Failure Mechanism Analysis of Circular Cfrp Components Under Unequal Impact Load

Liu Yanhui[1], Khalil AL-Bukhaiti[1,*], Zhao Shichun[1], Hussein Abas[1], Xu Nan[1], Yang Lang[1], Yan Xing Yu[1], and Han Daguang[2]

1 Southwest Jiaotong University, Chengdu, Sichuan, China

2 Art and Design Oslo Metropolitan University, Oslo, Norway

Contact: eng.khalil670@hotmail.com

Abstract

This paper investigates the responses of circular CFRP-RC components when subjected to an asymmetrical impact force. The impact performance of CFRP-RC components was investigated using drop-hammer impact test equipment. The failure mechanism and dynamic response properties of the CFRP-RC components were considered critical to obtaining. Three specimens were used in the experiments. The specimen's crack propagation pattern, failure mechanism, impact force, and deflection time history curves are all obtained. The test results indicate that shear fractures occur between the impact point and the adjacent support. The failure mode of reinforced concrete components transforms from bending to shear related to the unequal span impact load. A finite element modeling method was proposed and demonstrated efficiently. The control variables were used to analyze the failure mode and mechanism. Once the impact velocity or the number of CFRP layers decreases, the component fails in shear rather than bending. During an impact load, the internal force distribution of components differs significantly from that of a static load. The mechanical properties and failure mechanisms of CFRP-RC components are investigated using test and FE analysis. The failure modes of the components and the distribution and development of bending moments, shear forces, reinforcing strain, and energy consumption are all investigated.

Keywords: static load; bending failure; FE analysis; failure mode; shear crack; energy dissipation; impact velocity; unequal span; bearing capacity.

1 Introduction

Whether it is the past "iron engineering foundation"-railways, highways, airports, ports, water conservancy facilities, and other construction projects, or by 2022, "new infrastructure" including high-speed intercity railways and intercity rail transit, infrastructure construction plays an important basic role in the process of the world's economic development. The emergence of infrastructure has provided great convenience for human activities and improved people's living and working environment. However, at the same time, the destruction and failure of infrastructure under natural or man-made disasters seriously threaten human life and property safety and stability. When an accident occurs, the impact is impressive with its destructive power, and once it occurs, it will cause huge economic losses and casualties, which arouses people's attention. In recent years, many shock accidents have caused RC structural members relatively bad social impacts. In recent years, many shock accidents have caused relatively destructive social impacts. Reinforced concrete (RC) structure is one of the most commonly used structural forms. These RC structures may face various impact problems during their life cycle, such as impact

https://doi.org/10.2749/nanjing.2022.1668
Distributed by structurae