ALTERATIONS AND SEISMIC UPGRADE:

THE BUILDING CODE AS MITIGATION POLICY

A Special Projects and Initiatives report to Earthquake Engineering Research Institute

November 19, 2014
David Bonowitz, S.E.
605A Baker Street
San Francisco, CA 94117
dbonowitz@att.net

David McCormick, S.E.
Peter Somers, S.E.
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David Bonowitz, S.E.
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David McCormick, S.E.

Peter Somers, S.E.
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Executive Summary

This report addresses the question of when the building code should require seismic upgrade for a building undergoing a voluntary alteration. It proposes the re-introduction of an optional alteration-based upgrade trigger into the national model codes, but with a customizable feature that both respects local precedents and supports local mitigation planning.

The code change proposal is described in Section 4 and Appendix C. The balance of the report provides background and rationale. As such, the report is written primarily for building officials, risk reduction professionals, and others engaged in the development of mitigation policy, especially through building codes. However, Section 1 might also be useful as a general review of how building codes regulate alteration projects. Section 2 (with Appendix A) provides a detailed review of past and current code provisions, with examples of local amendments. Section 3 (with Appendix B) describes the results of a survey produced for this report, addressing the normative questions: How should the building code treat alteration projects, and what are the best ways to manage the seismic risks posed by existing buildings?

In the background sections, the report identifies a disconnect between the recent direction of model code development and the evolving field of resilience-based mitigation.

- Contrary to the expectations of most stakeholders, current model building codes in the U.S. almost never require a seismic upgrade when a deficient building undergoes a substantial alteration (Sections 2.1, 2.2). As a result, upgrade provisions for alteration projects remain only in the local codes of major jurisdictions (Section 2.6).
- Smaller jurisdictions, and even large jurisdictions that currently lack upgrade triggers, are unlikely to develop their own because the trend in regulation is strongly toward amendment-free adoption of national model codes. National model codes are unlikely to develop effective alteration-based upgrade triggers because the legitimate mitigation priorities of different jurisdictions vary so significantly (Section 2.6).
- Nevertheless, building code upgrade triggers represent an underused mitigation strategy that, along with mandates and voluntary incentives, should be part of a mitigation planner's toolkit. Triggered upgrades can be effective especially where mandatory mitigation would be politically or logistically infeasible (Sections 3.1 and 3.2).
- Meanwhile, building developers, owners, and tenants find it reasonable that a major alteration project should be required to address known seismic deficiencies, but in a way that is more effective than a generic or arbitrary-seeming code trigger (Section 3.3).

Thus, while alteration-based seismic upgrade triggers can represent good mitigation policy, current trends make such provisions unlikely, at least in model codes. Based on these findings, this report proposes a customizable upgrade trigger that would allow a jurisdiction to tailor its code to suit its mitigation priorities, without needing the same trigger to be adopted nationally (Section 4.1 and Appendix C).

The proposed model code provision would work like this: For a voluntary building alteration exceeding a certain scope—a triggering alter-
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Alteration—the code would require a seismic evaluation; if the evaluation finds deficiencies, it would trigger seismic retrofit as well. But the triggered seismic work would only be required for building types designated in advance. Typically, these would be vulnerable combinations of structural system, age, occupancy, and other readily known building attributes. But they could also include particular sectors of the building stock identified in a local mitigation plan. Each jurisdiction would designate its own list of building types, customizing the model alteration trigger to suit its own priorities and resources.

Compared with past and current alteration provisions, the proposed trigger is expected to better satisfy the recognized priorities of building owners, code officials, and mitigation advocates (Section 4.2). Compared with a retrofit mandate, the proposed trigger would be more politically viable and more administratively feasible.

But most important, the proposed provision would be customizable from jurisdiction to jurisdiction and adjustable within a jurisdiction over time. It would allow a community to focus on whichever of its buildings are most likely to affect its earthquake response and recovery.

Terminology

Alteration: This report assumes the following meanings for certain engineering and vernacular terms:

One of five broad project types addressed by the IBC and IEBC model codes. The 2012 IBC definition reads, “Any construction or renovation to an existing structure other than repair or addition.”

Unlike a repair, an alteration is voluntary and is not prompted by damage. Unlike an addition, an alteration does not add any floor area or height to the building. Though not mentioned in the IBC definition, an alteration is also distinct from two other code-identified project types—change of occupancy and relocation. A change of occupancy or relocation will often be executed together with alterations, but for code purposes, different project types are thought of as independent.

Thus, an alteration project can include anything from the upgrade or addition of a single piece of equipment to a room reconfiguration to a full building remodel.

- The 2012 IBC treats all alterations the same way.
- The 2012 IEBC splits them into three groups: Level 1 alterations for basic “remove and replace” upgrade projects; Level 2 for new equipment, changes to doors or windows, system extensions, and reconfigured space; and Level 3 where the reconfigured space exceeds half the building area.
- 2012 IRC Appendix J uses obsolete terminology: renovations, alterations, and reconstructions are similar but not identical to the IEBC’s Level 1, 2, and 3 alterations.

Building Code: The regulations, adopted and enforced within a given jurisdiction, that set minimum requirements for new buildings and for work in or related to existing buildings. The building code includes other codes and standards referenced by its provisions. The building code also effectively (if not explicitly) includes interpretations and variances approved by the jurisdiction.

Most building codes comprise a model code, such as the IBC or IEBC (but not necessarily the latest edition), and local amendments. See Appendix A for further discussion and relevant excerpts from various building codes.

Code: A shorthand term meaning the building code, as opposed to a local planning code or other codes. Depending on the context, it can refer to either a model code or to a jurisdiction’s building code.
**IBC:** The International Building Code, a model code primarily for new buildings but including some provisions for existing buildings. Through the 2012 edition, Chapter 34 addresses existing buildings. The 2015 edition will instead refer to the IEBC as a referenced code.

**IEBC:** The International Existing Building Code, a model code exclusively for projects involving existing buildings.

The IEBC contains three independent sets of provisions, called methods. Through the 2012 edition, two of them, the Prescriptive method and the Performance method, are identical by rule to source provisions in IBC Chapter 34. The third method, the Work Area method, is what distinguishes the IEBC. Consequently, references to the IEBC’s Work Area method are sometimes shortened to refer only to “the IEBC.”

**IRC:** The International Residential Code, a model code exclusively for townhouses of limited size and for one- and two-family dwellings. Though used primarily for new buildings, the IRC contains nominal provisions for existing IRC-eligible buildings, as well as an optional Appendix J specifically for existing IRC-eligible buildings.

**Model code:** A generic building code intended for adoption, with or without amendments, by jurisdictions or regulatory agencies. The IBC, IEBC, and IRC are leading examples of model codes.

**Trigger:** An existing or proposed condition that prompts additional work beyond the intended project scope. Along with targeted conditions, exceptions, triggered scope, and criteria, the trigger is part of a building code provision that requires additional work when certain conditions exist or when the intended work would exceed some threshold. While code provisions for existing buildings rely on the concept of a trigger, the word “trigger” is not actually found in the code itself.

For example, a code provision might say that when a project would replace 50 percent of a building’s roofing, parapet braces must be added to any unreinforced masonry building except for a one- or two-family dwelling. In this case:

- The intended work is the replacement of roofing,
- The trigger is the replacement beyond the 50 percent threshold,
- The targeted condition is an unreinforced masonry building with unbraced parapets,
- An exception is made for one- and two-family dwellings,
- The triggered scope is the installation of parapet braces (but not, in this case, retrofit of the entire building), and
- The criteria would be given elsewhere in the provision.

Alteration-based triggers can be based on the extent, location, or cost of the intended alteration, the structural effect of the intended alteration, or other conditions. See Appendix A for examples of alteration-based seismic triggers from various building codes.

Previous work (Hoover, 1992; FEMA, 2000, Appendix A; ASCE, 2006, Appendix A) sometimes referred to “active triggers” and “passive triggers.” Passive triggers were conditional requirements typical of building codes, as described above; the resulting upgrade is now referred to simply as triggered work, as discussed throughout this report. Active triggers were programs requiring mitigation independent of an intended project; this is now referred to as mandatory work. The newer terminology is consistent with recent publications by ATC (2009) and ASCE (2014, Appendix B), which distinguish among mandatory, voluntary, and triggered retrofits.

**UBC:** The Uniform Building Code, published by the International Conference of Building Offi-
cials (ICBO), a model code used throughout the western United States until it was replaced by the IBC in 2000. The UBC was first published in 1927 and later published on a triennial cycle through its final edition in 1997.

Work Area Method: See “IEBC” and Sections 2.3 and 2.5.

1. Introduction

If a building with seismic deficiencies is renovated, should public policy require that it be seismically upgraded as well?

That is the main question addressed in this report. As it happens, it has been asked before: in a report produced for EERI in 1992, Cynthia Hoover reviewed the local codes and practices of 24 California cities and recommended that jurisdictions adopt a uniform seismic upgrade trigger in their building codes (Hoover, 1992). Two decades on, model codes used throughout the country reflect half of that recommendation: they’re uniform, but they uniformly trigger almost nothing.

Much has changed in the last twenty years:

- Model codes and engineering standards that did not exist in 1992 now allow a more nuanced and sophisticated approach to evaluating and reducing earthquake risk. At the same time, widespread use of model codes has discouraged local amendments and innovation.

- In 1992, the focus of seismic retrofit was almost entirely on safety. Today, owners, lenders, insurers, and designers routinely think about sustainability, business continuity, repair cost, and recovery time as well.

- Trends in planning and design have brought new interest to old buildings, creating a substantial market for renovation and adaptive reuse.

- While building codes are still applied one project at a time, jurisdictions have begun to understand them as policy tools that also serve more comprehensive, community-wide resilience goals.

The prevalence of model codes, ongoing evolution of alteration provisions, new thinking about earthquake resilience, and a robust market for renovation together merit a new look at how and when building codes should call for seismic upgrade.

1.1 Why focus on alterations?

Over the last decade, the leading model building code, the IBC, has usefully organized its provisions for existing buildings by project type, following the approach of its companion model code, the IEBC. The five project types are addition, alteration, repair, change of occupancy, and relocation. Each project type has its own set of provisions identifying conditions that must be met, whether intended by the permit applicant or triggered by the code. Among these are provisions for structural elements, some of which involve seismic evaluation and retrofit.

The alteration provisions for structural and seismic issues, as Hoover showed, have a history of local modification and inconsistent application. Through the 2012 editions they remain the least consistent of any project type between the IBC, IRC, and IEBC Work Area method. Building additions (especially vertical additions) have long triggered seismic evaluation and potential retrofit. Change of occupancy was already a trigger for seismic work when Hoover studied it, though the provisions are clearer now. Repair-based triggers were added to IBC Chapter 34 in 2009, but they mimic the IEBC and are relatively well understood. Provisions for relocated buildings are also straightforward. But the alteration provisions remain different in each model code and continue to evolve. With each code cycle, some inconsistencies are removed, but others remain, or are even highlighted to reflect
differences in philosophy among the three model codes. Perhaps as a result, the current IBC alteration provisions for seismic work still lead to misunderstanding, inconsistent enforcement, and sometimes dissatisfaction, especially among earthquake safety advocates.

Alterations are also of interest because they are so much more common than additions or major repairs. Typical alterations are cost-effective improvements that allow a building to adapt to changing technologies, styles, and markets, maintaining the building stock and benefiting the local economy.

- Unlike additions or relocations, alterations are frequently of small scope or limited to only part of a building. An owner can tailor the project as needed to control direct, indirect, and triggered costs.
- Unlike repairs, alterations are almost always voluntary, so an owner can control the project timing and phasing.
- Unlike changes of occupancy, alterations rarely affect the use of the building, so they do not increase the safety risks the building code routinely regulates.

Alteration—which encompasses renovation, modernization, adaptive reuse, and other terms of art—has also been touted as culturally, aesthetically, and even environmentally beneficial (Priebe, 2013). A study by the National Trust for Historic Preservation found that “building reuse almost always offers environmental savings over demolition and new construction,” even when a new building would be 30 percent more energy-efficient than the one it replaced (NTHP, 2011). Indeed, of four cities studied—Atlanta, Chicago, Phoenix, and Portland—the one with the most pronounced seismic risk, Portland, also showed the best potential for environmental savings.

Whether for architectural, environmental, planning, or bottom line cost reasons, building alteration is an enormous market in both absolute and relative terms. In 2011, over 60 percent of all commercial construction projects nationally were alterations, comprising about a quarter of the total commercial market (McCook, 2012, p27). Where the built environment is already dense, the relative number of alteration projects can be overwhelming. Between 2006 and 2011, San Francisco issued almost 120,000 building permits, for buildings of all types and projects of all sizes; only 1090, less than 1 percent, were for new construction (DBI, 2007-2012).

And the alteration market share is growing, while the market for building additions remains steady and the number and value of new construction projects drops. The 60 percent alteration share in 2011 was up from about 45 percent in 2006. In absolute terms, the market for major alterations alone (more than $1 million) was $44 billion in 2010 but is projected to be $57 billion in 2015 (McCook, 2012, p28).

While most jurisdictions want to encourage alterations, they must also manage the earthquake risks posed by obsolete or non-compliant structures. A triggered seismic upgrade—not limited to a single floor or tenant space, no longer voluntary, and often of disproportionate cost—though itself beneficial in the long term, can discourage owners from doing other beneficial work in the short term.

1.2 The issues

The main question—should certain alterations trigger seismic upgrade?—raises, not surprisingly, more detailed questions about the purpose of building codes, the purpose of seismic mitigation, and the expectations of building owners, tenants, and users.

The first question might be: Despite what past building codes required or what the public might expect, what do our current building codes actually intend to achieve when existing buildings undergo alterations? As we show
in Section 2, revisions to the IBC in 2009 clarified that code’s alteration trigger, facilitating consistent enforcement, but leaving some jurisdictions and stakeholders (including not a few engineers) dissatisfied. The vagueness of the previous wording had allowed some jurisdictions to develop their own interpretations of how and when the trigger was supposed to apply. The clearer 2009 provision would be at odds with what had become local policy, so the basic question—what does the code intend?—was inadvertently reopened.

The 2009 revision clarified that the IBC would trigger seismic upgrade only for alterations that reduce structural capacity (by cutting walls or columns, for example) or increase seismic demand (by adding substantial mass). Most architectural and mechanical projects, even those that thoroughly renovate the whole building, would not pull the trigger. The apparent intent of the code is to allow an altered building’s seismic performance to stay as it is, neither increasing nor reducing risk.

Even if rational, is this intent consistent with the code’s more aggressive upgrade triggers for fire suppression, disabled access, or flood resistance? Do the concerns behind those triggers—safety, social equity, control of insured losses—not apply to earthquake risk?

Plus, if the intent is to keep the seismic risk where it is, one might ask: Doesn’t a major alteration in a deficient structure increase the risk by exposing all that new architecture and equipment to the effects of poor structural performance? And if the alteration extends the life of the building, doesn’t that increase risk by making the building vulnerable to larger earthquakes with longer return periods?

Meanwhile, as the widely used IBC was being updated in 2009, the IEBC’s Work Area method was gaining acceptance as an alternative. In contrast to the IBC, the Work Area method explicitly triggered mitigation for recognized seismic hazards such as unreinforced brick parapets. The IEBC was implementing a different philosophy, or at least a more proactive version of the IBC approach. But if different model codes make different requirements, might an owner or engineer be liable for the consequences of using one and not the other? From a policy perspective, if different approaches are equally appropriate, on what basis should a jurisdiction select one or the other? Further, if alterations are going to trigger seismic upgrade, why should the code focus on only one or two structure types or deficiency types?

More generally, was one of the two model codes out of line? That is, should it be the role of the building code to impose mitigation requirements on top of basic safety regulations? After all, if the risk from an existing building is unacceptable, why wait for an alteration to address it? Wouldn’t specific legislation, targeting all such risks, with or without alteration projects, be more appropriate?

It makes sense that these policy questions—whether to be proactive about mitigation, which deficiencies to target—might have rationally different answers in different jurisdictions. So even if local stakeholders can agree to support a set of alteration-based upgrade triggers, how would the provisions be structured within a model code? If local jurisdictions routinely amend the model code when they adopt it, this is perhaps a less important question. But the trend is in the other direction, with many states enforcing, or at least preferring, rules for “amendment-free” adoption.

In some cases “amendment-free” adoption is meant to ensure the benefit of using the model code, protecting it from being watered down by political interests or obsolete local practices. In other cases, the practice is less of a rule than a recognition that local building departments lack the resources to implement an amendment procedure. In 1992, for example, Hoover showed wide variation in amendments and enforcement among California jurisdictions. Since then, California law has been changed so that amend-
ments are made at the state level, and local variations require justification based on “local climatic, geological or topographical conditions” (CHSC, Sections 17958.5 and 17958.7). In practice, only the largest and most proactive California jurisdictions make local amendments.

The result is something of an unintended consequence. High quality national model codes give all jurisdictions access to the same state-of-the-art regulations without the need for tedious code amendment proceedings at the local level. The newer codes have smoothed out some of the inconsistencies Hoover identified in 1992, but in doing so they have allowed local policy-making to atrophy. If a proposed code change cannot succeed on the national stage, it now has little chance of being adopted anywhere but the largest cities.

For new buildings, uniformity across jurisdictions probably offers more pros than cons. But existing building stocks, and the seismic risks they pose, can vary substantially even from town to town. As regulation evolves to address community resilience in addition to building safety, occupancy will become more of a factor in policy, and variation between jurisdictions will be even greater.

So the final question becomes: How might an alteration trigger for seismic upgrade be reintroduced to the model codes in a way that allows local modification while leveraging the benefits of code uniformity?

1.3 Notes on terminology

This report is about seismic upgrades triggered by alteration projects. While those words have common meanings, each deserves some discussion of how it is used in the context of building codes and public policy. (For more specific definitions, see the Terminology section above.)

An alteration is a type of construction project within an existing building. Most alterations do not involve any structural work, and even structural alterations need not involve any elements of the seismic force-resisting system. Importantly, an alteration is undertaken voluntarily and is thus different from a repair (though historically the two project types might have been regulated the same way).

A seismic upgrade is any project that intends to improve a building’s expected performance under any load combination that includes earthquake effects. In common usage, the term “upgrade” suggests an actual physical improvement. Building codes, however, do not use the term “upgrade” with respect to seismic or structural work; instead, they simply call for compliance with certain criteria that might or might not be met already. Code-required work will either improve performance or merely confirm that the expected performance already satisfies the stated criteria. Compliance is often a two-step process (and current code provisions express it as such): first, evaluate the altered building; then make physical changes as needed to address any deficiencies found by the evaluation. Thus, “upgrade” in the building code context might be better understood as “potential upgrade.” If no deficiencies are found, no physical changes need be made; in this case, the evaluation represents an “upgrade” in the sense that it has changed our expectation about the performance of an older building. In this report, while we generally use the term “upgrade” to connote actual physical improvement, we also mean it to include the evaluation step contemplated by the code.

Where a seismic upgrade does involve physical changes to the building, the term is synonymous with seismic retrofit (the term now used in the title of the engineering standard ASCE 41-13) or seismic rehabilitation (the term used by its predecessor, ASCE 41-06).

In the most general sense, an upgrade can address structural elements, nonstructural components, geologic components (soil, slopes), or externalities (adjacent buildings or infrastruc-
tute). Regulations focused on resilience can expand the notion of improved performance to include a reduction in losses of any sort, including repair cost or downtime. Nevertheless, seismic upgrade provisions in building codes still generally consider only physical building components, and even then only rarely look beyond the structural elements.

From a public policy perspective, a seismic upgrade can be voluntary, mandatory, or triggered. A voluntary upgrade is initiated by the owner for her own reasons. A mandatory upgrade is required by the jurisdiction as a matter of policy, whether the building owner desires it or not. This report deals only with triggered upgrades, which are neither fully voluntary nor fully mandatory. In a triggered upgrade, the scope of a proposed project—typically, a building addition, change of occupancy, or major alteration—exceeds some defined threshold and thereby invokes seismic work beyond what was intended by the project owner. The triggered upgrade adds a triggered scope of work to the owner’s intended scope of work.

Some upgrades are done because an institution—a university or corporation, perhaps—has adopted its own policy that sets a minimum performance requirement for purchased or renovated buildings. Also, some upgrades are done to satisfy another party, such as a buyer, lender, or insurer. While these upgrades might seem mandatory or triggered from the perspective of the owner, they are done by agreement between private parties and are therefore voluntary from the perspective of the jurisdiction. This report does not include such upgrades as triggered.

In short, then, when we say that an alteration “triggers a seismic upgrade,” we mean that certain provisions for regulating alteration projects invoke a legal requirement to comply with seismic criteria that are usually, but not always, stricter than those that were used to design the existing structure.

1.4 Project methodology

Any new approach to a long-standing code topic such as triggered upgrades should account for both traditional and current practices. Our goal was to study both, to identify how and why the code has changed over time, and to develop code change proposals that would respect the fundamental priorities of multiple stakeholders.

We reviewed current provisions from model codes and local amendments and traced their origins and evolution over time. From these we identified the (often implicit) intent of past and current regulations.

We then constructed a survey to solicit current attitudes toward these traditional ideas. The survey, while non-scientific, was intended to find consensus that could support a code change proposal. Based on our review of past code provisions, we sought opinions and insights from a range of non-engineer stakeholders on the policy question of whether and when code provisions should call for proactive risk reduction in the case of building alterations.

Finally, combining the survey results with established code precedents, we developed a code change proposal suitable for adoption by the leading model code, the International Existing Building Code.

1.5 Organization of the report

The report’s three main chapters follow the steps in our methodology. Section 2 reviews past and current model code provisions, as well as trends in local amendments. Section 3 addresses questions about the purpose of certain code provisions, citing input we received through the stakeholder survey. Section 4 recommends certain changes to the model building codes to reflect conclusions from Sections 2 and 3.
Detailed background material is presented in three appendices. Appendix A gives examples of current code provisions and local amendments. Appendix B presents the survey questions and responses. Appendix C includes the text of the code change proposal submitted in the most recent code cycle to the International Code Council.


2.1 Pre-2009: UBC and IBC

The evolution of model code provisions for existing buildings, specifically those regulating alteration projects, has been traced by Hoover (1992), Holmes (2006), and Mattera (2006). Prior to the last few code cycles, the modern history breaks into three main phases, each characterized by a shorthand version of the relevant provision: The “25-50” rule, the “no more hazardous” rule, and the “10 percent” rule.

The “25-50” rule

The so-called “25-50” rule triggered upgrades based on the relative cost of an addition, alteration, or repair. The provision was found in Section 104 of the Administrative chapter of the UBC through its 1976 edition. At the time, there were no specialized codes or standards for existing non-conforming buildings. The only consensus code provisions were for new construction, so Section 104 simply addressed the question of whether the existing building should have to meet the code’s criteria for new buildings. Typical language, from the 1964 UBC, included the following:

When additions, alterations, or repairs within any 12-month period exceed 50 per cent of the value of an existing building or structure, such building or structure shall be made to conform to the requirements for new buildings or structures.

Additions, alterations, and repairs exceeding 25 per cent but not exceeding 50 per cent of the value of an existing building or structure and complying with the requirements for new buildings or structures may be made ... without making the entire building or structure comply.

Thus, the trigger is based on the cost of the intended alteration relative to the value of the entire building. Where the alteration cost exceeds 50 percent, the entire building must be “brought up to code.” Where the cost is between 25 and 50 percent, the alteration work itself must meet the code, but the balance of the building may remain non-conforming. For alterations under the 25 percent threshold, structural work was also required to be as for new buildings, but nonstructural alterations were allowed to use original materials and details, even if non-conforming.

These provisions say nothing about specific load cases. Seismic upgrade is simply implied by the reference to “the requirements for new buildings,” as is upgrade for gravity loading, wind loading, mechanical and electrical systems, or exiting and fire safety.

The intent of this three-tiered rule was clear. According to Holmes, it represented a policy in line with prevailing social and economic norms: “If sufficient resources were spent to renew a building, ... then the building should also be renewed seismically” (Holmes, 2006).

