

***Provisions* Chapter 1-General Provisions**

Summary: *Provisions* Chapter 1 provides the general requirements for seismic design using the *Provisions*. The chapter includes a statement of purpose, scoping requirements, procedures for determining occupancy category and Seismic Design Category. In addition there is a section covering additions, change of occupancy, and alterations to existing buildings and a section related to minimum requirements for Seismic Design Category A.

ASCE 7 Section 11-Seismic Design Criteria ASCE 7 Appendix 11B-Existing Building Provisions

Summary: Section 11 of ASCE 7 provides a statement of purpose, scoping requirements, procedures for determining design ground motion, procedures for determining occupancy category and Seismic Design Category, minimum requirements for Seismic Design Category A, and requirements for geologic hazards and geotechnical investigation. The corresponding items in *Provisions* Chapter 1 are including in ASCE 7 Sections 11.1, 11.5, 11.6, 11.7. Provisions for additions, change of occupancy, and alterations to existing buildings are contained in Appendix 11B

The comparisons between the *Provisions* and ASCE 7 relative to ground motion are contained in the *Report on Differences* covering *Provisions* Chapter 3. The comparisons between the *Provisions* and ASCE 7 relative to geological and geotechnical issues are contained in the *Report on Differences* covering *Provisions* Chapter 7.

Significant Differences

<i>Provisions</i> Section:	1.1.1 Purpose
ASCE 7 Section:	11.1.1 Purpose

Discussion: The text in these two sections is different, but the text itself (and therefore the difference) is primarily commentary in nature. Both sections loosely describe the performance objectives implicit with the use of the seismic design criteria. The text in the *Provisions* focuses on satisfying these objectives by limiting structural and nonstructural damage, while the text ASCE 7 focuses on post-elastic energy dissipation. The actual difference between the seismic performance delivered by the two documents is minimal since the seismic design criteria and procedures in each are very similar.

This section of ASCE 7 provides a reference to the quality assurance provisions and indicates that the seismic design provisions apply even to members for which seismic loading may not govern the design. Neither of these statements is included in this section of the *Provisions*. The first statement is not significant since the quality assurance provisions and requirements for application are clearly defined elsewhere in the *Provisions* (see also *Report on Differences* related to *Provisions* Chapter 2). The second statement, however, could be substantive. *Commentary* Sec. 1.1.1 does indicate that seismic design and detailing requirements apply whether or not wind loading governs the design, but this requirement does not appear to be stated in the *Provisions* themselves, either in Chapter 1 or Chapter 4. The text of *Provisions* Sec. 1.1.2.1, “every structure, and portion thereof, shall be designed and constructed to resist the effects of earthquake motions as prescribed by these *Provisions*,” may provide the necessary scoping, but ASCE 7 is more clearly worded.

The *Provisions* provides a more detailed description of the performance objectives than does ASCE 7. This is not a substantive difference, and is, in fact, probably more appropriately suited for the *Commentary*.

Recommendation: These sections do not contain technical differences, since they are largely commentary. However, the statement that seismic design and detailing requirements must be satisfied, even where seismic loading does not govern the design, is an important general design provision for achieving the seismic performance objectives contained in both documents. This statement should be added to the scoping section of the *Provisions*.

Provisions Section: 1.1.2.1 Scope
ASCE 7 Section: 11.1.2 Scope

Discussion: These sections provide criteria for structures that are exempt from all or part of the provisions contained in the documents. There are a few differences.

Exception 1 in both documents relates to detached one- and two-family dwellings. Both documents exempt these structures when assigned to SDC A through C. ASCE 7 adds an exemption for such structures where S_S is less than 0.4. This may allow some structures in SDC D to be exempt, but this is unlikely. In order to be assigned to SDC D, S_{DS} must be equal to or greater than 0.5. This would require a site coefficient equal to 1.875, which exceeds the values of all but Site Class F (site response analysis), so it is highly unlikely to apply. It is possible that the S_{DI} value associated with a site with S_S less than 0.4 could be equal to or exceed 0.20, but nearly all structures of this type should be able to qualify for the exception in ASCE 7 Sec. 11.6.1.1 whereby SDC can be determined by S_{DS} only. Therefore, this could be a substantive difference, but in practical terms, it is not likely to be the case.

Exception 2 in both documents relates to detached one- and two-family dwellings designed using the requirements for conventional light-frame construction. However, conventional light-frame construction is defined differently. The *Provisions* contains the requirements in Section 12.4, while ASCE 7 refers to the 2000 *International Residential Code* with the 2002 Supplement. Comparison between these two references is beyond the scope of this *Report*, and both references probably result in comparable designs worthy of the exemptions. However, this is a technical difference. See also the *Report on Differences* related to *Provisions* Chapter 12.

Provisions Exception 4 is not contained in this section of ASCE 7. The *Provisions* exempts structures assigned to SDC A or located where S_S is less than or equal to 0.15 and S_I is less than or equal to 0.04 from everything but *Provisions* Sec. 1.5. Structures on very soft soils in regions with ground motions less than these limits could be assigned to SDC B, so the exemption covers some structures within SDC B. ASCE 7 contains a similar exemption in Sec. 11.7, even though it is not directly referenced in ASCE 7 Sec. 11.1.2. However, ASCE 7 only exempts structures in SDC A, so the difference is for structures on very soft soils in regions with response parameters less than the *Provisions* limits that would be assigned to SDC B, but nonetheless exempt from everything but the minimal requirements for SDC A.

ASCE 7 Exception 4 is not contained in the *Provisions*. It relates to nonbuilding structures not addressed by ASCE 7 Sec. 15. Since these structures are not addressed in ASCE 7 to say that they are exempt from the provisions of ASCE 7 is probably redundant. Since they are also not addressed in the *Provisions* Chapter 14 (see *Provisions* Sec. 14.1.1), there is no substantive difference.

The primary differences in these sections results from the fact that the *Provisions* provides criteria based on both response parameters and SDC for exemption 4 and ASCE 7 provides similar criteria for exemption 1. These multiple criteria could allow the exemptions to apply differently between the two documents.

Finally, this section of ASCE 7 provides scoping for existing buildings per ASCE Appendix 11B. The comparable requirements in the *Provisions* are contained in subsequent sections. Therefore the comparison is addressed later in this *Report on Differences*.

Recommendation: Although only applying to a very small number of structures, the differences in exemptions between the *Provisions* and ASCE 7 could be very substantive for that small number of structures affected. It is likely that the multiple criteria are provided to eliminate the need to determine SDC for structures that would end up being exempt anyway, but there could be unintended exemptions for structures on very soft soils. These multiple criteria should be reviewed by the PUC. Also, the differences in requirements for conventional light-frame construction (the effect on exemptions is expected to be very minor if any) should be reviewed, but this is addressed in the *Report on Differences* for *Provisions* Chapter 12.

<i>Provisions</i> Section:	1.1.2.2 Additions
ASCE 7 Sections:	11B.2 Structurally independent additions 11B.3 Structurally dependent additions

Discussion: The only substantive difference is the trigger related to the increase in seismic forces related to an addition. The trigger in the *Provisions* is 5 percent, while it is 10 percent in ASCE 7. The effect is that ASCE 7 would allow a more substantial addition without requiring that the entire structure be brought into conformance with the provisions for new construction.

Recommendation: The increase of the trigger to 10 percent in ASCE 7 is new to the 2005 edition, it reflects current thinking among the ASCE committee and it is probably appropriate for the *Provisions* to follow suit. The PUC should review.

<i>Provisions</i> Section:	1.1.2.3 Change of use
ASCE 7 Section:	11B.5 Change of use

Discussion: One substantive difference is the trigger related to when the structure needs to be brought into full compliance with the provisions for new construction. There is an exemption for structures being reclassified from SUG I (Occupancy Category II) to SUG II (Occupancy Category III). In the *Provisions*, the exemption is S_{DS} less than 0.3, while in ASCE 7 the exemption is S_{DS} less than 0.33. While the difference is minor, it could be very substantive for structures located in areas where S_{DS} is between 0.3 and 0.33. However, since ASCE 7 is less restrictive, the effect of adopting ASCE 7 unmodified is beneficial to building owners without undue increase in overall risk.

The other difference is that ASCE 7 adds a second exemption, which essentially permits the change of use without full compliance if it can be demonstrated that the structure complies with the intent of the provisions for new construction. This is an appropriate alternative, permitting the use of performance-based procedures for existing buildings (ASCE 31, FEMA 356).

Recommendation: Absent any technical reason for the difference, it would not make practical sense to have the *Provisions* modify ASCE 7 for this slight adjustment. Therefore the recommendation is to adopt the value in ASCE 7. The PUC should review.

The second exemption in ASCE 7 seems appropriate to adopt into the *Provisions* by reference.

Provisions Section: 1.1.2.4 Alterations
ASCE 7 Section: 11B.4 Alterations

Discussion: One substantive difference is the trigger related to the increase in seismic forces or decrease in capacity as a result of an alteration. The trigger in the *Provisions* is 5 percent, while it is 10 percent in ASCE 7. The effect is that ASCE 7 would allow a more substantial alteration without requiring that the entire structure be brought into conformance with the provisions for new construction.

The other difference is that ASCE 7 adds a fifth requirement for voluntary seismic upgrades. This requirement states that the alteration does not create a structural irregularity or worsen an existing irregularity.

Recommendation: The increase of the trigger to 10 percent in ASCE 7 is new to the 2005 edition, it reflects current thinking among the ASCE committee and it is probably appropriate for the *Provisions* to follow suit. The PUC should review.

The added limitation on voluntary upgrades is appropriate, since there is not a stated minimum objective for the upgrade and the goal of the requirements overall is to maintain at least a level of seismic performance that is consistent with that for the unaltered structure. This requirement seems appropriate to adopt into the *Provisions* by reference.

Provisions Section: 1.1.3 References
ASCE 7 Section: N/A

Discussion: The *Provisions* provides a reference to ASCE 7-98 for all loads other than earthquake. This reference will obviously be updated to incorporate the latest edition of ASCE 7, which will become a reference standard for earthquake loads as well.

Recommendation: Update to current version of ASCE 7 consistent with reference for seismic design.

Provisions Section: 1.2 Seismic Use Groups
ASCE 7 Sections: 1.5.1 Nature of occupancy
11.5 Importance factor and occupancy category

Discussion: This is primarily an editorial difference. Beginning with the 2005 edition, ASCE 7 has eliminated the reference to Seismic Use Group, instead directly using Occupancy Category, a term that previously served as the basis for assigning Seismic Use Group. There is no substantive change and it is likely that the *Provisions* will head in this direction in any case.

Related to ASCE 7-02: In addition, there are a few differences between the types of occupancies assigned to SUG II (*Provisions*) and Occupancy Category III (ASCE 7 Table 1-1). The *Provisions* includes all structures with a capacity of more than 5,000 persons in this group, but ASCE 7 does not (explicitly). The *Provisions* includes “covered structures whose primary occupancy is public assembly with a capacity greater than 300 persons,” while ASCE 7 uses a more broad definition of “structures where more than 300 people congregate in one area.”

Recommendation: Consistent with ASCE 7, Seismic Use Group should be eliminated from the *Provisions*, replaced with Occupancy Category.

The assignment of occupancy category should be reviewed. However, it seems that there is no technical basis for having different criteria for the occupancy categorization between the two documents. This is part of a broader policy issue and related to other loads besides earthquake.

Provisions Section: 1.4.2 Site limitation for Seismic Design Categories E and F
ASCE 7 Section: 11.8.1 Site limitation for Seismic Design Categories E and F

Discussion: The only difference is that the *Provisions* exempts detached one- and two-family dwellings of light-frame construction from the site limitation, while ASCE 7 does not. These structures would never be assigned to SDC F and to SDC E only in limited locations.

Recommendation: Decide whether it is appropriate to exempt dwellings from the limitation.

Provisions Section: 1.5.1 Lateral forces (for SDC A)
ASCE 7 Section: 11.7.2 Lateral forces (for SDC A)

Discussion: The difference is the definition of the term, W , for determining the lateral forces for SDC A. The *Provisions* defines W as the seismic weight and includes other loads (portion of storage live load, partitions, portion of snow) consistent structures analyzed using the general procedures. ASCE 7 defines W as the dead load D , which does not include these other items. (However, note that this definition is in conflict with the notation section of this chapter, ASCE 7 Sec. 11.3). The net effect could be a reduction in design lateral forces for SDC A structures designed in accordance with ASCE 7 instead of the *Provisions*. However, since this is a lateral load intended to provide basic load path, continuity, and lateral strength, the inclusion of the other loads is probably not necessary to achieve the intended result. Because the one-percent factor is technically not a seismic load (it is a means of providing basic lateral stability and continuity), a small difference in effective seismic weight should not be significant.

Recommendation: There does not seem to be a technically valid reason to require inclusion of these other loads in the determination of seismic weight for SDC A structures. This is also consistent with the overall intent of making the lateral design very simple in these cases. Therefore, there does not seem to be a compelling reason to amend ASCE 7 if used as a reference document for this section.

Provisions Section: 1.5.2 Connections (for SDC A)
ASCE 7 Sections: 11.7.3 Load path connections (for SDC A)
11.7.4 Connection to Supports (for SDC A)

Discussion: ASCE 7 provides clarification that the connection force does not apply to the overall design (base shear) of the seismic-force-resisting system. ASCE 7 adds a clarification that the connection capacity need not exceed the maximum force delivered to the connection. ASCE 7 allows slabs designed as diaphragms to serve as the connection between a girder and support.

All three of these items seem beneficial to the clarity and intent of this section. The differences are not particularly substantive, and are consistent with the basic intended behavior of SDC A structures.

Recommendation: There does not appear to be any reason to modify the ASCE provisions if they are adopted by reference into the *Provisions*.

Provisions Section: 1.5.3 Anchorage of concrete or masonry walls (for SDC A)
ASCE 7 Section: 11.7.5 Anchorage of concrete or masonry walls (for SDC A)

Discussion: The *Provisions* requires a connection force of 100 plf and requires that the walls be designed for bending if the spacing of anchors exceeds 4 feet. ASCE 7 requires a connection force of 5 percent of the tributary wall weight (per reference to ASCE 7 Sec. 11.7.3) with a minimum force of 280 plf. ASCE 7 does not require the wall to be designed for bending between anchors.

This is a substantive difference. The difference between the minimum values of 100 plf and 280 plf is significant. Moreover, since the ASCE 7 design anchorage force is a function of wall weight, the difference could be even greater for relatively heavy walls. The *Provisions* requirement for designing the wall for bending between anchors is consistent with the requirements for higher SDCs (see *Provisions* Sec. 4.6.1.2), but for the level of demand for SDC A, may not be too significant in terms of design.

Recommendation: The requirements in ASCE 7 seem more appropriate for the design of wall anchorage in SDC A. Decide whether the *Provisions* requirement for designing the wall for bending should be included as an amendment to ASCE 7.

Provisions Section: 1.5.4 Tanks assigned to Seismic Use Group III (for SDC A)
ASCE 7 Section: N/A

Discussion: There is not a comparable requirement in ASCE 7 Sec. 11.7 nor does there appear to be one in Sec. 15 (nonbuilding structures).

Recommendation: Decide whether to retain this requirement.

Provisions Chapter 2-Quality Assurance

Summary: *Provisions* Chapter 2 provides quality assurance requirements for seismic-force-resisting systems and designated seismic systems. The requirements include testing, inspection, and structural observation and supplement the requirements provided in other reference standards.

ASCE 7 Appendix 11A-Quality Assurance Provisions

Summary: This section of ASCE 7 contains essentially the same scope items as *Provisions* Chapter 2.

Significant Differences

<i>Provisions</i> Section:	2.1.2 References
ASCE 7 Section:	23 Seismic design reference documents

Discussion: The *Provisions* refers to older versions of some standards than does ASCE 7.

Related to references, this chapter of the *Provisions* refers to versions of ACI 318, ACI 530, ACI 530.1, AISC LRFD, and AISC Seismic that are older than the versions referenced in the materials chapters (Chapters 9, 11, and 8 respectively). Therefore, it appears that the fact that these references in *Provisions* Chapter 2 are different from ASCE 7 may be just an oversight in the latest *Provisions* update cycle.

Recommendation: Update reference standards as appropriate.

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<i>Provisions</i> Section:	2.2 General Requirements
ASCE 7 Section:	11A.1.1 Scope

Discussion: This section of ASCE 7 has a direct reference to the quality assurance provisions for mechanical and electrical components in Seismic Design Category C. (The requirements for Seismic Design Category D through F are noted clearly in both documents.) The requirements themselves are the same, but the reference in ASCE is more complete than that in the *Provisions*.

Recommendation: The difference is not substantive, but ASCE 7 provides a better reference to the requirements for Seismic Design Category C.

<i>Provisions</i> Section:	2.3 Special inspection
ASCE 7 Section:	11A.1.3 Special inspection and testing

Discussion: Based on the text of ASCE 7 it appears that special inspection is required only for designated seismic systems, which are defined by Sec. 11.2 as the seismic-force-resisting system and certain architectural, electrical, and mechanical systems. The *Provisions* section does not indicate seismic systems explicitly. The presumption is that since this section of ASCE 7 is an appendix to Chapter 11, Seismic Design Criteria, it is intended to apply to seismic systems only, similar to the *Provisions*. Special inspection of other portions of the structure, therefore, would be covered by other provisions.

Recommendation: No difference.

Provisions Section: 2.3.1 Piers, piles, caissons
ASCE 7 Section: 11A.1.3.1 Foundations

Discussion: Both sections cover special inspection requirements for foundation elements. There are two primary differences. First, ASCE 7 does not specifically require special inspection of concrete placement in caissons, though similar to the *Provisions*, it does require special inspection for placement of concrete in piers and piles. Note, however, that ASCE 7 Section 11.2 defines piles as deep foundation components including piers, caissons and piles. Second, unlike ASCE 7, the *Provisions* does not require special inspection of the placement of reinforcement and concrete in shallow foundations.

The first difference appears to be a minor oversight in the wording of ASCE 7, with the intent being that caissons should be treated the same as piers and piles as indicated by the definition.

The second difference may be an intended or unintended difference in scope related to shallow foundations. Periodic special inspection for shallow foundations (which are identified as part of the seismic-force-resisting system) is required by ASCE 7 and not required by the *Provisions*. Note, however, that ASCE 7 does not provide a definition for shallow foundations – presumably the provision intends to cover spread footings and grade beams.

Recommendation: The first difference may end up being a simple editorial item within ASCE 7, but it should be reviewed. Determine the appropriate scope for inspection of shallow foundations. If special inspection is included, provide a definition.

Provisions Section: 2.3.6.2 (Structural steel)
ASCE 7 Section: 11A.1.3.6.2 Periodic special inspection (structural steel)

Discussion: For periodic special inspection of bolted connections, the *Provisions* refers to the requirements in AISC LRFD, while ASCE 7 refers to AISC LRFD or AISC ASD. Consistent with the strength design basis of the *Provisions*, allowable stress references are not used. Since the special inspection requirements are expected to be the same in both AISC specifications, there is no substantive difference.

Recommendation: No substantive difference.

Provisions Section: 2.4.5 Mechanical and electrical equipment
ASCE 7 Sections: 11A.2.7 Mechanical and electrical equipment
13.2.2 Special certification requirements for designated seismic systems

Discussion: The special inspection requirement is the same, but the testing requirements are different between the two documents. The *Provisions* requirements are the same as ASCE 7-02, but for ASCE 7-05, the requirements have been changed and moved to Sec. 13.2.2. While the overall intent may be the same, the wording and specific requirements appear to be substantively different.

The *Provisions* testing requirements apply to SDC D through F (per *Provisions* Sec. 2.2), while ASCE 7 Sec. 13.2.2 applies to SDC C through F as specified in the text.

Recommendation: Review the requirements in the two documents for consistency.

***Provisions* Chapter 3 – Ground Motion**

Summary: *Provisions* Chapter 3 outlines the process by which design ground motion parameters and response spectra are determined. The process includes selecting MCE values from maps, determining the site class, modifying MCE ground motion values for site class, computing design spectral response acceleration parameters, and computing spectral ordinates over a range of periods. Section 3.4 outlines a procedure for the determination of site-specific response spectra and design acceleration parameters.

