

Result Verification of Performance Based Material Design Method using Satisfaction Curves

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Summary

As introduced and discussed in previous papers, performance based material design (PBMD) method is used to design concrete material mixture content for construction usage considering a structure's specified performance requirements based on its usage targets, environmental conditions, structure types, expected design life, etc. Using the suggested PBMD scheme, a concrete mixture design satisfying the ultimate performance requested by a client (i.e., cost and service life) is found. In this paper, the analytical results are verified to show the validity of the proposed method and the possibility of application in practice.

Keywords: Performance based material design; Bayesian method; Satisfaction curve; Concrete mixture design.

1. Introduction

Performance based material design (PBMD)^{1~3} is a concrete mixture design method, in which concrete material is designed considering a structure's specified performance requirements based on its usage. PBMD is studied as a next generation a design method which can offer a wider variety of possible solutions and enables optimization of a material design solution for cost and functionality. And Bayesian method, which can evaluate the probability of success of concrete material mixture by using satisfaction curves, has been applied in PBMD to help assess the performance of concrete mixture design. The satisfaction curve describes the probability of exceeding a criterion level for various specified concrete material parameters. Thus, the development of satisfaction curves requires the characterization of the concrete material parameters and the identification of the different degrees of criterion level. The type, quantity, and quality of substrate materials (i.e., water, cement, aggregate, admixture, etc) are important characteristics that affect final concrete performance. Therefore, they need to be taken into consideration in the development of satisfaction curves.

2. Satisfaction curve

2.1 Procedure of developing satisfaction curve

When the raw data only consider a material performance based only one material parameter, the satisfaction curve can be setup using one parameter Bayesian method. Since a satisfaction curve describes the probability of exceeding a criterion value for a specified concrete material parameter, a satisfaction curve for a particular criterion value is obtained by computing the conditional probabilities within the range of that criterion value for various concrete material parameters. The conditional probabilities can be evaluated as follows.