But the implementation was problematic. First, the idea of applying a code to part of a building (as was required for the cases between 25 and 50 percent) might work for some architectural provisions, but not for seismic force-resisting structural elements, which require a degree of
symmetry and a load path to the foundation. Engineers learned quickly that it is difficult (and sometimes nonsensical) to apply the code for new buildings to older non-conforming ones. It was this conundrum that led, in part, to the development of performance-based, as opposed to prescriptive, engineering standards.

Second, the cost figures required by the provision proved difficult to calculate consistently (Galvan, 2006). Some interest groups, including the National Council of Structural Engineers Associations, have argued against the use of cost-based triggers because they put the building official in the position of vetting financial calculations and because they would require an owner (or permit applicant) to have a design estimated or bid before knowing whether the trigger would apply. Nevertheless, cost-based triggers are still found in model code provisions for flood hazard areas (see 2012 IBC Section 3404.2, discussed below) and in some local codes and policies for public buildings (CBSC, 2013, Section 3417.3; NIBS, 2011, Section 2.1).

But most significantly, the “25-50” rule was found to discourage even basic alterations. The full compliance triggered by the 50 percent threshold ballooned certain project costs and led some owners to cancel common-sense renovations and defer important maintenance (Galvan, 2006; Mattera, 2006). In particular, the U.S. Department of Housing and Urban Development concluded that the “25-50” rule was hampering efforts to rehabilitate and modernize low-income housing (NAHB et al., 1997; BTI, 2001). Following HUD’s recommendation, the “25-50” rule was removed from the UBC after the 1976 edition.

The “no more hazardous” rule
With no clear upgrade trigger after 1976, the UBC’s alteration provision through its final edition in 1997 prohibited only the creation of new “unsafe” or “hazardous” conditions. The provision remained in Administrative Section 104 through the 1991 code and was moved to Chapter 34, a new chapter for Existing Structures, in 1994. The text itself remained essentially unchanged for two decades, the key sentences from 1997 UBC Section 3403.2 being as follows:

Additions, alterations or repairs may be made to any building or structure without requiring the existing building or structure to comply with all the requirements of this code, provided the addition, alteration or repair conforms to that [sic] required for a new building or structure.

Additions or alterations shall not be made to an existing building or structure that will cause the existing building or structure to be in violation of any of the provisions of this code and such additions or alterations shall not cause the existing building or structure to become unsafe. ...

Additions or alterations shall not be made to an existing building or structure when such existing building or structure is not in full compliance with the provisions of this code except when such addition or alteration will result in the existing building or structure being no more hazardous based on life safety, fire safety and sanitation, than before such additions or alterations are undertaken.

As with the “25-50” rule, this provision is not specific to seismic upgrade or even to structural elements in general. Unsafe conditions can be related to the structure, exiting, fire resistance, or other issues.

The first sentence quoted above requires the alteration work itself to conform with standards for new buildings, similar to the “25-50” rule’s
middle tier. Again, however, this can be problematic for structural elements: What does it mean, for example, to strengthen a beam as part of an alteration project, but to leave untouched the rest of the frame system of which the beam is a part? The second and third sentences, though possibly contradictory, suggest an answer to this rhetorical question: One may do anything one likes to the structure as long as the building does not become “unsafe” or “more hazardous.” If the building is already non-conforming (or “in violation”), the alteration may still be made, according to this interpretation, as long as the alteration itself does not cause the violation.

But the larger issue was simply that the “25-50” trigger had been replaced by essentially no trigger at all. The fact that a building must remain safe—or as safe as it was—need hardly be stated in a building code, yet that was the low bar set for alterations by this new provision. The laudable intent was clearly to facilitate renovation and reuse of aging buildings. But this model code provision came to building officials who had already established decades of local practices based on interpretations of the “25-50” trigger. Their communities had come to expect that major alterations would impose at least some upgrade requirements. So it is perhaps not surprising that even after the model code replaced the “25-50” rule with the more permissive “no more hazardous” rule, its implementation was inconsistent, and many jurisdictions continued to enforce some variation of a cost trigger (NAHB et al., 1997) or judgmental rules about common-sense improvements related to the intended alteration (Holmes, 2006). Local provisions enforced, often on a case-by-case basis, triggers based on “increase in occupancy, major remodels, substantial structural alterations, vacancy, and change of ownership,” none of which were in the UBC proper (Hoover, 1992).

This was the situation when Hoover studied local seismic upgrade triggers in California. Just as the UBC was relaxing its general trigger for alterations in the late 1970s, Congress was creating FEMA and the National Earthquake Hazards Reduction Program (NEHRP), two organizations that would promote seismic retrofit and develop specialized engineering procedures for working with existing buildings. Over a decade after the “25-50” rule was removed from the UBC, Hoover found that about half the jurisdictions she surveyed enforced some sort of alteration-based seismic upgrade.

Surveying the variety of regulations, Hoover argued for uniformity across the state or region, in order to “[level] the playing field” for development (p 53), “reduce the influence of lobbying groups” (p 48), and spread the adoption of best practices. The patchwork nature of sometimes ad hoc local regulations in the absence of a clear model code provision, she wrote, “illustrates the level of responsibility that the UBC unwittingly burdens building officials with in not codifying these triggers” (p 28). Yet the ambiguity of the “no more hazardous” rule did have its intended effect, freeing local jurisdictions from the rigidity of the “25-50” rule. From a policy perspective, the resulting inconsistency between jurisdictions could even be viewed as salutary. As Holmes (2006) noted, locally developed regulation “ultimately reflects the local attitude concerning seismic safety. Aggressive communities develop easily and commonly triggered criteria, and passive or unaware communities require seismic upgrade only in cases of complete reconstruction or have poorly defined, easily negotiated triggers.”

The “10 percent” rule

When the UBC and the two other regional model codes were consolidated to form the first edition of the IBC in 2000, Section 3403, titled Additions, Alterations or Repairs, retained the “no new violations” provision from the UBC, along with a clearer statement that alterations do not trigger additional work:

Portions of the structure not altered and not affected by the alteration are not required to com-
 ply with the code requirements for a new structure. But the new code also expanded Chapter 34 significantly, adding, among other things, new sections for historic buildings and disabled access. The revised chapter also included a new Section 3403.2 dealing specifically with structural aspects of alterations. Where the earlier “no more hazardous” provision had left ample room for interpretation, the new section quantified a limit:

Additions or alterations to an existing structure shall not increase the force in any structural element by more than 5 percent, unless the increased forces on the element are still in compliance with the code for new structures, nor shall the strength of any structural element be decreased to less than that required by this code for new structures.

While this new rule only specified what was not allowed, the logical inference was that if the intended alteration would increase forces by 5 percent or decrease strength, then some additional work—the triggered scope—would have to be done to satisfy the provision.

For the first time, the model code was making an explicit requirement to upgrade certain structural elements based on the structural effect of an alteration, as opposed to its cost. Even so, the trigger only applied when the alteration would make the structure non-conforming. The intent, one might surmise, was to maintain roughly the same degree of structural compliance. What was compliant before the alteration must be compliant, or very nearly so, when the full project—both the intended scope and any triggered scope—is complete.

The 2006 IBC extended this idea with a new subsection just for “seismic considerations.” Borrowing from the latest NEHRP recommendations (Holmes, 2006), Section 3403.2.3.2 made the first link in any model code between a general alteration scope and a potential seismic upgrade:

Alterations are permitted to be made to any structure without requiring the structure to comply with [earthquake design provisions for new buildings], provided the alterations conform to the requirements for a new structure.

Alterations that increase the seismic force in any existing structural element by more than 10 percent cumulative since the original construction or decrease the design strength of any existing structural element to resist seismic forces by more than 10 percent cumulative since the original construction shall not be permitted unless the entire seismic force-resisting system is determined to conform to [design requirements] for a new structure.

The first sentence is recognizable as a remnant from the 1997 UBC. The second sentence begins the same way as the earlier version, by quantifying the degree of structural impact that is not allowed with the new “10 percent rule.” This new provision establishes that the 5 percent change in Section 3403.2 applies to load cases other than seismic (gravity, mostly), but for seismic the trigger is 10 percent.

Interestingly, the new provision ends with what appears to be a rather aggressive upgrade scope that recalls the most onerous part of the old “25-50” rule. On its face, this new provision appears to say that certain proposed alterations (those that exceed the 10 percent limits) may only be done in buildings that already have the seismic capacity of a new structure, or that the entire existing structure—not just the element exceeding 10 percent—must be upgraded. If
that is the correct reading, then this new provision would be triggering work well beyond the intended alteration scope.

But perhaps a different reading allows an out: If the right elements can be strengthened, or new elements can be added to replace any whose strength is decreased, would that avoid the “10 percent” upgrade trigger? This would seem the logical interpretation, consistent with the inferred meaning of the 5 percent rule for structural elements and non-seismic loads (Section 3403.2) and with the general IBC rule that alterations do not trigger work outside the alteration area (Section 3403.1).

In any case, the wording of the provision makes its intent unclear. Anecdotally, when the provision became effective through the 2007 California Building Code, some engineers and code officials understood and enforced it as a welcome upgrade trigger. For better or worse, the threat of a full-building upgrade almost certainly led to the scaling back or cancellation of some alteration projects. Other code officials read it as an upgrade trigger but ignored it as overly conservative and out of step with the judgmental rules they had been following for decades. Overall, this new provision, layered on top of vestigial cost triggers and local interpretations and innovations, only exacerbated the inconsistency with which alterations and seismic upgrades were regulated.

2.2 The 2009 IBC revision

The confusing 2006 provision, along with development of the IEBC Work Area method (discussed below), prompted a major rewrite of Chapter 34 for the 2009 IBC.¹ One major change split section 3403 into separate sections for the three different project types: additions, alterations, and repairs. Another rewrote the 2006 alteration trigger to better convey the plainest reading of its intent. Here is that 2006 IBC Section 3403.2.3.2 provision again:

Alterations are permitted to be made to any structure without requiring the structure to comply with [earthquake design provisions for new buildings], provided the alterations conform to the requirements for a new structure.

Alterations that increase the seismic force in any existing structural element by more than 10 percent cumulative since the original construction or decrease the design strength of any existing structural element to resist seismic forces by more than 10 percent cumulative since the original construction shall not be permitted unless the entire seismic force-resisting system is determined to conform to [design requirements] for a new structure.

- The broad intent is discernible: there is some sort of a 10 percent limit on structural effects, above which some additional work might be required. But with a close reading, many problems become apparent:
- The first sentence says “alterations are permitted” without upgrade. The second sentence says just the opposite: certain alterations “shall not be permitted” unless the entire structure already complies.
- The second sentence refers to 10 percent changes in “any existing structural element.” But this is a seismic provision. Why should seismic upgrade be triggered by a 10 percent change in a diaphragm or a member carrying primarily dead or live load?

¹ The revisions were proposed by the Existing Buildings Subcommittee of the National Council of Structural Engineers Associations (NCSEA), of which all three authors of this paper are members.
• The 10 percent trigger applies to the “seismic force” in an individual element. Does that mean a full seismic analysis is required before you know whether the provision even applies?

• Should a change to any single element always trigger evaluation or potential retrofit of “the entire seismic force-resisting system”?

• The provision says only that certain alterations “shall not be permitted.” Wouldn’t a more useful provision say how to proceed if the proposed alteration would pull the 10 percent trigger?

• Finally, the provision wants the existing structure to comply with current earthquake design provisions for new buildings. But how does one evaluate an obsolete structure type that the code for new buildings no longer even considers? This is a long-standing problem with the application of “new code” to old buildings; it is the principal reason why specialized seismic evaluation and retrofit standards were developed.

The revised 2009 IBC provision, now in Section 3404.4 tries to solve each of these problems with a thorough rewrite that preserves the most commonly understood intent of the 10 percent rule:

Where the alteration increases design lateral loads [or] results in a structural irregularity [or] decreases the capacity of any existing lateral load-carrying structural element, the structure of the altered building or structure shall be shown to meet [wind and seismic design requirements for a new building].

Exception: Any existing lateral load-carrying structural element whose demand-capacity ratio with the alteration considered is no more than 10 percent greater than its demand-capacity ratio with the alteration ignored shall be permitted to remain unaltered.

The changes, though perhaps subtle, clarify the implementation and either clarify or correct the intent, depending on how the earlier provision was read. The revised provision:

• Focuses on the elements of the lateral force-resisting system.

• Applies a trigger based on loads, not internal forces.

• Applies the 10 percent rule to demand-capacity ratios, closing the loophole of having a simultaneous increase in load and decrease in capacity, neither of which reaches 10 percent alone but together reach up to 19 percent.

• Applies the 10 percent rule as an exception to the general triggered scope, not as a limit on the extent of allowable alteration.

But most of all, the 2009 revision recognized that the 10 percent rule might never have meant to trigger a seismic upgrade to the whole structure but instead was bound to be applied to individual elements.

To jurisdictions that had always understood the 10 percent rule as a means of identifying the local effects of an alteration, the 2009 revision was merely a rewording. But to those who had read the 2006 version as a full upgrade trigger, the revision looked like a marked step backward in regulation of seismic risk. Suddenly, where there had been a provision to trigger full-building upgrades of seismically deficient structures, there was now essentially no upgrade trigger at all, or at best an easily avoided one. Of course, whether there had ever been an effective full upgrade trigger was at best uncertain. Now, at least, it was clear that the code was intending only to maintain the seismic risk at its pre-alteration level.
The revision also made clear how the 10 percent rule was to work. If the proposed alteration would pull any of three triggers—load increase, capacity decrease, or a new irregularity—the entire structure would be subject to a potential upgrade. Then, portions of the structure could be exempted from the upgrade element by element. In the end, only those elements significantly affected by the alteration would need to be strengthened, stiffened, supplemented, or otherwise improved. In many cases, an upgrade might be triggered, only to be waived because every element in the building would qualify for the 10 percent exception. The logical flow (first trigger, then exempt) might seem complicated, but it works.

The 2009 revision does raise some questions of reasonableness. For one, since the exception applies element by element, it is possible (though unlikely) that the resulting upgrade scope will involve a patchwork of isolated elements here and there in the structure that just happened to not meet the 10 percent exception. Thoughtful engineering and plan check should avoid this odd result, but perhaps this is the price of correcting the unclear all-or-nothing 2006 provision.

Otherwise, the effect of the revised 10 percent rule might be best understood by considering the various cases of demand-capacity ratios (DCRs) contemplated by the exception. Imagine an alteration that triggers seismic work, and apply the exception to an element whose DCR changes:

- From 0.90 to 0.95. The change in DCR is less than 10 percent, so the element is exempt from any upgrade.
- From 0.70 to 0.90. In this case, the change in DCR is greater than 10 percent, so the element is not exempt. But even with the alteration, the new DCR is still less than 1.0, so the element is acceptable as is.
- From 0.97 to 1.05. The change in DCR is less than 10 percent, so the element is exempt even though the alteration would push the DCR over 1.0. The issue is not the absolute value of the DCR, but the change caused by the proposed alteration.
- From 6.1 to 6.5. Again, the change in DCR is less than 10 percent, so the element is exempt from upgrade even though it is obviously deficient. Again, the purpose of the provision is not to find pre-existing deficiencies but to quantify the effects of proposed alterations. Though exempt from triggered upgrade, the obvious deficiency should perhaps prompt a conversation between the engineer and her client.

The last case is disquieting, as the code is allowing the alteration and continued use of a grossly deficient structure and relying on voluntary mitigation. An upgrade trigger might address the deficiency, but it also might discourage the alteration to begin with. If the deficiency is a serious concern, perhaps it is best targeted by mandatory mitigation, not left in place until an alteration triggers review. Still, this case illustrates the dissatisfaction some engineers and safety advocates have with model code provisions that fail to reduce an obvious risk. One purpose of the code, they argue, should be to remove the worst risks from the building stock. This proactive philosophy would be expressed in a new alternative to IBC Chapter 34, the IEBC Work Area method.

### 2.3 NARRP and the IEBC Work Area method

When the old “25-50” rule was deemed counterproductive, one reaction was to remove it from the model code. Alterations that did not significantly worsen a building would no longer trigger structural or other upgrades. While the IBC eventually evolved a “10 percent” rule to quantify the worsening, even the 2012 edition maintains this basic laissez faire philosophy.
ALTERATIONS AND SEISMIC UPGRADE

But another reaction led to a more nuanced alternative code. Developed by HUD—the same agency that had argued for the removal of the “25-50” rule—the Nationally Applicable Recommended Rehabilitation Provisions (NARRP) proposed breaking the broad category of alteration projects into three sub-types: renovation, alteration, and reconstruction (NAHB, 1997). The subtypes were based on the nature of the intended work, not its cost, and each would have its own set of scope-appropriate triggers. The NARRP approach developed in the 1990s from efforts in New Jersey and Massachusetts, themselves reactions to removal of the “25-50 rule.” Development of NARRP and its early adoption in several east coast states is described by BTI (2001), Mattera (2006), and Galvan (2006).

Often called “smart codes” or “rehabilitation codes,” the NARRP-influenced codes were specific to existing buildings and were guided by two main principles: predictability, requiring the elimination of vague or open-ended provisions, and proportionality, requiring a rational link between any triggered scope and its triggering alteration (BTI, 2001; Mattera, 2006). In concept, the NARRP provisions could simultaneously be both less conservative and more conservative than the model provisions they would replace. Less conservative, because by eschewing certain bright lines and prescriptive rules that apply to new buildings, the NARRP provisions could allow non-conforming conditions to remain even while the building was otherwise improved. A similar idea, recognizing that obsolete structural systems still have some capacity, had been embraced by FEMA’s seismic evaluation and retrofit guides (FEMA, 1992; 1997). And more conservative, because by considering the specific nature of the alteration, the NARRP provisions could trigger additional improvements in a cost-beneficial way. Indeed, it was recognized early on that the NARRP approach could be a vehicle for the implementation of the FEMA guidelines (BTI, 2001, p. x-xi), and even proponents of smart codes acknowledge that seismically active areas might need their own amendments to ensure that relaxed provisions will still provide acceptable earthquake safety (Galvan, 2006).

By 2003, the NARRP approach had been codified as the Work Area method in the first edition of the IEBC. The three alteration subtypes had been renamed as simply Level 1, Level 2, and Level 3 alterations and defined in part by the “work area” of the intended project. From Chapter 5 of the 2012 IEBC:

Level 1 alterations include the removal and replacement or the covering of existing materials, elements, equipment, or fixtures using new materials, elements, equipment, or fixtures that serve the same purpose.

Level 2 alterations include the reconfiguration of space, the addition or elimination of any door or window, the reconfiguration or extension of any system, or the installation of any additional equipment.

Level 3 alterations apply where the work area exceeds 50 percent of the aggregate area of the building.

The IEBC defines the “work area,” used to distinguish Level 3 alterations, as the area of any spaces to be “reconfigured” by the intended alteration project. From Chapter 2 of the 2012 IEBC:

WORK AREA. That portion or portions of a building consisting of all reconfigured spaces as indicated on the construction documents. Work area excludes other portions of the building where incidental work entailed by the intended work must be performed and portions of the building
where work not initially intended by the owner is specifically required by this code.

Requirements accumulate with each alteration level. That is, a Level 2 alteration project must also satisfy the requirements for a Level 1 project. A Level 3 project must also satisfy the requirements for Level 1 and Level 2 projects.

The graduated set of alteration levels is meant to align triggered upgrades with commensurate project scopes. Still, the IEBC’s implementation is not that well suited to structural and seismic issues. The main drawback stems from the definition of work area. Major alterations, for which full-building seismic upgrades might be appropriate, are only designated as Level 3 when more than half of the building area is being reconfigured. But significant projects, such as extensive mechanical or building envelope upgrades, can add value and extend building life with little or no reconfiguration of space. Even significant structural work, including the cutting or relocation of columns, diaphragms, bearing walls, or shearwalls, might not be classified as Level 3.

Therefore, while the IEBC includes a seismic upgrade trigger for so-called substantial structural alterations (in IEBC Chapter 9, described in the table below), it is expected to apply only in rare cases. The IEBC’s triggers for specific seismic mitigation associated with re-roofing (a Level 1 alteration) are more likely to be pulled.

As of October 2013, the IEBC is adopted or in use throughout or in selected jurisdictions of 39 states (ICC, 2013). Among the seismically active west coast states, according to ICC, Oregon, Alaska, and Hawaii do not adopt the IEBC (but see Appendix A for more specific information). Washington adopts the IEBC with amendments. California adopts only two appendix chapters and does not adopt the Work Area method in general. However, as of the 2009 editions, the IEBC is a “deemed to comply” alternative to IBC Chapter 34, so unless a state specifically removes that provision (in 2012 IBC Section 3401.6), the Work Area method is available to all IBC users.

(In 2015, the IEBC, with all three of its methods, will replace IBC Chapter 34.) Even so, the fact that the Work Area method contains an upgrade trigger while the Prescriptive method does not means that owners are unlikely to choose the Work Area method for their major alteration projects.

### 2.4 The IRC alternative

The International Residential Code is not the focus of this report. Still, for completeness it is worth noting that the IRC has upgrade triggers for flood resistance only, and no other upgrade triggers associated with alteration projects. While the IRC does address alterations, Section R102.7.1 maintains an even weaker version of the IBC’s obsolete “no more hazardous” rule:

> R102.7.1 Additions, alterations or repairs. Additions, alterations or repairs to any structure shall conform to the requirements for a new structure without requiring the existing structure to comply with all of the requirements of this code, unless otherwise stated. Additions, alterations or repairs shall not cause an existing structure to become unsafe or adversely affect the performance of the building.

The IRC does have an optional Appendix J for existing residential buildings, but it too is poorly maintained and seldom used. In fact, Appendix J still uses the original NARRP terms—renovation, alteration, and reconstruction—long since replaced in the IEBC.

### 2.5 Current model code provisions

As demonstrated above, even well-intentioned code provisions can be vague, sloppy, incomplete, or packed with arcane terminology. To understand a code provision for existing build-
In Table 2-1, we see the current version of the “10 percent” rule. As discussed above, if the alteration would meet any of the three triggering conditions, the entire structure is subject to review and possible upgrade. The “10 percent” rule then applies as an exception, possibly exempting the entire structure, but doing so one element at a time. Importantly, the “10 percent” rule allows deficient structural systems to remain in service as long as the intended alteration would not change the expected earthquake performance.

Table 2-2 provides a similar breakdown of the 2012 IEBC Work Area provisions. (The full text of the cited provisions is in Appendix A.)

Comparing Tables 2-1 and 2-2, the Work Area method is obviously more complicated. The three main substantive differences between the Work Area method and IBC Chapter 34 (or the IEBC Prescriptive method) are:

- For criteria, the Work Area method allows reduced seismic loads, whereas Chapter 34 refers only to the full design requirements for new buildings.
- The Work Area method includes proactive mitigation triggers to address two known seismic deficiencies – unreinforced masonry parapets and deficient roof-to-wall anchors. (This difference will be eliminated with the 2015 IEBC, when both the Prescriptive and the Work Area methods will have the proactive triggers.)
- The Work Area method includes a “substantial structural alteration” trigger that requires a full structure upgrade without “10 percent” rule exemptions.

Of these, the last one is the most significant. It represents the one case in which the Work Area method, unlike IBC Chapter 34 or the Prescriptive method, can trigger the upgrade of an entire deficient lateral system (as opposed to specific deficiencies at the roof level). But this trigger applies only in rare cases where the intended alteration project already involves substantial structural work. It would almost never apply to a typical tenant improvement or even a major architectural or mechanical renovation.