ASCE 7 Sections: 11.4 – Seismic Ground Motion Values
20 – Site Classification Procedure for Seismic Design
21 – Site-Specific Ground Motion Procedures for Seismic Design
22 – Seismic Ground Motion and Long Period Transition Maps

Summary: Section 11.4 of ASCE 7 outlines the process for determining the basic ground motion parameters used for every project and refers to more detailed or specialized information in other sections. Site classification is performed in accordance with Section 20. Ground motion maps are in Section 22. Site-specific ground motion procedures appear in Section 21.

Significant Differences

Provisions Section: 3.4 Site-Specific Procedure
ASCE 7 Section: 21 Site-Specific Ground Motion Procedures for Seismic Design

Discussion: The *Provisions* have long required site-specific study for varying circumstances (such as in Section 3.5.1) without defining the nature of the study required. *Provisions* Section 3.4 defines the method of determining a site-specific ground motion hazard analysis, which is the type of site-specific study intended in Sections 3.2.2 and 15.2.3.1 for systems with seismic isolation or damping and large mapped ground motion ($S_I > 0.6$). For class F sites Section 3.2.2 and Tables 3.3-1 and 3.3-2 intend to require site response analysis, although the text does not make this point very clear and the *Provisions* lack any description of such an analysis (although the *Commentary* to the 2003 *Provisions* did add guidance regarding site response analysis). ASCE 7 Section 21.2 provides detailed requirements for ground motion hazard analysis, which correspond to the requirements in *Provisions* Section 3.4. ASCE 7 Section 21.1 is entirely new text, defining requirements for site response analysis that are generally consistent with the guidance provided in the *Commentary*.

Recommendation: Accept the approach taken in ASCE 7 to more clearly define the type of site-specific study required.

Provisions Section: 3.5.1 Site class definitions
ASCE 7 Section: 20.3.1 Site F

Discussion: ASCE 7 clarifies the type of site specific evaluation required for Site Class F. See discussion in *Report on Differences* for Section 3.4.

Provisions Section: 3.5.2 Steps for classifying a site
ASCE 7 Section: 20.3.3 Site Class C, D, and E

Discussion: ASCE 7 clarifies the condition for intermediate soils by indicating, “Where the N_{ch} and s_u criteria differ, the site shall be assigned to the category with the softer soil.”

Recommendation: Accept clarification in ASCE 7.

Provisions Sections: Chapter 3
13.2.3.1 Design spectra
ASCE 7 Section: 11.4.6 MCE Response Spectrum

Discussion: This section of ASCE 7 indicates how to determine a MCE spectrum in all cases. Although the basic idea that MCE ground motion is 1.5 times design ground motion could be ascertained from Chapter 3 of the *Provisions*, explicit statement related to response spectra appears only in the chapter on seismically isolated structure design.

Recommendation: Accept the text of ASCE 7 as a clarification and refinement.

Provisions Sections: Chapter 3
13.2.3.1 Design spectra
13.2.4.1 Equivalent lateral force procedure
15.2.3.1 Design spectra
15.2.3.2 Time histories
15.2.4 Procedure selection
ASCE 7 Sections: 11.4.7 Site-Specific Ground Motion Parameters
17.3.1 Design spectra
17.4.1 Equivalent Lateral Force Procedure
18.2.3.1 Design Spectra
18.2.3.2 Ground Motion Histories
18.2.4 Procedure Selection

Discussion: These sections establish a threshold level of ground motion parameter S_I beyond which a ground motion hazard analysis must be performed and response history analysis must be performed. In the *Provisions* the trigger is for values of S_I **greater than** 0.6. In ASCE 7-05, the trigger is for values of S_I greater than **or equal to** 0.6. The difference is of some significance as there are considerable portions of the country with S_I exactly equal to 0.6 because of the application of the lower limit on deterministic ground motion.

Recommendation: Decide which expression of the threshold is appropriate and use that level.

***Provisions* Chapter 4-Structural Design Criteria**

Summary: *Provisions* Chapter 4 provides design criteria primarily for buildings. Included in the section are seismic load effects and combinations, seismic-force-resisting systems and related requirements, deformation requirements, and detailing requirements.

ASCE 7 Section 12-Seismic Design Requirements for Building Structures

Summary: This section of ASCE 7 contains both structural design criteria and analysis procedures for buildings. The corresponding items in *Provisions* Chapter 4 are including in ASCE 7 Sections 12.1, 12.2, 12.3, 12.4, 12.5, 12.6, 12.7.4, 12.10, 12.11, 12.12, 12.14. ASCE Section 12 also contains items that relate to other *Provisions* chapters, including the simplified alternative procedure (*Provisions* Alternate Chapter 4), modeling and analysis procedures (*Provisions* Chapter 5), and foundation requirements (*Provisions* Chapter 7). The *Report on Differences* discussion for those sections are including in the respective sections of this *Report*.

Significant Differences

Provisions Section: 4.1.2 References
ASCE 7 Section: 23 Reference documents

Discussion: Many of the references in this chapter of the *Provisions* are to older versions of the reference standards than those in ASCE 7-05. Furthermore, many of the *Provisions* references are older versions than referenced in the *Provisions* material chapters.

Recommendation: Update reference standards in all sections of both documents as appropriate.

Provisions Section: 4.2.2.1 Seismic load effect
ASCE 7 Sections: 12.4.2 Seismic load effect
12.4.2.2 Vertical seismic load effect
12.4.2.3 Seismic load combinations

Discussion: Though the format of the equations is different, the basic equations are substantively the same. The only difference in these sections is that ASCE 7 contains two conditions where the vertical seismic effects need not be considered that are not contained in the *Provisions*. Per the exceptions to ASCE 7 Sec. 12.4.2.2, the vertical seismic load effect may be taken as zero where S_{DS} is less than 0.125 and where considering foundation overturning.

ASCE 7 provides load combinations including all loads, while the *Provisions* only defines the E term for the special load combination. There is no substantive difference, however, since the *Provisions* refers to ASCE 7 for load combinations.

Recommendation: Decide whether or not to allow the exceptions if this section of ASCE 7 is adopted by reference.

Provisions Section: 4.2.2.2 Seismic load effect with overstrength
ASCE 7 Sections: 12.4.3 Seismic load effect with overstrength
12.4.3.2 Seismic load combinations with overstrength

Discussion: Though the format of the equations is different, the basic equations are substantively the same. ASCE 7 provides load combinations including all loads, while the *Provisions* only defines the *E* term for the special load combination. There is no substantive difference, however, the *Provisions* refers to ASCE 7 for load combinations.

Also, ASCE 7 provides combinations for applying the seismic load effect with overstrength where load combinations for allowable stress design are being used. This is not in the *Provisions*, since the *Provisions* does not cover allowable stress design.

Recommendation: There are not any substantive differences.

Provisions Sections: 4.3.1 Selection and limitations
Table 4.3-1
ASCE 7 Sections: 12.2.1 Selection and limitations
Table 12.2-1

Discussion: There are several substantive differences concerning recognized systems, system parameters, and height limitations between *Provisions* Table 4.3-1 and ASCE 7 Table 12.2-1. The specific differences are summarized below.

Differences in recognized systems:

System	2003 <i>Provisions</i>	ASCE 7-05
Bearing Wall Systems		
Light-framed walls with shear panels of all other materials	Not Included	Included
Building Frame Systems		
Composite steel plate shear walls	Included	Not Included
Light-framed walls with shear panels of all other materials	Not Included	Included
Moment Resisting Frame Systems		
Special masonry moment frames	Included	Not Included
Shear Wall-Frame Interactive System with Ordinary Reinforced Concrete Moment Frames and Ordinary Reinforced Concrete Shear Walls	Not Included	Included
Inverted Pendulum Systems and Cantilevered Column Systems		
Intermediate steel moment frames	Not Included	Included
Intermediate concrete moment frames	Not Included	Included
Ordinary concrete moment frames	Not Included	Included
Timber frames	Not Included	Included

Differences in R , Ω_0 , or C_d factors:

System	2003 <i>Provisions</i>	ASCE 7-05
Bearing Wall Systems		
Special reinforced masonry shear walls	$R=3.5$	$R=5$
Intermediate reinforced masonry shear walls	$R=2.5$	$R=3.5$
Building Frame Systems		
Ordinary steel concentrically braced frames (different in Supplement #1 to ASCE 7-05)	$R=5$ $C_d=4.5$	$R=3.25$ $C_d=3.25$
Detailed plain concrete shear walls	$R=2.5$ $C_d=2.5$	$R=2$ $C_d=2$
Composite eccentrically braced frames	$\Omega_0=2.5$	$\Omega_0=2$
Special reinforced masonry shear walls	$R=4.5$	$R=5.5$
Intermediate reinforced masonry shear walls	$R=3$ $C_d=2.5$	$R=4$ $C_d=4$
Dual Systems with Special Moment Frames		
Special reinforced concrete shear walls	$R=8$ $C_d=6.5$	$R=7$ $C_d=5.5$
Composite concentrically braced frames	$\Omega_0=2$	$\Omega_0=2.5$
Dual Systems with Intermediate Moment Frames		
Ordinary composite reinforced concrete shear walls with steel elements	$R=5.5$ $\Omega_0=2.5$	$R=5$ $\Omega_0=3$
Inverted Pendulum Systems and Cantilevered Column Systems		
Special steel moment frames	$\Omega_0=2$	$\Omega_0=1.25$
Ordinary steel moment frames	$\Omega_0=2$	$\Omega_0=1.25$
Special reinforced concrete moment frames	$\Omega_0=2$	$\Omega_0=1.25$

Differences in system limitations height limits

System	2003 <i>Provisions</i>	ASCE 7-05
Bearing Wall Systems		
Ordinary reinforced masonry shear walls	SDC C: NP	SDC C: 160 ft
Building Frame Systems		
Ordinary reinforced masonry shear walls	SDC C: NP	SDC C: 160 ft
Light-frame walls with shear panels	SDC D-F: 160 ft	SDC D-F: 65 ft
Inverted Pendulum Systems and Cantilevered Column Systems		
Special steel moment frames	SDC B-F: NL	SDC B-F: 35 ft
Special reinforced concrete moment frames	SDC B-C: NL	SDC B-C: 35 ft

All of these differences are substantive and presumably represent differences of opinion between those developing the two documents.

Recommendation: Review the differences and coordinate the two documents. Differences that are intended will have to be included as modifications to ASCE 7 assuming that the system tables in ASCE 7

will be used by reference. However, the *Provisions* will have to keep at least a partial system table to cover newer systems that are not yet to the point of being recognized by ASCE 7.

<i>Provisions</i> Sections:	4.3.1.2 Combination of framing systems 4.3.1.2.1 R and Ω_0 factors
ASCE 7 Sections:	12.2.2 Combinations of framing systems in different directions 12.2.3 Combinations of framing systems in the same direction 12.2.3.1 Vertical combinations 12.2.3.2 Horizontal Combinations

Discussion: For combinations of systems in different directions, the *Provisions* has a requirement that is not contained in ASCE 7. Specifically, if a non-dual system with an R -factor less than 5 is used for any direction, the lowest R -factor of all systems used must be used for all directions of loading.

For combinations of systems in the same direction, there are a few differences.

The basic requirements in the *Provisions* can be summarized as follows:

1. For dual systems – in any given direction, the R -factor at any story must be less than or equal to the lowest R -factor in any story above the story under consideration (excluding penthouses).
2. For non-dual systems – in any given direction, the lowest R -factor of any system used in that direction shall be used for all stories.
3. In all systems – the Ω_0 factor at any story must not be less than the largest value of the factor above the story under consideration.
4. There are two exceptions for which the previous items do not apply – supported structures with a weight not greater than 10 percent of the weight of the entire structure and detached one- and two-family dwellings.

The basic requirements in ASCE 7 can be summarized as follows:

1. For dual systems – there are no specific requirements.
2. For vertical combinations in non-dual systems – in any given direction, the R -factor at any story must be less than or equal to the lowest R -factor in any story above the story under consideration.
3. For vertical combinations in non-dual systems – the Ω_0 factor at any story must not be less than the largest value of the factor above the story under consideration.
4. There are three exceptions for which the previous items do not apply – rooftop structures not exceeding two stories in height and 10 percent of the weight of the total structure, other supported structures with a weight not greater than 10 percent of the weight of the entire structure, and detached one- and two-family dwellings.
5. In addition, ASCE 7 permits the use of a two-stage analysis for structures consisting of a flexible upper portion and rigid lower portion and subject to certain other requirements in lieu of satisfying the previous criteria.
6. For horizontal combinations in non-dual systems – in any given direction, the lowest R -factor of any system used in that direction shall be used for all stories.
7. There is one exception to the previous requirement. Specifically, for light-frame construction, two stories or less, in Occupancy Category I or II, and with flexible diaphragms at all levels, R -factor for each line of resistance can be treated independently.

8. [ASCE 7-05 Supplement #1 Proposal EQ-2-JDH-SUP-3] The limit on building height (and other applicable system limitations) for the combined system is the lesser of the height limit for each system.

Due to the non-parallel structure and overlapping requirements between the two documents, the substantive differences are not obvious. The differences can be summarized as:

1. ASCE 7 does not have any specific requirements for dual system, while the *Provisions* does.
2. The basic requirements for *R*-factors in vertical combinations in non-dual systems are different, but they are the same for horizontal combinations.
3. ASCE 7 permits the use of a two-stage analysis, but the *Provisions* does not.
4. ASCE 7 permits the use of independent *R*-factors for horizontal combinations in certain light-frame buildings with flexible diaphragms, but the *Provisions* does not.
5. ASCE 7 removes a potential loophole in the *Provisions* whereby the height limit for the combined system could be construed as additive.

Recommendation: There are substantive differences. However, some may result from the wording or organization of the sections and may not have been intended. Others are clearly substantive differences in the intent of the text. These differences will have to be reviewed by the PUC relative to how ASCE 7 is referenced from the *Provisions*.

<i>Provisions</i> Sections:	4.3.1.4 Seismic Design Category D 4.3.1.5.1 Plan or vertical irregularities (SDC E)
ASCE 7 Section:	12.3.3.1 Prohibited horizontal and vertical irregularities for seismic design categories D through F

Discussion: This difference is due to the fact that ASCE 7 defines an extreme weak story irregularity (vertical irregularity type 5b) that is not defined as such in the *Provisions* (see *Report on Differences* related to *Provisions* Sec. 4.3.2.3). ASCE 7 does not permit structures in SDC D or higher with this irregularity. Though the *Provisions* doesn't define the irregularity in the same manner, it prohibits structures with this configuration when assigned to SDC E and F. Therefore, the substantive difference relates to whether or not the configuration is permitted in SDC D.

Recommendation: Whether or not the *Provisions* should allow structures with an extreme weak story to be permitted in SDC D must be reviewed. The specific wording in the text of the sections depends on whether or not term vertical irregularity type 5b of ASCE 7 will be adopted into the *Provisions*.

ASCE 7-05 Supplement #1 Proposal EQ-2-JDH-4

<i>Provisions</i> Section:	4.3.1.4.1 Building height limits
ASCE 7 Section:	12.2.5.4 Increase building height limit for steel braced frames and special reinforced concrete shear walls

Discussion: Both documents have provisions for increasing the height limit for steel braced frames and special concrete shear walls from 160 feet to 240 feet. The *Provisions* is the source document for these requirements. The *Provision's* requirements have changed several times in the past 4-5 cycles, while the commentary represents a discussion for an older set of requirements. The purpose of the ASCE Supplement 1 requirements is to clarify what is meant by "torsional effects" by inserting the word

“accidental” when determining the total amount of seismic force that is resisting by braced frames or shears walls in any one plane. The 20 percent rule for assessing torsional sensitivity of the structure, which is open to interpretation when attempting to implement, is replaced by a requirement that the structure not have an extreme torsional irregularity, a check that is routinely done by engineers.

Recommendation: Since the Supplement 1 change clarifies the requirements, it is recommended that they replace those currently included in the *Provisions*.

Provisions Section: 4.3.1.4.2 Interaction effects
ASCE 7 Section: 12.7.4 Interaction effects

Discussion: While the requirements of these sections are the same, they apply to Seismic Design Category D through F in the *Provisions* but to all Seismic Design Categories (excluding SDC A) in ASCE 7.

Recommendation: Determine appropriate scope for this requirement.

Provisions Section: 4.3.1.4.3 Special moment frames
ASCE 7 Section: 12.2.5.5 Special moment frames in structures assigned to seismic design categories D through F

Discussion: There are two substantive differences between these sections. The first relates to other sections referred to by these sections (*Provisions* Sec. 4.6.1.6 and ASCE 7 Sec. 12.3.3.2); refer to the discussion on those sections elsewhere in this *Report on Differences*.

The second difference is that the *Provisions* requires special moment frames be configured such that $\rho=1.0$. ASCE 7 does not have such a requirement.

Recommendation: The requirement for the redundancy factor for special moment frames must be reviewed. Refer elsewhere for differences to the referenced sections.

Provisions Section: 4.3.2.1 Diaphragm flexibility
ASCE 7 Sections: 12.3.1.1 Flexible diaphragm condition
12.3.1.2 Rigid diaphragm condition

Discussion: Both documents define diaphragm construction that may be assumed to be flexible for analysis purposes without having to compute the diaphragm flexibility. The *Provisions* permits untopped steel decking and wood panelized construction with concrete and masonry shear walls to be assumed to be flexible. ASCE 7 includes those systems, but it also includes untopped steel decking and wood panelized systems with steel braced frames, composite braced frames, steel shear walls, or composite shear walls as well as these diaphragm systems in one- and two-family dwellings of light-frame construction. The actual difference between the two documents may be small since most of the systems indicated could probably be shown to be flexible based on calculated deflections. However, there could be differences, especially with wood diaphragms in dwellings.

Recommendation: The additional systems specified as flexible in ASCE 7 probably match the intent of the *Provisions*, so the differences could be eliminated without substantive changes to the *Provisions*, but the conditions should be reviewed. The treatment of wood diaphragms in buildings with light-frame shear walls (including, but not limited to, dwellings) should also be reviewed in light of recent research.

Provisions Section: 4.3.2.2 Plan irregularity
ASCE 7 Section: 12.3.2.1 Horizontal irregularity

Discussion: ASCE 7 Table 12.3-1 has more section references than *Provisions* Tables 4.3-2 for some of the types of irregularities. However, there are no substantive differences in scope. Overall, the scope of the requirements are the same whether or not there is a direct reference from the tables – the references in ASCE 7 essentially provide more guidance to requirements that are triggered elsewhere in the *Provisions* (and in ASCE 7). Any differences in the substance of the sections referenced by these tables are contained in the corresponding sections of this *Report on Differences*.

Recommendation: No differences.

Provisions Section: 4.3.2.3 Vertical irregularity
ASCE 7 Section: 12.3.2.2 Vertical irregularity

Discussion: ASCE 7 defines a vertical irregularity that is not defined in the *Provisions* – extreme weak story (Type 5b). This is defined as a condition where the lateral strength of a story is less than 65 percent of the story above as compared with 80 percent for the weak story irregularity (*Provisions* Type 5, ASCE 7 Type 5a). This difference is only substantive to the extent that the presence of the condition leads to different requirements in the *Provisions* and ASCE 7. The only substantive difference is that ASCE 7 does not permit this irregularity in SDC D (ASCE 7 Sec. 12.3.3.1). Without using the term “Type 5b,” *Provisions* Sec. 4.6.1.6, does not permit the same condition in buildings over 2 stories or 30 feet in SDC B or C unless the weak story is designed to resist increased seismic forces. The requirement for increased forces, however, is different from ASCE 7: see *Report on Differences* for that section for additional information.

ASCE 7 Table 12.3-2 has more section references than *Provisions* Tables 4.3-3 for some of the types of irregularities. However, there are no substantive differences in scope. Overall, the scope of the requirements are the same whether or not there is a direct reference from the tables – the references in ASCE 7 essentially provide more guidance to requirements that are triggered elsewhere in the *Provisions* (and in ASCE 7). Any differences in the substance of the sections referenced by these tables are contained in the corresponding sections of this *Report on Differences*.

Recommendation: Review whether or not extreme weak story should be defined in the *Provisions*, specifically as related to the prohibition of the irregularity in SDC D.

<i>Provisions</i> Sections:	4.3.3 Redundancy 4.3.3.1 Seismic Design Categories B and C 4.3.3.2 Seismic Design Categories D, E, and F
ASCE 7 Sections:	12.3.4 Redundancy 12.3.4.1 Conditions where value of ρ is 1.0 12.3.4.2 Seismic Design Categories D, E, and F

Discussion: There are a few differences between these sections in the two documents.

