Title:

FAST DUCTILE FRACTURE: DEPENDENCE OF PROPAGATION RESISTANCE ON CRACK VELOCITY

Introduction

Chris Bassindale is a PhD candidate in the Mechanical and Aerospace Engineering department here at Carleton studying ductile fracture in high toughness pipeline steels.

Abstract

In this paper, the effect of inertia on the steady-state velocity of a propagating crack in a modern high toughness pipeline steel was investigated. The line pipe steel examined in this work was an American Petroleum Institute (API) Standard X70 steel. A tensile plate model, simplified from the geometry of a pipe, was studied using the finite element code ABAQUS 6.14-2. The cohesive zone model (CZM) was used to simulate crack propagation. The CZM parameters were calibrated based on matching the crack tip opening angle (CTOA) measured from a drop-weight tear test (DWTT) finite element model to the experimental CTOA of the material. The CZM parameters were then applied to the tensile plate model. The effect of inertia on the steady-state crack velocity was systematically assessed by altering the density of the material used with the plate model. To isolate the influence of inertia, the effect of strain rate on the fracture process and material plasticity was neglected. The results of this study demonstrate that the steady-state crack velocity was affected by the density of the material. The steady-state crack velocity was reduced with increasing mass density, as demonstrated by the effect of backfill. Furthermore, it was shown that the CTOA extracted from the CZ model was not affected by the density of the model.