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Annotated Edition of CEBC Chapter A4
Incorporating amendments and revisions from
Technical Bulletin 15.27-1 (January 4, 2023)

Purpose: *This document combines the text of 2022* California Existing Building Code *(CEBC) Appendix Chapter A4 with the additional provisions, revisions, and commentary from Technical Bulletin 15.27-1 (TB15.27-1), Part C. It is provided for the convenience of design professional preparing designs to comply with Oakland Municipal Code Chapter 15.27.*

Revisions to CEBC provisions are shown in strikeout/underline format. Commentary is shown indented and italicized. Notes explaining changes in the 2022 CEBC relative to the 2019 edition are shown indented and italicized. "2019 TB15.27-1" refers to the previous edition of that Bulletin, dated May 19, 2019. All other references to TB15.27-1 refer to the current edition.

Consistent with CEBC Chapter 16, all references to "ASCE 7" mean ASCE/SEI 7-16 with Supplements 1, 2, and 3.

Annotated 2022 CEBC Chapter A4

EARTHQUAKE RISK REDUCTION IN WOOD-FRAME RESIDENTIAL BUILDINGS WITH SOFT, WEAK OR OPEN FRONT WALLS

SECTION A401 GENERAL

A401.1 Purpose. The purpose of this chapter is to promote public welfare and safety by reducing the risk of death or injury that may result from the effects of earthquakes on existing wood-frame, multiple-unit residential buildings. The ground motions of past earthquakes have caused the loss of human life, personal injury and property damage in these types of buildings. This chapter creates minimum standards to strengthen the more vulnerable portions of these structures. When fully followed, these minimum standards will improve the performance of these buildings but will not necessarily prevent all earthquake-related damage.

~~**A401.2 Scope.** The provisions of this chapter apply to existing buildings of wood construction that contain residential occupancies and are assigned to Risk Category II, and where the structure has a soft, weak, or open-front wall line, and there exists one or more stories above.~~

> ***Commentary:*** *In the context of OMC Chapter 15.27, the applicability of Chapter A4 is established by the Ordinance and by the definition of Subject Buildings in OMC Section 15.27.030.*
> ***2022 CEBC note:*** *The text of this provision has changed, but it is still not needed for application of OMC Chapter 15.27.*

SECTION A402 DEFINITIONS

A402.1 Definitions. Notwithstanding the applicable definitions, symbols and notations in the building code, the following definitions shall apply for the purposes of this chapter:

ASPECT RATIO. The span-width ratio for horizontal diaphragms and the height-length ratio for shear walls.

> ***2022 CEBC note:*** *Consistent with the 2019 TB15.27-1, the term Ground Floor has been removed as unnecessary. In the 2019 Chapter A4, the term was used in only two places: the exception to A403.2, which has also been omitted, and A404.1, where the plain English meaning is sufficient. In the context of OMC Chapter 15.27, the term was omitted also because it could be confused with the new term Target Story.*

NONCONFORMING STRUCTURAL MATERIALS. Wall bracing materials other than wood structural panels or diagonal sheathing.

OPEN-FRONT WALL LINE. An exterior wall line, without vertical elements of the lateral force-resisting system, that requires tributary seismic forces to be resisted by diaphragm rotation or excessive cantilever beyond parallel lines of shear walls. Diaphragms that cantilever more than 25 percent of the distance between lines of lateral force-resisting elements from which the diaphragm cantilevers shall be considered excessive. Exterior exit balconies of 6 feet (1829 mm) or less in width shall not be considered excessive cantilevers.

RETROFIT. An improvement of the lateral force-resisting system by alteration of existing structural elements or addition of new structural elements.

SOFT WALL LINE. A wall line whose lateral stiffness is less than that required by story drift limitations or deformation compatibility requirements of this chapter. In lieu of analysis, a soft wall line may be defined as a wall line in a story where the story stiffness is less than 70 percent of the story above for the direction under consideration.

STORY. A story as defined by the building code, including any basement or underfloor space of a building with cripple walls exceeding 4 feet (1219 mm) in height.

> ***2022 CEBC note:*** *Consistent with 2019 TB15.27-1, the term Story Strength has been removed as unnecessary and to avoid conflict with "expected story strength" as used in Section A403.3.1. In the 2019 Chapter A4, the term was used only once, in the definition of "weak wall line," but in the context of OMC Chapter 15.27, that definition is itself unnecessary because of the new definition of Target Story.*

TARGET STORY. Either (1) a basement story or underfloor area that extends above grade at any point or (2) any story above grade, where the wall configuration of such basement, underfloor area, or story is substantially more vulnerable to earthquake damage than the wall configuration of the story above, except that a story is not a target story if it is the topmost story or if the difference in vulnerability is primarily due to the story above being a penthouse or an attic with a pitched roof.

