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Concrete with Polypropylene Fiber Reinforcement

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Introduction

Basalt fiber/polypropylene fibre reinforced concrete (BPRC) was studied for its flexural behaviour. The addition of fibres boosts concrete's compressive strength when the BF and PF content is 0.1 percent. The compressive strength is most obviously improved by a BF content of 0.1 percent, whereas a hybrid fibre content of 0.2 percent demonstrates a detrimental effect. By increasing the flexural strength and the expansion tortuosity of the fracture cracks, the addition of BF and PF can improve the ductility of concrete. The hybrid fibres with a 0.1 percent component are best for boosting flexural strength.

However, when matrix strength increases, concrete ductility and fracture crack tortuosity decrease and the contribution of fibres to flexural strength improves less and less. The damage caused by BF remains essentially same when BF and PF are combined, whereas the damage caused by PF is more severe when PF and BF are combined. The change in the flexural toughness of BPRC is effectively characterised by the flexural toughness index FT. On FT-l/600 and FT-l/150, respectively, the hybrid fibre contents of 0.1 percent and 0.2 percent show the most notable enhancing effect. A hybrid content of 0.1 percent is the ideal choice of fibre content, taking into account the impact of fibres on the compressive strength, flexural strength, and flexural toughness of concrete [1].

Description

Concrete is being employed more and more in the construction of different engineering constructions as civilization develops. Ordinary concrete, on the other hand, has low flexural characteristics and fracture toughness due to its high brittleness, making it easier to break and negatively affecting its longevity. Currently, reducing concrete's brittleness and increasing its toughness can be accomplished by adding fibres to concrete or strengthening concrete using fiber-reinforced polymer. The most popular method of concrete toughening among them is the addition of fibres. Concrete cracking occurs on multiple scales, from the material scale to the structural scale. By incorporating different fibres and utilising them as crack limiters on various sizes, concrete's flexural characteristics and fracture toughness can be efficiently increased. The most successful and well-known method of mixing that increases the fracture toughness of concrete is the combination of steel fibre and polypropylene fibre (PF). Concrete's cracking resistance is significantly improved by high-strength steel fibre, while its ductility is raised by low-strength PF. The collaboration of PF and steel fibre increases the concrete's fracture toughness [2].

The principal cause of the property deterioration of structures in maritime environments is the corrosion of steel bars owing to chloride ion action. As a result, maritime engineering structures composed of hybrid steel fiber/polypropylene fiber-reinforced concrete may experience a faster rate of property deterioration due to the ease with which steel fibres corrode. In recent years, the usage of basalt fibre (BF), an environmentally favourable fibre, in concrete materials has increased. Basalt rock is melted at high temperatures and pulled into wires to create BF, which is produced with a negligible amount of energy. Strong acid and alkali corrosion resistance and outstanding mechanical qualities characterise BF. Furthermore, there is high compatibility between BF and cement-based materials. Therefore, the hybrid BF/PF-reinforced concrete (BPRC) can be utilised to improve the fracture toughness and durability of concrete in maritime conditions by substituting steel fibres with BF [3,4].

The influence of hybrid BF and PF on the fracture properties of high-performance concrete is the main focus of the few research studies that have been done so far on the flexural properties of BPRC. However, the influence mechanism of BF and PF on the flexural properties of concrete has not been clarified. Additionally, the BPRC flexural strength prediction model has not yet been developed. Ordinary concrete's matrix properties differ from those of high-performance concrete, which will inevitably result in different BF and PF effects on the flexural properties. However, a thorough investigation into how hybrid BF and PF affect the flexural quality of regular concrete has not yet been published [5].

Conclusion

The BPRC's flexural load-deflection curve is discovered. Systematically investigated are the changes in flexural strength, BPRC fracture morphology, and failure morphology of fibres with matrix strengths. The effective evaluation index of flexural toughness is established, and the change rule of the BPRC's flexural toughness is explained. Finally, a prediction model based on composite material theory is developed for the flexural strength of BPRC. The acquired results provide a solid foundation for designing the BPRC in accordance with its unique flexural performance.

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