ASCE 7 specifies several conditions for which the redundancy factor can be taken as 1.0 that are not specified in the *Provisions*: drift calculations and P -delta effects; nonstructural elements; design of collector elements, splices, and their connections where the special seismic load combination is not used; diaphragm loads using the diaphragm force equation for vertical distribution of diaphragm forces (but not for load transfer between vertical elements through diaphragms). Though the intent of the *Provisions* may be to permit $\rho = 1.0$ for these conditions, it doesn't appear to be the case based on the text of the *Provisions*.

ASCE includes criteria for computing ρ for systems with cantilever columns. Since it is not specified in the *Provisions*, systems with cantilever columns would fall under "all other systems" with $\rho = 1.0$.

Within the exception at the end of the section ASCE 7 provides definition for "shear wall bays" for all buildings, while the *Provisions* provides the same definition but applies it only to buildings of light-framed construction. It is unclear how to define bays for other systems.

Recommendation: The specific *Provisions* requirements and intent for $\rho = 1.0$ should be reviewed relative to the explicit requirements in ASCE 7. Consider the criteria for cantilever column structures in ASCE 7 for applicability in the *Provisions*. Review the definition of shear wall bays in the *Provisions* for systems other than light-frame construction.

<i>Provisions</i> Section:	4.4.1 Procedure selection
ASCE 7 Section:	12.6 Analysis procedure selection

Discussion: The only differences in this section are due to the fact that ASCE 7 contains a simplified analysis procedure while in the *Provisions*, it is in an appendix and not referenced in the main body of the text. The differences in *Provisions* Table 4.4-1 and ASCE 7 Table 12.6-1 lie in the applicability of this simplified procedure.

Recommendation: The resolution depends on how the simplified analysis procedure is incorporated into the *Provisions* – adopted ASCE 7 procedure by reference or retained *Provisions* procedure included still in the appendix.

<i>Provisions</i> Sections:	4.4.2 Application of loading 4.4.2.3 Seismic Design Categories D, E, and F
ASCE 7 Sections:	12.5 Direction of loading 12.5.4 Seismic Design Categories D, E, and F

Discussion: The *Provisions* requires that orthogonal effects be considered using a three-dimensional model for all structures assigned to SDC D, E, and F except for those with flexible diaphragms with parallel systems. ASCE 7 requires consideration of orthogonal effects only for structures with nonparallel systems (per reference to ASCE 7 Sec. 12.5.3); columns or walls that form part of two or more intersecting systems with axial load due to seismic effects exceeding 20 percent of the design axial strength. This is a substantive difference as the *Provisions* requires consideration of orthogonal effects for a much wider range of structures and elements than does ASCE 7.

Recommendation: Review the less restrictive requirements in ASCE 7 against the more restrictive requirements in the *Provisions* and modify the adoption of ASCE 7 as determined appropriate for the intent of the *Provisions*.

<i>Provisions</i> Section:	4.5.1 Deflection and drift limits
ASCE 7 Section:	12.12.1 Story drift limits

Discussion: In the text of this section, there is a difference in the way torsional effects are accounted for in drift determination. The *Provisions* provides a general requirement that “for structures with significant torsional deflections, the maximum drift shall include torsional effects,” while ASCE 7 has a specific requirement for determining design drift in structures with torsional irregularities (SDC C and above). This difference is only substantive to the degree that torsional effects could be considered in a less specific way under the *Provisions*.

In addition, *Provisions* Table 4.5-1 contains drift criteria for special masonry moment frames that is not contained in ASCE 7 Table 12.12-1 because the system is not recognized by ASCE 7 (see *Report on Differences for Provisions* Sec. 4.3.1)

Recommendation: Review the drift criteria for torsionally irregular buildings; recommend including the more-specific requirements in ASCE 7. Depending on whether or not the system of special reinforced masonry moment frames is added to ASCE 7, the specific deflection limits for this system may need to be included in the *Provisions* as a modification to ASCE 7.

<i>Provisions</i> Section:	4.5.3 Seismic Design Category D, E, and F
ASCE 7 Section:	12.12.4 Deformation compatibility for Seismic Design Categories D through F

Discussion: The exceptions contained in these sections are different. The *Provisions* contains general criteria for beams, columns, and their connections that are not part of the lateral system. ASCE 7 contains

a specific reference to ACI 318 for concrete frame elements not designed as part of the lateral system. These sections are probably not substantively different since the requirements are sufficiently general and the ACI 318 requirement would be picked up by the reference to ACI 318 in *Provisions* Chapter 9.

Recommendation: Review the language in both documents. Including the ACI 318 reference from ASCE 7 into the *Provisions* is not a substantive change, but eliminating the *Provisions* exception if not retained as a modification to ASCE 7 could be substantive depending on how it is applied.

<i>Provisions</i> Sections:	4.6.1.2 Anchorage of concrete and masonry walls 4.6.1.3 Bearing walls
ASCE 7 Sections:	12.11.1 Design for out-of-plane forces 12.11.2 Anchorage of concrete or masonry structural walls

Discussion: These sections provide the minimum requirements for anchorage of concrete and masonry as well as other walls for SDC B and above. The requirements are different in organization and content. The *Provisions* has requirements for anchorage of concrete and masonry walls and separate requirements for “bearing walls” (both anchorage and the walls themselves). ASCE 7 has requirements for “structural walls” (both anchorage and the walls themselves). ASCE 7 provides additional requirements for concrete and masonry walls in addition to those for other structural walls.

Provisions Sec. 4.6.1.2 requires a minimum anchorage force of 100 plf for wall anchorage.

Relative to bearing walls and structural walls, the specific requirements are the same except that ASCE 7 includes the importance factor in the force, while the *Provisions* does not. The other differences relate to anchorage of concrete and masonry walls. Including the requirements for structural walls, ASCE 7 requires a design anchorage force for concrete and masonry walls equal to the greatest of the following:

1. $0.4S_{DS}I$ times the wall weight
2. 10 percent of the wall weight
3. $400S_{DS}I$ (pounds per linear feet of wall)
4. 280 pounds per linear feet of wall

The *Provisions* requires:

1. 100 pounds per linear feet of wall
2. For bearing walls only: $0.4S_{DS}$ times the wall weight and 10 percent of the wall weight

Recommendation: There is a substantive difference between the two documents that must be reviewed by the PUC. The use of the importance factor for the design force for bearing (structural) walls must also be reviewed.

<i>Provisions</i> Section:	4.6.1.4 Openings
ASCE 7 Section:	12.10.1 Diaphragm design

Discussion: This section of the *Provisions* addresses openings in diaphragm and shear walls. There is a corresponding section in ASCE 7 covering diaphragms, but no shear walls. The difference unlikely to be substantive since the design of shear walls is covered by the materials chapters and reference standards.

Recommendation: Decide whether or not to retain a detailing section covering openings in shear walls.

Provisions Section: 4.6.1.6 Discontinuities in vertical system
ASCE 7 Section: 12.3.3.2 Extreme weak stories

Discussion: Both documents contain the same trigger (see also *Report on Differences* for *Provisions* Sec. 4.3.3.2), but the exception to the height restriction is different. The *Provisions* exception requires a weak story designed for $0.75C_d$ times the design force, while ASCE 7 requires a weak story designed for Ω_0 times the design force. Depending on the specific systems (ratio of C_d to Ω_0) the difference could be substantive. This also seems to be a philosophical difference – whether to base the increased force on a drift parameter or strength parameter.

Recommendation: Review the different requirements, including, perhaps, the philosophy behind them. For a weak story (as opposed to a soft story), it seems more appropriate to use a strength parameter.

Provisions Section: 4.6.1.7 Columns supporting discontinuities in walls or frames
ASCE 7 Section: 12.3.3.3 Elements supporting discontinuous walls or frames

Discussion: The section titles highlight the differences. The *Provisions* section applies specifically to columns, while ASCE 7 applies to all elements, including beams, trusses or slabs.

Recommendation: ASCE 7 seems to better represent the intent of the provision. Therefore, the *Provisions* scope would be improved by adopting the requirements of this ASCE 7 section.

Provisions Sections: 4.6.1.9 Diaphragms (SDC B)
4.6.3.4 Diaphragms (SDC D)
ASCE 7 Section: 12.10.1.1 Diaphragm design forces

Discussion: For structures assigned to SDC B and C, the *Provisions* provides a simplified formula for diaphragm design ($0.2S_{DS}$). For SDC D and above, there are more detailed requirements, including a vertical force distribution and minimum and maximum values. ASCE 7 applies this more detailed requirement to structures assigned to SDC B through F. Therefore, the substantive difference is in the treatment of diaphragms in SDC B and C.

ASCE 7 also contains more specific requirements for the redundancy factor than contained in the *Provisions*. In ASCE 7, the redundancy factor applies where forces are transferred through the diaphragm from one vertical element to another, but shall be taken as 1.0 for the basic diaphragm forces. The *Provisions* do not appear to contain a similar specific requirement.

Recommendation: Decide which diaphragm design force equation should be used for SDC B and C, and review the specific requirements for the redundancy factor as applied to diaphragms.

Provisions Section: 4.6.2.1 Anchorage to concrete and masonry walls (SDC C)

ASCE 7 Sections: 12.11.2.1 Anchorage of concrete or masonry structural walls to flexible diaphragms.
 12.11.2.2 Additional requirements for diaphragms in structures assigned to Seismic Design Category C through F.

Discussion: The anchorage force of walls to flexible diaphragms is the same. However, the requirements for anchorage of walls to rigid diaphragms are substantively different. The *Provisions* refers to Sec. 6.2.2 (which is an error; the correct reference should be Sec. 6.2.6) for the force equation, F_p , for nonstructural elements. ASCE 7 does not have such a requirement. Instead, the minimum anchorage requirements are those for all concrete and masonry structural walls per ASCE 7 Sec. 12.11.2 and Sec. 12.11.2.1. Depending largely on the location in the building's height where the anchorage is, the design force could be significantly different.

There are three other differences related to detailing requirements for wall anchorage in flexible diaphragms. The requirements in ASCE 7 Sections 12.11.2.2.2, 12.11.2.2.6, and 12.11.2.2.7 are not contained in contained in *Provisions* Sec. 4.6.2.1. ASCE 7 Sec. 12.11.2.2.2 requires that the strength design forces be increased by 1.4 for steel elements. ASCE 7 Sec. 12.11.2.2.6 requires consideration of eccentricities in wall anchorage connections. ASCE 7 Sec. 12.11.2.2.7 covers special anchorage requirements at walls with pilasters.

Recommendation: Correct the *Provisions* reference, and decide which anchorage design procedure is appropriate for structural walls connected to rigid diaphragms. Review the three additional ASCE 7 wall anchorage design requirements for appropriateness for inclusion in the *Provisions* by reference to ASCE 7.

Provisions Section: 4.6.3.1 Vertical seismic forces (SDC D)
ASCE 7 Sections: 12.4.4 Minimum upward force for horizontal cantilevers for Seismic Design Categories D through F.

Discussion: The requirements for cantilevers are the same. The *Provisions*, however, provide additional text related to prestressed elements. Technically, the requirement for prestressed elements is the same in both documents since it is essentially just an application of a seismic load combination for a non-seismic element ($0.9D - 1.0E$ which becomes $0.9D - 0.2S_{DS}D - E_h$, where E_h is equal to zero). In any case, the specific reminder in the *Provisions* is helpful.

Recommendation: There is no substantive difference, but the *Provisions* reminder that the load combination applies to prestressed elements is useful. The PUC should review whether or not this warrants amendment to adoption of ASCE 7.

Provisions Section: 4.6.3.3 Collector elements
ASCE 7 Sections: 12.10.2.1 Collector elements requiring load combinations with overstrength factor for Seismic Design Categories C through F.

Discussion: The requirements are the same, except that ASCE 7 applies to SDC C and above while the *Provisions* applies to SDC D and above. This is largely due to the fact that the vertical diaphragm force distribution referred to in these sections does not apply to SDC C according to the *Provisions* (see also *Report on Differences* for *Provisions* Sec. 4.6.1.9). The difference is in the scoping of the requirement.

Recommendation: Resolution of this difference depends on how the difference in applicability of the diaphragm equation is resolved.

***Provisions* Simplified Alternate Chapter 4-Alternate Structural Design Criteria for Simple Bearing Wall or Building Frame Systems**

Summary: This alternate Chapter 4 provides design criteria for simple buildings, based on certain limitations. Included in the section are seismic design parameters, seismic load effects and combinations, seismic-force-resisting systems and related requirements, deformation requirements, and detailing requirements.

ASCE 7 Section 12.14-Simplified Alternative Structural Design Criteria for Simple Bearing Wall or Building Frame Systems

Summary: This section of ASCE 7 contains a simplified procedure similar in scope to that of the *Provisions*. The corresponding items in *Provisions* Simplified Alternate Chapter 4 are including in this section of ASCE 7.

Significant Differences

<i>Provisions</i> Section:	Alt. 4 .1 General
ASCE 7 Section:	12.14.1 General

Discussion: Though not a strict difference in content, there is a difference in organization. In ASCE 7, the simplified procedure is embedded within the seismic design section and referred to in the permitted analysis procedures among other sections. In the *Provisions*, the simplified procedure is treated as an independent chapter. The basis for the *Provisions* organization is that the simplified procedure was relatively recently added on a trial basis, similar to the content in other *Provisions* appendix chapters. Since the simplified procedure is within the body of ASCE 7, it can be assumed that the procedure has been accepted into standard practice within the context of the ASCE standard. Therefore, it is now probably appropriate to include the simplified procedure in the body of *Provisions* Chapter 4 rather than as an alternative. Doing so would eliminate the differences between *Provisions* Sec. 4.4.1 and ASCE 7 Sec. 12.6 (see previous discussion in this *Report on Differences*).

Recommendation: Eliminate *Provisions* Alternate Chapter 4 and move the simplified procedure into *Provisions* Chapter 4 as a reference to ASCE 7 with modifications as necessary.

<i>Provisions</i> Section:	Alt. 4.1.1 Simplified design procedure
ASCE 7 Section:	12.14.1.1 Simplified design procedure

Discussion: These sections provide the limitations for using the simplified procedure. Both have the 12 items, but there are 4 differences.

- *Provisions* Item #7 (related to distribution of lateral elements) is not contained in ASCE 7.
- ASCE 7 Item #7 (related overhangs in buildings with flexible diaphragms) is not contained in the *Provisions*.
- ASCE 7 has an additional requirement in Item #8 that is not in the *Provisions*. This item relates to distribution of lateral elements and appears to have a similar purpose as *Provisions* Item #7.
- Item #11 prohibits the use of the simplified procedure for buildings with system irregularities caused by in-plane and out-of-plane offsets in the seismic-force-resisting elements. ASCE 7

contains an exception that is not in the *Provisions*. This exception permits the use of the simplified procedure for two-story buildings of light-frame construction as long as the framing supporting the upper elements is designed for overturning using Ω_0 forces.

Recommendation: Decide which combination of Items #7 and #8 to include in the *Provisions*. This exception in Item #11 appears reasonable and increases the applicability of the simplified procedure. It seems appropriate to incorporate it by reference to ASCE 7.

Provisions Section: Alt. 4.1.2 References
ASCE 7 Section: 12.14.1.2 Reference documents

Discussion: Some of the ASCE 7 reference documents are of newer versions.

Recommendation: Update references in both documents as necessary.

Provisions Section: Alt. 4.2.2.1 Seismic load effect
ASCE 7 Section: 12.14.2.2.1 Seismic load effect

Discussion: Though they are difference in appearance, the basic requirements of these sections are the same. However, ASCE 7 does not require the dead load term of the equation to be applied where S_{DS} is less than 0.125 or for considering foundation overturning. This is a substantive difference for these two conditions.

Recommendation: This exception should be reviewed for its appropriateness of adoption by reference into the provisions.

Provisions Section: Alt. 4.2.2.2 Seismic load effect with overstrength
ASCE 7 Section: 12.14.2.2.2 Seismic load effect with overstrength

Discussion: The basic requirements of these sections are the same. However, ASCE 7 does not require the dead load term of the equation to be applied where S_{DS} is less than 0.125 or for considering foundation overturning. This is a substantive difference for these two conditions.

Recommendation: This exception should be reviewed for its appropriateness of adoption by reference into the provisions.

Provisions Section: Alt. 4.3.1 Selection and limitations
Alt. Table 4.3-1
ASCE 7 Section: 12.14.3.1 Selection and limitations
Table 12.14-1

Discussion: There are substantive differences for various system parameters between *Provisions* Alt. Table 4.3-1 and ASCE 7 Table 12.14-1. These differences are as follows:

System	2003 <i>Provisions</i>	ASCE 7-05
Bearing Wall Systems		
Intermediate precast shear walls	Included	Not Included
Ordinary precast shear walls	Included	Not Included
Special reinforced masonry shear walls	$R=3.5$	$R=5$
Intermediate reinforced masonry shear walls	$R=2.5$	$R=3.5$
Prestressed masonry shear walls	Included	Not Included
Light-framed walls with shear panels of all other	Not Included	Included

materials		
Building Frame Systems		
Detail plain concrete shear walls	$R=2.5$	$R=2$
Intermediate precast shear walls	Included	Not Included
Ordinary precast shear walls	Included	Not Included
Composite concentrically braced frames	Included	Not Included
Composite steel plate shear walls	Included	Not Included
Special steel plate shear walls	Included	Not Included
Special reinforced masonry shear walls	$R=4.5$	$R=5.5$
Intermediate reinforced masonry shear walls	$R=3$	$R=4$
Prestressed masonry shear walls	Included	Not Included
Steel systems not specifically detailed for seismic resistance (concentric braced frame systems only)	Included	Not Included
Light-framed walls with shear panels of all other materials	Not Included	Included

All of these differences are substantive and presumably represent differences of opinion between those developing the two documents.

Recommendation: The PUC must review the differences and coordinate the two documents. Differences that are intended will have to be included as modifications to ASCE 7 assuming that the system tables in ASCE 7 will be used by reference. However, the *Provisions* will have to keep at least a partial system table to cover newer systems that are not yet to the point of being recognized by ASCE 7.

Provisions Section: Alt. 4.3.1.1 Combinations of framing systems
ASCE 7 Sections: 12.14.3.2 Combinations of framing systems
12.14.3.2.1 Horizontal combinations
12.14.3.2.2 Vertical combinations

Discussion: The *Provisions* does not permit combinations of systems in the same direction except for penthouses and other light rooftop structures. ASCE 7 permits combinations in the same direction as long as the least R value for any system in a direction is used for all systems in that direction. In addition, for two-story buildings of light-frame construction or with flexible diaphragms, different R factors are permitted for independent lines of framing. Finally, different systems are permitted in different stories as long as the least R factor for any system in a given direction is used for all of the systems in that direction.

All three of these differences are substantive and cause ASCE 7 to be less restrictive than the *Provisions*.

Recommendation: The PUC must review whether these less restrictive requirements in ASCE 7 are appropriate for incorporation by reference. For the types of structures for which the simplified procedure applies, the ASCE 7 relaxed requirements and the way combinations of systems are treated does not seem unreasonable.

Provisions Section: Alt. 4.5.2 Openings or re-entrant building corners
ASCE 7 Section: 12.14.6.2 Openings or re-entrant building corners

Discussion: On the surface, there appears to be a difference. The exception in ASCE 7 explicitly permits the use of the design procedures for perforated shear walls to satisfy the requirements of this section, while the *Provisions* does not contain this exception. However, the “except where otherwise specifically provided for in these provisions” can be used to incorporate the perforated shear wall procedure from the AF&PA SDPWS reference document in *Provisions* Chapter 12. There is no difference.

Recommendation: No difference.

Provisions Sections: Alt. 4.5.5 Anchorage of concrete and masonry walls
Alt. 4.5.5.1 Seismic Design Category B
ASCE 7 Section: 12.14.6.5 Anchorage of concrete or masonry walls

Discussion: This difference is similar to the differences in the corresponding section of *Provisions* Chapter 4. For SDC B, the *Provisions* has one requirement – that wall anchorage be designed for 100 plf except for bearing walls, where the additional requirements are $0.4S_{DS}$ times the wall weight and 10 percent of the wall weight. For SDC B and flexible diaphragms, ASCE 7 has similar requirements to those for SDC C and above ($0.4S_{DS}$ times the wall weight and 10 percent of the wall weight). For rigid diaphragms, ASCE 7 refers to the requirements for nonstructural components for SDC B. This represents a substantive difference in scope for SDC B buildings. The *Provisions* provides a more simple approach for SDC B buildings, but it may not be adequate for non-load bearing concrete and masonry walls (100 plf design force). ASCE 7, however, could be considered more simply since it does not distinguish between SDC B and other SDC C-D.

