



Finite Element Analysis of Local Pressure Failure Mechanism of RPC

Moneef Mohamed Elobaid Musa, Xiong Xueyu, Landry Wilfried Tim Sob, Wael Alhaddad

Department of Structural Engineering, Tongji University, 1239 Siping Road, Shanghai 200092, CHINA

Md Nasir Uddin, Faharidine Mahamoudou

Department of Disaster Mitigation for structure, Tongji University, 1239 Siping Road, Shanghai 200092, CHINA

Contact: moneef@tongji.edu.cn

Abstract

Reactive powder concrete (RPC) has been widely used due to its high tensile and compressive strength and excellent durability. However, the failure mechanism of RPC local pressure is still unclear. Therefore, reasonable structural dimensions of the finite element model (FEM) and the relevant parameters of the RPC were selected to deeply explore the local pressure of the RPC under the local loading. The FEM of the axial local compression of the RPC with different constitutive models was built. The whole nonlinear analysis process of the local pressure of RPC was completed, and the failure mode, stress distribution, and maximum plastic principal strain of the specimen were analyzed. The model shows that the local pressure performance of RPC is improved due to the increase of ultimate tensile strength, the local pressure failure mode of RPC conforms to the wedge split theory, and the orthogonal ties can uniformly distribute the pressure stresses.

Keywords: Reactive powder concrete (RPC); finite element model (FEM); local pressure; constitutive models.

1 Introduction

Reactive powder concrete (RPC) [1] is a new type of cement-based composite material. Compared with Ordinary Concrete, RPC has been widely used in high-rise structures, nuclear reactor waste storage containers, long-span bridges, and other practical projects [2]. RPC has significantly improved mechanical properties and durability [3, 4]. For bridge engineering [5], the improvement of compressive strength [6] and bending strength of RPC can effectively reduce the size of the structure under the same bearing capacity, thereby significantly improving the spanning capacity of the bridge structure itself. However, when the RPC is

combined with the prestressed structures, it can achieve a smaller cross-sectional size than the conventional prestressed concrete structural members [7]; it also makes the local pressure problem of the RPC structural members under the post-tensioned prestressed anchors more difficult, prominent, and complicated. The applied force on the steel strands will be transferred to the concrete through the bearing plate. The pressure transmitted by the bearing plate will cause vertical compression inside the concrete. In addition, due to the relatively concentrated pressure area of the bearing plate, the high compressive stress will cause lateral expansion inside the concrete. However, this local lateral expansion will be