

Behaviour analysis of stainless steel globe valve under different temperature conditions using FEA

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Abstract—The valve manufacturers use FEA simulation tools to effectively optimize the design. This paper briefly explains the typical problems faced in the industry with the conventional globe such gland packing eyebolts at low temperature, behaviour of globe valve under higher or lower temperature conditions. It deals with directional deformation, equivalent elastic strain, and equivalent von misis stresses with respect to changing temperature.

Index Terms—ANSYS, CRYOGENIC TEMPERATURE GLOBE VALVE, HIGHER AND LOWER TEMPERATURE CONDITIONS, FINITE ELEMENT ANALYSIS.

OBJECTIVES:

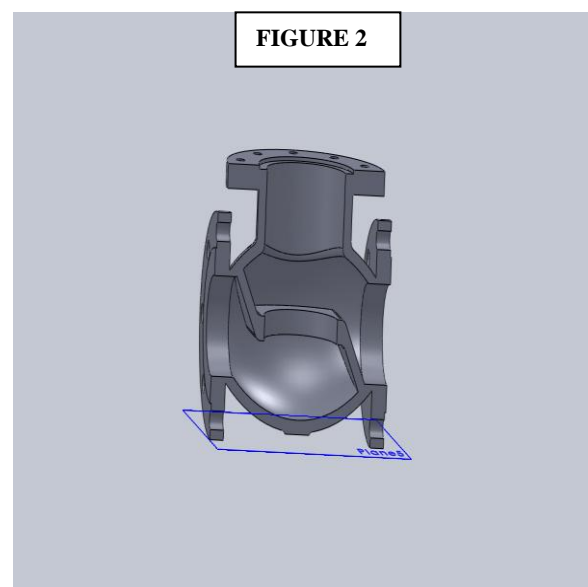
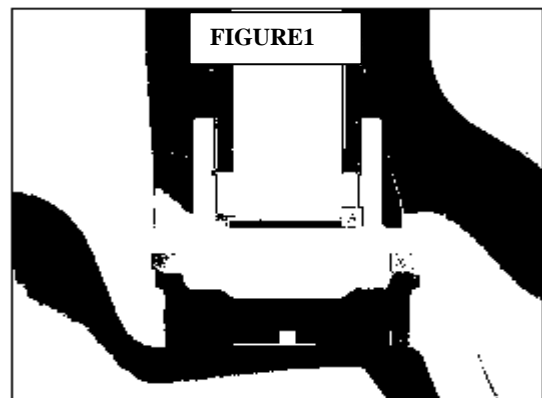
1. To know about effect of higher temperature on globe valve.
2. To know about effect of cryogenic temperature conditions on globe valve.
3. To know about modern FEA analysis.

I. INTRODUCTION

Economic and environmental constraints dictate the need for the efficient performance of valves in stringent environments. Keeping this in mind, the globe & control valve designs were optimized using the latest software for FEA. Standard globe valves are used in throttling applications where the flow rate is moderately regulated by manually adjusting the disc positions whereas in control valves the flow is very precisely controlled by the automatically operated actuators in the closed loop system. The control valves have inherent flow characteristics that define the relationship between the valve opening and flow rate under constant pressure conditions. Globe valves over a period of usage face several typical problems in the site like deteriorated packing performance, seat leakage, difficulty in operating the valve & stem bending problems in stainless trims and binding of yoke-sleeve and stem threads due to the galling process etc.. The cost focus was also given to reduce the valve weight in view of the global concerns on cost reduction. Weight reduction is done by optimizing the various parameters like cover flange thickness optimization using Finite element analysis (FEA).

II. USE OF BODY GUIDED DISC TYPE

In this arrangement, the disc is very closely guided along the ribs provided in the body, during the valve opening and closing. This supporting rib reduces the alignment variations caused by the bending of the stem. Also it takes up the bending load that comes on the stem when the hand wheel is over-tightened and also it resists the side thrust exerted on the disc. This guiding arrangement provides effective sealing of the disc by the effective transmission of the hand wheel force to the disc. The figure 1 & 2 shows the body guided ribs.



SECTIONED VIEW OF GLOBE VALVE WHERE BODY GUIDED DISC IS PLACED

III. MODULES OF PROJECT

Modeling: 3D models of critical components of Gate Valves are prepared using (SOLID WORKS). The detailed dimensions are taken from its 2D drawings.

Importing 3d Model: - 3D model prepared using SOLID WORKS is imported into FEA software (ANSYS).