Recommendation: The specific provisions require further review considering whether the requirements SDC B should be relaxed or kept the essentially the same as SDC C and D for the sake of consistency.

Provisions Section: Alt. 4.6.1 Seismic base shear
ASCE 7 Section: 12.14.7.1 Seismic base shear

Discussion: The substantive difference between these sections is the coefficient on the base shear equation. In the *Provisions*, the base shear equation is $1.25S_{DS}/R$ times the weight of the building for all heights. In ASCE 7, the coefficient is 1.0, 1.1, and 1.2 for one-, two-, and three- story buildings, respectively. The *Provisions* are more conservative for all heights, especially the buildings with fewer stories.

Recommendation: The factors on the base shear equation must be reviewed.

Provisions Section: Alt. 4.6.4 Overturning
ASCE 7 Section: 12.14.7.4 Overturning

Discussion: These sections are essentially the same except that the *Provisions* contains an equation for determining the overturning moment at a given level. There is no difference, since overturning can be determined from statics without having a specific equation provided.

Recommendation: No difference.

***Provisions* Chapter 5 – Structural Analysis Procedures**

Summary: *Provisions* Chapter 5 contains detailed requirements for four structural analysis procedures (equivalent lateral force, response spectrum, linear response history, and nonlinear response history) and direction for modification of two of those procedures (equivalent lateral force and response spectrum) for consideration of soil-structure interaction. No consistent modeling requirements are applied to all forms of structural analysis. Instead, each procedure includes some discussion of modeling either in a general section or as related to a specific aspect of the analysis being discussed (for instance, drift determination for the equivalent lateral force procedure in Section 5.2.6).

ASCE 7 Sections: 12.7 – Modeling Criteria
12.8 – Equivalent Lateral Force Procedure
12.9 – Modal Response Spectrum Analysis
16 – Seismic Response History Procedures
19 – Soil Structure Interaction for Seismic Design

Summary: These sections of ASCE 7 cover the same ground as *Provisions* Chapter 5, but in a more user-friendly manner. Modeling criteria that apply to all of the procedures are outlined in an over-arching section. Methods used most often (equivalent lateral force and modal response spectrum) appear near the front of the seismic requirements and the response history methods (both linear and nonlinear) appear in a section near the end of the structural requirements. The information on soil-structure interaction, which is used very rarely, appears immediately before requirements related to geotechnical concerns.

Significant Differences

Provisions Section: 5.2 Equivalent Lateral Force Procedure
ASCE 7 Section: 12.7.1 Foundation Modeling

Discussion: The *Provisions* requires that analysis for the equivalent lateral force procedure assume the structure “fixed at the base” (which might confuse some readers of Section 5.6, which provides a procedure to modify those results on the basis of soil-structure interaction). ASCE 7 permits explicit consideration of foundation flexibility (using Section 12.13.3) or implicit consideration of the same (using Section 19). Explicit consideration of foundation flexibility has been common for major structures for many years. Modeling approaches that are as consistent as possible across the various procedures serve practitioners well; a properly developed model may be used for a variety of analysis types—permitting ready comparison.

Recommendation: Accept the ASCE 7 approach.

Provisions Section: 5.2.1 Seismic Base Shear
ASCE 7 Section: 12.7.2 Effective Seismic Weight

Discussion: In Item 4 of the definition of W , the *Provisions* limits contribution of only 20 percent of the design snow load to the seismic weight by indicating “where siting and load duration conditions warrant, and where approved by the authority having jurisdiction.” Item 4 in ASCE 7 always permits use of only 20 percent of the design snow load.

The *Provisions* trigger for consideration of some snow load contribution to seismic weight is based on “design snow load”, where the ASCE 7 trigger is based on “flat roof snow load”.

Recommendation: Defer to ASCE 7 on these issues of statistical variation and correlation of loads as that committee is the accepted authority on such matters. Basing the trigger on “flat roof snow load” results in more geographically uniform application.

Provisions Section: 5.2.1.1 Calculation of seismic response coefficient
ASCE 7 Section: 12.8.1.3 Maximum S_s value in determination of C_s

Discussion: The caps on values of C_s for short, regular structures differ in that the *Provisions* specifies values for both S_{DS} and S_{DI} where ASCE 7 specifies a value for S_{DS} only. The ASCE 7 approach is simpler and produces slightly more conservative values for Site Class A or B and periods between 0.4 and 0.5 seconds. However, it may be argued that this simpler approach is a more “honest” way to arbitrarily cap otherwise larger demands.

Recommendation: Accept the ASCE 7 approach.

Provisions Section: 5.2.2 Period determination
ASCE 7 Section: 12.8.2 Period Determination

Discussion: The public ballot draft of Table 12.8-1 of ASCE 7 contains a superfluous row of data. A Public Ballot comment was submitted recommending that the last row be struck and the next-to-last row revised to read “ ≤ 0.1 ”.

Recommendation: No action required. The revision is editorial.

Provisions Section: 5.2.2.1 Approximate fundamental period
ASCE 7 Section: 12.8.2.1 Approximate Fundamental Period

Discussion: The metric values in ASCE 7 Table 12.8-2 are incorrect. ASCE 7 also provides no metric equivalent for Eq. 12.8-9. These problems were reported in a Public Ballot comment.

Recommendation: Confirm that the correct values and equation appear in the published edition of ASCE 7-05.

Provisions Section: 5.2.4.1 Inherent torsion
ASCE 7 Section: 12.8.4.1 Inherent torsion

Discussion: A strict application of the *Provisions* to flexible diaphragm conditions is not possible as there is no calculable center of rigidity. Appropriate consideration of inherent torsion is clarified in ASCE 7.

Recommendation: Accept the ASCE 7 revisions.

Provisions Section: 5.2.4.2 Accidental torsion
ASCE 7 Section: 12.8.4.2 Accidental torsion

Discussion: Where a strict reading of the *Provisions* would require application of accidental torsional moments to flexible diaphragm systems, ASCE 7 does not. Also ASCE 7 indicates explicitly how accidental torsional effects should be applied where considering orthogonal effects.

Recommendation: Accept the ASCE 7 revisions.

Provisions Section: 5.2.4.3 Dynamic amplification of torsion
ASCE 7 Section: 12.8.4.3 Amplification of Accidental Torsional Moment

Discussion: The *Provisions* requires application of the torsional amplification factor, A_x , to both accidental and inherent torsion. ASCE 7 applies that factor to the accidental torsion only. There was an understanding among developers of the 2003 *Provisions* (at least within TS 2) that this section of the *Provisions* would be revised to read as ASCE 7 does; however, the change was never made.

Some practitioners have interpreted this section of the *Provisions* to require iterative determination of A_x , since A_x is based on displacements that could be computed for loads including A_x . The ASCE 7 STC agreed that this was never the intent, so the text was revised to indicate that the displacements used to compute A_x are “computed assuming $A_x = 1$.”

Recommendation: Accept the ASCE 7 revisions.

Provisions Section: 5.2.5 Overturning
ASCE 7 Section: 12.8.5 Overturning

Discussion: This section of the *Provisions* contains an equation for story overturning moment; the ASCE 7 section does not. While this might appear to be a technically substantive difference, the ASCE 7 STC decided that the simple statement that “the structure shall be designed to resist overturning effects caused by the seismic forces in Section 12.8.3” more clearly and correctly indicates that intent and does not require computation of fictitious story moments that are not used in the subsequent design.

Recommendation: Accept the ASCE 7 approach.

Provisions Section: 5.2.6 Drift determination and P-delta effects
ASCE 7 Section: 12.7.3 Structural Modeling

Discussion: This section of the *Provisions* contains modeling requirements for determination of drift where the equivalent lateral force procedure is used. In ASCE 7 those requirements appear in a general section on structural modeling. It may be argued that no modeling requirements were applied to ELF-based strength designs under the *Provisions* and that, as a result, practitioners could model the structure as they wished until drift checks were performed. The ASCE 7 STC decided that that degree of variability was confusing and undesirable, so consistent modeling requirements were applied.

Recommendation: Accept the ASCE 7 approach.

Provisions Section: 5.2.6.2 P-delta limit
ASCE 7 Section: 12.8.7 P-Delta Effects

Discussion: Due to changes made to the *Provisions* during the 2003 update cycle, the treatment of P-delta effects in these two documents is now total different. In the *Provisions*, where the stability coefficient, θ is not greater than 0.1, no consideration of P-delta effects is required, but where $\theta > 0.1$, pushover analysis (using the Appendix to Chapter 5) must demonstrate positive tangent stiffnesses for all displacements up to the target displacement.

ASCE 7, which is based on the 2000 *Provisions*, allows one to ignore P-delta effects where the stability coefficient, θ is not greater than 0.1. For larger values of θ , ASCE 7 requires computation of an “incremental factor related to P-delta effects on displacements and member forces...by rational analysis” or by application of a multiplier expressed as $1.0/(1 - \theta)$. In no case may θ exceed the value of θ_{max} , given by Eq. 12.8-17. This latter limit, which is based roughly on consideration of residual stability, causes problems in application as Eq. 12.8-17 may produce values of θ_{max} that are less than 0.1, calling into question the rationale of checks whereby P-delta effects need not be considered (since $\theta < 0.1$), but the system is not permitted (since $\theta > \theta_{max}$).

See also the *Report on Differences* section discussing the *Provisions* Appendix to Chapter 5.

Recommendation: Decide whether the profession is ready for more current approaches to consideration of dynamic stability (such as that in the *Provisions*) or whether other changes can be made to improve the treatment of P-delta effects.

The PUC voted to retain Sec. 5.2.6.2 of the 2003 NEHRP vice Sec. 12.8.7 of ASCE-7-05.

Provisions Section: 5.3 Response Spectrum Procedure
ASCE 7 Section: 12.9 Modal Response Spectrum Analysis

Discussion: The *Provisions* contains several equations for modal response spectrum computations that are never used in practice. ASCE 7 better reflects current practice describing modal response spectrum analysis (assuming that digital computers will be used).

The *Provisions* also contains equations for the modification of the response spectrum used in modal analysis. The ASCE 7 STC agreed that the general design response spectrum, wherein spectral ordinates are reduced for periods below T_0 , is simpler and more appropriate for general application to all geographic locations and site soil conditions than is a spectrum tied to a period of 0.3 seconds.

Recommendation: Accept the ASCE 7 approach.

Provisions Section: 5.3.1 Modeling
ASCE 7 Section: 12.7.3 Structural Modeling

Discussion: The *Provisions* requires use of three-dimensional mathematical models for all irregular structures and for structures without independent orthogonal systems. ASCE 7 relaxes this requirement by requiring three-dimensional models only for structures with torsional irregularity, out-of-plane offsets, or nonparallel systems. The ASCE 7 STC agreed that requiring three-dimensional, rigid diaphragm modeling does not necessarily improve the analysis results for systems with vertical irregularities, re-entrant corners, diaphragm discontinuities, or elements common to two orthogonal systems. Where diaphragms do not satisfy requirements to be classified as rigid or flexible, ASCE 7 requires explicit modeling of the diaphragm, including additional dynamic degrees of freedom.

Recommendation: Consider the merits of the ASCE 7 approach, which may better reflect current practice.

Provisions Section: 5.3.3 Modal properties
ASCE 7 Section: none

Discussion: The *Provisions* contains a significant internal conflict. Section 5.3 permits use of “realistic assumptions with regard to the stiffness of foundations,” while Section 5.3.3 indicates that the analysis shall assume a “fixed-base condition.” It is likely that the requirement in Section 5.3.3 was overlooked when making changes related to introduction of new foundation modeling provisions in the Appendix to Chapter 7. This conflict does not exist in ASCE 7, which permits use of realistic foundation modeling for all analysis procedures.

Recommendation: Accept the ASCE 7 approach.

Provisions Section: 5.3.7 Design values
ASCE 7 Section: 12.9.3 Combined Response Parameters

Discussion: The *Provisions* does not provide direction for application of the CQC method of modal combination. ASCE 7 provides such direction by reference to ASCE 4.

Recommendation: Accept the ASCE 7 revision.

Provisions Section: 5.3.7 Design values
ASCE 7 Section: 12.9.4 Scaling Design Values of Combined Response

Discussion: This section of the *Provisions* indicates that scaling to 85 percent of the equivalent lateral force procedure base shear computed using limits on the fundamental period applies to “design story shears, moments, drifts, and floor deflections.” However, drift computations for design using the equivalent lateral force procedure do not require consideration of period limits. ASCE 7 resolves this discrepancy by indicating that scaling applies to “the forces, but not the drifts.” A similar change was made in the 2004/2005 *International Building Code*.

Recommendation: Accept the ASCE 7 revision.

Provisions Section: 5.4.2.2 Three-dimensional analysis
ASCE 7 Section: 16.1.3.2 Three-dimensional Analysis

Discussion: The *Provisions* indicate that ground motion pairs used for three-dimensional response history analysis must be scaled such that the average of the SRSS spectra is not less than 1.3 times the corresponding ordinate of the design spectrum. In ASCE 7 the ground motions have been reduced by indicating that the average must not fall below 1.3 times the corresponding ordinate of the design spectrum “by more than 10 percent.” This 10 percent reduction in required ground motion removes the inconsistency between ground motions used for structures with isolation or damping systems and those used for other structures.

The *Provisions* permit determination of the required target displacement using either the general or the site-specific method (Section 3.3.4 or 3.4.4). ASCE 7 indicates that the target spectrum must be determined using the site-specific procedure in Section 21.2 (without reference to general procedure in Section 11.4.5). This appears to be an error in ASCE 7 and was reported as a Public Ballot comment.

Recommendations: Maintain consistency of ground motion level for all structures, but confirm that this level of ground motion is appropriate.

If the published edition of ASCE 7 does not permit use of Section 11.4.5, consider making such a change.

Provisions Section: 5.5.3 Response parameters
ASCE 7 Section: 16.2.4 Response parameters

Discussion: This section of the *Provisions* erroneously refers to “scaled” values where no scaling is required. The ASCE 7 text is correct.

Recommendation: Accept the ASCE 7 revisions.

Provisions Section: 5.5.4 Design Review
ASCE 7 Section: 16.2.5 Design review

Discussion: *Provisions* Section 5.5.4, item 3 indicates: “Review of the preliminary design including the determination of the target displacement of the structure and the margins remaining beyond these displacements”. ASCE 7 indicates, “Review of the preliminary design including the selection of structural system and the configuration of structural elements”.

Recommendation: Since “target displacement” is not defined for nonlinear response history analysis, accept the ASCE 7 revision.

Provisions Section: 5.6.2.1.1 Effective building period
ASCE 7 Section: 19.2.1.1 Effective Building Period

Discussion: Provisions Table 5.6-1 is based on $S_{DS}/2.5$ where ASCE 7 Table 19.2-1 is based on S_{DI} . The difference can be significant. In all other locations where the *Provisions* are intended to be based on some measure of effective peak ground acceleration, $S_{DS}/2.5$ is used.

Recommendation: Consider appropriate measures of effective peak ground acceleration. Better yet, revise this section to be consistent with more recent information concerning shear modulus reduction as a function of EPGA (as $S_{DS}/2.5$) and site class (such as in Chapter 4 of FEMA 356).

Provisions Section: none
ASCE 7 Section: 16 Seismic Response History Procedures

Discussion: The public ballot draft of this section of ASCE 7 contains many typographical and editorial errors (some of which could result in substantive misapplication). These errors were reported in a Public Ballot comment. [If corrections are not made during resolution of the public ballot comments, detailed edits will be provided in the next draft of this document.]

Recommendation: If the published edition of ASCE 7 does not correct the errors noted, consider making such changes.

Provisions Section: none
ASCE 7 Sections: 16.2.2 Modeling
12.7.3 Structural Modeling

Discussion: The modeling requirements in these two sections of ASCE 7 could be better unified, removing repetitive material.

Recommendation: Consider revising the text of 16.2.2.

***Provisions* Appendix to Chapter 5 – Nonlinear Static Procedure**

Summary: *Provisions* Appendix to Chapter 5 contains trial requirements for pushover analysis.

ASCE 7 Section: None

Summary: ASCE 7 does not contain requirements for pushover analysis.

Discussion: The procedure in the *Provisions* defines the target displacement using a displacement modification (coefficient) method similar to (but simpler than) that in FEMA 356. The method uses a single shape vector, unlike FEMA 356, which requires consideration of two shape vectors. Some of the requirements in this section appear to be based loosely on early drafts of FEMA 440, which has since been completed.

The appendix procedure plays an important role in application of the *Provisions* as it must be used where the stability coefficient, θ , exceeds 0.10 (see Section 5.2.6.2). This was an important change in the 2003 cycle as it was intended to resolve long-standing concerns that the treatment of P-delta effects was incorrect (as discussed at length in the *Commentary*).

Recommendation: Consider whether the procedure should be updated on the basis of FEMA 440 and whether it is appropriate to move this approach to P-delta effects into ASCE 7.

***Provisions* Chapter 6-Architectural, Mechanical, and Electrical Component Design Requirements**

Summary: *Provisions* Chapter 6 provides design criteria for nonstructural components that are permanently attached to structures. General design requirements relate to seismic forces, relative displacements, and component anchorage. The chapter includes references to design standards as well as other documents related to the seismic design of nonstructural components.

ASCE 7 Section 13-Seismic Design Requirements for Nonstructural Components

Summary: The scope of ASCE 7 Section 13 is similar to that of the *Provisions* Chapter 6.

Significant Differences

<i>Provisions</i> Section:	6.1.2 References
ASCE 7 Sections:	13.1.6 Reference documents 23 Seismic design reference documents

Discussion: The *Provisions* divides the references into two types: adopted references and other references. Adopted references are considered to be part of the *Provisions* as referenced in this chapter. Other references represent acceptable practice but are not considered as part of the *Provisions*. ASCE 7 contains all of the references for seismic design in one section (Sec. 23) and does not distinguish between adopted and others. In addition, in some cases, ASCE 7 indicates which specific sections of the reference documents are used, rather than just referencing entire documents as the *Provisions* does. The *Provisions* contains several references not contained in ASCE 7 (IEEE-344, ASHRAE, SMACNA 95, SMACNA 80, and SMACNA 98), ASCE 7 contains some references not in the *Provisions* (ASTM C635, ASTM C636, and SP-58), and some of the reference documents in ASCE 7 are of newer dates, in particular those standards that have been updated in Supplement #1 of ASCE 7-05 [Proposal EQ8-JDG-SUP1-1].

Recommendation: Update reference documents as appropriate.

<i>Provisions</i> Section:	6.2 General design requirements
ASCE 7 Sections:	13.2 General design requirements 13.2.1 Applicable requirements for architectural, mechanical and electrical components 13.2.2 Special certification requirements for designated seismic systems 13.2.6 Experience data alternative for seismic capacity determination

Discussion: This section in the *Provisions* provides overall scoping for design provisions and quality assurance requirements for architectural and mechanical/electrical components by referencing the applicable sections using Table 6.2-1. ASCE 7 Sec. 13.2.1 contains a similar table (Table 13.2-1). However, the table provides expanded section references for various design aspects, but it doesn't contain references to the applicable quality assurance sections. This doesn't represent a substantive change except where the specific design and quality assurance provisions are different (as described below and in the *Provisions* Chapter 2 section of the *Report on Differences*).

In addition, ASCE 7 provides additional language describing the methods for satisfying the design criteria: either by project-specific design by a registered design professional or by qualification using

analysis, testing, or experimental data. Though not specifically stated in this section of the *Provisions*, there is not likely to be a substantive difference.

ASCE 7 Sec. 13.2.2, related to certification, does not have a corresponding section in the *Provisions*. See also discussion in this *Report on Differences* covering *Provisions* Sec. 2.4.5.

ASCE 7 Sec. 13.2.6, which contains an alternate to the analytical requirements, has not corresponding section in the *Provisions*. This section essentially provides for a prequalification on certain systems and is a substantive difference between the two documents unless the testing alternate in *Provisions* Sec. 6.1.1 serves to cover this content.

