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RECORD OF REVISIONS

Rev	Date	Description	POC	OIC
0	6/28/99	Initial issue in Facility Eng Manual.	Doug Volkman, *PM-2*	Dennis McLain, *FWO-FE*
1	2/09/04	Incorporated IBC & ASCE 7 in place of UBC 97; incorporated DOE-STD-1020-2002 versus 1994 and concepts from DOE O 420.1A; FEM became ESM, an OST.	Mike Salmon, *FWO-DECS*	Gurinder Grewal, *FWO-DO*

2	5/17/06	Major revision: Reduced commentary in favor of IBC 2003 amendments only; clarification of PC-0 applicability; OST became ISD.	Mike Salmon, *D-5*	Mitch Harris, *ENG-DO*
3	10/27/06	Administrative changes only. Organization and contract reference updates from LANS transition; 420.1A became 420.1B. IMP and ISD number changes based on new Conduct of Engineering IMP 341. Master Spec number/title updates.	Mike Salmon, *D-5*	Kirk Christensen, *CENG*
4	6/19/07	Incorporated new seismic hazard analysis results into the seismic design parameters (1.7.1); supersedes Salmon interim guidance of 1/22/07 (D5:07-021). Added App A on concrete anchor design.	Mike Salmon, *D-5*	Kirk Christensen, *CENG*
5	6/16/08	Incorporated IBC 2006 & ASCE 7-05 in place of IBC 2003 & ASCE 7-02; minor App A changes.	Mike Salmon, *D-5*	Kirk Christensen, *CENG*
6	6/20/11	Update for IBC 2009. New Commentary on design and inspection. Admin changes including document number.	Mike Salmon, *D-5*	Larry Goen, *CENG*
7	10/30/12	Added TA-50/55 ground motion values at 1613.5, mass concrete in 1904, erection planning at 2205.1, drawing requirements in App A. Updated references.	Mike Salmon, *AET-2*	Larry Goen, *ES-DO*
8	11/03/14	Consolidated anchorage App. A, added adhesive anchors and limited use of anchorage to masonry; also, eliminated former brittle PI anchor procedure in deference to similar provision in IBC 2009/ ACI 318-08. Other minor changes in section proper.	Mike Salmon, *AET-2*	Mel Burnett, *ES-DO*
9	3/27/15	Major revision. Incorporated IBC-2015, DOE-STD-1020-2012 versus 2002, and anchorage material from Sect I App A. Eliminated historical 10-psf future-floor-DL and, for roofs, 30-psf min roof LL (Lr) and prohibition on LL reduction. Eliminated Commentary companion to this document.	Mike Salmon, *AET-2*	Larry Goen, *ES-DO*
10	12/20/16	Programmatic anchorage flowchart superseded by Ch 16. Other changes to App A, mostly A.13 anchorage drawing requirements. Added App B on small offsite-built structures.	Mike Salmon, *AET-2*	Larry Goen, *ES-DO*

11	03/24/21	Adopted DOE O 420.1C Chg 3, DOE-STD-1020-2016; incorporated CIR-16-002 on seismically exempt anchors. Added 1.1.A to include guidance on mech & elec items outside IBC scope, added 1.4 for flood hazard; and edited 1.6 to reduce seismic hazard per updated PHSA (IM 2018-0495 CA 2) and add SDC C pathway; added A.12 to include requirement for f'c for design of anchorage of nonstructural components to nonstructural concrete, A.13 to clarify adhesive-anchor drawing requirements, and A.14 content on CIP masonry anchorage. Issued reference on SDC C/D impacts. Many basis footnotes moved to requirements ID document.	Glen Pappas, *ES-EPD*	Jim Streit, *ES-DO*
12	03/22/2023	Adopted 2021 IBC. Updated Snow (II.1.4), Wind (II.1.5) and Rain Loads (II.1.6). Clarified that SDC-C exception does not apply to nonbuilding structures. Provided guidance regarding the Risk Category for Explosive Facilities (II.1.2). Added IBC-required posting of live loads (II.1.3.A). Clarified seismic detailing of structures governed by wind load (II.1.5.D). In Appendix A, added guidance for prevention of galvanic corrosion in anchor bolts and shear lug design. Other minor changes.	Carlos Coronado, *ES-SPD*	Michael Richardson, *ES-DO*
13	12/24/2024	Updated II.1.8.A.1 to incorporate S_{DS} and S_{D1} seismic design parameters presented in Table 1 of memo ES-DO-Memo-24-022, Rev. 1; these coefficients apply to new designs that establish their Code of Record beginning 12/11/2024. Deleted II.1.8.A.2, which previously permitted the use of Seismic Design Category (SDC) C). Together, these changes incorporate VAR-10711. Added footnote 2 to clarify the scope. Other minor changes.	Carlos Coronado, *ES-SPD*	Michael Richardson, *ES-DO*

SECTION II- COMMERCIAL DESIGN & ANALYSIS REQUIREMENTS

New in this revision (older revisions addressed in Section 10.0 Record of Revisions)

Updated II.1.8.A.1 to incorporate S_{DS} and S_{D1} seismic design parameters presented in Table 1 of memo ES-DO-Memo-24-022, Rev. 1; these coefficients apply to new designs that establish their Code of Record beginning 12/11/2024. Deleted II.1.8.A.2, which previously permitted the use of Seismic Design Category (SDC) C. Together, these changes incorporate VAR-10711. Added footnote 2 to clarify the scope. Other minor changes.

Please contact the Structural Standards POC for interpretation, variance, and upkeep issues.

A. This Chapter is online at https://engstandards.lanl.gov. This Section provides the minimum requirements for the structural design and analysis of new and existing commercial (i.e., non-nuclear[1]) structures, systems, and components (SSCs), which include nonbuilding structures, nonstructural components and, as applicable, programmatic equipment[2]. Such designs and analyses are performed using the International Building Code (IBC) and International Existing Building Code (IEBC), which are "commercial codes" (Requirement 5-2001).

B. Acronyms, notations, references, etc. not defined herein are included in Sections I.2.0 to I.4.0 of this Chapter.

C. Per Section III of this Chapter, NDC-1 and NDC-2 SSCs require design and analysis per Section II (this Section). Subsection 1.0 of Section III provides the NPH-specific requirements for such SSCs.

