

# Manual for Production and Placement of self-Compacting Concrete

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# **Manual for Production and Placement of Self-Compacting Concrete**

## **Chapter 1 General**

### **1.1 Scope**

- (1) This Manual provides specific methods of production of and construction with self- compacting concrete with Rank 2 self-compactability to be observed to attain the required performance.
- (2) As to matters not specified in this Manual, the JSCE Standard Specification for Design and Construction of Concrete Structures should apply.

## **Chapter 2 Production and Production Control**

### **2.1 General**

The production of self-compacting concrete should be carried out in plants where the equipment, operation and materials are properly controlled. It should therefore be carried out at JIS-accredited plants or where the production is carried out with equipment and control systems equal or superior to JIS-accredited plants. The production control at plants should as a rule be performed by an engineer experienced in producing self-compacting concrete.

### **2.2 Selection of ready-mixed concrete plants**

Ready-mixed concrete plants for producing self-compacting concrete should be selected in consideration particularly of the production equipment, transportation time, concrete shipping capacity and state of quality control.

### **2.3 Storage of aggregate**

- (1) Aggregate should be stored to minimize the fluctuation of its surface moisture.
- (2) Where the fluctuation of aggregate grading can have adverse effects on the fluctuation of self-compacting concrete, aggregates with different gradings should be stored separately.

### **2.4 Batching**

- (1) The tolerances for batching errors should be as specified in the JSCE Standard Specification. However, batching errors should be controlled with lower tolerances where required. It is recommended that the maximum tolerance for batching errors of air-entraining and high-range water-reducing admixtures and superplasticizers be 2%.
- (2) When additional batching equipment is to be installed, it should be confirmed beforehand that the batching errors of the equipment are in the specified range.
- (3) Where such chemical admixtures as thickeners are manually charged into the mixer or aggregate batching tank, a system whereby charging control is ensured should be adopted.
- (4) The capacity of batching equipment should be confirmed beforehand, since insufficient capacities can limit the batch size.

### **2.5 Mixers**

Batch-type forced-action mixers conforming to JIS A 8603 should as a rule be used.

### **2.6 Mixing**

- (1) The method of mixing self-compacting concrete should be adequately established on the basis of field experience or testing.
- (2) The batch size should be determined in consideration of the type of self-compacting concrete, mixing efficiency of the mixer, quantity to be transported and shipping rate, and should as a rule be 80% to 90% of the maximum capacity of the mixer.
- (3) The mixing time should as a rule be not less than 90 seconds in the case of forced action mixers.
- (4) When the same mixer is used for mixing normal concrete and self-compacting concrete without washing in between, it should be confirmed beforehand by testing or field experience that no adverse effects are produced on the qualities of self-compacting concrete.

(5) Just prior to the mixing, the mixer should be "battered" with self-compacting concrete or mortar proportioned similarly to the batch to be mixed.

### **2.7 Trial mixing using mixers of the plant**

Prior to the start of work, it should be confirmed by trial mixtures that the specified mixture proportions attain the required quality using the materials to be used and mixers of the plant to be used for actual construction. In case of nonconformance, the specified mixture proportions should be modified accordingly.

### **2.8 Production control**

#### **2.8.1 Control of aggregate**

(1) When producing self-compacting concrete, quality tests on aggregate should be conducted, and the job mixture proportions should be adjusted from time to time to adapt to new qualities of aggregate based on the test results.

(2) The surface moisture of aggregate should be frequently measured to allow prompt correction of the unit water content.

#### **2.8.2 Quality control of fresh concrete**

(1) The mixing beds of the mixers should be constantly monitored during mixing. In addition, quality tests on freshly mixed concrete should be conducted where required to ensure the fulfillment of the quality requirements.

(2) Since the qualities of freshly mixed concrete may widely fluctuate at the beginning of production, tests should be conducted frequently until the qualities are stabilized.

(3) If modifications of job mixture proportions do not lead to concrete with the required qualities, the specified mixture proportions should be adequately modified.

## **Chapter 3 Construction and Construction Control**

### **3.1 General**

Since self-compacting concrete is based on placing without vibratory consolidation, an adequate construction plan should be formulated in consideration of the properties specific to self-compacting concrete so that the proportioned concrete can be transported/conveyed and placed while the required self-compactability is retained. Also, control should be performed so that construction can be carried out according to the plan.

### **3.2 Transportation/conveyance**

#### **3.2.1 Transportation to the site**

Self-compacting concrete should be transported to the site within an adequate time in consideration of the time required for placing so that placing can be completed while the required self-compactability is retained.

#### **3.2.2 Conveyance by pumping**

When concrete pumps are to be used, the diameter, layout and length of piping should be determined in consideration of the qualities of concrete, type of pumps, pumping conditions, operating efficiency and safety. The type and number of pumps should be selected in consideration of the qualities of concrete, pipe diameter, pumping distance, pump loads and discharge rate.