Recommendation: Except as related to the text in ASCE 7 Sec. 13.2.5 and Sec. 13.2.6, there does not appear to be a substantive difference in the scoping requirements in these sections. The PUC must determine whether to incorporate the ASCE 7 requirements into the *Provisions*.

<i>Provisions</i> Section:	6.2.6 Seismic forces
ASCE 7 Section:	13.3.1 Seismic design force

Discussion: The basic seismic design force equation and the minimum and maximum limits are the same in both documents. However, the *Provisions* adds an exception which permits the reduction in design force when the period of the component, T_p , is greater than T_{flx} . T_{flx} is the transition period, T_s , adjusted for location within the building height. The intent of this requirement is to provide a reduction in design force for nonstructural components with longer periods, consistent with the reduction of seismic force in primary structures with longer periods.

Note that *Provisions* Sec. 6.2.6.2 is a repeat of the text in the first paragraph of *Provisions* Sec. 6.2.6 and should be removed.

There is an additional sentence in ASCE 7 Section 13.3.1 that requires F_p to be assumed to act in any horizontal direction for vertically cantilevered systems, in conjunction with a concurrent vertical force. Also in ASCE 7 Section 13.3.1 there is an exception to the concurrent vertical seismic force requirement applicable to lay-in access floor panels and lay-in ceiling panels.

Recommendation: Decide whether to retain the design force reduction for components with longer periods. Remove redundant text in the *Provisions*. Decide whether to incorporate the additional requirements in ASCE 7 related to application of forces.

<i>Provisions</i> Section:	6.2.8.2 Anchors in concrete or masonry
ASCE 7 Section:	13.4.2 Anchors in concrete or masonry

Discussion: This section of the *Provisions* specifies a minimum anchorage force equal to the strength of the connected part. ASCE 7 has no such limit. The requirement that the force be not less than the maximum force that can be transmitted may override this requirement in most cases. However, the *Provisions* requirement could govern when the “connected part” is strong but the anchorage force is limited to another element of the load path.

Recommendation: Determine whether or not to retain the *Provisions* limit on anchorage force.

Provisions Section: 6.2.8.4 Multiple anchors
ASCE 7 Section: 13.4.4 Multiple attachments

Discussion: The *Provisions* refers to *Provisions* Sec. 9.6 for design of multiple anchors. This reference is old and apparently was not updated to be consistent with the updates to Chapter 9. Instead of Sec. 9.6, this section should refer to Appendix D of ACI 318-02 or to *Provisions* Sec. 9.2.2.8 which modifies Appendix D. The *Provisions* used to have a detailed section for design of anchorage to concrete, but this section was removed after Appendix D was added to ACI 318.

Depending on how the concrete anchorage section is referenced, there could be substantive differences between the *Provisions* and ASCE 7. The modifications to ACI 318-02 Appendix D contained in *Provisions* Sec. 9.2.2.8 are different from the current language in ASCE 7 Sec. 13.4.4 which references Appendix D of ACI 318 without modification. See *Report on Differences on Provisions* Chapter 9 for more information.

Recommendation: The reference within the *Provisions* should be updated to reflect the 2003 updates to *Provisions* Chapter 9, and the impact of the *Provisions* modifications to ACI 318-02 Appendix D should be reviewed by the PUC.

Provisions Section: 6.3.2 Exterior nonstructural wall elements and connections
ASCE 7 Section: 13.5.3 Exterior nonstructural wall elements and connections

Discussion: There is a difference between the *Provisions* and ASCE 7 related to the last item in the five-item list of requirements. For anchorage consisting of flat straps embedded in concrete and masonry, ASCE 7 adds a requirement that pullout of the anchorage is not the initial failure mechanism. Although the intent of both documents is the same, this may or may not be a substantive difference depending on how the requirements are satisfied in design.

Recommendation: Decide whether or not to incorporate the additional text of ASCE 7.

Provisions Section: 6.3.5.2 Special access floors
ASCE 7 Section: 13.5.7.2 Special access floors

Discussion: In item 1 of this section of ASCE 7, there is a reference to ACI 318 Appendix D for anchorage to concrete, while the corresponding item in the *Provisions* references *Provisions* Sec. 9.6. This appears to be a hold-over from a previous addition since the *Provisions* no longer contains specific requirements for anchorage design. Instead, like ASCE 7, the *Provisions* refers to ACI 318 Appendix D (*Provisions* Sec. 9.2.2.8).

Recommendation: Change reference in the *Provisions* to ACI 318 Appendix D similar to ASCE 7.

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Provisions Section: 6.3.6 Partitions
ASCE 7 Sections: 13.5.8 Partitions
13.5.8.1 General

Discussion: This section of ASCE 7 exempts lightweight partitions of modest height in regions of low to moderate seismic hazard from the lateral bracing requirements for typical partition walls. There is no such exception to the bracing requirements in the *Provisions*.

Recommendation: Decide whether or not the exemption is appropriate for the *Provisions*.

Provisions Section: 6.4 Mechanical and Electrical Components
ASCE 7 Sections: 13.6 Mechanical and Electrical Components
13.6.1 General
13.2.5 Testing Alternative for Seismic Capacity Determination

Discussion: The *Provisions* has a paragraph concerning design of “complex equipment” that is not in ASCE 7. The paragraph, however, appears to be essentially commentary, not representing a substantive difference.

Design coefficients for M/E components are contained in *Provisions* Table 6.4-1 and ASCE 7 Table 13.6-1. The table in ASCE 7 is more detailed and comprehensive with an expanded list of components that are sometimes more specifically defined. The a_p and R_p values for corresponding components are generally similar so the adoption of ASCE 7 Table 13.6-1 by reference is not likely to result in substantive changes to the *Provisions*. Two of the R_p values were revised in ASCE 7-05 Supplement #1 [Proposal EQ8-JDG-SUP1-5]. However, the values relate to specific mechanical and electrical components for which there are no corresponding systems defined in the *Provisions*.

Recommendation: Move the 2 paragraphs listed above into the *Commentary* and remove from the *Provisions*. Review ASCE 7 Table 13.6-1 for consistency with the intent of the *Provisions* and provide any necessary modifications to the table in the *Provisions*, including the ASCE 7 Supplement #1 revisions.

Provisions Section: 6.4.2 Mechanical Components
ASCE 7 Sections: 13.6.3 Mechanical Components
13.6.11 Other Mechanical and Electrical Components

Discussion: The only difference is between the requirements related to components with hazardous material and to boilers and pressure vessels not designed in accordance with ASME BPV, which are covered in *Provisions* Sec. 6.4.2, item 3 and ASCE 7 Sec. 13.6.11, item 2. The reduction values are different for mechanical components with nonductile materials (25 percent per *Provisions* item 3c, 10 percent per ASCE 7 item 2c) and threaded connections with nonductile materials (20 percent per *Provisions* item 3d, 8 percent ASCE 7 item 2d).

Recommendation: Decide which of the two requirements should be included in the *Provisions*.

Provisions Section: 6.4.4 Supports and Attachments
ASCE 7 Section: 13.6.5 Component Supports

Discussion: The text for the basic requirements of these sections is similar in both the *Provisions* and ASCE 7. The only difference within the text portion is that ASCE 7 provides language that “standard supports” and “proprietary supports” be designed by testing or for the calculated forces. Similar language is not in the *Provisions* section, but this aspect of design is covered by the general nonstructural design requirements in the *Provisions*. There is not a substantive difference.

There are some differences, however, in the list of additional requirements that follow the basic requirements. Both the *Provisions* and ASCE 7 provide a list of requirements that are compared as follows:

<i>Provisions</i> Item	ASCE 7 Item	Comments
1	section text	Identical
2	1	Identical
3	Sec. 13.4.6	Similar, but based on the organization of the section, ASCE 7 prohibits friction clips for anchorage of all components, while the <i>Provisions</i> prohibits them only for mechanical and electrical components.
4	2	Identical
5	3	Identical
6	4	Identical
7	5	Identical
8	6	Similar, but ASCE 7 adds 2 sub-items (a and b) that are not in the <i>Provisions</i>
9	7	Similar, but ASCE 7 item applies to piping in addition to boilers and pressure vessels, to which the <i>Provisions</i> apply
n/a	8	Item not in the <i>Provisions</i>

Recommendation: The differences between these “additional requirements” should be reviewed by the PUC. The difference between the requirements for friction clips seems to be due to section organization, but the intent related to architectural components should be reviewed. It seems that ASCE 7 Sec. 13.6.5, Item 8 (drilled and grouted anchors in tension applications) is an appropriate requirement to be retained. The added items in ASCE 7 Sec 13.6.5, Items 6 and 7 also seem like appropriate requirements.

Provisions Section: 6.4.5 Utility and Service Lines
ASCE 7 Section: 13.6.6 Utility and Service Lines

Discussion: The requirements of these sections are similar except that the trigger in the *Provisions* is S_{DS} greater than or equal to 0.4, while the trigger in ASCE 7 is S_{DS} greater than or equal to 0.33. The difference is not expected to be too significant since the requirement to which the trigger applies is somewhat general in nature (requiring “specific attention”), ASCE 7 applies to a greater area than the *Provisions*.

Recommendation: It does not appear that changing the trigger from 0.4 to 0.33 is very significant, but the PUC must determine if a modification to the adoption of ASCE 7 is warranted.

Provisions Section: 6.4.7.1 Fire Protection and Sprinkler Systems
ASCE 7 Sections: 13.6.8.2 Fire Protection and Sprinkler Systems in SDC C
13.6.8.3 Fire Protection and Sprinkler Systems in SDC D - F

Discussion: There are two significant differences between these sections related to sprinkler systems in Seismic Design Category D through F. Both sections reference NFPA-13, but each provides different additional design criteria. The *Provisions* requires a reduction in the spacing of longitudinal and transverse sway bracing. ASCE 7 requires a reduction of the material properties for piping and components. Both sets of criteria may be addressing a similar concern, but the application is different.

Recommendation: Determine which of the two sets of criteria should be included in the *Provisions*. Also review any future updates to NFPA-13 relative to the additional requirements.

Provisions Section: 6.4.7.2 Other Piping Systems
ASCE 7 Sections: 13.6.3 Mechanical Components
13.6.8.1 ASME Pressure Piping Systems
13.6.8.4 Other Piping Systems
13.6.11 Other Mechanical and Electrical Components

Discussion: The *Provisions* section has two requirements related to piping systems with I_p greater than 1.0 that do not appear to be in ASCE 7 Sec. 13.6.8.1 or Sec. 13.6.11. However, these requirements are contained covered by ASCE 7 Sec. 13.6.3, so it seems that there is no substantive difference. In ASCE 7-05 Supplement #1 [Proposal EQ-8-JDG-SUP1-2], a requirement that a certain simplified analysis procedure can not be used for piping systems with I_p greater than 1.0 was removed because it was considered an erroneous reference. The requirement is still in the *Provisions*.

Recommendation: Decide whether or not the first two requirements are adequately addressed by ASCE 7. Review and if confirmed, remove the erroneous reference from the *Provisions* consistent with the revision to ASCE 7.

ASCE 7-05 Supplement #1 Proposal EQ-8-JDG-SUP1-6

Provisions Sections: 6.4.9 Elevators
6.4.9.1 Elevators and hoistway structural systems
ASCE 7 Sections: 13.6.10 Elevators and escalator design requirements
13.6.10.1 Escalators, elevators and hoistway structural system

Discussion: Consistent with ASCE 7 Table 13.6-1, “escalators” is included in the title and text of these sections. Escalators are included in the corresponding table in the *Provisions*, but not in the section titles or text.

Recommendation: Incorporate editorial clarification into the *Provisions*.

***Provisions* Appendix to Chapter 6-Alternate Provisions for the Design of Piping Systems**

Summary: This appendix provides preliminary criteria for the establishment performance criteria and their use in designing piping systems. There are not any provisions for these systems in current building codes or standards.

ASCE 7 (No corresponding section)

Significant Differences

Discussion and Recommendation: This is the type of item for which the *Provisions* is intended – to provide guidance for design that is beyond the range of current building codes and standards. Therefore, this section ought to be retained in the 2008 *Provisions* with updates as deemed necessary based on feedback from users or based on recommendations by the PUC. The PUC should also review whether part or all of these guidelines warrant inclusion into the text of the *Provisions* or as modifications to ASCE 7.

***Provisions* Chapter 7 – Foundation Design Requirements**

Summary: *Provisions* Chapter 7 contains requirements for geotechnical investigations, general requirements for foundation analysis and design, and specific design and detailing requirements for foundation components of various materials.

ASCE 7 Sections: 11.8.2 – Soil Investigation Report for Seismic Design Categories C through F
11.8.3 – Additional Soil Investigation Report Requirements for Seismic Design Categories D through F
12.1.5 – Foundation Design
12.13 – Foundation Design
14.1.8 – Additional Detailing Requirements for Steel Piles in Seismic Design Categories D through F
14.2.3 – Additional Detailing Requirements for Concrete Piles

Summary: These sections of ASCE 7 contain requirements with the same scope as those in the *Provisions*, but with the three classes of requirements organized differently.

Significant Differences

Provisions Section: 7.4.3 Foundation ties
ASCE 7 Section: 12.13.6.2 Foundation Ties

Discussion: ASCE 7 clarifies the loads that are to be used in calculating the required tie force and specifies that the ties “shall have a design strength” rather than “shall be capable of carrying.” The *Provisions* say “product of the larger pile cap or column load times S_{DS} ”. ASCE 7 says: “ S_{DS} times the larger pile cap or column factored dead plus factored live load.”

Recommendation: Accept these clarifications of intent.

Provisions Section: 7.5.4 Special pile and grade beam requirements
ASCE 7 Section: 12.13.6.4 Batter Piles

Discussion: The *Provisions* require use of overstrength forces for design of batter piles, but use of nominal strength of the pile acting as a short column for connections thereto. ASCE 7 requires use of overstrength forces for batter piles and their connections.

Recommendation: Decide which design approach is appropriate.

Provisions Section: 7.5.4 Special pile and grade beam requirements
ASCE 7 Section: 12.13.6.5 Anchorage of Piles

Discussion: Item 1 in ASCE 7 adds “plus the pile weight.” The difference is substantive, but would usually be minor.

Recommendation: Accept this revision as it is consistent with typical design approaches.

Provisions Section: 7.5.4 Special pile and grade beam requirements
ASCE 7 Section: 12.13.6.8 Pile Group Effects

Discussion: The text in ASCE 7 attempts to provide more specific description of pile group effects but is worded poorly and should be revised. By changing “response” to “nominal strength”, ASCE 7 fails to recognize that pile spacing may affect strength or displacement or both. Further modifying “pile group effects” with “from soil” does not improve clarity and is not technically correct as group effects are really a form of pile-soil-pile interaction.

Recommendation: Revise ASCE 7 Section 12.13.6.8 as follows:

“Pile group effects ~~from soil~~ on lateral pile response (nominal strength and/or displacement) shall be included where pile center-to-center spacing in the direction of lateral force is less than eight pile diameters or widths. Pile group effects on vertical pile response (nominal strength and/or displacement) shall be included where pile center-to-center spacing is less than three pile diameters or widths.”

Provisions Section: 7.5.4 Special pile and grade beam requirements
ASCE 7 Section: 14.2.3.2 Concrete Pile Requirements for Seismic Design Categories D through F

Discussion: [A few editorial revisions for ASCE 7-05 were submitted as public comments to resolve differences between these sections. If those changes are not accepted, they will be reported here.]

ASCE 7 Section 14.2.3.2.3 adds a requirement for uncased concrete piles that “transverse confinement reinforcement shall extend the full length of the pile in Site Classes E or F.”

ASCE 7 Section 14.2.3.2.5 requires that precast concrete piles have “transverse reinforcement ... in accordance with Section 21.4.4.1, 21.4.4.2, and 21.4.4.3 of ACI 318 for the full length of the pile” for Site Class E and F only per the exception, where such is not required by the *Provisions*.

ASCE 7 Section 14.2.3.2.6 requires a 135-degree hook at the end of spirals where *Provisions* Section 7.5.4.4 requires a 90-degree hook.

The last sentence of ASCE 7 Section 14.2.3.2.2 does not appear in the *Provisions* per se, however, *Provisions* Section 7.5.4.4, first sentence says something like it, just broader in scope.

Recommendation: Confirm that the technical changes are appropriate.

Provisions Section: 7.5.4.5 Steel Piles
ASCE 7 Section: 14.1.8 Additional Detailing Requirements for Steel Piles in Seismic Design Categories D through F

Discussion: ASCE 7 expands the exception by indicating that “connections need not be provided where the foundation or supported structure does not rely on the tensile capacity of the piles for stability under the design seismic forces.”

ASCE 7 refers to “pile compression capacity” where the *Provisions* indicates “nominal compression strength of the pile”.

Recommendation: Decide whether the expanded exception is appropriate. Choose between “capacity” and “strength”.

Provisions Section: 7.5 Seismic Design Categories D, E, and F
ASCE 7 Section: 12.13.7 Requirements for Structures Assigned to Seismic Design Categories D through F

Discussion: The exception in *Provisions* Section 7.5 allows certain dwellings of light-frame construction in Seismic Design Category D, E, and F to satisfy only the requirements for Seismic Design Category C and the spread footing tie requirement for Site Class E and F. The corresponding exception in ASCE 7 Section 12.13.7 is different in three ways. First, reference is not made to 12.13.7.1 for the spread footing tie requirement. Second, reference to 12.13.2, which in turn points to Sections 14.1.8 and 14.2.7, will result in application of all of the pile detailing requirements for Seismic Design Categories D, E, and F.

Recommendation: Consider revising the ASCE 7 exception for light-frame dwellings so that it is consistent with that in the *Provisions*.

Provisions Section: 7.5.4.1 Uncased concrete piles
ASCE 7 Section: 14.2.7.2.3 Reinforcement for uncased Concrete Piles

Discussion: There were differences between these two sections, but a Public Ballot comment resolved the substantive differences.

Recommendation: Accept the ASCE 7 text.

***Provisions* Appendix to Chapter 7 – Geotechnical Ultimate Strength Design of Foundations and Foundation Load-Deformation Modeling**

Summary: *Provisions* Appendix to Chapter 7 provides trial requirements for ultimate strength design of geotechnical aspects of foundations and criteria for explicit modeling of load-deformation characteristics of foundations.

ASCE 7 Section: None

Summary: ASCE 7 does not contain similar requirements.

Discussion: While other documents containing guidance for explicit modeling of load-deformation characteristics of foundations (such as FEMA 356 and ATC-40) are available to and have achieved a degree of consensus within the structural engineering community, no similar documents provide ultimate strength design approaches for the geotechnical aspects of foundations. A much broader representation of the structural and geotechnical communities will need to develop further these requirements before they are suitable for standardized application.

Recommendation: Consider whether the modeling requirements for load-deformation behavior of foundations are sufficiently mature to move to ASCE 7. Work through other professional groups (such as the Geo-Institute and Structural Engineering Institute of ASCE) to validate and refine the strength design approach.

***Provisions* Chapter 8 – Steel Structure Design Requirements**

Summary: *Provisions* Chapter 8 outlines requirements for detailing of steel systems (primarily as modifications to reference standards). Design and detailing requirements are provided for buckling restrained braced frames and special steel plate walls.

ASCE 7 Section: 14.1 – Steel

Summary: This section of ASCE 7 has a scope similar to that of the *Provisions* except that no requirements are provided for buckling restrained braced frames and special steel plate walls.

Significant Differences

ASCE 7-05 Supplement #1 Proposal EQ-6-HWM-1

Provisions Section: 8.1.2 References
ASCE 7 Section: 14.1.1 Reference Documents

Discussion: Supplement #1 to ASCE 7-05 updates several steel references. AISC LRFD and AISC Seismic are updated to the 2005 editions (AISC 360-05 and AISC 341-05). These updated references resolve other differences between the *Provisions* and ASCE 7, such as the inclusion of requirements for buckling-restrained braced frames and special steel plate shear walls. The AISI references are updated to 2004 editions or supplements. Two new AISI references, which carry 2004 publication dates, are added.

Supplement #1 to ASCE 7-05 also removes from ASCE 7 the system entry for a dual system comprising a special moment frame and ordinary steel concentrically braced frames. This eliminates a difference between the 2003 *Provisions* and ASCE 7-05 (without the supplement).

Recommendation: Accept the changes made in Supplement #1 to ASCE 7-05.

NOTE: Jim Malley, Chair of TS6 reports the following major technical changes in AISC 341-05.

