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Guidelines for the simplified design of structural reinforced concrete for buildings

Lignes directrices pour la conception simplifiée du béton armé pour les structures de bâtiments

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 15673 was prepared by Technical Committee ISO/TC 71, *Concrete, reinforced concrete and pre-stressed concrete*, Subcommittee SC 5, *Simplified design standard for concrete structures*.

Introduction

The aim of this International Standard is to provide rules for the design and construction of low-rise concrete structures of small floor area to be built in the less developed areas of the world. The document is developed for countries that do not have existing national standards. This document shall not be used in place of a national standard unless specifically considered and accepted by the national standard body or other appropriate regulatory organization. The design rules are based in simplified worldwide-accepted strength models. The document is self-contained; therefore actions (loads) and simplified analysis procedures are included, as well as minimum acceptable construction practice guidelines.

The minimum dimensional provisions contained in this document are intended to account for undesirable side effects that will require more sophisticated analysis and design procedures. Material and construction provisions are aimed at site-mixed concrete as well as ready-mixed concrete, and steel of the minimum available strength grades.

The earthquake-resistance provisions are included to account for the fact that numerous underdeveloped regions of the world occur in earthquake-prone areas. The earthquake resistance is based upon the employment of structural concrete walls (shear walls) that limit the lateral deformations of the structure and provide for its lateral strength.

The document contains provisions that can be modified by the national standards body due to local design and construction requirements and practices. The specifications that can be modified are indicated using [“*boxed values*”]. The authorities in each member country are expected to review the “boxed values” and may substitute alternative definitive values for these elements for use in the national application of the document.

A great effort was made to include self-explanatory tables, graphics, and design aids to simplify the use of the document and provide foolproof procedures. Notwithstanding, the economic implications of the conservatism inherent in approximate procedures as a substitution to sound and experienced engineering should be a matter of concern to the designer who employs the document, and to the owner who hires him.

Guidelines for the simplified design of structural reinforced concrete for buildings

1 Scope

This International Standard applies to the planning, design and construction of structural reinforced concrete structures to be used in new low-rise buildings with restricted occupancy, number of stories, and area. The purpose of this International Standard is to provide a registered civil engineer or architect with sufficient information to design the reinforced-concrete structural framing of a low-rise building that complies with these limitations; see 6.1. The rules of design as set forth in the present document are simplifications of the more elaborate requirements.

This document may be used as an alternative to the development of a national concrete building code, or equivalent document, in countries where no national design codes themselves are available, or as an alternative to the national concrete building code in countries where it is specifically considered and accepted by the national standard body or other appropriate regulatory organization.

Although the provisions contained in this document were established to produce, when properly employed, a reinforced concrete structure with an appropriate margin of safety, this International Standard is not a substitute for sound and experienced engineering. In order for the resulting structure designed in accordance with these provisions to attain the intended margin of safety, the document must be used as a whole, and alternative procedures should be employed only when explicitly permitted by the provisions. The minimum dimensional provisions as prescribed in the document replace, in most cases, more elaborate procedures such as those prescribed in the national building code, and an eventual economic impact is realized from the simplicity of the procedures prescribed.

The professional performing the structural design in accordance with this International Standard should meet the legal requirements for structural designers in the country of adoption and have training and a minimum of appropriate knowledge of structural mechanics, statics, strength of materials, structural analysis, and reinforced concrete design and construction.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 679, *Methods of testing cements — Determination of strength*

ISO 680, *Cement — Test methods — Chemical analysis*

ISO 863, *Cement — Test methods — Pozzolanicity test for pozzolanic cements*

ISO 2103, *Loads due to use and occupancy in residential and public buildings*

ISO 2633, *Determination of imposed floor loads in production buildings and warehouses*

ISO 3010, *Basis for design of structures — Seismic actions on structures*

ISO/TR 3956, *Principles of structural fire-engineering design with special regard to the connection between real fire exposure and the heating conditions of the standard fire-resistance test (ISO 834)*

ISO 4354, *Wind actions on structures*

ISO 4355, *Bases for design of structures — Determination of snow loads on roofs*

ISO 6274, *Concrete — Sieve analysis of aggregates*

ISO 6782, *Aggregates for concrete — Determination of bulk density*

ISO 6783, *Coarse aggregates for concrete — Determination of particle density and water absorption — Hydrostatic balance method*

ISO 6935-1, *Steel for the reinforcement of concrete — Part 1: Plain bars*

ISO 6935-2, *Steel for the reinforcement of concrete — Part 2: Ribbed bars*

ISO 6935-3:1992, (as amended in 2000), *Steel for the reinforcement of concrete — Part 3: Welded fabric*

ISO 7033, *Fine and coarse aggregates for concrete — Determination of the particle mass-per-volume and water absorption — Pycnometer method*

ISO 9194, *Bases for design of structures — Actions due to the self-weight of structures, non-structural elements and stored materials — Density*

ISO 9597, *Cements — Test methods — Determination of setting time and soundness*

ISO 10144, *Certification scheme for steel bars and wires for the reinforcement of concrete structures*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
acceleration of gravity
g
acceleration produced by gravity at the surface of earth

NOTE For the purposes of this International Standard, its value can be approximated as $g \approx [10]$ m/s^2.

