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

Taketo UOMOTO
Professor
Center for Collaborative Research,
University of Tokyo, Japan

Taketo Uomoto, born 1947.
Received his doctor of engineering degree from the University of Tokyo in 1981.
Chairman of the International Committee on Concrete Model Code

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 Ekasit 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 manul 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 constructino 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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The ACI 318 Code Process

John HANSON
Professor
North Carolina State University
Raleigh, NC USA

John Hanson, born 1932, received civil engineering degrees from South Dakota State University in 1953, from Iowa State University in 1957, and from Lehigh University in 1964. He was a researcher with the Portland Cement Association from 1965 to 1972, when he joined Wiss, Janney, Elstner Associates, Inc. He served as President of WJE from 1979 to 1992, when he retired to join the faculty at NCSU.

Summary

After providing a brief history of the origin and development of the ACI Building Code, this paper presents a general overview of the process by which the code is revised and modified. In addition, significant changes introduced into the most recent revision, ACI 318-95, are summarized. The status of the current work of Committee 318, which is expected to lead to ACI 318-99, is briefly reviewed.

1. Brief History

The origins of the ACI Building Code (1)* go back to the early 1900s, to efforts of the National Association of Cement Users. The NACU was a society organized in 1905 (2) to deal with problems arising from the use of concrete. A code for reinforced concrete by the committee on Laws and Ordinances of the NACU appeared in 1907. This code apparently was the forerunner of the First Standard Building Regulations, which was adopted by the NACU in 1910.

However, another group known as the Joint Committee on Reinforced Concrete had been formed in 1904. This committee consisted of representatives of four major societies, all of whom were interested in the control of concrete construction. These societies were the American Society for Testing Materials, American Society of Civil Engineers, American Railway Engineering and Maintenance Association (which later became the American Railway Engineering Association), and the Association of American Portland Cement Manufacturers (which later became the Portland Cement Association). The first report of the JCRC on regulations for concrete was issued in 1910. A final report was issued in 1917.

In July, 1913, the name of the NACU was changed to the American Concrete Institute, to recognize the breadth of the aims and interests of the society. A revision of the First Standard Building Regulations was also issued in 1917, which was known as the ACI Code.

* Numbers in parenthesis refer to references listed in Section 7

Differences between the JCRC regulations and the ACI Code were a source of controversy among many engineers who felt there should be more uniform standardization of concrete practices. In subsequent years, a second and third Joint Committee were formed, each of which produced a final report in 1925 and 1940, respectively. However, ACI was also continuing to work on its document, resulting in regulations referred to as the 1925 and 1936 ACI Codes. The 1936 ACI Code was developed by Committee 501, because it was also referred to as ACI 501-36. Committee 501 was apparently organized in 1929, and later became Committee 318. The first code produced by Committee 318 was known as the Building Code Requirements for Reinforced Concrete (ACI 318-41).

Since that time the ACI Code, or rather the ACI Building Code as it has come to be known, has been updated on a regular basis, in 1947, 1951, 1956, 1963, 1971 and thereafter on a six year cycle, although there have been minor mid-cycle revisions in the recent intervals. A very interesting point of view on the development of the ACI Building Code during this period of time may be found in an interview of Chester P. Siess presented by Nancy L. Galvin (3). The informality that characterized the development of the ACI Building Code has been largely supplanted by more rigorous procedures now required with the emphasis on standardization. These procedures are discussed in this paper.

The current ACI Building Code is ACI 318-95 (4). The next code is expected to be published late this year, as ACI 318-99 (5). Thereafter, the code is expected to be revised in three year intervals. This change in procedure recently came about as a result of a merging of three separate model code groups in the United States into the International Code Council. The ICC intends to publish a single model building code, to be known as the International Building Code, in the year 2000, and every three years thereafter. The publication of the ACI Building Code will then always precede the IBC by a year. It is anticipated that the ACI Building Code will be adopted by reference in the IBC.

2. Current Mission and Organization

Committee 318 is a Technical Committee of ACI. As such it falls under the jurisdiction of the Technical Activities Committee, which is the final authority on technical issues in all publications. The mission of Committee 318 - Standard Building Code - is to develop and maintain standard building code requirements for plain and reinforced concrete (6). As a committee that produces standards, prescribed document adoption procedure set forth in the Technical Committee Manual (7) must be followed. This procedure will be reviewed in the next section. The work of Committee 318 is carried out in a Main Committee and Subcommittees.

Following the completion of a major revision of the code, i.e. the completion of a code cycle, the membership of Committee 318 has usually been discharged. A new chairman is appointed, although in infrequent circumstances the chairman of the committee during the last cycle has been reappointed. The incoming chairman makes recommendations to the TAC for reconstituting the committee.

Committee 318 has four classifications of membership, as follows: a. Active, b. Subcommittee, c. Consulting and d. Liaison. Only Active members have the privilege and obligation of voting on matters before the Main Committee. Subcommittees are made up of Active members of the Main Committee as well as other members who represent technical committees that cover issues related to a particular subcommittee or who provide special expertise for the subcommittee. These members vote only on matters before the subcommittee. The Consulting member classification is for persons with special expertise or a long time association with Committee 318. Liaison membership is a special classification for representatives of other organizations to provide such groups with current information about developments within Committee 318.

Committees such as 318 that produce standards are required to have balance in their voting membership, in order to ensure fairness and balance among affected interests. To achieve balance, members are classified as Producer, User, or General Interest. A producer interest is an organization or an individual that produces or sells materials, products, or systems covered in the committee mission. A member who represents a producer interest is classified as a Producer. A member who is a User represents an organization that purchases or uses materials, products, or systems covered in the committee mission. A member in the General Interest classification is anyone who is not classified as a Producer or User. For example, an employee of a government agency or a university is classified as General Interest. Balance is considered to be met in a committee when the combined number of voting members classified as User and General Interest equal or exceed the number of voting members classified as Producer, and each producer interest has no more than one voting member.

After the work on ACI 318-95 was completed, about one-half of the previous Active membership was reappointed for work on the next code cycle. With the addition of new members, the membership of the Main Committee consisted of 19 engineers or architects, 7 academic persons, 5 contractors, 5 persons from industry, and 4 persons from government.

Eight of the ten Subcommittees of Committee 318 are responsible for specific sections of the ACI Building Code. These 8 subcommittees are listed below:

<u>Subcommittees of ACI Committee 318</u>

318-A	General, Concrete, and Construction
318-B	Reinforcement and Development
318-C	Safety, Serviceability, and Analysis
318-D	Flexure and Axial Loads
318-E	Shear and Torsion
318-F	Two-Way Slabs
318-G	Precast and Prestressed Concrete
318-H	Seismic Provisions

The two remaining subcommittees are Metrication and Editorial. In addition to a code in English units, ACI 318 produces a document entirely in S.I. units. The Metrication subcommittee makes recommendations to the Main committee for issues that arise concerning the metrication of the code. The Editorial subcommittee seeks to maintain uniformity of style in the code.

3. The Adoption Procedure

Changes in or additions to the ACI Building Code are proposed as a result of new research and new or improved technology. The performance of existing structures, particularly in view of unexpected distress or catastrophic failure, provides impetus for change in code provisions.

While many of the changes originate with members of Committee 318, other ACI committees are encouraged to propose changes as well. For that matter, a change proposed by any interested party is considered.

