Outline of the 2016 Guidelines

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JCI Revision Committee for Guidelines for Control of Cracking of Mass Concrete 2008
Correction request and Announcement

Corrections
Page XI, the lower part of contents of the 2016 Guidelines

• Note: Material reference ⇒ Note: Reference material

Announcement
4 Reference materials of 8 placed in printed English version of the 2008 Guidelines are not placed in printed English version of the 2016 Guidelines. However, As CD including both English version of the 2008 Guidelines and that of the 2016 Guidelines with full reference materials is distributed to all participants, please see necessary reference materials through the CD.
Contents

1. General
2. Basis of Control and Prevention of Cracking Due to Heat of Hydration of Cement
3. Planning for Control and Prevention of Cracking Due to Heat of Hydration of Cement
4. Verification of Cracking Due to Heat of Hydration of Cement
5. Construction Works
6. Inspection of Cracks Due to Heat of Hydration of Cement

2 Appendices
18 Reference materials: Backgrounds for provision and commentary in the Guidelines
2 Case studies on verification of thermal cracking
1. General
   Scope

2. Basis of Control and Prevention of Cracking Due to Heat of Hydration of Cement
   Concept of thermal cracking control, DEF cracking prevention and the control and prevention procedures

3. Planning for Control and Prevention of Cracking Due to Heat of Hydration of Cement
   Limit values for thermal cracking control and DEF cracking prevention, and concrete countermeasures for the control and prevention
4. Verification of Cracking Due to Heat of Hydration of Cement
Design values of concrete, verification methods for thermal cracking, thermal crack width and DEF cracking based on 3D-FEM and simple equations

5. Construction Works
“Quality of construction works dominates quality of concrete structures” must not be forgotten above all
Execution of construction works based on the control plan for obtaining sufficient effects of measures for control of thermal effects

6. Inspection of Cracks Due to Heat of Hydration of Cement
Predetermined appropriate method, appropriate time, and appropriate criteria for the inspection, remedial measures when the targets are judged not to have been achieved from the inspection
Appendices

(A) Investigation on limit values of the maximum temperature in concrete to prevent DEF cracking in relationship between unit cement content and concrete temperature at placing

(B) Summaries of Cementitious Material Standards in Japan, USA and EU, and Quality of Typical Cement Applied to Concretes Provided in the 2016 Guidelines

Reference Materials of the 2016 Guidelines

18 reference materials included in the Guidelines provide data on background of new provisions, estimation methods for adiabatic temperature rise and so on.

Case studies of verification of thermal cracking

• Box culvert structures
• Piers
Main aspects of the 2008 Guidelines -1

The 2016 Guidelines follow the basic control principle and procedures of the 2008 Guidelines

1. Performance based verification method systemized for controlling thermal cracking is adopted.

2. The target of control of thermal cracking is provided to be prevention of cracking or control of crack width

(1) Thermal cracking probability related to the minimum thermal crack index \( \left( \frac{f_t}{\sigma_t} \right) \) is a reference index for control and verification in the case of prevention of cracking

(2) Crack width is a reference index for control and verification in the case of allowing thermal cracking.
Main aspects of the 2008 Guidelines -2

3. Design values of concrete using different types of cements are provided, including expansive concrete;

(1) Thermal properties (Adiabatic temperature rise, Thermal expansion coefficient, Heat transfer coefficient)

(2) Mechanical properties (Compressive and tensile strengths, Young’s modulus, Reduction coefficient for creep effect)

(3) Autogenous shrinkage depending on temperature, W/C and type of cement

(4) Expansive strain of expansive concrete
5. A simple equation for predicting crack width is recommended, which consists of reinforcement ratio and thermal crack index computed by 3D-FEM.

6. Simple equations for calculating thermal crack indices are recommended.

7. Drying shrinkage effect is not prescribed for the verification for thermal cracking, because the drying shrinkage effect on cracking of the mass concrete is generally not so considerable.
Main aspects of the 2008 Guidelines -4

8. **Surface cracking at early ages** due to temperature difference between the center and the surface layer of members **is not verification target**, because that shall and can be avoided by the appropriate curing, including a prohibition against demolding at early ages.
Main aspects of the 2016 Guidelines -1

1. The 2016 Guidelines systemize not only the control methods for thermal cracking but also prevention methods for DEF cracking.
2. Improvement of accuracy and extension of scope of application of design values of concrete are performed.
3. Simple equations for predicting thermal crack indices and thermal crack width are modified.
4. Simple equations for predicting the maximum temperatures in concrete members are recommended.
5. Provision of Prevention of DEF Cracking

- DEF cracking in mass concrete has not yet been reported in Japan, though that has been reported in other some countries. However, DEF cracking has been observed in some precast concretes in Japan, which are exposed to high temperature at early age similar to that in mass concrete. This fact means the possibility of DEF cracking in mass concrete even in Japan.

- In consideration of this, items with respect to prevention of DEF cracking are newly prescribed.

- The location to verify the maximum temperature in concrete is provided as a reference index to prevent DEF cracking in consideration of the penetration depth of water from surface.
Main aspects of the 2016 Guidelines -3

To avoid unnecessary work for verification of DEF cracking

• Experience based verification method for prevention of DEF cracking is provided

• Lines of limit values of the maximum temperature in concrete to prevent DEF cracking are drawn in relationship between unit cement content and concrete temperature at placing in consideration of member thickness, type of cement and heat transfer coefficient.

6. “Reference materials” are enriched by adding new technical data related to background on modified design values of concrete, limit values for DEF cracking prevention, a new equation for thermal crack width, estimation method of adiabatic temperature rise without using the equipment and so on, in the hope of application of the 2016 Guidelines overseas
Goal of the 2016 Guidelines

The 2016 Guidelines systemized not only the control methods for thermal cracking but also prevention methods for DEF cracking, provided limit values quantitatively for performance based verification and reference data on background of articles of provision, estimation methods of adiabatic temperature rise useful for engineers on construction sites and so on.

I’d like to expect that the Guidelines are applied overseas and contribute to creating high performance concrete structures with your, overseas engineers’ understanding and cooperation.
Thank you very much for your kind attention