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## Concrete Model Code for Asia - the Needs, Development and Details

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### Summary

This report presents the activities and achievements of an International Committee on Concrete Model Code initially established as a research committee by the Japan Concrete Institute in May 1992. The First Draft Asian Concrete Model Code published in January 1998 has been extensively revised before this second printing (March 1999). Once adopted, it is intended to serve as a basis for application in the Asian region taking into account the differences in natural and social environments in each country.

### 1. Background

Concrete are by far the most commonly used construction materials in the Asian region. Because of different historical reasons, the development of codes and standards for concrete structures in different Asian countries has taken divergent paths, frequently with strong umbilical ties to their respective colonial past. As a result many Asian countries have adopted codes and specifications of the United States and European countries including the ACI Codes and the British Standards. While Europe has Eurocode and ACI is commonly used in North America, most of the Asian countries have continued to use foreign codes for their practice. Not only are these codes do not necessarily reflect the local conditions of the countries in the Asian region, they also make economic and technological exchanges in the field of concrete engineering difficult amidst increasing economic, cultural and technological ties in an intra-Asia scope.

With the objectives of better understanding the codes and specifications used in some of the Asian countries and to carry out some preliminary groundwork for forming an international committee to develop the Asian Concrete Model Code, a Research Committee on Concrete Model Code for Asia was set up by the Japan Concrete Institute (JCI) in May 1992 under the chairmanship of Professor Jun Yamazaki of Nihon University. The study revealed that academic and engineers in the region recognized the need for and supported the idea of having a model code, which would be based on the Asian context. It should encompass the differences in economical, climatic and cultural environments of the region [1]. A survey of the design and construction practices in concrete work in the Asian region has served as background for the framework of the model code [2].



In 1994 the Committee under the chairmanship of Professor Hiroshi Noguchi of Chiba University evolved into an international committee independent of JCI though JCI continues to give financial support through its local committee. In this report activities and achievements of the committee are summarized.

## 2. Objective

The Asian Concrete Model Code is intended for use in the Asian societies and environment. The model code will aim to (i) serve as a guide for people writing their national codes; (ii) help to construct better infrastructures, effectively but in harmony with natural and social environment; and (iii) foster increased cooperation in the technological exchanges and research within Asia.

## 3. Collaborated Institutions and Membership

### 3.1 Collaborated Institutions

The committee activities have also been recognized by the following organizations:

- Association of Structural Engineers of the Philippines (ASEP)
- China Civil Engineering Society (CCES)
- Engineering Institute of Thailand (EIT)
- Indian Concrete Institute (ICI)
- Indonesian Society of Civil & Structural Engineers (HAKI)
- Japan Concrete Institute (JCI)
- Korea Concrete Institute (KCI)
- Sri Lankan Standards Institution (SSI)

### 3.2 Individual Members

Current membership of the Committee consists of representatives from Australia, Bangladesh, Cambodia, China, India, Indonesia, Japan, Korea, Pakistan, Papua New Guinea, Philippines, Singapore, Taiwan and Thailand.

### 3.3 Officers

#### *JCI Research Committee on Concrete Model Code for Asia (1992-1994)*

Chairman	Prof Jun Yamazaki, Nihon University
Secretary	Dr Tamon Ueda, Hokkaido University

#### *International Committee on Concrete Model Code (1994-1997)*

Chairman	Prof Hiroshi Noguchi, Chiba University
Vice Chairman	Prof Taketo Uomoto, University of Tokyo
Secretary	Dr Tamon Ueda, Hokkaido University



WG1 Coordinator	Prof Toshimi Kabeyasawa, University of Tokyo
WG2 Coordinator	Dr Takafumi Noguchi, University of Tokyo
WG3 Coordinator	Dr Sudhir Misra, Indian Institute of Technology, Kanpur

*International Committee on Concrete Model Code (1997-present)*

Chairman	Prof Taketo Uomoto, University of Tokyo
Vice-Chairmen	Prof Yew-Chaye Loo, Griffith University
	Prof Eksasit Limsuwan, Chulalongkorn University
Secretary	Prof Hiroshi Mutsuyoshi, Saitama University
WG1 Coordinator	Dr Tamon Ueda, Hokkaido University
WG2 Coordinator	Dr Somnuk Tangtermsirikul, Thammasat University
WG3 Coordinator	Dr Sudhir Misra, Indian Institute of Technology, Kanpur
Head, Editorial Group	Prof Yew-Chaye Loo, Griffith University

#### 4. Meetings and Workshops

The International Committee executes its business through correspondence. Two meetings per year have been scheduled generally in conjunction with planned events in the member countries. By doing so the committee can introduce the concepts of the model code to academics and practicing engineers participating in such events and at the same time receive their suggestions and comments. The occasions have also provided the International Committee members with opportunities to observe at first-hand the current situations in the countries hosting the event. Since its formation, the International Committee met on 9 occasions. The details of each workshop are summarized below.