Commentary: *This definition, given in OMC Section 15.27.150, is added as a preferred way to refer to the structural deficiency of interest in Chapter A4 and the subject of mandatory seismic retrofit.*

- *The definition simplifies and clarifies the Chapter A4 terminology. Chapter A4 and TB15.27-1 call for consideration of whole stories, but Chapter A4 only defines its critical deficiencies in terms of wall lines and does not clearly recognize complexities posed by sloped sites (e.g. the target story might not be the ground story, and a building might have more than one target story). That said, any story that contains a soft wall line, a weak wall line, or an open-front wall line as defined in Chapter A4 would normally be considered a target story.*
- *Because the definition is not quantitative, it usefully relies on the judgment of engineers or other qualified design professionals; Step 1, described in the Compliance Deadlines table above, offers each owner noticed by the City an opportunity to demonstrate that the building in question has no target stories or wood frame target stories.*
- *By including underfloor areas, the definition avoids confusion about crawl spaces and the building code definition of "story," especially on sloped sites.*
- *The definition facilitates coordination with similar programs in Berkeley and San Francisco and with Oakland's HMGP-funded SHOP program.*

WALL LINE. Any length of wall along a principal axis of the building used to provide resistance to lateral loads. Parallel wall lines separated by less than 4 feet (1219 mm) shall be considered to be one wall line for the distribution of loads.

WEAK WALL LINE. A wall line in a story where the story strength is less than 80 percent of the story above in the direction under consideration. For purposes of this definition, nonconforming structural materials shall not be considered.

Commentary: *The added sentence coordinates with the use of "expected story strength" in Section A403.3.1.*

WOOD FRAME TARGET STORY. A target story in which a significant portion of lateral or torsional story strength or story stiffness is provided by wood frame walls.

Commentary: *Together with the definition of target story, this definition, also given in OMC Section 15.27.150, identifies the deficiency of interest in Chapter A4 and the subject of mandatory seismic retrofit. As with the definition of target story, the definition of wood frame target story relies intentionally on the judgment of design professionals.*

SECTION A403
ANALYSIS AND DESIGN

A403.1 General. Modifications required by the provisions in this chapter shall be designed in accordance with the *California Building Code* provisions for new construction, except as modified or otherwise allowed by this chapter and by TB15.27-1.

~~**Exception:** Buildings for which the prescriptive measures provided in Section A404 apply and are used.~~

Alteration of the existing lateral force-resisting system or vertical load-carrying system shall not reduce the strength or stiffness of the existing structure, unless the altered structure would remain in conformance to the building code and this chapter.

> ***Commentary:*** *The exception is omitted because the additional phrase "or otherwise allowed" makes it moot.*
> ***2022 CEBC note:*** *Editorial changes were made to this section with no change in substance.*

A403.2 Scope of analysis. This chapter requires the alteration, repair, replacement or addition of structural elements and their connections to meet the strength and stiffness requirements herein. The lateral-load-path analysis shall include the resisting elements and connections from the wood diaphragm immediately above any wood frame target story ~~soft, weak or open-front wall lines~~ to the foundation soil interface or to the uppermost story of a podium structure comprised of steel, masonry, or concrete structural systems that supports the upper, wood-framed structure. Stories above the uppermost wood frame target story ~~with a soft, weak, or open-front wall line~~ shall be considered in the analysis but need not be modified. The lateral-load-path analysis for added structural elements shall include evaluation of the allowable soil-bearing and lateral pressures in accordance with the building code. Where any portion of a building within the scope of this chapter is constructed on or into a slope steeper than one unit vertical in three units horizontal (33-percent slope), the lateral force-resisting system at and below the base level diaphragm shall be analyzed for the effects of concentrated lateral forces at the base caused by this hillside condition.

> ***Commentary:*** *By substituting the definition of wood frame target story, this modification clarifies the scope of work. (It also makes the two sentences about podium structures and hillside conditions largely moot.)*
> ***2022 CEBC note:*** *Consistent with the 2019 TB15.27-1, the exception to this section was omitted because it improperly focused on individual wall lines; any reduced retrofit scope should be justified by full-story calculations. Also, many cases that would have been covered by the exception are also covered by the prescriptive solution of Section A404.*

A403.3 Design base shear and design parameters. The design base shear in a given direction shall be permitted to be 75 percent of the value required for similar new construction in accordance with the building code. The value of R used in the design of the strengthening of any story shall not exceed the lowest value of R used in the same direction at any story above. The system overstrength factor, Ω_0, and the deflection amplification factor, C_d, shall be not less than the largest respective value corresponding to the R factor being used in the direction under consideration.

Exceptions:

1. For structures assigned to Seismic Design Category B, values of R, Ω_0 and C_d shall be permitted to be based on the seismic force-resisting system being used to achieve the required strengthening.

