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Biaxial Fatigue Analysis of 30NiCrV12 steel circular specimens in the presence of sharp notch and variable torsional/axial stress ratios

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Fatigue under multiaxial loads has been studied in a very large number of research publications; the present work is focused on biaxial fatigue behavior of constant amplitude loading on 30NiCrV12 steel circular specimens, a class of high-strength steel widely with good performance in terms of strength, toughness and ductility, used in power train shafts, train applications and military vehicles. Two sharp and rounded notch geometries with respect to smooth conditions are investigated.
Proportional axial and torsional loads are mainly considered for fatigue limit determination and behavior of crack growth evolution. A proposed model for Biaxial Fatigue Analysis is implemented and compared to other methods in case of full elastic deformations, but the transition from the elastic strain conditions to a certain amount of plastic strain occurrence in the loading cycle is possibly considered for the fatigue life curve shape, since the material capabilities are often extend to maximized load levels for particular applications. The effects of the stress state and strain distribution will be analyzed and numerically simulated. more repetitions of the fatigue tests will give more accurate values for the amount of work introduced to the material as function of different biaxiality conditions and several reliable methods are already established, such as critical plane methods, well known Chaboche model and the theory of critical distances, in order to predict the fatigue life and cracking orientation of rupture; it is also well known that good results at low life cycles are obtained with better results with one method, but at high life cycle different approaches are better. In this work, the prediction under imposed stress will be investigated by the fixation of a stress and the modification of another, in a range of predetermined stress intervals; more experiments will possibly be done by inducing non-zero mean stress, to evaluate the effect on fatigue curve and the reliability of data elaboration methods, taking into account the notch severity. Finally, the effect of the loading sequence may be developed in the future for the same specimens, based on the actual results.

Autori principali: PANELLA, Francesco Willem; Dr. CALABRESE, Maurizio (Università del Salento); NOBILE, Riccardo (Università del Salento)

Relatori: PANELLA, Francesco Willem; NOBILE, Riccardo (Università del Salento)

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