#### **3.2.3 Other methods of conveyance within the site**

(1) Methods of conveying self-compacting concrete within the site should be selected in consideration of the construction conditions, such as the amount to be placed and rate of placing, as well as the qualities of concrete.

(2) When chutes are to be used, they should as a rule be drop chutes.

(3) In no case should belt conveyors be used.

(4) When other methods of conveyance are to be used, care should be exercised to avoid segregation due to excessive vibration.

### **3.3 Placing**

#### **3.3.1 Preparation**

- (1) Before placing self-compacting concrete, it should be confirmed that reinforcement and formwork are arranged as planned.
- (2) Before placing self-compacting concrete, it should be confirmed that the equipment and personnel distribution conform to the plan.
- (3) Where mortar losses are of concern as self-compacting concrete flows during placing, mortar should be placed prior to placing concrete.

#### **3.3.2 Distance of drop to placing surface**

The maximum distance of free drop of self-compacting concrete should as a rule be not more than 5 m.

#### **3.3.3 Flow distance**

The maximum lateral flow distance of self-compacting concrete should as a rule be 8 m, and must not exceed 15 m.

#### **3.3.4 Placing**

- (1) When placing self-compacting concrete, an elaborate plan should be formulated making the most of its characteristics. Basically, each concreting section should be placed continuously by the specified method.
- (2) Whereas the time from immediately after mixing to the end of placing is limited by such factors as fluidity and retention time for self-compactability, it should preferably be as short as practicable.
- (3) The rate of placing self-compacting concrete should be adequately selected according to the mixture proportions of concrete, shapes of members and reinforcement conditions.
- (4) When self-compacting concrete is placed in more than one layer, the upper layer must be placed within the time during which the previous layer retains its fluidity, so that both layers can be monolithically integrated.
- (5) The use of auxiliary methods of preventing or reducing air-voids on formed surfaces, such as form vibrators, tapping of the forms and spading along the forms, should be minimized to avoid segregation due to settlement of aggregate.

#### **3.3.5 Surface finishing**

The placement surfaces of self-compacting concrete should be roughly leveled to the specified shapes and dimensions, and the finishing should then be applied at an appropriate time before they become excessively stiff.

### **3.4 Curing**

- (1) The small amount of bleeding water of self-compacting concrete tends to cause surface drying. Initial curing should therefore be commenced immediately after placing, in order to prevent such surface drying.
- (2) The curing period after the initial curing of self-compacting concrete may be established similarly to normal concrete.

### **3.5 Construction joints**

- (1) When providing horizontal construction joints, the previously placed concrete should as a rule be made free from laitance and be sufficiently wetted. For vertical joints, the joint surfaces of the previously placed concrete should as a rule be roughened before placing new concrete.
- (2) Where it is confirmed that horizontal and vertical joints can attain the required performance, the jointing treatment may be simplified.

### **3.6 Reinforcement fabrication**

Embedded items, such as splicing wire and bar supports, for fabricating reinforcement should be placed in such a manner that they do not obstruct the flow and filling of self-compacting concrete.

### **3.7 Formwork and supports**

#### **3.7.1 Lateral pressure of concrete**

The lateral pressure of concrete should as a rule be regarded as liquid pressure when designing

formwork and supports.

### **3.7.2 Design of formwork and supports**

(1) When placing self-compacting concrete into inclined portions, it is necessary to install upper forms. Supports should be provided for such forms to resist the upward pressure and prevent floating of forms.

(2) When placing self-compacting concrete into confined spaces, vent holes should be provided at adequate positions in the top forms.

### **3.7.3 Sheathing materials**

When applying self-compacting concrete to structures where the aesthetic appearance of concrete surfaces is of particular importance, the materials for sheathing and type of form remover should be suitably selected to minimize air-voids on formed surfaces.

### **3.7.4 Construction of formwork and Supports**

Formwork for self-compacting concrete should be accurately constructed to prevent loss of concrete.

### **3.7.5 Removal of formwork and supports**

Similarly to normal concrete, formwork and supports of self-compacting concrete should be removed after the concrete has attained the required strength.

## **3.8 Construction control**

### **3.8.1 Quality tests on concrete**

(1) Quality test items for self-compacting concrete should be selected so that the structure can attain the required qualities, and tests should be basically conducted at the time of unloading by adequate methods.

(2) The frequency of quality tests should be established beforehand according to the type and properties of self-compacting concrete, construction scale and level of difficulty of construction. Since the qualities of fresh concrete tend to fluctuate at the beginning of production, it is recommended that the tests be conducted at short intervals until the qualities become stable.

### **3.8.2 Placement control**

The required items of placement control of self-compacting concrete should be selected, and control should be performed by suitable methods.