ACI 314R-11

Guide to Simplified Design for Reinforced Concrete Buildings

(For Buildings of Limited Size and Height, based on ACI 318-11 and IPS-1, "Essential Requirements for Reinforced Concrete Buildings")

Reported by ACI Committee 314

American Concrete Institute®

currently in preview, click buy full versi

First Printing
March 2012

American Concrete Institute®
Advancing concrete knowledge

Guide to Simplified Design for Reinforced Concrete Buildings

Copyright by the American Concrete Institute, Farmington Hills, MI. All rights reserved. This material may not be reproduced or copied, in whole or part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of ACI.

The technical committees responsible for ACI committee reports and standards strive to avoid ambiguities, omissions, and errors in these documents. In spite of these efforts, the users of ACI documents occasionally find information or requirements that may be subject to more than one interpretation or may be incomplete or incorrect. Users who have suggestions for the improvement of ACI documents are requested to contact ACI via the errata website at www.concrete.org/committees/errata.asp. Proper use of this document includes periodically checking for errata for the most up-to-date revisions.

ACI committee documents are intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. Individuals who use this publication in any way assume all risk and accept total responsibility for the application and use of this information.

All information in this publication is provided "as is" without warranty of any kind, either express or implied, including but not limited to, the implied warranties of merchantability, fitness for a particular purpose or non-infringement.

ACI and its members disclaim liability for damages of any kind, including any special, indirect, incidental, or consequential damages, including without limitation, lost revenues or lost profits, which may result from the use of this publication.

It is the responsibility of the user of this document to establish health and safety practices appropriate to the specific circumstances involved with its use. ACI does not make any representations with regard to health and safety issues and the use of this document. The user must determine the applicability of all regulatory limitations before applying the document and must comply with all applicable laws and regulations, including but not limited to, United States Occupational Safety and Health Administration (OSHA) health and safety standards.

Participation by governmental representatives in the work of the American Concrete Institute and in the development of Institute standards does not constitute governmental endorsement of ACI or the standards that it develops.

Order information: ACI documents are available in print, by download, on CD-ROM, through electronic subscription, or reprint and may be obtained by contacting ACI.

Most ACI standards and committee reports are gathered together in the annually revised ACI Manual of Concrete Practice (MCP).

American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
U.S.A.
Phone: 248-848-3700
Fax: 248-848-3701

www.concrete.org

ISBN 978-0-87031-761-3

Currently in preview, click buy full version

ACI 314R-11

Guide to Simplified Design for Reinforced Concrete Buildings

(For Buildings of Limited Size and Height, based on ACI 318-11 and ACI IPS-1, "Essential Requirements for Reinforced Concrete Buildings")

Reported by ACI Committee 314

JoAnn Browning,* Chair

Michael C. Mota, Secretary

Iyad M. Alsamsam
Kenneth B. Bondy
James R. Cagley
Omar D. Cardona
W. Gene Corley
Om P. Dixit
David A. Fanella
Yosef Farbiarz
Luis E. García*
Jose M. Izquierdo-Encarnación†
H. Rolfe Jennings
Mahmoud E. Kamara
Jason J. Krohn
James S. Lai

Lionel A. [illegible]ay
Andr[illegible] Lepa[illegible]e
[illegible]ber[illegible]t. Mast
Ad[illegible]fo B. Matamoros
L[illegible] Ga[illegible]riela Mendez Florez
Javeed Munshi
T. George Muste
Viral B. Patel
Santiago Pujol
William E. Rushing Jr.
Guillermo Santana
Jorge I. Segura
Larbi M. Sennour
Jairo Uribe

*Committee members responsible for the additions and revisions to ACI IP[illegible].
†Chair of Task Group.

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.

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

ACI Committee Reports, Guides, and Commentaries are intended for guidance in planning, designing, executing, and inspecting construction. This document is intended for the use of individuals who are competent to evaluate the significance and limitations of its content and recommendations and who will accept responsibility for the application of the material it contains. The American Concrete Institute disclaims any and all responsibility for the stated principles. The Institute shall not be liable for any loss or damage arising therefrom.

Reference to this document shall not be made in contract documents. If items found in this document are desired by the Architect/Engineer to be a part of the contract documents, they shall be restated in mandatory language for incorporation by the Architect/Engineer.

ACKNOWLEDGMENTS

The original 2002 draft of the guide, published by ACI as document ACI IPS-1, was produced by a Joint Committee of *ICONTEC — Instituto Colombiano de Normas Técnicas y Certificación* (Colombian Institute for Technical Standards and Certification) and *AIS — Asociación Colombiana de Ingeniería Sísmica* (Colombian Association for Earthquake Engineering).

ICONTEC-AIS JOINT COMMITTEE MEMBERS

Luis Enrique García, Chair
Nélson Sánchez, Secretary

Guillermo Alonzo
Gilberto Areiza
Omar Darío Cardona
Augusto Espinosa
Diego Jaramillo
José Miguel Paz
Marco Puccini
Roberto Rochel
Carlos Alberto Rodríguez

ACI 314R-11 was adopted and published February 2012.