Despite what a cursory look at Tables 2-1 and

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**Table 2-1. Earthquake-related alteration provisions in 2012 IBC Chapter 34**

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Triggered Scope</th>
<th>Criteria</th>
</tr>
</thead>
</table>
| The intended alteration will:  
  - Increase lateral loads (3404.4), or  
  - Decrease capacity of any lateral element (3404.4), or  
  - Create a structural irregularity (3404.4). | The entire altered structure shall comply with applicable criteria.  
Exception: Lateral elements with DCR increase of 10% or less may remain as is. | Earthquake design requirements for new buildings. |

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1. 2012 IBC Section 3401.6 allows the IEBC as a deemed-to-comply alternative to Chapter 34. See Table 2-2. See Table 2-2, note 1, for a further exception that could apply indirectly if the IEBC is used to comply with Chapter 34.

2. Chapter 34 will be removed from the 2015 IBC. Provisions similar to 2012 IBC Chapter 34 will remain in 2015 IEBC Chapter 4 as the Prescriptive method. However, several changes will be made to match more closely the Work Area method. See Table 2-2, notes 8 and 9.
### Table 2-2. Earthquake-related alteration provisions in the 2012 IEBC Work Area Method

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Triggered Scope</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1 re-roofing:</strong> 4 The intended alteration will re-roof more than 25 percent of a building with unreinforced masonry parapets assigned to Seismic Design Category D, E, or F (706.3.1).</td>
<td>Install parapet bracing, or demonstrate equivalence by evaluation.</td>
<td>Reduced seismic loads. 2</td>
</tr>
<tr>
<td><strong>Level 2 or Level 3 alteration with structural effect:</strong> 3,5 The intended alteration is Level 2 or Level 3 and will: • Increase lateral loads (807.5, 907.4.3), or • Decrease capacity of any lateral element (807.5, 907.4.3), or • Create a structural irregularity (807.5, 907.4.3).</td>
<td>The entire altered structure shall comply with applicable criteria. Exception: Lateral elements with DCR increase less than 10% may remain as is. Note: As written, this exception does not apply to the structural irregularity trigger. Level 3 Exceptions: 6 • For residential buildings up to 5 units, IRC-compliant alterations need only comply with the IRC. • For alterations involving only the lowest story, the triggered structural scope need only involve the load path from the lowest story to the foundation.</td>
<td>Reduced seismic loads. 2</td>
</tr>
<tr>
<td><strong>Level 3 substantial structural alteration:</strong> 3,6 The intended alteration is Level 3 and will alter, remove, or add structural elements carrying gravity load from more than 30 percent of the total floor and roof area (907.4.2).</td>
<td>The entire altered structure shall comply with applicable criteria. Level 3 Exceptions: 6 • For residential buildings up to 5 units, IRC-compliant alterations need only comply with the IRC. • For alterations involving only the lowest story, the triggered structural scope need only involve the load path from the lowest story to the foundation.</td>
<td>Reduced seismic loads. 2</td>
</tr>
<tr>
<td><strong>Level 3 with inadequate wall anchors:</strong> 9 The intended alteration is Level 3, the building is assigned to seismic design category D, E, or F, and the building is either a rigid wall-flexible roof structure or an unreinforced masonry structure (907.4.4).</td>
<td>Install wall anchors at the roof line, or demonstrate equivalence by evaluation.</td>
<td>Reduced seismic loads. 2</td>
</tr>
<tr>
<td><strong>Level 3 with inadequate parapet braces:</strong> 9 The intended alteration is Level 3, the building has unreinforced masonry parapets, and the building is assigned to seismic design category D, E, or F (907.4.5).</td>
<td>Install parapet braces, or demonstrate equivalence by evaluation.</td>
<td>Reduced seismic loads. 2</td>
</tr>
</tbody>
</table>

1 2012 IEBC Section 301.1 gives broad discretion to the code official. Though the provision is somewhat unclear, it allows any alteration short of a substantial structural alteration (Section 907.4.2) to use the original design code as criteria.
2 Where “reduced seismic loads” are indicated, the IEBC allows several options, including design loads for new buildings reduced with a factor of 0.75.
3 Level 2 alterations are also subject to provisions for Level 1 alterations. Level 3 alterations are also subject to provisions for Level 1 and Level 2 alterations.
4 A similar provision will be added to the Prescriptive method in the 2015 IEBC.
5 The wording of this provision differs from that of the similar provision in 2012 IBC Section 3404.4 (see Table 2-1). For the 2015 IEBC, the wording of Section 807.5 of the Work Area method will be revised to match that of the Prescriptive method.
6 These exceptions are presented only for Level 3 alterations, but they would presumably apply to eligible Level 2 alterations as well, since Level 3 alterations also invoke Level 2 requirements. The IEBC is unclear here.
7 The Level 3 exception for alterations that involve only the lowest story is probably not intended to apply to the wall anchor and parapet bracing triggers, which only affect the roof level. The IEBC is unclear here.
8 The 2015 Work Area method and Prescriptive method will both also trigger a seismic upgrade with the same scope and criteria for any Level 3 alteration in a building assigned to seismic design category F (that is, buildings assigned to Risk Category IV in regions of high seismicity).
9 The 2015 Prescriptive method will include a matching trigger. For both methods, the trigger for unreinforced masonry buildings or parapets will also apply to buildings assigned to seismic design category C.
2-2 would suggest, for most buildings the Work
Area method and Chapter 34 remain more simi-
lar than different. Except for a couple of specific
deficiencies, both codes will generally allow
almost any typical alteration project to pro-
ceed without requiring seismic upgrade of even
grossly deficient or obsolete structures.

2.6 Amendments to the model
codes

As Hoover (1992) noted, after the “25-50” rule
was removed from model codes in the mid-
1970s, many jurisdictions retained some form
of a cost-based retrofit trigger. Some of those
and similar precedents have been formalized
as local amendments either at the state or city
level, so that even today the current model code
is not the last word on alteration and seismic
upgrade triggers.

Table 2-3 presents alteration amendments
from selected jurisdictions. (The full text from
these and other amendments is in Appendix A.)
The table also includes provisions that apply
to state-owned buildings in California and to
buildings owned or leased by federal agencies.
Provisions for government buildings are more
properly thought of as institutional policies,
since they are imposed by owners or tenants
for their own purposes and do not regulate the
private building stock directly. Still, they help to
illustrate the range of risk management alterna-
tives to the model code.

In addition to the examples in Table 2-3, a num-
ber of jurisdictions that have no mandatory mit-
igation programs for unreinforced masonry do
have triggers that target that well-known defi-
ciency; many California cities, Portland, and the
states of Utah and Massachusetts are among
them (see Appendix A). Massachusetts extends
the IEBC’s proactive triggers from seismic
design category D down to B in order to cover
the whole state. Similarly, Seattle has an alter-
ation trigger that targets risky brick chimneys.

A few of the example triggers in Table 2-3 apply
only to specific building groups—residential
buildings in Los Angeles, pre-1974 buildings in
Portland—while others exempt specific groups,
lke one- and two-family dwellings, thought to
be of lower risk.

Exemptions are not always based on seismic
risk, however. The model code can be amended
to target certain risky buildings, but it can also
be amended to exempt certain buildings, risky
or not, because an alteration-based upgrade
trigger might discourage renovation. For exam-
ple, Table 2-3 shows that San Francisco amends
the California code to trigger seismic upgrade
when major alterations are proposed. But the
city waives that trigger for homeless shelters
(2010 SFBC Section 3401.9; see Appendix A).
Similarly, the California Building Code waives
any upgrade trigger for residential buildings
regulated by the state’s department of Hous-
ing and Community Development, allowing
“original materials” and “original methods of
construction” that might not be permitted in
other buildings (2010 CBC Section 3404.1.1;
see Appendix A). This allowance appears to
be a vestigial reaction to the “25-50” rule that
discouraged housing improvements but was
removed from the model codes thirty years ago.
Indeed, the Los Angeles example in Table 2-3 is
actually a reversal of this California provision,
imposing a local 50 percent cost trigger where
the state tried to eliminate one.

Table 2-3 also shows the variety of cost-based
triggers. As noted above, cost triggers can be
hard to enforce if they require vetting of finan-
cial calculations. They are perhaps less diffi-
cult when the authority enforcing the code (or
policy) is also the building’s owner or tenant,
as is often the case with California’s 25 per-
cent trigger for state-owned buildings and the
30 percent and 50 percent triggers for federal
facilities. Even so, Table 2-3 presents cost-based
triggers for private buildings in Los Angeles and
Portland (though Portland’s provision triggers
only evaluation).
Table 2-3. Earthquake-related alteration provisions in selected local code amendments and institutional policies

<table>
<thead>
<tr>
<th>Trigger</th>
<th>Triggered Scope</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Los Angeles cost trigger:</strong> For residential buildings, the cost of the intended alteration exceeds 50 percent of the building replacement value (2011 LAMC Section 91.3404.1.1).</td>
<td>The entire altered structure shall comply with applicable criteria.</td>
<td>Earthquake design requirements for new buildings.</td>
</tr>
<tr>
<td><strong>San Francisco &quot;substantial change&quot; trigger:</strong> The intended alteration adds, removes, or alters structural or architectural elements on at least two thirds of the building’s floors (2010 SFBC Section 3404.7.1).</td>
<td>The entire altered structure shall comply with applicable criteria.</td>
<td>Reduced seismic loads and alternative criteria. ¹</td>
</tr>
<tr>
<td><strong>Seattle &quot;substantial alteration&quot; trigger:</strong> The intended alteration “substantially extend[s] the useful physical and/or economic life of the building” (2009 Seattle building code Sections 3404.8, 3403.8.1).</td>
<td>The entire altered structure shall comply with applicable criteria.</td>
<td>Earthquake design requirements for new buildings. ASCE 31-03 and 41-06 generally allowed and used.</td>
</tr>
<tr>
<td><strong>Portland cost-triggered evaluation:</strong> The cost of the intended alteration of structural and architectural elements in a pre-1974 building exceeds $175,000 in 2004 dollars; houses are exempt (2009 PBR Section 24.85.060).</td>
<td>The entire structure shall be evaluated. (Retrofit is not triggered even if the evaluation finds deficiencies.)</td>
<td>ASCE 31-03, Life Safety performance.</td>
</tr>
<tr>
<td><strong>California cost trigger for state-owned buildings:</strong> The cost of the intended alteration exceeds 25 percent of the building replacement cost (2010 CBC Section 3417.3.1).</td>
<td>The entire building, including nonstructural components, shall be evaluated and, if deficient, retrofitted with applicable criteria.</td>
<td>Reduced seismic loads, using ASCE 41-06. ²</td>
</tr>
<tr>
<td><strong>Federal agency cost trigger for leased and owned buildings:</strong> The intended alteration “significantly extends the building’s useful life,” and its cost exceeds 30 percent of the replacement value of a building assigned to seismic design category D, E, or F, or 50 percent for a building assigned to seismic design category C (NIBS, 2011, Section 2.1). ³</td>
<td>The entire building, including nonstructural components, shall be evaluated and, if deficient, retrofitted. In leased buildings, nonstructural components that would not affect performance need not be evaluated or retrofitted.</td>
<td>For evaluation, ASCE 31-03 Life Safety performance. For retrofit, ASCE 41-06 Basic Safety Objective. ⁴</td>
</tr>
</tbody>
</table>

¹ For alteration-triggered seismic work, the San Francisco Building Code (Section 1604.11) generally cites as criteria the requirements for design of new buildings, but it waives the building separation requirements, it allows a factor of 0.75 on the design loads, and it allows alternative criteria such as ASCE 41.

² CBC Table 3417.5 gives the required evaluation and retrofit criteria, which vary by risk category and by the controlling state agency. Generally, the criteria cite ASCE 41-06, specifying a two-level performance objective expected to be less stringent than the design requirements for new buildings.

³ Exemptions are made for houses, other small buildings, small and short-term leases, and other conditions deemed low risk. In addition, the policy is a “recommended practice” that each federal agency may adopt or amend at its discretion.

⁴ Criteria shown are for the safety-based objective, applicable to most buildings. Buildings designated for an occupancy-based objective must meet stricter criteria.
Perhaps most interesting is Seattle's trigger for "substantial alteration." Without setting a hard trigger value like 25 or 50 percent, Seattle gets to the underlying question: Will the intended alteration extend the building’s useful life so as to justify an expectation of earthquake performance approaching that of a new building? The judgment is made on a case-by-case basis considering the cost of the intended work as well as the nature of the building and the scope of the alteration (Seattle, 2010). The federal recommended practice also listed in Table 2-3 now borrows this concept and language from the Seattle code. The idea of "extended life" as a basis for triggering seismic improvements seems more rational and less arbitrary than a single cost figure and is discussed further in the next section.

The final lesson from Table 2-3 is that local amendments, while still possible, are rare. Amendment-free adoption of model codes is becoming a preferred practice. Massachusetts, for example, is expected to enforce an amendment-free policy in its next code cycle despite a history of state-specific amendments. California, while amending the IBC for statewide use, requires cities and counties to file justifications for additional local amendments (CHSC, Sections 17958.5 and 17958.7). Even where local amendment is allowed, it can require resources no longer available to smaller jurisdictions. While Table 2-3 shows that Los Angeles retains a cost trigger, the cities of Oakland, Palo Alto, Santa Clara, and Santa Rosa no longer have the similar cost triggers Hoover described twenty years ago. Outside California, the Seattle and Portland amendments shown in Table 2-3 apply only in those cities and are not adopted statewide in Washington and Oregon.

Amendment-free adoption probably ensures more uniformity between jurisdictions (as Hoover recommended), but too much uniformity is likely to have unintended consequences. After all, the regional differences that eventually coalesced into the IBC did originally develop independently. The IEBC’s “substantial structural alteration” trigger is based on a San Francisco provision. Most of IEBC Appendix A developed originally in Los Angeles. With a single national code, where will further improvements come from if not from local innovations and amendments? Further, since the current code development process involves a lag of up to six years between proposal and enforcement, local jurisdictions should be encouraged to incorporate and test new provisions as soon as they are approved. Finally, jurisdictions have different existing building stocks and are differently affected even by the same perils. To the extent that the building code represents a policy for mitigating and managing risk, and policy must reflect local resources and priorities, there is no reason every community should have exactly the same code.

3. Regulation and Mitigation

3.1 The role of the building code

The IBC, IEBC, and IRC each include a brief statement of intent “to safeguard the public health, safety, and general welfare” through “minimum requirements.” This rather anodyne objective, which has scarcely changed since the first UBC was published in 1927, is typically repeated when the model code is adopted into a state or local building code.

With respect to new construction, the role of the building code is clear. With respect to existing buildings, the question of what level of non-conformance merits “safeguarding” is more complicated, but the codes have developed a number of trigger-based provisions to answer it.

As shown in Section 2, the current model codes provide what might be called “risk maintenance” for all projects, with a potential for “risk
reduction” in special cases. Risk maintenance assures that any intended alterations do not make the structure worse, for example by adding significant mass, reducing existing capacity, or creating a new irregularity. The “10 percent” rule exemplifies this priority. Any increase in an element’s demand-capacity ratio up to 10 percent is deemed to be an insignificant increase in earthquake risk. The quantitative limit both measures the effect of the intended alteration and discourages projects that would exceed it.

But where the project is more substantial, the code can go beyond risk maintenance to require risk reduction, or mitigation, relative to the existing condition. For a proposed vertical addition, or a change of occupancy that assigns the building to a higher risk category, both the IBC and the IEBC Work Area method trigger a full seismic upgrade. For alteration projects, however, the current model codes almost never trigger additional seismic work. Even the IEBC’s triggers for clear deficiencies such as unbraced brick parapets can be avoided (until the 2015 code becomes effective) by selecting the IBC or the IEBC Prescriptive method, or by invoking exemptions for historic buildings.

So it would appear that the model codes do not present themselves as vehicles for earthquake risk reduction. Yet leading mitigation proponents use the codes in just that way. Most importantly, FEMA policies rely on the building code as a mechanism for implementing federal, state, and local mitigation policies. For example:

- Adoption and consistent enforcement of building code upgrade triggers is used to establish eligibility for certain post-disaster repair funds (FEMA, 2007; 2008b).
- Compliance with the Disaster Mitigation Act of 2000 requires jurisdictions to incorporate mitigation recommendations into local regulations, including building codes (FEMA, 2008a, p3-47; Schwab, 2010). Compliance affects a jurisdiction’s eligibility for certain FEMA grants.

FEMA’s emphasis on mitigation is reflected in state and local plans. For example, California’s plan makes explicit the link between mitigation and building regulation (Cal OES, 2013, section 2.3):

- For safety, the plan states two objectives related to seismic upgrade and building codes. First, to “maximize the likelihood that structures are modified, as necessary, over time to meet life safety standards.” Second, to “encourage the incorporation of mitigation measures into repairs, major alterations, new development, and redevelopment practices.”
- Beyond safety, the plan also seeks to minimize damage and disruption through “adoption of cost-effective building and development laws, regulations, and ordinances exceeding the minimum levels needed for life safety.”

Further, the building code serves as a repository for provisions that implement mitigation programs initially developed through legislation separate from the regular code development process. Examples of mandatory programs include San Francisco’s “soft story” program (Chapter 34B of the San Francisco Building Code), Los Angeles’ tilt-up program (Division 91 of the Los Angeles Building Code), and unreinforced masonry programs adopted by various California jurisdictions to comply with a 1986 statewide mandate. Provisions for voluntary programs have also been incorporated into local codes. Examples include Los Angeles Building Code Divisions 92 through 96, precursors of prescriptive retrofit provisions now found in IEBC Appendix A. California is not the only state to encourage mitigation through its building code. Chapter 16 of the Florida Existing Building Code provides prescriptive retrofit provisions for gable walls prone to damage in high winds; these provisions were later developed into the IEBC’s voluntary Appendix C1.
In the end, the building code, for all its technical content, is a policy document. To the extent that local public policy—for regulation, mitigation, growth, historic preservation—involves the built environment, there is no reason it should not find voice in the building code.

### 3.2 The case for triggered risk reduction

If mandatory and voluntary mitigation can be supported by, or implemented through, the building code, certainly there is a role for mitigation using the code’s own triggers. Indeed, Hoover’s call for a uniform upgrade trigger was motivated in part by recognition that mandatory programs are politically or practically infeasible in many small jurisdictions (Hoover, 1992). Yet perhaps it is the nature of a model code—uniform and generic—that inhibits the development of upgrade triggers for alteration projects. All the examples cited above are local amendments to the model code, suited to local priorities. If model code triggers are to support mitigation, they will probably have to be carefully tailored as well.

As shown in Section 2.6, a seismic upgrade trigger based on substantial alteration would match the current practice of a few proactive jurisdictions, but it would reverse the position taken by the model codes since removal of the “25-50” rule over thirty years ago. Any proposal for such a policy should:

- Be clear about the problem it is trying to solve,
- Demonstrate that the proposal actually solves the problem, and
- Show that the problem cannot be solved just as well by other means.

Here, the problem involves a building with significant seismic deficiencies that the code fails to flag as deficient even when it undergoes a major nonstructural alteration. Under the current model codes, even a structure that might be evaluated as a collapse risk may remain in use—and even have its use extended or enhanced—if the intended alteration would leave the structural system alone. As discussed in Section 2.2, this allowance came into the code when the “25-50” rule was removed, but it received new attention when the alteration provisions and the “10 percent” rule were clarified in 2009.

Unreinforced masonry buildings in areas of moderate or high seismicity compose one class of obsolete and typically deficient structures. As shown in Table 2-2, the IEBC includes some alteration provisions that, when triggered, require parapet bracing and roof-to-wall anchors. A major alteration also triggers roof-to-wall anchors in concrete tilt-up buildings. But while these are important, even critical, they are not the only deficiencies in these buildings. Nor are these the only structure types with records of poor earthquake performance. Just as important, older brick and tilt-up buildings often have other functional limitations that make them unlikely to attract major alteration or investment, so the trigger might never get pulled. Alterations to other structure types with known deficiencies and perhaps better investment potential—non-ductile concrete frames, wood-frame multi-family housing, pre-Northridge steel frames, or archaic frame and infill structures, for example—are not addressed by any model code triggers. Further, as mitigation planning broadens its focus from safety to resilience, even buildings that are not necessarily collapse risks might be recognized as obstacles to recovery and therefore deserving of attention in a thoughtful mitigation plan.

So the problem is real. But is an upgrade trigger the best way to solve it? If a class of buildings is legitimately risky, why mitigate it only when an alteration trigger happens to be pulled? As noted above, some of the riskiest buildings are also so functionally obsolete that they are more likely to be abandoned than renovated. Some argue that only mandatory programs, imposed
by legislation through a consensus political process, actually reduce risk on a community or neighborhood scale. Others argue that incentives for voluntary retrofit will reduce more risk than new code provisions for triggered retrofit.

Mandates are certainly more effective, but they do not come about easily. In fact, because they target so many buildings at once, they generally face strong political opposition. Consider California's history:

- The destructive 1933 Long Beach earthquake led quickly to a ban on unreinforced masonry for new buildings. But it took another fifty years to pass the 1986 state law that required jurisdictions in regions of high seismicity to adopt mitigation programs. Even then, only about half of the subject jurisdictions adopted mandatory programs, and major cities in the Bay Area, including San Francisco and Oakland, did so only after the 1989 Loma Prieta earthquake (CSSC, 2006).

- After fatal collapses of so-called “soft story” apartment buildings in the Loma Prieta and 1994 Northridge earthquakes, San Francisco began cautious efforts targeting 6000 or so remaining vulnerable buildings. Special code provisions assisted owners motivated by the 1989 damage, but later financial incentives had only marginal effects, and a ballot measure to secure public bond funding narrowly failed in 2010. Only after an intensive study and thorough consensus building could an ordinance be passed in 2013, with the earliest retrofit deadline coming a quarter century after Loma Prieta (Otellini, 2013).

- It took two destructive earthquakes in Los Angeles to prompt a mandate for hospital retrofit. The 1971 San Fernando earthquake demonstrated the vulnerability and prompted laws regulating the design of new facilities, including eventually the creation of a new regulatory agency, OSHPD (Geschwind, 2001). But a statewide retrofit mandate was passed only after Northridge, two decades later (OSHPD, 2013), and even its implementation has been slowed by changes to the legislation.

It takes a lot of political effort to pass a retrofit mandate, and a lot of administrative effort to implement it. Mandates reduce risk more effectively than triggers, but as Hoover found in 1992, greater effectiveness comes at a political and administrative price that many jurisdictions cannot or will not pay. California's history suggests that mandates might really be feasible only to address the most pervasive, intractable, and critical risks—the most hazardous buildings, like unreinforced masonry, and the most essential, like hospitals. This problem is different from the one that alteration triggers would try to address. The problem here is not simply the risky building, but the risky building in which substantial resources are being invested through alteration. In fact, following Hoover, one might argue that the triggered approach is necessary to cover just those cases where a mandate is unworkable.

Voluntary programs will clearly produce fewer retrofits than mandatory programs, but how would they compare with an alteration trigger? Though no controlled comparative studies exist, a purely voluntary program with no public subsidy or incentive is unlikely to be successful without sustained messaging from experts and like-minded action by social network peers (Mileti, 2011). Unfortunately, neither of these conditions exists in the case of an individual building whose owner intends a major alteration but is left to consider on her own the costs and benefits of a concurrent retrofit. One might even argue that by allowing major alterations of seismically deficient buildings, the code is signaling to owners that their seismic risk is negligible. Another private sector application involves seismic evaluations of probable maxi-
mum loss, or PML, generated when a (typically commercial) building is sold. These evaluations are performed to satisfy the vetting rules of lenders and insurers; they are mandatory from the lender’s perspective but voluntary from the code’s perspective. However, voluntary PML studies do not routinely lead to retrofit; some engineers even suspect the entire PML process to be skewed toward unconservative results (Searer et al., 2009). So purely voluntary retrofit of the problem building in question is unlikely.

Incentive programs are more likely to succeed. In voluntary retrofit programs for unreinforced masonry buildings in California, offering a financial incentive increased the rate of retrofit by a factor of three, though it still lagged far behind the rate of mandatory programs (CSSC, 2006). However, incentive programs have obvious financial costs for the jurisdiction and, like mandates, have logistical costs as well. To be feasible, an incentive program must be linked in advance to certain eligible conditions, and this might limit its applicability compared with a more general alteration trigger. But most important, even with the incentive, there is no guarantee that the owner proposing a major alteration will voluntarily add to her already substantial project scope.

