UNIVERSITI PUTRA MALAYSIA

STRESS ANALYSIS AND THE INTERACTION BETWEEN HOLE AND STRAIGHT CRACK IN PLANE ELASTICITY

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STRESS ANALYSIS AND THE INTERACTION BETWEEN HOLE AND STRAIGHT CRACK IN PLANE ELASTICITY

By

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Chair: Assc. Prof. Nik Mohd Asri Nik Long, PhD

Faculty: Science

Using complex variable methods, some criteria for homothetic transformation and rotation in an infinite plane elasticity are established. Maclaurin series is used to analyze the stresses when the pressure exerted on half plane is of the class $L^1(-\infty, \infty)$. A vibration pressure on the edge of half plane is also considered and the stresses at every point on the half plane is obtained. The problems of two dimensional hole subjected to infinite plane elasticity are considered. These mechanical problems can be written in terms of mathematical boundary value problems. The holes are mapped onto a unit circle by a rational function, then the relevant boundary value problems are solved using modified complex potential (MCP). Analytical results for the stress intensity factor and displacement functions for hypocycloid holes are presented. A circular hole in infinite plane elasticity with a single straight crack outside the circle is considered. Crack opening displacement and stress intensity factor for the mentioned crack are found. Family of hypocycloid hole is considered in an infinite plane elasticity. The stress intensity factor at the cusp points and the displacement functions are obtained. Then a straight crack is considered

outside of the hypocycloid hole. Stresses are obtained at every point outside the hole using the two Muskhelishvili complex potentials.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

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Menggunakan kaedah pembolehubah kompleks, beberapa kriteria untuk transformasi homotetik dan putaran dalam satah anjal tak terhingga diterbitkan. Siri Maclaurin digunakan untuk menganalisis regangan apabila tekanan dikenakan ke atas satah separuh adalah dari kelas $L^1(-\infty, \infty)$. Tekanan bergetar ke atas sisi satah separuh juga dipertimbangkan dan regangan pada setiap titik atas satah separuh diperolehi. Masalah lubang dua dimensi tertakluk kepada satah anjal tak terhingga dipertimbangkan. Masalah mekanikal ini boleh ditulis dalam bentuk masalah nilai sempadan bermatematik. Lubang dipetakan ke atas bulatan unit oleh fungsi nisbah, kemudian masalah berkaitan nilai sempadan diselesaikan menggunakan potensi kompleks terubah (MCP). Keputusan beranalisis untuk faktor keamatan regangan dan fungsi sesaran untuk lubang hiposikloid dibentangkan. Satu lubang bulat di dalam satah anjal tak terhingga dengan satu rekahan lurus di luar bulatan dipertimbangkan. Sesaran bukaan dan faktor keamatan regangan untuk rekahan tersebut ditemui. Famili lubang hiposikloid dipertimbangkan dalam satah anjal tak terhingga. Faktor keamatan regangan pada titik bucu dan fungsi sesaran dipovolehi. Kemudian satu rekahan lurus dipertimbangkan di luar lubang hiposikloid. Regangan

diperolehi pada setiap titik di luar lubang menggunakan dua potensi kompleks Muskhelishvili.

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This thesis is the result of almost three and a half years of hard work where I have been accompanied by some people. I now have the pleasant opportunity to express my gratitude to all of them.

I certify that a Thesis Examination Committee has met on 28th March 2011 to conduct the final examination of **Mohammad Yaghobifar** on his thesis entitled "**Stress analysis and the interaction between hole and straight crack in plane elasticity**" in accordance with Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

MOHAMMAD YAGHOBIFAR

Date: 28 March 2011

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