**INFLUENCE OF GIRTH WELD FLAW AND PIPE PARAMETERS ON THE CRITICAL LONGITUDINAL STRAIN OF STEEL PIPES**

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**ABSTRACT**

The design of steel pipelines against longitudinal loading induced by soil movement and temperature requires an understanding of the strain demand induced by the environment in comparison with the strain resistance of the pipes. Girth weld flaws have been identified as the potential location of failure under longitudinal tensile strains due to being the least ductile. Strain based design for the prediction of the longitudinal tensile strain capacity of steel pipes have been extensively studied by Wang, et al and included in the Canadian standards association code of practice CSA Z662.11. The extensive track record of tests have culminated into two sets of equations for the critical strain in girth welded pipes with surface breaking and buried defects as functions of the different pipe and flaw parameters.

The CSA Z662.11 strain capacity equations were developed using wide plate tests with the obvious limitation of the inability to consider the effect of the internal pressure of the pipe. However, recent studies by Wang et al led to the development of a new set of equations that predict the tensile strain capacity for pipes with an internal pressure factor of 0.72.

This paper analyses the two critical strain equations in CSA Z662-11 to understand the effect of different

girth weld flaw and pipe parameters on the expected behavior of pipes. Also the critical strain equations developed in (6) have been analysed and compared to the equations in CSA Z662-11. Using the equations in CSA Z662-11, a and full factorial experimental design was conducted for the planar surface-breaking defect and the planar buried defect respectively. For the case of surface breaking defects the dependence of the tensile strain capacity ( ) on apparent CTOD toughness (), ratio of defect height to pipe wall thickness (), ratio of yield strength to tensile strength () and the ratio of defect length to pipe wall thickness () has been studied. has been evaluated at the maximum, minimum and intermediate values of each parameter according to the allowable ranges given in the code which resulted in the evaluation of for 81 different combinations of the parameters. The average value of at the maximum, minimum and middle value of each parameter has been calculated. The visualization of the results showed that , and have the most significant effect on among the four parameters for the case of surface breaking defect.

Similarly for buried defects the dependence of on , , , , and the pipe wall thickness () has been studied. The evaluation of for all possible combinations of the maximum, intermediate and minimum values of the 6 parameters resulted in values for 729 different combinations. The variation of the average over the maximum, intermediate and minimum values of the parameters showed that , , and are the parameters having the greatest effect on for the case of a buried defect.

Further investigations could be carried out to determine suitable upper and lower bounds for the parameters for which no bounded range is defined in the CSA Z662-11 code.