D. *Guidance: The structural design process generally consists of the following:*

- *Establish structural arrangement/geometry*
- *Establish loads and load combinations*[3]
- *Establish a complete load path for vertical and horizontal loads*
- *Evaluate the structural response to the loads*
- *Specification of strength, serviceability, deflection, and drift requirements (acceptance criteria)*
- *Application of special design considerations, such as ductile detailing requirements*
- *Specification of inspections (e.g., special inspections) and tests*

[1] Per DOE-STD-1020-2016, and as indicated in Section I, non-nuclear facilities are other than DOE Hazard Category 1, 2, and 3 nuclear facilities, and they can include radiological, chemical and/or toxicological hazards. Refer to Section I.3.0 for definitions of "nuclear facilities" and "non-nuclear facilities."

[2] Nonbuilding structures include structures in IBC Occupancy Classification Groups H, F, S, U and others included in ESM Chapter 16 IBC-GEN in-scope tables, and ASCE 7. Refer to ASCE 7 Sections 11.1.2 and 26.1.1 for specific details regarding the type of SSCs under the scope of ASCE 7 seismic and wind design requirements. ASCE 7 Chapter 15, also referenced in IBC 1613.1, includes seismic design requirements for self-supporting nonbuilding structures such as pipe racks, storage racks, earth retaining structures, chimneys, stacks, tanks, and vessels to name a few. Not within the scope of IBC or ASCE 7 are nonbuilding structures such as vehicular bridges, electrical transmission towers, hydraulic structures, buried utility lines and their appurtenances, and nuclear reactors. ASCE 7 Chapter 13, which is referenced by IBC Section 1613.1, includes seismic design requirements for architectural, mechanical, electrical, and piping (MEP) nonstructural components that are permanently attached to structures.
ASCE 7 Chapter 26, which is referenced in IBC Section 1609.1.1, includes wind design requirements for building structures, nonbuilding structures, and nonstructural components within the scope of (and sometimes amended by) the IBC.
Programmatic equipment anchorage and bracing is addressed by Appendix C herein.

[3] Unless noted/footnoted otherwise, "Design-Load Basis for LANL Structures, Systems, and Components," LANL Report No. LA-14165 [6] provides the basis for the non-seismic loads and analysis procedures.

E. The project records, quality control, quality assurance, design and construction of non-nuclear SSCs shall comply with the provisions of Section I of this Chapter; ESM Chapter 1, *General;* ESM Chapter 16, *Building Code Program* (which invokes a specific edition of the IBC and IEBC, and makes amendments to them); and the provisions contained herein (i.e., Section II), which include additional amendments to the IBC (i.e., Chapters 16–23) (Requirement 5-2002). The IBC and IEBC editions currently invoked are the 2021 ones.

F. *Guidance: Note that Chapter 6 – Mechanical, Chapter 7 – Electrical, and others of this ESM also contain design requirements for many nonstructural components, and non-building structures.*

1.0 IBC CHAPTER 16 STRUCTURAL DESIGN

1.1 Section 1601 General

A. **1601.1 Scope**

1. Guidance on outside, on-the-ground equipment: The IBC's applicability is "…buildings, structures and portions thereof…" Thus, mechanical and electrical items that are not in/on buildings or structures—and are not themselves nonbuilding structures—need not be designed for, or restrained to withstand, the effects of the natural phenomena hazards (NPH) included in this Section.[4] However, if any of the following are applicable, NPH design for such items should be considered:

- *Sliding, overturning and/or uplift of the item could damage an adjacent structure.*
- *Sliding, overturning and/or uplift of the item could either impede egress of occupants from—or ingress of emergency responders to—a facility after an NPH event.*
- *The item is difficult to acquire, costly, and/or critical; and sliding, overturning, and/or uplift of it could result in damage to and/or loss of use.*
- *Resiliency of the item and/or facility or mission it serves is desired (i.e., less downtime than normal/typical after an NPH event).[5]*

Finally, even if none of these NPH-design scenarios apply, it is recommended that such items be permanently attached to the foundation/ground, where the attachment isn't specifically designed for seismic and wind loads, but it is sized using basic engineering judgement. Therefore, anchorage of such items using post-installed anchors doesn't require special inspection under the Building Program.

1.2 Section 1604 General Design Requirements

A. **Table 1604.5 Risk Category of Buildings and Other Structures.** Add the following text at the end of foot note b. (Requirement 5-2003)

[4] For outside, on-the-ground equipment, the NPH included herein that are most likely to be applicable are seismic and wind. See footnote 2 for relevant/applicable codes and standards.
[5] The National Earthquake Hazards Reduction Program Reauthorization Act of 2018 (NEHRP18) goes beyond the goals of the IBC. With NEHRP18 preventing damage to structures and infrastructure, increasing resiliency, and reducing economic hardship (following a major earthquake) will be emphasized.

A facility Explosives Safety Site Plan, approved by the LANL DOE Field Office, constitutes an analysis of the quantity-distance relationships for the quantity of explosive materials permitted in the facility to ensure there is no threat to the public from blast pressures, fragments, or noise. Upon approval of same by NA-LA, these facilities may be taken as Risk Category II.[6]

1.3 Section 1607 Live Loads

A. **Live loads posting.** The Structural Engineer of Record (SEOR) is required to clearly indicate in floor plan drawings the areas with live loads greater than 50 psf (e.g., using keyed notes).

B. **1607.11 Impact loads**

1. Add Section **1607.11.5 Experimental explosion loads.**

a. Reactions from experimental explosion containment structures, due to explosions within them, shall be considered live loads that act concurrently with floor and roof live loads and that have a load factor of 1.0 for both strength design and allowable stress design (Requirement 5-2004).

b. External loads from experimental explosions shall comply with DOE-STD-1212 Section 7.2 and shall be considered live loads that act concurrently with floor and roof live loads and that have a load factor of 1.0 for both strength design and allowable stress design (Requirement 5-2005).

1.4 Section 1608 Snow Loads

A. Modify **IBC Section 1608.2** to read as follows:

1608.2 Ground snow loads. The ground snow load to be used in determining the design snow load for roofs shall be 30 psf (Requirement 5-2006).[7]

1.5 Section 1609 Wind Loads

A. **1609.1.1 Determination of Wind Loads.** Revise the second sentence of the first paragraph to read as follows:

The basic design wind speed, V, and the exposure category shall be as indicated in Section 1609 (Requirement 5-2007).[8]

B. Modify the first paragraph of **IBC Section 1609.3** to read as follows:

1609.3 Basic design wind speed. The basic design wind speed, V, for the determination of wind loads shall be as follows (Requirement 5-2008):

- 99 mph for Risk Category I,
- 104 mph for Risk Category II,
- 110 mph for Risk Category III, and
- 115 mph for Risk Category IV.