Preferences:

1. THERMAL analysis method is selected. Pre-processing:

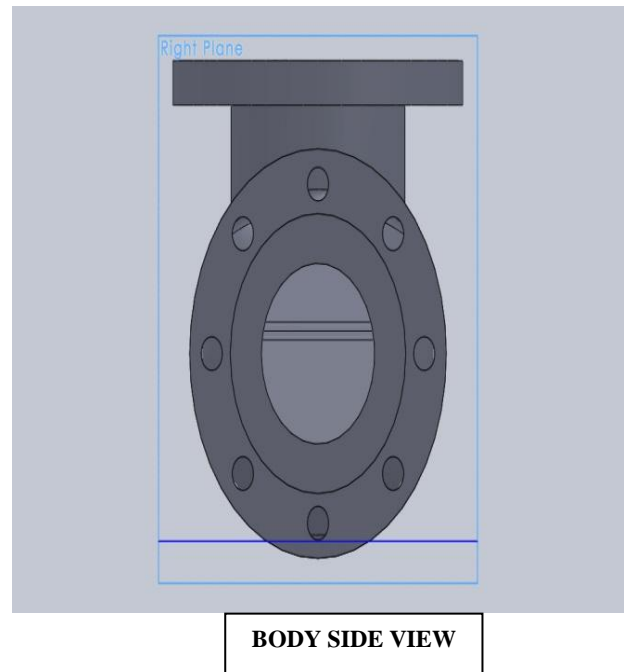
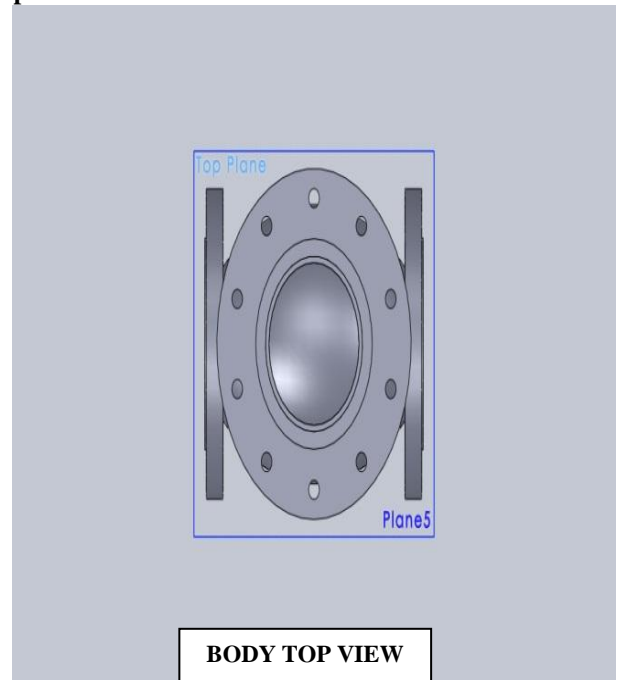
2. DEFINE ELEMENT TYPE

3. APPLY MATERIAL PROPERTIES

HERE MATERIAL IS STAINLESS STEEL



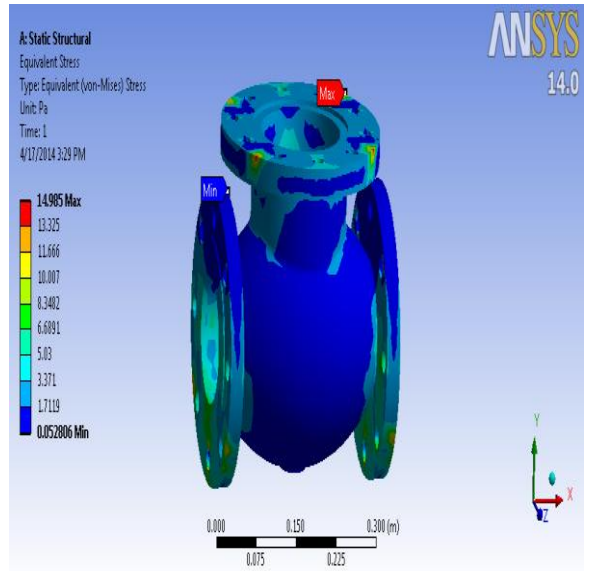
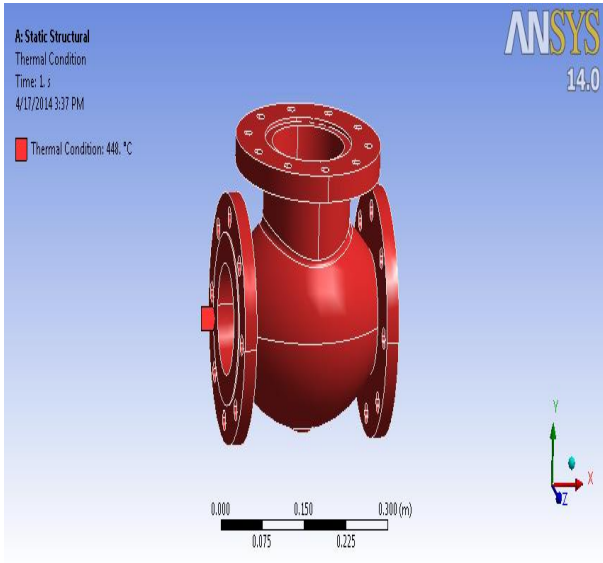
Design view of globe valve in solid works



