
Research on the selection of aggregate and determination of compaction completion for the improvement of productivity of concrete work

Toshinari HAYASHI

While the introduction of various ICT technologies is progressing, there is still room for improvement in improving the productivity of concrete works. In particular, in the concrete manufacturing and construction process, there is a high degree of reliance on the experience and know-how of engineers, and there is concern that the decrease in engineers in recent years will lead to deterioration of concrete quality. Therefore, on the premise of ensuring the quality of concrete, this paper worked on the development of technology that contributes to productivity improvement.

In the concrete work, I investigated the past research at each stage of material selection, mix design, mixing, placing, and curing. As a result, I focused on "aggregate selection" and "compaction", which I judged to have room for development that could contribute to productivity improvement, and started research.

The aggregate used for concrete is selected based on the JIS quality standard, but it is difficult to evaluate the performance of concrete using the selected aggregate based only on the results of the aggregate test. However, since the test using the concrete specimen takes several months, it is required to develop a technique that can appropriately evaluate the quality of the aggregate on the performance of the concrete in a short time. Therefore, I investigated the relationship between the dry shrinkage strain, which is important for concrete performance, and the quality of aggregates (water absorption characteristics and strain characteristics), and confirmed that there is a strong correlation with the strain characteristics. Furthermore, I found the compound water content as a factor that makes the strain of aggregate different, and clarified that the compound water content of coarse aggregate has a strong correlation with the strain characteristics of aggregate.

Judgment of the degree of concrete compaction has conventionally been made based on visual judgment and feeling based on the experience of workers. In this paper, I proposed and evaluated hollow balls as a new inexpensive and simple judgment method. The hollow ball is buried in concrete, and the hollow ball floats as the concrete liquefies due to compaction by a vibrator. It was shown that compaction can be determined when a hollow

ball with a diameter of 40 mm is used for concrete with a slump of 10 cm to 16 cm. In addition, I verified the relationship between the floating condition of the hollow ball and the acceleration, and showed the possibility that it can be judged by "cumulative acceleration" as a new index.

On the other hand, in contrast to the conventional visual judgment, I tried to introduce AI for the compaction completion judgment. As a result, by appropriately creating the learning data, it was possible to confirm the accuracy with which the correct answer rate of the AI judgment result for the correct answer label exceeds 80%. Furthermore, by inputting numerical data such as slump and air volume into AI, the judgment accuracy was improved and the judgment result was successfully visualized in real time.