[6] This exemption only considers effect of explosives on assignment of Risk Category. Risk Category may be greater than RC II for other reasons such as operability during or after seismic events, mission importance and security.
[7] For roofs that will have three-dimensional snow drifts, consider referring to "FEMA Roof Snowdrift Design Guide," 2019, since it includes consideration of such based-on assessments of actual roof collapses caused by them.
[8] For photovoltaic (PV) wind design, refer to SEAOC reports PV2-2012 and PV2-2017.

C. Modify the first paragraph of **IBC Section 1609.4** to read as follows:

1609.4 Exposure category. The exposure category shall be taken as Exposure C for each wind direction considered (Requirement 5-2009).

D. *Wind and Seismic Detailing guidance*: *Structures with wind demands/effects greater than seismic demands/effect (i.e., "governed" by wind load) shall meet the seismic detailing requirement and limitations of IBC and ASCE 7 as required per IBC Section 1604.9*

1.6 Section 1611 Rain Loads

A. **1611.1 Design rain loads**

1. *Guidance on determining design rainfall: per the National Oceanic and Atmospheric Administration (NOAA) National Weather Service Precipitation Frequency Data Server — Hydrometeorological Design Studies Center (LANL rainfall based on an event with 100-year mean recurrence interval is 1.3 in (i = 5.2 in/hr) for the 15-min duration event, and 2.17 in (i = 2.17 in/hr) for a 60-min duration event. Thus, for Los Alamos the rainfall intensity (i) for design of secondary (overflow) drains is 5.2 in/hr. Refer to ASCE 7 Section C8.3 to convert this intensity (i = 5.2 in/hr) to the hydraulic head (d_h) required in IBC Eqn. 16-19.*

1.7 Section 1612 Flood Loads

A. Modify **IBC Section 1612.3** to read as follows:

1612.3 Flood hazard areas. Pajarito Canyon, Los Alamos Canyon, and Water Canyon shall be considered *flood hazard areas*, the design flood elevations in which shall be determined in accordance with IBC Section 1612.3.1 (Requirement 5-2010).

B. Replace the first paragraph in **IBC Section 1612.3.1** with the following:

1612.3.1 Design flood elevations. To determine the design flood elevations, the engineer of record is required to do one of the following: (Requirement 5-2011).

1.8 Section 1613 Earthquake Loads

A. **1613.2 Seismic ground motion values**

1. The following parameters shall be used for all Risk Categories (Requirement 5-2012):

a. Modify **IBC Section 1613.2.1** to read as follows:

1613.2.1 Mapped acceleration parameters. Mapped acceleration parameters shall not be used.

b. Modify **IBC Section 1613.2.2** to read as follows:

1613.2.2 Site class definitions. The site class shall be taken as Site Class D except as demonstrated otherwise by site specific geotechnical information that Site Class C requirements are met.[9]

[9] To meet Site Class C requirements, borings must be deeper than what has become the norm for LANL geotechnical investigations. Refer to IBC 1613.2.2 and ASCE 7 Ch. 20 for details. If the geotechnical investigation indicates that Site Class E or F exist, Section II.3.3.B (1809.13 Footing seismic ties) herein is applicable and shall be complied with.

c. Modify **IBC Section 1613.2.3** to read as follows:

1613.2.3 Site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters. The maximum considered earthquake spectral response acceleration for short periods, S_{MS}, and at 1-second period, S_{M1}, adjusted for site class effects shall be determined as follows:

S_{MS} and S_{M1}

Parameter	TA-16	TA-03	TA-55/50	Sitewide
At short periods, S_{MS}	1.02	0.99	0.90	1.02
At long periods, S_{M1}	0.89	0.96	1.02	1.02

d. Modify **IBC Section 1613.2.4** to read as follows:

1613.2.4 Design spectral response acceleration parameters. Five-percent damped design spectral response acceleration at short periods, S_{DS}, and at 1-second period, S_{D1}, shall be determined as follows:

Parameter	TA-16	TA-03	TA-55/50	Sitewide
At short periods, S_{DS}	0.68	0.66	0.60	0.68
At long periods, S_{D1}	0.59	0.64	0.68	0.68

e. Modify **IBC Section 1613.2.5** to read as follows:

1613.2.5 Determination of seismic design category. The seismic design category shall be taken as Seismic Design Category D.[10]

B. Add Section **1613.4 Amendments to ASCE 7**

1. **1613.4.1 Siting**. Modify **ASCE 7 Section 11.8.1** to read as follows:

11.8.1 Site Limitation. Hazardous waste treatment, storage and disposal facilities must not be located within 200 feet of a fault that has had displacement within the last 11,000 years (Requirement 5-2013).

2. **1613.4.2 Design Approach to Commercially Fabricated Buildings Used in Multi-State Jurisdictions.** Refer to Section II Appendix B.

3. **1613.4.3 Nonstructural Components Exempt from Seismic Design**. Modify **ASCE 7 Section 13.1.4, Exemptions**, to read as follows (Requirement 5-2014):

Exemptions. The following nonstructural components are exempt from the requirements of this chapter.

a. Furniture except for "Cabinets," as noted in ASCE 7 Table 13.5-1[11].

[10] If the geotechnical investigation indicates that Site Class E or F exists, Section II.3.3.B (1809.13 Footing seismic ties) herein is applicable and shall be met.
[11] No cabinet-like furniture is exempt (e.g., relatively tall, narrow, and heavy components/equipment, like some safes, etc.).

b. Temporary[12] or movable components/equipment[13].

c. As stated in numerals 5 to 7 of ASCE 7 Section 13.1.4.

4. **1613.4.4 Anchorage of architectural, mechanical, and electrical components.** Refer to Section II Appendix A, *Anchorage to Concrete and Masonry*.

5. **1613.4.5 Restraint of Non-Facility Equipment (e.g., Programmatic, Utilities, Infrastructure, Environmental Remediation, etc.).** Refer to Section II Appendix C, *Restraint of Non-Facility Equipment*.

1.9 Add Section 1617 Accidental Blast Loads

A. Permanent explosive facilities shall comply with DOE-STD-1212 Section 7.1 (Requirement 5-2015). When evaluating for accidental blast load, A_B, A_B shall replace E (earthquake load) in the load combination equations (Requirement 5-2016). All potential blast effects shall be considered including blast overpressure, gas pressure, fragments, and ground shock (Requirement 5-2017).

B. The design of all new facilities containing explosives, or those that can be affected by detonation (inadvertent or planned) of explosives, shall comply with DOE-STD-1212 Section 7.5[14] (Requirement 5-2018).

1. This requirement also applies to significant (e.g., IEBC Alteration Level 3) modifications of facilities containing explosives, or of facilities that can be affected by detonation (inadvertent or planned) of explosives (Requirement 5-2019).

