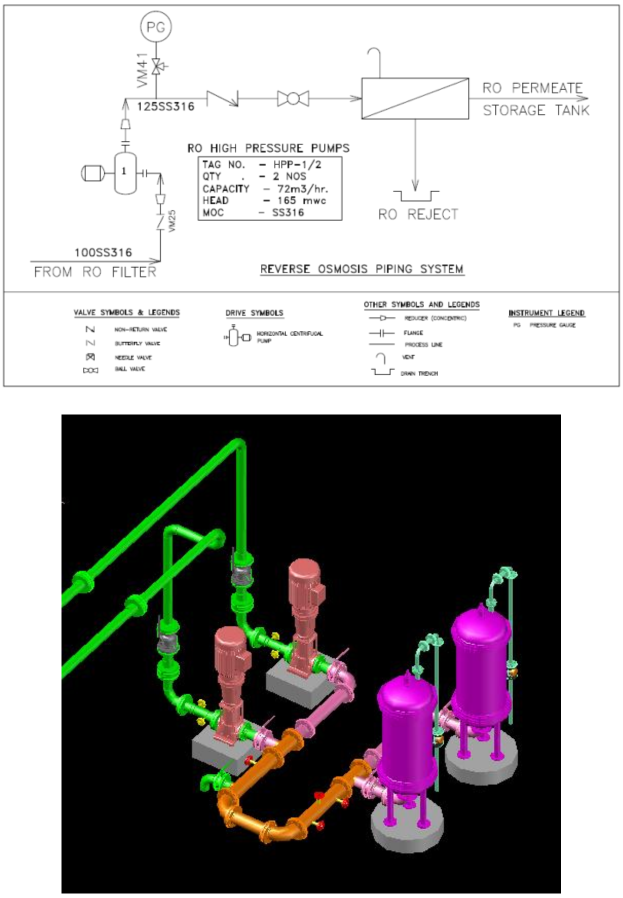

Fig.1.1 RO Piping System

II. Literature Review

According to Ming Li, "Stress analysis of non-uniform thickness piping system with general piping analysis software", he analyzed that an analysis procedure is introduced to enable a general piping software to conduct ASME III class 1 piping analysis with non-uniform wall thickness. The demonstration is performed on CANDU (Canadian Deuterium Uranium) feeder pipes, which have been subjected to FAC (Flow accelerated Corrosion) caused wall thinning. The feeders are made of SA106 Grade B carbon steel and range from NPS 1.5 to 3.5 in. of sch. 80 nominal thicknesses, with lengths from 20 feet (6.1m) to 60 feet (18.3 m). The results are compared with both conventional uniform thicknesses piping analysis and non-uniform thickness solid finite element analysis. The comparison shows the validity of the proposed "average-minimum-average" approach by employing the general piping analysis software. The approach remains conservative compared to the benchmark solid finite element analysis results. Meanwhile it provides lower acceptable thickness than the conventional piping analysis. [1]

According to Fu-Zhen Xuan, "Finite element-based limit load of piping branch junctions under combined loadings", he analyzed that an analysis procedure is introduced to enable general piping software to conduct ASME III class 1 piping analysis with conventional piping analysis. [2]

According to M. Balaji, "Optimization of piping layout with respect to pressure and temperature using CAESER-II", he analyzed the piping system by considering the geometrical properties such as diameter, thickness, span length. The variation of the pipe material density with respect to change of pressure and temperature of the operating medium was used to vary the span length between the supports and the number of supports was optimized. The variation of the pipe material density with respect to change of pressure and temperature of the operating medium was used to vary the span length between the supports and the number of supports was optimized. [3]

According to Ramakrishnan.T, "Design analysis and optimization of power piping routing system from Boiler to turbine under operating condition", he optimized the stress of the piping system by selecting pipe routing from Boiler to Turbine with respect to ASME standards. In this work, power piping system was identified and analyzed with respect to the following data: (Design pressure = 7109.82 kpa, Working medium = SH steam, Working temperature = 5400C, Pipe size = dia 114.3 x 8 mm, Pipe material = SA 335 P22, Pipe density = 0.078 kg/cm3. In this analysis, three types of load cases were analyzed such as operating conditions, sustained conditions and expansion conditions. [4]