##### 4.1 First Workshop (Tokyo, April 1994)

The Committee held a one-day workshop in Tokyo in April 1994 to conclude the first stage of its investigation and discuss its future task. Nearly 100 participants which included local and international members took part in the workshop. A framework for the model code was drawn up.

##### 4.2 Second Workshop (Bangkok, December 1994)

The second workshop was held at Chulalongkorn University in Bangkok, Thailand in December 1994 which was organized by the Engineering Institute of Thailand. During the workshop, the concepts for the code were discussed and the following 3 working groups (WG) were set up:

- WG1: Design
- WG2: Materials and construction
- WG3: Maintenance and management

Each working group consists of members from both the International and Local Committees. The groups were asked to revise the proposed framework and contents of the model code for presentation at the next meeting.



#### **4.3 Third Workshop (Tokyo, March 1995)**

The third workshop was held at the Tokyo Metropolitan University in March 1995 at which future tasks of the Committee and the time frame for drafting and implementing of the model code were discussed and agreed upon.

#### **4.4 Fourth Workshop (EASEC-5, Gold Coast, July 1995)**

The 5th East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-5) was organized by Griffith University Gold Coast Campus. At the conference, a special session was assigned to the Committee in which six papers concerning its activities and the current situation of concrete codes in Asia were presented. At the Committee meeting the committee discussed the WG reports and the necessity to involve national engineering organizations of each member country and region in the committee work.

Due to the ability of the conference series to attract wide participation from many Asian countries, it was agreed that the Committee would request future EASEC hosts to organize special sessions on the model code, and provide venues to hold the International Committee meetings.

#### **4.5 Fifth Workshop (Jakarta, March 1996)**

At the Jakarta workshop organized by the Indonesian Society of Civil & Structural Engineers committee members were requested to present papers relating to the Great Hanshin Earthquake Disaster and its damage to buildings, SRC buildings and bridges. Other presentations covered high-rise buildings in the Asian countries and durability of civil engineering structures. Respective coordinators of the 3 working groups presented the first drafts of the model code components.

#### **4.6 Sixth Workshop (Dalian, October 1996)**

Dalian University of Technology organized the Dalian workshop in October 1996. Besides presenting papers on the recent research activities on concrete engineering in civil engineering in their respective countries, committee members discussed the Revised Draft I of the model code presented by the 3 working group coordinators. The Committee also reiterated the importance of involving national engineering institutions in the committee work.

#### **4.7 Seventh Workshop (Hyderabad, March 1997)**

The seventh workshop was organized by Jawaharlal Nehru Technological University to coincide with an International Conference on Maintenance and Durability of Concrete Structures, March 4-6, 1997 in Hyderabad. A special session was held in which the Committee chairman introduced the activities and future tasks of the Committee. The 3 WG coordinators presented progress reports on the drafting of the model code.

#### **4.8 Eighth Workshop (Jakarta, August 1997)**

The 8th workshop was organized by the Indonesian Society of Civil and Structural Engineers (HAKI) held in conjunction with an international conference on structural engineering. The main business undertaken was to put forward the main contents of the Level 1 and Level 2 code documents that had been drafted. The discussion led to the decision on the publication of the first draft of the code at the 9th workshop in Taipei.



#### **4.9 Ninth Workshop (Taipei, January 1998)**

As was done during the 5th East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-5) in Gold Coast, a special session was assigned to the Committee during EASEC-6 organized by the National Taiwan University. Six papers concerning the Committee activities and the current situation of concrete codes in Asia were presented. The Committee meeting was held at the Department of Civil Engineering, National Taiwan University. The content of the first draft of the code was discussed. Necessary revisions would be completed prior to and finalized at the 10th workshop in Singapore.

#### **4.10 Tenth Workshop (Singapore, August 1998)**

The tenth workshop was held at the National University of Singapore. Revisions to the first draft of the code were discussed leading to the agreement on the content of the second draft and the publication schedule. The Thai Group who is currently organizing the IABSE Colloquium on Concrete Model Code for Asia (Phuket, March 1999) will handle the reproduction. Decision on administrative issues namely the location of the permanent secretariat, revenue generation, etc. will be made during the Phuket meeting.