If a problem exists, and if mandates or incentives are no more likely to solve it, the question remains whether an alteration trigger would solve it either. Even if a controlled study of trigger effectiveness were attempted, it would be limited by the sheer number of variables involved, not least of which are inconsistent and judgmental enforcement between and within jurisdictions, documented by Hoover (1992). It stands to reason that more retrofit will happen with a trigger than without one. Absent evidence to the contrary, one might conjecture that a triggered retrofit program will lead to at least as many retrofits as a lightly incentivized voluntary program, but without the public cost of the incentive. At the very least, re-introduction of an alteration trigger into the building code will signal to owners and designers that certain deficiencies should not be overlooked simply because a proposed alteration would not make them worse. But there are arguments against an alteration trigger as well:

- The main argument is that a trigger will actually discourage beneficial renovation and modernization, or possibly encourage projects to be done without permits or inspections. There is some anecdotal evidence of this backfire effect, though the rate of cancelled or deferred projects might be less than one would expect from talking with engineers and code officials (see Section 3.3). Hoover had interviewed code officials on this point, but her findings were inconclusive (1992, p43).

- Even if an alteration trigger is applied, its mitigation effects will be piecemeal, applied only one building at a time. Such an effect would be unlikely to make measurable, timely progress toward a jurisdiction wide mitigation goal. Of course, the same can be said for voluntary programs.

- A triggered program, like a mandatory program, can be limited by political viability and by a perception that targeting certain building types devalues them or leads to unnecessary disruption in use.

Thus, the case for an alteration trigger might be inconclusive. Of course, if the case were easy to make, the triggers would already (or still) be in the model codes.

For a varied building stock, a successful mitigation program is likely to involve a jurisdiction-specific mix of mandates, incentives, and triggers. Currently, however, the triggered component is missing from the model codes. Smaller jurisdictions that cannot support local amendments, especially if they also cannot muster support for mandatory retrofit programs, find themselves lacking any tools with which to regulate major alterations of seismically defi-
cient buildings. Even large jurisdictions might find their local triggers discouraged in time, as amendment-free adoption of the model codes becomes the norm.

We therefore conclude that the model codes are currently underutilized as potential mitigation tools. Developing an effective alteration trigger is challenging; the history of code revisions and alternate approaches proves that. Still, if differences between jurisdictions can be accommodated, a set of alteration-based upgrade triggers can make a valuable and effective contribution to seismic mitigation.

3.3 Stakeholder perspectives

Since the building code is a policy document, and good policy must reflect public expectations and priorities, we surveyed selected stakeholder groups about the nature of alteration projects and about the purpose and effectiveness of building regulation. A complete description of the online survey, as well as the full text of the questions and responses, is in Appendix B. In the following summary, question numbers refer to the survey details in Appendix B.

The 78 respondents to the survey described their roles in seven stakeholder categories (Question 1). For this summary (and in Appendix B), we group them in three broad classes:

- Users (43 respondents), including owners, developers, tenants, lenders, insurers, and investors.
- Planners (19), including code officials, mitigation planners, emergency responders, and emergency managers
- Designers (16), including architects, engineers, and builders.

The emphasis on Users was intentional. While some engineers and other designers did participate, development of upgrade triggers requires more policy judgment than technical judgment. Planners certainly offer policy judgment, but their perspective as public servants is different from that of private sector stakeholders. (Hoover interviewed only code officials; her 1992 report is unclear as to whether it reflects those officials’ personal opinions or just the policies already in place in their jurisdictions.) In addition, both the Planner and Designer groups are already well represented in the code development process. Our intent was to solicit opinions and insights from decision makers who know about buildings but generally do not participate in building code development.

The respondents represented interests in a full range of building and structure types (Questions 2 and 3). Interestingly, the respondents as a group seemed least familiar with unreinforced masonry and tilt-up structures, the two types that already have dedicated alteration triggers in the IEBC. The group was dominated by professionals working in regions of high seismicity (Question 4), but they did not consider their portfolios especially vulnerable to earthquake damage (Question 5). While a strong majority of the Users had experience with building alteration (Question 7), less than half indicated any direct experience with seismic upgrade projects (Questions 8 and 9).

As discussed in Section 3.2, one argument against alteration triggers is that they can cause otherwise beneficial alterations to be scaled back or cancelled to avoid the trigger. Yet of 42 Users responding, only one reported that as a regular occurrence (Question 10). Of the eleven Users with experience on multiple seismic retrofit projects, eight had been involved in code-triggered (or possibly mandated) upgrades, but only three reported ever seeing a project re-scoped to avoid seismic work. Of course, this is a count of respondents, not a count of projects, but it does suggest that trigger “backfire” might not be especially pervasive, and is probably less frequent than project fruition.

Interestingly, the Planners and Designers seemed to have more experience with trigger backfire than the Users. Of the 19 Planners and
Designers with experience on multiple upgrade projects, 11 reported at least one re-scoped project. Possibly this is because code officials and engineers are routinely involved when a code trigger might be invoked but are less involved in routine alterations. In any case, the difference suggests that code developers—engineers and code officials—are perhaps overly sensitive to the concern that a trigger might discourage alteration.

Responses to several questions indicated clear, if not unanimous, support for the idea of an alteration-based seismic upgrade trigger:

- Only six out of 39 Users felt that market-based solutions alone are “the best way for a community to mitigate the seismic risks posed by its most hazardous buildings” (Question 16). However, of the 33 Users who saw the need for some public sector regulation or investment, most were not ready to recommend a single approach (mandates, incentives, or triggers). Rather, the majority liked the idea of a combination of approaches “that accounts for local politics and resources.”

- Only a minority of Users objected to the idea that a “major alteration” should trigger seismic upgrade to address known deficiencies.
  - About a third of the Users (12 of 37) objected to the trigger, given a hypothetical in which the alteration would not increase risk (Question 17).
  - Only 10 percent (4 of 39) found the trigger concept “unreasonable” in a more generic sense as a code provision (Question 18).
  - About 39 percent (14 of 36) said the public should be satisfied as long as a project does not increase seismic risk (Question 19).

Questions 17, 18, and 19 did raise different topics, but on the key point they asked essentially the same question in three ways. The variation in the number who opposed the idea of an alteration trigger—always a minority, but varying by a factor of four—confirms the observation that a question’s wording and emphasis can affect responses.

- Despite the general support for an alteration trigger, a clear majority preferred limits or conditions on the trigger or the upgrade scope. A majority of Users supporting a trigger preferred to limit the mitigation based on convenience and disruption (as in the case of parapet braces triggered by re-roofing) or based on cost (as the code does with alteration triggers for disabled access) (Question 17). A majority also wanted cost to be a factor in the trigger, but there was no consensus on the appropriate metric (Question 18). About half of Users who would support triggered upgrade nevertheless thought it was reasonable that some “serious deficiencies” might be allowed to remain (Question 19).

- Compared with existing triggers and requirements involving disabled access and energy efficiency or sustainable design, most respondents who offered written comments felt that seismic safety was a higher priority and should be given at least equal emphasis by codes and regulations (Questions 20 and 21).

In addition to gauging support for a specific code provision, we are also interested in the philosophical basis for distinguishing, as the code does, between risk maintenance and risk reduction. As discussed in Section 3.1, the current model codes are geared toward risk maintenance. As long as the seismic risk, as measured by structural demands and capacities, is not increased, the alteration is permitted; risk
ALTERATIONS AND SEISMIC UPGRADE

reduction, or mitigation, is rarely triggered. But doesn’t the very act of altering a deficient building without upgrade increase risk? By modernizing or improving a building, even if the structure is untouched, aren’t the new architectural components, mechanical systems, and equipment put at risk? By renovating, isn’t the useful life of an aging building extended, exposing the deficient structure to more and stronger earthquakes? If so, then the current code approach is not as risk-neutral as it seems. From this perspective, some structural improvements would be warranted just to maintain the pre-alteration risk.

Survey respondents did not support this theory with any strength or consistency. Only 15 percent of Users (6 of 38) agreed that a “major alteration” puts significant new investment at risk, even in an “obsolete” building (Question 11). Designers agreed at twice the rate of Users, but Planners were even more skeptical. All respondents were more likely to agree that a major alteration might increase risk by extending a building’s life (Question 12), but even this was a minority opinion.

If building stakeholders do not think of alteration projects as increasing risk, how then to explain their general support for the idea of an alteration-based upgrade trigger? A simple answer is that they just want to reduce the existing risk and recognize a trigger as a reasonable way to do so. But if that were true, why is there not more voluntary risk reduction and more support for mandatory programs, independent of alterations? Cognitive dissonance, perhaps. Or just misleading survey results from a small, non-random sample. Or possibly the different responses to Questions 11 and 12 offer a clue. Twice as many respondents agreed that a major alteration extends the life of a deficient building than felt the alteration exposes new investment to risk. This suggests something disquieting about the idea of prolonging risk, or imposing the risk of a deficient building on tenants, passersby, or the community any longer than necessary. Perhaps extending the life of a seismically risky building with an expensive nonstructural alteration seems like unjust interference with some natural process of structural attrition.

As shown in Table 2-3, Seattle has implemented a local amendment that triggers seismic upgrade when an alteration “substantially extend[s] the useful physical and/or economic life of the building.” San Francisco’s “substantial change” trigger and Los Angeles’ 50 percent cost trigger can be viewed as quantitative applications of the same idea: Public policy expects a new building to provide a certain level of performance over its lifetime, so an older building altered to have a similar lifetime should be subject to similar policy expectations.

If a work area or cost trigger is really a surrogate for extended life, then the survey respondents’ preference for a limited or measured alteration trigger (Questions 17-19) can be understood as supportive of the Seattle approach. How, then, to quantify the appropriate trigger?

The current IEBC Work Area method defines a Level 3, or major, alteration as one that involves half of the building area. As discussed in Section 2.3, this is rarely a useful measure of structural or mechanical work, but it at least sets a mark where the IEBC developers think certain upgrade provisions should apply. For comparison, San Francisco’s local amendment sets a work area trigger for structural upgrade at two-thirds of a building’s floors. Asked how much of a building in mid-life would need to be altered to make it comparable to a new one, survey responses ranged from less than 50 percent to “impossible” (Question 13). The most common answer was “less than 50%,” but the median answer, if one might be identified as such, was probably a bit over 50 percent.

The current model codes do not use a cost trigger, but of course their predecessor, the “25-50” rule, drew the line at 50 percent of building replacement cost. As shown in Table 2-3, Los Angeles continues to use that figure, while other
entities use values as low as 25 or 30 percent. Survey respondents again matched these precedent values, with the most common estimate of the cost of full-building renovation being “between 10% and 50% of the replacement cost” (Question 14).

Despite the fact that survey respondents generally confirmed (or perhaps just reflected) ideas and specifics already in the model codes and local amendments, there was quite a bit of variation. If the respondents expressed any consensus, it was that effective regulation should consider a mix of ideas, and not settle on a one size fits all approach (Questions 15, 16, and 18).

4. Recommendation

In her prescient 1992 review of upgrade triggers, Hoover made a clear recommendation about regulating alteration projects:

A remodel trigger should be re-introduced to the UBC. If a proposed building renovation is of a significant scope, it should be a requirement that the seismic safety of the building be established. This trigger must be carefully crafted so as not to discourage routine maintenance or minor remodeling activity.

This report makes a similar recommendation and proposes code language to effect it (see Appendix C). But our recommendation also reflects new thinking about the purpose of building codes, about code adoption and amendment, and about earthquake performance objectives.

4.1 A customizable model code provision

In brief, we recommend a code change proposal to add optional criteria to the Alterations sections of the IEBC’s Prescriptive method (Section 403) and Work Area method (Section 907) to do the following:

- Allow a jurisdiction to designate, in advance, certain buildings that would be subject to seismic work in the event of a triggering alteration.
- Identify the nature of the alteration that would trigger seismic evaluation and possibly upgrade.
- Identify the scope of any triggered upgrade.
- Specify the criteria for any triggered upgrade.

A code change of this sort was presented in the code cycle that resulted in the 2015 IBC and IEBC. It was narrowly disapproved. Appendix C describes that process and reprints the proposed text.

Of the four pieces of the proposed provision, the last three—the trigger, the scope, and the criteria—could come directly from existing code provisions (see Table 2-2). Or they could be set especially for this new provision, perhaps borrowing from one or more of the local practices shown in Table 2-3 (and Appendix A). For the sake of model code uniformity, these three pieces would be set in the model code, but they would of course be changeable through local adoption. For the model code version, each would be negotiable through the normal consensus-based code development process.

Trigger

The trigger might be any Level 3 Alteration. But since the trigger would only apply to designated buildings—presumably buildings already representing a mitigation priority—a lower threshold might be equally rational. For this provision, the trigger should consider the existing deficiencies that merited designation, not just the size or extent of the intended alteration. In other words, as discussed in Section 3, the provision should consider not only how the intended alteration extends the life of an indi-
individual building, but how that alteration extends or prolongs the risk to the community.

In any case, as Hoover noted, the challenge is to select a trigger threshold high enough not to inhibit routine maintenance and minor renovations, but not so high that it would never be crossed.

**Triggered scope**
The triggered scope would probably be the entire seismic force-resisting system. In concept, the exceptions already allowed by IEBC Chapter 9 for alterations involving only the first story might be retained. Similarly, borrowing from IEBC Appendix A, if the designated buildings were known to have particular deficiencies of interest (as in "soft story" apartment buildings, or tilt-up structures), the scope could be limited to those critical conditions. Importantly, however, this triggered work would not involve a “10 percent” rule or other exception based on the effect of the alteration. The point here is to mitigate known deficiencies, not to measure the effect of the intended work.

**Criteria**
The criteria would presumably allow the use of reduced seismic loads, consistent with existing alteration-based triggers. Alternatively, since one purpose of the provision would be to achieve some mitigation benefit for the community, the criteria could be based on community-wide objectives regarding response, recovery, loss reduction, or economic stability.

A shift of focus away from the individual building and toward community resilience is a new and evolving concept. It makes sense, as community-wide objectives should be the proper basis for a public policy instrument like a building code, but few concrete examples exist, and best practices have yet to emerge. In principle, community-based criteria could look beyond safety, to ensure post-earthquake habitability or reparability, for example. By the same token, one could argue that community-based criteria can actually allow some existing safety deficiencies to remain (as the current codes do) and address them only when they become so pervasive that they affect the jurisdiction's capacity to respond and recover. Ideally, community-based criteria would be derived from a careful study of potential jurisdiction-wide losses and from a corresponding mitigation plan. In any case, community-based retrofit criteria would be jurisdiction-specific by definition, so it would be hard to select appropriate criteria for the model code.

**Designated buildings**
The key feature of this proposal, however, is the designation, in advance, of certain buildings as eligible for triggered upgrade. Appendix C refers to these as “priority buildings,” but they could be given any name or simply referenced generically, as “Section 907 buildings,” for example.

Upon adoption of the model code, a jurisdiction could, but would not be required to, identify the buildings for which a qualifying alteration would trigger seismic work. Designation would be based on combinations of building attributes, possibly including:

- Risk category (from IBC Table 1604.5)
- Seismic design category (from IBC Section 1613.3.5)
- Occupancy or use (from IBC Chapter 3)
- Size (height, stories, or total floor area)
- Structural material or system (from ASCE 7, as referenced by IBC Section 1613)
- Age (perhaps with reference to a table of benchmark years, as in ASCE 41-13)
- Location (to capture local seismicity or geologic hazards, or to coordinate with mitigation or development plans).

To the extent that they are known for a given building, irregularities or deficiencies might also be suitable designation criteria, but designation should be based on readily known attributes so that all stakeholders can know a building’s status at the start of the alteration project.
Designation should not depend on the nature of the intended alteration.

The model code provision, as suggested by the version in Appendix C, would not specify any particular attributes. Each jurisdiction would have the opportunity to select its own. Selecting none—the default selection—would mean that no buildings are specially targeted for seismic work, so the jurisdiction’s code would have only the alteration provisions that it has already. In this way, alteration-based triggers would be not only customizable by jurisdiction, but entirely optional as well.

There is precedent for model code provisions that are not entirely determined prior to adoption. The IEBC itself, for example, allows the permit applicant to select from among three methods and, within the Work Area method, to select from four ways to apply reduced seismic loads. Similarly, IRC Section R301.2.1.1 allows the user to select one of five alternative methods for wind design. Perhaps most similarly, IRC Section R301.2 provides a format for specifying local climatic and geographic design criteria, but each jurisdiction sets its own values. To be sure, most of Table R301.2(1) is to be filled out in a prescriptive way, but parts of it call for the judgment of the jurisdiction with respect to “local historical data” and allow code official discretion regarding “local climates or local weather experience.”

Ideally, the designation of certain buildings for potential seismic upgrade would be derived from a jurisdiction-specific loss study and mitigation plan. In the interim, most jurisdictions would probably rely on well-known histories of poor earthquake performance. Such a list might start with the building types for which specialized or simplified retrofit criteria have already been developed. IEBC Appendix A, for example, gives special attention to unreinforced masonry buildings, tilt-up structures, houses with wood-frame cripple walls, and multi-unit wood-frame residential buildings with soft story, weak story, or open front irregularities. (IEBC Appendix A also addresses non-ductile concrete frame structures but does not provide simplified or prescriptive retrofit provisions for them.)

Indeed, the model codes and local amendments already target certain building attributes, as shown in Table 2.2, Table 2.3, and Appendix A:

- Unreinforced masonry buildings assigned to seismic design category D, E, or F.
- Rigid wall-flexible roof structures assigned to seismic design category D, E, or F.
- In Utah: Pre-1975 buildings.
- In Massachusetts: masonry wall buildings with “educational occupancies K to 12.”

Buildings covered by various mandatory retrofit or incentive programs would also be logical candidates for designation. For example, San Francisco’s “soft story” program rather specifically targets pre-1978 wood frame buildings with 3 or more stories and 5 or more residential units and makes further stipulations for Assembly, Educational, Business, or Mercantile ground floor uses (SFIBC, 2013, Chapter 34B). Where a mandatory program might not be justified, the same cohort of buildings could be designated for triggered retrofit upon a major alteration.

Finally, code provisions for other project types already target certain building attributes, and these provisions could be revised or referenced for designation here. For example, for change of occupancy projects, IEBC Section 1007.3 triggers seismic upgrade based on specific combinations of risk category, building height, and occupancy (though these will be simplified in 2015). For repair of structures with significant earthquake-damage, Oakland uses a local amendment to trigger seismic upgrade for eight different building types including unreinforced masonry buildings, buildings with Assembly,
Educational, or Institutional occupancy, residential buildings with five or more units, "office or retail" buildings with occupant loads greater than 100, and any building taller than three stories (Oakland, 2013, Section 15.24.050). This is perhaps too extensive a list for an alteration-based trigger, but it establishes the precedent that for a given community, certain buildings can be identified and prioritized for seismic upgrade by the code.

4.2 A satisfying alteration trigger

The proposed code change resolves the issues identified in Sections 2 and 3 of this report. As a customizable trigger applicable only to suspect buildings and substantial retrofits, it balances stakeholders’ desires for non-arbitrary regulation with the code’s emphasis on risk maintenance and the mitigation planner’s objective of targeted risk reduction.

From the owner’s perspective, the customizable trigger properly handles buildings based on the risks they pose, not based on the nature or extent of alteration. If the trigger thus discourages modernization and renovation, it does so rationally and predictably; whether a building might be subject to triggered evaluation or retrofit can be known well in advance. And, as with the codes’ current alteration-based triggers, disruptive retrofit can still be avoided by carefully scoping the intended project. Finally, a trigger is less regressive than a mandate, because it only affects those who knowingly undertake a major alteration project.

From the code official’s perspective, the proposed trigger restores the emphasis on local conditions that arose, almost accidentally, when the “25-50” rule was eliminated in the 1970s. The wide variation between jurisdictions that Hoover identified in 1992, which might have made sense when viewed case by case but which disparaged the idea of a “uniform” code, might now be properly instituted through a model code provision that even invites local amendment.

For mitigation advocates, the proposal addresses the unsatisfying result of the current “10 percent” rule in which a grossly deficient building is allowed to be substantially altered with no thought to seismic performance, just because the alteration would not make the structure even worse. But with the proposed provision, if the deficient building can be characterized in advance as a proper candidate for retrofit, a major alteration will trigger seismic work, or at least call attention to the building’s shortcomings.

Further, the customizable trigger offers the chance to enhance the building code as an instrument of public policy. The code will still fill its traditional regulatory role, applied one project at a time. But if the designated buildings are selected to match especially vulnerable portions of a jurisdiction’s building stock, the alteration trigger becomes also a means to advance a mitigation plan already tailored to the jurisdiction’s resources and priorities. The customizable trigger makes it possible for one jurisdiction to focus, say, on its housing stock, while another seeks to protect local industry and jobs, and another targets, perhaps, a gentrifying neighborhood where resources are more plentiful. Though certainly less effective than a broad retrofit mandate, the proposed upgrade trigger would also be more effective and better targeted than a strictly voluntary program.

In addition to these conceptual benefits, and compared with any of the past or current alteration triggers described in Section 2, the customizable model code provision proposed here offers the following practical and administrative advantages as well:

- It is consensus-friendly. Because the model provision designates no buildings itself, it has a better chance of being approved for the model code than one of
the more comprehensive triggers used in the past.

- It respects, yet can survive, the trend toward amendment-free code adoption. As a model code provision, the trigger would come with the model codes by default. The details of which buildings to designate could then be proposed or negotiated separately, as a relatively small regulation, without interfering with pro forma adoption of the whole set of model codes.

- It is self-maintaining and “mainstreamed.” As part of the model code, the proposed provision would come with the code’s administrative provisions, enforcement rules, authority and accountability structure, related definitions and technical provisions, reference standards, and legal precedents, not to mention the consensus of professional communities. By contrast, for example, stand-alone California legislation regarding hazardous building types is not maintained and continues to use terminology and concepts long out of date (CHSC, Section 19160 ff). Having the trigger as part of the normal set of alteration provisions, as opposed to a separate building code chapter or stand-alone legislation is also consistent with the practice of mainstreaming mitigation, a preferred practice among disaster risk reduction professionals (Benson and Twigg, 2007).
References


DBI (Department of Building Inspection), 2007-2012. “City and County of San Francisco Department of Building Inspection Annual Report.” Available at: http://sfdbi.org/index.aspx?page=212


Mattera, Philip, 2006. “Breaking the Codes: How State and Local Governments are Reforming Building Codes to Encourage Rehabilitation of Existing Structures.” Good Jobs First, Washington, DC.


Appendix A: Selected code provisions

Appendix A presents the annotated text of example model code provisions and local amendments related to earthquake evaluation and performance of existing buildings. The information is current as of June 2013. Similar or related provisions for wind, flood, fire life safety, means of egress, etc. might be described for comparison purposes but are generally not included. Both structural and nonstructural scope is considered, but the provisions themselves are frequently unclear on the nonstructural scope. All occupancies are considered, except for IRC model code provisions and local provisions for one- and two-family dwellings. The material presented here is for reference only in the context of this report. In no way should it be understood as exhaustive or used instead of the actual code.

Included are:

- 2012 IBC Chapter 34
- 2012 IEBC Work Area method
- Selected California jurisdictions
  - Berkeley
  - Oakland
  - Palo Alto
  - Pasadena
  - San Francisco (2010 San Francisco Building Code)
  - San Jose
  - Santa Clara
  - Santa Monica
  - Santa Rosa
- Major west coast jurisdictions
  - Anchorage
  - Oregon
  - Portland (2009 Portland Building Regulations)
  - Washington
  - Seattle (2009 Seattle Building Code)
- Other selected jurisdictions
  - Utah
  - St. Louis
  - Charleston
  - Massachusetts (2010 Code of Massachusetts Regulations)

Legend

*Italic text* indicates wording discussed in the Remarks column.