According to Bhairavnath Uttamrao More,"Development of steam piping system with stress analysis for optimum weight & thermal effectiveness", he analyzed steam piping for boiler area. Also calculated of all applied loads, pipe components were designed and analyzed both ASME B31.1 power piping and on ANSYS software & compare these both results. He was concluded that For header pipe the calculated wall thickness is 3.54 mm and the standard minimum wall thickness is 8.18 mm which is greater than the calculated one by more than 2.3 times. [5]

According to John C. Oliva, "Pipe Stress Analysis – Different Tools, Different Results" Presented at the 2014 ANSYS Regional Conference, Chicago, that Pipe stress analysis program results and results with general purpose finite element tool like ANSYS are different. Such pipe stress analysis software's are developed for the sole purpose of evaluating pipe configurations per specific pipe design codes. He concluded at end that the pipe stress analysis tool reported a value that may be 25% too low a compare to ANSYS. [6]

III. Problem Statement and Objective

One of the major tasks in any process industry is to transportation of fluid from one place to another. The majorcommonly used method for the same is to circulate the fluid through piping system with pressure.
The piping system is the interconnected piping subject to the same set of design conditions. The piping system involves not only pipes but also the fittings, valves, flanges, Gaskets, bolting and other specialties.

3.1 Problem Statement:

"Analyze Reverse Osmosis piping system for optimization of pipe wall thickness considering its geometric properties with sustainable, occasional and thermal load cases by analysis of piping system through pipe stress analysis software & ANSYS software in conjunction with ASME design code ANSI B31.3 process piping."

3.2 Objectives:

The prime objective of this project is to design the piping system for optimize its weight considering pipe wall thickness of piping system. Wall thicknesses are calculate for all pipes which shall be safe for the given three types of load cases such as operating conditions, sustained conditions and expansion conditions through conventional ASME code designing procedure.

Analyze piping system through Propipe software and ANSYS software. Compare the results obtained from ANSYS with conjunction with pipe design standard ASME B31.1. Also optimized system is validated based on the experimental results.

IV. Theoretical Analysis

A. Process Design

This process is design based on the process requirements & technical variables. Itelaborates the required length & cross sectional area of pipe, the fluid properties inside the pipe, nature & rate of flow in it. These variables affect the positioningand placements of equipment's during layouting and routing of piping. Thedesign and operating working conditions are clearly defined. Process Plant Design is the creation of a Process Flow Diagram (PFD) and Process &Instrumental diagram, which are used in the plant designing & piping layout.

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B. Piping Structural Design

In piping structural design, according to pressure in pipelines, the design thickness and minimum allowable thicknesses are calculated; according to the codes formulae and ASME standards. ASME codes for piping standards are available, for process fluid piping flow, ASME B31.3 is used. In the piping system design of pipes, when all type of loads is calculated then the required support span is also calculated for supporting the pipe line.

B.1 Pipe Thickness Calculations

Piping codes ASME B31.3 Paragraph 104.1.2 required that the minimum thickness tm should including the allowance for mechanical strength & shall not be less than the thickness calculated using Equation [2].

$$tm = \frac{P \times Do}{2 \times (S \times Eq + P \times Y)} + A$$

Or

$$tm = t + A$$

Where

tm = minimum required wall thickness, mm
t = pressure design thickness, mm
P = internal pressure, kPa
Do = outside diameter of pipe, mm
S = allowable stress at design temperature (known as hot stress), kPa
A = allowance, additional thickness is provided for material which removed in threading, corrosion allowance; manufacturing tolerance (MT) should also be considered.
Y = coefficient that takes material properties and design temperature into account.
For temperature below 900°F, 0.4 may be assumed.
Eq. = quality factor.

