# DSA IR PC-5

# PRE-CHECK (PC) DESIGN CRITERIA FOR PRECAST CONCRETE BUILDINGS: 2022 CBC

**Disciplines:** All

**History:** Revised 12/06/22 Under 2022 CBC
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Division of the State Architect (DSA) documents referenced within this publication are available on the DSA Forms or DSA Publications webpages.

## PURPOSE

This Interpretation of Regulations (IR) clarifies requirements relating to pre-check (PC) submittals to promote uniform statewide criteria for code compliance in design and plan review of precast concrete buildings for projects under DSA jurisdiction. The PC Design Criteria documents were created by DSA as a means for the responsible engineer to demonstrate code compliance when developing and submitting construction documents for DSA review.

The provisions of this IR are intended to be a tool to identify and highlight the common and unique, critical and/or overlooked code requirements that must be considered and incorporated into the design, as applicable, to provide a complete and consistent set of construction documents accepted at all DSA regional offices. Other methods proposed by design professionals to solve a particular issue may be considered by DSA and reviewed for code and regulation compliance, subject to concurrence of DSA Codes and Standards Unit. For methods not specifically prescribed in the code, see California Building Code (CBC) Section 104.11.

Appendix A below is provided as a guide to assist design professionals and DSA plan reviewers when preparing and reviewing site-specific project applications that incorporate PC precast concrete buildings designed in accordance with this IR.

## SCOPE

The provisions of this IR apply to 2022 PC plans for new buildings utilizing precast concrete wall panels submitted to DSA under the 2022 CBC. This document does not address, modular buildings, relocatable buildings, nor modular elevator towers.

As noted in *Bulletin* (*BU) 18-01: Applicability of Pre-Check (PC) Design Criteria for Non-PC Projects*, these provisions shall also be considered and incorporated in site-specific submittals for structures of the same project type, even if the submittal is not part of a PC application.

## BACKGROUND

The PC approval process is intended to streamline DSA plan review by providing a procedure for approving the design of commonly used structures prior to the submittal of plans to DSA for construction projects. The PC approval process allows designers to incorporate designs for structures that have already been “prechecked” by DSA into their plans for actual site-specific construction projects. The design criteria provided in this document are neither regulations nor law and are not appropriate for verbatim inclusion in project specifications. The design professional in responsible charge is responsible for specifying and detailing requirements for each project. Additional information regarding the design and site application of PC structures can be found in *Procedure (PR) 07-01: Pre-Check (PC) Approval* and *Policy (PL) 07-02: Over-the-Counter Review of Projects Using Pre-Check (PC) Approved Designs*.

# PRE-CHECK (PC) DESIGN CRITERIA FOR PRECAST CONCRETE BUILDINGS: 2022 CBC

## 1. GENERAL

### 1.1 Pre-Check Submission Requirements

Refer to PR 07-01 for a detailed list of items that are required for all PC submittals. The documents required to be submitted for PC approval are listed on form *DSA 3: Project Submittal Checklist*. Site-specific information is not necessary, as that information will be provided when a specific construction project is submitted for DSA review.

### 1.2 Cover Sheet and General Notes

**1.2.1** In accordance with PR 07-01 Section 2.4 the first sheets(s) of the PC drawings shall include a design information section that defines the basis of the PC design. Refer to PR 07-01 Appendices B and C and the remainder of this IR for required content of the design information section.

**1.2.2** The PC construction documents shall include complete and comprehensive general notes and/or specifications as required for construction and inspection. It is common for PC construction documents to consist of drawings only without a book specification or project manual. Refer to PR 07-01 Appendix B, Footnote 6. In this case, the PC drawings shall include information that might otherwise be communicated in a project manual or book specification. For each primary material or group of materials, the following information shall be specified in the construction documents when applicable:

**1.2.2.1** Required material properties, including compliance with American Society for Testing and Materials (ASTM) specifications when applicable.

**1.2.2.2** Proprietary products' name, manufacturer, and evaluation report number. Refer to Section 1.11 below.

**1.2.2.3** Quality control performed by the supplier.

**1.2.2.4** Standards for the execution of the work, including associated tolerances. References to recognized standards are acceptable.

**1.2.2.5** Required qualifications of personnel performing the work for each applicable trade.

**1.2.2.6** Product and material finishes where required for weather protection or safety.

**1.2.2.7** Quality assurance tests and frequency requirements, including specification of ASTM standards when applicable, not covered by Section 1.3 below.

### 1.3 Structural Tests and Special Inspections

Provide example form(s) *DSA 103: List of Required Structural Tests and Special Inspections* on the drawings. See PR 07-01 Section 2.5 for additional information.