2. For structures assigned to Seismic Design Category C or D, values of R, Ω_0 and C_d shall be permitted to be based on the seismic force-resisting system being used to achieve the required strengthening, provided that when the strengthening is complete, the strengthened structure will not have an extreme weak story irregularity defined as Type 5b in ASCE 7, Table 12.3-2.

3. For structures assigned to Seismic Design Category E, values of R, Ω_0 and C_d shall be permitted to be based on the seismic force-resisting system being used to achieve the required strengthening, provided that when the strengthening is complete, the strengthened structure will not have an extreme soft story, a weak story, or an extreme weak story irregularity defined, respectively, as Types 1b, 5a and 5b in ASCE 7, Table 12.3-2.

4. For retrofit systems involving different seismic force-resisting systems in the same direction within the same story, resisting elements are permitted to be designed using the least value of R for the different structural systems found in each independent line of resistance if all of the following conditions are met:

4.1. The building is assigned to Risk Category I or II.

4.2. The building height is no more than four stories above grade plane.

4.3. The seismic force-resisting systems of the retrofitted building comprise only wood structural panel shear walls, steel moment-resisting frames, steel cantilever columns and steel braced frames. Values for C_d and Ω_0 shall be consistent with the R value used.

5. With reference to ASCE 7 Table 12.2-1, ordinary intermediate and special steel systems, and all light-frame systems shall be permitted without limitation where those systems are used only for retrofit to comply with the requirements of this chapter.

Commentary: *Where applicable, the allowance for a capped base shear coefficient in ASCE 7 Section 12.8.1.3 may be applied so that the value of $0.75S_{DS}$, including the 75 percent factor allowed by Chapter A4 Section A403.3, need not be taken greater than 1.00.*

More than one of the exceptions to Section 403.3 can apply in a single building.

2022 CEBC notes:

- *Consistent with 2019 TB15.27-1, Exception 4 has been added. It implements the SEAONC recommendation to allow retrofit schemes that involve different structural systems on different lines. Without this exception, a retrofit using an intermediate or ordinary steel frame along one line and wood structural panels elsewhere would be forced to over-design the wood elements.*
- *Consistent with 2019 TB15.27-1, Exception 5 has been added. It recognizes that height limits applicable when certain structural systems are used for a whole building should not apply when the same system is used only within a single story. In this regard, Exception 5 is like Exceptions 1 through 3, in that it decouples the design of the new retrofit system from non-conforming conditions in the existing structure.*
- *Consistent with 2019 TB15.27-1, editorial corrections and clarifications have been made.*

A403.3.1 Expected story strength. Despite any other requirement of Section A403.3 or A403.4, the total expected strength of retrofit elements added to any wood frame target story need not exceed 1.7 times the expected strength of the story immediately above in a two-story building, or 1.3 times the expected strength of the story immediately above in a three-story or taller building, as long as the retrofit elements are located symmetrically about the center of mass of the story above or so as to minimize torsion in the retrofitted story. Calculation of expected story strength and identification of irregularities in Section A403.3 shall be based on the expected strength of all wall lines, even if sheathed with nonconforming materials. The strength of a wall line above the retrofitted story shall be permitted to be reduced to account for inadequate load path or overturning resistance.

> ***2022 CEBC note:*** *Consistent with 2019 TB15.27-1, this added provision implements the allowance in OMC Section 15.27.170 that "the strength of a retrofitted Target Story need not exceed that required to develop the strength of stories above." It is based on a SEAONC recommendation to cap the required strength, consistent with FEMA P-807. The expected strength of the story above may be calculated using the FEMA P-807 criteria. If the strength is reduced to account for an inadequate load path, as allowed, the load path should be documented by field observation and condition assessment; otherwise, the strength calculation should assume an adequate load path to avoid underestimating the upper story strength.*

A403.3.2. Seismicity parameters, site class, and geologic hazards. With reference to ASCE 7 Sections 11.4.3 and 11.4.4, and for purposes of complying with OMC Chapter 15.27, seismicity parameters and site coefficients shall be those corresponding to the default designation of Site Class D unless site-specific geotechnical data is shown to justify a different designation. For any site designated as Site Class E or F, the value of F_a shall be taken as 1.2. Site-specific procedures are not required for compliance with this chapter. Mitigation of existing geologic site hazards such as liquefiable soil, fault rupture or landslide is not required for compliance with this chapter.