1.10 Add Section 1618 Minimum Antiterrorism Structural Design Measures

Structural design measures on progressive-collapse avoidance and window protection presented in DOD UFC 4-010-01 shall be considered for those buildings where there is a credible terrorist threat (Requirement 5-2020). LANL Physical Security (PS) Division shall specify (to the LANL Project Manager) whether these minimum antiterrorism measures are to be implemented; see also ESM Chapter 9, *Facility Protection and Security* (Requirement 5-2021).

2.0 IBC CHAPTER 17 SPECIAL INSPECTIONS AND TESTS

Refer to LANL ESM Chapter 16, *Building Program* for LANL amendments to this and other IBC chapters.

3.0 IBC CHAPTER 18 SOILS AND FOUNDATIONS

3.1 Section 1803 Geotechnical Investigations

A. **1803.5 Investigated Conditions.**

1. IBC Section **1803.5.12 Seismic Design Categories D through F.** Modify numeral 1 to read as follows (Requirement 5-2022):

[12] Refer to ESM Ch. 16, IBC-GEN [*Article, TEMPORARY FACILITIES, STRUCTURES, AND BUILDING SYSTEMS & COMPONENTS*]
[13] Movable components/equipment that are not "temporary", are not moved often, are in/near occupied areas, and that are cabinet-like will likely require at least "non-permanent anchorage (e.g., detachable cable restraint, etc.)." Contact the ESM Ch. 5 POC for guidance.
[14] Per DOE-STD-1020 Section 2.2.5, it is permissible to use DOE-STD-1212 to satisfy the provisions of 10 CFR Part 851. This portion of "1020" also refers to 29 CFR Part 1910.109.

The determination of dynamic seismic lateral earth pressures on foundation walls and retaining walls supporting more than 6 feet (1.83 m) of backfill height due to *design earthquake ground motions*. A conservative approach for obtaining such pressures on foundation walls (i.e., exterior embedded building walls or basement walls) is to use of the Simplified Method presented in ASCE 4-16 Section 8.2.2. Similarly, for earth retaining walls such pressures can be obtained using the Mononobe-Okabe approach in accordance with ASCE 4-16 Sections 8.3 and C8.3, provided that the wall displacements required to develop the active earth pressure can be justified without loss of wall function.

3.2 Section 1808 Foundations

A. **1808.1 General.** Add the following text (Requirement 5-2023):

Permanent buildings and similar structures shall have a permanent foundation (e.g., full perimeter support, rodent-excluding, no trailer skirting, etc.). Permanent is described in ESM Chapter 16, Section IBC-GEN.

1. Exception: For non-temporary relocatable buildings (as defined in ESM Chapter 16, Section IBC-GEN), a permanent foundation may be achieved by placing gravity bearing pads on 24 inches of non-frost susceptible ground or fill (95% compacted granular material with less than 6% material passing the 200 sieve)*, and providing insulated skirting around the perimeter of the building, and by providing a means to resist the lateral and uplift forces that result from seismic and wind loads. *For temporary foundations for temporary relocatable buildings, see LANL Standard Detail ST-Z1052-1 and -2.*

* If fill is used, it must replace the existing material to depth of at least 24 inches.

3.3 Section 1809 Shallow Foundations

A. Modify **IBC Section 1809.5**, numeral 1 (one) to read as follows:

1. Extending below the ground surface to a depth of 36” (Requirement 5-2024).

B. Modify **IBC Section 1809.13** first sentence to read as follows (Requirement 5-2025):

1809.13 Footing seismic ties. Individual spread footings founded on soil defined in Chapter 20 of ASCE 7 as Site Class E or F shall be interconnected by ties.

4.0 IBC CHAPTER 19 CONCRETE

4.1 Section 1901 General

A. Modify **IBC Section 1901.3** to read as follows (Requirement 5-2026):

1901.3, Anchoring to concrete. Anchoring to concrete shall be in accordance with Section II Appendix A, *Anchorage to Concrete and Masonry*; ACI 318 Chapter 17; and the amendments to ACI 318 Chapter 17 in Section 1905, and applies to cast-in (headed bolts, headed studs, and hooked J- or L-bolts), post-installed expansion (torque-controlled and displacement-controlled), undercut, screw, and adhesive anchors.

Exception: Seismic-related provisions are not applicable to anchoring that is seismically-exempt per Appendix A.

4.2 Section 1904 Durability Requirements

Add Section **1904.3 Mass Concrete** (Requirement 5-2027):

A. Mass concrete is defined as "any volume of structural concrete in which a combination of dimensions of the member being cast, the boundary conditions, the characteristics of the concrete mixture, and the ambient conditions can lead to undesirable thermal stresses, cracking, deleterious chemical reactions, or reduction in the long-term strength as a result of elevated concrete temperature due to heat from hydration." *In general, a placement of structural concrete with a minimum dimension ≥ 4 ft should be considered mass concrete. Similar considerations should be given to other concrete placement that do not meet this minimum dimension but contain Type III cement, accelerating admixtures, or cementitious materials in excess of 660 lb/yd³ of concrete. Consideration should also be given to placements that trap heat.*

B. The Construction Documents shall designate those portions of the structure, or concrete placement that are to be treated as mass concrete. The Project Specification (e.g., Section 03 3001, *Reinforced Concrete*) shall adopt the ACI 301, Section 8 requirements. The structural Engineer of Record (SEOR) shall review the Project-Specification-version of 03 3001 against the checklists presented in ACI 301 (i.e.., Mandatory, Optional Requirements, and Submittals) to ensure that this Section adequately addresses mass concrete.

1. In lieu of mass concrete designation and specification requirements, the SEOR can opt to demonstrate (analytically, using ACI 207.2R) that these requirements are not required/applicable.

5.0 IBC CHAPTER 20 ALUMINUM

No change.

6.0 IBC CHAPTER 21 MASONRY

6.1 Section 2107 Allowable Stress Design

A. **2107.1 General.** Add the following sentence to the end (Requirement 5-2028):

Anchoring to masonry shall be in accordance with Section II Appendix A, *Anchorage to Concrete and Masonry* and TMS 402.

6.2 Section 2108 Strength Design of Masonry

A. **2108.1 General.** Add the following sentence to the end (Requirement 5-2029):

Anchoring to masonry shall be in accordance with Section II Appendix A, *Anchorage to Concrete and Masonry* and TMS 402.

