The Effect of Normal Stress and Shear Stress on Critical Plane in Biaxial Fatigue Loading

S.A.N. Mohamed¹ --- S. Abdullah² --- A. Arifin³ --- A. K. Ariffin⁴

¹,²,³,⁴ Department of Mechanical and Materials Engineering, University Kebangsaan Malaysia, Selangor, Malaysia

Abstract

The critical evaluation of fatigue failure subjected to multiaxial loading is been considered in many engineering automotive components such as axles, crankshafts, and connecting rod. The uniaxial fatigue is different from multiaxial fatigue because of the complex stress acting on activated plane that contribute to the structure failure.

In the present study, a detailed analysis of biaxial (tension/torsion) fatigue for medium carbon steel is presented. A new assessment on the critical plane that containing the greatest amount of damage parameter is proposed. Specific attention is given to show the dominant stress acting on the critical plane using the graphical visualization on the Mohr’s circle.

A solid smooth specimen is undergone the cyclic fatigue tests under constant amplitude biaxial loading using the servo-hydraulic biaxial fatigue test machine. Different loads from 0.5Su, 0.6Su, 0.7Su, 0.8Su, and 0.9Su are applied to find the effect of the loads to the maximum value of principle normal stress and maximum shear stress that acting to the critical plane due to loading and unloading condition. Thus, the relationship showed the increasing of loads applied gives the incremental trend on the maximum principle normal stress from 612 MPa to 767 MPa and maximum shear stress values from 457 MPa to 486 MPa. The results attempt to indicate that the principle normal stress significantly dominant to the biaxial fatigue failure.

Keywords: fatigue, steel, stress