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New Design Concepts and Codes of Practice

Nouvelle conception de dimensionnement et normes techniques

Bemessungskonzepte in Normen und Vorschriften

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SUMMARY

This paper gives reasons for the need to reconsider the current, traditional form of Codes of Practice for the design of concrete structures. It is recommended to replace – at least partly – the relevant, isolated design rules with a more general, comprehensive concept. Proposals for the basic elements of this new concept are submitted. It is intended to implement them – as far as possible – in the future European Standards issued by CEN.

RÉSUMÉ

Cet article explique les raisons du besoin de reconsidérer les formes courantes des normes de dimensionnement des structures en béton armé. Il s'agit donc de remplacer, au moins partiellement, les règles de conception isolées courantes par un concept plus général et plus intelligible dans ce contexte. Des propositions concernant des éléments de base sont présentés. On cherchera à les insérer de façon la plus étendue possible dans les futures Normes européennes du CEN.

ZUSAMMENFASSUNG

Dieser Beitrag begründet die Notwendigkeit, die bisherigen traditionellen Strukturen von Normen und Vorschriften für die Bemessung von Betonbauwerken zu überprüfen und zumindest bereichsweise zugunsten eines moderneren, umfassenderen Konzepts aufzugeben. Vorschläge für die wesentlichen Elemente dieses neuen Konzepts werden unterbreitet. Sie sollen – soweit dies möglich ist – in den künftigen europäischen CEN-Normen verankert werden.

1. INTRODUCTORY NOTE

In the following considerations, the term "design concept" is not limited to a specific design procedure, such as for example, the numerical verification of the structural performance in the serviceability or in the ultimate limit states.

Design concept ist rather understood as the complete set of information necessary for the planning, dimensioning, execution and maintenance of buildings and civil engineering works. New concepts therefore means an appropriate structure, form of presentation and technical contents of these Codes which meet the requirements of the users.

2. ASSESSMENT OF EXISTING CODES OF PRACTICE

Codes of Practice for the design, execution and maintenance of concrete structures were first prepared at the beginning of this century when the rapidly growing knowledge of this new construction material and ingenious ideas of engineers opened the way for its world wide application which very soon culminated in outstanding concrete structures [1]. Since its beginning the evolution of concrete construction was marked by the continuous progression of both theoretical and practical knowledge. This led to a step by step improvement and up-dating of these documents reflecting increasing expertise and experience.

However, due to the predominent preoccupation in the past to preparing documents which give immediate reliable answers to the growing technical problems, more attention was paid to the technical contents rather than to considerations concerning adequate concepts for a rational and consistent presentation.

One result of this development is that - even today - Codes of Practice very often constitute more a conglomeration of individual design rules than a sound physical basis. Their use is difficult and is likely to lead to misinterpretations. Therefore and taking into account the need of the today-user, increased attention should be paid to improving the conceptional quality of these documents.

3. REQUIREMENTS FOR FUTURE CODES OF PRACTICE

A Code of Practice is applied by several user groups. When considering the construction sector, the main groups are:

- building authorities,
- public or private clients,
- architects and civil engineers,
- contractors, sub-contractors and material suppliers
- universities, science,
- national or international Standards Organizations which are involved in the up-dating and revision of the codes,

and finally

- secondary industries such as for example, the computer and software industry.

It is obvious that the needs and consequently the requirements of these groups are more or less different and concern mainly legal, contractual, economic and technical aspects. On the other hand - and this is an experience - a future Code will be accepted only by these groups if their needs are in an appropriate form taken into account.

Recently, when developing new Codes of Practice [2], [3] or similar documents [4], the requirements of the user-groups have been soundly discussed on a national and an international level. The result of this discussion may be summarized as follows:

- the structure of future Codes shall be characterised by unambiguity, clarity and transparancy of the Code as a whole and of its individual clauses;
- concerning the technical contents, rationality of the design concept is required; it should permit flexibility, progress and new developments;
- the Code shall be user-friendly; that means that the form by which and the (scientific) level on which information is given takes account of the need and the skill of the user; the language used shall be understandable;
- the replacement of individual clauses by equivalent rules should be possible without affecting the structure of the Code as a whole. This allows a permanent adjustment to progressing knowledge;
- it is wished that - by means of an appropriate structure - the Codes can be revised in a short-term period.

It is obvious that some of these requirements have a qualitative character only. For example, the skill of the user differs within and between the user-groups and - with regard to the future European Codes - from country to country. In this example, the term "user-friendliness" therefore depends on the individual conditions, the education and motivation of the user. In spite of these difficulties, a rough description of the main elements of a future code can be given.

4. GUIDELINES FOR FUTURE CODES OF PRACTICE

4.1 Types of Technical Documents

More than in the past, two categories of technical documents should be distinguised: A first group which is as far as possible independent from a specific type of building or civil engineering work and in which all requirements and informations are compiled which are relevant for the majority of concrete structures. They will be complemented by a second set of technical documents representing only those aspects which are valid for particular types of structures, design procedures or technologies. The interface between these types of documents shall be without any ambiguity.

4.2 Defition of Requirements

The user of a Code of Practice expects an answer to the question "why". For this reason, it is important to define the performance requirements clearly distinguishing between safety aspects, serviceability and durability criteria [1].

Safety is understood as the ability of a structure as a whole and of its individual parts to sustain with appropriate levels of reliability all agents liable to act upon it either directly or indirectly in normal use (including construction) during the course of its anticipated life.

Serviceability denotes the ability to perform adequately in normal use during the anticipated service life with an appropriate level of reliability.

Durability means the ability of a structure and its parts to maintain the required performance during the design service life. This requires in particu

lar to withstand biological, chemical and physical deterioration processes - with levels of reliability appropriate both to safety and all serviceability requirements including appearance.

These specific aspects should be considered in all parts of the Code, corresponding rules and design models should be given (ultimate limit states, serviceability limit states). Mixing of these requirements in individual clauses should be avoided.

4.3 Improvement of Design Models

For design purposes, the physical reality of the structural behaviour is approximately described by a number of isolated design models. The term "isolated" means that very often various design rules are used in parallel without veryfying whether they are compatible or not. A typical example is the use of models based on Bernoulli's assumption of plane strain destribution also in cases where this precondition is not fulfilled. A further example concerns the application of different models for prestressed and reinforced concrete even if their physical behaviour is similar. Therefore, more rationality is required in the future.

Design models should as far as possible be usable - their field of application should not a priori limited to specific types of structures. All aspects related to the model should be considered in all parts of the Code, e.g. in the clauses dealing with structural analysis, verification of the limit states and the detailing. From this basic model, appropriate simplifications can be derived which may be used for a limited field of application. These limits, however, should be defined clearly in order to avoid inappropriate application.

4.4 Quality Assurance

Quality assurance is one main item which is actually discussed on national and international levels. There is no doubt that the quality of concrete structure depends to a certain extent on the quality of the Codes of Practice by means of which it has been designed. Therefore, quality assurance aspects need to be taken into account.

This can be done in two ways: to define measures and procedures in the Code which are directly related to quality assurance. A second (and more difficult) procedure is to find a lay-out and a form of presentation which leads - in connection with the skill of the user - to an adequate quality.

It is recognized that quality assurance is the most difficult area in future Codes of Practice. Nevertheless, improvement will be necessary.

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