A PCI Standard

ANSI/PCI 150-24

SPECIFICATION FOR THE DESIGN OF PRECAST CONCRETE INSULATED WALL PANELS

PCI® Precast/Prestressed Concrete Institute

ANSI Accredited Standards Developer

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Substantial effort has been made to ensure that all data and information in this standard are accurate. However, PCI cannot accept responsibility for any errors or oversights in the use of materials or in the preparation of engineering plans. This standard is intended for use by professional personnel competent to evaluate the significance and limitations of its contents and able to accept responsibility for the application of the material it contains. Special conditions on a project may require more specific evaluation and practical engineering judgment.

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FOREWORD

This standard provides minimum requirements for the design of precast and precast,prestressed concrete insulated wall panels. Included within are provisions for composite action, wythe connectors, reinforcement, strength evaluation, service-level analysis, earthquake resistance, and temperature effects, among others. The behavior of insulated wall panels generally depends on the degree of shear transfer between the two concrete wythes, in addition to the inherent mechanics of the wythes. Several computational models, such as those developed by Gombeda et al. (2017) and Al-Rubaye et al. (2019), have demonstrated the complexity of evaluating the response of insulated wall panels to various loading conditions and therefore also proposed simplified approaches to facilitate design and analysis of these structures. Furthermore, their conclusions indicate that modeling and design approaches that account for both strength- and stiffness-driven mechanisms are more effective in assessing out-of-plane response to lateral loads. Additional modifications or modeling extensions to these approaches can also be implemented for other conditions, such as in-plane loads or thermal bowing.

The PCI Design Standard Committee developed this standard with the intent to issue unified provisions to facilitate the construction of safe, cost-effective, and reliable precast concrete insulated wall panels using design methods developed from extensive computational and experimental research on the behavior and mechanics of these structures.

The PCI Precast Insulated Wall Panel committee produces other documents that provide recommendations for design, fabrication, erection, quality control, and other various topics pertinent to precast concrete insulated wall panels.

This standard was developed for use with U.S. customary units.

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PREFACE

This standard was developed following the protocols required by the PCI Group Operations Manual. The provisions were first generated and balloted by the PCI Insulated Wall Panel Task Group under the Design Standards Committee. A review by the PCI Technical Activities Council followed. The document was then submitted to the PCI Standards Committee, where additional review and balloting took place. The membership of that committee is balanced according to the rules of American National Standards Institute (ANSI) accreditation. In addition, a public review period was provided, and public comments were resolved through the PCI Standards Committee. The entire process is a consensus process involving PCI members, nonmembers of PCI, and the general public.

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CHAPTER 1—GENERAL REQUIREMENTS

1.1 Scope

1.1.1—This standard provides minimum requirements for the design and detailing of plant-cast, precast concrete insulated wall panels. It provides requirements in addition to those of ACI 318 and ASCE/SEI 7 as referenced herein.

1.2 Applicability

1.2.1—This standard shall apply to the design of nonprestressed and prestressed, precast concrete insulated wall panels.

1.3 Definitions

average effective compressive stress—an equivalent uniform concrete compressive stress $A_{ps}f_{se}/A_g$ due to prestressing.

composite wall panel—a precast concrete insulated wall panel designed in accordance with Section 4.2.6 of this standard, using both concrete wythes to provide the stiffness and design strength of the wall by internal shear transfer via wythe connectors or solid zones.

idealized fully composite wall panel—a composite wall panel assumed to provide flexural stiffness and resistance based on a continuous, linear strain profile through the thickness of the entire wall section.

noncomposite wall panel—a precast concrete insulated wall panel designed in accordance with Section 4.2.5 of this standard and detailed for the two concrete wythes to act independently except for out-of-plane deformation compatibility. It shall be permitted to design the panel with one wythe providing the stiffness and strength for the wall.

nonstructural wythe—the wythe of a noncomposite precast concrete insulated wall panel that is not considered to provide any of the strength required by Section 4.1.1 of this standard.

partially composite wall panel—a precast concrete insulated wall panel designed in accordance with Sections 4.2.2 through 4.2.3 or per Section 4.2.4 that provides stiffness and flexural resistance dependent on the degree of shear transfer between the wythes by the wythe connectors.

precast concrete insulated wall panel—a precast concrete structural wall consisting of a layer of insulation placed between two reinforced concrete layers (wythes) interconnected with mechanical ties (wythe connectors) or solid zones to act as a unit.

ratio of composite action for flexural strength—a factor calculated by the following expression:

$$\beta_{Mn} = \frac{M_{n,PC} - M_{n,NC}}{M_{n,FC} - M_{n,NC}}$$

ratio of composite action for moment of inertia—a factor calculated by the following expression:

$$\beta_1 = \frac{I_{PC} - I_{NC}}{I_{FC} - I_{NC}}$$

ratio of composite action for section modulus—a factor calculated by the following expression:

$$\beta_{Sm} = \frac{S_{m,PC} - S_{m,NC}}{S_{m,FC} - S_{m,NC}}$$

solid zone—an area of a precast concrete insulated wall panel where the insulation is discontinued, with a cross section of plain or reinforced concrete.

structural wythe—the wythe of a noncomposite precast concrete insulated wall panel that is considered to solely provide the strength required by Section 4.1.1 of this standard.

wythe—one of the concrete layers of a precast concrete insulated wall panel.

wythe connector—discrete or semicontinuous mechanical connector between concrete wythes penetrating through the insulation and anchored in each concrete wythe.