

SUMMARY

題目 Utilization of a simplified non-destructive test with water spraying for cover concrete quality inspection

(かぶりコンクリートの品質検査における散水簡易非破壊試験の活用)

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This study aimed to investigate the applicability of the water intentional spraying test (WIST) for evaluating the cover concrete quality. The usability of WIST was investigated under controlled measurement conditions via laboratory tests. First, this study presented an experimental program to prove the usability of WIST under various conditions including all key factors in concrete. Second, in order to expand the applicability of WIST method, this study then described an investigation to expand the usability of the WIST method. Next, this study showed an investigation to validate the effectiveness of the WIST method for evaluating the quality of early-age cover concrete. In addition, this study described an investigation to determine the influence of several temperature regimes on the results of three nondestructive methods including Torrent air permeability, surface water absorption test (SWAT), and water intentional spraying test (WIST). Finally, this study provided a novelty approach to service life prediction of steam-cured concrete utilizing in-situ air permeability measurements and WIST results.

The observed results first revealed that the strong correlation between kT and rN , with rN increasing with increasing kT . A high coefficient of determination was obtained for an approximate linear function of the relationship. The strong and single correlation, which was observed under various conditions, verifies the applicability of WIST to evaluate the transport properties of cover concrete. Both rN and kT increase with increasing w/c , whereas an increase in the curing (sealing) time decreases both rN and kT . The WIST sensitively detects poor-quality concrete caused by a high W/C and short curing time. Next, as expected, numerous outstanding results thereafter were withdrawn to expand the applicability of WIST method. In details, the study established a new index to improve the accuracy of the WIST measurements that provided a generalized approach for evaluating cover concrete; developed and validated a more rapid evaluation procedure utilizing the double spraying technique; and proposed a novel durability index for quality classification of cover concrete. The results also indicated that the WIST is highly sensitive in detecting poor- and normal-quality concrete 1st and 7th day, respectively, after demolding. The results of this study contribute to the establishment of a rapid evaluation of the quality of cover concrete at several days just after demolding. In addition, the results indicated that, under temperature changes, the corresponding changes in surface moisture content is main reason explaining for the changes in air permeability and water absorption (determined by Torrent, WIST, and SWAT methods). In particular, the observed good relationship between the air permeability and water absorption under given temperature changes (from 5 to 35 °C) providing a flexible approach for evaluating the performance of concrete in case of knowing one of two parameters.

Finally, this study provided a novelty approach to service life prediction of steam-cured concrete utilizing in-situ air permeability and water absorption measurements. The in-situ air permeability and water absorption measurement approaches to evaluate the carbonation resistance of steam-cured concrete have performed. The results indicate that kT and rW are good indexes for predicting carbonation resistance of steam-cured concrete. A novel application of the kT and rW indexes for predicting the service life of steam-cured concrete is demonstrated on mock-up box culvert elements produced in a precast concrete plant.

In conclusion, this study verified the usability of the WIST as a simple and promising NDT method for evaluating the cover concrete quality. The WIST result can be used as a cost-effective, and potential durability indicator for practical applications in assessing cover concrete quality. In practice, the WIST method can be used to assess the quality of workmanship during the construction of durable concrete structures and can solve typical problems of NDT methods related to the high moisture content in concrete.