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Design Guide for Tilt-Up Concrete Panels

Reported by ACI Committee 551



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Design Guide for Tilt-Up Concrete Panels

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American Concrete Institute
38800 Country Club Drive
Farmington Hills, MI 48331
Phone: +1.248.848.3700
Fax: +1.248.848.3701

www.concrete.org

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Reported by ACI Committee 551

Jeff Griffin, Chair

James R. Baty II, Secretary

Iyad M. Alsamsam
William R. Braswell
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Darryl E. Dixon
Michael Fulton
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Robert P. Hirsch

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Kimberly Waggle Kramer
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Andrew S. McPherson
Trent C. Nagele
Craig J. Olson
Lance Osborne
Jayendra R. Patel
J. Edward Sauter
Nandu K. Shah

Joseph J. Steinbicker
Jason A. Swagert

Consulting Members
Hugh Brooks
David L. Kelly

This guide presents information that expands on the provisions of ACI 318 applied to the design of site-cast precast, or tilt-up, concrete panels, and provides a comprehensive procedure for the design of these important structural elements. In addition, this guide provides design recommendations for various support and load conditions not specifically covered in ACI 318, including design guidelines for in-plane shear.

Keywords: panel; panel design; panel lifting; precast; reinforcement design; seismic design of tilt-up; slender wall analysis; tilt-up; tilt-up design, tilt-up detailing.

CONTENTS

CHAPTER 1—INTRODUCTION, p. 2

CHAPTER 2—NOTATION AND DEFINITIONS, p. 2

- 2.1—Notation, p. 2
- 2.2—Definitions, p. 3

CHAPTER 3—ANALYSIS CONCEPTS FOR SLENDER CONCRETE WALLS, p. 4

- 3.1—Panel design model, p. 4
- 3.2—Bending stiffness evaluation, p. 4
- 3.3—Iteration method for P - Δ effects, p. 6

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- 3.4—Moment magnifier method, p. 7
- 3.5—ACI 318 provisions, p. 7
- 3.6—Comparison to 1997 Uniform Building Code, p. 8
- 3.7—Limitations on panel slenderness, p. 9

CHAPTER 4—LOADING CONDITIONS, p. 9

- 4.1—Lateral loads, p. 9
- 4.2—Axial loads, p. 10
- 4.3—Panel self-weight, p. 11
- 4.4—Load factors and combinations, p. 11

CHAPTER 5—MINIMUM REINFORCEMENT, p. 11

- 5.1—General, p. 11
- 5.2—ACI 318 provisions, p. 12

CHAPTER 6—CONTROL OF DEFLECTIONS, p. 12

- 6.1—Creep and initial deflections, p. 13
- 6.2—Deflection calculations, p. 13
- 6.3—Deflection limits, p. 13

CHAPTER 7—PANEL DESIGN PROCEDURES, p. 14

- 7.1—Solid panels without openings, p. 14
- 7.2—Panels with openings, p. 14
- 7.3—Concentrated axial loads, p. 14
- 7.4—Concentrated lateral loads, p. 15
- 7.5—Multiple spans and effects of continuity, p. 15
- 7.6—Isolated footings or pier foundations, p. 16
- 7.7—Cantilever panels, p. 16

CHAPTER 8—IN-PLANE SHEAR, p. 17

- 8.1—Resistance to panel overturning, p. 18

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- 8.2—Resistance to sliding, p. 18
- 8.3—Concrete shear resistance, p. 19
- 8.4—Seismic ductility, p. 19
- 8.5—In-plane frame design, p. 19
- 8.6—Lateral analysis of wall panels linked in-plane, p. 20

CHAPTER 9—CONNECTIONS FOR TILT-UP PANELS, p. 20

- 9.1—Connection types, p. 20
- 9.2—Design considerations, p. 22

CHAPTER 10—CONSTRUCTION REQUIREMENTS, p. 25

- 10.1—Forming and construction tolerances, p. 25
- 10.2—Concrete for tilt-up panels, p. 25
- 10.3—Panel reinforcement, p. 26