B.2 Allowable Working Pressure

The allowable working pressure for the pipe spool can be determined by Equation [2].

$$P = \frac{2 \times (S \times Eq) \times t}{(Do - 2 \times Y \times t)}$$

Where

t = specified wall thickness or actual wall thickness in mm.
For bends the minimum wall thickness after bending should not be less than the minimum required for straight pipe.

B.3 Sustained Load Calculations

Sustained loads are those loads which are caused by mechanical forces and these loads are present throughout the normal operation of the piping system. These loads include both weight and pressure loadings. The support must be capable of holding the entire weight of the system, including that of that of the pipe, insulation, fluid components, and the support themselves.

$$\text{Pipe Weight} = \frac{\Pi}{4} \times {}^{\rho}Steel \times (Do^2 - Di^2) \frac{g}{gc}$$

$$\text{Fluid Weight} = \frac{\pi}{4}\ {}^{\rho}Fluid \times (Di^2) \times \frac{g}{gc}$$

$$\text{Insulation Weight} = \textit{Insulation factor} \times {}^{\rho}Insu. \times \frac{g}{gc}$$

Where

D0 = Outside diameter of pipe, mm
Di = Inside diameter of pipe, mm 10^TH
t = Insulation Thickness depend on the NPS, mm
g = Acceleration due to gravity, m/sec²
gc = Gravitational constants, m/ sec²
ρSteel = Density of steel, kg/mm³
ρfluid= Density of water, kg/mm³
ρinsul= Density of Insulation, kg/mm³

Insulation factor depends on the thickness of the insulation of the pipe.

B.4 Wind Load Calculations

Wind load like dead weight, is a uniformly distributed load which act along the entire length or portion of the piping system which is exposed to air.

For standard air, the expression for the wind dynamic pressure is given below:

$$P = 0.00256 \times V^2 \times C\,D$$

And to calculate the wind dynamic load (lb/ft), the following expression is used:

$$F = 0.000213 \times V^2 \times C\,D \times D$$

Where

P = Dynamic pressure, kg/cm²
V = basic wind speed, miles/hr
CD = Drag co-efficient, dimensionless

CD can be calculated using table and the following equation;

R = 780xVxD
R = Reynolds number
F = Linear dynamic pressure loading (kg/cm²)
D = Pipe Diameter (cm)

B.5Thermal Loads Calculations

All pipes will be installed at ambient temperature. If pipes carrying hot fluids such steam, then they expand, especially in length, with an increase from ambient to working temperatures. This will create stress upon certain areas within the distribution system, such as pipe joints, which, in the extreme, could fracture. The amount of the expansion is readily calculated using the following expression [6].

$$\textit{Expansion (mm)} = \alpha \times L \times \Delta T$$

Where

ΔL = Length of pipe (m)
T = Temperature difference between ambient and operating Temperatures (°C)
α = Expansion coefficient (mm/m °C) x 10^{-3}

B.6 Occasional Loads

Occasional load will subject a piping system to horizontal loads as well as vertical loads, whereas sustained loads are normally only vertical (weight). There are different types of occasional loads that act over a piping system but for our analysis we will use wind loads and seismic loads.

B.7 Seismic Loads

Earthquake loads are of two major types

- Operation Based Earthquake Load
- Safe Shutdown Earthquake Load

Piping systems and components are designed to withstand two levels of site dependent hypothetical earthquakes, the safe shut down earthquake and the operational basis earthquake. Their magnitudes are expressed in terms of the gravitational g. There motions are assumed to occur in three orthogonal directions, one vertical and two horizontal directions. Earthquake loads can either be calculated by dynamic Analysis or static Analysis. In Dynamic analysis frequency response of the system is used to calculate the Earthquake load whereas in Static Analysis, these loads are taken to be some factor of the Pipe Dead load.