7.0 IBC CHAPTER 22 STEEL

7.1 Section 2205 Structural Steel

A. **2205.1 General:** Add the following text (Requirement 5-2030):

Designs shall allow for, if not ensure, compliance with OSHA provisions 29 CFR 1926, Subpart R (Steel Erection), Section 755(a), General Requirements for Erection Stability. Columns shall be securely anchored with a minimum of four (4) anchor rods or anchor bolts to address construction safety. Furthermore, each column base plate assembly, including the column-to-base plate weld and the column foundation, shall be designed to resist a minimum eccentric gravity load of 300 pounds located 18 inches from the

extreme outer face of the column in each direction at the top of the column shaft to address construction safety. *See also LANL Master Specification Section 05 1000, Structural Metal Framing, for additional discussion*.

8.0 IBC CHAPTER 23 WOOD

No change.

9.0 IBC CHAPTER 31 SPECIAL CONSTRUCTION

9.1 Section 3108 Telecommunication and Broadcast Towers

A. ***Guidance on 3108.1 General:*** *The IBC states, "…Towers shall be designed for seismic loads; exceptions related to seismic design listed in Section 2.7.3 of TIA-222 shall not apply."*[15]

[15] Recent LANL experience indicates that this industry isn't aware of this provision.

APPENDIX A – ANCHORAGE TO CONCRETE AND MASONRY

A.1 Scope

A. This appendix establishes the technical requirements for designing concrete anchors for non-nuclear SSCs at LANL. An anchor type/product acceptable for a nuclear SSC may be used for a non-nuclear SSC.

1. Design of anchorage for nuclear NDC-1 or NDC-2 SSCs must also follow this appendix (as required by, and per modifications in, Section III) (Requirement 5-2031).

B. Cast-in-place (CIP) anchors: This appendix covers the design of the following cast-in-place anchors: Headed bolts, threaded-and-nutted bolts, headed studs, and hooked bolts. Cast-in anchors are ASTM A36, A193, A354, A449, A572, A588, or F1554 material. ASTM F1554 is the preferred material specification in AISC 360. Welding and mechanical properties of headed studs shall comply with AWS D1.1 (per AISC 360) and ESM Chapter 13–*Welding, Joining, and NDE* (Requirement 5-2032).

C. Post-installed (PI) anchors: This appendix covers the design of the following types of post-installed concrete anchors: expansion, adhesive, undercut, screw, and power-actuated. Post-installed anchorage to grout-filled concrete masonry ("grouted-masonry anchors" hereafter) is also covered, as is grouted rebar. Purchase, installation, and testing requirements for post-installed anchors are given in the LANL Master Specification Sections listed below.

D. Definitions: Definitions of anchors per ACI 355.2 and ACI 355.4 apply (Requirement 5-2033).

A.2 Applicable Codes

IBC International Building Code by International Code Council (ICC), edition per ESM Ch. 16 (Requirement 5-2034).

A.3 Applicable Industry Standards and Reports (Requirement 5-2035)

ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary

ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary

ACI 318 Building Code Requirements for Structural Concrete and Commentary

ICC-ES ACs ICC Evaluation Service Acceptance Criteria (http://www.icc-es.org/) (reference only; bases for ES Reports)

- AC01, "Expansion Anchors in Masonry Elements," March 2018
- AC58, "Adhesive Anchors in Masonry Elements," March 2022
- AC106, "Predrilled Fasteners (Screw Anchors) in Masonry," March 2018

ICC ES Reports ICC Evaluation Services Reports (http://www.icc-es.org/)

A.4 LANL Documents

Master Specification STD-342-200 (Requirement 5-2036)

Section 03 6000 *Grouting*

Section 03 6021 *Grouting High-Confidence*

Section 05 0520 *Post-installed Concrete and Grouted-Masonry Anchors – Normal Confidence*

Section 05 0521 *Post-installed Concrete Anchors – Nuclear Safety*

Engineering Standards Manual (Requirement 5-2037)

Chapter 13 Welding, Joining, and NDE

Chapter 16 Building Program, Section IBC-GEN

LANL Standard Details for anchorage

Note: At time of writing, these details include anchorages complying with IBC-2015 expectations (update as appropriate).

- Sign Base Detail and Alternate, ST-G2040-4
- Motor Control Center Anchorage, ST-D5020-3
- Wall-Mounted Equipment (I&C), ST-F1033-1
- Square D Three-Phase Transformer Anchorage and Concrete Slabs on Grade, ST-G4010-38

A.5 Prerequisites for Determining Anchor Design Loads

A. As indicated in IBC/ASCE 7, the magnitude of natural-phenomena-hazard (NPH) loading that a structure (i.e., building, or non-building structure) and its anchorage must be designed to resist depends on its Risk Category (RC). If the RC of a building/structure has not already been assigned (per IBC 1604.5), then this must be accomplished by the Project design team (Requirement 5-2038). *This team will likely consist of at least some of the following: LANL Project Management, a safety analyst, the SEOR, and the Cognizant System Engineer (responsible for the design of mechanical and electrical equipment).*

B. Unlike the design of the anchorage of structures (refer to A.5.A), the design of the anchorage of many nonstructural systems and components is NOT directly tied to the structure Risk Category. The only type of NPH that many systems and components must be braced and/or anchored to resist is seismic; and to determine the seismic-design load, F_p, ASCE 7 Chapter 13 requires the use of a Component Importance Factor, I_p. *Guidance: The value of I_p can be 1.0 or 1.5, depending on the importance of the system/component. ASCE 7 Section 13.1.3 lists the conditions that require the use of I_p = 1.5, and only numeral 3 is related to the structure Risk Category. Thus, additional time and effort will be required by the Project design team (refer to A.5.A) to provide the necessary input for the design of nonstructural system/component anchorage.*

C. Consequential Damage: The value of I_p for a given nonstructural system or component (ref. A.5.B) and the component/support (anchorage) design must consider the potential for Consequential Damage per ASCE 7 Section 13.2.3), and System Interaction per DOE-STD-1020-2016 Section 2.3.2(b). Consideration of consequential damage requires the Project design team (refer to A.5.A) to assess the potential for functional and physical interactions between essential/safety systems and components and nonessential/non-safety systems and components. If the potential exists for such interactions, the team must then determine if they are both credible and significant. In short, the failure of essential or nonessential systems and components shall not cause the failure of essential SSCs and ensuring such can affect anchorage design (Requirement 5-2039). *For example, if there is a suspended 'I_p = 1.0' piping system directly above an 'I_p = 1.5' motor control center (MCC), increasing the I_p used to design the anchorage of the piping*

system (to 1.5) might be necessary. Similar considerations apply to an 'I_p = 1.0' piping system located above an NDC-3/safety-class MCC, etc.[16] If the affected essential SSC is SDC-3 then Section III.2.7.B, Common-Cause Failure and System Interaction must be met.