*Yellow highlight* indicates the “trigger.”

*Magenta highlight* indicates a targeted risk, generally a specific structure type or occupancy.

*Green highlight* indicates the triggered scope or scope exceptions.

*Blue highlight* indicates the criteria to be used for triggered work.

Berkeley
- No changes to CBC relative to section 3404.
• Berkeley has mandatory retrofit programs for unreinforced masonry and, as of September 2013, woodframe “soft story” buildings.

Los Angeles
• The City of Los Angeles has a mandatory parapet bracing ordinance (Section 91.8114) and mandatory ordinances for retrofit of unreinforced masonry buildings (Division 88) and concrete tilt-up buildings (Division 91).

• The Los Angeles code also provides criteria for voluntary retrofit of houses with cripple walls (Division 92), “soft story” woodframe buildings (Division 93), hillside houses (Division 94), non-ductile concrete buildings (Division 95), and rigid wall-flexible roof buildings, including tilt-ups (Division 96).

2012 International Building Code (IBC)

<table>
<thead>
<tr>
<th>Code Text: 2012 (IBC)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3401.5 Alternative compliance.</strong> Work performed in accordance with the International Existing Building Code shall be deemed to comply with the provisions of this chapter.</td>
<td>The IBC allows the IEBC as an alternative. The 2012 IEBC provisions are tabulated below.</td>
</tr>
<tr>
<td><strong>3404.1 General.</strong> Except as provided by Section 3401.4 or this section, alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is no less complying with the provisions of this code than the existing building or structure was prior to the alteration.</td>
<td>In this general context, alterations ... shall comply is understood to mean only the alteration work itself, not the building affected by the alteration project. No less complying, is vague. The most conservative interpretation is that the building may not be made more hazardous by any measure. The more common understanding is that conformance, or compliance, is a true/false condition without degrees, so no less complying means that the alteration must not make a compliant building out of compliance on any issue.</td>
</tr>
<tr>
<td>Exceptions: 1. An existing stairway ... 2. Handrails ...</td>
<td></td>
</tr>
<tr>
<td><strong>3404.4 Existing structural elements carrying lateral load.</strong> Except as permitted by Section 3404.5, where the alteration increases design lateral loads in accordance with Section 1609 or 1613, or where the alteration results in a structural irregularity as defined in ASCE 7, or where the alteration decreases the capacity of any existing lateral load-carrying structural element, the structure of the altered building or structure shall be shown to meet the requirements of Sections 1609 and 1613.</td>
<td>Section 3404.5 is for voluntary seismic improvement. Section 1609 is wind design. Section 1613 is earthquake design. This is the IBC’s key provision for alteration-triggered seismic upgrade. There are three different possible triggers: increased load, new irregularity, and decreased capacity. Where any trigger condition applies, the full building must be made to comply with wind and seismic provisions for new buildings, subject to the following exception.</td>
</tr>
</tbody>
</table>
**Exception:** Any existing lateral load-carrying structural element whose demand-capacity ratio with the alteration considered is no more than 10 percent greater than its demand-capacity ratio with the alteration ignored shall be permitted to remain unaltered. For purposes of calculating demand-capacity ratios, the demand shall consider applicable load combinations with design lateral loads or forces per Sections 1609 and 1613. For purposes of this exception, comparisons of demand-capacity ratios and calculation of design lateral loads, forces, and capacities shall account for the cumulative effects of additions and alterations since original construction.

This is the “10 percent” rule, rewritten in terms of demand-capacity ratio for the 2009 edition. It can significantly reduce the scope of triggered work; in concept, section 3404.4 triggers work on the whole structure, but this exception then waives that triggered work for any element not made significantly worse—that is, 10% worse—by the proposed alteration.

The exception applies element by element. In theory, then, section 3404.4 and its exception can result in strengthening of individual elements in disparate locations throughout the structure, perhaps even without regard for load path or overall system performance.

Note that there is no scope exception by structure type, occupancy, project cost, etc.

This section says that by default, existing buildings are assumed to have obsolete or “ordinary” detailing of the sort no longer allowed for much new construction in areas of high seismicity.

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**3401.4.3 Existing seismic force-resisting systems.** Where the existing seismic force-resisting system is a type that can be designated ordinary, values of $R$, $Q$, and $C_d$ for the existing seismic force-resisting system shall be those specified by this code for an ordinary system unless it is demonstrated that the existing system will provide performance equivalent to that of a detailed, intermediate or special system.
**2012 International Existing Building Code (IEBC), Work Area Method**

The IEBC classifies alteration projects into three types, or levels. The requirements are cumulative: Level 2 Alterations must also comply with requirements for Level 1 Alterations, and Level 3 Alterations must also comply with requirements for Level 1 and Level 2 Alterations.

<table>
<thead>
<tr>
<th>Code Text: 2012 (IEBC)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>301.1 General.</strong> The repair, alteration, change of occupancy, addition or relocation of all existing buildings shall comply with one of the methods listed in Sections 301.1.1 through 301.1.3 as selected by the applicant. ... Where this code requires consideration of the seismic force-resisting system of an existing building subject to repair, alteration, change of occupancy, addition or relocation of existing buildings, the seismic evaluation and design shall be based on Section 301.1.4 regardless of which compliance method is used.</td>
<td>This section references the IEBC’s three distinct methods, two of which are identical to IBC Chapter 34. The remainder of this table references the Work Area Method, which differs from IBC Chapter 34. Section 301.1.4 gives the options for seismic criteria, which include provisions for new construction, national standards ASCE 31-03 and ASCE 41-06, and IEBC Appendix A for certain structure types. Within limits, this key exception in Chapter 1 allows a jurisdiction to waive nearly all upgrades triggered by alterations. If the exception is applied and upgrades are waived, any triggered seismic evaluation or retrofit would be required only in the case of a substantial structural alteration (see section 907.4.2).</td>
</tr>
</tbody>
</table>

*Exception:* Subject to the approval of the code official, alterations complying with the laws in existence at the time the building or the affected portion of the building was built shall be considered in compliance with the provisions of this code unless the building is undergoing more than a limited structural alteration as defined in Section 907.4.3. New structural members added as part of the alteration shall comply with the International Building Code. Alterations of existing buildings in flood hazard areas shall comply with Section 701.3.

**701.2 Conformance.** An existing building or portion thereof shall not be altered such that the building becomes less safe than its existing condition.

*Exception:* Where the current level of safety or sanitation is proposed to be reduced, the portion altered shall conform to the requirements of the International Building Code.

2012 Chapter 7 covers Alteration Level 1, which generally includes replacement of existing components with new ones that serve the same purpose. This general provision is the IEBC’s version of the IBC’s “no less complying” rule. The “less safe” trigger, while broad and vague, is not expected to apply to structural issues, which are addressed with more specific provisions elsewhere in the three alteration chapters. Specific code requirements are understood to supersede general requirements.
### Code Text: 2012 (IEBC)

#### 706.3.1 Bracing for unreinforced masonry bearing wall parapets.
Where a permit is issued for reroofing for more than 25 percent of the roof area of a building assigned to Seismic Design Category D, E or F that has parapets constructed of unreinforced masonry, the work shall include installation of parapet bracing to resist the reduced International Building Code seismic forces level as specified in Section 301.1.4.2 of this code, unless an evaluation demonstrates compliance of such items.

#### 807.5 Existing structural elements resisting lateral loads.
Alterations affecting the demands or capacities of existing elements of the lateral load-resisting system shall be evaluated using the wind provisions of the International Building Code and the reduced IBC-level seismic forces. Any existing lateral load-resisting structural elements whose demand-capacity ratio with the alteration considered is more than 10 percent greater than its demand-capacity ratio with the alteration ignored shall be brought into compliance with those wind and seismic provisions. In addition, the alteration shall not create a structural irregularity prohibited by ASCE 7 unless the entire structure complies with Section 301.1.4.2. For the purposes of this section, comparisons of demand-capacity ratios and calculation of design lateral loads, forces and capacity shall account for the cumulative effects of additions and alterations since the original construction.

#### 907.4 Existing structural elements resisting lateral loads.
All existing elements of the lateral force-resisting system shall comply with this section.

### Remarks

This provision targets unreinforced brick parapets, again in areas of high seismicity, and again allowing reduced loads. This triggered scope is thought to be commensurate with typical reroofing.

2012 IEBC Chapter 8 covers Alteration Level 2, which generally includes the types of work associated with tenant improvements or remodeling projects limited in area. Any alteration involving the reconfiguration of spaces or the reconfiguration or extension of any system, presumably including structural systems, is classified as Level 2.

The 2012 version of this provision was rewritten to more closely match the format of IBC Chapter 34, with the “10 percent” rule construed as a scope exception, not as a trigger. The revision also clarified the confusing link between the requirements for Level 2 and Level 3 alterations. Two other changes: The 2012 edition includes an irregularity trigger and allows the use of reduced forces for the triggered evaluation. The allowance of reduced forces is not a significant difference, since it is the change in DCR, not the absolute value, that is of interest.

2012 IEBC Chapter 9 covers Alteration Level 3, which includes any alteration with a work area greater than half of the building area.
<table>
<thead>
<tr>
<th>Code Text: 2012 (IEBC)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exceptions:</strong></td>
<td>Here the trigger is simple: The mere classification of work as a Level 3 alteration triggers an evaluation and possible retrofit. There are two exceptions: One for small multi-unit residential buildings, waiving any triggered upgrade, and one waiving upper story work in the case of first story alterations.</td>
</tr>
<tr>
<td>1. Buildings of Group R occupancy with no more than five dwelling or sleeping units used solely for residential purposes that are altered based on the conventional light-frame construction methods of the International Building Code or in compliance with the provisions of the International Residential Code.</td>
<td></td>
</tr>
<tr>
<td>2. Where such alterations involve only the lowest story of a building and the change of occupancy provisions of Chapter 10 do not apply, only the lateral force-resisting components in and below that story need comply with this section.</td>
<td></td>
</tr>
<tr>
<td><strong>907.4.1 Evaluation and analysis.</strong> An engineering evaluation and analysis that establishes the structural adequacy of the altered structure shall be prepared by a registered design professional and submitted to the code official.</td>
<td>The triggered scope begins with evaluation.</td>
</tr>
<tr>
<td><strong>907.4.2 Substantial structural alteration.</strong> Where more than 30 percent of the total floor and roof areas of the building or structure have been or are proposed to be involved in structural alteration within a five-year period, the evaluation and analysis shall demonstrate that the altered building or structure complies with the International Building Code for wind loading and with reduced IBC-level seismic forces. The areas to be counted toward the 30 percent shall be those areas tributary to the vertical load-carrying components, such as joists, beams, columns, walls and other structural components that have been or will be removed, added or altered, as well as areas such as mezzanines, penthouses, roof structures and in-filled courts and shafts.</td>
<td>This section adds a sub-trigger that further classifies Level 3 alterations by the amount of intended structural work.</td>
</tr>
<tr>
<td><strong>907.4.3 Limited structural alteration.</strong> Where the work does not involve a substantial structural alteration, the existing elements of the lateral load-resisting system shall comply with Section 807.5.</td>
<td>Though written as a trigger, this section is actually the default for any Level 3 alteration that does not involve substantial structural alteration.</td>
</tr>
<tr>
<td><strong>907.4.4 Wall anchors for concrete and masonry buildings.</strong> For any building assigned to Seismic Design Category D, E or F with a structural system consisting of concrete or reinforced masonry walls with a flexible roof diaphragm or unreinforced masonry walls with any type of roof diaphragm, the alteration work shall include installation of wall anchors at the roof line to resist the reduced IBC-level seismic forces, unless an evaluation demonstrates compliance of existing wall anchorage.</td>
<td>The 2012 edition triggers roof-to-wall anchorage in SDC D – F only for Level 3 alterations. However, the triggered scope does not explicitly include a full load path, with continuity ties and adequate subdiaphragms.</td>
</tr>
</tbody>
</table>
ALTERATIONS AND SEISMIC UPGRADE

<table>
<thead>
<tr>
<th>Code Text: 2012 (IEBC)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>907.4.5 Bracing for unreinforced masonry parapets.</strong> Parapets constructed of unreinforced masonry in buildings assigned to Seismic Design Category D, E or F shall have bracing installed as needed to resist the reduced IBC-level seismic forces, unless an evaluation demonstrates compliance of such items.</td>
<td>This 2012 section targets the same buildings and has the same parapet bracing scope and criteria as section 706.3.1, but here the trigger is simply the classification of work as Level 3, even if there is no intended reroofing.</td>
</tr>
</tbody>
</table>

Selected California Jurisdictions

2010 California Building Code (CBC)
The 2010 CBC is based on the 2009 IBC, Chapter 34 of which was nearly identical to the 2012 IBC tabled above. The following table includes California amendments applicable to most public and private buildings, but not public schools, hospitals, or other buildings regulated by DSA or OSHPD.

<table>
<thead>
<tr>
<th>Code Text: 2012 CBC</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3401.8 Alternative compliance.</strong> Work performed in accordance with the International Existing Building Code shall be deemed to comply with the provisions of this chapter.</td>
<td>The CBC keeps this section (renumbered), even though California does not separately adopt the entire IEBC.</td>
</tr>
</tbody>
</table>

| **3404.1 General.** Except as provided by Section 3401.4 or this section, alterations to any building or structure shall comply with the requirements of the code for new construction. Alterations shall be such that the existing building or structure is no less complying with the provisions of this code than the existing building or structure was prior to the alteration. Exceptions: 1. An existing stairway . . . 2. Handrails . . . 3. For state-owned buildings, including those owned by the University of California and the California State University and the Judicial Council, the requirements of Sections 3404.3 through 3404.5 are replaced by the requirements of Sections 3417 through 3422. | For state-owned buildings, California replaces much of Chapter 34 with its own provisions, shown below. |

| **3404.1.1 Replacement, retention and extension of original materials.** [HCD1] Local ordinances or regulations shall permit the replacement, retention and extension of original materials, and the use of original methods of construction, for any building or accessory structure, provided such building or structure complied with the building code provisions in effect at the time of original construction and the building or accessory structure does not become or continue to be a substandard building. For additional information, see Health and Safety Code Sections 17912, 17920.3, 17922(d), 17922.3, 17958.8 and 17958.9. | California makes no changes to section 3404.1, but it adds this general waiver on triggered upgrades for buildings regulated by the Department of Housing and Community Development—essentially all housing. The intent (once rational but now obsolete) is to avoid having renovations be discouraged by upgrade triggers. |
### 3417.3 Applicability.

**3417.3.1 Existing state-owned buildings.** For existing state-owned structures including all buildings owned by the University of California and the California State University, the requirements of Section 3417 apply whenever the structure is to be retrofitted, repaired or modified and any of the following apply:

1. **Total construction cost,** not including cost of furnishings, fixtures and equipment, or normal maintenance, for the building exceeds 25 percent of the construction cost for the replacement of the existing building.

   The changes are cumulative for past modifications to the building that occurred after adoption of the 1995 California Building Code and did not require seismic retrofit.

2. **There are changes in occupancy category.**

3. **The modification to the structural components increases the seismic forces in or strength requirements of any structural component of the existing structure by more than 10 percent cumulative since the original construction,** unless the component has the capacity to resist the increased forces determined in accordance with Section 3419. If the building’s seismic base shear capacity has been increased since the original construction, the percent change in base shear may be calculated relative to the increased value.

4. **Structural elements need repair where the damage has reduced the lateral-load-resisting capacity of the structural system by more than 10 percent.**

5. **Changes in live or dead load increase story shear by more than 10 percent.**

### 3417.4 Evaluation required.

If the criteria in Section 3417.3 apply to the project under consideration, the design professional of record shall provide an evaluation in accordance with Section 3417 to determine the seismic performance of the building in its current configuration and condition.

### 3417.5 Minimum seismic design performance levels for structural and nonstructural components.

Following the notations of ASCE 41,...[t]he minimum seismic performance criteria are given in Table 3417.5.... The building shall be evaluated at both the Level 1 and Level 2 performance levels, and the more restrictive requirements shall apply.

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In this context *substandard building* becomes a critical term. Though outside the scope of this report, it is worth noting that the California Health and Safety Code definition of substandard includes seismic inadequacy, so one could argue that HCD’s intent to waive triggered seismic upgrades is at odds with their own rationale.

Since this provision is not labeled as an exception, it is unclear what requirements apply if the building is substandard; presumably the substandard condition would need to be eliminated and the other triggers in section 3404 would apply.

For state-owned buildings, this section replaces the triggers of IBC section 3404.4.

The most significant revision is the addition of a cost trigger: Seismic evaluation is triggered if the cost of the intended alteration exceeds 25 percent of the building replacement cost.

Otherwise, the triggers include provisions similar to (but in older code language) the 10% rule of IBC section 3404.4.

These provisions apply a two-step trigger: The first trigger leads to evaluation; failing the evaluation triggers retrofit.

These provisions reference ASCE 41-06 with customized performance objectives. For buildings assigned to Occupancy Category I, II, or III, the triggered criteria are structural Life Safety and nonstructural Hazards Reduced in a probabilistic BSE-R event (20% probability of exceedance in 50-years).
ALTERATIONS AND SEISMIC UPGRADE

<table>
<thead>
<tr>
<th>Code Text: 2012 CBC</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3417.6 Retrofit required.</strong> Where the evaluation indicates the building does not meet the required performance objectives of this section, the owner shall take appropriate steps to ensure that the building’s structural system is retrofitted in accordance with the provisions of Section 3415 [Correction: 3417]. Appropriate steps are either: 1) undertake the seismic retrofit as part of the additions, modifications and/or repairs of the structure; or 2) provide a plan, acceptable to the building official, to complete the seismic retrofit in a timely manner . . . .</td>
<td></td>
</tr>
<tr>
<td>This section provides the second part of the two-step trigger.</td>
<td></td>
</tr>
<tr>
<td><strong>3417.7</strong> The additions, modification or repair to any existing building are permitted to be prepared in accordance with the requirements for a new building. Chapter 16, Part 2, Title 24, C.C.R., 2007 edition, applied to the entire building.</td>
<td></td>
</tr>
<tr>
<td>This provision allows the provisions for new construction as alternative criteria. Applied to the entire building is unclear; presumably it means the full structure, regardless of where deficiencies are found using the reduced evaluation criteria. It might also mean full nonstructural retrofit, even outside the alteration area.</td>
<td></td>
</tr>
</tbody>
</table>

Following are notes or tabulated summaries of relevant provisions from selected California cities. In general, every California city must adopt the state building code, summarized above, but may make local amendments. Local amendments are supposed to be related to local climate or geology, but some larger jurisdictions continue to enforce local amendments that pre-dated this rule.

Hoover (1992) surveyed code officials from around California about their local adoption and enforcement of alteration-based seismic upgrade triggers. Table A-1 presents her 1992 findings. The current status for several of these jurisdictions follows the table. As shown, much of the “case by case” judgment applied locally in 1992 no longer applies. Instead, local jurisdictions enforce only the state code (CBC) or formally adopt written local amendments.
### Table A-1. Local jurisdiction seismic upgrade practices circa 1992, from Hoover (1992)

<table>
<thead>
<tr>
<th>City</th>
<th>&quot;Major remodel extending life of building?&quot;</th>
<th>Remodel Notes</th>
<th>&quot;Substantial structural alteration?&quot;</th>
<th>SSA notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berkeley</td>
<td>No</td>
<td>—</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>Concord</td>
<td>No</td>
<td>—</td>
<td>No</td>
<td>—</td>
</tr>
<tr>
<td>Daly City</td>
<td>No</td>
<td>50% remodel triggers sprinklers</td>
<td>Yes</td>
<td>If capacity reduced</td>
</tr>
<tr>
<td>Gilroy</td>
<td>Maybe</td>
<td>Case by case</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>Hayward</td>
<td>No</td>
<td>—</td>
<td>Yes</td>
<td>URM and tilt-up</td>
</tr>
<tr>
<td>Long Beach</td>
<td>No</td>
<td>—</td>
<td>Yes</td>
<td>For “major change”</td>
</tr>
<tr>
<td>Los Angeles</td>
<td>Yes</td>
<td>Alt &gt; 50% replacement cost</td>
<td>Yes</td>
<td>Alt &gt; 50% replacement cost</td>
</tr>
<tr>
<td>Los Gatos</td>
<td>Yes</td>
<td>URM and pre-1975 tilt-up</td>
<td>Yes</td>
<td>“If structural integrity of the whole is affected”</td>
</tr>
<tr>
<td>Napa</td>
<td>Maybe</td>
<td>Case by case</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>Oakland</td>
<td>Maybe</td>
<td>Case by case if Alt &gt; 50% building value</td>
<td>Maybe</td>
<td>Case by case if Alt &gt; 50% building value</td>
</tr>
<tr>
<td>Palo Alto</td>
<td>Yes</td>
<td>If Alt &gt; 50% building value</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>Richmond</td>
<td>Maybe</td>
<td>Case by case</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>San Francisco</td>
<td>Yes</td>
<td>“substantial change” to 2/3 of floors or 75% of partitions</td>
<td>Yes</td>
<td>30% of structure is altered</td>
</tr>
<tr>
<td>San Jose</td>
<td>No</td>
<td>—</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>San Leandro</td>
<td>Maybe</td>
<td>Case by case if extending building life</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>San Mateo</td>
<td>No</td>
<td>—</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>San Rafael</td>
<td>No</td>
<td>—</td>
<td>No</td>
<td>—</td>
</tr>
<tr>
<td>Santa Clara</td>
<td>Maybe</td>
<td>Case by case if Alt &gt; 25% building value</td>
<td>Maybe</td>
<td>Case by case if affecting &gt;25% of structure</td>
</tr>
<tr>
<td>Santa Cruz</td>
<td>No</td>
<td>—</td>
<td>Yes</td>
<td>Hoover, p27: “[R]equires seismic improvements for a ‘rebuild’ which is defined as replacing more than 50% of the exterior walls;”</td>
</tr>
<tr>
<td>Santa Rosa</td>
<td>Yes</td>
<td>Plus, by ordinance: Prescriptive strengthening required for alteration or addition costing more than $50,000 on “split level houses,” or presumably house-over-garage. (Hoover, 1992, p27)</td>
<td>Yes</td>
<td>—</td>
</tr>
<tr>
<td>Sonoma</td>
<td>No</td>
<td>—</td>
<td>No</td>
<td>—</td>
</tr>
<tr>
<td>Sunnyvale</td>
<td>No</td>
<td>—</td>
<td>Maybe</td>
<td>Case by case</td>
</tr>
<tr>
<td>Vallejo</td>
<td>Yes</td>
<td>URM or “older concrete” or if “gutting” building</td>
<td>Yes</td>
<td>3 or more stories, if “gutting building”</td>
</tr>
</tbody>
</table>

#### 91.3404.1.1. Replacement, Retention and Extension of Original Materials. [HCD1]. The replacement, retention and extension of original materials, and the use of original methods of construction, for any building or accessory structure may remain, provided the aggregate value of work in any one year does not exceed 10 percent of the replacement value, and provided further that no hazardous conditions and [sic] such building or structure complied with the building code provisions in effect at the time of original construction and the building or accessory structure does not become or continue to be a substandard building. For additional information, see Health and Safety Code Sections 17912, 17920.3, 17922(d), 17922.3, 17958.8 and 17958.9.

Alterations, repairs or rehabilitation of the existing portion in excess of 10 percent of the replacement value of [sic] building or structure may be made provided all the work conforms to this Code for a new building and that no hazardous conditions or substandard buildings as [sic] are continued or created in the remainder of the building as a result of such work.

Whenever the aggregate value of the addition, alterations, repairs, or rehabilitation of the existing portion is in excess of 50 percent of the replacement value of the building or structure, the entire building or structure shall be made to conform to this Code.

#### 91.8107.1. Alterations, Repairs or Rehabilitation. Any alterations may be made to any building in any location, provided the building as altered conforms to the requirements of the Los Angeles Municipal Code for new buildings in the same location.