CHANGES AND NEW INFORMATION IN 2005 AISC SEISMIC

A major change to the 2005 AISC Seismic Provisions is in format. Consistent with the changes to the main design specification, the 2005 Seismic Provisions combine ASD and LRFD into a single specification. As such, Part III in previous editions (which addressed ASD) of the Seismic Provisions has been absorbed into Part I. Note that this approach was applied to both the BRBF and SPSW systems as well (the 2003 NEHRP versions were only in LRFD format).

A number of other significant technical modifications have occurred. These include the following:

- 1) Clarifying the scope of structures to be covered include “building-like non-building structures”.
- 2) Clarifying that all steel buildings designed with an R factor of greater than 3 must comply with the Seismic Provisions (see discussion below).
- 3) Adds new requirements to delineate the expectations for structural design drawings and specifications, shop drawings and erection drawings.
- 4) Adds new ASTM materials specifications that are commonly used in the metal building industry.
- 5) Added R_t values for all materials to be used in determining susceptibility of connections to fracture failure modes.
- 6) Relaxing the limitations of oversize holes in bolted joints.
- 7) Defining a new term “Demand Critical Welds” that have additional quality and toughness requirements. For each system, welds considered to be demand critical are defined.
- 8) Defining a new term “Protected Zone” to ensure that areas expected to be subjected to significant inelastic strains are not disturbed by other building operations. For each system, what areas are considered to be protected zones are defined.
- 9) Making the requirements on splices in columns that are not part of the SLRS apply to all systems, not just moment frames.
- 10) Improving the provisions related to the design of column bases.
- 11) Making the stability bracing requirements more consistent throughout the document.
- 12) Added references to the new AISC Standard on Moment Connection Prequalification (ANSI/AISC 358) as one means for SMF, IMF and EBF (link-to-column) connection acceptance. ANSI/AISC 358 is also adopted into ASCE 7-05 with Supplement No. 1 by reference.
- 13) Decreasing the column splice shear capacity requirements for SMF systems.
- 14) Increasing the stability bracing requirements for IMF systems.
- 15) Clarified that connections meeting the requirements for SMF or IMF systems are also acceptable for OMF applications.
- 16) Increased the requirements on SCBF systems that employ high Kl/r ratio braces.
- 17) Reduced the connection force demand on OCBF bracing to allow the use of the Amplified Seismic Load factor.
- 18) Eliminated the requirement to design all members in OCBF systems for the Amplified Seismic Load. This was done in concert with a commensurate reduction in the R factor for this system in ASCE 7-05.
- 19) Added the special bracing configuration requirement checks for V and inverted V bracing configurations to OCBF systems.
- 20) For BRBF systems, increased the deformation that the system is required to be demonstrated to accommodate from 1.5 to 2.0 times the Design Story Drift.
- 21) Added a strong column-weak beam check for frames in SPSW systems.
- 22) Significantly improving the provisions related to quality assurance and quality control to address many of the issues identified in FEMA 353.
- 23) Adding new requirements for welded joints based on FEMA 353 recommendations including the following:
 - Qualifications for inspection personnel
 - Acceptable non-destructive testing procedures
 - Intermixing of filler metals
 - Acceptable limits of diffusible hydrogen in filler metal
 - Maximum wind speeds for gas shielded welding
 - Limitations on maximum interpass temperatures
 - Proper application of weld tabs

- Additional requirements for Demand Critical Welds related to welding processes, filler metal packaging and exposure, and the use of tack welds.

Provisions Section: 8.3 Structural Steel
ASCE 7 Section: 14.1 Steel

Discussion: The *Provisions* modifies AISC Seismic by changing R_y in some conditions from 1.1 to 1.2. ASCE 7 makes no modifications to AISC Seismic.

Recommendation: Determine whether R_y should be modified by ASCE 7.

Provisions Section: 8.4 Cold-Formed Steel
ASCE 7 Section: 14.1.4 Cold-Formed Steel

Discussion: The *Provisions* refers to three documents. ASCE 7 does not reference AISI-GP in Section 14.1.4; however AISI-GP is referenced in ASCE 7 Section 14.1.1.

Recommendation: Determine whether the missing reference is needed. If so, add to ASCE 7.

Provisions Section: 8.4.1 Modifications to references
ASCE 7 Section: 14.1.4 Cold-Formed Steel

Discussion: The *Provisions* modifies ASCE 8 by changing the load factor for nominal earthquake load from 1.5 to 1.0. ASCE 7 makes no modifications to ASCE 8. It is likely that the date on ASCE 8 in the *Provisions* was changed from 1990 to 2002 without removing the modification.

Recommendation: Confirm that modification of ASCE 8 is no longer needed.

Provisions Section: 8.4.2 Light-frame walls
ASCE 7 Section: 14.1.4. Light Framed Wall Requirements

Discussion: The *Provisions* refers to AISI NAS and AISI-GP while ASCE 7 refers to AISI NAS, AISI GP, AISI WSD, and AISI Lateral.

TS 6 reports that the revisions previously made in *Provisions* Sections 8.4.2.1 through 8.4.2.5 are not needed due to changes in the reference standards.

Recommendation: Determine which set of references is correct. Revise the *Provisions* or ASCE 7 as needed.

Accept the most current references.

Provisions Section: 8.5 Steel Cables
ASCE 7 Section: 14.1.7 Steel Cables

Discussion: The *Provisions* and ASCE 7 refer to different editions of ASCE 19 (1996 and 2002, respectively). Different modifications to ASCE 19 are indicated.

Recommendation: Confirm that the ASCE 7 reference and modifications to ASCE 19 are correct.

Provisions Section: 8.6 Recommended Provisions for Buckling-Restrained Braced Frames
ASCE 7 Section: 14.1.1 Reference Documents

Discussion: The *Provisions* contains requirements and design parameters for BRBFs in this section and in Table 4.3-1. Supplement #1 to ASCE 7-05 has corresponding parameters and requirements and makes reference to AISC 341-05, which has the necessary information for BRBFs.

Recommendation: Confirm that the requirements in AISC 341-05 do not need to be modified.

Provisions Section: 8.7 Recommended Provisions for Special Steel Plate Walls
ASCE 7 Section: 14.1.1 Reference Documents

Discussion: The *Provisions* contains requirements and design parameters for “special steel plate walls” in this section and in Table 4.3-1. Supplement #1 to ASCE 7-05 has corresponding parameters and requirements for “special steel plate shear walls” and makes reference to AISC 341-05, which has the necessary information for “special plate shear walls”.

Recommendation: RConfirm that the requirements in AISC 341-05 do not need to be modified. Coordinate the system name with AISC 341.

***Provisions* Chapter 9-Concrete Structure Design Requirements**

Summary: *Provisions* Chapter 9 contains a reference to and several modifications to ACI 318-02 as the primary reference standard for concrete design. The chapter contains general design requirements including classification of seismic force-resisting systems and detailing based on SDC. This chapter also contains an extensive section for validation testing of special precast concrete shear walls.

ASCE 7 Section 14.2-Concrete

Summary: This section of ASCE 7 also contains a reference to and several modifications to ACI 318-05 as the primary reference standard for concrete design. It contains requirements for classification of seismic force-resisting systems and detailing requirements based on SDC. In addition, there are provisions for concrete piles, which correspond to the content in *Provisions* Sec. 7.4 and 7.5. Validation testing of special precast concrete shear walls is not included.

Significant Differences

<i>Provisions</i> Section:	9.1.2 References
ASCE 7 Section:	14.2.1 Reference Document

Discussion: The *Provisions* uses ACI 318-02 as the primary reference document, while ASCE 7 refers to the newer edition, ACI 318-05 [ASCE 7-05 Supplement #1 Proposal EQ-4-NMH-3]. The *Provisions* contains two other references that are used for validation testing of precast shear walls; these are not contained in ASCE 7.

Recommendation: Update references as appropriate. The references related to validation testing will need to remain in the *Provisions* as long as the validation testing section remains. The modifications to the reference standard in both the *Provisions* and ASCE 7 will have to be reviewed and updated depending on updates to the reference standard. It should be noted that in some cases the differences between ACI 318-02 and ACI 318-05 result in differences between ASCE 7 and the *Provisions*. In other cases differences between the text of ASCE 7 and the *Provisions* have been eliminated, for example, where the modifications to ACI 318 that had been in ASCE 7 (but not in the *Provisions*) were incorporated into ACI 318-05, thus allowing the modifications to be eliminated from ASCE 7. An assessment of the updates to ACI 318 is beyond the scope of this project, so the PUC will require additional review of the impacts of the changes to ACI 318 itself. (An article explaining the significant changes in ACI 318-05 is located at www.skghoshassociates.com/sk_publication/138p94-99.pdf.)

<i>Provisions</i> Section:	9.2.2.4 Special structural walls constructed using precast concrete
ASCE 7 Section:	No corresponding section

Discussion: The *Provisions* modification to ACI 318 permits the use of substantiating testing and analysis, per *Provisions* Sec. 9.6, as an alternate to satisfying the prescriptive requirements of ACI 318 Sec. 21.8.1.

Recommendation: This section provides the scoping for *Provisions* Sec. 9.6 and must remain in the *Provisions* if Sec. 9.6 remains. Note that ACI is in the process of developing a provisional standard on validation testing to be referenced in a future edition of ACI 318.

ASCE 7-05 Supplement #1 Proposal EQ-4-NMH-3

Provisions Sections: 9.4.2 Plain Concrete
9.4.2.1 Walls
9.4.2.2 Footings
ASCE 7 Section: 14.2.2.16 ACI 318-05, Section 22.10

Discussion: There are two differences between the ASCE 7 modifications to ACI 318 and those in the *Provisions*. ASCE 7 places more restrictions on the use of plain concrete walls in detached one- and two-family dwellings assigned to Seismic Design Category D or E. These restrictions include maximum height of wall, maximum height of retained soil, and minimum wall thickness.

In addition, ASCE 7 adds an exception to the minimum reinforcement requirements for plain concrete footings (minimum of one bar at top of stem wall and bottom of footing).

Recommendation: Decide whether or not to include these additional requirements in the *Provisions*.

ASCE 7-05 Supplement #1 Proposal EQ-4-NMH-3

Provisions Section: No corresponding section
ASCE 7 Section: 14.2.2.1 ACI 318-05, Section 7.10

Discussion: ASCE 7 contains a modification to ACI 318 that requires hooks at the free ends of ties used for confining anchor bolts at the top of columns or pedestals for structures assigned to Seismic Design Category C, D, E, or F. There is no similar requirement in the *Provisions*.

Recommendation: Decide whether or not to include this requirement in the *Provisions*.

Provisions Section: No corresponding section
ASCE 7 Section: 14.2.2.18 ACI 318-05 Section D.4.2.2

Discussion: This section of ASCE 7 adds an exception to the referenced section of ACI 318 Appendix D (anchorage to concrete). The exception removes requirements for validation testing of anchors in certain circumstances.

Recommendation: This modification could have a substantive impact on the design requirements of the *Provisions* related to large or deep anchors. The PUC will need to review the modification depending whether or not this requirement is incorporated into the next edition of ACI 318.

Provisions Section: 9.6 Acceptance criteria for special precast structural walls based on validation testing
ASCE 7 Section: No corresponding section

Discussion: This section, new to the 2003 *Provisions*, provides acceptance criteria based on experimental evidence and mathematical analysis as an alternate to satisfying the prescriptive requirements of ACI 318 Sec. 21.8.1. See also *Provisions* Sec. 9.2.2.4. ASCE 7 contains no such section or provisions.

Not related to content, this section of the *Provisions* does not match the outline and format of the 2003 *Provisions* which had been significantly revised editorially in that update cycle. The outline seems to have too many different sections (each paragraph seems to have a different outline number) and many of the sections have numbers but not titles. There are separate sections for definitions and notation (Sec. 9.6.1 and 9.6.2) that should be located at the beginning of the chapter (within Sec. 9.1.3 and new Sec. 9.1.4) consistent with the *Provisions* format. In addition, *Provisions* Sec. 9.6.10 contains a reference to ASCE 7, which is unnecessary since ASCE 7 is, (and certainly will be to a greater degree in the future) a general reference document in the *Provisions* (see *Provisions* Sec. 1.1.3).

Recommendation: This is the type of item for which the *Provisions* is intended – to provide guidance for design that is beyond the range of current building codes and standards. Therefore, this section ought to be retained in the 2008 *Provisions* with updates as deemed necessary. The format of this section should be updated and revised to be consistent with the other sections and general outlining of the 2003 *Provisions*. This includes moving the definitions and notation and removing the unnecessary reference to ASCE 7. ACI is developing a provisional standard on validation testing of special precast concrete shear walls for reference in a future edition of ACI 318.

The PUC voted to retain Sec. 9.6 of the 2003 NEHRP since it was not covered by ASCE-7-05.

***Provisions* Appendix to Chapter 9-Untopped Precast Diaphragms**

Summary: This appendix provisions guidelines for the design of diaphragms using untopped precast concrete elements for structures assigned to Seismic Design Category D-F. There are no provisions for these systems in current building codes or standards.

ASCE 7 (No corresponding section)

Significant Differences

Discussion and Recommendation: This is the type of item for which the *Provisions* is intended – to provide guidance for design that is beyond the range of current building codes and standards. Therefore, this section ought to be retained in the 2008 *Provisions* with updates as deemed necessary based on feedback from users or based on recommendations by the PUC. The PUC should also review whether part or all of these guidelines warrant inclusion into the text of the *Provisions* or as modifications to ASCE 7 or ACI 318.

***Provisions* Chapter 10 – Composite Steel and Concrete Structure Design Requirements**

Summary: *Provisions* Chapter 10 outlines requirements for steel-concrete composite structures consisting primarily of revisions to AISC Seismic, Part II.

ASCE 7 Section: 14.3 – Composite Steel and Concrete Structures

Summary: This section of ASCE 7 identifies reference documents for use in the design of steel-concrete composite structures.

Significant Differences

Provisions Section: 10.1.2 References
ASCE 7 Section: 14.3.1 Reference Documents

Discussion: The *Provisions* prohibits use of ACI 318 Appendix C (Alternative Load and Strength Reduction Factors), while ASCE 7 does not. ASCE 7 permits use of Part III of AISC Seismic (ASD), while the *Provisions* does not; for several cycles the *Provisions* has addressed only strength design.

Recommendation: Decide whether use of alternate load and strength reduction factors is acceptable. Also decide how to resolve the overall issue of permitting ASD, which affects most of the materials.

RTL response: The new 2005 AISC now allows ASD in Part II. When ASCE 7 adopts AISC Seismic 2005, this inconsistency will be removed.

Provisions Section: 10.4 Seismic Design Categories D, E, and F
ASCE 7 Section: 14.3 Composite Steel and Concrete Structures

Discussion: The *Provisions* requires “substantiating evidence...to demonstrate that the proposed system will perform as intended by AISC Seismic, Part II” and that evidence often must be “based upon cyclic testing.” ASCE 7 requires nothing beyond compliance with AISC Seismic.

Recommendation: Decide what substantiation (if any) beyond compliance with AISC Seismic is needed.

RTL response: AISC Seismic 2005 is more specific. For example, for PRCC systems its requires that “Connections shall meet the requirements in Section 7 and shall have a minimum inelastic interstory drift angle of 0.025 radians and a total interstory drift angle of 0.04 radians that is substantiated by cyclic testing as described in **Part I Section 9.2a.**” Thus I believe that by requiring compliance with AISC 2005 Seismic, ASCE 7 and the *Provisions* will be equivalent.

Provisions Section: 10.5 Modifications to AISC Seismic, Part II
ASCE 7 Section: 14.3 Composite Steel and Concrete Structures

Discussion: Although both documents refer to the 2002 edition of AISC Seismic, the *Provisions* contains about six pages of modifications to AISC Seismic, Part II while ASCE 7 has no modifications to that

document. Perhaps the writers of ASCE 7-05 anticipated adoption of the 2005 edition of AISC Seismic and felt that all of the important modifications are reflected in that edition.

Recommendation: If ASCE 7-05 Supplement 1 updates the edition of the reference standard, decide whether any additional modifications to AISC Seismic, Part II are needed.

RTL response: This is correct; once ASCE 7 adopts AISC 2005, all the current conflicts between the *Provisions* and the AISC Specification (and thus implicitly with ASCE 7) should disappear.

It was the intent of the BSSC TS-11 that as for all-steel structures, the *Provisions* should just make reference to the AISC 2005 Seismic (Part II, in this case). Thus in the next *Provisions*, Chapter 10 should just make reference to AISC 2005 Seismic Part II and contain no other clauses to differentiate it from that document.

***Provisions* Chapter 11 – Masonry Structure Design Requirements**

Summary: *Provisions* Chapter 11 outlines material-specific seismic design requirements for masonry structures.

ASCE 7 Section: 14.4 – Masonry

Summary: This section of ASCE 7 has the same scope as the corresponding section the *Provisions*.

Significant Differences

Provisions Section: 11.1.2 References
ASCE 7 Section: 14.4.1 Reference Documents

Discussion: Revisions for Supplement #1 to ASCE 7-05 update the reference documents (ACI 530, 530.1, and 318) to the 2005 editions. Numerous section number changes, etc., are made to correspond to the updated reference documents.

Recommendation: Accept the ASCE 7 text.

Provisions Section: none
ASCE 7 Section: 14.4.4 Anchorage Forces

Discussion: ASCE 7 provides this clarification that anchorage forces in ACI 530 do not replace those of ASCE 7. The *Provisions* contains no such clarification.

Recommendation: Accept the ASCE 7 text.

Provisions Section: none
ASCE 7 Section: 14.4.6 Modifications to Chapter 2 of ACI 530/ASCE 5/TMS 402

Discussion: ASCE 7 contains modifications to Chapter 2 of ACI 530, while the *Provisions* does not. This is likely due to the fact that the *Provisions* addresses only strength design requirements (and that chapter of ACI 530 is for allowable stress design).

Recommendation: Decide how to address the allowable stress design issue consistently throughout the *Provisions*.

Provisions Section: 11.2.1.6 Shear keys
ASCE 7 Section: 14.4.7.5 Shear Keys

Discussion: The *Provisions* adds new content to Section 1.13.2.2.5 of ACI 530. ASCE 7 adds the same content to Section 3.2.3.7 of ACI 530.

Recommendation: Decide where this new information belongs.

Provisions Section: 11.2.2.1 Additional definitions
ASCE 7 Section: 14.4.5 Modifications to Chapter 1 of ACI 530/ASCE 5/TMS 402

Discussion: The *Provisions* adds 11 definitions to ACI 530 and ACI 530.1; ASCE 7 does not.

Recommendation: Consider whether these modifications are needed.

JJT Response: The definitions and notations are needed as they address primarily the requirements for moment frames. Additional definitions fill gaps not addressed by MSJC provisions.

Provisions Section: none
ASCE 7 Section: 14.4.6 Modifications to Chapter 2 of ACI 530/ASCE 5/TMS 402

Discussion: ASCE 7 adds a restriction related to allowable stress design, which is not included in the *Provisions*. It reads as follows:

14.4.6.1 Stress Increase. If the increase in stress given in Section 2.1.2.3 of ACI 530/ASCE 5/TMS 402 is used, the restriction on load reduction in Section 2.4.1 of this standard shall be observed.

Recommendation: Accept the text of ASCE 7.

Provisions Section: 11.2.2.3 [Untitled]
ASCE 7 Section: 14.4.8 Modifications to ACI 530.1/ACE 6/TMS 602

Discussion: The *Provisions* deletes article 1.3 AE from ACI 530.1; ASCE 7 does not.

Recommendation: Decide whether this modification is needed.

JJT Response: This revision was added to the 2003 *Provisions*. ASCE 7 balloted a similar revision, I had thought it passed, but must be mistaken. The deletion of Article 1.3 AF from the *Provisions* is maintained for now.

Provisions 11.2.2.x [Revisions to reference standard]
ASCE 7 Section none

Discussion: Jason Thompson reports that he does “not necessarily agree with the revisions” indicated below, but that they would be needed if the substantive content of the *Provisions* were not to be changed.

11.2.2.7. Replace Sec. 3.3.2.3.4(b) and 3.3.2.3.4(c) of ACI 530/ASCE 5/TMS 402 ~~ACI 530.1/ASCE 6/TMS 602~~ with the following: (remainder unchanged)

11.2.2.8. Add the following new Sec. 3.32.3.4.1 and 3.2.3.4.2 to ACI 530/ASCE 5/TMS 402:

“3.32.3.4.1 Lap splices shall not be used in plastic hinge zones of special reinforced masonry shear walls. The length of the plastic hinge zone shall be taken as at least 0.15 times the distance between the point of zero moment and the point of maximum moment.

