PREDICTION OF DUCTILE FRACTURE IN NOTCHED STEEL PLATES USING SMCS METHOD

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ABSTRACT

In this paper the goal is to study where, when and how the cracks in the steel connection plate between beam and column initiate and how far would the crack continue before it fails and how to detect crack initiation and prevent the same by utilizing piezoelectric sensors. In this analysis piezoelectric is placed in line of crack propagation for sensing strain and changing it to voltage. A thin plate with edge notch which is an ideal model of typical beam to column connection is assumed. The uniaxial uniform load is applied on it. With the aid of ABAQUS software, the plate is analyzed in both elastic and plastic stages. The strain-stress curve with kinematic hardening part is considered and modeled with multi-linear method. The micromechanical based model Stress Modified Critical Strain (SMCS) model are utilized for prediction of ductile crack initiation. Based on the combined effects of the triaxiality and plastic strain, the model can capture the void growth phenomenon in steel material. The triaxiality and plastic strain for several load levels are obtained. The SMCS criterion corresponding to each load is calculated and the crack status is determined.

INTRODUCTION

THE STRESS MODIFIED CRITICAL STRAIN MODEL (SMCS)

The Stress Modified Critical Strain [SMCS] criterion provides alternative approaches for modeling Ductile Crack initiation by relating the fundamental process of void initiation, growth and coalesces to macroscopic stresses and strains, obtained using detailed finite-element models. The material-specific parameters of the SMCS model are calibrated for mild A 572 Grade 50 Steel SMCS is dependent on the evolution of two key quantities: the equivalent plastic strain ε_p, and the stress triaxiality. The stress triaxiality, $T=\frac{\sigma_m}{\sigma_e}$, is a ratio of the mean or hydrostatic stress σ_m, and the effective or von Mises stress σ_e. Building on Rice and Tracey's model for void growth (Rice and Tracey, 1969), Hancock and Mackenzie (1976) suggest that ductile crack initiation depends upon the interaction of triaxiality and the equivalent plastic strain. Specifically, this implies that a larger triaxiality will hasten the onset of fracture. Consequently,