**Exceptions:**

1. Alterations or repairs to any existing nonconforming building outside of every fire district may be of the same type of construction as the existing building, provided the aggregate value of such alterations or repairs in any two-year period does not exceed 50 percent of the replacement value of the building.

2. Alterations or repairs may be made to any building in any location provided the new construction conforms to that required for a new building of like area, height and occupancy in the same location.

### Remarks

Los Angeles replaces the general HCD waiver in CBC section 3404.1.1 with a traditional 10-50 cost trigger: Original methods may be continued for projects up to 10 percent of replacement value, provisions for new construction apply to the alteration for projects up to 50 percent, and projects over 50 percent trigger an upgrade. (Note: This section has been deleted from the 2014 LABC.)

Los Angeles also adds this 50 percent cost trigger, but this is in section 91.8107 Requirements Outside of a Fire District and does not appear intended to cover about structural or seismic issues.
ALTERATIONS AND SEISMIC UPGRADE

Oakland

- No apparent changes to triggers in CBC 3404.
- Oakland does delete the word “replacement” in the HCD amendment 3404.1.1.
- Oakland has upgrade triggers that apply to earthquake-damaged buildings, the text of which refers to buildings being “altered.” However, this is a common conflation of alteration and repair. In current code terms, Oakland’s provision applies only to repair projects, not alterations.

San Diego

- No changes to CBC Chapter 34

San Diego's URM ordinance is based on triggers. Parapet bracing is mandatory (145.3710), and building retrofit is mandatory for essential facilities and buildings with hazardous materials (145.3706). Otherwise, seismic retrofit is triggered by change of occupancy or by alteration as described here.

Palo Alto

- No relevant changes to CBC Chapter 34. Palo Alto apparently no longer has the 50 percent cost trigger noted by Hoover.


<table>
<thead>
<tr>
<th>Section</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>145.3702 When the Archaic Materials and Methods of Construction Regulations Apply.</strong></td>
<td>Except as provided in Section 145.3703, the provisions of this division apply to buildings constructed or under construction before March 24, 1939, or for which a Building Permit was issued before March 24, 1939, and to City-owned buildings designated pursuant to Council resolution, which on January 1, 1994, had at least one “unreinforced masonry bearing wall” as defined in this division.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Remarks</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>San Diego’s ordinance targets pre-1939 unreinforced masonry buildings.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>145.3703 Exemptions from the Archaic Material and Methods of Construction Regulations.</strong></th>
<th>This division shall not apply to the following:</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Any detached single or two-family dwelling unit and detached apartment houses containing five or fewer units used solely for residential purposes and the accessory buildings for these occupancies. The exemption does not apply to buildings or structures containing mixed or nonresidential occupancies.</td>
<td>San Diego’s ordinance targets pre-1939 unreinforced masonry buildings.</td>
</tr>
</tbody>
</table>

| (b) Buildings that have been completely seismically retrofitted to comply with earlier editions of these regulations as provided in San Diego Municipal Code Chapter 9, Division 88, (Archaic Materials and Method of Construction), or equivalent, Chapter 14, Article 5, Division 4 (Additional Building Regulations for Archaic Materials and Methods of Construction) before January 1, 2008. Complete seismic retrofit shall be as determined by the Building Official. | |

Small residential buildings are exempt.

The ordinance uses criteria specially developed for unreinforced masonry bearing wall buildings, as opposed to general criteria from CBC chapter 16, ASCE 31, or ASCE 41. Chapter A1 of the 2010 California Existing Building Code is a slight modification of 2009 IEBC Appendix Chapter A1.
### 145.3705 General Regulations for Archaic Materials and Methods of Construction

(a) When structural seismic upgrading is required or is being voluntarily provided, the **building elements regulated by this division shall be those listed in Table No. A1-A of the 2010 California Existing Building Code**.

...  

### 145.3707 Regulations for Remodels Exceeding 100 Percent of Valuation

(a) The regulations of this section apply to buildings within the scope of this division that meet the following condition:

(1) The **Cumulative Value of Remodel or Renovation** excluding the cost of seismic retrofit or the removal stabilization or bracing of External Hazards, **exceeds 100 percent of the value of the building within any 5-year period after January 1, 2001**.

(A) The 100 percent value shall exclude the value of any nonstructural tenant improvements made or performed after the date a building owner provides floor-to-wall and roof-to-wall anchors under this section; ...

(b) The Building Official may serve an order to comply with this division in accordance with Sections 145.3713, 145.3714, and 145.3715.

(c) The order shall require **preparation of a Structural Survey and Engineering Report** of the building to be completed in accordance with Sections 145.3718, 145.3719, 145.3720, and 145.3721.

(d) If the Structural Survey and Engineering Report shows that the building meets the requirements of the California Historical Building Code, if applicable, or the 2010 California Building Code for new buildings of the same occupancy category, no further action is required. **If the report shows otherwise, the owner shall prepare and submit a Retrofit Guideline Document to the Building Official.**

(e) The time schedule shall specify completion dates for each phase of the seismic retrofit with the final date for completion of all items listed in the Structural Survey and Engineering Report to be a maximum of 10 years from the date of permit issuance for the portion of remodeling or renovation which cost exceeds 100 percent of the value of the building.

---

**Remarks**

San Diego's ordinance has a two-tiered cost trigger. The trigger sets the scope of work and the compliance timeline.

The ordinance uses a two-step trigger: first, evaluation; second, if the building fails evaluation, triggered retrofit.
145.3711 Regulations for Remodels over 50 Percent of Building Value

(a) The regulations of this section apply to buildings within the scope of this division that meet the following conditions:

(1) The buildings or structures are not Essential or Hazardous Facilities subject to the use limits of Section 145.3705 (f); and

(2) The cumulative value of remodel or renovation accumulated since January 1, 2001, excluding the cost of seismic retrofit, or the removal, stabilization, or bracing of External Hazards, exceeds 50 percent of the value of the building within any 5-year period after January 1, 2001.

(A) The 50 percent value shall exclude the value of any nonstructural tenant improvements made or performed after the date a building owner provides floor-to-wall and roof-to-wall anchors under this section. …

(b) The owner of a building regulated by this Section shall, within 5 years after the Date of Service of an order to comply, provide floor-to-wall and roof-to-wall anchors around the perimeter of the entire building. Existing floor-to-wall and roof-to-wall anchors must meet, or shall be upgraded to meet, the minimum requirements of Section A113.1 of the 2010 California Existing Building Code, or new anchors meeting those requirements shall be installed.

(c) If the building is a Historical Building, the installation shall comply with the requirements of the California Historical Building Code.

(d) The owner may have a Structural Survey and Engineering Report prepared. Installation will not be required if the owner establishes to the satisfaction of the Building Official, through a Structural Survey and Engineering Report, that the existing anchoring system meets those requirements.
### San Francisco
- San Francisco has a mandatory parapet bracing ordinance and mandatory ordinances for retrofit of unreinforced masonry and, as of April 2013, woodframe "soft story" buildings.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1604.11 Minimum lateral force for existing buildings.</strong></td>
<td>San Francisco adds this section to provide code-based seismic design criteria appropriate for existing buildings. The principal feature is a traditional set of reduced loads, but other provisions acknowledge conditions specific to existing buildings and to the local building stock.</td>
</tr>
<tr>
<td><strong>1604.11.1 General.</strong> This section is applicable to existing buildings when invoked by Section 3401.10. This section may be used as a standard for voluntary upgrades.</td>
<td></td>
</tr>
<tr>
<td>An existing building or structure which has been brought into compliance with the lateral force resistance requirements of the San Francisco Building Code in effect on or after May 21, 1973, shall be deemed to comply with this section except when a vertical extension or other alterations are to be made which would increase the mass or reduce the seismic resistance capacity of the building or structure.</td>
<td>The criteria target only buildings older than 1973, but even younger buildings qualify for the age exemption only if the triggering alteration work would not affect the seismic demand or capacity. The provision does not have an explicit &quot;10% rule.&quot;</td>
</tr>
<tr>
<td><strong>1604.11.2 Wind forces.</strong> Buildings and structures shall be capable of resisting wind forces as prescribed in Section 1609.</td>
<td>Exempted from compliance by Section 3401.10 should read &quot;exempted from compliance with Section 3401.10.&quot; This refers, for example, to section 3404.7.2 Exception 1 (see below).</td>
</tr>
<tr>
<td><strong>1604.11.3 Seismic forces.</strong> Buildings and structures shall comply with the applicable provisions of Sections 1613, except that, when compliance with this section is required by Section 3401.10, then structures and elements may be designed for seismic forces of not less than 75 percent of those given in Section 1613, and the building separation limitations of Section 1613.8 do not apply.</td>
<td>Alternative lateral analysis procedure allows criteria such as ASCE 41 to be used in lieu of the reduced forces and other provisions of section 1613.</td>
</tr>
<tr>
<td>When upper floors are exempted from compliance by Section 3401.10, the lateral forces generated by their masses shall be included in the analysis and design of the lateral force resisting systems for the strengthened floor. Such forces may be applied to the floor level immediately above the topmost strengthened floor and distributed in that floor in a manner consistent with the construction and layout of the exempted floor.</td>
<td></td>
</tr>
<tr>
<td>In lieu of meeting the specific requirements of this section, an alternative lateral analysis procedure incorporating inelastic behavior may be submitted and approved in accordance with rules and regulations adopted by the Building Official pursuant to Section 104A.2.1.</td>
<td></td>
</tr>
<tr>
<td><strong>1604.11.4 Design values for existing materials.</strong> The incorporation of existing materials, construction and detailing into the designed lateral force system shall be permitted when approved by the Building Official. Minimum quality levels and maximum load and stress values shall comply with Table 16C-D of this code, Tables 8-8-A and 8-8-B of the State Historical Building Code, or with other rules, regulations and standards adopted by the Building Official pursuant to Section 104A.2.1.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code Text</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3401.9 Homeless shelters.</strong> Notwithstanding any other provision of this section, any addition, alteration, repair, installation, change or reconstruction of any building or structure, which is made in order to initiate, expand or continue a facility which, as approved by an authorized government agency, shelters otherwise homeless persons and which is operated by an organization exempt from federal income tax under Internal Revenue Code Sections 501(c)(3) or 501(d), shall meet only those requirements of this code which are determined by the Building Official, pursuant to rules and regulations adopted by the Building Official in accordance with Section 104A.1, after consultation with the Fire Department, to be necessary or appropriate to prevent a life hazard, or to prevent the building or structure from being or becoming <em>substandard</em>. With respect to minimum lateral force requirements, said bulletin shall not waive any requirement which can be satisfied by work eligible to receive financial assistance from the State of California. Any provisions waived by said bulletin shall be applied when homeless shelter use ceases and may be applied when homeless shelter use is reduced.</td>
<td></td>
</tr>
</tbody>
</table>

San Francisco adds this section, waiving upgrade triggers, presumably to encourage the use of existing buildings as homeless shelters. As with the HCD provision in CBC section 3404.1.1, however, the waiver might depend on the jurisdiction's reading of the term *substandard*. |

| **3401.10 Lateral force design requirements for existing buildings.** Whenever other provisions of this code require compliance with this section, the lateral force provisions of Section 1604.11 shall apply to the entire building or structure except as otherwise provided therein. |

San Francisco adds this pointer to special seismic criteria added to chapter 16. |

| **3404.7 Substantial change.** |

San Francisco adds an explicit seismic upgrade trigger not found in the IBC or CBC: Seismic upgrade can be triggered by a substantial alteration regardless of how the intended work would affect the structural demand or capacity. San Francisco has had an essentially identical trigger since 1975 (Hoover, 1992, p27). |

Substantial changes to elements such as walls, partitions or ceilings is interpreted through long-standing precedent by the San Francisco code official. (2012 Administrative Bulletin 102, for example, clarifies that alteration of walls is substantial only when it affects the framing; replacement of plaster with gypsum board is not considered substantial.) The key point is that the intended alteration work need not affect the structure to reach the triggering level. |

Section 3401.10, discussed above, points to seismic criteria for existing buildings, in section 1604.11, that feature a traditional set of reduced loads. |
**3404.7.2 Structural alterations.** When more than 30 percent, cumulative since May 21, 1973, of the floor and roof areas of the building or structure have been or are proposed to be involved in *substantial structural alteration*, the building or structure shall comply with Section 3401.10. The areas to be counted towards the 30 percent shall be those areas tributary to the vertical load carrying components (joists, beams, columns, walls and other structural components) that have been or will be removed, added or altered, as well as areas such as mezzanines, penthouses, roof structures and infilled courts and shafts.

**Exceptions:**

1. When such alterations involve only the lowest story of a wood frame building or structure and Section 3408 does not apply, only the lateral force resisting components in and below that story need comply with Section 3401.10, or

2. When such alterations involve the lowest story of a Type V building or structure of R3 occupancy and that floor’s proposed use is as a garage, that level is exempt from Section 3404.7.2. Such alterations need not be counted as part of the cumulative total of tributary area of structural alterations.

San Jose
- In addition to the 2010 CEBC (similar to IEBC Appendix Chapters A1), San Jose adopts the 2009 IEBC, as well as Appendix Chapters A2, A3, and A4.
- Otherwise, San Jose makes no modifications to 2010 CBC 3404.

Santa Clara (city)
- No relevant changes to CBC Chapter 34. Apparently Santa Clara no longer has the 25 percent cost trigger noted by Hoover.

Santa Monica
- No apparent changes to 2010 CBC Chapter 34.

Santa Rosa
- No relevant changes to CBC Chapter 34. Apparently Santa Rosa no longer has the $50,000 cost trigger for “split level houses” noted by Hoover. The City does use a 50 percent area rule to trigger fire suppression sprinklers, but it does not mention seismic.

Major west coast jurisdictions

**Anchorage**
- Anchorage adopts the 2009 IEBC, including Appendix A, but it changes all the 5% gravity load triggers to 10%.
- No apparent changes to 2009 IBC Chapter 34.
- However, the Anchorage Administrative Code has special provisions for moved structures and does say:

  **23.10.101.7 Application to existing buildings and building service equipment.** Buildings, structures and the building service equipment to which additions, alterations or repairs are made shall comply with all the requirements of the technical codes for new facilities, except as specifically provided in [Section 101, which only addresses Moved buildings] or the International Existing Buildings Code.
State of Oregon

• The 2009 Oregon state building code (called the Oregon Structural Specialty Code), based on the 2009 IBC, makes no amendments to section 3404 that affect alteration-based triggers.

• Oregon SSC Section 3401.5 cites as a deemed-to-comply alternative “the latest revision of Oregon alternate method 08-05,” the May 2010 version of which is an adoption with amendments of the 2009 IEBC. There is at least one substantive amendment: Reduced forces are not allowed for Level 1 Alteration parapet bracing or for Level 3 Substantial Structural Alteration.

Portland

• Portland adopts and amends the 2009 IBC.

<table>
<thead>
<tr>
<th>Code Text: 2009 Portland Building Regulations</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>24.85.020 Seismic Related Definitions.</strong> (Amended by Ordinance Nos. 169427, 170997, 178831 and 180917, effective May 26, 2007.) The definitions contained in this Section relate to seismic design requirements for existing buildings outlined in this Chapter.</td>
<td>Where triggered, Portland uses the national standard ASCE 31-03 and specifies different performance levels for essential and non-essential facilities, presumably with reference to the state code, which in turn references the 2009 IBC. The scope, however, is unclear: Is it structural only, or are nonstructural components to be evaluated as well? And if so, throughout the whole building or just in the altered area?</td>
</tr>
<tr>
<td>A. ASCE 31 means the Seismic Evaluation of Existing Buildings ASCE/SEI 31-03 published by the American Society of Civil Engineers and the Structural Engineering Institute.</td>
<td></td>
</tr>
<tr>
<td>B. ASCE 31 Evaluation means the process of evaluating an existing building for the potential earthquake-related risk to human life posed by that building, or building component, and the documentation of that evaluation, performed and written according to the provisions of ASCE 31. ASCE 31 Evaluation is divided into two categories:</td>
<td></td>
</tr>
<tr>
<td>1. Non-essential facilities evaluation means a Tier 1 and a Deficiency-Only Tier 2 analysis to the Life Safety (LS) performance level as defined by ASCE 31 unless a complete Tier 2 analysis is required by ASCE 31.</td>
<td></td>
</tr>
<tr>
<td>2. Essential facilities evaluation means a Tier 2 analysis to the Immediate Occupancy (IO) performance level as defined by ASCE 31.</td>
<td></td>
</tr>
<tr>
<td>C. ASCE 31 Improvement Standard means the Tier 1 and Tier 2 Life Safety Performance Level Criteria of ASCE 31. …</td>
<td></td>
</tr>
<tr>
<td>G. Building Alteration means any change, addition or modification in construction. …</td>
<td></td>
</tr>
<tr>
<td>I. Essential Facility has the same meaning as defined in the OSSC.</td>
<td></td>
</tr>
<tr>
<td><strong>24.85.050 Building Additions or Structural Alterations.</strong> (Amended by Ordinance No. 178831, effective November 20, 2004.) An addition that is not structurally independent from an existing building shall be designed and constructed such that the entire building conforms to the seismic force resistance requirements for new buildings unless the three conditions listed below are met. Furthermore, structural alterations to an existing building or its structural elements shall also meet the following three conditions:</td>
<td>Relative to the 2009 or 2012 IBC or IEBC, Portland uses an obsolete formulation of the typical seismic trigger. First, the Portland provision uses a 5 percent rule (as opposed to 10 percent). Second it presents that rule as a trigger, not as a scope exemption. Third, it confusingly describes only what is not allowed, not how to improve the structure to accommodate the intended alteration.</td>
</tr>
</tbody>
</table>
### ALTERATIONS AND SEISMIC UPGRADE

<table>
<thead>
<tr>
<th>Code Text: 2009 Portland Building Regulations</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. The addition or structural alteration shall comply with the requirements for new buildings;</td>
<td>Presumably, the provision should be understood to mean that where triggered by demand increase or capacity decrease, the element in question must comply with provisions for new construction applied to the altered structure.</td>
</tr>
<tr>
<td>B. The addition or structural alteration shall not increase the seismic forces in any structural element of the building by more than 5 percent unless the capacity of the element subject to the increased forces is equal to or greater than that required for new buildings. Multiple force increases on an element are allowed provided the cumulative force increase does not exceed 5 percent of the force on the element from its original, unaltered state; and</td>
<td>Portland applies a cost trigger, but the scope of triggered work is evaluation only. (For URM buildings, see section 24.85.065.) The performance level for the triggered ASCE 31 evaluation is given with the definitions in section 24.85.020. As noted there, however, the nonstructural scope is unclear.</td>
</tr>
<tr>
<td>C. The addition or structural alteration shall not decrease the seismic resistance of any structural element of the existing building unless the reduced seismic resistance of the element is equal to or greater than that required for new buildings.</td>
<td></td>
</tr>
</tbody>
</table>

### 24.85.060 Required Seismic Evaluation.
(Added by Ordinance No. 169427; amended by 178831, effective November 20, 2004). When an alteration for which a building permit is required has a value (not including costs of mechanical, electrical, plumbing, permanent equipment, painting, fire extinguishing systems, site improvements, eco-roofs and finish works) of more than $175,000, an ASCE 31 evaluation is required. This value of $175,000 shall be modified each year after 2004 by the percent change in the R.S Means Construction Index for Portland on file with the Director. A letter of intent to have an ASCE 31 evaluation performed may be submitted along with the permit application. The evaluation must be completed before any future permits will be issued. The following shall be exempted from this requirement:

A. Buildings constructed or renovated to seismic zone 2, 2b or 3 under a permit issued after January 1, 1974.

B. Detached One- and two-family dwellings, and their accessory structures.

C. Single story, light frame metal and light wood frame buildings, not more than 20 feet in height from the top surface of the lowest floor to the highest interior overhead finish and ground area of 4,000 square feet or less.

A previously prepared seismic study may be submitted for consideration by the Director as equivalent to an ASCE 31 evaluation.

### 24.85.065 Seismic Strengthening of Unreinforced Masonry Bearing Wall Buildings.
(Added by Ordinance No. 169427; amended by 170997 and 178831, effective November 20, 2004). When any building alterations or repairs occur at an Unreinforced Masonry Bearing Wall Building, all seismic hazards shall be mitigated as set forth in Subsections 24.85.065 A. and B. A previously permitted seismic strengthening scheme designed in accordance with FEMA 178/310 documents is cited as the retrofit design criteria, even though it is primarily an evaluation standard.
ALTERATIONS AND SEISMIC UPGRADE

Code Text: 2009 Portland Building Regulations

may be submitted for consideration by the Bureau Director as equivalent to the ASCE 31 improvement standard:

A. Roof Repair or Replacement. When a roof covering is repaired or replaced, as defined in 24.85.020, the building structural roof system, anchorage, and parapets shall be repaired or rehabilitated such that, at a minimum, the wall anchorage for both in-plane and out-of-plane forces at the roof and parapet bracing conform to the ASCE 31 improvement standard. In-plane brick shear tests are not required as part of the ASCE evaluation under this subsection.

B. Additional Triggers.

1. Building alterations or repair. When the cost of alteration or repair work which requires a building permit in a 2 year period exceeds the following criteria, then the building shall be improved to resist seismic forces such that the entire building conforms to the ASCE 31 improvement standard.

TABLE 24.85-C

<table>
<thead>
<tr>
<th>Building Description</th>
<th>Cost of Alteration or Repair</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Story Building</td>
<td>$40 per square foot</td>
</tr>
<tr>
<td>Buildings Two Stories or Greater</td>
<td>$30 per square foot</td>
</tr>
</tbody>
</table>

2. Special building hazards. Where an Unreinforced Masonry Building of any size contains any of the following hazards, the building shall be seismically improved if the cost of alteration or repair exceeds $30 per square foot:

  a. The Building possesses an Occupancy Classification listed within the Relative Hazard Category [sic] 5 as determined in Section 24.85.040 of this Chapter; or

  b. The building is classified as possessing either vertical or plan irregularities as defined in the OSSC.

... 5. Automatic cost increase. The dollar amounts listed in Subsections 24.85.065 B.1. and 2. shall be modified each year after 2004 by the percent change in the R.S. Means of Construction Cost Index for Portland, Oregon. The revised dollar amounts will be made available at the Development Services Center.

Remarks

The first URM trigger is reroofing.

The second URM trigger is alteration cost.

The provision sets the triggered retrofit scope as the entire building. Presumably this includes nonstructural components, but the provision is not explicit.


State of Washington

- 2011 Washington State Building Code makes no amendments to 2009 IBC Section 3404 that affect alteration-based triggers.

Seattle

- Seattle adopts and amends the 2009 IBC.

- Washington also adopts the 2009 IEBC, and the state and Seattle separately amend it.
3404.7 Unreinforced masonry chimneys. Whenever an unreinforced masonry chimney is altered or when the building in which such a chimney is located undergoes substantial alteration, the chimney shall conform to rules promulgated by the building official.

3404.8 Substantial alterations or repairs. Any building or structure to which substantial alterations or repairs are made shall conform with the requirements of this section and Sections [sic] 403 (high rise buildings) when applicable, special requirements for the Fire District found in Chapter 4 when applicable, Section 716 (protection of ducts and air-transfer openings), Chapter 8 (interior finishes), Section 903 (automatic sprinkler systems), and Chapter 10 (means of egress). Fire alarms shall be provided as required by the International Fire Code. See Section 3404.7 for specific requirements for unreinforced chimneys.

3403.8.1 Definition. For the purpose of this section, substantial alterations or repairs mean any one of the following, as determined by the building official:
1. Repair of buildings with damage ratios of 60 percent or more.
2. Remodeling or additions that substantially extend the useful physical and/or economic life of the building or a significant portion of the building, other than typical tenant remodeling.
3. A change of a significant portion of a building to an occupancy that is more hazardous than the existing occupancy, based on the combined life and fire risk as determined by the building official. The building official is permitted to use Table 3404.8 as a guideline. A change of tenant does not necessarily constitute a change of occupancy.
4. Reoccupancy of a building that has been substantially vacant for more than 24 months in occupancies other than Group R-3.
5. A significant increase in the occupant load of an unreinforced masonry building.

