Experimental and numerical study on unequal lateral impact behavior of Circular RC and CFRPRC components

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Abstract

The dynamic response of Reinforced Concrete (RC) and Carbon Fiber Reinforced Polymers with Reinforced Concrete (CFRPRC) is studied. These tests were performed on RC members covered in one to six layers of CFRP. Once the energy is high, the two components' deflection-time histories are produced. It increases component impact resistance in studies. Component deflection is reduced by carbon fiber reinforced polymer (CFRP). RC members shear while CFRPRC components bend due to significant concrete damage. It fractures more easily when wrapped with CFRP. The model's predictions match the tests adequately. A numerical simulation study looked at the impact force of members under unequal-span lateral collisions. Regardless of impact velocity, lateral impact on an unequal span induces severe shear failure of RC members. However, CFRPRC component bending deformation reflects impact velocity. Increasing the reinforcement ratio of RC members has little effect on the impact resistance of CFRPRC components. To avoid steel fracture, greater reinforcing ratios are used.

Keywords: impact test; reinforcement ratio; failure Mechanism; impact velocity; damage parameter; unequal lateral impact; deflection time history.

1 Introduction

Many scholars have investigated the dynamic behavior of RC beams [1]–[5]. According to the literature [6]–[14], the drop hammer will promote vertical bending and oblique shear cracks in the RC beam. Shear deformation is considered to dominate the destruction of RC members under specified impact kinetic energy, and the shear resistance of RC members is a problem to discuss under impact[15]. Furthermore, using appropriate methods, strengthening the concrete beam improves its shear resistance and prevents further structural damage. Recent research has focused on using new materials to increase structural member impact resistance. In high-speed railway station buildings, bridge piers, and other constructions, CFRP cloth is appropriate since it is lightweight and strong. CFRP-RC beams have been studied under static loads by Pham et al. [16]. Researchers found that FRP reinforcement may increase the shear bearing capacity of square RC beams when tested under static force. According to Md. Akter et al. [17], CFRP-RC beams have better bending resistance and ductility than standard RC beams.

On the other hand, Pham et al. proposed the dynamic compressive strength formula for CFRP-constrained RC under dynamic load. The drop hammer impact test of CFRP-RC beams demonstrated that CFRP-RC beams had higher impact resistance. It is difficult to find the current study on the shear resistance of CFRP-RC beams under the impact, and it is insufficient to comprehend their dynamic behavior. The existing literature also emphasizes the component's mid-span or equal-span influence. Additionally, the current CFRPRC component impact test has low impact energy, and the component failure mode is only cracking. In severe, the impact effect may cause more significant concrete damage.