To facilitate consideration, Committee 318 requires that each proposed revision or new inclusion cover only one subject and include the Section or Sections of the ACI 318 Code that are affected, a complete description with proposed wording where possible, and the reason for the change. The proposed wording should be the precise language that is desired for incorporation as well as the existing language that should be removed. Major reasons for changes include:

- Correcting shortcomings in the present code for those cases where the code does not provide adequate safety or serviceability
- Reducing cost of construction while maintaining public safety and serviceability
- Reducing design costs while retaining adequate public safety and serviceability
- Simplifying design or construction procedures
- Clarifying provisions where ambiguity has been found in application

Finally, the proposal should include all of the supporting material for the change. If the proposed change will result in revision to design procedures, one or more examples should be included that show how the change affects design practice.

Requests for a proposed revision from the public at large and the ACI membership should be sent to the Chairman of ACI Committee 318, with copies to the Secretary of ACI 318 and the ACI Director of Engineering. The Chairman assigns each revision to a lead Subcommittee, and notifies other concerned Subcommittees. If a proposed revision originates in a Subcommittee or an ACI committee designated for liaison with the concerned Subcommittee, the revision is submitted to the Subcommittee Chairman, with copies to the Chairman and Secretary of ACI 318 and the ACI Director of Engineering.

After review and discussion, the lead Subcommittee either declines to consider the proposal or accepts the proposal for further action. If declined, the reasons must be reported in the minutes of a Subcommittee meeting, after which the Secretary of ACI 318 informs the proponent as well as the Chairman of ACI 318 and the Director of Engineering. If accepted, the lead Subcommittee Chairman assigns a Change Submittal Number which is used for subsequent processing.

After due consideration, a final Subcommittee vote is taken, which may either be oral at a Subcommittee meeting or written. Negative votes must be accompanied by a reason. If the revision is not approved, it may be discussed and further revised in the Subcommittee as needed, and then reballoted. If and when the revision is approved, the Change Submittal is moved to the Main Committee for action, along with a summary of the results of the action.

The lead Subcommittee chairman, or his or her delegate, presents the Change Submittal to the Main Committee. After presentation and discussion including further revision, if agreed to,the Subcommittee Chairman may move the item for Main Committee ballot, or take the item back to the Subcommittee for further consideration. If balloted in the Main Committee, the goal is to obtain practically unanimous approval. The ACI standardization procedure require approval by at least two-thirds of the Yes and No votes but not less than 50% of the eligible votes.

After an item is successfully balloted in the Main Committee, the Chairman and Secretary of ACI 318 submit the action to the Technical Activities Committee for further steps in the standardization process. If the TAC proposes any editorial changes as a result of its review, they are referred back to the lead Subcommittee Chairman for concurrence or comment. Proposed substantive changes are also referred back to the lead Subcommittee, if necessary, and to the Main Committee for appropriate action.

Following TAC approval, the document is submitted to the Standards Board for verification that all of ACI's standardization procedures have been followed. The document is then published for public review and for discussion for three months. ACI members as well as the public at large may suggest revisions. After publication, the revisions are presented by Committee 318 for oral discussion at an annual or fall ACI convention.

In accord with its normal procedure, Committee 318 will review all comments and suggested revisions, including further revision and approval of amendments to the document, and the Chairman of Committee 318 will then write a closure statement that is reviewed by the committee. TAC further reviews the public comments, amendments and closure statement, and after agreement forwards the closure to the Standards Board. Upon approval of the Standards Board, the closure statement and any revisions are published, and the document is submitted to the entire voting membership of ACI, The document must receive a two-thirds affirmative vote of all ballots marked Yes or No. If approved, the document becomes an official ACI standard upon certification of the results of the letter ballot.

4. Incorporation Into Legally Binding Building Codes

The provisions in the ACI Building Code are not legally binding until they are incorporated in the building code of a local jurisdiction, such as a city or municipality. However, since the building code of a local jurisdiction generally covers all aspects of construction, and since the local jurisdiction may not have the capability to maintain a code and assure its rigor, the local jurisdiction usually joins an agency that produces a model building code.

In recent years, there have been three recognized agencies in the United States that have produced a model building code, each intended for use in a certain geographical area in the United States. These agencies have incorporated the provisions of the ACI Building Code in their code either by reference or by transcription. The agency that incorporated the provisons by transcription has, over time, also made some changes in the document. ACI Committee 318 has sought recently to minimize these differences, to facilitate the adoption of the ACI Building Code by reference in the International Building Code or IBC 2000 referred to earlier in this paper.

5. Future Directions

There were a number of significant changes in ACI 318-95 (4). These included a change in the title of the document, from "Building Code Requirements for Reinforced Concrete" to "Building

Code Requirements for Structural Concrete," to reflect the incorporation of a new chapter on "Structural Plain Concrete" in the code. Other notable changes include the modification and expansion of design provisions for slender columns, major revision of the design provisions for torsion which apply equally to non prestressed as well as prestressed concrete, simplification of the calculation of development length for deformed bars in tension, and a substantial expansion of provisions on precast concrete incorporating detailed requirements for structural integrity. In addition, a new Appendix B on "Unified Provisions for Reinforced and Prestressed Concrete Flexural Members" was introduced into the code, allowing heavily reinforced beams to be used with a reduced capacity reduction factor based on the net tensile strain in the extreme tension steel. This new provision also provides a smooth transition in flexural strength of columns as axial load decreases to zero. A new Appendix C on "Alternative Load and Strength Reduction Factors" was provided for the design of mixed concrete and steel systems.

Changes that are in the process of being incorporated into ACI 318-99 are limited as a result of the reduction in the code cycle from 6 to 4 years. Further, the decision to make this change was taken after the completion of the code cycle leading to ACI 318-95, thus reducing the time that would otherwise have been available for processing.

There will be extensive revisions in Chapter 21 of ACI 318-99 (8), Special Provisions for Seismic Design. These revisions were brought forward as a result of the 1994 Northridge earthquake in California, and are expected to include the following:

- New detailing provisions for structural diaphragms
- Provisions for walls that relate requirements more directly to displacement demands
- Revisions in requirements for transverse reinforcement for columns
- Introduction of requirements for diagonally-reinforced coupling beams
- Allowing the use of high-performance mechanical splices in yielding regions.

In recent years, Committee 318 has been developing a new chapter on fastenings to concrete. As of the time that this paper is written, however, it is uncertain whether this chapter will be included.

6. Concluding Remarks

Over the last three or four code cycles, the ACI Building Code has become more voluminous and complex. This has been a rather natural process, as a result of incorporation of extensive research on the behavior and strength of structural concrete members into the code. The advancement of technology based on research, along with the demand for structures that are both safe and economical, has led to many significant improvements in building codes, largely based on strength design procedures. While some improvements have been simplifications, most have been complications because dealing with so-called disturbed regions in concrete structures invariably requires very specific and detailed requirements. As a consequence, the code has become more difficult and time consuming to use in the design process.

Further, while serviceability and durability have received more attention in recent codes, there is growing recognition that volume changes and environmental factors have more influence on life than strength requirements, provided of course that an adequate level of safety is provided by the structure. In ACI 318-89, construction requirements relating to durability were placed in a separate Chapter 4 of the code. Controversy continues about some of these provisions, along with the realization that minimum requirements, as given in a code, can never provide full protection in all circumstances.

Another factor affecting the code is that the process of adoption has become more stringent, to assure opportunity for all interested parties to provide comment and proposals. At the same time, the ability to make revisions has become cumbersome and time consuming as a result of providing due process to all comments.

Finally, there is increasing need that a building code have worldwide applicability. While some people have interpreted this as competition for a code that would have preference over other codes, it is the view of the author that any code which can be shown to provide safe, serviceable and durable designs should be permitted for use by engineers with familiarity and understanding of the applicability of that document.

