Design Guide for Tilt-Up Concrete Panels

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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

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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} (mm^2)
A_s = area of tension reinforcement, in.^{2} (mm^2)
A_{se} = effective area of tension reinforcement, in.^{2} (mm^2)
A_v = area of shear reinforcement, in.^{2} (mm^2)
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_{pi} = 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} (mm^4)
I_e = effective moment of inertia, in.^{4} (mm^4)