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Principles for the Realistic Determination of the in-situ Concrete Compressive Strength under Consideration of Rearrangement Effects

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Abstract : The preservation of existing structures is of great economic interest because it contributes to higher sustainability and resource conservation. In the case of existing buildings, in addition to repair and maintenance, modernization or reconstruction works often take place in the course of adjustments or changes in use. Since the structural framework and the associated load level are usually changed in the course of the structural measures, the stability of the structure must be verified in accordance with the currently valid regulations. The concrete compressive strength of the existing structures concrete and the derived mechanical parameters are of central importance for the recalculation and verification. However, the compressive strength of the existing concrete is usually set comparatively low and thus underestimated. The reasons for this are too small numbers, and large scatter of material properties of the drill cores, which are used for the experimental determination of the design value of the compressive strength. Within a structural component, the load is usually transferred over the area with higher stiffness and consequently with higher compressive strength. Therefore, existing strength variations within a component only play a subordinate role due to rearrangement effects. This paper deals with the experimental and numerical determination of such rearrangement effects in order to calculate the concrete compressive strength of existing structures more realistic and economical. The influence of individual parameters such as the specimen geometry (prism or cylinder) or the coefficient of variation of the concrete compressive strength is analyzed in experimental small-part tests. The coefficients of variation commonly used in practice are adjusted by dividing the test specimens into several layers consisting of different concretes, which are monolithically connected to each other. From each combination, a sufficient number of the test specimen is produced and tested to enable evaluation on a statistical basis. Based on the experimental tests, FE simulations are carried out to validate the test results. In the frame of a subsequent parameter study, a large number of combinations is considered, which had not been investigated in the experimental tests yet. Thus, the influence of individual parameters on the size and characteristic of the rearrangement effect is determined and described more detailed. Based on the parameter study and the experimental results, a calculation model for a more realistic determination of the in situ concrete compressive strength is developed and presented. By considering rearrangement effects in concrete during recalculation, a higher number of existing structures can be maintained without structural measures. The preservation of existing structures is not only decisive from an economic, sustainable, and resource-saving point of view but also represents an added value for cultural and social aspects.

Keywords : existing structures, in-situ concrete compressive strength, rearrangement effects, recalculation
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