3.2.3.4.2 Bars spliced by non-contact lap splices shall not be spaced transversely farther apart than the lesser of one-fifth the required length or 8 in. (203 mm).”

11.2.2.9. Add the following new Sec. 3.2.2(h) to ACI 530/ASCE 5/TMS 402:

“(h) For out of plane bending, the width of the equivalent stress block shall not be taken greater than 6 times the nominal thickness of the masonry wall or the spacing between reinforcement, whichever is less.”

11.2.2.910. Replace Sec. 1.9.4.2.3 of Add the following new Sec. 3.2.7 to ACI 530/ASCE 5/TMS 402 with the following:

“3.2.7 Flanged shear walls

3.2.7.1 Effective width. Where wall intersections are constructed in accordance with Sec. 1.9.4, the effective flange width for design shall be determined in accordance with this section.

3.2.7.2 Compression. The width of flange considered effective in compression on each side of the web shall be taken equal to 6 times the thickness of the flange or the actual width of the flange on that side, whichever is less.

3.2.7.3 Tension. The width of flange considered effective in tension on each side of the web shall be taken equal to 3/4 of the wall height or the actual width of the flange on that side, whichever is less.”

“1.9.4.2.3 The width of flange considered effective in compression on each side of the web shall be the lesser of 6 times the flange thickness or the actual flange on either side of the web wall. The width of flange considered effective in tension on each side of the web shall be taken equal to 3/4 of the floor to floor wall height or the actual width of the flange on that side, whichever is less.”

11.2.2.1011. Add the following new Sec. 3.32.4.2.6 to ACI 530/ASCE 5/TMS 402:

“3.32.4.2.6 Coupling beams. Structural members that provide coupling between shear walls shall be designed to reach their moment or shear nominal strength before...(remainder unchanged)

11.2.2.1112. Add the following new Sec. 3.3.4.2.73-2.5 to ACI 530/ASCE 5/TMS 402:

“3.3.4.2.73-2.5 Deep flexural member detailing. Flexural members with overall-depth-to-clear-span ratio greater than 2/5 for continuous spans or 4/5 for simple spans shall be detailed in accordance with this section.

3.3.4.2.7.13-2.5.1. Minimum flexural tension reinforcement shall conform to Sec. 3.2.4.3.2.

3.3.4.2.7.23-2.5.2. Uniformly distributed horizontal and vertical reinforcement shall be provided throughout the length and depth of deep flexural members such that the reinforcement ratios in both directions are at least 0.001. Distributed flexural...(remainder unchanged)

11.2.2.13. Add the following new Sec. 1.13.7.4 to ACI 530/ASCE 5/TMS 402:

“1.13.7.4 For structures in Seismic Design Category E or F, corrugated sheet metal anchors shall not be used.”

11.2.2.1214. Revise Sec. 1.1413.3.2 of ACI 530/ASCE 5/TMS 402/ to read as follows.

“The calculated story drift of masonry structures due to the combination of design seismic forces and gravity loads shall not exceed the allowable story drift...(remainder unchanged)

11.2.2.1315. Add the following as the first paragraph in Sec. 3.1.6 of section to ACI 530/ASCE 5/TMS 402:

~~“1.13.4.3 Anchoring to masonry.~~ Anchorage assemblies connecting masonry elements that are part of the seismic force resisting system to diaphragms and chords shall be designed so that the strength of the anchor is governed by steel tensile or shear yielding. Alternatively, the anchorage assembly may be designed to be governed by masonry breakout or anchor pullout provided that the anchorage assembly is designed to resist not less than 2.5 times the factored forces transmitted by the assembly.”

The anchorage forces given in Sec. 1.13.3.3 of ACI 530/ASCE 5/TMS 402 shall not be interpreted to replace the anchorage forces set forth in this standard.”

~~11.2.2.18. Revise the following commentary to Sec. 3.1.6.3 of ACI 530/ASCE 5/TMS 402:~~

~~“3.1.6.3 Nominal shear strength of headed and bent bar anchor bolts — The shear strength of a headed or bent bar anchor bolt is governed by yield and fracture of the anchor steel, or by masonry shear breakout, or by masonry shear pryout. Steel strength is calculated conventionally using the effective tensile stress area (that is, threads are conservatively assumed to lie in the critical shear plane). Under static shear loading, bent bar anchor bolts (J or L bolts) do not exhibit straightening and pullout. Under reversed cyclic shear however, available research^{3.1} suggests that straightening and pullout may occur.”~~

Recommendation: Consider the technical merit of these items during the cycle. Incorporate only those items that are deemed necessary.

Provisions Section: 11.2.2.14 [Untitled]
ASCE 7 Section: none

Discussion: The *Provisions* revises Section 1.13.3.2 of ACI 530 by referring to the allowable story drifts in the *Provisions*. ASCE 7 contains no similar requirement.

Recommendation: Decide whether this modification is needed.

JJT Response: MSJC provisions need updating. Maintain modification and refer to MSJC.

Provisions Section: 11.2.2.15 [Untitled]
ASCE 7 Section: 14.4.7.6 Anchoring to Masonry

Discussion: The *Provisions* adds requirements for anchoring to masonry to Section 1.13.4.3 of ACI 530. ASCE 7 adds the same content to Section 3.1.6 of ACI 530.

Recommendation: Decide where this new information belongs.

Provisions Section: 11.2.2.18 [Untitled]
ASCE 7 Section: none

Discussion: The *Provisions* contains modifications to Section 3.1.6.3 of the *Commentary* to ACI 530. ASCE 7 does not. Since it is inappropriate for a standard to refer to non-mandatory commentary language, the ASCE 7 text is correct.

Recommendation: The text of the *Provisions* should not modify commentary.

Provisions Section: 11.3 Special Moment Frames of Masonry
ASCE 7 Section: none

Discussion: The *Provisions* contains about four pages of design requirements for special moment frames of masonry, a system that does not appear in ASCE 7.

Recommendation: Decide whether special moment frames of masonry is a system that deserves special treatment in U.S. codes and standards. If so, work to have them added to ASCE 7.

JJT Response: Maintain moment frame requirements in *Provisions*. ASCE 7 concluded that it was not worth the effort to introduce masonry moment frames at this time.

Provisions Section: 11.4 Glass-Unit Masonry and Masonry Veneer
ASCE 7 Section: none

Discussion: The *Provisions* contains a few pointers to appropriate design sections and one limitation (that corrugated sheet metal anchors not be used in SDC E for masonry veneer). No similar requirements appear in ASCE 7.

Recommendation: Decide whether this content is needed. If so, decide whether the requirement for sheet metal anchors should also apply to SDC F, as would likely be the case.

Provisions Section: 11.5 Prestressed Masonry
ASCE 7 Section: none

Discussion: This section of the *Provisions* requires that prestressed masonry be designed in accordance with Chapter 4 of ACI 530. ASCE 7 does not.

Recommendation: Decide whether this requirement is needed.

***Provisions* Chapter 12-Wood Structure Design Requirements**

Summary: *Provisions* Chapter 12 contains a reference to and several modifications to AF&PA SDPWS-01 as the primary reference standard. Included in the modifications is the replacement of the shear wall and diaphragm tables in the SDPWS with tables in the *Provisions*. This chapter also contains an extensive section for seismic design of conventional light-frame construction.

ASCE 7 Section 14.5-Wood

Summary: This section of ASCE 7 is basically a reference to AF&PA SDPWS-01 for seismic design of wood structures. The section provides only a few modifications to the reference standard and provides other reference documents and materials standards.

Significant Differences

<i>Provisions</i> Section:	12.1.2 References
ASCE 7 Section:	14.5.1 Reference Documents

Discussion: The *Provisions* contains references for three types of documents: engineered wood construction, conventional light-frame construction, and materials standards. ASCE 7 contains similar types of references, but there are differences. The primary reference for seismic design of engineered wood structures, AF&PA SDPWS, is the same in both documents, though ASCE 7 references a newer version [ASCE 7-05 Supplement #1 Proposal EQ-7-BD-5]. While the *Provisions* contains a reference to ASCE 16-95 for LRFD-based design, there is no such reference in ASCE 7 because the 2005 edition of the AF&PA NDS, as referenced in ASCE 7 [ASCE 7-05 Supplement #1 Proposal EQ-7-BD-1], contains provisions for both ASD and LRFD. ASCE 7 contains a reference to the AF&PA NDS-05 (allowable stress design), but the *Provisions* does not contain such a reference since the *Provisions* is entirely strength-based in design approach. Both documents reference the 2003 IRC for conventional light-frame construction (IRC is referenced in ASCE 7 Sec. 11.1.2 [ASCE 7-05 Supplement #1 Proposal EQ-7-BD-4]). The NDS is the only document referenced in ASCE 7 that is not referenced in the *Provisions*. The *Provisions* contain several references not in ASCE 7, many of which are included in reference documents but not directly referenced in the text. .

Recommendation: Update references as appropriate, including the newer versions as referenced in ASCE 7-05 Supplement #1. Other than the references for conventional light-frame construction (see also comments related to *Provisions* Sec. 12.4), it does not appear that the differences in the secondary reference documents are substantive.

<i>Provisions</i> Sections:	12.2 Design Methods 1.1.2.1 Scope
ASCE 7 Section:	11.1.2 Scope

Discussion: *Provisions* Sec. 12.2 provides scoping for engineered construction and conventional light-frame construction based on SDC. ASCE 7 contains no corresponding section. However, the scoping can be compared using *Provisions* Sec. 12.2 and 1.1.2 and ASCE 7 Sec. 11.1.2 as follows:

Provisions:

- Exempted by Sec. 1.1.2.1:
- 1) Detached one- and two-family dwellings in SDC A-C
 - 2) Detached one- and two-family dwellings designed using conventional

	light-frame construction of Sec 12.4 (SDC A-D and SDC E in SUG I per Table 12.4-1).
	3) Agricultural structures
	4) All structures in low seismic hazard or assigned to SDC A
Engineered or conventional light-frame construction:	Other structures assigned to SDC B-D
Engineered:	Other structures assigned to SDC E-F
ASCE 7:	
Exempted by Sec. 11.1.2:	1) Detached one- and two-family dwellings in SDC A-C
	2) Detached one- and two-family dwellings designed using conventional light-frame construction of IRC (all SDC where IRC is applicable).
	3) Agricultural structures

It appears, therefore, that the *Provisions* allows the use of conventional light-frame construction for non-dwellings in SDC B-D, while ASCE 7 does not. However, the limitations in *Provisions* Sec. 12.4.1.1 in most cases would effectively limit the use of conventional light-frame construction to dwellings, so there is not likely to be a significant difference.

Recommendation: The scoping does not appear to be much different in application. The *Provisions* contains scoping and limitations in three sections (Sec. 1.1.2.1, Sec. 12.2, and Sec. 12.4), which are somewhat repetitive and at the very least more complicated than need be. These sections should be coordinated and clarified if not entirely removed by reference to ASCE 7. Removal of the text and reference to ASCE 7 does not appear to be a significant change in application.

<i>Provisions</i> Sections:	12.2.3 Modifications to AF&PA SDPWS for SDC B, C, and D
	12.2.4 Modifications to AF&PA SDPWS for SDC E and F
ASCE 7 Section:	14.5.3 Modifications to AF&PA SDPWS-01

Discussion: The *Provisions* contains 17 specific modifications to SDPWS for SDC B-D and three additional modifications for SDC E-F. ASCE 7 contains one modification, which is identical to the *Provisions* modification. ASCE 7 Sec. 14.5.3.1 is the same as *Provisions* Sec. 12.2.3.8 (although *Provisions* section adds a reference to the shear wall tables in the *Provisions*). The *Provisions* contains a modification that limits the shear value for perforated shear walls. This modification was in ASCE 7, but was removed in Supplement #1 [ASCE 7-05 Supplement #1 Proposal EQ-7-BD-5] since the requirement was incorporated into SDPWS-05. The other modifications (15 total for SDC B-D and 18 total for SDC E-F) are not contained in ASCE 7. These modifications include the following:

- An alternate method for computing shear capacity of a perforated shear wall (Sec 12.2.3.9)
- Modified requirements for uplift anchorage (Sec 12.2.3.11) and sill plate anchorage (Sec 12.2.3.12)
- Deletion of several non-wood structural panel shear wall systems (Sec 12.2.3.15).
- Addition of several shear wall and diaphragm design values for configurations not contained in the SDPWS (Sec, 12.2.3.16, Sec. 12.2.3.17 and Tables 12.2-2a, 12.2-2b, 12.2-3a, and 12.2-3b)
- Requirement for blocked wood structural panel diaphragms in SDC E and F (Sec 12.2.4.1)
- Use of one-half tabulated shear values for structures in SDC E and F with concrete or masonry walls (Sec 12.2.4.2)

Some of these changes are written in advisory rather than enforceable language, and are identified in the commentary as recommended principles that might not be ready for enforcement.

The diaphragm and shear value tables in the *Provisions* contain configurations that are not in the SDPWS including diaphragms with multiple lines of fasteners and shear walls with wood structural panels applied over gypsum wallboard. However, the addendum tables have some significant differences in format that make the modification somewhat awkward. They apply only to seismic loading, contain values in SI and English units, and do not provide the G_a values in the SDPWS tables.

Specific modifications aside, there are several differences between the SDPWS-01 referenced in the *Provisions* and the SDPWS-05 referenced in ASCE 7-05. Most of these fall in the area of clarifying already existing provisions. Six changes that are technically substantive are as follows:

- Sec. 4.1.5 & 4.1.6 – differentiation between structures supporting concrete and masonry walls and those supporting other concrete and masonry weight. The updates remove restrictions on torsional force distribution for concrete and masonry weight other than walls.
- Sec. 4.2.1 – permissible deflection language moved from 4.2.2 and modified to defer to building code for permissible deflection.
- Sec. 4.2.3, last sentence – modification of phi factor from 0.65 to 0.80.
- Sec. 4.3.1 – permissible deflection language moved from 4.3.2 and modified to defer to building code for permissible deflection.
- Sec. 4.3.3, last sentence – modification of phi factor from 0.65 to 0.80.
- Sec.4.3.6.3.1 Adhesives – use of adhesive fastening for sheathing expanded to SDC C.

Recommendation: The PUC will have to review whether or not the *Provisions* modifications should be retained in the 2008 *Provisions* as modifications to ASCE 7. The PUC could consider abandoning the duplicate tables in SI and English units since the SDPWS tables, which will be used by reference for most shear wall and diaphragm systems, do not contain tables in SI units.

Provisions Section: 12.4 Conventional Light-Frame Construction
ASCE 7 Sections: N/A

Discussion: The *Provisions* contains a detailed section for seismic design of conventional light-frame construction that references the IRC but is considered a modification to the IRC, though it is unclear how to apply the modifications since specific sections of the IRC are never referenced. ASCE 7 contains a reference to the IRC in Sec 14.5.1 (reference documents), but does not contain any specific references to conventional light-frame construction in Sec 14.5. The only reference to conventional light-frame construction is in the exemptions of Sec 11.1.2.

Recommendation: The PUC will have to review the next edition of the IRC and update Sec 12.4 accordingly. The *Provisions* version of conventional light-frame construction (as modifications to the IRC) could remain as a modification to ASCE 7 if the content is not incorporated into the IRC or ASCE 7.

<p>The PUC voted to retain Sec. 12.4 of the 2003 NEHRP in association with adopting Sec. 14.5 of ASCE-7-05.</p>

***Provisions* Chapter 13 – Seismically Isolated Structure Design Requirements**

Summary: *Provisions* Chapter 13 contains design requirements for seismically isolated structures. These requirements have remained largely unchanged for several cycles and are nearly identical to earlier requirements in the *Uniform Building Code*.

ASCE 7 Section: 17 – Seismic Design Requirements for Seismically Isolated Structures

Summary: This section of ASCE 7 contains the same requirements as the *Provisions* with very few editorial or technically substantive differences.

Significant Differences

Provisions Section: 13.1.2 Definitions
ASCE 7 Section: 17.1.2 Definitions

Discussion: ASCE 7 adds a definition for “scragging”.

Provisions Section: 13.2.3.1 Design spectra
ASCE 7 Section: 17.3.1 Design spectra

Discussion: The threshold level of ground motion parameter S_I used as a trigger in the *Provisions* differs from that in ASCE 7-05. See discussion in the *Report on Differences* for Chapter 3.

Provisions Section: 13.2.4.1 Equivalent lateral force
ASCE 7 Section: 17.4.1 Equivalent Lateral Force Procedure

Discussion: The threshold level of ground motion parameter S_I used as a trigger in the *Provisions* differs from that in ASCE 7-05. See discussion in the *Report on Differences* for Chapter 3.

Provisions Sections: 13.2.5.6 Vertical-load stability
13.6.1.2 Sequence and cycles
13.6.1.5 Maximum and minimum vertical load
ASCE 7 Sections: 17.2.4.6 Vertical-Load Stability
17.8.2.2 Sequence and Cycles
17.8.2.5 Maximum and Minimum Vertical Load

Discussion: The *Provisions* identifies situations in which isolator units must be designed and/or tested with vertical loads based on 0.8D. The similar sections of ASCE 7 simply refer to the basic strength design load combinations, which use 0.9D.

The load combinations for maximum and minimum vertical load are $(1.2D + 1.0L + E)$ and $(0.9D - E)$. According to Sec. 2.3.2, the factor for L can be reduced to 0.5 if the original live load does not exceed 100 psf, with the exception of garage or areas occupied as places of public assembly. This allowance would now apply to seismically isolated structures.

Recommendation: Accept the ASCE 7 text as it is approved by the committee that is considered to be the authority on matters of load combination.

<i>Provisions</i> Sections:	13.3.5 Drift limits 13.4.4 Drift limits
ASCE 7 Sections:	17.5.6 Drift Limits 17.6.4.4 Drift Limits

Discussion: The *Provisions* clearly indicate that the drift limits in these sections supercede those indicated in Section 4.5.1. The *Commentary* discusses why this is appropriate. Because ASCE 7 does not include similar text, the drift limits for higher Occupancy Types as indicated in Section 12.12.1 will govern. That is not the intent of TS 12. A Public Ballot comment was submitted on this topic.

Recommendation: If the published edition of ASCE 7 does not contain these clarifying statements, consider adding them.

***Provisions* Chapter 14-Nonbuilding Structure Design Requirements**

Summary: *Provisions* Chapter 14 provides design criteria for nonbuilding structures, including those similar to and those not similar to buildings.

ASCE 7 Section 15-Seismic Design Requirements for Nonbuilding Structures

Summary: This section of ASCE 7 provides design criteria for nonbuilding structures, including those similar to and those not similar to buildings.

Significant Differences

<i>Provisions</i> Section:	14.1.1 Scope
ASCE 7 Section:	15.1.1 Nonbuilding Structures

Discussion: *Provisions* Sec. 14.1.1 contains more specific exclusions (“vehicular and railroad bridges, electrical power substation equipment, overhead power line support structures, buried pipelines, conduits and tunnels, lifeline structures, nuclear power generation plants, offshore platforms, and dams”) than does ASCE 7 (“other nonbuilding structures where specific seismic provisions have yet to be developed”). In practical terms, there is not a substantive difference since none of the above types of structures is covered by either the *Provisions* or ASCE 7.

Also, ASCE 7 contains a reference to several ASCE 7 sections for foundation design of nonbuilding structures. There doesn’t seem to be a similar reference in the *Provisions* (either in Chapter 14 or Chapter 7). Therefore, there is no direct reference to the foundation requirements for nonbuilding structures in the *Provisions*.

Recommendation: Review foundation requirements for nonbuilding structures and determine whether or not specific foundation design requirements should apply.

<i>Provisions</i> Section:	14.1.2 References
ASCE 7 Sections:	15.2 Reference documents 23 Seismic Design reference documents

Discussion: The *Provisions* divides the references into two types: adopted references and other references. Adopted references are considered to be part of the *Provisions* as referenced in this chapter. Other references represent acceptable practice but are not considered as part of the *Provisions*. ASCE 7 contains all of the references for seismic design in one section (Sec. 23.1) and does not distinguish between adopted and others. In addition, in some cases ASCE 7 indicates which specific sections of the reference documents are used, rather than just referencing entire documents as the *Provisions* does. The *Provisions* contains one references not contained in ASCE 7 (NCEL R-939), ASCE 7 contains one reference not in the *Provisions* (NFPA 59A), and some references are of different dates, in particular those references that were updated in Supplement #1 of ASCE 7.

