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**Essential Requirements for
Reinforced Concrete Buildings
(U. S. Customary Units Version)**

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IP-001 was produced by a joint technical committee of the Instituto Colombiano de Normas Técnicas y Certificación (ICONTEC) and the Asociación Colombiana de Ingeniería Sísmica (AIS) that drafted the information contained in it. This document was drafted in both English and Spanish, and in SI and US Customary units. During the drafting process, suggestions for improvement were received from members of ACI, ICONTEC, AIS, and other international technical organizations. ACI International has not performed a review following procedures of the Technical Activities Committee (TAC) and has not adopted or approved this information. This is the first publication of the English version; a Spanish translation is available through ICONTEC.

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ACI

American Concrete Institute

P. O. Box 9094
Farmington Hills, Michigan 48333-9094
USA
Phone:
(Int + 1 + 248) 848-3700
Fax:
(Int + 1 + 248) 848-3701
web page:
www.aci-int.org



ICONTEC

Instituto Colombiano de Normas Técnicas y Certificación

Carrera 37 N° 52-95
Bogotá, D. C.,
COLOMBIA
Phone:
(Int + 57 + 1) 315-0377
Fax:
(Int + 57 + 1) 222-1435
web page:
www.icontec.org.co



AIS

Asociación Colombiana de Ingeniería Sísmica

Carrera 20 N° 84-14 Oficina 502
Bogotá, D. C.,
COLOMBIA
Phone:
(Int + 57 + 1) 530-0826
Fax:
(Int + 57 + 1) 530-0827
Email:
ais@uniandes.edu.co

Keywords: aggregates; beam-column frame; beams (supports); building codes; cements; columns (supports); compressive strength; concrete construction; concrete slabs; construction joints; continuity (structural); cover; curing; drawings; earthquake resistant structures; embedded service ducts; flexural strength; floors; footings; formwork (construction); frames; joints (junctions); joists; loads (forces); materials; mixing; mix proportioning; moments; placing; quality control; reinforced concrete; reinforcing steels; serviceability; shear strength; shearwalls; spans; specifications; splicing; strength; strength analysis; stresses; structural analysis; structural concrete; structural design; structural integrity; T-beams; torsion; walls; water; welded wire fabric.

Essential Requirements for Reinforced Concrete Buildings

Foreword

Publication of “Essential Requirements for Reinforced Concrete Buildings” is the result of an agreement between the *American Concrete Institute* and two Colombian Institutions: the *Instituto Colombiano de Normas Técnicas y Certificación* (Colombian Institute for Technical Standards and Certification) and the *Asociación Colombiana de Ingeniería Sísmica* (Colombian Association for Earthquake Engineering).

The document was motivated by frequent world-wide criticism that current reinforced concrete codes might be unnecessarily sophisticated for some uses, such as small low-rise structures. The need for guidelines and minimum requirements for the design and construction of structures that fall in these categories is felt throughout the world. The document is expected to be especially useful in the education and training of young engineers in reinforced concrete design.

A useful precedent for the drafting committee was the simplified rules for design and construction of masonry one- and two-story dwellings contained in some building codes. Current knowledge on reinforced concrete behavior obtained through experimentation and experience, and its status and dissemination as a structural material used worldwide, made the task of development of a simplified design and construction document, not only feasible, but challenging.

Among the subjects covered are: aggregate size; allowable soil bearing capacity; analysis and design; beams; bearing strength; columns; combined footings; concrete cover; concrete curing; concrete mixing and transportation; concrete mixture proportions; concrete quality, mixing, and placing; concrete strength evaluation; construction joints; definitions of terms used; design and construction procedure; design for axial load with flexure; design for flexure; design for shear; development length and splicing of reinforcement; drawings and specifications; durability requirements; embedded pipes; flexural and axial loads; floor systems; footings; form removal; formwork; foundation mats; foundations; geotechnical investigation; girders; grade beams; inspection; joists; lateral load resistance; layout of the structural system; limit states; loads (dead, live, rain, snow, wind earthquake, and soil lateral pressure); materials for reinforced concrete construction; minimum depth for members; one-way and two-way slabs; project specifications; reinforcement details; retaining walls; shear and torsion; shear walls; slab systems; slab-column systems; slabs-on-grade; special provisions for seismic design; spread footings; stairways and ramps; standard hooks; strength and serviceability; structural drawings; wall footings; walls; water tanks.