> ***Commentary:*** *In general, Site Class and associated coefficients and seismicity parameters should be determined following the normal procedures for new construction. This provision combines a new provision in 2022 CEBC (discussed below) with additional modifications in TB15.27-1. The first sentence indicates that the Bureau has not made any determinations regarding soil type that would affect application of ASCE 7 Section 11.4.3. Further, it makes clear that default values should be used in the absence of reliable site-specific data; this ensures that where the actual site class is unknown, the design does not inadvertently use unconservative criteria that might arise from a well-meaning but incorrect assumption of Site Class E or F. In the second sentence, the new CEBC provision specifies a value of* F_a *for similar reasons, as discussed below. TB15.27-1 applies the same concept to Site Class F to simplify the derivation of design criteria, since the intent of both Chapter A4 and OMC Chapter 15.27-1 is to avoid requiring additional geotechnical investigation. Thus, the first sentence applies where the site class is unknown, and the second sentence applies a similar idea even where the site class is known to be Site Class E or F.*

Seismic hazard parameters as needed may be obtained from the ASCE 7 Hazard Tool at https://asce7hazardtool.online/. Note that when using this or similar tools, the "default" Site Class D specified by this provision and by ASCE 7 Sections 11.4.3 and 11.4.4 is not the same as a known Site Class D. Also, where Site Class E or F is known, these tools might not automatically use the value of F_a *required here, so design professionals might need to make that adjustment separately.*

History note: *The 2019 TB15.27-1 included a link to a USGS map of Bay Area site classes. USGS no longer publishes that map, however, so the link has been removed.*

2022 CEBC notes:

- *Consistent with 2019 TB15.27-1, this new provision sets a default value for* F_a *for Site Class E as a condition of avoiding site-specific soil investigation. The 2019 TB15.27-1 set a default value of 1.3, consistent with SEAONC consensus based on observed performance and recorded ground motions in the Loma Prieta earthquake. The same value, 1.3, was part of the overall code change proposal that added this provision to IEBC Chapter A4 (proposal EB159-19), but the value of 1.3 was changed to 1.2 by floor modification. The value of 1.2, which matches the value for Site Class C in high seismicity areas, is consistent with the allowance given in the Exception to ASCE 7-16 Section 11.4.8; it also matches the requirement for default Site Class D, new in ASCE 7-16 Section 11.4.4. Going forward, the Bureau accepts this model code and CEBC consensus value of 1.2.*
- *Consistent with 2019 TB15.27-1, the site-specific ground motion procedures normally required by ASCE 7 Section 11.4.8 are waived for these retrofit projects. Many buildings eligible for CEBC Chapter A4 would be exempt from site response analysis in any case by the exception to ASCE 7 Section 20.3.1.*

A403.4 Story drift limitations. The calculated story drift for each retrofitted story shall not exceed the allowable deformation compatible with all vertical load-resisting elements and 0.025 times the story height. The calculated story drift shall not be reduced by the effects of horizontal diaphragm stiffness but shall be increased where these effects produce rotation. Drift calculations shall be in accordance with the building code.

A403.4.1 Pole structures. The effects of rotation and soil stiffness shall be included in the calculated story drift where lateral loads are resisted by vertical elements whose required depth of embedment is determined by pole formulas. The coefficient of subgrade reaction used in deflection calculations shall be based on a geotechnical investigation conducted in accordance with the building code.

A403.5 Deformation compatibility and P Δ effects. The requirements of the building code shall apply, except as modified herein. Structural framing elements and their connections not required by design to be part of the lateral force-resisting system shall be designed and detailed to be adequate to maintain support of expected gravity loads when subjected to the expected deformations caused by seismic forces. Increased demand caused by P Δ effects and story sidesway stability shall be considered in retrofit stories that rely on the strength and stiffness of cantilever columns for lateral resistance.

A403.6 Ties and continuity. All parts of the structure included in the scope of Section A403.2 shall be interconnected as required by the building code.

A403.7 Collector elements. Collector elements shall be provided to transfer the seismic forces between the elements within the scope of Section A403.2.

> ***2022 CEBC note:*** *Consistent with 2019 TB15.27-1, this provision has been revised to eliminate potential confusion over the words "other portions of the building," which could be misread to mean even parts of the building outside the scope identified in Section A403.2.*

A403.8 Floor diaphragms. Floor diaphragms within the scope of Section A403.2 shall be shown to have adequate strength at the following locations:

1. For straight lumber sheathed diaphragms without integral hardwood flooring: Throughout the diaphragm. The code official is authorized to waive the requirement where it is shown that the condition occurs in areas small enough not to affect overall building performance.

2. For all other diaphragms: At locations where forces are transferred between the diaphragm and each new or strengthened vertical element of the seismic force-resisting system. Collector elements shall be provided where needed to distribute the transferred force over a greater length of diaphragm.

Exception: Where the existing vertical elements of the seismic force-resisting system are shown to comply with ~~this chapter~~ OMC Chapter 15.27 by evaluation, diaphragms need not be evaluated.