Recommendation: References for both documents will need to be verified and updated for the next cycle.

<i>Provisions</i> Section:	14.1.5 Nonbuilding structures supported by other structures
ASCE 7 Sections:	15.3 Nonbuilding structures supported by other structures 15.3.1 Less than 25 percent combined weight condition 15.3.2 Greater than or equal to 25 percent combined weight condition

Discussion: For nonbuilding structures weighing less than 25 percent of the combined weight, the *Provisions* and ASCE 7 are similar, though ASCE 7 provides more commentary-type language for design intent.

For nonbuilding structures weighing greater than or equal to 25 percent of the combined weight that have rigid characteristics, the *Provisions* requires that the R factor for the supporting system be used for the entire system. ASCE has a similar basic requirement, but goes on to state that the nonbuilding structure and attachments are to be designed using the procedures for nonstructural components using an R_p equal to the R for the combined system and an a_p factor equal to 1.0. This second requirement related to the a_p factor is not in the *Provisions*.

For nonbuilding structures weighing greater than or equal to 25 percent of the combined weight that have non-rigid characteristics, the *Provisions* require that the R factor for the supporting system be less than or equal to 3.0. ASCE 7 [Supplement #1 Proposal EQ-13-GS-5R] clarifies the requirement by stating that the R factor is the lesser of the nonbuilding structure or the supporting structure.

Recommendation: This difference in a_p factors may or may not be substantive depending on the types of combined systems. The PUC should review this condition as well as decide whether to incorporate the ASCE 7-05 Supplement #1 revision into the *Provisions*.

<i>Provisions</i> Section:	14.2.1 Seismic Use Groups and importance factors.
ASCE 7 Section:	15.4.1.1 Importance factor

Discussion: In the *Provisions*, importance factor is determined from one of three methods: as indicated in a reference standard, using Table 14.2-1, or as indicated elsewhere in Chapter 14. ASCE 7 also specifies three methods: as indicated in a reference standard, per Table 11.5.1, or as indicated elsewhere in Chapter 15. The first and third methods are similar to the extent that the reference standards are the same (see *Report on Differences* related to *Provisions* Sec. 14.1.2) and that the other sections of these chapters are similar (where differences occur, they are noted elsewhere in this *Report on Differences*).

While both *Provisions* Table 14.2-1 and ASCE 7 Table 11.5.1 assign an importance factor based on Occupancy Category (converted to Seismic Use Group in the *Provisions*), the *Provisions* contains additional categorization of Seismic Use Group based on “function” and “hazard” that is specific to nonbuilding structures. The importance factors for each Occupancy Category are the same in both documents.

Recommendation: Determine which method for determining Occupancy Category to include in the *Provisions*.

<i>Provisions</i> Sections:	14.2.3 Design basis 14.2.4 Seismic-force-resisting system selection and limitations 14.2.8 Minimum base shear
ASCE 7 Sections:	15.4.1 Design basis

15.1.2 Design

Discussion: All of these *Provisions* and ASCE 7 sections interrelate, so they are discussed together. These sections provide similar bases of design for nonbuilding structures, but there are some differences. In particular, ASCE 7 appears to contain several specific requirements related to these sections that are not in the *Provisions*.

Substantive differences include:

- Exception 1 in *Provisions* Sec. 14.2.8 does not appear to be included in ASCE 7. This exception explicitly requires that the minimum base shear requirements (*Provisions* Eq. 5.2-4 and Eq. 5.2-5) in the *Provisions* apply to nonbuilding systems designed to an adopted reference.
- The exception to ASCE 7 Sec. 15.4.1, item 2 is slightly different from that contained in the *Provisions*. This exception provides minimum base shear values (different from the general minimum base shear for nonbuilding structures) for tanks and vessels designed in accordance with any of the several listed reference documents.
- ASCE 7, Sec. 15.4.1, item 5 does not appear to be contained in the *Provisions*. This item requires that the minimum design force not be less than that in the appropriate reference standard for nonbuilding structures containing liquids, gases, and granular soils supported at the base.
- ASCE 7, Sec. 15.4.1, item 8 does not appear to be contained in the *Provisions*. This item explicitly permits the reduction of base shear accounting for the effects of soil-structure interaction.
- A clarification was added to the detailing reference in ASCE 7 Table 15.4-2 [ASCE 7-05 Supplement #1 Proposal EQ-13-GS-7] for “All other steel and reinforced concrete distributed mass cantilever structures not covered herein including stacks, chimneys, silos, and skirt-supported vertical vessels that are not similar to buildings” to require that the same ($I/R = 1$) designs provisions be applied to “other” buckling sensitive structures. As currently written, one could go to two entries for the same vertical vessel and get different answers. This change fixed that ambiguity
- Heights of structures is defined in ASCE 7 Tables 15.4-1 and 15.4-2 [ASCE 7-05 Supplement #1 Proposal EQ-13-GS-4R2] as to the height of the structural frame. The *Provisions* (Tables 14.2-2 and 14.2-3) does not contain this clarification, which is a significant clarification for use with elevated tanks.

There are substantive differences concerning system parameters for ordinary steel concentrically braced frames. The specific differences are summarized below.

Differences in R , Ω_0 , or C_d factors:

System	2003 <i>Provisions</i>	ASCE 7-05 with Supplement #1
Building Frame Systems		
Ordinary steel concentrically braced frames with AISC Seismic detailing and typical height limits	$R=5$ $\Omega_0=2$ $C_d=4.5$	$R=3.25$ $\Omega_0=2.5$ $C_d=3.25$
Ordinary steel concentrically braced frames with AISC Seismic detailing and height limit increase	$R=3.5$ $C_d=3.5$	$R=2.5$ $C_d=2.5$

Recommendation: These differences are substantive and should be reviewed by the PUC for appropriateness based on the intent of the *Provisions*, future updates to ASCE 7, and future updates to the various reference standards during the next *Provisions* update cycle.

<i>Provisions</i> Sections:	14.3.3 Piers and wharves 14.3.3.1 Additional seismic mass 14.3.3.2 Soil effects
ASCE 7 Sections:	15.5.6 Piers and Wharves 15.5.6.2 Design basis

Discussion: ASCE 7 provides general design guidance for piers and wharves that include the effects of liquefaction, soil failure, marine loading conditions, and the marine environment. The *Provisions* contains the same general requirements and adds specific design criteria related to the additional seismic mass of the displaced water and the dynamic forces from the soil.

Recommendation: Determine whether or not to include the additional design requirements.

<i>Provisions</i> Section:	14.3.5 Steel storage racks 14.3.5.1 Testing
ASCE 7 Section:	15.5.3 Steel storage racks 15.5.3.1 General requirements (exceptions)

Discussion: For general design in accordance with either document, $R=4$. However, the *Provisions* permits a higher R value where justified by test data, while ASCE 7 permits higher R value where detailing requirements of reference documents listed in ASCE 7 Sec. 14.1.1 are satisfied. This seems to be a different approach to achieving the same goal: a higher R value can be used when adequate justification is provided.

Recommendation: Decide which method(s) for justifying the use of a higher R value to include in the *Provisions*.

<i>Provisions</i> Section:	14.4.2 Earth retaining structures
ASCE 7 Section:	15.6.1 Earth-retaining structures

Discussion: ASCE 7 contains additional requirements related to occupancy categories of areas adjacent to retaining walls, though it is not clear how occupancy category affects retaining wall design. The remaining additional text provides general design guidance that is not specific to seismic design of retaining walls.

Recommendation: In practical terms, it does not appear that assigned occupancy category has any impact on retaining wall design. Therefore, there does not seem to be a substantive difference. Suggest further review of the intent of the occupancy category requirement.

<i>Provisions</i> Section:	14.4.6 Secondary containment systems
ASCE 7 Sections:	15.6.5 Secondary containment systems 15.6.5.1 Freeboard

Discussion: The sloshing requirements for secondary containment systems have some subtle differences between the two documents.

The *Provisions* requires that secondary containment systems be designed to withstand the effects of an MCE level event when empty and full. ASCE 7 requires MCE consideration when empty and only two-thirds MCE when full unless a seismic hazard assessment or the local jurisdiction determines that the site may be subject to aftershocks of the same magnitude as the main shock of the MCE level event.

In addition, the requirements for the impound height could be different. The *Provisions* requires freeboard of not less than the sloshing height determined use equation 14.4-11 ($\delta_s=0.5D_iI_{S_{ac}}$). ASCE 7 has a similar requirement and equation except that ASCE 7 equation 15.6-1 does not contain the importance factor. Furthermore, ASCE 7 has some additional requirements related to the importance factor and the primary containment. Therefore, it appears that there are substantive differences concerning the freeboard requirement for secondary containment systems.

Recommendation: While the differences are subtle and may be minor in a practical sense, the PUC should review the appropriateness ASCE 7 requirements.

Provisions Section: 14.4.7.1 Design Basis
ASCE 7 Section: 15.7.2 Design Basis

Discussion: ASCE 7-05 Supplement 1 [Proposal EQ-13-GS-2R] removes the importance factor from the vertical earthquake provisions. The importance factor is in the corresponding equation in the *Provisions*. The importance factor is not used in the vertical earthquake provisions for building structures, so the revision to ASCE 7 is intended to provide consistency.

Recommendation: Determine whether to incorporate the revision into the *Provisions*.

Provisions Sections: 14.4.7.5 Ground-supported storage tanks for liquids
14.4.7.5.1 Seismic forces
ASCE 7 Sections: 15.7.6 Ground-supported storage tanks for liquids
15.7.6.1 General

Discussion: There are several substantive differences between these two sections.

The equations for seismic base shear, which combine impulsive and convective components, are different. Per *Provisions* Eq. 14.4-3 base shear is the SRSS combination of the two components, while ASCE 7 Eq. 15.7-4 uses a simple algebraic sum.

In addition, ASCE 7 includes the importance factor in the equations for determining the impulsive and convective components (ASCE 7 Eq. 15.7-5 and 15.7-6), while the *Provisions* does not (*Provisions* Eq. 14.4-4 and 14.4-5).

The limits for using the ASCE 7 equations to determine the spectral acceleration of the sloshing contain reference to a cutoff period, T_L . This is the long-period transition period from maps. Such notation is not included in the *Provisions* methodology. Therefore, the equations in the *Provisions* have different limits.

Instead of T_L , the limit is defined as 4.0 seconds. This could lead to substantive differences, depending on period and location in the country.

Recommendation: Determine which set of equations and limits to include in the *Provisions*.

Provisions Section: 14.4.7.5.6 Sliding resistance
ASCE 7 Section: 15.7.6.1.5 Sliding resistance

Discussion: ASCE 7 permits the friction factor to be determined by test. The *Provisions* does not explicitly state such a requirement, though there may be a way to get there using a general alternate.

Recommendation: In practical terms, this is probably not a significant difference. However, the PUC may want to consider the impact of allowing the friction factor to be determined by test if ASCE 7 is adopted by reference.

Provisions Section: 14.4.7.6.1 Welded steel
ASCE 7 Section: 15.7.7.1 Welded steel

Discussion: The bridging equations that are in the *Provisions* have been removed from ASCE 7-05 Supplement #1 [Proposal EQ-13-GS-1R], since the latest editions of API 650 (10th Edition Addendum 4) and AWWA D100-05, where are adopted in ASCE 7-05 Supplement 1, have been revised to conform to the requirements in ASCE 7. Therefore, the bridging equations are no longer required.

It should be noted that the equations that were removed from ASCE 7 contain reference to a cutoff period, T_L . This is the long-period transition period from maps. Such notation is not included in the *Provisions* methodology. Therefore, the equations in the *Provisions* have different limits. Instead of T_L , the limit is defined as 4.0 seconds. This could lead to substantive differences, depending on period of structure and location in the country.

Recommendation: These equations should be reviewed depending on whether or not the *Provisions* adopts the long-period transition period approach. If consistent, then consider revising the *Provisions* to match ASCE 7-05 Supplement #1.

Provisions Section: 14.4.7.6.3 Reinforced and prestressed concrete
ASCE 7 Section: 15.7.7.3 Reinforced and prestressed concrete

Discussion: The design lateral force equations in ASCE 7 contain reference to a cutoff period, T_L . This is the long-period transition period from maps. Such notation is not included in the *Provisions* methodology. Therefore, the equations in the *Provisions* have different limits. Instead of T_L , the limit is defined as 4.0 seconds. This could lead to substantive differences, depending on period of structure and location in the country.

Recommendation: These equations should be reviewed depending on whether or not the *Provisions* adopts the long-period transition period approach.

Provisions Section: 14.4.7.7.1 Welded steel

ASCE 7 Section: 15.7.8.1 Welded steel

Discussion: The bridging equations that are in the *Provisions* have been removed from ASCE 7-05 Supplement #1 [Proposal EQ-13-GS-1R], since the latest editions of API 650 (10th Edition Addendum 4) and AWWA D100-05, where are adopted in ASCE 7-05 Supplement 1, have been revised to conform to the requirements in ASCE 7. Therefore, the bridging equations are no longer required.

It should be noted that the equations that were removed from ASCE 7 contain reference to a cutoff period, T_L . This is the long-period transition period from maps. Such notation is not included in the *Provisions* methodology. Therefore, the equations in the *Provisions* have different limits. Instead of T_L , the limit is defined as 4.0 seconds. This could lead to substantive differences, depending on period of structure and location in the country.

Recommendation: These equations should be reviewed depending on whether or not the *Provisions* adopts the long-period transition period approach. If consistent, then consider revising the *Provisions* to match ASCE 7-05 Supplement #1.

ASCE 7-05 Supplement #1 Proposal EQ-13-GS-6R2

Provisions Section: 14.4.7.9.4 Evaluation of structures sensitive to buckling failure
ASCE 7 Sections: 15.7.10.5 Evaluation of structures sensitive to buckling failure

Discussion: The foundation requirement in the *Provisions* (Sec. 14.4.7.9.4, item 3) is not contained in ASCE 7-05 Supplement #1. The ASCE 7 requirement was removed because experience applying the increased force provisions to the foundations show that the resulting foundations are of unreasonable proportions. Because the foundation requirements for buildings and nonbuilding structures are the same and because reinforced concrete foundations do not have low structural redundancy, the ASCE 7-05 was revised to delete the foundation requirement.

Recommendation: Determine whether to incorporate the change into the *Provisions*.

Provisions Section: 14.4.7.9.5 Welded steel
14.4.7.9.5.1 Analysis procedures
14.4.7.9.5.2 Structure period
ASCE 7 Section: 15.7.10.6 Welded steel water storage structures

Discussion: The bridging equations that are in the *Provisions* have been removed from ASCE 7-05 Supplement #1 [Proposal EQ-13-GS-1R], since the latest editions of API 650 (10th Edition Addendum 4) and AWWA D100-05, where are adopted in ASCE 7-05 Supplement 1, have been revised to conform to the requirements in ASCE 7. Therefore, the bridging equations are no longer required.

In addition, the ASCE 7 sections corresponding to *Provisions* Sec. 14.4.7.9.5.1 and Sec. 14.4.7.9.5.2 are no longer in ASCE 7, presumably because this information is contained in the reference standard or no longer is required to supplement the reference standard.

Note that the *Provisions* provides a modified equation for T greater than 4.0 seconds. This equation is not necessary since the *Provisions* (Sec. 14.4.7.9.5.2) limits the period used to calculate the seismic response coefficient to 4.0 seconds or less.

Recommendation: These equations should be reviewed depending on whether or not the *Provisions* adopts the long-period transition period approach. If consistent, then consider revising the *Provisions* to match ASCE 7-05 Supplement #1. In any case, the superfluous equation for $T > 4.0$ seconds in the *Provisions* should be removed. Determine whether or not it is necessary to retain the addition sections that have been removed from ASCE 7.

Provisions Section: 14.4.7.10.1 ASME boilers and pressure vessels
ASCE 7 Section: 15.7.11.2 ASME boilers and pressure vessels

Discussion: The *Provisions* and ASCE 7 appear to be doing different things in resolving the same issue – providing equivalence with the strength design basis of these documents with the working stress design basis of ASME Boiler and Pressure Vessel Code (BPVC). The *Provisions* requires that the forces and displacements for nonstructural elements (*Provisions* Chapter 6) be used, while ASCE 7 requires that the ASCE 7 forces and displacements be scaled to the working stress design basis. The difference is to be expected since the *Provisions* do not have a working stress design basis, while ASCE 7 does contain some conversions. Equivalence depends on the procedures in the BPVC.

Recommendation: The PUC should review for equivalence, specifically whether using the BPVC with the *Provisions* strength design level forces is the same as scaling the ASCE 7 strength design forces to working stress levels and then using BPVC.

Provisions Section: 14.4.7.11.1 ASME spheres
ASCE 7 Section: 15.7.12.2 ASME spheres

Discussion: The *Provisions* and ASCE 7 appear to be doing different things in resolving the same issue – providing equivalence with the strength design basis of these documents with the working stress design basis of ASME Boiler and Pressure Vessel Code (BPVC). The *Provisions* requires that the forces and displacements for nonstructural elements (*Provisions* Chapter 6) be used, while ASCE 7 requires that the ASCE 7 forces and displacements be scaled to the working stress design basis. The difference is to be expected since the *Provisions* do not have a working stress design basis, while ASCE 7 does contain some conversions. Equivalence depends on the procedures in the BPVC.

Recommendation: The PUC should review for equivalence, specifically whether using the BPVC with the *Provisions* strength design level forces is the same as scaling the ASCE 7 strength design forces to working stress levels and then using BPVC.

Provisions Appendix to Chapter 14-Other Nonbuilding Structures

Summary: This appendix is a resource for the development of future provisions for nonbuilding structures not currently contained within the *Provisions* (including electrical transmission, substation, and distribution structures and telecommunications towers) and for alternate design methods for nonbuilding structures that are contained in the *Provisions*(buried structures, tanks and vessels).

ASCE 7 (No corresponding section) However, telecommunications towers are addressed very broadly in ASCE 7 Sec. 15.6.6.

Significant Differences

Discussion and Recommendation: This is the type of item for which the *Provisions* is intended – to provide guidance for design that is beyond the range of current building codes and standards. Therefore, this section ought to be retained in the 2008 *Provisions* with updates as deemed necessary based on feedback from users or based on recommendations by the PUC. The PUC should also review whether part or all of these guidelines warrant inclusion into the text of the *Provisions* or as modifications to ASCE 7.

Determine which design criteria for telecommunications towers to include in the *Provisions*.

***Provisions* Chapter 15 – Structures with Damping Systems**

Summary: *Provisions* Chapter 15 contains seismic design requirements for structures with damping systems, which previously appeared in an appendix to Chapter 13.

ASCE 7 Section: 18-Seismic Design Requirements for Structures with Damping Systems

Summary: This section of ASCE 7 has the same scope and organization as the corresponding material in the *Provisions* with only minor differences, which are described below.

Significant Differences

<i>Provisions</i> Sections:	15.2.3.1 Design spectra 15.2.3.2 Time histories 15.2.4 Procedure selection
ASCE 7 Sections:	18.2.3.1 Design Spectra 18.2.3.2 Ground Motion Histories 18.2.4 Procedure Selection

Discussion: The threshold level of ground motion parameter S_I used as a trigger in the *Provisions* differs from that in ASCE 7-05. See discussion in the *Report on Differences* for Chapter 3.

<i>Provisions</i> Section:	15.7.1.4 Acceptance criteria for the response parameters of interest
ASCE 7 Section:	18.7.1.4 Acceptance Criteria for the Response Parameters of Interest

Discussion: The *Provisions* permits story drift of 125 percent of the typically allowed story drift and indicates that “the maximum story drift shall include torsional effects.” ASCE 7 does not contain similar requirements, so the typical story drift limits and rules concerning consideration of torsional effects would apply.

Recommendation: Decide whether ASCE 7 should include the provisions that are lacking.

<i>Provisions</i> Section:	15.9.1 Prototype tests
ASCE 7 Section:	18.9.1 Prototype Tests

Discussion: The two conditions under which the representative sizes of each type of device may be used for prototype testing differ.

Recommendation: Accept the text of ASCE 7 as representative of practice.