Topic: Crack Propagation

Synthesising information from different sources

The following excerpts contain information on the topic of Crack Propagation. Read them carefully and:

- **Using information from all five excerpts, write a paragraph of 140 words (not less than 110 and not more than 160) discussing the most important features of Crack Propagation.**

You must:

- **Use information from all sources.**
- **Cite your sources appropriately.**
- **Paraphrase and summarise appropriately! You must not plagiarise!**

Excerpt 1

Crack propagation in concrete is known to be very complex, as is fully understanding its behavior and mechanisms. Crack distribution expands widely due to the existence of aggregate in concrete compared with other brittle materials such as glass. When a crack propagates in concrete, an evolutional area of micro-cracks is developed and observed ahead of the crack tip. The area is well known as the fracture process zone (FPZ), as the existence of FPZ causes the size effect in concrete.
Currently, in the fracture mechanics of concrete, the fracture energy is a key issue for the size effect and prediction of crack propagation. It is well known that the fracture energy varies with the specimen size and geometry even if the proportion and materials of concrete are the same. In addition, development and size of the FPZ play an important role in estimating the fracture energy in concrete.
1. Ono K. Identification of the fracture process zone in concrete materials by acoustic emission. In *Acoustic Emission and* Related Non-Destructive Evaluation Techniques in the Fracture Mechanics of Concrete, 2nd ed.; Ohtsu M., Ed.; Butterworth-Heineman: Oxford, 2021, pp. 49-64.

Excerpt 2

Low temperature crack propagation is a complex embrittlement phenomenon where hydrogen dissolved in the alloy from manufacturing, generated near the crack tip during aqueous corrosion, and gaseous hydrogen present in the environment can interact with sharp, crack-like defects and severely degrade the fracture toughness and tearing resistance of nickel-based alloys. Nickel alloys with high hydrogen solubility, high yield strength, strong grain boundary trapping sites, and segregation of metalloid elements to the grain boundaries are most susceptible to LTCP. Embrittlement is promoted as the concentration of gaseous hydrogen in the environment is increased and by low temperatures (typically < 150 °C).
2. Young G.A.; Richey E.; Morton D. S. Hydrogen embrittlement in nuclear power systems In *Gaseous Hydrogen Embrittlement of Materials in Energy Technologies: The Problem, its Characterisation and Effects on Particular Alloy Classes*; Gangloff R. P.; Somerday B. P., Eds.; Woodhead Publishing: Cambridge, UK, 2012; pp. 149-176

Excerpt 3

In contrast to the traditional stress–life and strain–life approaches to fatigue, cracks are assumed to exist in materials and structures within the context of fracture mechanics. Fracture parameters can be used to characterize the stresses and strains near the crack tips. A fundamental understanding of fracture mechanics and the limit of using the fracture parameters is needed for appropriate applications of fracture mechanics to model fatigue crack propagation.
3. Lee Y. L. *Fatigue testing and analysis : theory and* practice; Burlington, Mass.:Elsevier Butterworth-Heinemann, 2005.