

# Subcommittee on Examination and Inspection Systems for the Design of Concrete Mix Proportions Based on the Construction Performance of Fresh Concrete

## (Subcommittee 341)

### 1. Introduction

Concrete construction has been undergoing drastic change due to the depletion of aggregate, the growing size of structures, and the increasing density of steel reinforcement bars to improve earthquake resistance. Concrete with smaller water-cement ratios and slumps has long been required for quality concrete structures, but to build high quality concrete structures, the concrete also must have sufficient workability and the ability to be placed into every corner of the forms and around the reinforcing steel. Concrete with extremely small slumps may produce honeycombs or cavities. Concrete structures will perform as required only if the structures are properly designed, the concrete materials of the required quality are properly mixed, and the concrete is appropriately applied.

Currently, the only method being used for examining and inspecting the workability of concrete is the slump test, which is conducted to evaluate deformation caused by dead loads. The workability required for transportation, placement, compaction, finishing, and other work operations is difficult to determine from slump tests because the performance (consistency) of fresh concrete *per se* does not determine the workability of the concrete. Rather, workability depends largely on the structural and construction conditions of the structures in which the concrete is cast. To determine workability, especially when concrete is poured into forms using vibration compaction, both the structural conditions of the structures and the concrete movements during vibration must be understood. However, because a variety of materials are used, the quantitative evaluations produced by slump tests are limited.

Under these circumstances, Subcommittee 341 was organized in November 2008 with Dr. Chikanori Hashimoto of the University of Tokushima as its chairperson, and two working groups.

### 2. Study on a Workability Examination System Working Group

The Japan Society of Civil Engineers published “*Recommendation for Mix Design of Fresh Concrete and Construction Placement-related Performance Evaluation*” to facilitate the use of concrete with appropriate slump according to the structure’s construction requirements. The guidelines propose methods for reducing the possibility of a poor filling caused by insufficient concrete workability. However, the guidelines do not mention the actions or measures to take during the design and planning stages to ensure appropriate construction. Rather, the guidelines describe only actions to take during the construction stage, with an emphasis on slump changes. Therefore, the guidelines pose risks when using simple construction techniques that depend on slump changes. Therefore, this working group conducted a study on an ideal workability evaluation system and proposed specific ideas for the system. (Figure 1)