C. Pipe Span Calculations

The maximum allowable spans for horizontal piping systems are limited by three main factors that are bending stress, vertical deflection and natural frequency. By relating natural frequency and deflection limitation, the allowable span can be determined as the lower of the calculated support spacing based on bending stress and deflection.

C.1 Span Limitations

The formulation and equation obtained depend upon the end conditions assumed. Assumptions

- The pipe is considering to be a straight beam
- Simply supported at both ends

Based on limitation of stress [2]

$$L_s = \sqrt{\frac{0.33ZS_h}{w}}$$

Based on limitation of deflection [2]

$$L_s = \sqrt[4]{\frac{\Delta EI}{22.5w}}$$

Where

Ls = Allowable pipe span, m
Z = Modulus of pipe section, mm³
Sh = Allowable tensile stress design temperature, psi
w = Total weight of pipe, kg/m
Δ = Allowable deflection/sag, mm
I = Area moment of inertia of pipe, mm^4

E = Modulus of elasticity of pipe material at design temperature, mPa.

C.2 Expansion Loop Calculations

Thermal expansion are calculated for all the pipes by using equation Expansion (mm) Based on thermal expansion calculated above, size of expansion loops can be calculated from equation below as

$$L = \sqrt{\frac{3ED_0\Delta}{144S_A}}$$

Where

L = Length of expansion Loops, mm
E, Do, SA, same as in above calculations

Size of Expansion Loops assuming to be symmetrical U shaped.L = 2H + W

Where H = 2W for U shaped loop.

D. Physical Properties

Physical properties of pipe material, insulation and water are arranged in Table 1-2below;

Material	Parameter	Value
Carbon Steel	Modulus of Elasticity'E'	27.5 Mpsi
	Allowable stress S all	14.4 ksi
	Density, 'ρsteel'	0.283 lb/in³
Insulation	Density, 'ρRock wool'	0.00343lb/in³
Water	Density, 'ρwater'	0.0361 lb/in³

Table 1-1 Material Properties [Appendix Table A-9]

D.1 Design Calculations

Piping design calculation means to find out the pipe thickness for the available size and operating pressure of the fluid. This thickness is then compared to the allowable minimum standard thickness defined by the code. After thickness calculations all loads applied on this pipe can be calculated, which will form the basis for spacing of supports and sizing of expansion loops.

D.2 Pipe Thickness Calculations

Piping codes require that the minimum thickness tm including the allowance for mechanical strength, shall not be less than the thickness calculated using Equationas follows.

$$\text{Design thickness } tm = \frac{P \text{ x } Do}{2 \text{ x } (S \text{ x } Eq + P \text{ x } Y)} + A$$

Parameter	Value
Do	8.625 in
Pg	193.3 Psi
E	1
Y	0.4
S	14400 Psi
Tolerance limit	±12.5%
A	3 mm = 0.0393in

Table 1-2 Input Parameters used in pipe thickness calculation

Putting all these values in above equation of minimum thickness

$$tm = \frac{193.3 \text{ x } 8.625}{2\text{x}(144000\text{x}1 + 193.3\text{x}0.4)} + 0.03937$$

tm= 0.0998 *In*
tm = 0.0998 / 0.85
tm = 0.12 in
tm = 2.9 mm

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Standard tm = 0.282 in

From the above calculation, it is cleared that calculated thickness is nearly 2 to 3 time greater than code design, so our calculated thickness is safe.

D.3 Pipe Stress Calculations

The effects of the pressure, weight, and other sustained loads must meet the requirements of the following equation [11].

$$S = \frac{PD_0}{4t} + \frac{0.75i \times M_A}{Z} \leq 1.0S_h$$

Where,

P = Internal Pressure, psi

Do = Out Side diameter of Pipe, in

t = nominal wall thickness, in

Z = Section modulus of pipe, in^3

MA = Resultant moment due to weight and other sustained loads, lb-in

Sh = Allowable stress at design hot pressure, psi

i = stress intensification factor

Parameter	Value for 8" pipe	Value for 2" pipe
P	1212.86kPa	1103.43kPa
Do	219.08 mm	60.33 mm
T	3.34 mm	2.158 mm
Z	275302.7 mm^3	9193.143 mm^3
MA	3.542×10^6 N-mm	143.183×10^3 N-mm
Sh	99284.5 kPa	99284.5 kPa
i	1	1