**1.3.1** Example form(s) DSA 103 will be used as a guide to develop a site-specific form DSA 103 for the site-specific project. Example forms on the PC drawings will be crossed out when the site-specific form DSA 103 is provided during with the site-specific project application.

**1.3.2** The example form DSA 103 will include both in-plant and on-site testing and inspection requirements. Manufacturers shall be involved in the coordination of in-plant testing and inspection with the project inspector, Laboratory of Record (LOR), and owner of the site-specific project application using the PC design prior to commencing fabrication.

**1.3.3** Only the site-specific form DSA 103 can identify exemptions from the required structural tests and special inspections; therefore, the Appendix of the example form(s) DSA 103 should not be included on the PC drawings. Applicability of exemptions may be considered during plan

review for site-specific applications, shall be justified by the applicable project design a a professional, and is subject to DSA review and approval. Refer to Appendix A below for additional information.

**1.3.4** The load testing criteria for post-installed anchors shall be in accordance with CBC Section 1910A.5. The PC drawings shall specify installation torque loads (or tension test loads if used) for expansion and screw anchors and tension test loads for adhesive anchors. Tension test loads shall be justified by the structural calculations.

### 1.4 Options and Variations

The PC drawings shall provide checkboxes of options and variations if there is more than one configuration or design criteria. See PR 07-01 Section 3 for more information, including the maximum number of options permitted.

### 1.5 Design Parameters

The PC drawings shall provide on the cover sheet (and subsequent sheets as necessary) design information as defined in PR 07-01 Section 2.4 and Appendix B. If the PC includes design variations for multiple tiers or levels of the same design parameter(s), all or part of the design information should be presented in a checklist format and provide general direction to future users (design professionals and plan reviewers) for the application of the PC to site-specific projects. Additionally, refer to and coordinate with PL 07-02 Section 3, which summarizes common site-specific parameters to be verified at Over-the-Counter (OTC) plan reviews.

### 1.6 Risk Category and Occupant Load

The PC drawings shall indicate the maximum Risk Category (RC) and Occupant Load the structure is designed for in the design information section. In addition, the design information section shall require the intended Use and Occupancy be specified on the site-specific application drawings. This information is necessary for the DSA plan reviewer to verify the RC of the PC building as it applies to the site in accordance with CBC Section 1604A.5.

### 1.7 Flood Zone

Design shall comply with CBC Section 1612A and *PR 14-01: Flood Design and Project Submittal Requirements*.

**1.7.1** The design information section of the PC drawings shall include a note requiring the building pad be raised above the design flood elevation. See PL 07-02 section 4.9 for additional information.

**1.7.2** The location of electrical elements shall conform to American Society of Civil Engineers Standard 24: Flood Resistant Design and Construction (ASCE 24), Section 7.2.

### 1.8 Geohazard Report

The design information section shall include a note stating that a geohazard report is required to be submitted to and approved by the California Geological Survey (CGS) with the site-specific application. See *IR A-4: Geohazard Report Requirements*.

### 1.9 PC Sheet Index

The PC drawings shall include a sheet index**.** When a PC includes multiple major options such that not all sheets are applicable to a given site-specific project application based on the option being used, the sheet index shall include check boxes. When the PC drawings are incorporated into a site-specific application, the submitted sheets will be identified by marking the check

boxes (i.e., it is not necessary to strike out sheets that are not applicable). See PR 07-01 Appendix E for additional information.

### 1.10 PC Stamp

The PC drawings shall include the following:

**1.10.1** 2022 CBC PC Stamp per PR 07-01 Section 6.1.

**1.10.2** Two blank areas on each PC sheet title block as indicated in procedure *PR 18-04: Electronic Plan Review for Design Professionals of Record*, Section 1: one for the PC Identification Stamp and one for the future site-specific Identification Stamp. ←

### 1.11 Structural Products Acceptance

All structural products shall meet the requirements set forth in *IR A-5: Acceptance of Products, Materials, and Evaluation Reports*. For load combinations with seismic loads, the design capacity shall be reduced per IR A-5 Section 4.2 unless established by cyclic tests. Code-based engineering calculations to support a manufactured product will be considered.

## 2. PRECAST CONCRETE BUILDINGS

### 2.1 Wall Panels

**2.1.1** Wall panels shall meet the minimum reinforcement requirements of CBC Section 1905A.1.5, including continuous ties at the roof line and base of the wall.

**2.1.2** Out-of-plane wall anchorage forces are often transferred between panels at corners. It is recommended to allow for small vertical movements to reduce cracking and avoid damage to the connection.

