

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



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Guide to Simplified Design for Reinforced Concrete Buildings

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

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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.

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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 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 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;

- (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.

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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 in 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 ft² (1000 m²).

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