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Enhancing Fire Resistance of Piloti Structures using Insulated CFRP-Reinforced RC Column

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Extended Abstract

Piloti-type buildings have been widely constructed for the convenience of parking. However, the 2016 Gyeongju earthquake and the 2017 Pohang earthquake revealed the vulnerability of these structures to shear in the soft-story structures and local fires in the car parks.[1],[2] To address these issues, seismic retrofitting with carbon and glass fiber polymers (CFRP and GFRP) has been applied to improve the ductility and strength of the structural components.[3] Despite this, few studies have examined the fire performance of seismically designed piloti structures, highlighting the need for further research in this area.[4]

In this study, the fire performance of typical piloti building structures with CFRP strengthening was numerically investigated to prevent fire spread through structural fire analysis. A representative type of existing piloti buildings was selected, and a construction method suitable in terms of fire resistance of structural members was proposed through seismic performance evaluation and seismic retrofit design.[4] Possible fire scenarios were established conservatively, considering the parking space at the first story of the selected piloti structures and varying the number and arrangement of cars.[5],[6]

The fire performance of the insulated FRP-strengthened RC column was evaluated using a computational fluid dynamics (CFD) code, fire dynamic simulator (FDS), and the temperature loads on the considered piloti structures were determined. Cars of Class 3 were selected to generate fire,[7] and the calculated temperature data were mapped into the thermal-structural model constructed in a finite element (FE) code, ABAQUS, to evaluate the effect of seismic strengthening to fire. The flexural and shear capacities of the structural members due to fire were investigated in comparison to those calculated at room temperature, and the fire responses for the real fires in car parks were examined in comparison to those for the standard fire curves as per the ISO-834 or ASTM E119 for evaluation of the applicability of the standard fire curves for car park fires.[8],[9]

Overall, this study provides insights into the fire performance of seismically designed piloti structures and contributes to the development of strategies to enhance their safety and resilience in the event of fires.

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