### 2.2 Floor and Roof Framing Connections

Long spans and/or heavy loads may result in large forces on embedded connections, require several anchors to the panel, and/or require close coordination of the embedded plate with the rebar to avoid conflicts in construction and field problems. The design of anchors to wall panels shall be per American Concrete Institute (ACI) 318 Chapter 17. Where rebar dowels are used for anchorage see ACI 318 Section 17.1.6. Anchorage shall account for combined gravity and lateral loads: see Section 4.5 below.

### 2.3 Embedded Items and Reinforcement

Construction details shall be designed to coordinate closely spaced and/or large size reinforcement, ties, plates, welded studs, and other embedded items to avoid conflict at congested locations**.** Sufficient space shall be provided for the reinforcement from or around the connection, weld plate or similar detail to lap with and fit in between the panel reinforcement.

**2.3.1** Rebar dowels used to transfer forces to concrete slabs through shear friction shall be designed in accordance with ACI 318 Section 22.9.

**2.3.2** Development lengths for straight, hooked, and headed bars shall be in accordance with ACI 318 Section 25.4.

### 2.4 Panel Shortening

The PC design shall comply with ACI 318 Sections 4.3 and 5.2. Shortening over a long line of panels can lead to a buildup of forces and cracking around the connections spanning the gap between adjacent panels.

**2.4.1** Adequate de-bonding shall be provided at panel gaps as required to accommodate shrinkage and temperature changes. Refer to Section 4.4 of the Precast/Prestressed Concrete Institute (PCI) Design Handbook 8th Edition for additional guidance.

**2.4.2** Continuous ledgers, if used as chords with ties between panels, will commonly need some type of allowance for horizontal in-plane slip near the panel ends for temperature and shrinkage.

### 2.5 Canopies

If canopies are part of the PC design, the load path to the building shall be coordinated. The allowed locations or options of canopies shall be indicated on the PC drawings. Partial plans shall show any added roof framing or bracing required where canopies frame to the side of a wall. Wall panel design shall account for all loads imposed by the canopy.

### 2.6 Utility and Service Lines

In accordance with ASCE Standard 7: Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7), Section 13.6.9 all pipes, conduits, and other utility lines crossing separation joints shall be designed to accommodate, without rupture or distress, differential movements from design displacements between connection points. PC drawings shall indicate the maximum lateral displacement demand for each building option in the design information section.

## 3. GRAVITY LOAD DESIGN

### 3.1 Dead Loads

**3.1.1** Per CBC Section 1606A.6 the design dead load shall include the weight of at least one additional roof covering in addition to other applicable loadings.

**3.1.2** The roof plans shall show the allowed locations and weights of mechanical equipment, coordinated with the mechanical plans.

### 3.2 Solar Zone on Solar Ready Roof

Refer to *PR 18-02: Pre-Check (PC) Permanent Modular or Relocatable Building Designs CALGreen/Energy Code Compliance Review* and CBC Sections 1603A.1.8.1 and 1607A.14.4.

**3.2.1** Where portions of the roof are designated as solar zones, the building design loads (i.e., dead load, roof live load, any superimposed load for future solar components, etc.) for the solar zone shall be clearly indicated on the construction documents. Include information to define the effective seismic weight accounted for in the structural design. The selection of the superimposed design loads for future solar components are solely at the discretion of the design professional and DSA will not mandate any additional prescribed minimum load.

**3.2.2** The design information section of the PC drawings shall include a note stating that future solar installation will require a separate DSA application.

### 3.3 Load Posting

The PC drawings shall specify signage requirements for the posting of floor live loads and roof snow loads in accordance with CBC Section 106.1. Signs for load postings shall be posted in public view.

### 3.4 Snow Load

**3.4.1** The design information section shall state snow and ice loads accounted for in the PC design. The PC drawings shall indicate 0 (zero) pounds per square foot if the design does not account for snow or ice loads.

**3.4.2** If the structure is designed for snow load, the design information section of the PC drawings shall include a note the same as or similar to the following: “Site application design professional and DSA plan reviewer shall verify the structure to be located at least xx feet from any adjacent higher structure” where the distance “xx” is calculated and stated by the PC applicant. See ASCE 7 Section 7.7. If the horizontal separation from a higher structure is less than 20-feet and six times the vertical dimension separating the roofs, snow drift analysis shall be provided by the PC applicant, and the project is not eligible for OTC submittal.