> ***2022 CEBC note:*** *Consistent with 2019 TB15.27-1, this replacement provision implements an interpretation considered appropriate for the limited objective of Chapter A4, though the wording was changed slightly through the code development process. The exception allows compliance by evaluation (Part D of TB15.27-1) to focus on the vertical SFRS elements – the walls and frames – without considering a diaphragm deficiency by itself to justify an intrusive retrofit. While the 2022 CEBC provision largely adopts the 2019 TB15.27-1 allowance, the reference to "this chapter" in the Exception is still necessary because OMC Chapter 15.27 does not allow Chapter A4 as criteria for evaluation.*
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> ***Commentary:*** *Straight lumber sheathed diaphragms without integral hardwood flooring are weaker and more flexible than other diaphragm systems. Though there are no known collapses due to this condition, expected poor performance could compromise the building's ability to meet even the limited objective of Chapter A4. Integral hardwood flooring – but not newer "floating" wood flooring – provides significant added strength and stiffness. Even in buildings with original hardwood flooring, some remodeled, carpeted, or tiled areas might have had the original wood flooring removed. Areas of the diaphragm that form a roof for the target story (such as the portion of a garage that extends beyond the wall line above, or at a lightwell or building setback) are also unlikely to have hardwood flooring to supplement the straight sheathing. These areas should be identified as part of the condition assessment and evaluated. Small isolated areas without hardwood flooring are not expected to affect overall building performance, so the*

provision grants a waiver for these cases. As a rule of thumb, an area up to 150 square feet per unit might represent such an acceptable condition.

For other less vulnerable diaphragm types, the provision requires a local check for each new or strengthened SFRS element but does not require an overall analysis of the full diaphragm. The unit shear demand at each vertical element is calculated as the force in the element divided by the total length of the element and its collectors. The shear demand is then compared to the unit shear capacity of the diaphragm. Where demand is greater than capacity, either the diaphragm must be strengthened or the collector lengthened. An existing diaphragm can be strengthened by adding a wood structural panel soffit to the bottom of the floor joists in the critical area. Diaphragm capacity need not be checked at existing vertical elements that are not strengthened because (except for straight lumber sheathed diaphragms) it is assumed that the unit capacities of the existing vertical elements and the diaphragm are comparable.

A403.9 Wood-framed shear walls. Wood-framed shear walls shall have strength and stiffness sufficient to resist the seismic loads and shall conform to the requirements of this section. Where new sheathing is applied to existing studs to create new wood-framed shear walls, the new wall elements shall be considered bearing wall systems for purposes of determining seismic design parameters.

2022 CEBC note: *Consistent with 2019 TB15.27-1, the second sentence has been added. Since existing studs are presumed to carry existing gravity loads, the walls they frame must be considered bearing walls, as opposed to "building frame" systems. This affects the selection of seismic design coefficients R,* C_d, and Ω_0.

A403.9.1 Gypsum or cement plaster products. Gypsum or cement plaster products shall not be used to provide the strength required by Section A403.3 or the stiffness required by Section A403.4.

2022 CEBC note*: Consistent with 2019 TB15.27-1, this provision has been rewritten for clarity. Since Chapter A4 is based on code provisions for new construction, code provisions and standards that allow like materials do not apply, and non-conforming materials are not allowed to be counted toward the minimum required strength. They must be considered, however, if the cap in Section A403.3.1 is applied, which is why the provision is modified.*

A403.9.2 Wood structural panels.

A403.9.2.1 Drift limit. Wood structural panel shear walls shall meet the story drift limitation of Section A403.4. Conformance to the story drift limitation shall be determined by approved testing or calculation. Individual shear panels shall be permitted to exceed the maximum aspect ratio, provided the allowable story drift and allowable shear capacities are not exceeded.

A403.9.2.2 Openings. Shear walls are permitted to be designed for continuity around openings in accordance with the building code. Blocking and steel strapping shall be provided at corners of the openings to transfer forces from discontinuous boundary elements into adjoining panel elements. Alternatively, perforated shear wall provisions of the building code are permitted to be used.

A403.9.3 Hold-down connectors.

A403.9.3.1 Expansion anchors in tension. Expansion anchors that provide tension strength by friction resistance shall not be used to connect hold-down devices to existing concrete or masonry elements.

A403.9.3.2 Required depth of embedment. The required depth of embedment or edge distance for the anchor used in the hold-down connector shall be provided in the concrete or masonry below any plain concrete slab unless satisfactory evidence is submitted to the code official that shows that the concrete slab and footings are of monolithic construction.

A403.10 Steel retrofit systems. Steel retrofit systems shall have strength and stiffness sufficient to resist the seismic loads and shall conform to the requirements of this section.

