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Building Code Requirements for Concrete Thin Shells (ACI 318.2-19)

Commentary on Building Code Requirements for Concrete Thin Shells (ACI 318.2R-19)

Reported by ACI Committee 318

ACI 318.2-19

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Building Code Requirements for Concrete Thin Shells and Commentary

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ACI 318.2-19 supersedes ACI 318.2-14, was adopted May 9, 2019, and published September 2019.

PREFACE

This document governs the design of thin shell concrete structures. Where required for design of thin shell concrete structures, provisions of ACI 318 are to be used to complement the provisions of this Code.

KEYWORDS

folded plates; inelastic analysis; ribbed shells; thin shells

NOTES FROM THE PUBLISHER

ACI 318.2-19, Building Code Requirements for Concrete Thin Shells, and ACI 318.2R-19, Commentary, are presented in a side-by-side column format. These are two separate but coordinated documents, with Code text placed in the left column and the corresponding Commentary text aligned in the right column. Commentary section numbers are preceded by an "R" to further distinguish them from Code section numbers.

The two documents are bound together solely for the user's convenience. Each document carries a separate enforceable and distinct copyright.

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CODE

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CHAPTER 1—SCOPE

R1—GENERAL

1.1—Scope

This Code provides minimum requirements for the design, analysis, and construction of concrete thin shells.

R1.1—Scope

Because this Code applies to concrete thin shells of all shapes, extensive discussion of their design, analysis, and construction in the Commentary is not possible. Additional information can be obtained in Tedesko (1953) and Billington (1982).

1.2

Provisions of this Code shall govern for nonprestressed and prestressed concrete thin shell structures, including ribs and edge members.

R1.2

Discussion of the application of thin shells in structures such as cooling towers and circular prestressed concrete tanks may be found in ACI 334.1R, ACI 334.2R, ACI 372R, and the IASS Working Group No. 5 report (1979).

1.3

All provisions of ACI 318-19 not specifically excluded and not in conflict with provisions of this Code shall apply to thin shell structures.

R1.3

This Code is dependent on ACI 318-19. Common terms, notation, definitions, and references used in this Code are in ACI 318-19. Terms, notation, and definitions unique to this Code are defined herein.

CHAPTER 2—GENERAL

R2—GENERAL

2.1—Terminology

analysis, elastic—An analysis of deformations and internal forces based on equilibrium, compatibility of strains, and assumed elastic behavior, and representing, to a suitable approximation, the three-dimensional action of the shell together with its auxiliary members.

R2.1—Terminology

Elastic analysis of thin shells can be performed using any method of structural analysis based on assumptions that provide suitable approximations to the three-dimensional behavior of the structure. The method should determine the internal forces and displacements needed in the design of the shell proper, the rib or edge members, and the supporting structure. Equilibrium of internal forces and external loads and compatibility of deformations should be satisfied.

Methods of elastic analysis based on classical shell theory, simplified mathematical or analytical models, or numerical solutions using finite element (ACI SP-110), finite differences (ACI SP-28), or numerical integration techniques (ACI SP-28; Billington 1990) are described in the cited references.

The choice of the method of analysis and the degree of accuracy required depends on certain critical factors. These include: the size of the structure, the geometry of the thin shell, the manner in which the structure is supported, the nature of the applied load, and the extent of personal or documented experience regarding the reliability of the given method of analysis in predicting the behavior of the specific type of shell (ACI SP-28).

analysis, experimental—An analysis procedure based on the measurement of deformations, strains, or both, of the structure or its model.

Depending on the magnitude of the loads, the experimental results may correspond to either elastic response or inelastic behavior of the shell.

analysis, inelastic—An analysis of deformations and internal forces based on equilibrium, nonlinear stress-strain relations for concrete and reinforcement, consideration of cracking and time-dependent effects, and compatibility of strains. The analysis shall represent, to a suitable approxi-

Inelastic analysis of thin shells can be performed using a refined method of analysis based on the specific nonlinear material properties; nonlinear behavior due to the cracking of concrete; and time-dependent effects such as creep, shrinkage, temperature, and load history. These effects are