**3.4.3** The effective seismic weight shall include snow load per ASCE 7 Section 12.7.2.

### 3.5 Ponding Loads

Roof configurations that allow for ponding are to be properly drained with primary and secondary drain systems, and roof framing shall be designed to account for any ponding buildup in the event of primary drain blockage. Refer to ASCE 7 Chapter 8 and CBC Sections 1502 and 1611A.

### 3.6 Member Design

Concrete members not designated as part of the seismic force resisting system shall comply with ACI 318 Section 18.14.

## 4. LATERAL LOAD DESIGN

### 4.1 Seismic Load Criteria

**4.1.1** The seismic design criteria upon which the PC design is based shall be stated in the design information section of the PC drawings in accordance with PR 07-01 and CBC Section 1603A.1.5.

**4.1.2** If the design is based upon the maximum $S_S$ and $S_1$ values (as defined by ASCE 7 Section 11.3) occurring in the state of California, the PC can be used at any site in the state. The PC design may be based on other $S_S$ and $S_1$ values but doing so will limit the site locations where the PC can be used.

**4.1.3** The base shear is permitted to be calculated using a cap on the maximum design spectral response acceleration parameter value of $S_{DS}$ in accordance with ASCE 7 Section 12.8.1.3, provided that *all* of the noted criteria are met.

**4.1.3.1** The PC design shall demonstrate compliance with the required criteria specific to the precast concrete building structure (e.g., no irregularities, period not exceeding 0.5 seconds, redundancy factor equal to 1.0, etc.). The PC drawings shall list these properties in the design information section. For the purpose of checking compliance with these criteria, the period shall be determined based on the actual properties of the structure, including foundation flexibility, and not use the approximate period in ASCE 7 Section 12.8.2.1.

**4.1.3.2** The design information section of the PC drawings shall also contain a note stating the site-specific limitations of the design based on the $S_{DS}$ cap and requiring these be verified by the site-specific project applicant (e.g., Site Class E not allowed, RC I or II, etc.).

**4.1.3.3** Per PR 07-01 Appendix C, if a capped value of $S_{DS}$ is used to determine $C_S$, the design information section shall list the $S_{DS}$ (cap) used to determine $C_S$ as well as the $S_{DS}$ (no cap) used for verification of site-specific application and to determine other parameters such as nonstructural component anchorage.

### 4.2 Ground Motion Hazard Analysis

The 2022 CBC adopts ASCE 7 with Supplement 3, which modifies Section 11.4.8. Due to the site-specific ground motion analysis requirements of ASCE 7 Section 11.4.8, the seismic load criteria used for PC designs per Section 4.1 above on Site Class D and E shall consider the Exceptions of ASCE 7 Section 11.4.8, Items 1 and 2.

**4.2.1** The PC option for Site Class D shall include a note in the design information section the same or similar to the following: "Unless a site-specific ground motion hazard analysis is performed, the $S_{M1}$ value increased by 50% shall be less than the design criteria stated herein."

**4.2.2** The PC option for Site Class E shall state in the design information section whether or not the PC design complies with the conditions of Exception 1 of ASCE 7 Section 11.4.8, Item 2.

### 4.3 Seismic Analysis

The structural analysis of the building and its seismic force resisting system (SFRS) shall include consideration of the following:

**4.3.1** The mathematical model shall represent actual panel to panel interconnection, panel to base connection, and floor and roof deck stiffness values. The effect of the connections made between panel joints shall be accounted for in evaluating the rigidity of a line of concrete wall panels. A stiffness analysis shall be performed, complying with ASCE 7 Section 12.7.3. Refer to the PCI Design Handbook Section 4.5.6 for additional guidance.

**4.3.2** When the building's diaphragms are rigid or semi-rigid the structural analysis shall include an evaluation for torsional irregularity as defined by ASCE 7 Table 12.3-1. An extreme torsional irregularity is not permitted in accordance with CBC Section 1617A.1.10 (which modifies ASCE 7 Section 12.3.3.1) unless one of the Exceptions of that section is met.

**4.3.3** At the interface of roofs with different elevations, the design shall justify the adequacy of load paths and deformation compatibility.

### 4.4 Concrete Shear Walls

PC designs utilizing shear walls as the SFRS shall consist of intermediate precast structural walls or special structural walls as defined by ACI 318. SFRS design parameters shall be in accordance with ASCE 7 Table 12.2-1.

**4.4.1** In-plane forces on concrete wall panels with large openings or multiple openings can cause frame-like action. Wall piers and lintels shall be justified for shear and moment demands.