3.2
admixture
material other than water, aggregate, or hydraulic cement, used as an ingredient of concrete and added to concrete before or during its mixing to modify its properties

3.3
aggregate
granular material, such as sand, gravel, crushed stone, and iron blast-furnace slag, used in conjunction with a cementing medium to form a hydraulic cement concrete or mortar

3.4
anchorage
device used to anchor a non-structural element to the structural framing

3.5
bar diameter, nominal
approximate diameter of a steel reinforcing bar, often used as a class designation

NOTE The nominal diameter for deformed bars is usually taken as the diameter of a plain bar having the same area.

3.6
base of structure
level at which earthquake motions are assumed to be imparted to a building

NOTE This level does not necessarily coincide with the ground level.

3.7
beam
horizontal, or nearly horizontal, structural member supported at one (such as a cantilever) or more points, but not throughout its length, transversely supporting a load, and subjected primarily to flexure

3.8
bearing capacity of the soil
maximum permissible stress on the foundation soil that provides adequate safety against bearing failure of the soil, or settlement of the foundation of such magnitude as to impair the structure

NOTE The value of the bearing capacity of the soil is defined at the working stress level.

3.9
bending moment
product of a force and the distance to a particular axis, producing bending effects in a structural element

3.10
boundary element
portion along a wall edge strengthened by longitudinal and transverse reinforcement

NOTE A boundary element does not necessarily require an increase in thickness of the wall.

3.11
building
structure, usually enclosed by walls and a roof, constructed to provide support or shelter intended for occupancy

3.12
caisson
foundation pile of large diameter, built partly or totally above ground and sunk below ground usually by digging out the soil inside

3.13
cement
material as specified in the corresponding referenced International Standards, which, when mixed with water, has hardening properties, used either in concrete or by itself

3.14
column
vertical member used primarily to support axial compressive loads

3.15
collector element
element that serves to transmit the inertia forces within the diaphragm to members of the lateral-force resisting system

3.16
combined footing
footing that transmits to the supporting soil the load carried by several columns or structural concrete walls

3.17
compression reinforcement
reinforcement provided to resist compression stresses induced by flexural moments acting on the member section

3.18
concrete
mixture of Portland cement and any other hydraulic cement, fine aggregate, coarse aggregate, and water, with or without admixtures

3.19
concrete mix design
choice and proportioning of the ingredients of concrete

3.20
confinement hook
hook on a stirrup, hoop, or crosstie having a bend of not less than 135° with a six-diameter (but not less than 75 mm) extension that engages the longitudinal reinforcement and projects into the interior of the stirrup or hoop

3.21
confinement stirrup
tie
closed stirrup, tie or continuously wound spiral

NOTE A closed stirrup or tie can be made up of several reinforcement elements, each having a confinement hook at both ends. A continuously wound spiral should have a confinement hook at both ends.

3.22
corrosion
gradual removal or weakening of metal from its surface that requires the presence of humidity and oxygen, and is helped by the presence of other materials

3.23
cover
⟨concrete⟩ thickness of concrete between the surface of any reinforcing bar and the nearest face of the concrete member

3.24
crosstie
continuous reinforcing bar having a 135° hook at one end and a hook of not less than 90° at least a six-diameter extension at the other end

NOTE The hooks normally engage peripheral longitudinal bars. The 90° hooks of two successive crossties engaging the same longitudinal bars are normally alternated end for end.

3.25
curing
keeping the concrete damp for a period of time, usually several days, starting from the moment it is cast, in order to provide the cement with enough water to harden and attain the intended strength

NOTE Appropriate curing will greatly reduce shrinkage, increase strength of concrete, and normally reduces surface cracking. Curing time will depend on the temperature and the relative humidity of the surrounding air, the amount of wind, the direct sunlight exposure, the type of concrete mix employed, and other factors.

3.26
curtain wall
wall that is part of the façade or enclosure of the building

3.27
deformed reinforcement
steel reinforcement that has deformations in its surface to increase its bond to the concrete

NOTE The following steel reinforcement are normally considered deformed reinforcement under this International Standard: deformed reinforcing bars, deformed wire, welded plain wire fabric, and welded deformed wire fabric conforming to the appropriate International Standards.