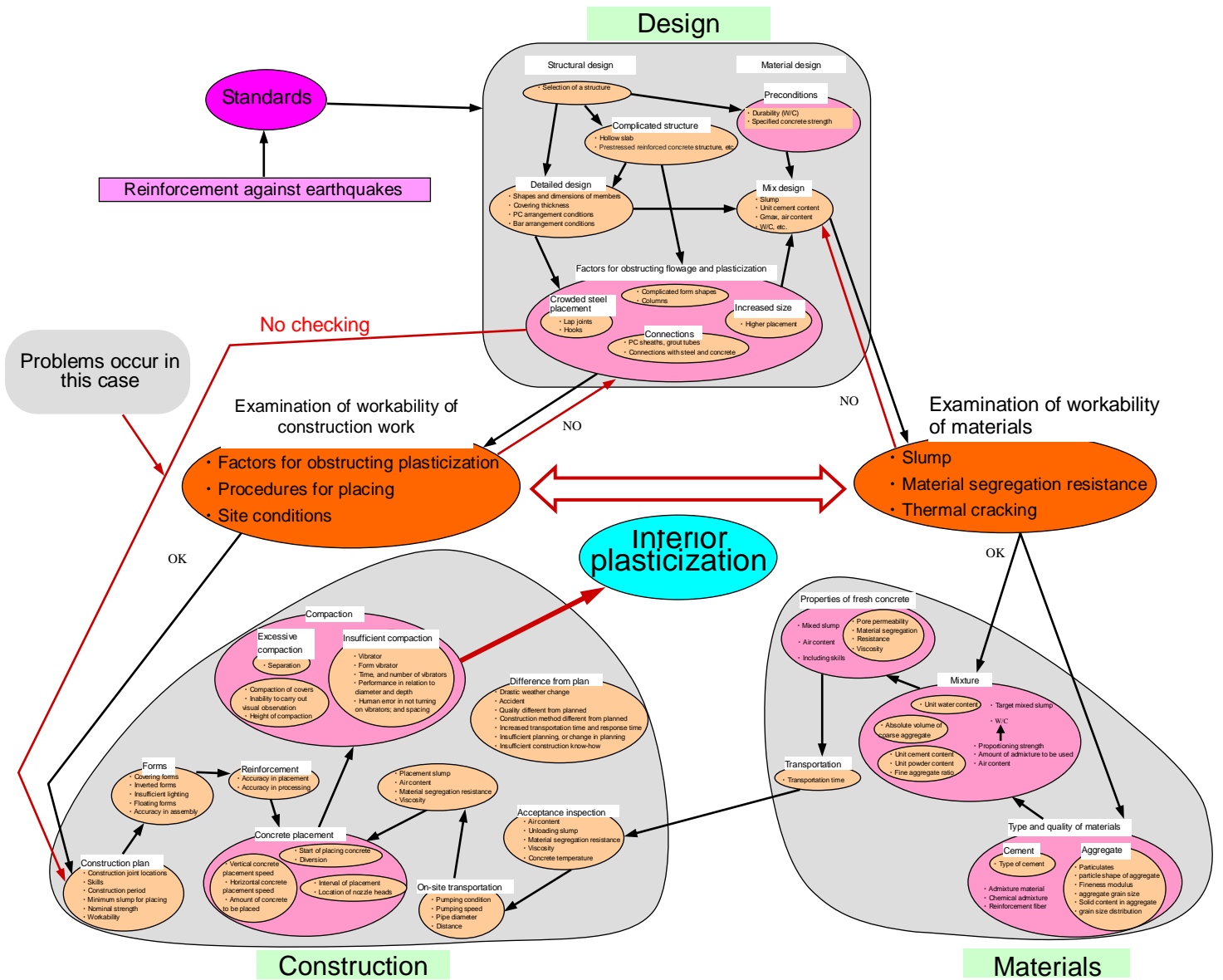


Figure 1. Factor analysis (interrelation diagram) of quality control issues and quality problems with regard to the construction of civil engineering structures

3. Study on an Examination and Inspection Testing Method Working Group Slump, as evaluated by slump tests, indicates the final change in length. In this case, because only the dead load of fresh concrete is exerted on the concrete, only one aspect of workability is evaluated. After summing up the present conditions and issues regarding slump, as described in section 2 above, this working group examined documentation for a new evaluation and testing method and proposed a testing method using existing testing devices, a box-type container, a long internal vibrator (Figure 2), and tamping tests (Figure 3).

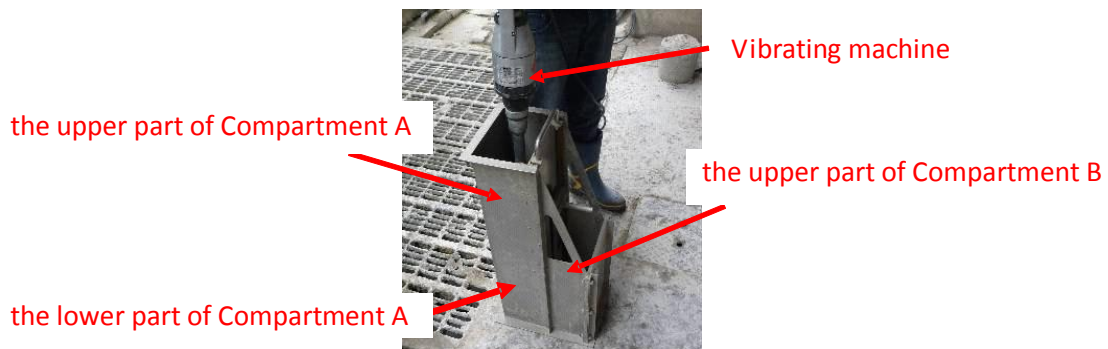


Figure 2. Box-shaped container of the specified type and a vibrating machine

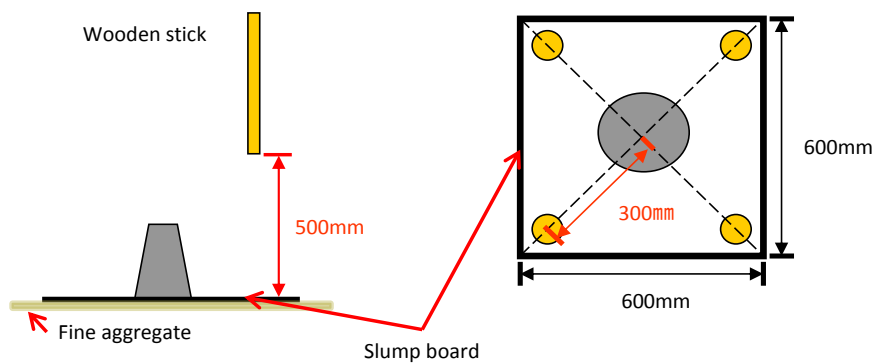


Figure 3. Tamping test