

ห้องสมุดงานวิจัย สำนักงานคณะกรรมการวิจัยแห่งชาติ



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ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย



INFLUENCE OF THICKNESS ON DISTRIBUTION OF STRESS INTENSITY FACTORS

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A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Engineering Program in Civil Engineering

Department of Civil Engineering

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วิทยานิพนธ์ฉบับนี้นำเสนอผลการศึกษาค่าอิทธิพลของความหนาของชิ้นส่วนทดสอบแบบ CT ที่มีต่อการกระจายตัวของตัวประกอบความเข้มของความเค้นแบบเปิดตามขอบของรอยแตกร้าว โดยทำการจำลองชิ้นส่วนทดสอบ CT แบบสามมิติที่มีความหนาต่างๆกัน เพื่อให้สามารถคำนวณค่าตัวประกอบความเข้มของความเค้นที่จุดต่างๆตลอดขอบรอยแตกร้าวได้ ข้อมูลดังกล่าวนี้ทำให้ทราบพฤติกรรมบริเวณที่ใกล้กับจุดที่ขอบรอยแตกร้าวตัดกับผิวของชิ้นส่วนทดสอบซึ่งค่าตัวประกอบความเข้มของความเค้นมีอัตราการเปลี่ยนแปลงสูง และทราบความกว้างของขอบรอยแตกร้าวที่มีค่าตัวประกอบความเข้มของความเค้นค่อนข้างคงที่หรือมีพฤติกรรมความเครียดแบบระนาบสำหรับชิ้นส่วนทดสอบที่มีความหนาต่างๆกัน การวิเคราะห์ปัญหาการรอยแตกร้าวแบบสามมิติใช้ระเบียบวิธีปาวดาร์เอลิเมนต์แบบสมมาตรของกาเลอร์คินชนิดเอกฐานอย่างอ่อน ซึ่งเป็นระเบียบวิธีเชิงตัวเลขที่นิยมใช้ในการแก้ปัญหาการรอยแตกร้าวซึ่งให้ผลเฉลยเชิงตัวเลขที่มีความถูกต้องสูงและประหยัดค่าใช้จ่ายในการคำนวณ สมการกำกับเชิงปริพันธ์เกี่ยวข้องเฉพาะพื้นผิวของชิ้นส่วนที่ทำการจำลองเท่านั้น ดังนั้นจำเป็นต้องสร้างโครงตาข่ายสำหรับการประมาณผลเฉลยเฉพาะบริเวณผิวของชิ้นส่วนทดสอบและผิวของรอยแตกร้าวเท่านั้น นอกจากนี้ชิ้นส่วนพิเศษได้ถูกนำมาใช้สำหรับจำลองพฤติกรรมบริเวณขอบรอยแตกร้าวเพื่อให้สามารถคำนวณค่าตัวประกอบความเข้มของความเค้นได้สะดวกและมีความถูกต้องมากยิ่งขึ้นแม้ว่าชิ้นส่วนพิเศษที่ใช้จะมีขนาดค่อนข้างใหญ่ก็ตาม วิทยานิพนธ์ฉบับนี้นำเสนอและสรุปผลที่ได้จากการศึกษาชิ้นส่วนทดสอบ CT ทั้งในกรณีที่ทำมาจากวัสดุยืดหยุ่นเชิงเส้นประเภทไอโซโทรปิกและประเภททรานเวอร์สไอโซโทรปิก

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This thesis offers an extensive investigation of the influence of specimen thickness on the distribution of the mode-I stress intensity factor (SIF) along the fracture front of the compact tension specimen. The analysis is carried out in a fully 3D context and the characteristic of the SIF-distribution and width of the layer in the vicinity of surface breaking points where the stress intensity factor exhibits rapid variation and the layer where the SIF is nearly constant are thoroughly examined for various thicknesses of testing specimens. In the modeling, a well-known numerical technique, called a weakly-singular symmetric Galerkin boundary element method (SGBEM), is employed. The most attractive features of this technique include that the mesh generation cost is comparatively cheap since only 2D discretization on the outer boundary of the specimen and on the fracture surface is required and the calculated stress intensity factor along the fracture front is highly accurate with use of relatively coarse mesh. The latter feature results from applications of high order, special crack-tip elements in the local region surrounding the fracture front along with the use of a direct formula to extract the SIF. Extensive results are reported and discussed for specimens made from both isotropic and transversely isotropic materials.

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Student's Signature

Advisor's Signature

The image shows two handwritten signatures in black ink. The top signature is more stylized and appears to be the student's signature. The bottom signature is more legible and appears to be the advisor's signature.

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