IV. DESIGN OPTIMIZATION – USING FEA

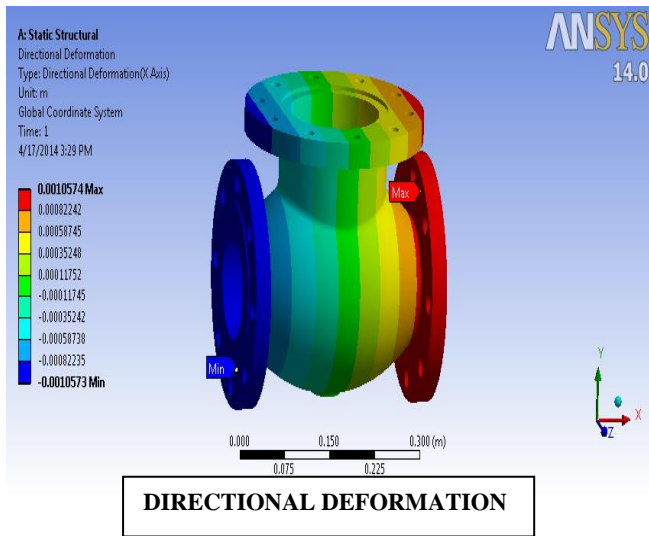
Finite element analysis is done on the temperature subjected components like body, bonnet & disc using FEA package. Thermal analysis ensures that the stresses and deflection induced are within the allowable limits. The thermal loads are applied on the body and disc surfaces exposed to the line fluid these gives the realistic picture of how the valve behaves under the temperature conditions. Fixed constraints are given on the end flanges of the body to stimulate that it is fixed on the pipe flanges. The following Figure shows the FEA analysis on body.

