Crack interacting with an individual hole by the fracture criterion of configurational force

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Abstract

The material configurational forces plays an important role in fracture and damage mechanics[1]-[7]. The configurational force is able to provide the information from the macroscopic perspective, suggesting a method on predicting the crack propagation. In this paper, we will study the problem based on the configurational-force fracture criterion. The fracture criterion based on the resultant of configurational forces assumes that the crack begins to extend when the resultant of configurational forces reaches a critical value, and the direction of the crack propagation is in the direction of resultant configurational forces[8].

Moreover, the crack interacting with an individual hole is studied by the fracture criterion of configurational force where the problem of fracturing with holes is very common in engineering. Based on the C-force criterion, a finite element method is developed to simulate the crack propagation interaction with holes, and the crack propagation is simulated to verify the accuracy of the computational methods. The practical application of fracture criterion based on the configuration force is developed, and numerical simulation of the crack interacting with the single hole is carried out. The crack propagation is simulated where an individual hole is located at various angle with the crack as shown in Fig.2a. The significant influence of single hole on the crack growth is discussed. The results show that the effects of the hole on the crack propagation can be divided into three types. That is, i) the crack propagation is almost free from the influence of the single void.(see Fig.2f, Fig.2g, Fig.2h). ii) the crack propagation is promoted by the single hole(see Fig.2b, Fig.2c, Fig.2d). iii). the crack propagation is suppressed (see Fig.2e). Particularly, some intuiting results are found when the hole is located at 45 degree with the crack. the resultant of C-force as shown in Fig.3 This demonstrates that the hole suppresses the crack growth.

It has important guiding significance to the fracture problem in engineering.

Keywords: Configurational force; Fracture criterion; Numerical simulation; Crack propagation; Hole

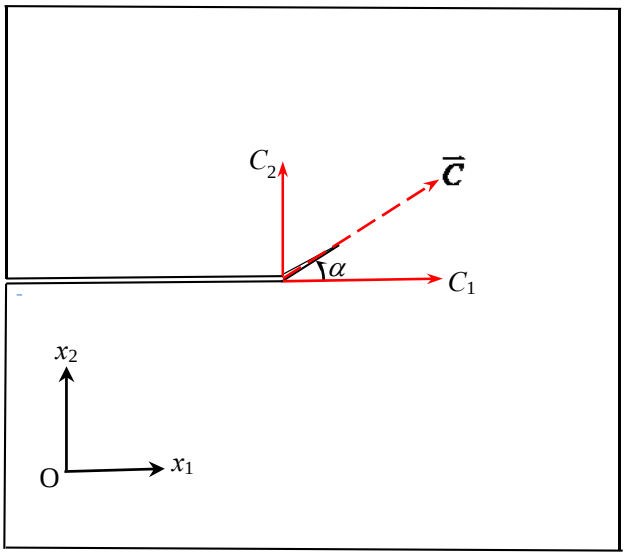
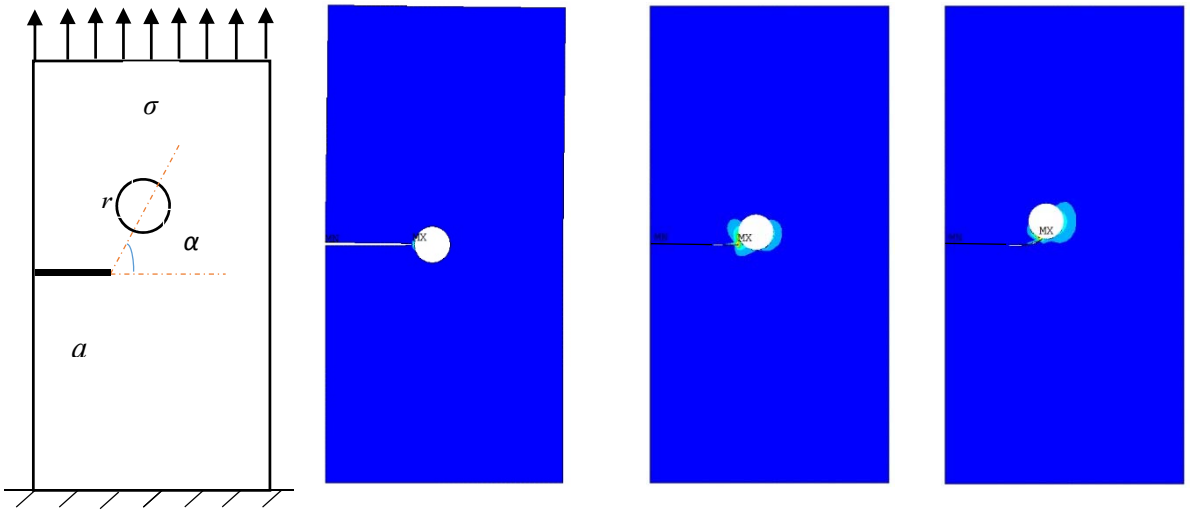
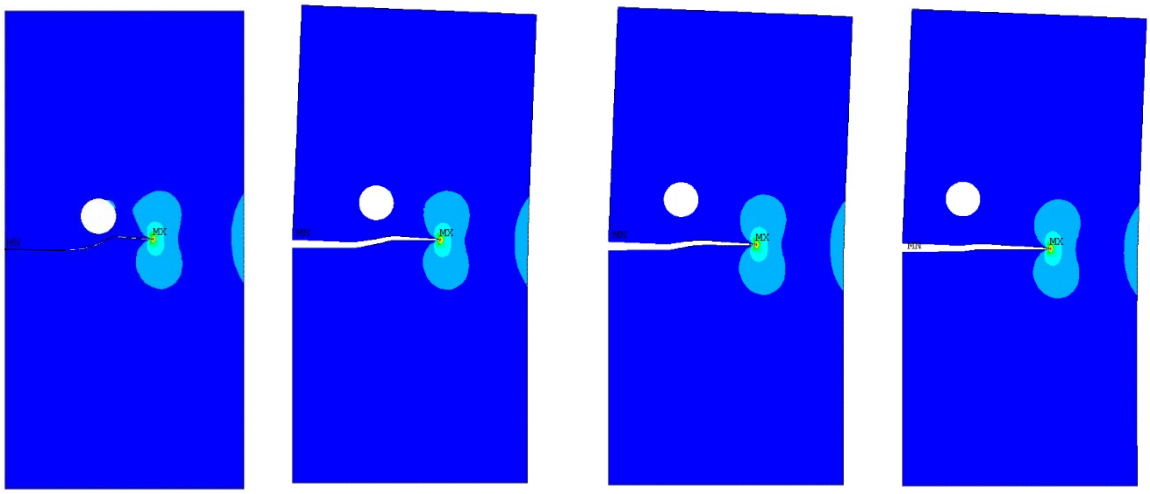