A403.10.1 Special moment frames. Steel special moment frames shall comply with all applicable provisions of AISC 341, including but not limited to connection design and lateral bracing of beams, except that Section E3.4a addressing strong-column/weak-beams of AISC 341, is not required for columns that carry no gravity load. Proprietary frame systems that qualify as special moment frames shall be permitted.

> ***2022 CEBC note:*** *Consistent with 2019 TB15.27-1, Section A403.10 and the first sentence of Section A403.10.1 have been added. The exception referring to AISC Sec E3.4a is the same as in 2019 TB15.27-1, but it was moved into the provision.*
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> ***Commentary:*** *The phrase regarding connection design and lateral bracing, which was also in 2019 TB15.27-1, was not added to the model code or to the CEBC because, while a useful reminder, it was considered redundant to the phrase "all applicable provisions." The second sentence, regarding proprietary systems, is a simplified rewording of the same idea from 2019 TB15.27-1; it was proposed for the model code but deemed unnecessary.*

A403.10.2 Inverted moment frame systems. Cantilevered column systems shall be permitted to be designed as inverted special, intermediate, or ordinary moment frames, with corresponding moment frame seismic design coefficients, where the system satisfies the following conditions:

1. The columns carry no gravity load.
2. The columns are configured in pairs or larger groups connected by a continuous reinforced concrete foundation or grade beam.
3. The foundation or grade beam shall be designed to resist the expected plastic moment at the base of each column, computed as $R_y F_y Z$ in accordance with AISC 341.
4. The flexibility of the foundation or grade beam, considering cracked section properties of the reinforced concrete, shall be included in computing the deformation of the steel frame system.
5. The column height shall be taken as twice the actual height when checking lateral torsional buckling.

> ***2022 CEBC note:*** *Consistent with 2019 TB15.27-1, this provision was added. It implements a SEAONC recommendation developed to accommodate a modification of traditional cantilevered column systems. Cantilevered column systems for new construction are normally assigned*

seismic design coefficients that severely limit their use. When used for retrofit of wood frame structures, however, the columns are less vulnerable to buckling failure because they carry no gravity load. SEAONC has therefore recommended that these cantilever column systems, configured as upside-down moment frame bents (with concrete cross beams), should be allowed to be designed as moment frame systems.

A403.10.3 Intermediate or ordinary moment frames. Steel intermediate or ordinary moment frames shall comply with all applicable provisions of AISC 341.

Commentary: *See Section A403.3 Exception 5 for a waiver on height limits otherwise applicable to these systems.*
2022 CEBC note: *This provision was proposed for the 2021 IEBC but was deemed unnecessary for the model code. TB15.27-1 retains it for clarity and completeness..*

A403.10.4 Cantilevered column systems. Steel special or ordinary cantilevered column systems shall comply with all applicable provisions of AISC 341.

2022 CEBC note: *This provision was proposed for the 2021 IEBC but was deemed unnecessary for the model code. TB15.27-1 retains it for clarity and completeness..*

SECTION A404
PRESCRIPTIVE MEASURES FOR WEAK STORY

A404.1 Limitation. These prescriptive measures shall apply only to two-story buildings ~~and only where deemed appropriate by the code official~~. These prescriptive measures rely on rotation of the second floor diaphragm to distribute the seismic load between the side and rear walls around a ground floor open area. In the absence of an existing floor diaphragm of wood structural panel or diagonal sheathing at the top of the first story, a new wood structural panel diaphragm of minimum thickness of 3/4 inch (19.1 mm) and with 10d common nails at 6 inches (152 mm) on center shall be applied.

Commentary: *These prescriptive measures are deemed appropriate for compliance with OMC Chapter 15.27.*
2022 CEBC note: *A few editorial clarifications have been made with no substantive effect.*

A404.1.1 Additional conditions. To qualify for these prescriptive measures, the following additional conditions need to be satisfied by the retrofitted structure:

1. Diaphragm aspect ratio L/W is less than 0.67, where W is the diaphragm dimension parallel to the soft, weak or open-front wall line and L is the distance in the orthogonal direction between that wall line and the rear wall of the ground floor open area.

2. Minimum length of side shear walls = 20 feet (6096 mm).

3. Minimum length of rear shear wall = three-fourths of the total rear wall length.

4. Plan or vertical irregularities shall not be other than a soft, weak or open-front wall line.

5. Roofing weight less than or equal to 5 pounds per square foot (240 N/m2).

6. Aspect ratio of the full second floor diaphragm meets the requirements of the building code for new construction.

A404.2 Minimum required retrofit.

A404.2.1 Anchor size and spacing. The anchor size and spacing shall be a minimum of 3/4 inch (19.1 mm) in diameter at 32 inches (813 mm) on center. Where existing anchors are inadequate, supplemental or alternative approved connectors (such as new steel plates bolted to the side of the foundation and nailed to the sill) shall be used.