A. DURING HIGHER TEMPERATURE CONDITION(AT 448deg)

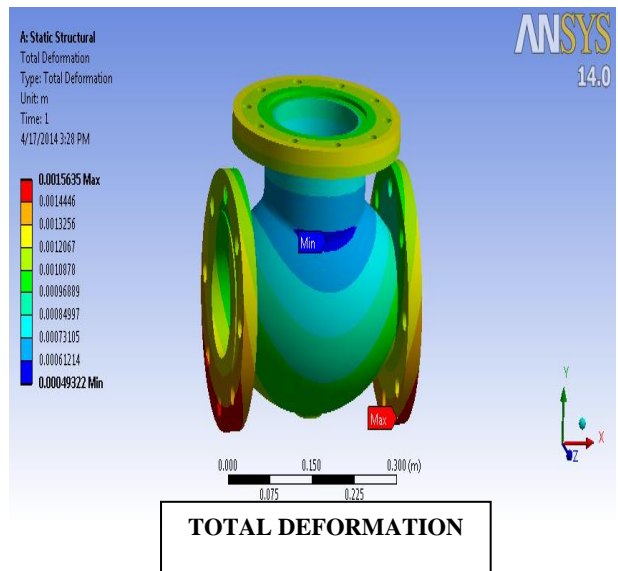


EQUIVALENT VON MESIS STRESS

RESULTS

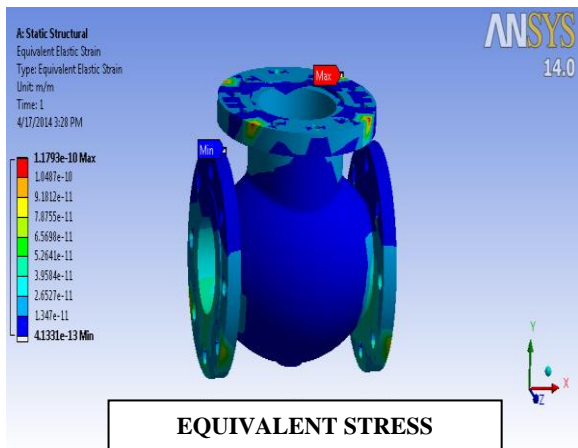


DIRECTIONAL DEFORMATION

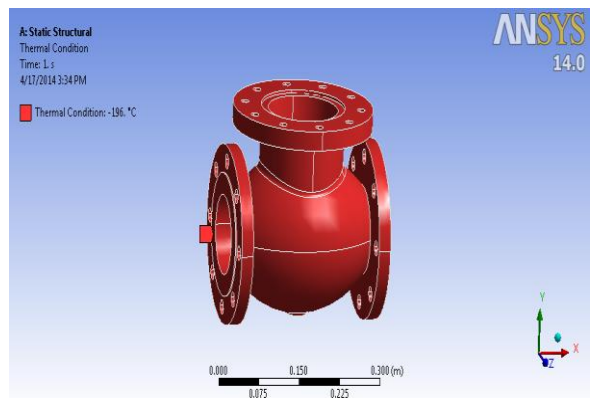


TOTAL DEFORMATION

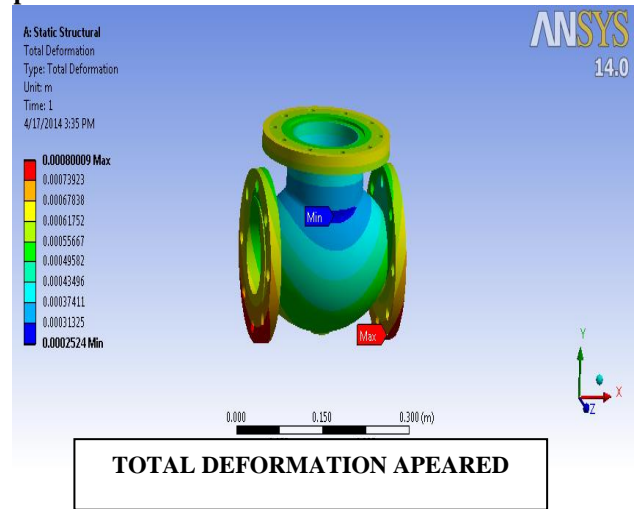
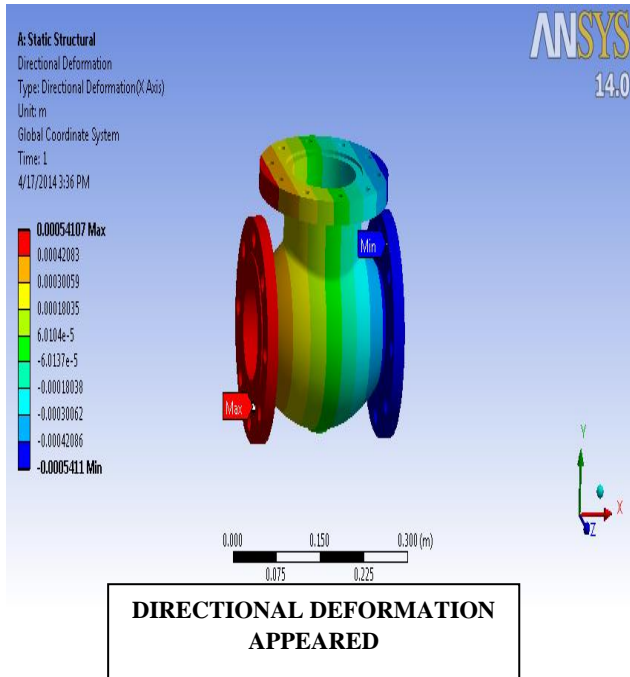
B. DURING LOWER TEMPERATURE OR CRYOGENIC TEMPERATURE CONDITIONS AT -196deg



EQUIVALENT STRESS



RESULTS



V. CONCLUSION

1. It has been shown that how FEA tools help in analyzing valve behavior in different temperature conditions
2. Behavior of stainless steel material under higher or lower temperature condition is analyzed

REFERENCES

- [1] Valve handbook by GH Pearson.
- [2] Fluids Handling Principles and practice, 2nd edition.
- [3] Schweitzer, Philip A., Handbook of Valves.
- [4] Heat Transfer, Thermodynamics and Fluid Flow Fundamentals, Columbia, MD, General Physics Corporation, Library of Congress Card #A 326517, 198

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