7. References

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The development of an international codification for structural concrete with the CEB-FIP model codes

Michel **VIRLOGEUX**
President of the
Fédération Internationale du Béton

Michel Virlogeux, born in 1946, graduated 1970 at the Ecole Nationale des Ponts et Chaussées. Former head of the large bridges division of the SETRA, he designed many bridges among which the Normandie Bridge. Now independent consultant.

Joost **WALRAVEN**
Deputy President of the
Fédération Internationale du Béton

Joost Walraven, born in 1947, graduated 1972 from the Delft University of Technology. As research assistant he finished his PhD in 1980. Afterwards worked for Corsmit Consulting Engineers in the Hague, and was in 1985 appointed Professor of concrete structures at the Delft University of Technology.

Summary

This paper reminds the goals of the foundation of CEB and FIP in the beginning of the fifties, and evidences the evolution of codes which have been produced along the years mainly by CEB activities. The development of the Eurocodes on the basis of the CEB-FIP Model Code for Concrete Structures was a recognition of the previous work done by this organization. The recent merger between FIP and CEB makes the new Fédération Internationale du Béton, ***fib***, to a truly international association for structural concrete, with the task to develop an international design philosophy and model codes, recommendations and guidance far beyond any nationalistic approach.

1. Introduction

The development of a Concrete Model Code for Asia is of course of major importance considering the rapid development in the region, at present and in the future.

As ***fib*** officers, we encourage that such an initiative takes place within our association between its Asian members, either by using the ***fib***-expertise, or by creating a specific ***fib***-Model Code tailored to Asian conditions. Anyhow, ***fib*** felt extremely engaged when the Thailand group of IABSE decided to organize a specific Symposium in Phuket, and we are honoured to have been invited to give a keynote lecture on this decisive issue.

Of course it is of major importance that a real convergence between the different codes can be achieved. More and more an international market for construction is developing, with large international companies and gigantic projects, and it is a key issue that there should be a clear understanding between the different partners, including the local ones ; this is not possible without an internationally accepted design philosophy and standards. And if true competition is wanted, it is not acceptable any more that a particular codification could protect or favour certain designers or contractors of any specific nation or region.

We must develop a really international code philosophy, and this is one of the major goals of ***fib***.

2. CEB and FIP history

2.1. The Fédération Internationale de la Précontrainte, FIP, was founded in 1952 by the pioneers of prestressing – Freyssinet, Torroja, Magnel and many others – to develop this technique which was ignored by the majority of engineers, and which had not received enough attention from IABSE at the time. Being not conveniently considered by the existing bodies, these now famous pioneers founded their own association with its official address in Paris though the headquarters were installed from the beginning in England ; these headquarters were at first hosted by the Cement and Concrete Association at Wexham Springs, and later by the Institution of Structural Engineers in London.

The goals of FIP were clearly the dissemination of knowledge and the promotion of the prestressing philosophy, -design and -techniques on a world wide scale. FIP has been a really international association with member countries from the five continents.

FIP has been strongly supported by the inventors and industrialists of prestressing systems, and developed very practical activities including the preparation of state-of-the-art-reports and recommendations oriented to applications. For this reason, FIP attracted owners, designers and contractors and the FIP congresses have been the major events in the world of concrete every fourth year, as will be the ***fib*** congresses in the future.

2.2. The CEB was founded as Comité Européen du Béton (European Concrete Committee) in 1953, on the initiative of the French contractor Balency-Béarn. He and the co-founders Nennig, Base, Rüsch, Torroja and Wästlund, coming from contractors and research, had the vision that post-war Europe would need a common approach in concrete design and construction. Now, 45 years later, this is, inspite of all the progress made in creating a common market, not yet completely achieved ; but we can appreciate today how farsighted these founders have been.

Their greatest concern was the enormous disparity between codes in Europe, and their very limited scientific bases. Clearly, the goal of CEB has been from the start the development of a European code ; with the development of more scientific approaches as a first step and the harmonised preparation of a Model Code as a second and major step.

Since this is the precise theme of this presentation, we shall later regard more in detail the development of the CEB Model Codes, which was done in close relation with FIP. But we must not forget the intense scientific activity in the CEB Commissions, which led to the publication of some 250 Bulletins ; some of them have been a real breakthrough for the scientific and technical knowledge in the field concerned. We shall just cite the work on buckling, non-linear analysis of hyperstatic structures and shear behaviour.

2.3. During decades, the elaboration of international recommendations and Model Codes directly inspired national codes, producing step by step the desired convergence. Milestones were :

- 1964 First CEB International Recommendations, translated into 15 languages.
- 1968 UNESCO Code and Manual based on the 1964 Recommendations.
- 1970 CEB/FIP 2nd International Recommendations.
- 1974 CEB initiated an effort together with FIP, ECCS, CIB and RILEM to create an "International System of Unified Standard Codes of Practice for Structures".
- 1978 CEB/FIP Model Code (Vol. 1 and 2 of the above International System).
- 1985 CEB Model Code for Seismic design.
- 1990 2nd CEB/FIP Model Code.

Especially the two Model Codes were of great influence on many national codes and quite naturally served as a basis for the drafting of Eurocodes when the European Commission launched this activity : the necessity of pre-codification based on a thorough discussion of research results and experience from practice became once more evident.

With time, the CEB became more international with a new name for the same logo adopted in 1976: Comité-Euro international du Béton, since many countries outside Europe were interested in its activities and took part in them more and more frequently. And European countries also understood that Europe is only a part of the world and must be open to other continents.

2.4. Finally we must briefly evoke the merger between FIP and CEB.

It appeared more and more unlogical to have two different associations in the same field, and it was felt to be necessary to limit the number of events and meetings, the more as many members were working in both associations and could not maintain such a demanding involvement. It took a long time to merge the two associations, but the preparation time has been extremely useful since it helped understanding each other, making from this merger a great success.

We just want to add that the need for a closer international collaboration is not limited to CEB and FIP. The new ***fib*** is a member of the Liaison Committee of International Associations, and has developed – and will continue to develop – a privileged and friendly relation with IABSE as evidenced by our presence here.

3. The Model Codes

3.1. As already said, the concrete codes in Europe – and in the world – were dramatically different 40 years ago. An excellent example was given during the Quebec IABSE Symposium in 1974 : the bearing capacity of a reinforced concrete column has been evaluated considering second order effects in the different participating countries following their own code ; the values differed from 1 to 3 between the extremes. The need of common bases and philosophy was clear.

3.2. But the major input of the CEB codification activity has been the introduction of a new design philosophy on the basis of limit states.

Some researchers and pioneers foresaw the drawbacks of the traditional approaches more than 50 years ago, and began developing new safety concepts based on the notion of limit states and on partial safety factors. It is the great merit of CEB to have adopted, developed and introduced this new philosophy in its Model Code, pioneering in the field and being in advance as compared to all national codes and giving to concrete structures a leading position as compared to other materials. For this reason, the 1970 CEB/FIP International Recommendations are a historical reference as well as it has been a real model to many national codes in Europe. In 1985, Theodossios Tassios – then the CEB President – established that CEB strongly influenced the concrete codes in Belgium, Brazil, Finland, France, Greece, Italy, Portugal and Spain, and moderately influenced the concrete codes in China, Germany, Netherlands, United Kingdom, Switzerland, Turkey and Yugoslavia.

Safety concepts were developed in the seventies with semi-probabilistic approaches, and later-on real probabilistic analyses were made as a basis for a better evaluation of structural safety and for a more scientifically based definition of the partial safety factors.

3.3. With the two editions of the Model Code – in 1978 and 1990 – improved models were developed for a more accurate representation of the structural behaviour of reinforced and prestressed concrete structures, and new chapters were introduced to cover new fields. It could only be reproached to these Codes that they tried to cover all situations with too specific models, with as a consequence not enough difference between the major points and details. This could be a serious drawback for a real code, but it is only a small one for a Model Code.