**4.4.2** The design of wall piers shall comply with ACI 318 Section 18.10.8. See ACI 318 Section 18.10.4 for shear strength requirements and ACI 318 Section 18.10.8.2 for horizontal reinforcement required above and below openings. Refer to ACI 318 Commentary Section R18.10.8 for additional information.

**4.4.3** Concrete panel to panel connections shall satisfy the ductility requirements of CBC Section 1905A.1.9. Refer to Federal Emergency Management Agency (FEMA) P-1051, 2015 NEHRP Recommended Seismic Provisions: Design Examples document Chapter 11. Specifically, the design example in FEMA P-1051 Section 11.3.5 illustrates an acceptable approach for satisfying the 1.5 $S_y$ and 80 percent of design strength requirements.

**4.4.4** Construction details shall provide sufficient space and clearance at the connection to the foundation for the reinforcement from the weld plate or other hold down to lap with the vertical reinforcement, particularly where boundary elements are required.

**4.4.5** "Knock-outs" are predetermined regions of precast concrete walls that can be removed to create optional openings in the future. All knock-out locations and sizes shall be shown and dimensioned on the PC drawings. The optional nature of knock-outs can result in multiple wall configurations of varying rigidity and in-plane load distribution. The PC design shall justify the local wall design and global building design for all possible configurations that could result from the knock-outs.

**4.4.6** Intermediate precast structural walls shall comply with ACI 318 Section 18.5 and CBC Section 1905A.1.9.

**4.4.7** Special structural walls shall comply with ACI 318 Sections 18.10 and 18.11 and CBC Sections 1905A.1.9 and 1905A.1.10.

**4.4.7.1** Rebar development and splices shall comply with ACI 318 Section 18.10.2.3.

**4.4.7.2** Longitudinal wall reinforcement shall comply with ACI 318 Section 18.10.2.4 except where deformation demands are concentrated at panel joints per ACI 318 Section 18.11.2.1.

**4.4.7.3** Walls shall have sufficient strength to resist the design shear force required by ACI 318 Section 18.10.3.

**4.4.7.4** The design of boundary elements shall comply with ACI 318 Section 18.10.6, including the transverse reinforcement requirements of ACI 318 Sections 18.10.6.2 and 18.10.6.4.

**4.4.7.5** For walls with openings, coupling beams shall comply with ACI 318 Section 18.10.7, including the determination of when coupling beam design is required.

### 4.5 Out-of-Plane Design of Concrete Walls

The path of vertical and lateral loads shall be accounted for in the wall design. Each separate concrete wall panel or element shall be designed for the out-of-plane wall forces tributary to it. Refer to the 2018 IBC SEAOC Structural/Seismic Design Manual, Volume 2, Example 5 for additional information.

**4.5.1** Out-of-plane seismic forces shall be determined as required by ASCE 7 Section 12.11 and CBC Section 1604A.8.2.

**4.5.2** Concrete wall design shall comply with ACI 318 Chapter 11, including ACI 318 Section 11.8 for slender wall design.

**4.5.3** The wall panel design shall account for the effect of wall openings. Refer to ACI 551.2R Chapter 7 for additional information.

**4.5.4** When the design includes wall pilasters, the effect of pilasters on the vertical and lateral load paths shall be accounted for. Refer to ACI 551.2R for additional guidance on the out-of-plane design of walls with pilasters.

### 4.6 Concrete Wall Anchorage to Diaphragm

The design of concrete wall panel anchorage to diaphragms shall be based on a detailed evaluation including the load path, analysis assumptions, and statics used to determine anchorage forces. Connections shall be designed for combined gravity loads and out-of-plane wall anchorage forces.

**4.6.1** The seismic anchorage force per ASCE 7 Section 12.11.2.1 need not be increased by the overstrength factor as permitted by the Exception of CBC Section 1905A.1.8.

**4.6.2** The seismic anchorage force used in the design of steel elements (not anchors or reinforcement) shall be increased per ASCE 7 Section 12.11.2.2.2.

**4.6.3** Subdiaphragms and continuity ties transferring seismic wall anchorage forces shall comply with ASCE 7 Section 12.11.2.2.

**4.6.4** Bare metal deck is permitted to serve as a continuous tie only in its span direction (i.e., parallel to flutes). ASCE 7 Section 12.11.2.2.4 does not permit the deck to be used as a continuous tie for wall anchorage forces perpendicular to the flutes. The design of steel deck shall comply with American Iron and Steel Institute (AISI) S100 for combined axial and bending forces. The design of welds shall include combined forces where applicable.

### 4.7 Collectors

Collector elements and connections shall be designed for loads complying with ASCE 7 Section 12.10.2.1 in combination with gravity loads. At collector connections to panels the design shall demonstrate adequate connection to the panel reinforcing.

