An ACI Standard and Report

Building Code Requirements for Concrete Thin Shells (ACI 318.2M-14)

Commentary on Building Code Requirements for Concrete Thin Shells (ACI 318.2RM-14)

Reported by ACI Committee 318

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PREFACE

This document governs the design of thin shell concrete structures, previously presented in ACI 318M-11 Chapter 19. Where required for design of thin shell concrete structures, provisions of ACI 318M are to be used to complement the provisions of this Code. Transition keys showing how the code was reorganized are provided on the ACI website on the 318 Resource Page under Topics in Concrete.

KEYWORDS

folded plates; inelastic analysis; ribbed shells; thin shells

NOTES FROM THE PUBLISHER

ACI 318.2M-14, Building Code Requirements for Concrete Thin Shells, and ACI 318.2RM-14, 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

CHAPTER 1—GENERAL REQUIREMENTS

1.1—Scope

This Code provides information on the design, analysis, and construction of concrete thin shells.

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

1.1.2 All provisions of ACI 318M-14 not specifically excluded, and not in conflict with provisions of this Code, shall apply to thin shell structures.

CHAPER 2—TERMINOLOGY

2.1—Terminology

2.1.1 *Thin shells*—Three-dimensional spatial structures made up of one or more curved slabs or folded plates whose thicknesses are small compared to their other dimensions. Thin shells are characterized by their three-dimensional load-carrying behavior, which is determined by the geometry of their forms, by the manner in which they are supported, and by the nature of the applied load.

2.1.2 *Folded plates*—A class of shell structures formed by joining flat, thin slabs along their edges to create a three-dimensional spatial structure.

2.1.3 *Ribbed shells*—Spatial structures with material placed primarily along certain preferred rib lines, with the area between the ribs filled with thin slabs or left open.

2.1.4 *Auxiliary members*—Ribs or edge beams that serve to strengthen, stiffen, or support the shell; usually, auxiliary members act jointly with the shell.

2.1.5 *Elastic analysis*—An analysis of deformations and internal forces based on equilibrium, compatibility of strains, and assumed elastic behavior, and representing, to a

COMMENTARY

R1—GENERAL REQUIREMENTS

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 from the references. Performance of shells and folded plates requires attention to detail (refer to Tedesko [1980]).

R1.1.1 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. 2 Report (1979).

R1.1.2 This Code is dependent on ACI 318M. Common terms, symbols, definitions and references used in this Code are in ACI 318M. Terms, symbols and definitions unique to this Code are defined herein.

R2—TERMINOLOGY

R2.1—Terminology

R2.1.1 Common types of thin shells are domes (surfaces of revolution) (Billington 1982; ASCE Task Committee 1963), cylindrical shells (ASCE Task Committee 1963), barrel vaults (ACI SP-28), conoids (ACI SP-28), elliptical paraboloids (ACI SP-28), hyperbolic paraboloids (Esquillan 1960), and groined vaults (Esquillan 1960).

R2.1.2 Folded plates may be prismatic (Billington 1982; ASCE Task Committee 1963), nonprismatic (ASCE Task Committee 1963), or faceted. The first two types consist generally of planar thin slabs joined along their longitudinal edges to form a beam-like structure spanning between supports. Faceted folded plates are made up of triangular or polygonal planar thin slabs joined along their edges to form three-dimensional spatial structures.

R2.1.3 Ribbed shells (ACI SP-28; Esquillan 1960) generally have been used for larger spans where the increased thickness of the curved slab alone becomes excessive or uneconomical. Ribbed shells are also used because of the construction techniques employed and to enhance the aesthetic impact of the completed structure.

R2.1.4 Most thin shell structures require ribs or edge beams at their boundaries to resist the shell boundary forces, to assist in transmitting them to the supporting structure, and to accommodate the increased amount of reinforcement in these areas.

R2.1.5 Elastic analysis of thin shells and folded plates can be performed using any method of structural analysis based on assumptions that provide suitable approxima-