3.4. Clearly, ***fib*** will have to fix its position for the future. Is it useful or not to prepare a new version of the Model Code, a ***fib*** Model Code now ? This would have some major advantages in our opinion, at least to develop a really international philosophy when several "regions" are now unifying their code : the American Code, ACI ; the Eurocodes already evoked ; and later the Concrete Model Code for Asia, theme of this Symposium. An international approach would have the merit of avoiding the development of unnecessary differences and of "regionalist" antagonisms as well as any tentative of impairing the competition through "regional" codes.

4. The goals for a new code

4.1. A good code must have several qualities ; it must be coherent, scientifically based, open-minded, transparent, simple, oriented to practice and flexible. This needs some comments.

4.2. We probably do not need to explain why a code must be "coherent" and "scientifically based": a code must be based on a clear and scientific theory, consistent and coherent, corresponding to a good representation of the structural behaviour, and of the material physics. We cannot accept specifications only justified by habits or tradition, which are not justified by a quantified analysis of a clear physical phenomenon.

4.3. A code must be "open-minded", which means that it cannot be based on a given theory excluding other ones. To take an example, many oppose now the "classical" approach and the "strut and tie" theory ; this is clearly a mistake and both approaches have advantages and fields of application. In addition the development of computer software will change the situation in the future – as it has already done though it has not been really recognized by codes –, allowing for more and more sophisticated non-linear analyses, including for example the prediction of the distribution of cracks in a three dimensional solid.

A code must be adapted to the different existing theories, making possible for the designer the use of the most appropriate one for his specific problem, or the most transparent one.

4.4. "Transparent" means that a code has not been prepared for those who made it but for those who will use it.

The ordinary users, who have not been involved in the redaction of the code, must understand its philosophy, and also the physical phenomenon behind each specification. This is a clear condition for an intelligent application of the code ; and more important for an understanding of its limits. A "blind" specification or formula cannot help ; it can be misunderstood or used outside its limits of validity. If the philosophy of the specification is clear for the designer, he will be able to see if something is outside the limits of his problem, and he can adapt the code to his need.

But it must be clear in the same time that a code – even a Model Code – is not an education book. This is an occasion to say that an association like ***fib*** certainly has to develop its activity in the education field and probably has – at least in our opinion – to prepare a Model Education Book on structural concrete, or perhaps education books of two different levels : a rather simple one for practitioners, and a more complete one for researchers and professors. This would be a great help for the redaction of a code, transferring detailed explanations to a more adapted document.

4.5. "Simple". Not forgetting the famous sentence by Albert Einstein : as simple as possible but not simpler.

This means that a code must not aim at covering 100% of the potential applications but only the most frequent ones, 99% of the practical cases. It is clear that exceptional structures – very large bridges, big offshore platforms etc...- need special provisions but are as well designed by very qualified teams of engineers which are able to adapt and complement standard specifications, provided that adapted comments clearly precise the limits of the specifications and that the design philosophy specified by the code is clear. Another possibility is that the code is complemented by a book of comments as was done on some occasions in some countries.

What must be very clear in the code is the philosophy, which is not to be confused with the application method which may be adapted or developed in specific applications, or changed with the development of software capacities. And finally, a code must not be a collection of specifications developed by researchers to promote their works. A code must be reduced to the essence, and specific problems related to such or such type of structures must be detailed in specific recommendations as was done by FIP.

4.6. "Oriented to practice" is very strong and clear. Codes are made to help designers to design properly and have no other purpose. They must be adapted to them.

4.7. Finally codes must be "flexible" to adapt to the technical evolution and to the evolution of materials. This is another reason to reduce them to the essence, to the basic philosophy and to the definition of the structural behaviour.

Codes must not prevent progress. And this is a major problem as we shall see.

5. New problems for concrete codes

5.1. The development of modern codes, model codes or application codes, is made difficult by new problems.

We have already evoked the development of new theories, or of new representations of the structural behaviour such as the modelisation with struts and ties. Very clearly this method has very large advantages, explaining and making logical what was only covered previously by the "règles de l'art" to use the French word, "règles de l'art" which were to be supplemented to the results of very simple analyses. This is why strut and tie models can be a simple and reliable tool to design the reinforcement of classical structural elements – like footings for a well known example – or regions in a structure. But for large and complicated structures, strut and tie models must be supported, or checked, by a FEM analysis – preferably non-linear – to establish the flow of forces which can be different for each loading case.

Clearly modern codes will have to be adapted to different approaches and be very flexible as regards modelisation.

5.2. At the same time, because of the rapid development of the computational capacities, there is a tendency to ask for more and more sophisticated analyses.

An excellent example can be given for seismic analysis. Some softwares can now evaluate the non-linear time history response of a concrete structure, as was recently shown for the Rion-Antirion Bridge. It is evident that those facilities will change the philosophy of seismic design.

Seismic codes must not forbid such a development, and modern codes must accept – in parallel with the now classical specifications based on the concept of capacity design, which includes many "règles de l'art" in fact – the emergence of new approaches which will replace, with a convenient frame, the more or less conventional specifications. The pre-definition of a behaviour coefficient, as an example, loses any significance when a non-linear time history of the dynamic response can be produced. Modern codes will have to allow for both approaches, the existing one being most probably favoured during many years for classical structures.

This is another occasion to say that codes must leave liberties to designers, specially for very large projects, and refrain from codifying what is under development. Codes must codify what is well mastered, and not prevent progress.

5.3. Finally, we must evoke the fantastic evolution of materials and specifically concrete.

In the pioneer applications of prestressed concrete by Freyssinet, the concrete strength was often about 50 MPa, obtained with extremely qualified manpower and with engineers on the site. With the enormous development of the scale of construction there has been a clear regression and in the seventies and eighties it was classical to limit the concrete strength between 30 and 40 MPa, partly due to the limited interest of the cement industry in the civil engineering market. Only the prefabrication industry pioneered high strength and high performance concrete.

Under the influence of several countries – and specially the Norwegian offshore industry – we have recently seen a fantastic development of concrete strength, up to 100 MPa. And some companies and engineers – like Bouygues in France in cooperation with Lafarge – are developing completely new materials, such as the reactive powder concrete which can have a compressive strength comparable to the strength of steel.

But the mechanical and physical characteristics and these different types of concrete cannot be compared, and cannot be evaluated from the same specifications. Even more, it is now possible to "design" a specific concrete for a given application : for example high strength and reduced shrinkage to fill pockets of concrete slabs in composite bridges. We now have a real development of "material design", of the design of the concrete itself which must be considered in the codes. Codes must be – once more – flexible enough to be applicable to these specific and special concretes. This is certainly not the simplest task.

6. Conclusion

It is clear that the development of adequate Model Codes is of significant importance. We know now that this awareness exists in Asia as well, and ***fib*** will be glad to cooperate with Asian countries in order to realize this ambitious goal.

Concrete Model Code for Asia - Concept to National Implementation

Ekasit Limsuwan
Professor in Structural Engineering
Chulalongkorn University
Bangkok, Thailand

Dr. Ekasit Limsuwan, born in 1947, received his Ph.D. from the University of Texas at Austin 1977.
He has experienced in structural design, construction supervision and research work in high performance concrete, structural concrete, formwork technology and concrete durability.