### 4.8 Lateral Seismic Displacement

The minimum seismic separation shall be determined in accordance with ASCE 7 Section 12.12.3. The PC drawings shall indicate the maximum lateral displacement demand for each building option in the design information section for use by the site-specific project applicant in correctly locating the building on the project site relative to existing and other new buildings.

### 4.9 Wind Load Design

Wind design loads shall be determined in accordance with ASCE 7 Chapters 26 through 30.

**4.9.1** For conditions where roof beams, purlins, or trusses are subject to net uplift from wind forces, the bottom flange or chord shall be braced or justified by calculation as not requiring bracing. ←

**4.9.2** Member end connections shall be designed for wind uplift where occurs. ←

**4.9.3** The design of exterior walls shall include a determination of whether wind or seismic loads govern at each critical location and load combination. Special attention should be given to wall corners in wind zone 5.

### 4.10 Metal Roof Panel System

Metal roof panel systems shall comply with CBC Sections 1504.4 and 1507.4. A manufacturer, product, and basis of approval for the metal roof panel system and fastener parts/layout shall be specified. The interpretations noted below do not preclude the project from meeting the other requirements in CBC Chapter 15 (e.g., fire classification, insulation, etc.).

**4.10.1** The PC drawings shall fully detail the panel clip spacing and fasteners, metal material specification, panel profile, thickness, etc.

**4.10.2** The underlayment, flashing and other waterproofing shall be fully detailed on the PC drawings and shall comply with CBC Chapter 15.

**4.10.3** The wind load uplift resistance provided by the panels and their connections shall be based on test data in accordance with ASTM E1592, Underwriters Laboratory (UL) 580, UL 1897, or Factory Mutual (FM) 4474 as appropriate by an independent accredited laboratory. Qualification of the metal roof panel system shall be provided in accordance with the one of the following methods:

**4.10.3.1** If the system has a UL or FM certification or has an evaluation report issued by an accepted agency per IR A-5, this basis of approval shall be denoted on the PC drawings. A copy of the UL or FM product report, if applicable, shall be submitted to substantiate the design capacity of the products.

**4.10.3.2** If the system does not have a qualified certification per Section 4.8.3.1 above, a wind uplift test report by an independent accredited testing laboratory shall be submitted with the PC project. The test results shall be interpreted for applicability and adjusted for factor of safety in accordance with AISI S100 Section I6.3.1 by a California registered Structural Engineer. The testing laboratory shall be accredited by International Organization for Standardization (ISO) 17025 in accordance with International Code Council Evaluation Service (ICC-ES) AC85. Other accreditations (e.g., ISO 17020) may be acceptable with DSA approval.

## 5. FOUNDATION

### 5.1 Foundation Design

The foundation design shall comply with CBC Sections 1617A.1.15 and 1808A.1. A geotechnical report is required per CBC Section 1803A with the site-specific project application.

### 5.2 Wall Panel to Foundation Connections

Concrete panel to foundation connections shall comply with CBC Section 1905A.1.9 and ACI 318 Sections 18.5.2 and 18.13.

**5.2.1** The design of connections to the foundation shall be justified for the amplified seismic loads required by CBC Section 1617A.1.15 (e.g., load combinations with overstrength factor). All connections of precast concrete walls to the foundation shall be designed to comply with this requirement, including in-plane shear dowels, overturning tie downs, intermediate tie downs at piers, connection plates, etc.

**5.2.2** ACI 318 Sections 18.5.2.2 (80 percent design strength) and 18.5.2.3 (1.5 $S_y$), as modified by CBC Section 1905A.1.9, need not be satisfied for the foundation connection if designed for the amplified seismic loads from one of the three options (i.e., strength of superstructure elements, fully yielded structural system, or load combinations with overstrength factor) in CBC Section 1617A.1.15. However, these ACI 318 sections as modified by CBC Section 1905A.1.9 need to be satisfied if the foundation connection is designed to respond inelastically per Exception 2 of CBC Section 1617A.1.15.

**5.2.3** The design forces used to establish when the minimum foundation tension tie per ACI 318 Section 18.13.2.4 and 18.13.2.5 is required shall include the amplified seismic forces from CBC Section 1617A.1.15.

**5.2.4** When designing the wall panel-to-foundation connection for the amplified seismic loads per CBC Section 1617A.1.15, the connecting elements (e.g., rebar, headed studs, etc.) embedded in the wall panel shall also comply with the amplified seismic loads and must be fully developed into the wall panel.

