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Guide for Design of Slab-Column Connections in Monolithic Concrete Structures

Reported by Joint ACI-ASCE Committee 352

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This guide provides recommendations for determining proportions and details of monolithic reinforced and post-tensioned concrete slab-column connections.

Included are recommendations regarding appropriate uses of slab-column connections in structures resisting gravity and lateral forces; procedures for determination of connection load-carrying capacity; and reinforcement details to achieve adequate strength, ductility, and structural integrity. Recommendations are based on a review of the literature for ultimate and serviceability limit states. A commentary is provided to clarify the recommendations and identify reference material. Design recommendations are set in standard type. Commentary is set in italics.

Keywords: connection; flat plate; flat slab; joint; lateral drift; post-tensioned; punching shear; seismic; shear reinforcement; slab-column.

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ACI 352.1R-11 supersedes ACI 352.1R-89 and was adopted and published March 2012.

CHAPTER 1—INTRODUCTION AND SCOPE

1.1—Introduction

The recommendations in this guide are for determining connection proportions and details to provide adequate performance of cast-in-place reinforced concrete (RC) and post-tensioned concrete (PT) slab-column connections. The recommendations are written to satisfy serviceability, strength, and ductility requirements related to the intended functions of the connection.

*Design of the connection between a slab and its supporting member requires consideration of both the joint and the portion of the slab, or slab and beams, immediately adjacent to the joint. Several connection failures associated with inadequate performance of the slab adjacent to the joint have been reported (*Engineering News-Record (ENR) *1956, 1971, 1973; Joint ACI-ASCE Committee 426 1974; Leyendecker and Fattal 1977; Lew et al. 1982a,b; Rosenblueth and Meli 1986; Freyermuth 1989; Moehle 1996; Hueste and Wight 1997). However, no reported cases of connection failure due to distress within the joint have been identified. Some connection failures have occurred during construction when young concrete slabs received loads from more than one floor as a consequence of shoring and reshoring (Agarwal and Gardner 1974; Lew et al. 1982a,b; Sbarounis 1984; ACI 347-05). The disastrous consequences of some failures, including total collapse of the structure, emphasize the importance of the design of the connection. These recommendations are intended to alert the designer to those aspects of behavior that should be considered in design of the connection and to suggest design procedures that will lead to adequate connection performance.*

1.2—Scope

Information and design recommendations have been summarized by Joint ACI-ASCE Committee 426 (1974, 1977). This guide is an update of ACI 352.1R-89 (Joint ACI-ASCE Committee 352 1989), based on research information presented in references such as Moehle (1996); Moehle et al. (1988); Kang and Wallace (2005); ACI 318-08, Chapter 21; and Cheng et al. (2010). Modifications to the previous report include expanding the coverage to include slab-column connections with shear reinforcement, slab-column connections with post-tensioning reinforcement, and lateral drift capacity of both RC and PT slab-column connections.

These recommendations apply only to slab-column connections in monolithic concrete structures, with or without drop panels or column capitals, and using normal-weight or lightweight concrete. For strength calculation purposes, the specified concrete compressive strength should not be taken greater than 6000 psi (42 MPa). The recommendations are limited to slab-column connections with slab thickness ranging between 5 and 12 in. (125 and 300 mm); a slab span-to-thickness ratio varying from 20 to 45, except for slab-column connections with transverse beams; and a ratio of long-to-short cross-sectional column dimensions less than 4. The recommendations for PT slab-column connections are applicable only for monolithic concrete connections with unbonded post-tensioning tendons applying an average compressive stress in the concrete not less than 125 psi (0.86 MPa). Construction that combines slab-column and beam-column framing in orthogonal directions at individual connections is included, but these recommendations are limited to issues related to the transfer of loads in the direction perpendicular to the beam axis. Slab-column framing systems are considered inappropriate as seismic-force-resisting systems assigned to high seismic design categories, but they are commonly used as frames not designated as part of the seismic-force-resisting system along with a stiffer seismic-force-resisting system, such as shear walls or beam-and-column moment-resisting frames.

These recommendations are limited to slab-column connections of cast-in-place RC and PT floor construction, including two-way ribbed floor slab construction (Meli and