Summary

Concrete Model Code for Asia is necessary since the region has shown great potential for construction by volume and complexity. Achievement of the "First Draft" in 1998 has proved some unification among codes of practice in each country. Ultimate achievement can be obtained if this model code is adopted into the national code and then implemented and practiced amoung professional engineers. Current codification modular of ACI, CEB/FIP(fib), and some Asian countries will be compared procedure, then each country modifies it to suit their need. The engineering institute in each country will be the most important organisation to adopt the national code which is compatible with the current code of conduct, government regulation and social acceptance. The ultimate goals of the Concrete Model Code for Asia are high performance of structural concrete in strength, serviceability and durability. The success will depend on each individual engineer, professional institution and co-operation among the organisations.

1. Introduction

Structural concrete is considered as a major construction material for infra-structures such as bridge, building, dam, port, habour, tunnel and off-shore structures etc. Potential of construction industry in Asian countries is quite large by means of construction volume and its complexity. The projects become gigantic, involve different partners, and lead toward international contracts. The needs to develop the concrete Model Code for Asia are quite essential and the ultimate goals can be achieved only if the national code is adopted and implemented conformingly. The principal objective of the Concrete Model Code is the high standard of structural performance and public safety concerning natural and social environments.

Achievement of the "First Draft, Concrete Model Code for Asia" in 1998 has proved some efforts in technical co-operation among engineers in the region through the International Committee on Concrete Model Code (ICCMC) with the action support of Japan Concrete Institute (JCI) and some other national engineering institutes. The important task is to collect industrial standards and codes of practice in each country to unify and develop a model one for all Asian Countries. The code contains design, construction and maintenance in which they can be converted and adopted into the national one of the same framework.

Implementation of the model code would be more effective if the code has convergence of the differences in technical background of practical standard and relevant regulations. Codification process of some major organisations such as the American Concrete Institute (ACI), Comite Euro-International du Beton (CEB), and Federation International de la Preconstrainte(FIP), should be considered as a module for development, adoption and implementation. National code adoption is the first step for the implementation process. This paper introduces some typical approaches that engineering education, professional practices, and natural and social environments co-inside in the process. For legal aspects, the national code must be incorporated into the local jurisdiction process which becomes more complicated especially in some countries. The engineering institutes or similar institutions must take some active roles in policy making, strategic planning, intensive operation, specific monitoring and proper control. The ultimate goals of the Concrete Model Code implementation are the high performance of structural concrete.

2. Concrete Code Modular

Normal engineering practices in Asia, national code is already a part of the Building Control Act or a part of the regulation. Then the implementation process must be concentrated in legal aspects rather than the technical one. On the contrary, some national codes may be adopted from international model codes such as ACI or CEB/FIP, or duplicated from some other national codes. The achievement in development of the Concrete Model Code for Asia, will liberate the national code adoption and the implementation process. Several modulars have been studies and it is found that differences in scientific background, technology development, practical standard, and legal aspect, would lead to the best practice developed by their own professional institution. A module introduced in this paper can be adjusted to satisfy the local conditions of natural and social environments.

Modular A: Code of practice is coherent of research work and practical experience (Fig. 1). This module is initiated by academic institutions by means of research to improve or develop technology for better performance of the existing structures. The research and development may be financed and supported by governmental bodies or private sectors. However, the outcome will normally be reviewed by technical committee of the conference, seminar or congress. Then some of those problems may be proposed for change by the code committee. The procedure will take place after the proposal is accepted by the code committee. The merits to change are normally related to safety, serviceability, cost reduction, simplicity and clarification. Legally binding will be incorporated in jurisdiction process of the city or municipality. This process is quite sound and inclusive amoung academic, professional, and official institutions. Revision of the code can be done periodically every 4-8 years. This module is particularly applied for the ACI-Building Code Requirement for Structural Concrete.

Modular B: Code of practice is a convergence of different practices in design, construction and maintenance, in model code development. The international organisations such as CEB, FIP or European Community (EU) will provide forum for practitioners to share their problems, knowledge, experience and expertise, by means of meeting, colloquium, symposium, or congress. The solutions of the problems can be obtained at broader views of common interests. The model code can then be developed internationally with the group efforts, and legal aspect has less impacts. Some research activities may be required to support or confirm the model. Those researches can be formulated by the working commission, then they may be carried out by academic institutions, and supported by the industries. The model code will be synthesized and academic institutions, and supported by the industries. The model code will be synthesized and simplified for national code adoption to specific implementation as a code of practice required by professional institutes or societies. Public law or regulation will automatically be recognised by official authorities since the code normally harmonised professional practices, legal aspects, and industrial standards. This module (Fig. 2) seems to be one of the most effective implementation processes whose revision or changes have to be done periodicly every 6-10 years.

Modular C: Code of practice as part of the building regulation is formulated to regulate social functions, public safety and environmental issues in one single model (Fig. 3). As the regulation, the module is rather difficult to change, then it is always far behind advanced technology and current development. Some variations have been observed that they are influenced by the relationship among the governmental bodies, professional institutions and educational institutions. This module will be more effective for small countries where all functions can be centralised in a single system. However, the system is rather weak for implementation process, since advanced technology and practical problems are never considered as an important function of the code. The engineering education, research and development, and professional practices can play only passive roles for code implementation.

In Asia, combination of the three modulars with some modifications should be appropriate for each country. The implementation process with strong supports in technical aspects from professional and academic institutions as which legal issues can be incorporated with jurisdiction process with which social functions and environmental issues are concerned.

3. National Code Adoption

To adopt national code would be more difficult than the model code already under development. The process will involve several aspects, practical standards, local conditions and legally binding. It will be essential to determine principal variations such as aspects of the model code in technical and official issues. It should be noticed that the model code should fully deal with the technical issues while the national code should concern practical standards and legal aspects. The local conditions as natural and social environments can be taken into account either technical or official issues. Advanced or currently developed technology must be considered in the process. The engineering institute will take a major role in adoption process since the code must conform to the professional practices, comply with the law and regulation, and satisfy natural environment and cultural heritage. Adoption process introduced in Fig.4 can be modified to appropriate utilization. Several aspects have to be considered as follows:

Practical Standards: Principal objectives of professional practices normally deal with quality assurance, public safety and environments. Then the major issues are technology and the public. The process involves engineering education, industrial standards and professional development. The most important factors in engineering education are academic background of basic science, engineering core courses, and engineering disciplines. Industrial standards are influenced by material manufacturing, fabrication and maintenance. Professional development can be done through research and development for new technology, improvement of standards, and cost reduction in design, construction and maintenance.

Legally Binding: Social impacts on construction industry are public concerns, such as environmental impacts, and human resource development. For structural concrete, professional practice will provide public safety, life quality, and environmental conditions. On the other hand, the governmental bodies such as city or municipality, would incorporate the technical issues to be the official one. Some extents of official control mainly depend upon the interaction between professional institution and governmental offices. Strengths of engineering education and profession development can lead toward minimum control by the public if the quality assurance in professional practice can be established.

Local Conditions: The local conditions can be categorised into natural and social conditions. The geographic, climatic and environmental phenomena are parts of the natural issues, while the culture, life style, or social function are the social or public issues. Both factors can be treated as technical issues by research and development for advanced technology. The enteraction between natural action and human responses can become the social issues such as diaster prevention, and diaster relieves. In such cases, law and regulation will be very important in professional practice or the model code. The cultural pride, or national heritage can also be reflected in the national code if proper treatment can be made. The professional institute in each country has to establish the differences between technical and social issues so that legally binding can be incorporated properly.

4. Implementation Process

Even the social and legal structures in Asian countries are completely different from other continents such as Europe and America, but the implementation process for concrete model code will not be so much different if the module is well prepared. The module as synthesized in Fig.5 can be conducted in the most effective way if the professional institute can guide national policies in social issues, economics and technologies. Structural concrete as one of the most important construction industry and engineering services in the region has taken sharing around 20-35% of the GDP. Then the impact could be tremendous not only in economic consideration, but the social, technology and the environment would also be taken into account.