Table 1-3 Input Parameters used in pipe stress calculation

For 8" Pipe

After putting values from above table in Equation, gives the following comparison

$$\frac{1212.8 \times 219.08}{4 \times 3.34} + \frac{1000(0.75 \times 1 \times 3.5424 \times 10^{6})}{275302.7} \leq 1.0 \times 99284.5$$

$$29.729 \times 10^3 < 99.285 \times 10^3$$

For 2" Pipe

After putting values from above table in Equation, gives the following comparison

$$\frac{1103.43 \times 66.33}{4 \times 2.158} + \frac{1000(0.75 \times 1 \times 143.183 \times 10^{3})}{9193.143} \leq 1.0 \times 99284.5$$

$$20.160 \times 10^3 < 99.285 \times 10^3$$

It means that the pipe is safe by more 3& 5 times for 8" & 2" size respectively than allowable limits under the sustainable loads.

D.4 Seismic Loads Calculations

For a system seismic supports designed in the rigid range, the designed load for a system decreases. For such a system the seismic stress and load are given below;

Seismic stress

A simplified seismic analysis can be done by assuming the simple beam formulas and the load is to be most often considering in the lateral directions of the pipe. Seismic stress based on seismic acceleration is calculated as follows [3].

$$S = 0.75 \times i \times 12 \times \left(\frac{WL^2}{8 \times Z} \times 1.5G\right)$$

Where

Z = Section modulus of pipe, in^3 = 16.8 in^3

G = seismic acceleration in gs = 0.15 (Data provided)

I = stress Intensification factor for straight pipe = 1.00

Seismic Lateral load

For seismic lateral load based on static analysis is to be used to evaluate power piping.

It is performed by analyzing a piping system for the statically applied uniform load equivalent to the site dependent earth-quake acceleration in each of the three orthogonal directions. For seismic lateral load considering only in horizontal direction using equation below [1]:

$$V = Z \times I \times K \times C \times S \times W$$

V = Seismic lateral load, lb

Z = constant depend upon earth quake zone 0.5 up to 1.0 = 1(Assuming maximum)

K = Occupancy factor b/w 1.00 and 1.5 = 1 (Low occupancy region)

$$C = \frac{1}{15\sqrt{T}} = 0.12$$

T =Fundamental period of structure, s = 0.3 sec

S = soil factor b/w 1 and 1.5 = 1.5 (Data provided)

W = Total dead weight of the structure = 10,000lb (For 200 feet of pipe length)

$$V = 1 \times 1 \times 1.5 \times 0.12 \times 1.5 \times 10000$$

$$V = 2700\ lb$$

Verification from Code B31.3

To verify that the applied seismic loads are within the limits as defined by the code, following equation is used [1].

$$\frac{PD_0}{4t} + \frac{0.75i(M_A + M_B)}{Z} \leq KS_h$$

Where

P = Internal Pressure, psi

Do = Out Side diameter of Pipe, in

t = nominal wall thickness, in

MA = Resultant moment due to loading on cross section due to weight and other sustained loads = in-lb

MB = Resultant moment loading on cross section due to occasional loads, psi

MB = σ x Z = 108.482 x 16.8 = 1822.5 psi

K= Constant factor depend on plant operation time

Using the values given in Table 7-8, below for obtaining the comparative results of seismic load,

Parameter	Value
P	193.7 psi
D0	8.625 in
T	0.322 in
Z	16.8 in^3
MA	32700 in.lb
Sh	14400 psi
K	1.2

Table 1-4 Input Parameters used in pipe Seismic load calculation

Equation Becomes;

$$\frac{193.7 \times 8.625}{4 \times 0.322} + \frac{0.75 \times 1 \times (32700 + 108.482 \times 16.8)}{16.8} \leq 1.2 \times 14400$$

$$2.838 \times 10^3 < 17.280 \times 10^3$$

It means that the pipe is safe by more 7 times than allowable limits under the seismic loads.