3404.8.2 Seismic regulations. The provisions of Section 1613 apply to all buildings or structures to which substantial alterations or repairs are made. In addition, the building official is authorized to require testing of existing materials when there is insufficient evidence of structural strength or integrity.

Seattle targets a particular element, independent of structure type or occupancy. Substantial alteration is defined in section 3403.8.1.

Seattle adds this trigger based on substantial alteration, defined in section 3403.8.1. Section 403 contains no special triggered seismic scope for high rise buildings. (In fact, section 403.2.2 refers to chapter 16 for seismic requirements, where section 1613.3 points back, in circular fashion, to chapter 34.)

Presumably, the references to Chapter 8 and Section 903 are meant to trigger seismic improvements to existing interior finishes and fire suppression systems.

For alterations, Seattle defines a substantial alteration in subjective terms based on extended life, as opposed to a strict measure of work area or cost. The definition has remained essentially unchanged since at least 1991 (Hoover, 1992, p22). Guidance for classifying alterations as substantial is given in Client Assistance Memo 314, published by the Seattle Department of Planning and Development (Seattle, 2010). An alteration can be a substantial alteration based on a combination of cost, extensiveness of the proposed work, and the deficiencies or remaining life of the existing building.

Where triggered, Seattle cites the provisions for new construction. Reduced loads (as allowed by other alteration triggers) are not explicitly allowed but might be acceptable under Exception 2.
ALTERATIONS AND SEISMIC UPGRADE

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exceptions:</strong></td>
<td></td>
</tr>
<tr>
<td>1. If an alteration is substantial only because it is a change to a more hazardous occupancy, compliance with this subsection is required only if the life hazard risk increases, as determined by the building official.</td>
<td></td>
</tr>
<tr>
<td>2. The building official is authorized to accept a proposal in lieu of compliance with Chapter 16, The proposal shall be based on a comprehensive report prepared by a licensed structural engineer according to rules promulgated by the building official. The report shall include an investigation and structural analysis of the building based on an approved standard. The report shall specify the building's seismic deficiencies, and propose measures that will provide an acceptable degree of seismic safety considering the nature, size and scope of the project. This requirement shall also apply to Section 102 as conditions require.</td>
<td>Exception 3 allows the triggered scope to be reduced for typical cripple wall houses.</td>
</tr>
<tr>
<td>3. In lieu of compliance with the seismic provisions of Chapter 16 for Group R-3 occupancies, when approved by the building official the applicant is permitted to evaluate and strengthen portions of the building lateral support structure, such as foundations and cripple walls</td>
<td></td>
</tr>
</tbody>
</table>

Other selected jurisdictions

Utah

- As of July 1, 2012, Utah Building Code adopts and amends the 2009 IBC.

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>3401.6 Parapet bracing, wall anchors, and other appendages.</strong> Until June 30, 2014, a building constructed before 1975 shall have parapet bracing, wall anchors, and appendages such as cornices, spires, towers, tanks, signs, statuary, etc. evaluated by a licensed engineer when the building is undergoing structural alterations, which may include structural sheathing replacement of 10% or greater or other structural repairs. Reroofing or water membrane replacement may not be considered a structural alteration or repair for purposes of this section. Beginning July 1, 2014, a building constructed before 1975 shall have parapet bracing, wall anchors, and appendages such as cornices, spires, towers, tanks, signs, statuary, etc. evaluated by a licensed engineer when the building is undergoing a total reroofing. Parapet bracing, wall anchors, and appendages required by this section shall be evaluated in accordance with 75% of the seismic forces as specified in Section 1613. When allowed by the local building official, alternate methods of equivalent strength as referenced in an approved engineering judgment.</td>
<td>Utah adds a section with a phased two-step trigger. The first step is evaluation; if deficient, the second step triggers retrofit. In the first phase, structural alteration (generally undefined, but possibly including some repairs) triggers evaluation. The scope includes wall anchors but appears to target nonstructural falling hazards. The second phase adds a reroofing trigger. For both phases, the evaluation criteria are code-based but allow reduced seismic loads. Presumably, the retrofit criteria match the evaluation criteria, but the provision appears to allow ample engineering judgment.</td>
</tr>
</tbody>
</table>
### Code Text: 2009 Seattle Building Code

When found to be deficient because of design or deteriorated condition, the engineer's recommendations to anchor, brace, reinforce, or remove the deficient feature shall be implemented.

### Remarks

The emphasis on parapets and wall anchors appears to target URM buildings, but Utah's many brick houses (R-3 occupancy) are exempt.

The second exemption is borrowed from ASCE 31-03.

#### Exceptions:

1. **Group R-3 and U occupancies.**
2. Unreinforced masonry parapets need not be braced according to the above stated provisions provided that the maximum height of an unreinforced masonry parapet above the level of the diaphragm tension anchors or above the parapet braces shall not exceed one and one-half times the thickness of the parapet wall. The parapet height may be a maximum of two and one-half times its thickness in other than Seismic Design Categories D, E, or F.

### St. Louis

- St. Louis adopts the 2009 IBC and 2009 IEBC with no apparent changes to either.

### Charleston

- The state of South Carolina appears to adopt the 2006 IBC with no apparent changes to Chapter 34.

### Massachusetts

In August 2010, Massachusetts adopted both the 2009 IBC and the 2009 IEBC, with building code amendments published in the Code of Massachusetts Regulations, known as 780 CMR. The state’s first amendment to IBC Chapter 34 is to delete it and replace it with the IEBC. So Massachusetts retains the IEBC’s three distinct methods, one of which (the Prescriptive Method) is essentially identical to Chapter 34. 780 CMR then makes additional amendments to each method of the 2009 IEBC. Unless indicated “IBC,” the code section numbers below refer to the IEBC. Massachusetts also adopts the 2009 IRC, including Appendix J for existing buildings, with amendments. Neither the IRC nor the Massachusetts amendments are listed here.

### Code Text: 2010 8th Edition 780 CMR

**IBC 3401.1 Scope.** Chapter 34 of the International Building Code 2009 (IBC 2009) is deleted in its entirety. The alteration, repair, addition, and change of occupancy of existing buildings shall be controlled by the provisions of the International Existing Building Code 2009 (IEBC 2009) and its appendices, and as modified with Massachusetts Amendments as follows: …

**101.5.4.1 Item 1.** Replace this Item as follows:

1. The International Building Code 2009 with Massachusetts Amendments using 100% of the prescribed forces. For existing buildings with seismic force resisting systems found in Table 101.5.4.1.0, the values of R, Ω₀, and C_d from this table shall be used in the analysis For seismic force resisting systems not found in Table 101.5.4.1.0, the values of R, Ω₀, and C_d used for analysis in accordance with Chapter 16 of the International Building Code 2009 with Massachusetts
Amendments, (780 CMR 16.00) shall be those specified for structural systems classified as “Ordinary” in accordance with Table 12.2-1 of ASCE 7, unless it can be demonstrated that the structural system satisfies the proportioning and detailing requirements for systems classified as “Intermediate” or “Special”.

### 101.5.4.2 Item 1 Exceptions:

1. The [International Building Code 2009 with Massachusetts Amendments using 50% of prescribed forces](#) when directed here by sections [sic] 807.4.3

2. The International Building Code 2009 with Massachusetts Amendments using

   a. 50% of prescribed forces when directed here by Section 1003.3.1 and when the vertical addition increases the building area less than or equal to 30%.

   b. 75% of prescribed forces when directed here by section 1003.3.1 and when the vertical addition increases the building area more than 30% but less than 50%.

### 101.9 Cumulative Effects of Alterations, Additions, or Changes of Occupancy on Structural Elements.

As noted in several sections of this code, evaluation of structural elements and their connections shall consider the cumulative effects of alterations, additions, or changes of occupancy since original construction. Alterations, additions, or changes in occupancy that meet all of the following criteria, are exempt from consideration of cumulative effects on structural elements:

1. Structural work does not involve more than 2% of the total tributary area of horizontal framing members of any existing framed floor or roof.

2. Structural work does not alter shear walls above the foundation.

3. Structural work does not alter columns or diagonal braces.

4. Structural work does not create an opening in any framed floor or roof that has an area more than 2% of the framed floor or roof.

5. Structural work does not alter any floor or roof diaphragm and its connections such that in-plane shear resistance is reduced by more than 5%.

6. Structural work does not remove or reconfigure lateral load resisting frames, or foundations supporting them.

Massachusetts adds these exceptions. 2009 IEBC section 101.5.4.2 gives the four options for evaluation or retrofit criteria with reduced seismic loads. Item 1 cites the IBC provisions for new construction, with a factor of 75% on the seismic design loads. Section 807.4.3, cited in Exception 1, is for Level 3 alterations that involve limited structural alteration. As Item 1 already allows a 75% load factor, Massachusetts makes the triggered criteria even less onerous.

Exception 2 is for additions, not alterations.

Massachusetts adds this subsection. This added provision is not really a trigger, triggered scope, or triggered criteria. It is closer to a definition or description of what to count toward the effect of a past or proposed alteration. It is included here only to illustrate how Massachusetts has been thinking about structural alterations.
### Code Text: 2010 8th Edition 780 CMR

<table>
<thead>
<tr>
<th><strong>101.10 Masonry Walls.</strong> For alterations to buildings with masonry walls, all masonry walls shall comply with the provisions of Appendix A1 as modified by Massachusetts Amendments, where any of the following conditions exist:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. the <strong>work area exceeds 50% of the aggregate area</strong> of the building, or</td>
</tr>
<tr>
<td>2. an occupancy increase of more than 25% and to a total of 100 or more, or</td>
</tr>
<tr>
<td>3. a change of occupancy to a relative hazard category of 1 or 2 per Table 912.5, or <strong>educational occupancies</strong> K to 12, or</td>
</tr>
<tr>
<td>4. a <strong>Level 2 Alteration</strong>, as defined by section 404, to an <strong>Occupancy Category IV</strong> per ASCE 7.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Remarks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts adds this set of triggers for masonry buildings. Because these triggers have a history of use in Massachusetts, they are kept together and added to IEBC chapter 1, instead of being split and added to the sections or chapters appropriate to each project type. Note also that the first sentence refers to “alterations” in a general sense, when some of the triggers are clearly about change of occupancy, not alteration. Some jurisdictions traditionally treat major repairs and certain change of occupancy projects as major alterations; this can lead to misunderstandings and conflicts with the recent IEBC and IBC, which treat these project types separately.</td>
</tr>
</tbody>
</table>

- **Trigger 1,** where **work area exceeds 50% of the aggregate area,** corresponds to IEBC Alteration Level 3.
- **Trigger 3** is confusing: Is the intent that any alteration to a building with educational occupancy should be triggered, or only that a change of occupancy to an educational occupancy should be triggered?

- **Massachusetts extends the Level 1 reroofing triggers for wall anchors and parapet bracing down to seismic design category B.**

- **Massachusetts adds this exception to the Level 1 triggered scope for parapet bracing.** The aspect ratio of 2.5 is consistent with the ASCE 31-03 Tier 1 checklist item for areas of lower seismicity.

- **Massachusetts adds a trigger for alterations that result in irregularities.** A similar trigger was added to this section in the 2012 IEBC.

| **606.2.1** Replace ‘D, E, or F’ with ‘B, C, D, E, or F’ |
| **606.3.1** Replace ‘D, E, or F’ with ‘B, C, D, E, or F’ |
| **606.3.1 Exception.** Masonry parapets with a height to thickness ratio of 2.5 or less. The height of the parapet shall be measured from the level of where the unreinforced masonry walls are connected to the roof diaphragm. |
| **707.5.1** Irregularities. Where the alteration results in a structural irregularity as defined in ASCE 7, the lateral load-resisting structural elements shall comply with the structural requirements specified in section 807.4. |

### Appendix B: Stakeholder Survey

This appendix provides details about the opinion survey described in Section 3.3 of this report.

The survey was conducted online in 2011 using Survey Monkey. The authors of this report conceived and wrote the survey questions; there was no professional survey design. We did not vary the sequence of the questions.

Respondents were recruited primarily through mass emails and newsletter notices of various professional organizations. In addition, we used
personal contacts and networks to distribute a brief invitation to take the survey. As described in the report, we were especially interested in the responses of professionals in fields related to building usage who would be affected by an alteration-based upgrade trigger, but not necessarily contractors, designers (including engineers), or experts in earthquake mitigation or building code enforcement.

We contacted the following organizations and proposed to place a short description and invitation to take the survey in their regular communications to members:

**Owners, developers, and private sector owner-builders**
- ICSSC (RP 8 committee). Federal agencies
- Apartment Owners Associations
  - California Apartment Association (CAA)
  - San Francisco Apartment Association (SFNA)
  - Rental Housing Owners Association (RHOA) of Southern Alameda County
  - CAA, Tri-County Division (South Bay)
  - CAA, Contra Costa Division
  - Marin Income Property Association
  - CAA, Los Angeles Division
  - CAA, Greater Inland Empire Division (Riverside, San Bernardino, East Los Angeles)
  - CAA, South Coast Division (Irvine)
- Building Owners and Managers (BOMA) Chapters
  - San Francisco
  - Oakland/East Bay
  - Greater Los Angeles
  - Silicon Valley
  - Seattle King County
- NAIOP Chapters (Commercial real estate development)
  - Bay Area
  - Southern California
  - Silicon Valley
  - Washington state
- National Association of Home Builders (NAHB)

**Tenants**
- SBN (Small Business Network)
- Small Business California

**Finance professionals (lenders, insurers, investors)**
- Institute of Business and Home Safety (IBHS)
- RIMS (The Risk Management Society), Golden Gate and Los Angeles Chapters
- Mortgage Bankers Association of California

**Code officials and regulators**
- International Code Council
- California Building Officials (CALBO)

**Mitigation planners**
- FEMA
- CalEMA
- Emergency Managers Association
- SF CARD
- CESA (California Emergency Services Association)
- WSSPC
- SPUR

Each organization was encouraged to customize the notice to its members in the way that it felt would be most productive. We provided the following basic invitation, or one like it, to each organization:

**When should the building code require seismic upgrade? Take the quick survey.**
The Earthquake Engineering Research Institute is funding a study that seeks CAA members’ input. A short survey about building alterations and triggered upgrades is at https://www.surveymonkey.com/s/FN3BGTK.

Here’s what it’s about: Say you’re doing a tenant improvement or a mechanical upgrade. Should the building code also require a seismic evaluation – and possibly a retrofit – even if your project wouldn’t touch the structural system? You can contribute to the code change process by taking a survey developed by researchers funded by the Earthquake Engineering Research Institute (www.eeri.org). The 2010 CBC triggers upgrades in a few cases already, but some are asking whether the code should be more proactive about seismic mitigation.

• What role should the code play in a city’s mitigation plan?
• Would code-triggered upgrades reduce risk or would they just discourage modernization projects?
• Should a seismic trigger be related to project cost?

Take the quick, anonymous survey at https://www.surveymonkey.com/s/FN3BGTK. For more about the study, contact David Bonowitz, S.E. at dbonowitz@att.net.

Respondents were not vetted to ensure representative participation of any particular group. Rather, the respondents were self-selected in the sense that our invitation probably attracted individuals with pre-existing opinions – on both sides – on at least some of the topics covered in the survey.

All responses were anonymous, but individual respondents were given the option of providing contact information in order to receive a copy of the final survey results.

Following is the text of each survey question, along with the responses, cross-tabulated by the “role” or expertise of each respondent as reported in Question 1.

1. In your work with buildings—and for purposes of this survey—what role are you normally in?

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner or Developer</td>
<td>28 36%</td>
<td>28 65%</td>
<td>0 0%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Tenant</td>
<td>9 12%</td>
<td>9 21%</td>
<td>0 0%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Lender, Insurer, or Investor</td>
<td>6 8%</td>
<td>6 14%</td>
<td>0 0%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Architect, Engineer, or Builder</td>
<td>16 21%</td>
<td>0 0%</td>
<td>0 0%</td>
<td>16 100%</td>
</tr>
<tr>
<td>Code Official</td>
<td>4 5%</td>
<td>0 0%</td>
<td>4 21%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Mitigation Planner</td>
<td>4 5%</td>
<td>0 0%</td>
<td>4 21%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Emergency Responder or Manager</td>
<td>11 14%</td>
<td>0 0%</td>
<td>11 58%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

2. In your normal role, which occupancy type are you most familiar or experienced with?

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2 unit residential</td>
<td>12 16%</td>
<td>7 16%</td>
<td>0 0%</td>
<td>5 33%</td>
</tr>
<tr>
<td>Multi-unit residential</td>
<td>14 18%</td>
<td>11 26%</td>
<td>2 11%</td>
<td>1 7%</td>
</tr>
</tbody>
</table>
### 3. In your normal role, which structure type are you most familiar or experienced with?

<table>
<thead>
<tr>
<th>Structure Type</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office/commercial/mercantile</td>
<td>30 39%</td>
<td>15 35%</td>
<td>11 58%</td>
<td>4 27%</td>
</tr>
<tr>
<td>Parking or warehouse</td>
<td>4 5%</td>
<td>2 5%</td>
<td>0 0%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Mixed use</td>
<td>4 5%</td>
<td>2 5%</td>
<td>1 5%</td>
<td>1 7%</td>
</tr>
<tr>
<td>Other, or no standout</td>
<td>13 17%</td>
<td>6 14%</td>
<td>5 26%</td>
<td>2 13%</td>
</tr>
</tbody>
</table>

### 4. For the buildings you normally work with, what is the typical seismicity?

<table>
<thead>
<tr>
<th>Seismicity Description</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>High: Mostly in coastal California, Oregon, or Washington, or similar.</td>
<td>52 69%</td>
<td>26 63%</td>
<td>13 72%</td>
<td>13 81%</td>
</tr>
<tr>
<td>Moderate: Mostly in California central valley, Salt Lake City, Memphis, or similar.</td>
<td>6 8%</td>
<td>2 5%</td>
<td>3 17%</td>
<td>1 6%</td>
</tr>
<tr>
<td>Low: Mostly elsewhere.</td>
<td>3 4%</td>
<td>2 5%</td>
<td>0 0%</td>
<td>1 6%</td>
</tr>
<tr>
<td>Mixed: Widely spread among different seismicity levels.</td>
<td>11 15%</td>
<td>9 22%</td>
<td>1 6%</td>
<td>1 6%</td>
</tr>
<tr>
<td>Other, Don't know, or Does not apply.</td>
<td>3 4%</td>
<td>2 5%</td>
<td>1 6%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

### 5. For the buildings you normally work with, how would you characterize their vulnerability to earthquake damage?

<table>
<thead>
<tr>
<th>Vulnerability Description</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>High: Mostly obsolete structure types, and subject to damaging earthquakes.</td>
<td>10 13%</td>
<td>5 12%</td>
<td>1 5%</td>
<td>4 25%</td>
</tr>
<tr>
<td>Low: Mostly new or modern structure types, or in areas of low seismicity.</td>
<td>22 29%</td>
<td>12 29%</td>
<td>5 26%</td>
<td>5 31%</td>
</tr>
</tbody>
</table>
## ALTERATIONS AND SEISMIC UPGRADE

<table>
<thead>
<tr>
<th>Mixed: Wide variations from building to building.</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>42 55%</td>
<td>23 56%</td>
<td>12 63%</td>
<td>7 44%</td>
</tr>
<tr>
<td>Other, Don’t know, or Does not apply</td>
<td>2 3%</td>
<td>1 2%</td>
<td>1 5%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

### 6. Compared with others in your field, how would you characterize your familiarity with building codes?

<table>
<thead>
<tr>
<th>Much higher than average.</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33 43%</td>
<td>16 38%</td>
<td>8 42%</td>
<td>9 56%</td>
</tr>
<tr>
<td>About average.</td>
<td>38 49%</td>
<td>25 60%</td>
<td>6 32%</td>
<td>7 44%</td>
</tr>
<tr>
<td>Much lower than average.</td>
<td>6 8%</td>
<td>1 2%</td>
<td>5 26%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

### 7. How much experience do you have with building alteration projects (major renovations, tenant improvements, etc.)?

<table>
<thead>
<tr>
<th>Multiple projects, including recent projects.</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>54 70%</td>
<td>24 57%</td>
<td>15 79%</td>
<td>15 94%</td>
</tr>
<tr>
<td>1 or 2 projects.</td>
<td>11 14%</td>
<td>9 21%</td>
<td>1 5%</td>
<td>1 6%</td>
</tr>
<tr>
<td>No direct experience to speak of.</td>
<td>12 16%</td>
<td>9 21%</td>
<td>3 16%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

### 8. How much experience do you have with seismic upgrade projects?

<table>
<thead>
<tr>
<th>Multiple projects, including recent projects.</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 39%</td>
<td>11 26%</td>
<td>8 42%</td>
<td>11 69%</td>
</tr>
<tr>
<td>1 or 2 projects.</td>
<td>14 18%</td>
<td>8 19%</td>
<td>3 16%</td>
<td>3 19%</td>
</tr>
<tr>
<td>No direct experience to speak of.</td>
<td>33 43%</td>
<td>23 55%</td>
<td>8 42%</td>
<td>2 13%</td>
</tr>
</tbody>
</table>

### 9. Have you been involved in building alteration projects that included seismic upgrades only because the building code required it?

<table>
<thead>
<tr>
<th>Yes, several.</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>21 28%</td>
<td>8 20%</td>
<td>6 32%</td>
<td>7 44%</td>
</tr>
<tr>
<td>Yes, 1 or 2 projects.</td>
<td>12 16%</td>
<td>7 17%</td>
<td>3 16%</td>
<td>2 13%</td>
</tr>
<tr>
<td>No, or Don’t know.</td>
<td>43 57%</td>
<td>26 63%</td>
<td>10 53%</td>
<td>7 44%</td>
</tr>
</tbody>
</table>
10. Have you been involved in proposed building alteration projects that were canceled, de-prioritized, or modified in scope to avoid code-required seismic upgrades?

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes, several.</td>
<td>9 12%</td>
<td>1 2%</td>
<td>4 21%</td>
<td>4 25%</td>
</tr>
<tr>
<td>Yes, 1 or 2 projects.</td>
<td>9 12%</td>
<td>5 12%</td>
<td>1 5%</td>
<td>3 19%</td>
</tr>
<tr>
<td>No, or Don’t know.</td>
<td>59 77%</td>
<td>36 86%</td>
<td>14 74%</td>
<td>9 56%</td>
</tr>
</tbody>
</table>

11. Some experts say a major alteration ADDS VALUE to an obsolete building and therefore increases seismic risk by exposing more assets to future earthquakes. Do you agree?

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree. A major alteration to an obsolete building puts a significant new investment at risk immediately.</td>
<td>12 16%</td>
<td>6 15%</td>
<td>1 6%</td>
<td>5 33%</td>
</tr>
<tr>
<td>Maybe. A major alteration adds some value, but it’s not always significant compared with the investment already at risk.</td>
<td>31 42%</td>
<td>21 51%</td>
<td>5 28%</td>
<td>5 33%</td>
</tr>
<tr>
<td>Disagree. Alterations are necessary and prudent from time to time and are already figured into the long-term cost of owning a building; therefore, even a major alteration rarely increases the risk significantly.</td>
<td>26 35%</td>
<td>11 27%</td>
<td>10 56%</td>
<td>5 33%</td>
</tr>
<tr>
<td>Don’t know or No opinion.</td>
<td>5 7%</td>
<td>3 7%</td>
<td>2 11%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

12. Some experts say a major alteration EXTENDS THE LIFE of an obsolete building and therefore increases seismic risk by exposing it to more future earthquakes. Do you agree?