Implementation of the concrete model code may be separated in two stages; first to adopt national code and the second to implement the code in professional practices. Flow chart shown in Fig.5 indicates initial stage of institute actions in planning and co-operation among involved organisations. Since the code of practice is the interaction among engineering education, industrial standard, and professional development, then the code adoption would require contribution from those groups. The second stage is to implement the code in construction industries and professional practices, which require various forms of supports for advanced technology and construction techniques.

The engineering institute must establish the objective and strategic plan to adopt the national code. Some related regulations in human resource development, professional engineers, and construction industries, must be reviewed and analysed to accommodate the most appropriate outcome to the code of practices. The code may be a part of the regulation or may be incorporated in the jurisdiction process as legally binding of the city or municipality.

The implementation process in each country will be somewhat different by local conditions and legal aspects. The interactive measures monitored from advanced technology and practical standards through social functions and environmental issues should be incorporated in the process. Feedback from construction industries and structural performance in professional practice by means of assessment and evaluation would push forward to up-dating and improvement. Research and development in materials, structures, and technologies can be adjusted periodically in the implementation process. The engineering institutes or related societies should take their lead for the change and improvement.

5. Conclusion

The implementation of the Concrete Model Code for Asia is done by means of national code or application code and professional practices. The ultimate goal of high performance of structural concrete should be pursuit as follows:

1) Professional institute must take its important role to establish the objectives and stragetic plan to adopt the national code.
2) Module for implementation can be the combination of various outstanding models to suit the technical and social functions in each respective country.
3) National code adoption must consider engineering education, professional practices, local conditions and legally binding to the most acceptance by industrial and social preferences.
4) Implementation process can be effective only when educational institute, profession practice and public acceptance through high performance of structural concrete are incorporated without any failure.

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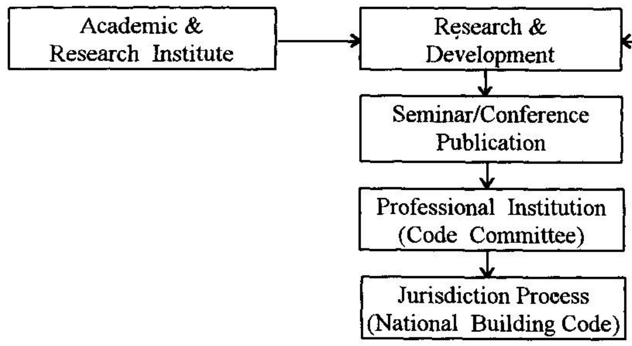