V. Finite Element Analysis

Considering pipe segment of pipe no. 201 and then taking its halfsymmetry for analysis by assuming the pipe segments to be straight and acts justa cantilever beam as shown in Fig.1.2. The pipe no. 201 has been dividedinto different sections. As this pipe has two sections, one is the as shown below fig. and the other is vertical leg which is perpendicular to the main line.

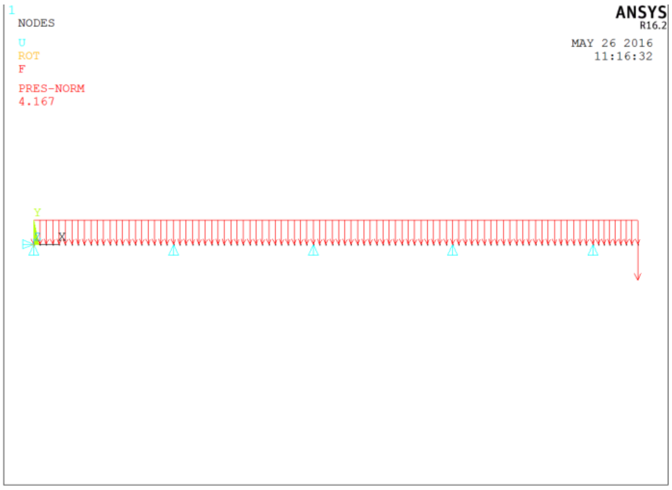

Fig.1.2Loaded view of meshed beam

Analysis was performed for the pipe in ANSYS for using the followingdata.

Element type = Beam 3

Material properties

Modulus of Elasticity = 189605.8 Mpa

Poison's Ratio = 0.283

Density = 7833 kg/mm3 (0.283 lb/in3)

Vertical constraints in the middle only and one all degree ofFreedomconstrained at the start.

Gravity = 9.81 m/s (386.22 in/sec*2*)

Final Meshing = 96 elementsfor total length of the beam (32 elements forfirstfour each sections and 8 elements for the last section. Refining the meshfrom 32 elements up to 96 elements but there are no changes found in deformationvalues and bending moment values).

