

PROCEEDINGS

Study on Crack Propagation Behavior of Concrete with Water Fracture Interactions

Wenhu Zhao^{1,2,*}, Chengbin Du² and Xiaocui Chen²

¹School of Infrastructure Engineering, Nanchang University, Nanchang, 330031, China

²College of Mechanics and Materials, Hohai University, Nanjing, 211100, China

*Corresponding Author: Wenhu Zhao. Email: whzhao@ncu.edu.cn

ABSTRACT

Concrete structures such as offshore platforms, costal and port structures, dams, etc., are often submerged in water [1]. The water within concrete pores or cracks has a great influence on crack propagation behavior [2,3]. Several wedge-splitting experiments of compact specimens are conducted with a designed sealing device to study the water effects on concrete crack propagation. Different water pressures and different loading rates are considered loading on the pre-crack surfaces and waterproof strain gauges are stuck along the crack path to observe the fracture process during the experiments. Water pressure values on crack surfaces are recorded by diffused silicon water pressure sensors via the precast holes. The results show that the water pressure on crack surfaces accelerates the crack propagation of the concrete. The critical value of the splitting force decreases in a shape of exponential curve with the increase in the external applied water pressure. The hydraulic crack propagation speed increases at the beginning and tends to reach a peak value finally. Under larger loading rate, the water fails to fill the crack and only the trapped water interacts with the crack surface. The water pressure is mainly a parabolic curve distribution along the crack path and the peak value decreases with the increases in the crack length. The effect of the water fracture interactions in concrete is severe in fast loading conditions rather than in quasi-static conditions during crack sudden opening.

KEYWORDS

Concrete; crack propagation; water pressure distribution; hydraulic loading; wedge splitting

Funding Statement: This work was supported by the National Natural Science Foundation of China (Grant No. 52109152) and Jiangxi Provincial Natural Science Foundation (Grant No. 20232BAB214086).

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

References

1. Wang, Y., Jia, J. (2017). Experimental study on the influence of hydraulic fracturing on high concrete gravity dams. *Engineering Structures*, 132, 508-517.
2. Slowik, V., Saouma, V.E. (2000). Water pressure in propagating concrete cracks. *Journal of Structural Engineering*, 126(2), 235-242.
3. Tian, Y., Zhao, X., Zhou, J., Nie, Y. (2022). Investigation on the influence of high-pressure water environment on fracture performance of concrete. *Construction and Building Materials*, 341, 127907.



This work is licensed under a Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.