A404.2.2 Connection to floor above. Shear wall top plates shall be connected to blocking or rim joist at upper floor with a minimum of 18-gage galvanized steel angle clips 4-1/2 inches (114 mm) long with 12-8d nails spaced no farther than 16 inches (406 mm) on center, or by equivalent shear transfer methods.

A404.2.3 Shear wall sheathing. The shear wall sheathing shall be a minimum of 15/32 inch (11.9 mm) 5-Ply Structural I with 10d nails at 4 inches (102 mm) on center at edges and 12 inches (305 mm) on center at field; blocked all edges with 3 by 4 board or larger. Where existing sill plates are less than 3-by thick, place flat 2-by on top of sill between studs, with flat 18-gage galvanized steel clips 4-1/2 inches (114 mm) long with 12-8d nails or 3/8-inch-diameter (9.5 mm) lags through blocking for shear transfer to sill plate. Stagger nailing from wall sheathing between existing sill and new blocking. Anchor new blocking to foundation as specified above.

A404.2.4 Shear wall hold-downs. Shear walls shall be provided with hold-down anchors at each end. Two hold-down anchors are required at intersecting corners. Hold-downs shall be approved connectors with a minimum 5/8-inch-diameter (15.9 mm) threaded rod or other approved anchor with a minimum allowable load of 4,000 pounds (17.8 kN). Anchor embedment in concrete shall be not less than 5 inches (127 mm). Tie-rod systems shall be not less than 5/8 inch (15.9 mm) in diameter unless using high-strength cable. High-strength cable elongation shall not exceed 5/8 inch (15.9 mm) under a 4,000 pound (17.8 kN) axial load.

SECTION A405
MATERIALS OF CONSTRUCTION

A405.1 New materials. New materials shall meet the requirements of the *California Building Code*, except where allowed by this chapter.

A405.2 Allowable foundation and lateral pressures. The use of default values from the building code for continuous and isolated concrete spread footings shall be permitted. For soil that supports embedded vertical elements, Section A403.4.1 shall apply.

A405.3 Existing materials. The physical condition, strengths, and stiffnesses of existing building

materials shall be taken into account in any analysis required by this chapter. The verification of existing materials conditions and their conformance to these requirements shall be made by physical observation, material testing or record drawings as determined by the registered design professional subject to the approval of the code official.

> ***Commentary:*** *While an overall condition assessment is often beneficial, this provision is applicable primarily to the existing structural elements that will be relied on to provide the required strength and stiffness. If the cap allowed in Section 403.3.1 is used, this will include all existing elements contributing to the expected story strength in each target story and the story above, as well as diaphragms and foundations. If the cap is not used, the condition assessment may be limited to just the structural scope identified in Section A403.2. ASCE 41-17 provisions and commentary for condition assessment may be useful as a guide to the work. The investigation should be based on a combination of non-destructive testing or inspection, destructive testing or inspection, and reference to record documents. Where record documents are used to reduce the scope of testing or other on-site work, appropriate field verification is normally required. The building official is authorized to require additional investigation as needed to fulfill the purpose of the condition assessment. Findings of the condition assessment should be included with the structural calculations per Section A.2.4 of TB15.27-1.*
>
> *With the approval of the building official, field verification of assumed conditions may be performed during construction; in these cases adjustments to previously approved structural calculations and plans might be needed, which is why Section A.2.3 of TB15.27-1 calls for field verification items to be shown on the plans.*

A405.3.1 Wood-structural-panel shear walls.

A405.3.1.1 Existing nails. Where the required calculations rely on design values for common nails or surfaced dry lumber, their use in construction shall be verified by exposure.

A405.3.1.2 Existing plywood. Where verification of the existing plywood is by use of record drawings alone, plywood shall be assumed to be of three plies.

A405.3.2 Existing wood framing. Wood framing is permitted to use the design stresses specified in the building code under which the building was constructed or other stress criteria approved by the code official.

A405.3.3 Existing structural steel. All existing structural steel shall be permitted to be assumed to comply with ASTM A36. Existing pipe or tube columns shall be assumed to be of minimum wall thickness unless verified by testing or exposure.

A405.3.4 Existing concrete. All existing concrete footings shall be permitted to be assumed to be plain concrete with a compressive strength of 2,000 pounds per square inch (13.8 MPa). Existing concrete compressive strength taken greater than 2,000 pounds per square inch (13.8 MPa) shall be verified by testing, record drawings or department records.

A405.3.5 Existing sill plate anchorage. The analysis of existing cast-in-place anchors shall be permitted to assume proper anchor embedment for purposes of evaluating shear resistance to lateral loads.

