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論　文　内　容　要　旨

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学位論文題目	Evaluation of repair effect for chloride-damaged reinforced concrete by using patch repair materials containing fly ash (フライアッシュを含む断面修復材による塩害劣化鉄筋コンクリートの補修効果の評価)		

内容要旨

Abstract

As a conventional repair method for reinforced concrete (RC) structures deteriorated by the chloride attack, the patch repair has been applied widely. When the patch repair method is applied, the re-deterioration has been sometimes observed around the joint part of the substrate concrete and the repair material. One of the major deterioration mechanisms after the patch repair is the macro-cell corrosion caused by the remained chlorides in concrete or by the corrosive products like chloride ions (Cl^-) supplied through the inadequate joint part.

In Japan and Taiwan, patch repair is the very common method to repair the corroded RC members. Because Portland cement mortar is low cost and high compatibility with substrate concrete, it is widely used to repair deteriorated RC structures in Japan and Taiwan. However, the Portland cement mortar could not effectively resist the degradation factor, such as chloride ions (Cl^-), water, carbon dioxide (CO_2), oxide (O_2) and so on. According to the past researches, mortar-based patch repairing materials are added to the polymeric material to improve the mechanical properties, e.g. compressive strength, tensile strength, bonding strength and flexural strength. The polymer-modified cement is considered to solve the problem of degradation factor attacking and increase the durability of the repaired RC structures. However, the polymeric material is very expensive compared to the cement.

On the other hand, fly ash is a byproduct in thermal power generation. Fly ash is used as a supplementary cementitious material, when used in conjunction with Portland cement, contributes to the properties of the hardened concrete through hydraulic or Pozzolanic activity. Its Pozzolanic properties provide good durability and achieve economic benefits in the construction without sacrificing its intensity. The advantage of fly ash is not only reducing the cost, and the ability to resist Cl^- is also outstanding. Moreover, the corrosion prevention effect of NO_2^- had been found in many researches which can regenerate the passive film to control the formation of rust. It is very useful to increase the durability of repaired RC structures.In this study, the effects of fly-ash-mixing and the dosage of $LiNO_2$ in the patch repair materials on the basic properties of repair materials, and on the penetration due to the chloride around the interface between the substrate concrete and the repair material were investigated.

In this study, the effects of fly-ash-mixing and the dosage of $LiNO_2$ in the

patch repair materials on the basic properties of repair materials, the ability of repair materials to resist chloride ion penetration and on the chloride-induced steel corrosion due to the supply of Cl^- ions around the interface between the substrate concrete and the repair material were investigated.

As a result of this study, fly ash mixing increased the workability of PCM; however, $LiNO_2$ greatly reduced the flow value to some extent. Namely, admixing of fly ash enhanced the flowability of repair materials. The fly-ash-mixing decreased compressive strength of repair mortar a little but the dosage of $LiNO_2$ could increase the tensile strength and the bond strength. The bond strength data measured by the proposed method showed generally similar tendency with the data obtained by the conventional pull-off test. The bond strength of PCM-based repair material decreased a little with mixing fly ash but increased with a dosage of $LiNO_2$.

Cl^- penetration into the PCM-based repair materials was slower than the cases of normal mortar containing fly ash. Cl^- penetration into concrete around the joint face was accelerated by jointing with PCM-based materials compared with the cases of jointing with the normal mortar. Such tendency was observed in both saltwater immersion test and the electrochemical Cl^- migration test. Although all cases of PCM based repair material accelerated the Cl^- penetration into concrete around the joint surface, each diffusion coefficient was lower than 1.35 cm^2/year as the specified. On the other hand, the PCM containing both fly ash and $LiNO_2$ showed a high protection effect against steel corrosion in the RC joint specimens and the macro-cell current around the joint face was also suppressed compared with the case of a general PCM.

As well as the mechanical strength, workability and chloride resistance are considered in this study. For most RC buildings with an age of over 30 years in Japan and Taiwan, which have the average testing compressive strength of approximately 20 MPa, the repair materials of this study can be recommended for patch repair materials.