### **5. Permanent Body**

The concept of having a permanent body responsible for the model code was discussed. The body which may be called the "Asian Model Code Committee" would comprise an advisory committee, an organizing committee and several task groups. Its main office will be located in any member country chosen by the committee with branch offices in the other member countries. In the meantime, JCI office in Tokyo will serve as an interim secretariat.

### **6. Financial Supports**

The Committee receives financial support from the following sources:

- The Japan Concrete Institute (JCI). Since its establishment in May 1992 of the Model Code Committee till the present, JCI has been providing an annual grant of 1.5 million yen to support the activities of the committee.
- The Ministry of Education and Culture of Japan (Monbusho). An annual grant of 3 million yen for 3 years (1994-97) under the category of international cooperative research supported the activities of the Model Code Committee followed by a second 3-year grant for the period 1997-2000.
- The Overseas Contractors Association of Japan (OCAJ) and more than 20 general contractors. Starting April 1997 OCAJ has provided, through JCI, a total grant of 7 million yen for a 2-year period.
- Respective organizations in member countries. At each of the eight workshops, respective organizations in the host country and member countries have provided financial supports for hosting the events, and for individual international members to attend the meetings.



## 7. An Overview of the Draft Model Code

### 7.1 General

The draft model code consists of three parts which are (1) Design, (2) Materials and Construction, and (3) Maintenance. The three parts provide specifications for three different stages of concrete structures, namely the stages before, during and after construction. The draft model code is being prepared in three different levels which conform to provisions of the ISO/TC 71. The Level 1 document provides the framework and basic concepts of the model code which is a performance-based code. The Level 2 document clearly specifies the required performances or items necessary to obtain the performances. It also contains provisions that are common to any country/region where the model code is applied. The Level 3 document will have practical guidelines which provide verification or acceptable solutions taking into consideration the local conditions in a country/region where the model code is applied. Currently, the committee has completed the drafting of the Level 1 and Level 2 documents. Examples of Level 3 document are included in the second draft, however, it is envisioned that the Level 3 documents are to be prepared by each participating country guided by the Level 1 and Level 2 documents.

### 7.2 Part 1 - Design

The Level 1 document for design underscores the main concept of the model code and that is the performance-based design. The contents of the Level 1 document are as follows:

0. Notation
1. General
2. General Principles
3. Requirements
4. Materials
5. Actions
6. Analyses
7. Examination of Performance
8. Evaluation of Performances

The Level 2 document specifies the performance indices together with actions to be considered for all the required performances. The document contains four chapters for four major actions as listed below since the methods of analysis necessary for calculating the performance indices are different among these actions:

- Design for Actions in Normal Use
- Design for Wind Actions
- Design for Seismic Actions
- Design for Environmental Actions

The Level 3 document contains the complete process for the examination of each required performance. It acts like a design manual and is to be prepared only for a particular type of structure or for a particular region or country. The Second Draft include some examples of the Level 3 document.



### 7.3 Part 2 - Materials and Construction

To ensure that the model code can be used in the Asian countries/regions regardless of the environmental conditions, the type of available resources and the level of construction technology, Part 2 of the code on Materials and Construction has been drafted with the following considerations: (1) performance-based; (2) user-friendly; (3) NAD (National Application Document)-friendly; (4) environmental-friendly.

The Level 1 and Level 2 documents provide a series of minimum requirements for the performance of construction materials, the standard of workmanship, measures of quality control and appropriate construction records that may be achieved on site in order to ensure that all the requirements in design for resistance, serviceability and durability of structures will be achieved. Both documents have six chapters:

1. General
2. Essential Requirements
3. Formwork
4. Reinforcement
5. Concrete
6. Prestressed Concrete

In the Second Draft, a test methods are listed in the Appendix.

### 7.4 Part 3 - Maintenance

The Level 1 and Level 2 documents on Maintenance were drafted by compiling various methods for maintaining the completed structures as designed. The methods are in two categories: (1) for preventive maintenance; (2) for corrective maintenance. The documents also include selection of materials and the methods for maintenance work.

The Level 1 and Level 2 documents consist of the following seven chapters:

1. General
2. Basis of Maintenance
3. Inspection
4. Deterioration Mechanism and Its Prediction
5. Evaluation and Decision Making
6. Remedial Action
7. Records

## 8. Conclusions

It took the Committee 6 years to come up with the First Draft of the Asian Concrete Model Code and another year to have the Second Draft published. Needless to say that considerable efforts have been made by people within and outside the Committee in numerous ways. The Code is now ready to be adopted as the national ones. I hope that experiences and knowledge shared among participants during this Colloquium will lead to an effective implementation of the Concrete Model Code.



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