Copyright © 2012, American Concrete Institute.

All rights reserved including rights of reproduction and use in any form or by any means, including the making of copies by any photo process, or by electronic or mechanical device, printed, written, or oral, or recording for sound or visual reproduction or for use in any knowledge or retrieval system or device, unless permission in writing is obtained from the copyright proprietors.

Currently in preview, click buy full version

Daniel Rojas
Mauricio Sánchez
Jorge Segura
Pedro Theran
Luis Yamin

The following individual members of ACI offered useful comments and suggestions during the drafting of ACI IPS-1 (2002):

Sergio M. Alcocer
Shuaib H. Ahmad
John E. Breen
Juan P. Covarrubias
Werner Fuchs
John C. Glumb
David P. Gustafson
Bilal Hamad
Neil M. Hawkins
Kenneth C. Hover
James G. MacGregor
James O. Jirsa
Dov Kaminetzky
Richard E. Klingner
Leslie D. Martin
Jack P. Moehle
Vilas S. Mujumdar
James S. Pierce
Basile G. Rabbat
Julio A. Ramírez
Mete A. Sozen
Richard D. Stehly*
James K. Wight
Min-Hong Zhang

*Deceased

FOREWORD

Guide information presented is derived from:

1. "Building Code Requirements for Structural Concrete (ACI 318-11) and Commentary," by ACI;

2. "Minimum Design Loads for Buildings and Other Structures (ASCE 7-10)," by the American Society of Civil Engineers; and

3. "International Building Code (IBC 2009)," by the International Code Council.

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 reference documents above, 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 ACI 314R-11 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 non-mandatory 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 318-11, ASCE 7-10, and IBC 2009. As this guide will be used as a design aid, it is the licensed design professional's responsibility to ensure that the requirements of ACI 318-11, ASCE 7-10, and IBC 2009 are satisfied.

PREFACE

Publication of ACI IPS-1 (2002) was the result of an agreement between ACI and the two Colombian Institutions: ICONTEC and 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 on reinforced concrete behavior obtained through experimentation and experience, and its status and domination 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 the following: ACI 318-11, ASCE 7-10, and IBC 2009.

This guide presents simplified approaches to assist engineers in designing low-rise buildings within certain limitations. This guide is a design aid and educational tool, but not a code. It does not fully satisfy the requirements of ACI 318-11, ASCE 7-10, and IBC 2009. 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. It is the licensed design professional's responsibility to ensure a structure's design satisfies the legal requirements of the local jurisdiction.

This guide provides simplified design information that is interdependent, and a user should not employ only a portion of this guide and disregard the remainder. This guide provides adequate design information when used as a whole and for structures within its scope. It is unsafe to use only selected sections of this guide or for structures outside its scope.

Many of the tables, charts, and values included in this guide are drawn from information in the reference standards, but are modified or reorganized to be more conservative, to match design process flow, or better support the holistic and simplified design approach. This guide is expected to be especially useful in the education and training of young engineers in reinforced concrete design of low-rise structures of small to medium floor areas.

This guide presents:

(a) Information in 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;

currently in preview, click buy full versi

American Concrete Institute Copyrighted Material—www.concrete.org

(i) Shear walls as the seismic-force-resisting system; and

(j) Material and construction guidelines based on commonly available steel grades and medium-strength concrete that can be site mixed.

CONTENTS

Currently in preview, click buy full version

American Concrete Institute Copyrighted Material—www.concrete.org

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 the 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 by the guide. The minimum dimensioning prescribed in the guide replaces, in most cases, more detailed procedures prescribed in the supporting codes and standards listed in 1.4.

1.2—Purpose

The 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 the reference standards listed in 1.4.

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's 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 structural walls for lateral load resistance. Observing these limits justifies the simplified analysis and design methods here without the need for special analyses including slenderness and second-order effects. Buildings with offsets, reentrant corners, and vertical or horizontal irregularities are outside the scope of this guide.

1.3.1 *Use and occupancy*

1.3.1.1 *Permitted uses and occupancies*—Table 1.3.10 lists building occupancy groups and subgroups, indicating for each whether the use of this guide is permitted.

1.3.1.2 *Mixed occupancy*—Recommendations described in this guide apply to cases involving combinations of the uses identified in 1.3.1.1.

1.3.2 *Maximum number of stories*—Recommendations described in this guide apply to buildings with five or fewer stories above ground and no more than one basement level.

1.3.3 *Maximum area per floor*—The area per floor should not exceed 10,000 ft^2 (1000 m^2).

1.3.4 *Maximum story height*—Story height, measured from floor finish to floor finish, should not exceed 13 ft (4 m).

Currently in preview. click buy full versi

American Concrete Institute Copyrighted Material—www.concrete.org