邊界元素法 Fall 1997

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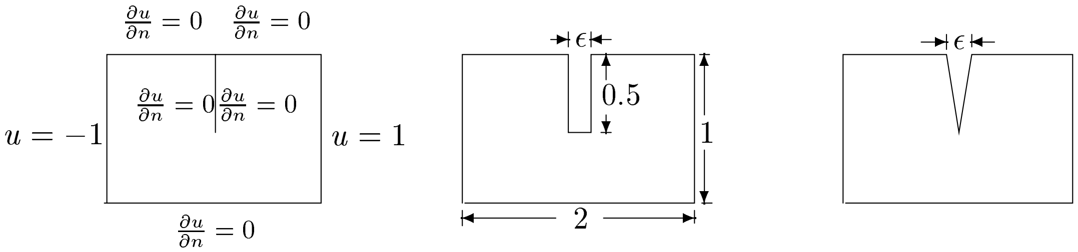
習題 4.1: BEPO2D 程式實例演練 1



(a)degenerate　(b)nondegenerate　(c)nondegenerate

(1) Problem statement

G.E.

$$\nabla^2 u(x,y) = 0 \qquad \forall (x,y) \in D,$$

B.C. as shown in the figure.

(2) Solve $u(x,y)$ for case (a) by the dual BEM.

(3) Solve $u(x,y)$ for case (b) and (c) by the UV and by the LM method,

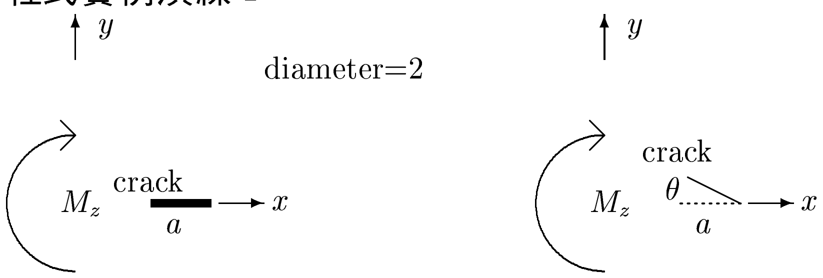
(4) Discuss the results due to the change of ε and compare with the dual BEM.

References

[1] J. T. Chen, H. K. Hong and Chyuan, S. W., Boundary Element Analysis and Design in Seepage Flow Problems with Sheetpiles. *Finite Elements in Analysis and Design*, **17**, 1-20, (1994).

[2] O. E. Lafe, J. S. Montes, A. H. D. Cheng, J. A. Liggett and P. L-F. Liu, Singularity in Darcy Flow Through Porous Media, *J. Hydraul. Div. ASCE*, **106**, HY6, pp. 977-997, 1980.

習題 4.2: BEPO2D 程式實例演練 2



symmetric case　　　　　　unsymmetric case

(1) Problem statement:

$$G.E. \quad \nabla^2 \Psi(x,y) = 2 \qquad \forall (x,y) \in D,$$

$$B.C. \quad \Psi(x,y) = 0 \qquad \forall (x,y) \in \partial D.$$

(2) By a change of variables, the problem becomes

$$G.E. \quad \nabla^2 \Psi^*(x,y) = 0 \qquad \forall (x,y) \in D,$$

$$B.C. \quad \Psi^*(x,y) = (x^2+y^2)/2 \qquad \forall (x,y) \in \partial D,$$

where $\Psi = \Psi^* - (x^2+y^2)/2$

(3) Solve Ψ^* by the dual BEM.
(4) Solve the stress functions Ψ from Ψ^*.
(5) Determine the torsion by

$$M_z = \iint_A (x\tau_{yz} - y\tau_{zx})dxdy,$$

where $\tau_{yz} = -\alpha G \frac{\partial \Psi}{\partial x}, \quad \tau_{zx} = \alpha G \frac{\partial \Psi}{\partial y}$

G: shear modulus, α : the twist angle per unit length.