**5.2.5** The “pour strip” that ties the slab to the wall panel often serves as the connection to the foundation. When weld plates are used the design shall comply with ACI 318 Chapter 17 for the anchorage to concrete. Design of the panel to slab or footing welded plate connections shall include design for the eccentricity of forces on the connections and welds. Where dowels are used to connect the panel to the pour strip and/or slab, the required development length shall be calculated and specified.

### 5.3 Footings at Panel Openings

Openings in panels at the foundation level on continuous foundations wider than four times the footing depth and extensions of the footing beyond the end of the panel by more than two times the footing depth require design of the footing for amplified seismic loads per CBC Section 1617A.1.15. The design of footing reinforcement shall also comply with CBC Section 1905A.1.3. ←

### 5.4 Allowable Soil Bearing Pressure

When permitted by the site-specific geotechnical report the following adjustments may be used in the design of foundations.

**5.4.1** An allowable stress increase in the allowable soil bearing pressure is not permitted when using the allowable stress design load combinations per ASCE 7 Section 2.4. An allowable stress increase is permitted when using the alternative allowable stress load combinations per CBC Section 1605A.2 that include seismic loads.

**5.4.2** A reduction of foundation overturning per ASCE 7 Section 12.13.4 is permitted when using the allowable stress design load combinations per ASCE 7 Section 2.4. This reduction is not permitted when using the alternative allowable stress load combinations per CBC Section 1605A.2.

### 5.5 Liquefiable Soil or Site Class F

PC designs will not be approved with an option for construction on sites with liquefiable soil and/or Site Class F.

### 5.6 Foundations on or Adjacent to Slopes

The PC drawings shall specify minimum setback limits (values are required) of the structure per CBC Section 1808A.7 for building clearance, foundation setback, etc. for protection from slope drainage, erosion, and shallow failures.

### 5.7 Concrete Mix

In addition to those requirements dictated by the PC design, the concrete mix used in the foundation elements shall comply with the durability requirements of the ACI 318 Section 19.3. The PC drawings shall account for the dependency of these durability requirements on site-specific characteristics.

**5.7.1** In accordance with CBC Section 1803A.7, the site-specific geotechnical report shall quantify sulfate content and any other soil parameters required to define the exposure class of foundation concrete for each category (i.e., F, S, W and C) defined in ACI 318 Section 19.3.1. The PC drawings shall clearly state the exposure class for each category or combination thereof the PC design is approved for. The maximum water/cement ratio, minimum compressive strength, cementitious material requirements, and admixture limitations shall be stated on the PC drawings for each approved case in accordance with ACI 318 Section 19.3.2.

**5.7.2** The PC drawings shall include a note requiring that concrete exposed to freezing-and-thawing cycles be air entrained per ACI 318 Section 19.3.3.

## 6. ACCESS COMPLIANCE REQUIREMENTS

Accessibility requirements shall comply with CBC Chapter 11B. Appropriate details shall be provided on plans to assure compliance with all applicable code requirements.

When a PC design includes restrooms, the plans, elevations, and details shall be presented on separate sheets for each age-related user group (e.g., age 3 to 4, age 5 to 8, etc.).

## 7. FIRE AND LIFE SAFETY REQUIREMENTS

### 7.1 Type of Construction

Specify type of construction per CBC Chapter 6.

### 7.2 Total and Allowable Areas of Structure

Specify total area of structure and demonstrate that total area complies with the permitted allowable area per CBC Table 506.2 based on type of construction and proposed occupancy classification(s).

### 7.3 Use and Occupancy Classification(s)

Specify proposed use and occupancy classification(s) per CBC Chapter 3.

### 7.4 Occupant Load

Indicate the calculated occupant load based on function of the space per CBC Table 1004.5.

The following may be required where the calculated occupant load exceeds 49:

**7.4.1** Two or more exits per CBC Table 1006.2.1. Exit and exit access doorway configuration shall comply with CBC Section 1007.1.

**7.4.2** Panic hardware per CBC Section 1010.2.9.

**7.4.3** Emergency power for egress illumination (including exterior landings) per CBC Section 1008.3.

**7.4.4** Exit signs with backup power per CBC Section 1013.

**7.4.5** Occupant load signage per CBC Section 1004.9.

### 7.5 Roof Fire Classification

Specify roof fire hazard classification per CBC Section1505, and Section 705A for buildings located in designated hazardous fire areas.

### 7.6 Fire Extinguishers

Indicate fire extinguisher locations and specify type per California Fire Code (CFC) Section 906.