Fig 1. Modular A

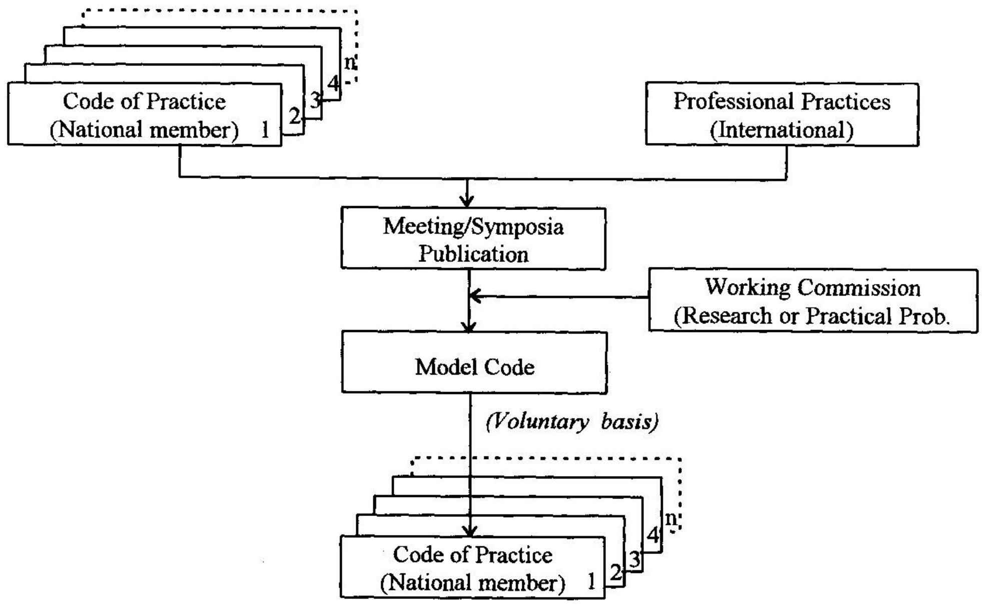

Fig 2. Modular B

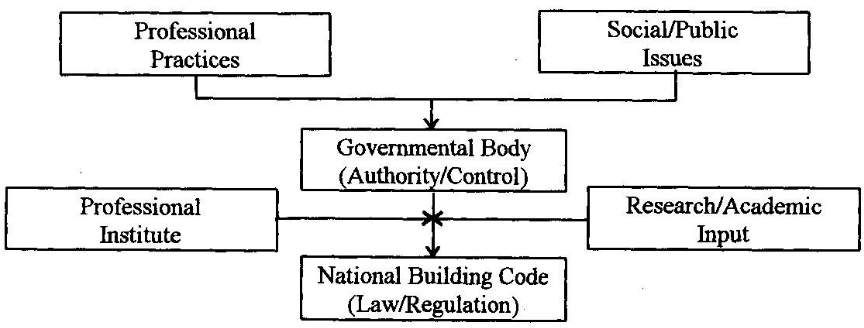

Fig 3. Modular C

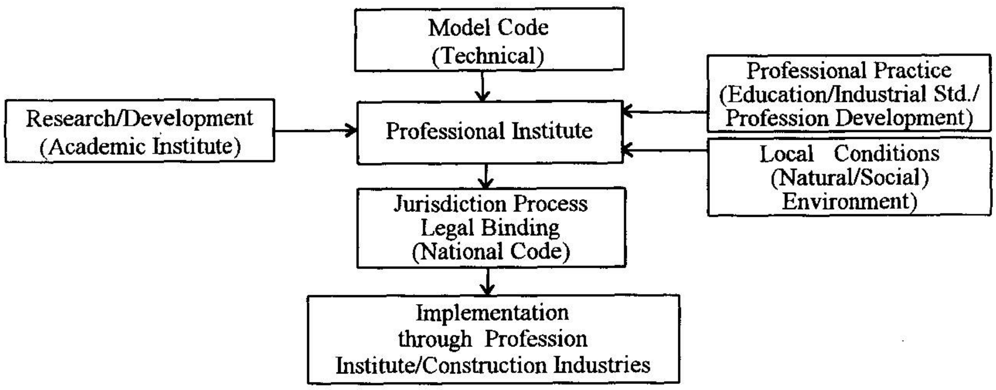

Fig 4. Adoption Process

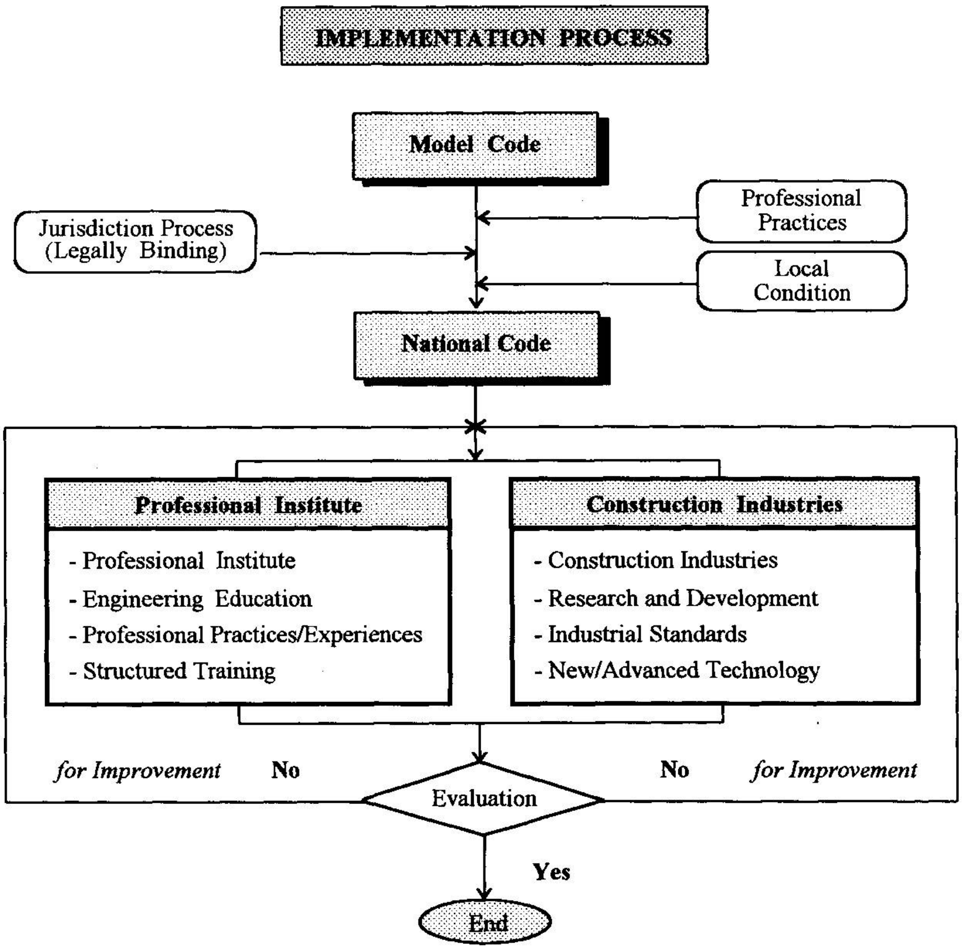

Fig 5. Implementation Process

Concrete Model Code for Asia - Editorial Philosophy and Promotional Strategy

Yew-Chaye LOO
Professor of Civil Engineering and Head
School of Engineering
Griffith University Gold Coast Campus
PMB 50 Gold Coast Mail Centre
Queensland, Australia 9726

Born in Malaysia, Yew-Chaye Loo obtained his PhD (in Bridge Engineering) in 1971 from Scotland's Dundee University. He is a Fellow of the Institution of Engineers, Australia and that of Britain's Institution of Civil Engineers and Institution of Structural Engineers.

Summary

Since its inception in 1992, the Concrete Model Code for Asia has undergone 6 years of preparation and development work, culminating in the publication of the (incomplete) "First Draft" in 1998. This report summarises the progress made to date and underscores the principles underlying the editorial work and promotional plans for the Code. For promoting and further developing the Code, a schedule is suggested. Also proposed is the establishment of a Marketing Group to complement the existing technical and editorial Groups.

1. Introduction

It is generally accepted that the Asia-Pacific region has the fastest growing economy in the world. The recent setback is but a temporary phenomenon and the indications are that many national economies are on their way to recovery. The region is where construction and related activities are estimated to worth around USD 1 trillion per annum. Another estimate would put the worth of concrete and concrete related construction work to constitute 60% of the annual construction turnover. This enormous volume of work is undertaken in a time when national trade boundaries are breaking down and most of the projects of significance would have international involvements in their design, construction and maintenance. Many Asian countries already have their codes of practice or national standards for concrete design and construction which may be indigenous in their development or they may have been adapted from similar codes developed elsewhere. Needless to say, in a concrete engineering project which has input from and is managed by engineers from different countries, the use of multiple standards is highly undesirable. A unified code of practice is the pragmatic alternative.

The Japan Concrete Institute (JCI) set up a Research Committee in May 1992 whose members were academics and practitioners drawn from most Asian countries including Australia. This Committee worked on the concepts of a "Concrete Mode Code for Asia". A Code framework (1) was discussed and accepted in principle by the Research Committee in its meeting held in Tokyo in April 1994 (2). Subsequent meetings were conducted in Bangkok in December 1994 (where the Research Committee was reorganised and renamed the International Committee on Concrete Model Code); Tokyo, again, in March 1995; Gold Coast in July 1995; Jakarta in March 1996; Dalian, China in October 1996; Hyderabad, India in March 1997; Jakarta, again, in August 1997. These international discussions culminated in the publication of the "First Draft" of the Code at the Taipei meeting in January 1998. This was followed by a meeting in Singapore in August 1998 where discussions centred on the plan to update and enhance the "First Draft".

This report summarises the progress made to date and underscores the principles underlying the editorial work and promotional plans for the Code. For promoting and further developing the Code, a schedule is suggested. Also proposed is the establishment of a Marketing Group which is in addition to the 4 technical and editorial Groups already in existence.

2. Editorial Objectives

As the title would suggest the Code is developed for all Asia and one would suspect that when popularised within the intended region the document will be used in countries beyond Asia. Within each user country the Code is expected to be used, in one form or another, by teachers and practitioners alike of structural concrete design, construction and maintenance. In view of these objectives, the Research Committee agreed very early on to present the Code contents in 3 levels, viz Levels 1, 2 and 3.

It turns out that the Levels 1 and 2 documents generally cover the basic knowledge and fundamental provisions. The site-dependent recommendations and case-studies are presented as Level 3 works. Whereas the first 2 levels of contents are applicable in all countries, the Level 3 components may be country-specific or of a problem-solving nature.

Efforts will be continued to refine and upgrade the Levels 1 and 2 documents while new developments and practical experiences gained in the meantime will be published from time to time as Level 3 documents to enhance the universality of the Code. The document levels and the intended readership may be summarised in Table 1. To render the Code more readable, it was agreed to present the materials, at each level, under 3 major headings: Part I - Design; Part II - Materials and Construction; Part III - Maintenance.

Table 1. Level of presentation and intended readership

Level 1	Level 2	Level 3
Engineering managers; technicians; university and technical college students; architects	Technical college teachers; university lecturers and students; designers; construction engineers; architects	Researchers; designers; university lecturers and students; code writers; construction engineers

The International Committee recognised at the early stages of discussion (3) that the excellent Asia-wide efforts by academics and senior practitioners in producing the various components of the Code must not be tarnished as a result of an inadequate and poor presentation. To ensure that the quality of presentation especially the use of the English language is up to a professional standard, an Editorial Group was appointed at the Singapore meeting in August 1998. It is with this mandate that this report is given at the present Colloquium (in Phuket in March 1999).

3. Peculiarities

The 3 Parts of the Code have been written in English by 3 separate Working Groups (WG), viz

- WG1 on Design
- WG2 on Materials and Construction
- WG3 on Maintenance.

The first two Groups comprise mainly Japanese, Thai and other East Asian colleagues whereas the majority of the WG3 members are academics from the Subcontinent. Most of the time members of the Groups worked independently and might maintain irregular contacts via email where available with the Secretariat as well as with the Editorial Group. The Secretariat is located in Sapporo, Hokkaido while members of the Editorial Group are Australian, Malaysian and Philippino nationals scattered around the three named countries on two continents.

The technical materials presented in the Code are objective information the applicability of which may cross national boundaries. On the other hand, the writing style and standard of presenting these materials, in English, vary from country to country and even from person to person depending on the tradition and experience of the writer(s). On top of the language problems, there were matters concerning the format of presentation which would require harmonisation.