D. Engineering drawings shall indicate the Risk Category, I_p, and I_e values used to design the anchorage of SSCs (Requirement 5-2040).

A.6 Environmental Conditions

A. Anchors for indoor use in non-aggressive chemical environments may be carbon steel with zinc electroplating. Anchors for use outdoors or in aggressive environments shall be galvanized or made of stainless steel (Requirement 5-2041). *Guidance: Additionally, the difference in free corrosion potential between the anchor and the anchored part should be as low as possible to reduce galvanic corrosion*.

1. *Guidance: Generally, to minimize galvanic corrosion, anchors/fasteners should always be made of the same or a more noble metal than the part to be anchored, since anchors typically have a smaller surface area than the anchored part.*

A.7 Seismically Exempt Anchors[17]

A. Anchors for nonstructural components that are exempt per IBC Section 1613.4.3 as amended in this Chapter Section II.1.8.B need not be designed for seismic forces.

B. Seismically exempt anchors must comply with the provisions of this Appendix other than those related to the design for seismic forces, and the prohibition herein against the use of post-installed anchors in masonry (refer to A.11) doesn't apply to seismically-exempt anchors in masonry (Requirement 5-2042).

A.8 Power-Actuated Fasteners

A. Power-actuated fasteners may be used for anchorage of nonstructural components provided that such use is in accordance with ASCE 7 Section 13.4.5 (Requirement 5-2043). "Approved" in ASCE 7 Section 13.4.5 shall be taken to mean allowed by the IBC and the applicable ICC-ES report (ESR) (Requirement 5-2044). Finally, design shall comply with all requirements of the applicable ESR (e.g., minimum spacing, edge distance, embedment; maximum loads; etc.) (Requirement 5-2045).

A.9 Grouted Reinforcing steel

A. Reinforcing steel (rebar) may be post-installed into hardened concrete by using an epoxy or acrylic grout (i.e., adhesive anchor per ACI 318 Chapter 17, or post-installed reinforcing bar per ICC-ES AC308). The design of epoxy and acrylic grouted rebar shall be in accordance with the applicable ICC-ES ESR, or equivalent (Requirement 5-2046).

B. Rebar may be post-installed into hardened concrete by using a cementitious grout. The design of cementitious grouted rebar shall be in accordance with a procedure that must be reviewed and approved by the ESM Structural POC prior to use (Requirement 5-2047). *Use of ACI 349 Section D.12, Grouted embedments, is pre-approved; thus, need not be submitted for review to ESM Structural POC prior to use.*

[16] For more information and examples, see ASCE 7 Section C13.2.3 and DOE-STD-1020-2016, Section 2.3.2.
[17] The term "non-structural anchors" was used in this document prior to the Rev. 9 (Mar 2015) edition.

A.10 Requirements for Transfer of Shear Load to Foundations

A. For structures where the eave height exceeds twenty feet, in order to rely on all anchor rods equally sharing in the transmission of shear loads from steel columns of the lateral force-resisting system to concrete foundation elements, in addition to complying with the applicable provisions in AISC 360 Section J9, *Anchor Rods and Embedments*; AISC 341 Section D2.6, *Column Bases*; and ACI 318 Chapter 17, *Anchoring to Concrete*, both of the following requirements shall be met (Requirement 5-2048):

1. Plate washers of proper thickness, and with holes 1/16 inch larger than the rod diameter, must be welded to the base plate at all anchor locations.
    a. In lieu of plate washers, a setting plate of proper thickness can be used and welded to the base plate after the column is erected.
2. The thickness of the washers/setting plate shall be based on the bearing force from the rod, and the rod diameter shall be adequate to resist the effects of bending/flexure (i.e., in addition to the effects of tension, and combined tension and shear).

Exception: Above sections A.10.A.1 and A.10.A.2 are not applicable to base plates where shear lugs are used to transmit the total of shear demand to foundation elements, the shear lug design is in accordance with ACI 318 Section 17.11 and, where there is no conflict, per the recommendations of the most current version of the AISC Steel Design Guide 1, Base Plate and Anchor Rod Design.

A.11 General Design Requirements

A. *Cast-in-place anchors should be used in lieu of post-installed anchors whenever possible.*

B. Use of post-installed (PI) anchors shall comply with the following:

1. PI anchor design shall provide for limited anchor relocation (at least $\pm$ 1 inch) to facilitate anchor installation (Requirement 5-2049). Due consideration shall be given to the location tolerances of the anchors to avoid interferences with reinforcement.
2. Welding of PI anchors is not permitted without the permission of the anchor manufacturer (Requirement 5-2050). And such permission must be submitted to the SEOR (for review and approval) prior to commencement of welding (Requirement 5-2051).
3. Except as indicated in A.12 below, PI anchors shall not be used in hollow/ungrouted masonry walls (Requirement 5-2052). Through-bolting is an acceptable alternative.
4. PI anchors shall not be located in the bottom of precast and pre/post-tensioned T-beam stems (Requirement 5-2053). PI anchors in the sides of the T-beam stems shall be designed, and the design must be approved by the SEOR (Requirement 5-2054).
5. Adhesive anchors shall not be used in in environments with temperature extremes more than that allowed by the applicable ESR (Requirement 5-2055). Manufacturer's data and ESRs typically require a reduction in strength at elevated temperatures, and stipulate limitations on use in aggressive exposure conditions including fire. *Guidance: At elevated temperatures where strength*

reduction is significant for epoxy and adhesive anchors, consider the use of cementitious grout.

A.12 Design Requirements

A. Anchor types/products must comply with the IBC as amended below.

B. Additional requirements for architectural, mechanical, and electrical components, and their supports and attachments. (Refer to Section II.1.8.B, 1613.4 Amendments to ASCE 7).

1. Revise **ASCE 7, Section 13.4.2 Anchors in Concrete or Masonry** as follows:

   Modify **ASCE 7, Section 13.4.2.1** to read as follows (Requirement 5-2056):

   13.4.2.1 Anchors in Concrete. Anchors in concrete used for component anchorage shall be designed in accordance with LANL ESM Chapter 5 Section II.

   Modify the first paragraph of Section 13.4.2.2 to read as follows (Requirement 5-2057):

   13.4.2.2 Anchors in Masonry. Anchors in masonry shall be designed in accordance with LANL ESM Chapter 5 Section II. Anchors shall be designed to be governed by the tensile or shear strength of a ductile steel element.

