FINITE ELEMENT ANALYSIS FOR HYDRAULIC PRESSURE PIPING SYSTEM FOR EFFECTING DESIGN CHANGE TO CURB THE TENDENCY OF CRACK IN THE CRITICAL REGION OF CONCERN

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ABSTRACT

The high pressure line for the Press Machine connected to the Powerpack supports an internal pressure in excess of 350bar. The flow of oil as a working fluid bifurcates into two lines at the T- junction in the system. The conventional joint used for the assembly develops cracks at the junction. The problem is being investigated using computational techniques while deploying ANSYS Fluent as a Solver for CFD analysis. Upon trials and testing at the Sponsoring Company, a suitable variant of the proposed joint in the form of alternative material or alternative geometry shall be evolved over the course of this dissertation work. Stress are sought to be measured using strain gauges.

KEYWORDS – *T joint, hydraulic piping system, cracked joint, ANSYS Fluent*

I. INTRODUCTION

Pipe bursting and related techniques are well-established methods for trenchless replacement of worn out and undersized gas, water or sewer pipelines. They can offer significant potential savings and drastically reduced surface disruption to public and private utility owners under favorable conditions. The methods result in an existing pipe being replaced size-for-size or up-sized with a new pipe in the same location. The techniques are most advantageous in cost terms (1) when there are few lateral connections to be reconnected within a replacement section, (2) when the old pipe is structurally deteriorated, (3) when additional capacity is needed, and (4) when restoration/environmental mitigation requirements are onerous.

II. LITERATURE SURVEY

After Studying the Literature it can be concluded that a lot of work has been done in the field of Hydraulic piping system to avoid bursting of pipe.Xueguan Song et al(2014)studied dynamics of a direct-operated safety reliefvalve mounted on a pressure vessel by using CFD, understanding of the flow and dynamic characteristics of SRVs and Also studied dynamic events of the opening and closing process of a SRV mounted on a pressure vessel.H. Li, J. Wood et al. (2013) Investigates the ratcheting and fatigue behavior of 90degree single unreinforced mitred pipe bends subjected to a cyclic in-plane for that The Basquin-Coffin Manson equation over Predicted the fatigue life while the modified equation provided a reasonable estimation. Mihaela Eliza et al.(2012)Studied Fatigue limit assessment on seamless tubes in presence of in homogeneities: Small crack model vs. Full scaletesting experiments. Rahman Seifi, Majid Babalhavaeji(2012) investigate on bursting pressure of Autofrettagecylinders with inclined external cracks bursting pressure increases with increasing the ratio of outer to inner radius (k). I.A. Khan, P. Ahuja et al. (2011) Fracture investigations on piping system having large through-wall circumferential crack and Analysis of surface flaw that might have gone undetected in the NDT would not become through thickness during the life time of the component. T. AseerBrabin et al.(2011)used Faupel's bursting pressure formula for mild steel cylindrical vessels for predicting the burst strength of thick and thin-walled steel cylindrical vessels. ErlingOstbyAsle O. Hellesvi(2008)prepare model for Large- scale experimental investigation of the effect of biaxial loading on the deformation capacity of pipes with defects. X.K. Suna, et al. (1999) investigate the bursting problem of filament wound composite pressure vessels, The higher the strength of the composite material is, the lower the relative loading capacity of the dome is, and the relatively easier the case may burst at the dome.

Even though sufficient literature is available on piping system and bursting phenomena, no systematic study has been reported so far to correlate the FEA and CFD to avoid Bursting of pipe. Hence, in this investigation an attempt is made to develop mathematical model with analysis of pipe and it's Flow.

III. PROBLEM STATEMENT

At the forging station with over 3000 Ton of hammer load and over 350 bar pressure delivered by the power-pack system, safety and maintenance comes at the fore front. Currently, cracks are observed near the T-Joint in the piping system. The working fluid oozes out of the system through these cracks and pose a threat of jetting that can cause fatality in the vicinity.

The current remedy for filling the crack with a `weld' has not proved to be of any use. The crack re-surfaces at an adjacent location to the weld–line and the problem continues to baffle the maintenance staff. Looking into the chronic nature of the problem and the safety concern associated with the same, immediate and lasting action is sought by the management of the Company.

