

ACI 349-13

**Code Requirements for Nuclear
Safety-Related Concrete Structures
(ACI 349-13) and Commentary**

An ACI Standard

Reported by ACI Committee 349



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Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary

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Code Requirements for Nuclear Safety-Related Concrete Structures (ACI 349-13) and Commentary

An ACI Standard

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*Ranjit L. Bandyopadhyay was a long-time member of ACI Committee 349 and the Committee Chair of ACI 349 at the time of his death in 2010. The committee expresses its appreciation for his friendship and leadership.

This standard covers the proper design and construction of concrete structures that form part of a nuclear power plant and that have nuclear safety-related functions, but does not cover concrete reactor vessels and concrete containment structures (as defined by Joint ACI-ASME Committee 359).

The structures covered by the Code include concrete structures inside and outside the containment system.

This Code may be referenced and applied subject to agreement between the owner and the Regulatory Authority.

All notation sections have been removed from the beginning of each chapter and consolidated into one list in Chapter 2.

The format of this Code is based on the "Building Code Requirements for Structural Concrete (ACI 318-08)" and incorporates recent revisions of that standard.

The commentary, which is presented after the Code, discusses some of the considerations of ACI Committee 349 in developing "Code Requirements for Nuclear Safety-Related Concrete

Structures (ACI 349-13)." This information is provided in the commentary because the Code is written as a legal document and therefore cannot present background details or suggestions for carrying out its requirements.

Keywords: anchorage; authority having jurisdiction (AHJ); beam-column frame; beams; building codes; columns; composite construction; concrete cover; cracking (fracturing); creep; curing; deep beams; deflection; earthquake-resistant structures; floors; folded plates; footings; formwork; inspection; joints; joists; load tests; loads; mixture proportioning; modulus of elasticity; nuclear power plants; nuclear reactor containments; nuclear reactor safety; nuclear reactors; precast concrete; prestressed concrete; quality control; reinforced concrete; safety; serviceability; shear strength; shearwalls; shells; slabs; specifications; splicing; structural analysis; structural design; temperature; torsion; walls.

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CODE

INTRODUCTION

This Code covers the design and construction of concrete structures that form part of a nuclear facility and that have nuclear safety-related functions, but does not cover: i) Concrete reactor vessels and concrete containment structures, as defined by Joint ACI-ASME Committee 359; or ii) Steel-plate composite walls and steel-plate composite slabs, as defined by AISC-N690 Technical Committee 12.

The structures covered by this Code include concrete structures inside and outside the containment system.

This Code may be referenced and applied subject to agreement between the owner and the Regulatory Authority.

All notation sections have been removed from the beginning of each chapter and consolidated into one list in Chapter 2.

The format of this Code is such that it depends on the “Building Code Requirements for Structural Concrete (ACI 318-08) and Commentary” and any applicable errata issued up to September 2011, and should be used in conjunction with that Code and applicable issued errata.

The Commentary, which is presented after the Code, discusses considerations of ACI Committee 349 in developing, “Code Requirements for Nuclear Safety-Related Concrete Structures (ACI 349-13).” This information is provided in the Commentary because this Code is written as a legal document and, therefore, cannot present background details or suggestions for carrying out its requirements. For design of nuclear structures, in cases of conflict between this Code with other documents, except wherever this Code is in conflict with the specific requirements of the authority having jurisdiction (AHJ), ACI 349 shall govern.

The materials, processes, quality control measures, and inspections described in this Code should be tested, monitored, or performed as applicable only by individuals holding the appropriate ACI Certifications or equivalent.

COMMENTARY

INTRODUCTION

This Commentary discusses some of the considerations of Committee 349 in developing the provisions contained in “Code Requirements for Nuclear Safety-Related Concrete Structures (ACI 349-13)” hereinafter called the Code. The Code is based on “Building Code Requirements for Structural Concrete (ACI 318-08),” which is hereinafter called the Building Code. In preparing ACI 349-13, the committee has followed the text of the Building Code wherever appropriate.

Structural plain concrete, as described in Chapter 22 of ACI 318-08, is not endorsed for use in nuclear safety-related structures.

In the following commentary, all references to the Building Code and its commentary are to the 2008 revision unless specifically noted otherwise. Provisions of the commentary of ACI 318-08 apply except:

- The term “building official” is replaced with the term “licensed design professional”;
- λ , the modification factor for lightweight concrete, is not applicable for ACI 349-13 structures. The value of λ for ACI 349-13 structures is 1.0.

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CODE

COMMENTARY

CHAPTER 1—GENERAL REQUIREMENTS

R1—GENERAL REQUIREMENTS

1.1—Scope

1.1.1 This Code provides minimum requirements for design and construction of nuclear safety-related concrete structures and structural members for nuclear facilities. Safety-related structures and structural members subject to this Code are those concrete structures that support, house, or protect nuclear safety class systems or component parts of nuclear safety class systems.

Specifically excluded from this Code are those structures covered by “Code for Concrete Containments,” ASME Boiler and Pressure Vessel Code Section III, Division 2, and pertinent General Requirements (ACI 359).

This Code includes design and loading conditions that are unique to nuclear facilities, including shear design under biaxial tension conditions, consideration of thermal and seismic effects, and impact and impulsive loads.

For structural concrete, f_c' shall not be less than 3000 psi, unless otherwise specified.

1.1.2 This Code shall govern in all matters pertaining to design and construction of reinforced concrete structures, as defined in 1.1.1, except wherever this Code is in conflict with the specific provisions of the authority having jurisdiction (AHJ).

1.1.3 Same as ACI 318-08.

1.1.4 Intentionally left blank.

The commentary on ACI 318-08 is applicable to this chapter except as described as follows.

R1.1—Scope

The American Concrete Institute “Code Requirements for Nuclear Safety-Related Concrete Structures (ACI 349-13),” called the Code, provides minimum requirements for reinforced concrete design or construction in applications where protection against potential radioactive releases is a concern. The scope of the Code provides requirements for the analysis, design, construction, testing, and evaluation of new and existing concrete nuclear structures. While the requirements of this Code pertain primarily to new concrete structures, corresponding recommendations for the evaluation of existing concrete nuclear structures are provided in ACI 349.3R.^{1.1} Some special structures involve unique problems that are not covered by the Code, such as structures that function as leakage barriers to contain the effects of the loss of coolant accident. The owner is to identify nuclear safety-related structures and establish which of them are covered by “Code for Concrete Containments (ACI 359)”^{1.2} and its latest revisions instead of this Code. The Code is applicable to radioactive waste repository structures; however, considerations of thermal loads, load combinations, and long-term durability should be considered.

R1.1.1 In general, the Code requirements are based on test results from concrete specimens having a compressive strength of 6000 psi or less. Although no maximum concrete compressive strength is specified, the applicability of various requirements and formulations should be verified when concrete compressive strengths are higher than 6000 psi.

Minimum compressive concrete strength has been established as 3000 psi to be consistent with the seismic provisions of Chapter 21 of ACI 349-13 and ACI 318.

R1.1.4 Intentionally left blank, as this Code does not deal with residential structures.