FINITE ELEMENT MODELING OF STEPPED DOUBLE TORSION FRACTURE TOUGHNESS SPECIMEN

By

Abd Allah Shokry Mahmoud Ali

B.Sc. Mechanical Engineering
Cairo University

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE

In

MECHANICAL DESIGN AND PRODUCTION

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Under the Supervision of

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Approved by the
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To my wife
To my mother
To my daughter

ABSTRACT

The double torsion test has been widely used to investigate the brittle fracture behavior for metallic and non-metallic materials. The advantages of using double torsion test than the ASTM standardized test, that it requires only a very simple specimen configurations, eliminating the need for expensive and time-consuming specimen machining operations, and that it eliminates the need for pre-cracking by fatigue or wedge-opening. Investigators studied the factors affecting fracture toughness of double torsion test specimen, the fracture thickness is found to be the main parameter governing the fracture toughness values.

The present work aims to perform an accurate, three-dimensional finite element modeling of realistic specimens, to determine the effect of the fracture thickness on the fracture toughness of gray cast iron, and to reach the effective thickness of the DT test specimen using: first, the plain double torsion test specimens, second, new step specimens which have more than one side groove fracture thickness (3-step DT specimens, 5-step DT specimens).

The results obtained by the finite element modeling for plain DT specimens test and new step DT specimens test compared with an experimental study made by Ghada Essa (2006). The results obtained by the finite element modeling of plain DT test specimens need to comment, but the results obtained by the finite element modeling of 3-step DT test specimens and 5-step DT test specimens give a good agreement with that obtained by Ghada Essa (2006), and give the same phenomena obtained by another ASTM standardized test.