

CHAPTER 4 VERIFICATION OF ENVIRONMENTAL PERFORMANCE

4.1 General

When conducting design, construction, use, maintenance/management, dismantling, disposal and reuse after dismantling of a concrete structure, it shall be confirmed at the design stage that environmental performance required for the structure is satisfied.

【Commentary】 The Standard Specifications for Concrete Structures stipulate that, in principle, fulfillment of performance requirements concerning safety, serviceability and durability throughout the design service life of a structure must be confirmed at its design stage. To achieve objective verifications of various performance requirements for a structure in a unified manner, it is desirable to verify environmental performance of the structure by following the same processes as for safety, serviceability and durability. This Recommendation (draft) is exactly in line with this idea.

In the framework of designs for verifying performance, verifying performance is nothing but an act of confirming that the performance requirements for a structure are satisfied by comparing the “performance retained by” the structure quantified by using an engineering index and the “performance required for” the structure, which is indicated by the same index. Thus, “verification” itself is a simple and objective act and usually does not involve supposition or judgment. In many cases, it only confirms whether the inequality is satisfied. This can also be said of environmental performance subject in this Recommendation (draft). In this chapter “Verification of Environmental Performance,” in other words, it confirms whether environmental performance retained by a structure, which was quantitatively evaluated in “Chapter 3 – Evaluation of Environmental Performance,” satisfies the regulation, limit or target value determined from performance requirements set in “Chapter 2 – Environmentality.”

4.2 Verification

(1) Environmental performance of a concrete structure shall be verified by confirming that the retained performance (R) of the structure defined by using engineering indexes regarding the environmental aspects of objects to be verified is larger (or smaller) than the set value (S) of performance determined by the performance requirements of the structure.

(2) Regarding the items for which performance can be ensured by providing specifications, verification of performance may be omitted if specifications based upon past experiences are satisfied by the structure

【Commentary】 (1): In Chapter 2, environmental aspects subject to verification were selected, and the set value (S) was determined by the performance requirements. Performance requirements may be given to the designer as the regulation or limit value that can be used for verification, according to legal regulations or instructions from the owner, or the designer may set the target value (S) by request from the owner.

In Chapter 3, performance (R), which is presumed to be retained or displayed by a structure, is quantified by using the same engineering index used for the regulation, limit or target value (S), concerning environmental aspects, for which S was set.

Whether the structure satisfies performance requirements for the environmental aspects subject to verification is confirmed by whether or not $R > S$ (or $R < S$). The direction of the inequality sign varies

by the type of environmental aspect subject to verification. For example, in cases involving the lifecycle carbon dioxide emission, verification is achieved by setting the upper limit (S) and confirming that it is higher than the estimated carbon dioxide emission (R) of the structure. In cases of reducing environmental impact only to a certain degree from the standard value, verification is done by confirming that the ratio of the actual impact to the standard impact is lower than “environmental impact reduction factor γ_{eir} ”, described in the Commentary of Section 2.3.1. In cases involving the amount of byproducts used, it may be possible to decide that the requirement is met if the amount used for the structure (R) is larger than the predetermined minimum necessary amount (S).

The process of verification introduced here is similar to the process of verification for cross-sectional failure of members in safety of structures. In other words, verification of safety against cross-sectional failure can be achieved if the design cross-sectional bearing capacity (R_d) estimated from the materials used and the shape and dimension of cross-section is greater than the design cross-sectional force (S_d) as determined by the load ($S_d/R_d \leq 1.0$). As such, in this Recommendation (draft) environmentality is handled in the same manner as in the performance verification system of the standard Specifications for Concrete structures.

(2): If it is obvious from past results and other data that a structure satisfies a certain range of specifications (such as materials used for concrete, shape/size of the structure, construction method) and the performance is above a certain level, specifications being satisfied by the structure may be used in place of performance verification, without conducting quantitative evaluations of individual structures.