Ref.: IIIj03-002

Assessment of the von Mises stresses and stress triaxiality in notches using modified tensile specimens

Apresentador: Letícia dos Santos Pereira

Autores (Instituição): Pereira, L.d.(IPEN-CNEN/SP); Donato, G.H.(Centro Universitário FEI); Mattar Neto, M.(IPEN-CNEN/SP);

Resumo:
Stress triaxiality is important in fracture mechanics to check the safety of several structures. Stress triaxiality is one of the main factors that influence the fracture process of high toughness steels. For example, a ductile fracture tends to be more predominant for a low constrain geometry with less plastic restriction. The configuration and loading of the structural components are different from those of the mechanical test specimens used to obtain the materials fracture properties. So, understanding the local stress triaxiality is essential to ensure structural safety. Combination of tests with numerical simulations is a way to assess this effect. Modifying the standard tensile test geometry (ASTM E8) with a notch causes a change in the stress triaxiality. Based on the literature information, two notches were chosen: 1 and 2 mm. These geometries were tested, and the results were numerically reproduced using a non-linear model with the GTN damage model in the software Abaqus/Explicit 2020. The properties (elastic and plastic) were obtained from the standard specimen. An axisymmetric finite element model was developed considering the symmetry in the specimen longitudinal direction, and a mesh with the smallest element having the dimensions of 0.2x0.4 mm. First, a test speed of 0.015 mm/s was applied in the specimen longitudinal direction and convergence problems occurred. Thus, the speed was increased to 100 mm/s to solve these problems. Finally, the nine GTN damage parameters were calibrated to describe numerically the experimental curve. The stresses were obtained for the centroid of the elements. All the analyses were done for two points, i.e.,. first is the plastic instability point for a standard specimen, and second is the maximum force of the load vs. displacement curve. The numerical results analysis allowed the assessment of the stress field and stress triaxiality near the notch to compare with the standard specimen. The notch influences the stress locally, but, after a short distance, approximately 45 mm in these specimens, the tendency was the same for three geometries. The evaluation of the triaxiality considered the stress in the specimen longitudinal direction and the hydrostatic stress. Before the point of plastic instability (first point), the stress triaxiality is low, practically an uniaxial stress state. To the second point, the stress state is no longer uniaxial. The notch increases the stress triaxiality across the cross-section, and the biggest value occurred in the center of the specimen. These specimens results can help to identify the region affected by the notches in structural components.