Figure 1. Fracture criterion by the configurational force (C-force)



(a) (b) (c) (d)



(e) (f) (g) (h)

Figure 2. Crack growth trajectory for a crack with a hole obtained by C-force criterion under different angle α (a) Schematic of crack interaction with hole; (b) α=0° (c) α=15° (d) α=30° (e) α=45° (f) α=60° (g) α=75° (h) α=90°

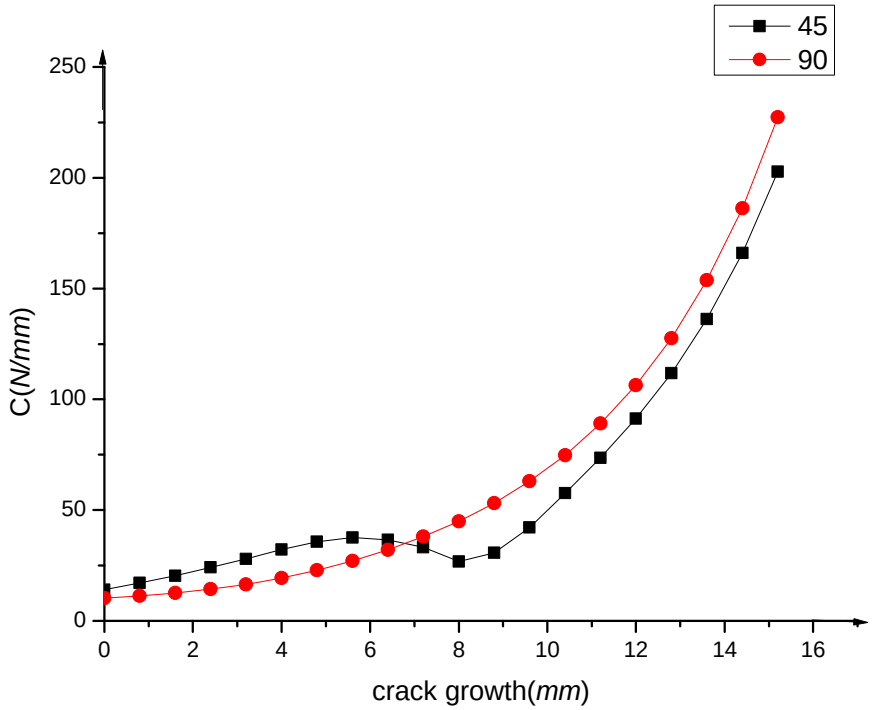


Figure 3. The variation of the resultant of configurational force with crack propagation at α=45° and 90°

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