   Modify **ASCE 7, Section 13.4.2.3** to read as follows (Requirement 5-2058):

   13.4.2.3 Post-Installed Anchors in Concrete and Masonry. PI anchors in concrete shall be prequalified for seismic applications in accordance with ACI 355.2 or other approved qualification procedures. PI anchors in masonry used for component anchorage shall be prequalified for seismic applications in accordance with ICC-ES AC01, AC58, or AC106.

C. **Sections 2107.1 and 2108.1 General.** Add the following text at the end of 2107.1 and 2108.1 first paragraph (Requirement 5-2059):

   PI anchors can be used in masonry provided they comply with all applicable provisions in Section II Appendix A Section A.11 General Design Requirements above.

D. Anchorage of nonstructural components to nonstructural concrete (e.g., miscellaneous concrete per Specification Section 03 3053) shall be based on a value of f'c that doesn't exceed 2,500 psi (Requirement 5-2060).

1. Exception 1: The design of anchorage to existing nonstructural concrete can be based on a value of f'c > 2,500 psi if documentation that proves/verifies the value of f'c used in the design is appended to the design calc and submitted for review.

2. Exception 2: The design of anchorage to new nonstructural concrete can be based on a value of f'c > 2,500 psi if strength-test cylinders, and Special Inspection of the associated preparation and test results, are indicated as being required.

A.13 Drawing Requirements

A. For non-seismically-exempt (seismic) anchors, the SEOR shall specify each anchor to be installed as follows: type, size, location requirements, effective embedment depth,

projection, length, minimum edge distance (in accordance with ACI 318 Section 17.9), and installation requirements in ACI 318 Section 26.7 (Requirement 5-2061).[18]

B. In addition to the above, for PI anchors, the SEOR shall indicate the manufacturer's name, product name, anchor diameter, minimum spacing, and the ESR number (Requirement 5-2062). Also, if the product has options for the type and grade of the steel, specify the steel type and grade (Requirement 5-2063). Finally, for adhesive anchors, in addition to the drawing requirements given in Specification Section 05 0520, also indicate the following (Requirement 5-2064):

1. Anchors that are horizontal or upwardly inclined that support sustained tension.
2. For anchors in tension, parameters associated with the characteristic bond stress used for design per ACI 318 Sections 17.6.5 and 26.7.1.
3. Anchors requiring proof loading in accordance with ACI 355.4, or the inspection program established (by the SEOR).
4. Certification required for installers of adhesive anchors including anchors that are horizontal or upwardly inclined to support sustained tension.

C. The SEOR shall specify, for each location in which a PI anchor is to be installed, parameters associated with the strength used for design, including anchor category and "base-material-specific information" listed below (Requirement 5-2065). If none of these parameters/properties change from one anchorage location to another, they need only be indicated once.

1. Concrete Installations: Concrete type (i.e., normal- versus light-weight); compressive strength, f'c; required installation torque, requirements for hole drilling and preparation, and thickness.
2. Grouted-Masonry Installations: Masonry compressive strength (f'_m) and thickness; concrete masonry unit (CMU) type (i.e., grade; type; and weight); mortar type (i.e., M, S, or N); and grout compressive strength, f'_g.

NOTE: There are differences in CMU and mortar types permitted by the ESRs for masonry anchors acceptable for use per A.12.B.

D. The SEOR shall indicate which, if any, anchors to be installed are Seismically Exempt Anchors per A.7 herein (Requirement 5-2066).

E. The SEOR shall indicate corrosion protection for exposed anchors intended for attachment with future Work (Requirement 5-2067).

A.14 Recommended Methodology for Seismic Design of Anchorage to Concrete or Masonry for Nonstructural Components

A. Determine demand on component.

2021 IBC (1613) → ASCE 7-16 (Chapter 13, 13.2.3, 13.3 and 13.4)

[18] Per Section 1.3.F of LANL Master Spec Section 05 0520, seismically exempt anchors must be identified; however, such identification need not include all the specificity required for non-seismically-exempt anchors.

B. Compute demand(s) on anchorage, to include any prying effects and allowance for (potential) $\pm$ 1 inch anchor relocation.

1. For concrete, ACI 318-19 Section 17.10 will affect the demand(s) that must be designed for in many instances.
2. For grouted masonry, Allowable Stress Design (ASD) is a permissible alternative to Strength Design (SD; also known as Load and Resistance Factor Design, or LRFD).[19]

C. Compute anchor capacities, to include allowance for (potential) $\pm$ 1 inch anchor relocation.

1. For concrete, compute anchor capacities for various failure modes per ACI 318-19 Sections 17.3 through 17.5.
2. For grouted masonry, use TMS 402-16 (Chapter 8, 8.1.3.2 or 8.1.3.3 for ASD; or Chapter 9, 9.1.4.1, 9.1.6.2 or 9.1.6.3 for SD) for cast-in-place anchors; and, for PI anchors, use ICC-ES reports based on ICC-ES AC01, AC58, or AC106.

D. Determine capacity of anchorage.

1. For concrete, compute the anchor strengths indicated in ACI 318-19 Sections 17.5.1 through 17.5.3.
2. For grouted masonry, compute the anchor strengths using TMS 402-16 (Chapter 8, 8.1.3.2 or 8.1.3.3 for ASD; or Chapter 9, 9.1.4.1, 9.1.6.2 or 9.1.6.3 for SD) for CIP anchors[20]; and, for PI anchors, using ICC-ES reports based on ICC-ES AC01, AC58, or AC106.

E. Check capacity $\geq$ demand, to include, if applicable, interaction.

1. For concrete, ensure compliance with ACI 318-19 Sections 17.5.2 and 17.8. Regarding the latter, the provisions of 17.8 or the equation in Fig. R17.8 may be used.
2. For grouted-masonry, ensure compliance with TMS 402-16 (Chapter 8, 8.1.2, 8.1.3.2, or 8.1.3.3.3 for ASD; or Chapter 9, 9.1.2 - 9.1.4.1, 9.1.6.2, or 9.1.6.3.3 for SD) for cast-in-place anchors; and with ICC-ES reports based on ICC-ES AC01, AC58, or AC106 for PI anchors.

[19] If ASD is selected, the seismic demand, Fp (ref. ASCE 7, 13.3) can be reduced by 30% (i.e., multiplying by 0.7). This reduction is required by ASCE 7, Section 13.1.8 for some ASD designs. Regardless of whether ASD or SD is selected, the demand for a CIP anchor(s) may have to be increased per ASCE 7 Section 13.4.2.2.
[20] Per ASCE 7 Section 13.4.2.2 a ductile steel element shall govern capacity, or else either ductile yielding of the support prior to anchor capacity being reached shall govern capacity, or the demand shall be increased by 2.5.

