

学位論文概要

題 目 Application of Porous Ceramic Aggregate Derived from Roof Tile Waste as an
 Internal Curing Agent to Structural Blast Furnace Slag Type-B Concrete
(内部養生材としての廃瓦の構造用高炉B種コンクリートへの適用性)

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In this study, the applicability of porous ceramic waste roof tile aggregate (PCA) to structural Portland blast furnace slag cement Type B concrete (BBC) was investigated. The adopted water to cement ratios (W/C) were 0.5 and 0.35. The replacement ratios of PCA in the case of coarse aggregate replacement (PCCA), were 0, 10%, 20% and 0, 10%, 20%, 30% by volume for W/C=0.5 and W/C=0.35, respectively. In the case of fine aggregate replacement (PCFA), for comparison purposes, the amount of internal curing water was adjusted to be the same as in the case of PCCA, and the resultant replacement volume ratios were 0, 12%, and 24% for both W/Cs. The factors considered in the investigation were water to cement ratio (W/C) and the replacement ratio of PCA. The investigated parameters were effects on plain BBC in terms of strengths and fracture energies, as well as the effects on reinforced BBC in terms on flexural cracking properties and shear capacity of RC beams exposed to drying at the age of 7 days. In addition, the effect of PCA on autogenous shrinkage of BBC and shear capacity of reinforced BBC, both cured under high temperature history was also investigated.

The results showed that the PCA was effective in improving the strengths of plain BBC under drying conditions, independent of replacement ratio and W/C. The results were particularly remarkable in the case of W/C=0.35. In addition, a decrease in Young's modulus of concrete with increase in PCA replacement ratio was observed. The fracture energies of the internally cured concretes had similar or higher values compared to the reference concretes, independent of W/C, with the lower replacements of 10~12% having the highest increase. However, the characteristic length of the internally cured concretes, a parameter that shows the brittleness of concrete was found to decrease, especially in the case of higher replacements of PCA. In the case of loading tests of RC beams, the PCA was found to have no significant effect on the flexural cracking properties of W/C=0.5. However, the PCA was found to improve the flexural cracking behavior of W/C=0.35, by increasing the flexural cracking moment and reducing maximum crack width of the internally cured beams, independent of PCA replacement ratio. In the case of shear capacity of RC beams, the PCA was found to increase the shear capacity of RC beams in the case of W/C=0.5, especially in the case of low replacement ratios of 10~12%. However, in the case of W/C=0.35, the shear capacity was found to decrease with increase in replacement ratio of PCCA, and no significant effect in the case of PCFA replacement. In the case of effect on BBC under high temperature history, the PCA was found to mitigate the increased autogenous shrinkage, as well as improve the shear capacity of RC beams cured under high temperature history, independent of replacement ratio of PCA and W/C.

In conclusion, the PCA showed its potential effects as an internal curing material in improving the properties of structural BBC, both in the plain and reinforced form. Based on the obtained results, The application range was found to be from 10~30% replacement ratio of both fine and coarse aggregate in the case of plain BBC, while the replacement ratio of PCA in the range of 10~12% was found to be the most appropriate in improving the performance of reinforced concrete, regardless of curing condition.