IV. SCOPE

While the problem is being investigated on different fronts, this dissertation work would focus on the design aspect of the `T – Joint ' or its adjacent area. The problem would be diagnosed with Analytical tools using CFD (Computational Fluid Dynamic)to model the nature of flow and the pressure exerted over the system. Possible design options would be dealt with in the context of the exact problem and the feasible solution is expected to be arrived through limited numbers of iterations. Only the critical areas of concern would be studied for the work and suitable recommendation made while concluding the work. Practicality of the recommended solution pertaining to the cost and ease of deployment would be considered while suggesting the variants for design.

V. OBJECTIVES

Benchmark the existing system by recording or analyzing (CFD) the existing structure (geometry) over the operating conditions.

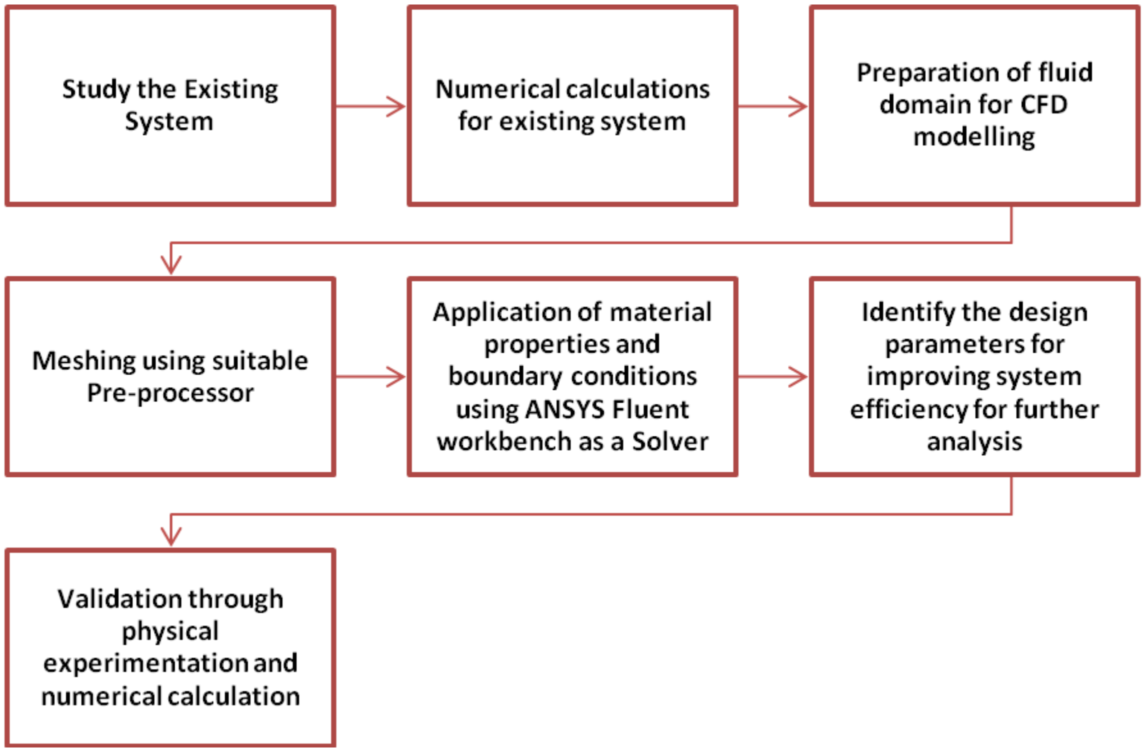
Identify suitable design parameters and assign values for iterations.

Run CFD analysis for finding solution for the variants under consideration.

Validate results with physical experimentation for one of the feasible variants (benchmark /existing)

Recommend for reinforcing new design solution.

VI. METHODOLOGY



VII. EXPERIMENTATION

The recommended solution in the `design' Domain shall be proposed to the management of the Company. The same shall be monitored and stress level recorded either over a miniature prototype or a full scale implementation at the shop floor. For scaled prototype, suitable pressure would be applied while conducting the test under controlled conditions. These conditions shall be referred to the operating conditions at the shop floor or `standard test conditions' as would be feasible for the prototype.

VIII. VALIDATION

A favorable comparison between the given methodology –namely; Analytical (computational) and the Physical Experimentation is anticipated for reinforcing the solution.
Typically, an error margin of about 5 to 20% could be accommodated in this case looking into the solution. The mathematical model would be engaged only in the preliminary investigation phase. The Analytical methodology (for CFD) shall validated by physical experimentation.

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