APPENDIX B – DESIGN APPROACH FOR COMMERCIALLY FABRICATED BUILDINGS USED IN MULTI-STATE JURISDICTIONS[21]

B.1 Approval is currently limited to the following vendors (others with Chapter POC written permission): ARMAG, MSSI, and US Chemical.

B.2 Risk Category I, II, and III (per ASCE 7 Table 1.5-1), commercially fabricated building-like structures designated as ML-4 that are not included as credited SSCs in nuclear or radiological safety documentation; and that are not one of the structural systems described in ASCE 7 Chapter 12 may be designed/treated as follows:

a. Such buildings may be treated, designed and detailed in accordance with ASCE 7 Section 15.5 for non-building structures similar to buildings, as stipulated in ASCE 7 Section 11.1.3. However, if a nationally marketed structure type does not fit into the categories included in ASCE Section 12.2 or 15.5, then ASCE 7 Section 15.6 covering non-building

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[21] A commercial building that is marketed nationally is termed "commercial building structure." Typically, these structures are factory built, transported to the site on trailers, and anchored to engineered foundations. At LANL, the intended purpose for these structures is to serve as storage facilities, control facilities for experimental work, weather proofing structures for materials, equipment or piping systems, security portals for entry access, etc. These structures are sometimes occupied, but not continuously; the occupancy is limited for the special purpose of the facility. These structures have building geometries and framing systems that may be different from the broader class of occupied structures addressed in ASCE 7, Chapter 12.

ASCE 7, 11.1.3, states:

"Structures and their nonstructural components shall be designed and constructed in accordance with the requirements of the following chapters based on the type of structure or component:

a. Buildings: Chapter 12
b. Nonbuilding Structures: Chapter 15
c. Nonstructural Components: Chapter 13
d. Seismically Isolated Structures: Chapter 17
e. Structures with Damping Systems: Chapter 18

Buildings whose purpose is to enclose equipment or machinery and whose occupants are engaged in maintenance or monitoring of that equipment, machinery or their associated processes shall be permitted to be classified as nonbuilding structures designed and detailed in accordance with Section 15.5 of this standard…"

The limited nature of the occupancy associated with these structures reduces the life-safety risk associated with their performance in hazards such as wind and earthquakes, and therefore their designation as non-building structures appropriately applies to these classes of structures as implied in the text of Section 11.1.3. This approach to Section 11.1.3, to cover both Section 15.5 and the default structure reference of Section 15.6, is necessary to cover structures in which hybrid structural systems, such as when structural steel and cold formed members are used concurrently, or other non-listed structural types that are commonly fabricated and marketed nationally.

These structures are comparatively small with respect to normal building structures and have inherent strength that is not always accounted for in normal engineering calculations. Also, given that they are transported to the site on trailers, they are essentially load-tested while in transport through road vibration and wind resistance. This provides added assurance of acceptable performance.

This approach is in keeping with ASCE 7, Section 11.1.4 Alternate Materials and Methods of Construction, which states "alternate materials and methods of construction to those prescribed in the seismic requirements of this standard shall not be used unless approved by the authority having jurisdiction. Substantiating evidence [as described in this clarification] shall be submitted demonstrating that the proposed alternate will be at least equal in strength, durability, and seismic resistance for the purpose intended." Approval relies on the fact that commercially fabricated building structures are engineered and that all such structures have design documents that have been appropriately stamped by a registered professional engineer. See ESM Ch 16 IBC-GEN Section 10.0 "Prefab Structure Requirements".

This appendix incorporates and supersedes Clarification CIR-16-004.

structures not similar to buildings shall be used, and the default structure type per Table 15.4-2 shall be *"All other self-supporting structures, tanks, or vessels not covered above or by reference standards that are not similar to buildings."*

APPENDIX C – RESTRAINT OF NON-FACILITY (E.G., PROGRAMMATIC) EQUIPMENT

Note: This appendix supersedes similar material where it exists in ESM Ch. 16.

Restraint (i.e., anchorage and/or bracing) of non-facility (e.g., programmatic, utility, infrastructure, environmental remediation) equipment is required in either of the following circumstances (Requirement 5-2068)**:**

C.1. When required by the manufacturer for normal operation.[22]

a. If this is the sole reason restraint is required (i.e., seismic restraint per criterion 2 below is not required), then the design need not be per ESM Ch. 5 if the manufacturer provides alternative design requirements (Requirement 5-2069).

C.2. In a non-nuclear facility, seismic restraint is required unless the equipment is "Seismically Exempt" per Section II.1.8.B.3, 1613.4.3 Nonstructural Components Exempt from Seismic Design (Requirement 5-2070).

a. If seismic restraint is required, the design must comply with Ch.5 Section II, the installation and quality control per the appropriate LANL Master Spec(s), and the QA per ESM Ch. 16 (Requirement 5-2071).

b. An alternative method may be proposed to the ESM Structural POC for approval provided:

1) An analysis that determines the interaction effects of the unrestrained equipment[23] is acceptable at the DBE, or

2) The equipment will be in an essentially unoccupied area[24] and is protected as such through administrative or engineering control.

3) Anchorage and/or restraint is not practical.

c. In an existing facility, unless the building is undergoing an alteration that involves the structural provisions of IEBC (2021) Section 304; Chapter 5; or Sections 705, 805, or 906; it may be that restraint can be designed to lesser requirements; see Code of Record/Structural discussion in ESM Ch. 16 (*Sect. IBC-GEN Att. B., 301.1, which specifically addresses anchorage*).

NOTE for Equipment Outside: Both of the above criteria also apply outside of a building. If the above require an item to be restrained for wind and/or seismic when it is inside of a facility; then restraint must either be provided or shown/proven to be not required (Requirement 5-2072).

NOTE for Laboratory Equipment Inside: Seismic restraint of lab equipment inside of a building can be achieved using the Safe-T-Proof Laboratory Equipment Anchorage Kit (STP-MP-203-09-ICC) in accordance with ICC ES ESR-4167 or other approved means.

[22] Reasons related to performance, functionality, operability, etc. (e.g., motor, centrifuge, certain suspended items/systems, etc.)
[23] For example, interaction due to rocking, swaying, overturning, sliding, impact, etc. Refer to ASCE 4-16 Chapter 11 for guidance on methods that can be used for such analyses. However, notice that in all cases, equipment must be anchored if it is permanently attached to utility services (electricity, gas, and water) per ASCE 7 Section C13.1.1.
[24] That is, incidental occupancy: occupied for a total of less than 2 hours/day, yearly average (RP 8 exemption 1.3.d utilized herein). Not the same as *incidental use* (IBC Section 509 term relating to certain adjunct uses).