CHAPTER 11—DESIGN FOR LIFTING STRESSES, p. 26

- 11.1—General lifting concepts, p. 26
- 11.2—Steps for performing a lifting design, p. 27
- 11.3—Lifting considerations: building engineer of record, p. 27
- 11.4—Lifting design considerations: panel specialty engineer, p. 28

CHAPTER 12—TEMPORARY PANEL BRACING, p. 29

- 12.1—Brace geometry and number of braces, p. 29
- 12.2—Knee and lateral bracing, p. 29
- 12.3—Bracing to slab-on-ground, p. 29
- 12.4—Deadmen, p. 29
- 12.5—Base sliding, p. 29
- 12.6—Alternate bracing methods, p. 30

CHAPTER 13—REFERENCES, p. 30

- Authored references, p. 30

APPENDIX A—DERIVATION OF M_n AND I_{cr} , p. 30

- A.1—Derivation of M_n and I_{cr} based on rectangular stress block, p. 30
- A.2—Derivation of M_n and I_{cr} based on triangular stress distribution, p. 31

APPENDIX B—DESIGN EXAMPLES FOR OUT-OF-PLANE FORCES, p. 31

- B.1—Panel with no openings design example, p. 33
- B.1M—Panel with no openings design example (metric), p. 35
- B.2—Panel with a 10 x 15 ft door opening design example, p. 39
- B.3—Panel with concentrated axial load design example, p. 44
- B.4—Panel with concentrated lateral load design example, p. 48
- B.5—Multi-story panel design example, p. 51
- B.6—Panel with dock-high condition design example, p. 56
- B.7—Plain panel with fixed end design example, p. 61

B.8—Plain panel on isolated footing or pier design example, p. 65

B.9—Panel with stiffening pilasters and header design example, p. 68

CHAPTER 1—INTRODUCTION

Tilt-up concrete buildings have been constructed in North America for over 100 years, but it was not until the late 1990s that ACI 318 specifically addressed the requirements for design of slender concrete walls. ACI 318-11, 14.8, provides a method of analysis and covers only the basic requirements for evaluating the effects of vertical and transverse out-of-plane loads. ACI 318-11, Chapter 10, may also be used to design slender walls, but the requirements are more general and should be applied with discretion.

This guide expands on the provisions of ACI 318-11, Section 14.8, and ASCE/SEI 7 and provides a comprehensive procedure for the design of these structural elements. This guide also provides design recommendations for various support and load conditions not specifically covered in ACI 318, and includes design guidelines for in-plane shear.

CHAPTER 2—NOTATION AND DEFINITIONS

2.1—Notation

- A_g = gross area of concrete section, in.² (mm²)
- A_s = area of tension reinforcement, in.² (mm²)
- A_{se} = effective area of tension reinforcement, in.² (mm²)
- A_v = area of shear reinforcement, in.² (mm²)
- a = depth of equivalent rectangular stress block, in. (mm)
- b_d = design width, in. (mm)
- b_t = tributary width, in. (mm)
- b_w = width of the concrete section, in. (mm)
- c = distance from the extreme fiber to the neutral axis, in. (mm)
- D = dead load
- d = distance from the extreme concrete compression fiber to the centroid of tension reinforcement, or the effective depth of section, in. (mm)
- d_t = distance from the extreme compression fiber to centroid of extreme layer of longitudinal tension steel, in. (mm)
- E = loads due to seismic force
- E_c = concrete modulus of elasticity, psi (MPa)
- E_s = steel modulus of elasticity, psi (MPa)
- e_{cc} = eccentricity of applied load(s), in. (mm)
- F = loads due to weight or pressure of fluids
- F_p = factored load
- f'_c = specified compressive strength of concrete, psi (MPa)
- f_r = modulus of rupture, psi (MPa)
- f_y = reinforcement yield stress, psi (MPa)
- GC_p = external pressure coefficient
- GC_{pt} = internal pressure coefficient
- H = horizontal line load or soil pressure
- h = panel thickness, in. (mm)
- I_e = importance factor
- I_{cr} = cracked section moment of inertia, in.⁴ (mm⁴)
- I_e = effective moment of inertia, in.⁴ (mm⁴)