The following features were considered the general guidelines to be kept in mind in drafting the “Essential Requirements for Reinforced Concrete Buildings:”

- The aim of the document is to provide rules for the design and construction of common, low-rise structures of small to medium floor areas.
- The design rules are based on simplified accepted strength models; other limit states are accounted by specified dimensional requirements. The minimum dimensional requirements contained in the document are intended to replace the need for more-sophisticated analysis and design procedures.
- Material and construction requirements are aimed at available steel grades and concrete of medium strength that could be site mixed.
- The document is self-contained; therefore, loads and simplified analysis procedures are included as well as geotechnical exploration requirements to be used in defining a soil bearing capacity and minimum acceptable construction practice guidelines.
- Earthquake-resistant requirements are based on the use of structural concrete walls (shear walls) that limit the lateral deformations of the structure and provide lateral strength.
- The document is written in mandatory
- Where explanatory non-mandatory material was required, this material was included at the appropriate places and a special cursive type font was employed to indicate the non-mandatory character.

- In a departure from traditional Code-related publications, the document contains graphs and graphical explanations.
- Requirements are introduced in the order needed in the course of a design.
- The design can be carried out using solely the document and a hand calculator without need for a computer.
- For international use, SI Metric and US Customary Units versions in English and a SI Metric version in Spanish of the document were produced.

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Icontec-AIS Joint Drafting Committee

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Luis Enrique García (Chairman)		Omar D. Cardona (Secretary)
Guillermo Alonzo	José Miguel Paz	Mauricio Sánchez
Gilberto Areiza	Marco Puccini	Jorge Segura
Nelson Sánche	Roberto Roch	Pedro Theran
Augusto Espinosa	Carlos Alberto Rodríguez	Luis Yamín
Diego Jaramillo	Daniel Rojas	

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Shuaib Ahmad	James G. MacGregor	Basile G. Rabbat
John E. Breen	James O. Jirsa	Julio A. Ramírez
James R. Cagley	Leslie D. Martin	Mete A. Sozen
W. Gene Corley	Jack P. Moehle	James K. Wight
David P. Gustafson	James S. Pierce	

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Essential Requirements for Reinforced Concrete Buildings

INTRODUCTION

The “Essential Requirements for Reinforced Concrete Buildings” (See 1.4) is based on the 2002 version of the “Building Code Requirements for Structural Concrete (ACI 318-02) and Commentary (ACI 318R-02),” developed by the American Concrete Institute, the 1998 version of the “Minimum Design Loads for Buildings and Other Structures (ASCE 7-98),” developed by the American Society of Civil Engineers, and the year 2000 version of the “International Building Code (IBC 2000),” developed by the International Code Council.

The quality and testing of materials used in construction are covered by reference to the appropriate ASTM (American Society for Testing and Materials) standard specifications.

The document is written in mandatory language and the requirements are drawn in such a manner that any structure designed and built following the document will, in principle, meet the Codes and Standards on which the “Essential Requirements for Reinforced Concrete Buildings” was based.

All mandatory material in the “Essential Requirements” has been printed in Helvetica, the same font in which this paragraph is set.

[This paragraph is set in Briem Script, and all portions of the text corresponding to non-mandatory material are enclosed in brackets and printed in this font.]

The document presents the material in an order that follows the design procedure with the requirements being introduced when the designer will need them in the course of the design.

The “Essential Requirements” uses the load combination and load factors as presented in Chapter 9 of ACI 318-02. In the 2002 ACI code, the load factor combinations and strength reduction factors of the 1999 code were revised and moved to Appendix C. The load combinations contained in Chapter 9 of ACI 318-99 were replaced with those of ASCE 7-98 (See 1.4). The strength reduction factors were replaced with those of the 1999 Appendix C. These new strength reductions factors are lower than those contained in previous editions of ACI 318, from 1971 to 1999, except for the factor for flexure that was maintained equal. The changes were made to further unify the design profession on one set of load factors and combinations and to facilitate the proportioning of concrete building structures that include members of materials other than concrete.