(6) Vary the crack length a, and construct the curve of M_z versus $a(0 < a < 2)$.
(7) Vary the crack angle θ, and construct the curve of M_z versus $\theta(-45^o \sim 45^o)$.
(8) Compare the results with the following analytical solutions for Ψ and T:

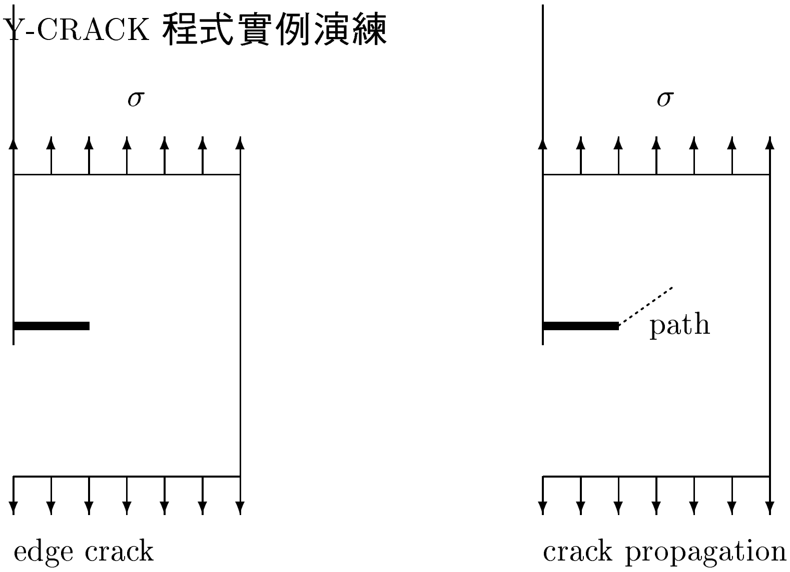
$$\Psi(r,\phi) = 32\frac{a^2}{\pi}\sum_{n=0}^{\infty}\frac{(\frac{r}{a})^{(2n+1)/2} - (\frac{r}{a})^2}{(2n+1)[16-(2n+1)^2]} sin\frac{(2n+1)\phi}{2}, \quad T = 0.878Ga^4\theta.$$

The torsional rigidity C $(= G\pi a^4/2$ for circle) is

$$C = Ga^4\{\frac{512}{\pi}\sum_{n=0}^{\infty}\frac{1}{(2n+1)^2(2n+5)[16-(2n+1)^2]} - \frac{\pi}{2}\} = 0.878Ga^4$$

(9) Show the BEM mesh, stress distribution and deformed shape.

習題 4.3: BEASY-CRACK **程式實例演練**



(1) Find the stress intensity factor(K_I) for the edge crack problem by the dual BEM.

(2) Predict the path of crack propagation under fatigue loading.

(3) Please show

(i) BEM mesh.

(ii) Constraint (boundary condition).

(iii) Deformed plot.

(iv) Some interior points.

(v) Max and min principal stress plot on undeformed geometry.

(vi) Max and min principal stress plot on deformed geometry.

(vii) The path of crack propagation.

繳交日期: 1998 年 1 月 13 日 (附磁片, 內含輸入資料、輸出資料各檔)

Easy manual of BEASY-CRACK

(1) 準備輸入檔, 如EXP1.

(2) 執行 BEGEN.EXE, 可得幾何資料檔 (檔名自行輸入),

(3) 執行 BEPLT.EXE, 可得爆炸網格圖 (HPMSH1.PLT) 和網格配置圖 (HPMSH2.PLT),

(4) 執行 CRACKER4.EXE, 可得分析結果資料檔 (檔名自行輸入),

(5) 執行 BEPLT.EXE, 可得變形圖 (HPMSH3.PLT), 主應力分佈圖畫在未變形位置 (HPMSH4.PLT) 和主應力分佈圖畫在變形位置 (HPMSH5.PLT),

(6) 執行 CPATH.EXE, 可得裂縫成長軌跡圖 (CPATH.PLT)。