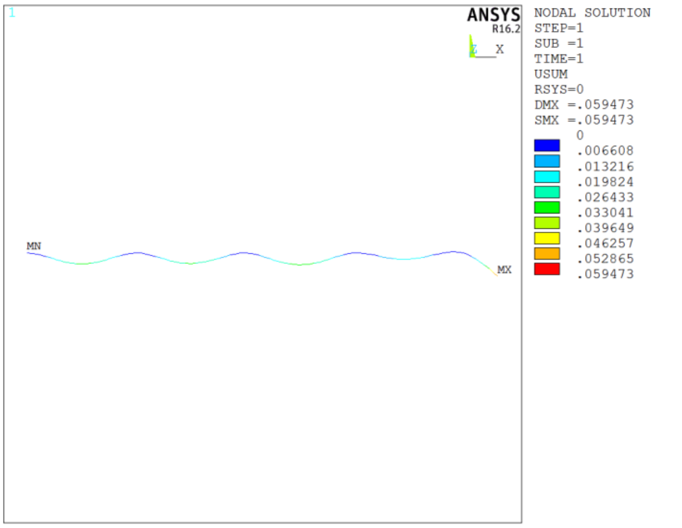

Fig.1.3Deflection in pipe

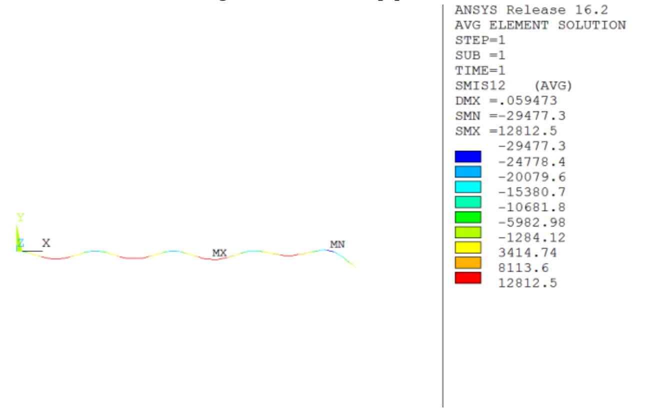

Fig.1.4Stress plot in pipe

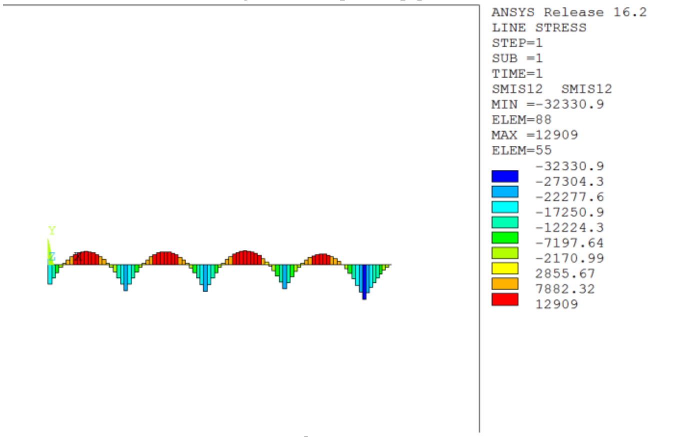

Fig.1.5Bending Stress in pipe

Comparison of Analysis

The maximum deflections and bending moment values obtained from both methods are arranged in Table 1-2 below,

Method	Max. Deflection (in)	Max. Bending (lb-in)
Manual Result	0.065	32741.45
ANSYS Result	0.059	32921

Table 1-3 Comparison of analysis for pipe beam

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From the results obtained both manually and on ANSYS, the difference in maximum deflection is 6.4% where the difference in the max. Bending moment is 1.349%. Deformation is less than 0.1 inches and also the maximum bending stress are 1947.54 psi which is less than the allowable stress of the pipe.

VI. EXPERIMENTAL VALIDATION

In order to validate theoretical calculations of engineering practice & FEA based solution, the experimental data collected from the testing done inMetallurgical Laboratory.

Methodology:-

1) To fulfill above stated objectives, anexperimentation set up isproposed &used sample specimen of Carbon steel pipe as shown inFigure 1-7.
2) For testing & sample preparation, ASTM A106 standard has beenfollowed. Static load has been found out for different deflection.
3) Manual &FEA (Ansys) analysis has been done on 8" size pipe, but testingof 8" size pipe is not feasible, Hence 2" size pipe selected forexperimentation with UTM of 1000 Tonecapacity.

Specimen Data:
Pipe Material: Carbon steel
Pipe size: 2 inch (50NB)
Pipe wall thk: 1.334mm (2mm)
Testing standard: ASTM A106

Fig. 1-6Experimental test rig (UTM)

4) The readings of load Vsdeflectionsare noted.
5) The comparative graph plotted betweentheoretical& experimental deflection

Sr. No.	Load in KN	Load in Kgf	Experimental Deflection in mm	Calculated Deflection in mm
1	0.2	20	0.2	0.17
2	0.24	24	0.3	0.2
3	0.26	27	0.4	0.22
4	0.28	29	0.5	0.23
5	0.3	31	0.5	0.25
6	0.33	34	0.6	0.27
7	0.38	39	0.7	0.31
8	0.56	57	0.8	0.46
9	0.98	100	0.9	0.81
10	1.14	116	1	0.94
11	1.38	141	1.1	1.14
12	1.58	161	1.2	1.31
13	2.18	222	1.4	1.81
14	2.34	239	1.5	1.94
15	2.48	253	1.9	2.06

