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Photoelastic Analysis and Finite Elements Analysis of a Stress Field Developed in a Double Edge Notched Specimen

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Abstract : Finite elements analysis and photoelasticity are used to determine the stress field developed in a double edge notched specimen loaded in tension. The specimen is cut in a birefringent plate. Experimental isochromatic fringes are obtained with circularly polarized light on the analyzer of a regular polariscope. The fringes represent the loci of points of equal maximum shear stress. In order to obtain the stress values corresponding to the fringe orders recorded in the notched specimen, particularly in the neighborhood of the notches, a calibrating disc made of the same material is loaded in compression along its diameter in order to determine the photoelastic fringe value. This fringe value is also used in the finite elements solution in order to obtain the simulated photoelastic fringes, the isochromatics as well as the isoclinics. A color scale is used by the software to represent the simulated fringes on the whole model. The stress concentration factor can be readily obtained at the notches. Good agreements are obtained between the experimental and the simulated fringe patterns and between the graphs of the shear stress particularly in the neighborhood of the notches. The purpose in this paper is to show that one can obtain rapidly and accurately, by the finite element analysis, the isochromatic and the isoclinic fringe patterns in a stressed model as the experimental procedure can be time consuming. Stress fields can therefore be analyzed in three dimensional models as long as the meshing and the limit conditions are properly set in the program.

Keywords : isochromatic fringe, isoclinic fringe, photoelasticity, stress concentration factor
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