A unified format was discussed and adopted in Dalian in October 1996 to ensure that the three Working Groups would follow the same guidelines in styling the headings for chapters, sections, subsections and sub-subsections as well as the graph and table captions. While such a format was easily developed and adhered to, no quantity of guidelines can ensure the uniformity of the written presentation in English. Hence it was felt imperative to establish the Editorial Group whose function it is to organise the outcome of the international efforts into a readable, coherent and precise document.

4. Promotion as a Marketing Exercise

Although financially supported by various Japanese establishments over the years, the efforts of the various Working Groups are strictly voluntary, with all the inherent drawbacks and inefficiency of a voluntary international body of academics. The members of the Groups being full-time working academics who met only infrequently tended to aggravate the situation. Thus the successful publication of the First Draft of the Code in January 1998 and the revised and expanded Second Draft in March 1999 is indeed an admirable achievement.

Being a non-government sponsored project, the outcome (in the form of the Code) does not carry any official status. Therefore its adoption for use in the various countries has to rely mainly on its relative merits. Despite its superior contents, the Code is a "new kid on the block" so to speak in the presence of many established national codes and standards. Consequently, considerable work will be required over a number of years to promote its use in the intended countries.

Currently generous funding is provided by Japanese establishments but one day the Code's upgrading and maintenance work will have to be self-funded. (It should also be remembered that the continuity of the quality efforts harnessed within the various Working Groups has to be maintained to prevent a possible loss of such international expertise and experience. However this matter is beyond the scope of this report and should be discussed by the International Committee in due course.)

In view of the above requirements, to promote the adoption of the Code may be treated as a marketing exercise. As such some basic specifications may be identified. They are enumerated below.

(i) The target users of the Code include those listed in Table 1 with emphasis on selling the model code ideas to university academics and technical college teachers who would in due time impart the knowledge to their students, the future practitioners of concrete engineering.

(ii) At an attractive price tag, distribute the Code via on and off campus book dealers. (It is believed that the Levels 1, 2 and 3 documents collectively are as good a reference work as any publication in concrete engineering practice.)

(iii) Organise national and international seminars and workshops aimed at informing and educating civil engineering teachers, structural designers, construction engineers, engineering managers as well as practitioners in various government authorities whose work may cover design, construction and/or maintenance. This should be a continuing effort over at least a couple of years in various countries.

(iv) To supplement the promotion efforts, technical papers should be prepared for publication in relevant regional and international journals.

(v) A website should be developed to attract additional attention to the Code, the International Committee and its activities.

Then there is the question of recognition by national authorities of the region. The Code is the outcome of the voluntary efforts of an international group of academics and practitioners. As such it has no official status in any country. However with its all-encompassing and superior contents, the official recognition of the Code in the concerned countries, in one form or another, is a matter of time if the correct promotional strategy is followed. For consideration of the International Committee such strategy should comprise, inter alia, the following approaches:

(i) For countries where there are no national standards, the relevant national authorities should be lobbied for and assisted in establishing the standards based on the Code provisions. As a first step such countries should be identified whose relevant national bodies should be subsequently convinced of the merits of adopting the Code. These efforts require at least some initial funding which may have to be, in part, provided by or sourced from the influential leading members of the International Committee.

(ii) In countries where there are national standards or where a number of foreign codes are in use, the Code should be promoted as a superior "product" which can be applied initially as an alternative code. The long-term aim is for it to ultimately replace fully or partially whatever are in current use. As appropriate, the contents of the Code may also be incorporated into the national standards. Or, they may be used to complement the existing standards/codes.

In view of the many tasks that are required to be carried out in a planned manner, it may be necessary to set up a Marketing Group as a subcommittee of the International Committee.

5. Upgrading and Maintenance

In concrete engineering there are fundamentals that hardly change with time or locality; there are also the site-dependent knowledge and practical experiences that keep on growing which may vary across national and geographical boundaries. For the Code to gain and retain popularity as intended, it ought to contain all the necessary basic materials, as well as the most up-to-date technical information and Asian concrete engineering experiences.

The format adopted for the Code employs the Levels 1 and 2 documents to present the fundamental principles and theories. This enables the latest developments to be covered in the Level 3 presentation. This format is ideal since unlike other major national and international codes the Concrete Model Code for Asia does not have an accompanying journal for expounding the new information and new experiences.

The earlier drafts of the Code are but an assembly of the efforts of 4 different Working Groups doing their work thousands of kilometres from each other between Groups as well as between members within each Group! Recognising this handicap, the materials so produced and presented in the draft Code would need time to harmonise and to render it a readable, coherent and precise document. Adding to all this is the urgent effort required to promote its use and adoption. And hopefully the use of the Code will soon gain popularity which will in turn generate funds to perpetuate this very worthwhile project. For deliberation of the International Committee, the development and promotion schedule as summarised in Table 2 is proposed.

6. Conclusion

The Concrete Model Code for Asia is written as an all-encompassing code of practice which has an in-built growth mechanism in that the latest technical know-how and Asian experiences in concrete engineering are published as additional Level 3 documents.

The Code should be promoted as a superior product in Asian countries where currently national standards of practice may or may not exist. To this end some practical approaches are suggested. This would require the creation of a Marketing Group whose function it is to refine and implement the promotion strategy expounded herein.

7. References

(1) Japan Concrete Institute (JCI) Research Committee. "A Framework for Concrete Model Code", Proceedings of JCI Symposium, Tokyo, April 1994, pp. 91-122.

(2) Ueda, T. "Concrete Model Code for Asia - Notes of the Meetings and Panel Discussion on 25 & 26 April 1996, Tokyo", 6p.

(3) Loo, Y.C. "Development and Propagation Strategy for the Concrete Model Code for Asia", Proceedings, JCI Bangkok Symposium, December 1994, pp. 97-101.

Table 2. Code development and promotion schedule

1992 - 1997	Preparation and individual drafting of Part I: Design; Part II: Materials and Construction; Part III: Maintenance.
1998	Assembling and presentation of the First Draft which includes for Parts I and III Levels 1 and 2 documents and for Part II Level 1 only.
1999	Assembling process continuing and presentation of the Second Draft which includes the revised Levels 1 & 2 documents for all the 3 Parts plus Level 3 documents on selected topics.
1999	Presentation of the Third Draft which incorporates all revisions, refinements and additional Level 3 documents.
	Preparation of technical and promotional papers for publication in engineering journals.
	Development of a website to supplement the promotion efforts.
2000	Publication of the Concrete Model Code for Asia - 2000 (CMCA-2000).
	Presentation of small-scale trial promotional seminars and workshops in Australia and Japan.
	Lobbying of relevant national authorities with the aim of having CMCA-2000 adopted or otherwise recognised.
2001	Publication of amendments to CMCA-2000 and additional Level 3 documents.
	Presentation of seminars/workshops in China, India/Pakistan and Thailand for the benefit of potential users and national authorities in North and East Asia, Southeast Asia and the Subcontinent and Central Asia.
	Lobbying efforts to continue; assisting adoption of the Code by agreed national authorities.
2002	Publication of CMCA-2002 which incorporates all amendments, updates and Level 3 documents published to date.
	Promotional seminars/workshops in more selected centres.
	Assisting adoption of the Code in more countries.
2003 and beyond	Publication of Level 3 documents (on selected specialist topics), amendments and updates as necessary.
	As justified, presentation of seminars/workshops mainly on the new Level 3 documents.
	Publication of the updated version of the Code every 4 years incorporating the Level 3 documents previously published as monographs.

NOTE: Subject to adequate financial returns, publication of the Code and relevant documents in electronic form should be encouraged.