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree. A major alteration significantly increases the time a building will remain in service and therefore the time it will be exposed to damaging earthquakes.</td>
<td>24 32%</td>
<td>11 27%</td>
<td>4 22%</td>
<td>9 56%</td>
</tr>
<tr>
<td>Maybe. A major alteration adds a few years of life, but nothing close to the useful life one would get from a new building.</td>
<td>22 29%</td>
<td>14 34%</td>
<td>5 28%</td>
<td>3 19%</td>
</tr>
<tr>
<td>Disagree. A major alteration changes the quality of a building’s useful life but does not add time to it.</td>
<td>24 32%</td>
<td>14 34%</td>
<td>6 33%</td>
<td>4 25%</td>
</tr>
<tr>
<td>Don’t know or No opinion.</td>
<td>5 7%</td>
<td>2 5%</td>
<td>3 17%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>
13. Imagine a 30-year old building that’s in good condition but has never had a major alteration. Not including any seismic upgrade, about how much of it would need to be altered to make it comparable to a similar new building constructed today?

<table>
<thead>
<tr>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impossible. You can't match a new building with even a 100% renovation of all major architectural systems and building services.</td>
<td>9 13%</td>
<td>4 11%</td>
<td>3 17%</td>
</tr>
<tr>
<td>Renovation of all or nearly all (say 90-100%) of the building’s spaces and systems.</td>
<td>7 10%</td>
<td>4 11%</td>
<td>2 11%</td>
</tr>
<tr>
<td>Renovation to selected spaces and systems; probably between 50% and 90% of the building.</td>
<td>14 19%</td>
<td>6 16%</td>
<td>4 22%</td>
</tr>
<tr>
<td>Renovation to selected spaces and systems; probably less than 50% of the building.</td>
<td>22 31%</td>
<td>12 32%</td>
<td>3 17%</td>
</tr>
<tr>
<td>Don’t know or No opinion.</td>
<td>20 28%</td>
<td>12 32%</td>
<td>6 33%</td>
</tr>
</tbody>
</table>

14. Again imagine a 30-year old building that’s in good condition but has never had a major alteration. Not including any seismic upgrade, about how much would it cost to make it comparable to a similar new building constructed today?

<table>
<thead>
<tr>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>It will always be less costly to build new if you want the quality and features of new construction.</td>
<td>4 6%</td>
<td>3 8%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Probably more than 50% of the cost of replacing the building.</td>
<td>14 19%</td>
<td>8 21%</td>
<td>2 11%</td>
</tr>
<tr>
<td>Probably between 10% and 50% of the replacement cost.</td>
<td>30 42%</td>
<td>14 37%</td>
<td>9 50%</td>
</tr>
<tr>
<td>Probably less than 10% of the replacement cost.</td>
<td>1 1%</td>
<td>0 0%</td>
<td>1 6%</td>
</tr>
<tr>
<td>Don’t know or No opinion.</td>
<td>23 32%</td>
<td>13 34%</td>
<td>6 33%</td>
</tr>
</tbody>
</table>

15. When the code for new buildings changes due to new knowledge about seismicity or structural behavior, should obsolete structures be required to be upgraded?

<table>
<thead>
<tr>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Existing buildings should be allowed to remain in service, as long as they met the code at the time they were built.</td>
<td>16 23%</td>
<td>7 18%</td>
<td>4 24%</td>
</tr>
<tr>
<td>Yes, but only for the most hazardous deficiencies.</td>
<td>17 25%</td>
<td>9 24%</td>
<td>4 24%</td>
</tr>
<tr>
<td>Yes, but only if the cost is low and the compliance period is long.</td>
<td>2 3%</td>
<td>1 3%</td>
<td>1 6%</td>
</tr>
</tbody>
</table>
ALTERATIONS AND SEISMIC UPGRADE

Yes, but only when triggered by other significant work on the building, such as a major alteration.

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 7%</td>
<td>4 11%</td>
<td>1 6%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

Some combination of the last three answers, but none of them by itself.

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28 41%</td>
<td>16 42%</td>
<td>7 41%</td>
<td>5 36%</td>
</tr>
</tbody>
</table>

Don’t know or No opinion.

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 1%</td>
<td>1 3%</td>
<td>0 0%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

If you chose a combination, which issue is most important?

- How am I going to upgrade [the residential buildings I own] given the stranglehold that rent control has on [them]? If the City decides to mandate improvements without affording a means to pay through tax incentives or low cost loans, what happens then?
- Depends on the resilient needs of the community.
- Hazardous conditions that present serious instabilities during an EQ event.
- Most hazardous deficiencies and low cost.

16. What is the best way for a community to mitigate the seismic risks posed by its most hazardous buildings?

<table>
<thead>
<tr>
<th></th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandatory upgrade programs targeted at structure types known to be risky.</td>
<td>5 7%</td>
<td>4 10%</td>
<td>1 6%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Incentives for voluntary upgrade of structure types known to be risky.</td>
<td>15 22%</td>
<td>7 18%</td>
<td>5 29%</td>
<td>3 23%</td>
</tr>
<tr>
<td>Building code provisions that trigger evaluation, and possibly upgrade, when significant alterations, repairs, or changes of occupancy are made.</td>
<td>8 12%</td>
<td>2 5%</td>
<td>3 18%</td>
<td>3 23%</td>
</tr>
<tr>
<td>Regulations that trigger evaluation, and possibly upgrade, when buildings are sold or re-financed.</td>
<td>2 3%</td>
<td>2 5%</td>
<td>0 0%</td>
<td>0 0%</td>
</tr>
<tr>
<td>Some combination of the previous answers that accounts for local politics and resources.</td>
<td>27 39%</td>
<td>18 46%</td>
<td>5 29%</td>
<td>4 31%</td>
</tr>
<tr>
<td>Market-based solutions only; no special ordinances, codes, or public investment is needed.</td>
<td>10 14%</td>
<td>6 15%</td>
<td>2 12%</td>
<td>2 15%</td>
</tr>
<tr>
<td>Don’t know or No opinion.</td>
<td>2 3%</td>
<td>0 0%</td>
<td>1 6%</td>
<td>1 8%</td>
</tr>
</tbody>
</table>

If you chose a combination, which do you think is the best policy: mandates, incentives, or triggers?

- Mandates and triggers
- A combination of incentive driven upgrades or alternate mandatory upgrades if guaranteed financing by the local governments is available.
ALTERATIONS AND SEISMIC UPGRADE

- Market-based solutions alone are not enough. ... In general, I believe evaluations have to be required.
- Triggers, followed by mandates.
- Incentives ... coupled with code-triggered upgrade if lateral-force resisting system is altered or significant load added.
- Mandates clearly most effective; triggers and incentives more palatable but not uniformly effective.
- [If] voluntary through an incentive based program, the facility is much more likely to be upgraded.
- Mandates, triggered by required evaluation along with financial incentives (tax breaks, low cost financing and 100% accelerated pass-throughs).
- Mandates and triggers.
- Incentives, plus evaluation triggered by sale of a building
- Any seismic retrofitting to older buildings should carry an incentive. ... The best trigger would be to combine it with an upgrade or significant alterations, but not when buildings are sold.
- Mandate most risky buildings (URM) and trigger others based on alterations/change of occupancy.
- For some building types, mandates are appropriate. For others incentives are best.

17. If a major alteration would NOT increase a building's seismic risk, but the building is known to have significant seismic deficiencies already, should upgrade be required as a condition of permitting the alteration?

<table>
<thead>
<tr>
<th>Option</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. If the alteration does not increase the risk, there is no basis for requiring upgrade. Serious deficiencies should not be addressed by adding requirements to typical projects.</td>
<td>21 30%</td>
<td>12 32%</td>
<td>5 29%</td>
<td>4 29%</td>
</tr>
<tr>
<td>Yes, deficient structures should be upgraded, but only the areas exposed by the intended alteration.</td>
<td>12 17%</td>
<td>6 16%</td>
<td>1 6%</td>
<td>5 36%</td>
</tr>
<tr>
<td>Yes, deficient structures should be upgraded, but with a limit on the upgrade cost (similar to triggered accessibility upgrades).</td>
<td>21 30%</td>
<td>12 32%</td>
<td>7 41%</td>
<td>2 14%</td>
</tr>
<tr>
<td>Yes, without exemptions or limits. This is a reasonable way of making mitigation happen.</td>
<td>12 17%</td>
<td>7 18%</td>
<td>3 18%</td>
<td>2 14%</td>
</tr>
<tr>
<td>Don't know or No opinion.</td>
<td>3 4%</td>
<td>1 3%</td>
<td>1 6%</td>
<td>1 7%</td>
</tr>
</tbody>
</table>

18. If the building code requires a seismic upgrade as a condition of permitting a major alteration, that’s reasonable as long as:

<table>
<thead>
<tr>
<th>Condition</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>The building has severe seismic deficiencies.</td>
<td>20 29%</td>
<td>10 26%</td>
<td>5 29%</td>
<td>5 36%</td>
</tr>
<tr>
<td>The cost of the upgrade is small compared with the cost of the intended alteration.</td>
<td>4 6%</td>
<td>2 5%</td>
<td>2 12%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>
ALTERATIONS AND SEISMIC UPGRADE

<table>
<thead>
<tr>
<th>The cost of the upgrade is small compared with the value or replacement cost of the building.</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 9%</td>
<td>3 8%</td>
<td>2 12%</td>
<td>1 7%</td>
<td></td>
</tr>
<tr>
<td>The intended alteration was already going to be extensive, affecting a very substantial portion of the building.</td>
<td>8 11%</td>
<td>4 10%</td>
<td>1 6%</td>
<td>3 21%</td>
</tr>
<tr>
<td>Some combination of the previous answers, but none of them by itself.</td>
<td>25 36%</td>
<td>16 41%</td>
<td>5 29%</td>
<td>4 29%</td>
</tr>
<tr>
<td>It is NOT reasonable to require seismic upgrade in such a case.</td>
<td>6 9%</td>
<td>4 10%</td>
<td>1 6%</td>
<td>1 7%</td>
</tr>
<tr>
<td>Don’t know or No opinion.</td>
<td>1 1%</td>
<td>0 0%</td>
<td>1 6%</td>
<td>0 0%</td>
</tr>
</tbody>
</table>

If you chose a combination, which issue is most important?

- The intended alteration was already going to be extensive.
- The first 3 answers are the most relevant ones.
- The building has severe deficiencies.
- Severe seismic deficiencies plus small upgrade costs compared to building costs.

19. When a major alteration is undertaken, what are the public’s reasonable expectations regarding the building’s seismic risk?

<table>
<thead>
<tr>
<th>That the alteration work itself is done per code, but not that the rest of the building must be considered.</th>
<th>All [N, %]</th>
<th>Users [N, %]</th>
<th>Planners [N, %]</th>
<th>Designers [N, %]</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 18%</td>
<td>7 18%</td>
<td>4 25%</td>
<td>1 7%</td>
<td></td>
</tr>
<tr>
<td>That the structure overall is no more risky after the alteration than it was before.</td>
<td>14 21%</td>
<td>7 18%</td>
<td>3 19%</td>
<td>4 29%</td>
</tr>
<tr>
<td>That at least some of the investment put into the project addresses existing seismic deficiencies.</td>
<td>18 26%</td>
<td>12 32%</td>
<td>3 19%</td>
<td>3 21%</td>
</tr>
<tr>
<td>That all serious seismic deficiencies are eliminated as a condition of having the major alteration permitted.</td>
<td>19 28%</td>
<td>10 26%</td>
<td>4 25%</td>
<td>5 36%</td>
</tr>
<tr>
<td>Don’t know or No opinion.</td>
<td>5 7%</td>
<td>2 5%</td>
<td>2 13%</td>
<td>1 7%</td>
</tr>
</tbody>
</table>
20. Please share any thoughts about how the building code should treat seismic deficiencies in existing buildings, compared with how it treats ACCESSIBILITY (ADA compliance).

User responses
- There should be a reasonableness in either situation – ADA involves reasonable accommodation and mandated seismic improvement of old buildings should also involve a reasonable approach that reduces but not necessarily eliminates risk in a cost-efficient manner.
- Do make work like ADA does. Serious seismic work needs to be done, but not every sidewalk corner like ADA.
- If a modification triggers ADA retrofits, it should surely trigger some seismic upgrades, if necessary, as well.
- ADA compliance has allowed building owners compliance time lines and cost saving measures that are feasible and meet the needs of the law. Seismic deficiencies should be classified differently however as they pose a greater risk to human life on a much larger scale. Therefore, I think that building code for seismic deficiencies should be much more stringent.
- These are two completely different issues. The ADA compliance is for accessibility rights of “the total population,” a right of access. The seismic question is about upgrading, code compliance and when they should or should not be triggered. The seismic question concerns “right of ownership and responsibility.” Each owner must decide on the type of product it offers to the public. However, with that said, I think the government’s role is to require that owners make it known to all present and future tenants about the condition of the building, its level of compliance with seismic codes etc. Then it is up to the owner, the public, etc. to make their decision on action to be taken.
- ADA changes can be expensive but certain seismic changes might render the building useless. There needs to be a reasonable approach that takes into account if the building is really used much for general public access and use (shopping mall) vs. a low use application like a warehousing and shipping operation.

- Seismic risk is more serious than ADA issues. The code is intended to protect occupants. Serious risk should require mandatory repairs. Moderate risk should trigger repairs in connection with major alteration work.
- Seismic deficiencies are a safety hazard, and are more important to correct than ADA.
- [In order of importance:] Seismic, ADA, finally Green.

Planner responses
- Most ADA compliance ruins the building entrance and looks (long ramps); bathrooms eat up the space; the upgrade helps a few and Attorneys. Seismic upgrades are usually hidden and can save many lives.
- In high risk areas they should have equal enforcement. ADA directly benefits perhaps 10% of population (i.e., the % that have impairments – clearly, it also benefits many more indirectly). EQ safety benefits the entire population.
- ADA compliance is done because code required and fear of lawsuits. Seismic upgrades have no immediate fear of lawsuits. It is best to assign a rating to a building so public/investor/buyer would know standing of building when it is bought, sold or leased.
- Accessibility under the ADA is seen as a human right, and the government is the agent to assure that it is provided. Safety of citizens, similarly, is a right that the government is charged to oversee.
- ADA compliance is straight across the board and totally unnecessary in many incidences. Just another regulation that should not apply to all. If the building was to code 50 years ago, let it be.
- ADA allows civil law suits to enforce compliance, or force compensation for allowing
ALTERATIONS AND SEISMIC UPGRADE

barriers to remain after reasonable requests to remove them. Seismic codes have only OSHA life safety complaints for enforcement.

- Not comparable; access will be increasingly required by an aging population; seismic risk is probabilistic/uncertain.

**Designer responses**

- Gross seismic deficiencies are much more necessary to fix than to comply with ADA
- While the ability for all users to access a building is important, the primary reason for a building code is to protect life safety and prevent collapse of the building due to natural hazards such as an earthquake.
- Owners of Private Buildings should determine what level of protection, or accessibility, energy consumption, etc. they are willing to pay for.
- Frequent changes to the accessibility codes require frequent upgrades to public facilities that are insignificant and do not improve true accessibility (an inch here or there doesn’t keep users out of the toilet stall). A seismic upgrade that is deemed to protect against loss of life and collapse should be adequate from a public policy standpoint and once completed should stand without new upgrade requirements over time.
- Typically, ADA issues aren’t as expensive as seismic issues. Theoretically, I would treat them the same, but I wouldn’t want other health and safety issues (fire, indoor air quality, energy efficiency, etc.) to not be updated because the building owner can’t afford seismic retrofit in addition.

21. Please share any thoughts about how the building code should treat seismic deficiencies in existing buildings, compared with how it treats ENVIRONMENTAL SUSTAINABILITY (Green Building Codes, LEED compliance, etc.).

**User responses**

- Be reasonable. I spent $45 for a motion switch to save energy cost of 5 cents a month.
- Life safety should take priority over environmental sustainability, but incentives should be in place to stimulate adoption of sustainable systems.
- Green Building Codes in the construction industry have been much more of a joke than seismic deficiencies. Seismic deficiencies have proven to work whereas environmental sustainability has not.
- Green Building Codes, LEED compliance etc. should be voluntary, and not mandated. Notice to the public about compliance is OK, but to mandate compliance is over reaching public interest.
- Seismic is substantially more important than green building codes.
- Seismic safety is more important.
- [In order of importance:] Seismic, ADA, finally Green.

**Planner responses**

- Seismic is a safety issue!
- New buildings and major renovations should, like green features, trigger seismic retrofit. Improvements are accomplished over time. Smaller mandatory seismic improvement measures, such as equipment bracing or cripple-wall bracing, like smaller green measures such as mandatory recycling, allow incremental seismic safety upgrades. Many are reasonably done at time of property sale.
- A LEED certified building that falls down in an earthquake wasn’t a good investment or in the public’s best interest. Enforcement of seismic mitigation of existing buildings should be at least as strong as LEED compliance.
- Seismic deficiencies are a safety hazard, and are more important to correct than [sustainability].

**Designer responses**

- Seismic should be more important as it relates to safety. Save lives, save communities, then be sustainable.
Seismic deficiencies are much more critical than environmental sustainability.

It is more important for the code to address seismic deficiencies. An existing building already has a leg up in terms of sustainability because only the resources necessary to alter or upgrade the building need to be spent. Even in a “gut renovation” this will be less than for a new building.

A green, energy-efficient building isn’t very green if needs to be rebuilt following an earthquake. A building that remains intact after a significant event(s) is truly sustainable.

Green ordinances are good public policy because they address scarce resources that affect us all. The requirements for seismic upgrades should address the same issues. Beyond what is necessary to protect the public interest the owners should make their own judgment.

I have been a green architect since the late 70’s (then I called myself a passive solar architect), so green things are important to me. However, I think seismic deficiencies are even more important because of the risk to human life, however, I can also see that there is a differential in the amount of expense.

APPENDIX C: CODE CHANGE PROPOSAL

This appendix presents the code change proposal described in Section 4.

The proposal was put before the IBC-Structural Committee of the International Code Council as proposal G213-12 during the 2012/2013 code cycle leading to the 2015 editions of the I-codes. Initially, two versions of the proposal were submitted, one for IBC Chapter 34 and one for Chapter 9 of the IEBC Work Area Method.

At the ICC code development hearings in Dallas in April-May 2012, the Committee heard testimony on the proposal, including support from NCSEA and FEMA, and offered comments on the text and format. The Committee disapproved the proposal, but some Committee members suggested on the record that the proposed text should be reformatted as an IEBC Appendix (as is customary for innovative code provisions) and resubmitted during the public comment period, to be heard at the ICC’s Final Action Hearings later in the year.

The proposal reproduced below is the version reformatted and resubmitted as suggested by the Committee. At the ICC’s Final Action Hearings in Portland in October 2012, testimony was again heard, this time on the reformatted version. A majority of the ICC membership present voted to approve the proposal, but the majority was less than the two-thirds needed to secure approval during Final Action. The proposed IEBC appendix therefore will not be part of the 2015 model codes. However, the text remains available for states and cities to consider as a local amendment to their building code.

Although the text below references chapters from the IEBC’s Work Area Method, it should ideally be incorporated into the Prescriptive method as well. Otherwise, a permit applicant could avoid the trigger simply by choosing the Prescriptive method.

The following summary points were presented to ICC in support of the proposal:

- Local jurisdictions, especially those attempting to address questions of disaster resilience, need locally tailored mitigation programs that account for a community’s particular mix of building types and uses.
- Code-based upgrade triggers can play an important role within broader mitigation plans.
- Currently, IBC and IEBC alteration provisions are not customizable to a local building stock or mitigation policy.
- Currently, IBC and IEBC alteration provisions only require seismic evaluation or upgrade when the intended alteration would significantly worsen a building’s lateral system. Thus, major alterations involving multiple systems throughout the building and costing well over half of a building’s replacement cost, may be done without even considering the structure’s earthquake resistance.
The solution: The code should provide a consistent means for jurisdictions to implement simple, customizable seismic upgrade triggers suited to their building stock and local priorities. These upgrade triggers would be optional and would only supplement, not replace, the code’s current uniform provisions.

Some features of the proposal:

- Priority buildings will be designated based on “readily known attributes.” Thus, a potential priority building is identifiable in advance, without the need for a detailed engineering evaluation or analysis. Priority status also does not depend on the nature of the proposed Level 3 alteration project. This means that owners, tenants, lenders, building officials, planners, and others can know in advance what the provision’s effects might be.

- Designation of priority buildings is entirely at the jurisdiction’s option. The default condition is that no buildings are designated at all. In this case, the jurisdiction has in effect the building code it would have had if these provisions did not exist.

- As proposed, the provisions would apply only reduced seismic loads, consistent with traditional allowances for existing buildings and with similar provisions throughout the IEBC.

- An owner can still avoid a retrofit by modifying the scope of her project to avoid the trigger level. This aspect of triggered retrofit provisions makes them more politically feasible and less disruptive than outright mandates.

- By being part of the building code, the proposed provisions bring with them all the advantages of the I-codes: the consensus of professional communities, administrative provisions, an authority and accountability structure, a full array of technical provisions and reference standards, etc. Otherwise, a special ordinance outside the building code would have to incorporate or specify all these items.

Following is the text of the proposal, formatted as potential Appendix D to a future edition of the IEBC.

* * *

IEBC APPENDIX D

Supplemental Seismic Provisions for Priority Buildings

The provisions contained in this appendix are not mandatory unless specifically referenced in the adopting ordinance.

SECTION D101
GENERAL

D101.1 Purpose. This chapter supplements the provisions of Section 907. It requires improvements to the seismic force resisting systems of certain buildings undergoing certain alterations regardless of the structural scope or effect of those alterations. Its purpose is to promote seismic mitigation of key sectors of the building stock, which can vary from jurisdiction to jurisdiction.

D101.2 Implementation. To implement these provisions, the authority having jurisdiction shall adopt this chapter and shall establish one or more types of priority buildings by setting forth their defining attributes in Table D103, adding rows as necessary.

D101.2.1 Completing Table D103. For each type of priority building, the jurisdiction shall provide content for each column of Table D103. Content for the column labeled Priority Building Type shall be any descriptive text or distinct identifier. Each of the other columns represents an attribute of the priority building type. For any attribute that does not contribute to the description of a given priority building type, the content of the corresponding table cell shall be “Any.” At the jurisdiction’s discretion, other attributes consistent with the definition of priority building shall be provided as content for the column labeled Other.
SECTION D102
DEFINITIONS

PRIORITY BUILDING. A building designated by Section D103 for special consideration during alteration projects, based on its risk category, seismic design category, occupancy, size, structural system(s), age, or other readily known attributes.

SECTION D103
DESIGNATION OF PRIORITY BUILDINGS

D103.1 Priority building types. A building described by one or more rows of Table D103 shall be deemed a priority building.

Table D103. Designation of Priority Buildings

<table>
<thead>
<tr>
<th>PRIORITY BUILDING TYPE</th>
<th>RISK CATEGORY</th>
<th>SEISMIC DESIGN CATEGORY</th>
<th>OCCUPANCY</th>
<th>SIZE</th>
<th>STRUCTURAL MATERIAL OR SYSTEM</th>
<th>AGE</th>
<th>OTHER</th>
</tr>
</thead>
</table>

*a* Upon adoption of this chapter, the jurisdiction shall complete one row of Table D103 for each type of building it seeks to designate as a priority building, adding rows as necessary. See Section D101.2.

*b* Where the triggering alteration is associated with a change of occupancy, the risk category, seismic design category, and occupancy shall be taken as those of the new occupancy.

SECTION D104
SEISMIC IMPROVEMENT TRIGGER, SCOPE, AND CRITERIA

D104.1 Trigger. A priority building undergoing a Level 3 alteration shall comply with Sections D104.2 and D104.3 in addition to the applicable provisions of Chapters 7, 8, and 9.

D104.2 Scope. The seismic force-resisting system of the altered building shall be made to satisfy the criteria given in Section D104.3. Existing nonstructural components and their bracing or anchorage are not required to be altered.

D104.3 Criteria. Seismic forces and design criteria for seismic improvements triggered by Section D104.1 shall be, at a minimum, those specified in Section 301.1.4.2.