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Experimental and Analytical Studies for the Effect of Thickness and Axial Load on Load-Bearing Capacity of Fire-Damaged Concrete Walls

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Abstract : The objective of this paper is an investigation of the effects of the thickness and axial loading during a fire test on the load-bearing capacity of a fire-damaged normal-strength concrete wall. Two factors are attributed to the temperature distributions in the concrete members and are mainly obtained through numerous experiments. Toward this goal, three wall specimens of different thicknesses are heated for 2 h according to the ISO-standard heating curve, and the temperature distributions through the thicknesses are measured using thermocouples. In addition, two wall specimens are heated for 2 h while simultaneously being subjected to a constant axial loading at their top sections. The test results show that the temperature distribution during the fire test depends on wall thickness and axial load during the fire test. After the fire tests, the specimens are cured for one month, followed by the loading testing. The heated specimens are compared with three unheated specimens to investigate the residual load-bearing capacities. The fire-damaged walls show a minor difference of the load-bearing capacity regarding the axial loading, whereas a significant difference became evident regarding the wall thickness. To validate the experiment results, finite element models are generated for which the material properties that are obtained for the experiment are subject to elevated temperatures, and the analytical results show sound agreements with the experiment results. The analytical method based on validated thought experimental results is applied to generate the fire-damaged walls with 2,800 mm high considering the buckling effect: typical story height of residual buildings in Korea. The models for structural analyses generated to deformation shape after thermal analysis. The load-bearing capacity of the fire-damaged walls with pin supports at both ends does not significantly depend on the wall thickness, the reason for it is restraint of pinned ends. The difference of the load-bearing capacity of fire-damaged walls as axial load during the fire is within approximately 5 %.

Keywords : normal-strength concrete wall, wall thickness, axial-load ratio, slenderness ratio, fire test, residual strength, finite element analysis
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