### 7.7 Interior Finishes

Interior wall, ceiling, floor, and decorative finishes shall comply with CBC Chapter 8.

### 7.8 Group E Door Hardware

Group E doors shall be lockable from the inside as required per CBC Section 1010.2.8.2.

### 7.9 Stairways

Stairways shall comply with CBC Section 1011.

### 7.10 Ramps

Ramps shall comply with CBC Section 1012.

### 7.11 Handrails

Handrails shall comply with CBC Section 1014.

### 7.12 Guards

Guards shall comply with CBC Section 1015.

### 7.13 Safety Glazing

Safety glazing is required in hazardous locations (in doors, adjacent to doors, in windows, etc.) per CBC Section 2406.4.

### 7.14 Solar Zones and Solar Ready Roofs

Reflect required fire department access aisles per CBC Section 3111.3.4.

## 8. SUSTAINABILITY REQUIREMENTS

PC designs for precast concrete buildings shall comply with the mandatory measures of California Green Building Standards Code (CALGreen) and the California Energy Code.

**8.1** The PC drawings shall show that primary exterior entries are protected from water intrusion by adding a recessed door, awning, or roof overhang at least four feet in depth in addition to using nonabsorbent floor and wall finishes within 2 feet around and perpendicular to such openings in accordance with CALGreen Section 5.407.2.2.

**8.2** For a more detailed list of CALGreen and California Energy Code requirements for PC submittals refer to PR 07-01, PR 18-02, and form *DSA 403-PC: CALGreen and Energy Code-Compliance Checklist for Pre-Checked (PC) Permanent and Modular Relocatable Building Designs*.

**REFERENCES:**

2022 California Code of Regulations (CCR) Title 24
- Part 2: California Building Code (CBC).
- Part 6: California Energy Code.
- Part 9: California Fire Code (CFC).
- Part 11: California Green Building Standards Code

# PRE-CHECK (PC) DESIGN CRITERIA FOR PRECAST CONCRETE BUILDINGS: 2022 CBC

## APPENDIX A: SITE-SPECIFIC APPLICATION GUIDE

The following notes are provided as a guide to assist design professionals and DSA plan reviewers when preparing and reviewing site-specific project applications that incorporate PC precast concrete buildings designed in accordance with this IR. This Appendix is not intended to be an all-inclusive list of design and submittal requirements but rather is an aid to identify aspects of the design criteria described in this IR of particular interest to its site application. ←

- ☐ Verify site-specific suitability of the PC including all parameters in PL 07-02 Section 3.
- ☐ Verify site-specific requirements of PL 07-02 Section 4 are met.
- ☐ Review the site-specific form DSA 103 in comparison with the example form DSA 103 and for any exemptions from the required structural tests and special inspections. Refer to Section 1.3 above for additional information.
- ☐ Verify Risk Category (RC) of the site-specific design is compliant with the design information section of the approved PC. Refer to Section 1.6 above for additional information.
- ☐ Verify utility and services lines crossing building separation joints are designed to accommodate, without rupture or distress, differential building movements as defined on the PC drawings. Refer to Section 2.6 above for additional information.
- ☐ If the site has a ground snow load greater than zero, verify the building is positioned with sufficient distance from any adjacent structures as defined on the PC drawings. If the horizontal separation is less than 20 feet, snow drift analysis shall be provided by the PC applicant, and the project is not eligible for OTC review. Refer to Section 3.4 above for additional information.
- ☐ If the site is classified as Site Class D or E and the seismic design of the PC is not based on the short period seismic response parameter $S_{DS}$ as indicated in the Design Information section of the PC drawings, verify if a site-specific ground motion hazard analysis is required. Refer to Section 4.2 above for additional information.
- ☐ In addition to the requirements of PL 07-02 Section 3.1.3, if the PC design is based on a capped $S_{DS}$ value per ASCE 7 Section 12.8.1.3 verify the site-specific criteria are met. Refer to Section 4.1.3 above for additional information.
- ☐ Verify the location of the building on the site complies with the dimensional requirements for building separation relative to existing or other new buildings as defined on the PC drawings. Unless a detailed analysis is provided, the movement of an adjacent existing building shall be assumed to be that corresponding to the maximum drift allowed by the governing code at the time of the existing building's design or construction. Alternately, the lateral displacement of an existing building can be assumed to be 3 percent (0.03h) of its height in accordance with ASCE 41 Section 7.2.13.1. Refer to Section 4.8 above for additional information.
- ☐ If the building is placed adjacent to a slope, verify the building location complies with the setback requirements defined on the PC drawings. Refer to Section 5.6 above for additional information.