Table 1-4 Comparison of Experimental & calculated Deflection

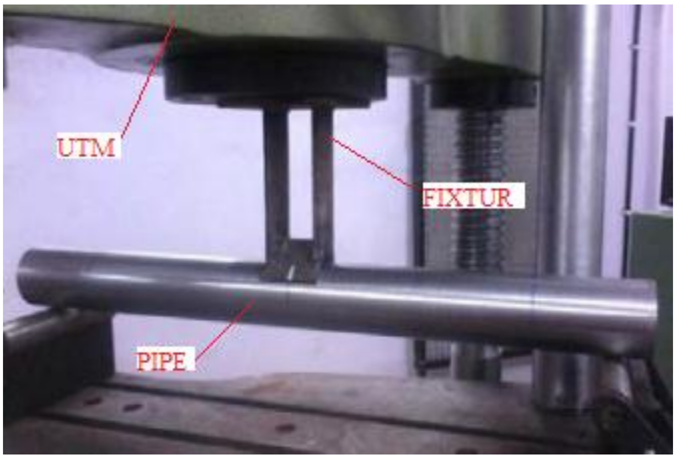

Fig. 1-7Specimen for experimental testing

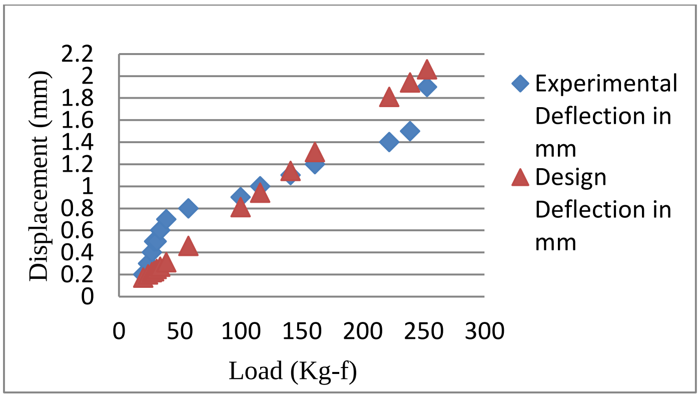

Fig. 1-8Graph for Experimental deflection & for calculated deflection

The comparison of experimental data and predicted results is shownin Table 1-4. As our static loading for 2" pipe in our project is 96.93 Kg-f, so where only concentrating area for loading from 80 kg-f to 120 kg-f. From the graph 1-8, it can be seen that the difference in calculated & experimentaldeflection is 9%.
Hence, from above graph, calculated pipe deflection for given pipe system is verified with experimental pipe deflection.

VII. CONCLUSION

From this research it is concluded that standard pipe thickness & allowable pressure for the piping system is much greater than required for the given fluid pressure & fluid flow. Standard pipe wall thickness is almost greater than 2.2 times than design thickness & allowable pressures are greater than 4 times of Design pressure. During experimentation, we found difference in calculated &experimental deflection as 9%. Also the effect of moments & loads due to Sustained load as 29.7 MPa which is less than 99.28 MPa as per Code limit.Stresses induced in pipe or piping systems due to various loads are found to be safe for modified thickness by providing proper supporting arrangement & restricted the axial movement of deflection.

VIII. FUTURE SCOPE

For future work more stress should be given on below point.

1. Analytical / Computational comparison for any other response factor thanstress dealt with in this current work
2. Loads due to settlement of Piping & Pressure vessel, Tank can be alsoconsidered for analysis
3. Dynamic analysis due to effect of vibration can be done.
4. Utilizing Finite Volume Method for solving the problem in the fluiddomain can be used for determining the associated fluid pressure & flowin the system for accurate result.
5. Optimization of Anchor support column for varying elevation in piperouting is suggested.

Using this case to solve problems for modern materials like composites whereweight could pose a challenge for the given application.

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