A405.3.6 Existing masonry partitions. Masonry partitions or fire separation walls within a target story shall be investigated to determine their capacity to resist story shears and deformations, whether intended as seismic force-resisting elements or not. The investigation shall consider their material strength and condition, grouting and reinforcing, connections and continuity to stories above and foundation below, and related detailing and load path as they relate to likely performance in in-plane shear, out-of-plane shear, overturning moment, and uplift. Based on the investigation, the design professional shall document and substantiate a design approach and acceptability criteria.

> ***Commentary:*** *Some Oakland buildings are known to have concrete masonry fire separation partitions that might act as de facto seismic force-resisting elements, even if not designed to carry lateral forces and not detailed for ductile response. Since the construction of these partitions is not well documented, it is the responsibility of the design professional to understand their likely performance and to account for it in the retrofit design. In some cases, the walls might be usable as SFRS elements (as is, or as strengthened). In other cases, it might be preferable to isolate them from the seismic response by breaking the load path, as long as necessary fire safety and support for gravity loads is maintained.*

A405.3.7 Existing unreinforced brick footings. The capacity of an existing brick footing to resist shear or pullout of an existing or new anchor shall be established by testing or by reference to approved tests of similar conditions.

> ***Commentary:*** *Older buildings might have unreinforced brick footings. In general, these are unlikely to be adequate for new or strengthened shear walls, but the added provision allows a method to substantiate their capacity.*

SECTION A406
CONSTRUCTION DOCUMENTS

~~**A406.1 General.** The plans shall show all information necessary for plan review and for construction and shall accurately reflect the design. The plans shall contain a note that states that this retrofit was designed in compliance with the criteria of this chapter.~~

> ***Commentary:*** *Section A.2.3 of TB15.27-1 replaces Chapter A4 Section A406.1.*

A406.2 Existing construction. The plans shall show existing diaphragm and shear wall sheathing and framing materials; fastener type and spacing; diaphragm and shear wall connections; continuity ties; collector elements; and the portion of the existing materials that needs verification during construction. If the cap allowed by Section A403.3.1 is used to limit the scope of retrofit, the foregoing information shall be shown for each retrofitted story and at least one story above the uppermost retrofitted story. If the cap allowed by Section A403.3.1 is not used, the foregoing information need only be shown for each retrofitted story and for the floor at the top of that story.

2022 CEBC note: *Consistent with 2019 TB15.27-1, the two sentences referencing Section A403.3.1 have been added.*

A406.3 New construction.

A406.3.1 Foundation plan elements. The foundation plan shall include the size, type, location and spacing of all anchor bolts with the required depth of embedment, edge and end distance; the location and size of all shear walls and all columns for braced frames or moment frames; referenced details for the connection of shear walls, braced frames or moment-resisting frames to their footing; and referenced sections for any grade beams and footings.

A406.3.2 Framing plan elements. The framing plan shall include the length, location and material of shear walls; the location and material of frames; references on details for the column-to-beam connectors, beam-to-wall connections and shear transfers at floor and roof diaphragms; and the required nailing and length for wall top plate splices.

A406.3.3 Shear wall schedule, notes and details. Shear walls shall have a referenced schedule on the plans that includes the correct shear wall capacity in pounds per foot (N/m); the required fastener type, length, gage and head size; and a complete specification for the sheathing material and its thickness. The schedule shall also show the required location of 3-inch (76 mm) nominal or two 2-inch (51 mm) nominal edge members; the spacing of shear transfer elements such as framing anchors or added sill plate nails; the required hold-down with its bolt, screw or nail sizes; and the dimensions, lumber grade and species of the attached framing member.

Notes shall show required edge distance for fasteners of structural wood panels and framing members; required flush nailing at the plywood surface; limits of mechanical penetrations; and the sill plate material assumed in the design. The limits of mechanical penetrations shall be detailed showing the maximum notching and drilled hole sizes.

A406.3.4 General notes. General notes shall show the requirements for material testing, special inspection and structural observation.

~~**SECTION A407**~~
~~**QUALITY CONTROL**~~

Commentary: *Section A.3 of TB15.27-1 replaces Chapter A4 Section A407.*

~~**A407.1 Structural observation.** Structural observation, in accordance with Section 1704.6 of the *California Building Code* is required, regardless of seismic design category, height or other conditions. Structural observation shall include visual observation of work for conformance to the approved construction documents and confirmation of existing conditions assumed during design.~~

~~**A407.2 Contractor responsibility.** Contractor responsibility shall be in accordance with Section 1704.4 of the *California Building Code*.~~

~~**A407.3 Testing and inspection.** Structural testing and inspection for new construction materials, submittals, reports and certificates of compliance shall be in accordance with Sections 1704 and 1705 of the *California Building Code*. Work done to comply with this chapter shall not be eligible for Exceptions 1, 2, or 3 of Section 1704.2 of the *California Building Code* or for the exception to Section 1705.13.2 of the *California Building Code*.~~