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Guide to Simplified Design for Reinforced Concrete Buildings

(For Buildings of Limited Size and Height, based on ACI 318-14 and ACI IPS-1, "Essential Requirements for Reinforced Concrete Buildings")

Reported by ACI Committee 314

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This document is dedicated to the memory of late subcommittee member W. Gene Corley.

This guide presents simplified methods and design techniques that facilitate and speed the engineering of low-rise buildings within certain limitations. Material is presented in an order that follows typical design process with procedures introduced as the designer will need them in the course of a building design. Much of the information presented in this guide is derived from ACI 318, ASCE 7, and the 2015 International Building Code (IBC) (International Code Council 2015). The quality and testing of materials used in construction are covered by references to the appropriate ASTM standard specifications.

Whereas many of the tables, charts, and values included in this guide originated from the aforementioned reference documents, they have been modified or reorganized to be more conservative, to match design process flow, or better support the holistic and simplified design approach presented.

Although this guide is not written in mandatory language, the information is presented in such a manner that a structure designed following this guide will, in principle, comply with the codes and standards on which it was based. Although this guide is written in nonmandatory language, it is meant to be applied as a whole, because the simplified provisions are interdependent, and it would be unsafe to employ only a portion of this guide and disregard the remainder. This guide is not a code and is not deemed to satisfy ACI 318, ASCE 7, and the International Building Code (International Code Council 2015). This guide is expected to be especially useful in the education and training of engineers in reinforced concrete design of low-rise structures of small to medium floor areas.

There are many options within these standards that are not considered in this guide, such as the use of supplementary cementitious materials in concrete mixtures. As this guide will be used as a design aid, it is the licensed design professional's responsibility to ensure that the structure design satisfies the requirements of ACI 318, ASCE 7, the International Building Code (International Code Council 2015), and the legal requirements of the local jurisdiction. The original draft of the guide, published as ACI IPS-1 (2002), was produced by a Joint Committee of Instituto Colombiano de Normas Técnicas y Certificación (Colombian Institute for Technical Standards and Certification) (ICONTEC) and Asociación Colombiana de Ingeniería Sísmica (Colombian Association for Earthquake Engineering) (AIS).

The initial drafting of ACI IPS-1 (2002) was motivated by frequent worldwide discussions that reinforced concrete codes might be unnecessarily sophisticated for some applications, such as small low-rise buildings. Current knowledge of reinforced concrete behavior obtained through experimentation and experi-

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ence, and its status and dissemination as a structural material used worldwide, made developing a simplified design and construction guide feasible. This guide used ACI IPS-1 (2002) as a basis, with information derived from ACI 318, ASCE 7, and the International Building Code (International Code Council 2015).

This guide presents simplified approaches to assist engineers in designing low-rise buildings within certain limitations, in addition to the following:

(a) Information on the order needed in the course of a design
(b) Explanatory material at appropriate places
(c) Computations only requiring a hand calculator
(d) Graphs and graphical explanations
(e) Design information based on simplified strength models
(f) Other limit states accounted for by minimum dimensions
(g) Conservative loads and simplified analysis guidelines
(h) Simplified geotechnical information to help define soil-bearing capacity
(i) Shear walls as the seismic-force-resisting system
(j) Material and construction guidelines based on commonly available steel grades and medium-strength concrete that can be site mixed.

Keywords: concrete quality; foundation design; frame analysis; inspection; low-rise building construction; low-rise structure; mixing; placing; section analysis; seismic design; simplified design; specifications; structure design; structure layout.

CONTENTS

CHAPTER 1—GENERAL

1.1—Scope

This guide is intended for the planning, design, and construction of reinforced concrete structures in new low-rise buildings of restricted occupancy, number of stories, and area. Although the information presented was developed to produce, when properly used, a reinforced concrete structure with an appropriate margin of safety, this guide is not a replacement for a licensed design professional's experience and working knowledge. For the structure designed by this guide to attain the intended margin of safety, the guide should be used as a whole, and alternative procedures should be used only when explicitly permitted herein. The minimum dimensioning prescribed in the guide replace, in most cases, more detailed procedures prescribed in ACI 318, ASCE 7, and the International Building Code (International Code Council 2015).

1.2—Purpose

This guide provides a licensed design professional with sufficient information to design structural reinforced concrete members that comprise the structural framing of a low-rise building with the limits set in 1.3. Design rules set forth in this guide are simplifications that, when used together, comply with the more detailed requirements of ACI 318, ASCE 7, and the International Building Code (International Code Council 2015).

1.3—Limitations

This guide is only meant for buildings meeting all the limitations set forth in 1.3.1 to 1.3.10. These limits maintain the guide scope in close adherence to the collective experience of the original drafting committee (ICONTEC-AIS). Buildings within this scope are expected to have a normal rectangular footprint with simple standard geometries and member dimensions in both plan and vertical directions. Such buildings also depend primarily on reinforced concrete