CALBO’s Interim Guidance for Barricading, Cordonning, Emergency Evaluation and Stabilization of Buildings with Substantial Damage in Disasters

November 2013

Preface

Experience from recent disasters in California and elsewhere indicates gaps in safety and awareness of best practices for barricading, emergency evaluations and stabilization of damaged structures. For example, in an aftershock during the 2010-2011 Christchurch sequence of earthquakes in New Zealand, previously-damaged buildings that had been barricaded and partially stabilized, collapsed and killed many. In the worst case, a row of buildings fell beyond barricades during an aftershock killing eight people in a bus and four people on a sidewalk. Upon comparison, barricading and stabilization practices in New Zealand are similar to practices in California.

This interim guidance is intended to help manage transitions between emergency operations and recovery. It provides stopgap guidance until such time that more comprehensive resources can be developed by others, to reduce the potential for life loss and injury to the public from damaged buildings, to help mitigate property damage, and to speed recovery after disasters.

CA-OES’s January 2012 Safety Assessment Program Coordinator Student Manual and training curricula refers to the need for such practices and offers recommendations for how to implement them. However, gaps in practice extend beyond the scope of CA-OES’s Safety Assessment Program and are partially addressed in this interim guidance.

Initial Situation Awareness, Requesting and Triaging of Resources

After damaging events, government personnel from multiple departments will deploy to districts within the jurisdiction that are reported to have experienced damage or districts known to be vulnerable based on prior inventories such as those identified in Multi-hazard Mitigation Plans. Initial drive-by and walk-by surveys will help develop situational awareness about the scope and severity of damage. Based on the Incident Command System (ICS), those personnel first to arrive at a scene of severe damage should take steps to initiate the evacuation of people out of harm’s way, to prevent traffic and other public access into harm’s way, to request help, and manage the incident until relieved by better-equipped and more-qualified responders consistent with ICS and Standardized Emergency Management System (SEMS) protocols. Building Department personnel will then take the lead to initiate a Safety Assessment Program (SAP) operation. Between disasters, government first responders, including Building Department personnel, must be trained so that they have appropriate levels of knowledge, skills, and experience to execute ICS and SAP, while functioning within SEMS effectively and safely.

Concurrent with safety assessments, building department personnel will also provide technical advice and regulatory support to emergency evacuation and barricading activities. Emergency response from multiple agencies will likely include police, fire, Urban Search and Rescue (USAR) personnel, other Task Force personnel, building officials, public works, transportation, building managers, and emergency managers. First responders could be overwhelmed until Mutual Aid arrives, so Building Officials, inspectors and
plan reviewers could find themselves in situations as first responders. Responders have the objectives of: 1) Identifying structures that are obviously or suspected to be damaged; 2) Reducing the public’s exposure to risks; and 3) Setting up temporary barricades at safe horizontal distances of up to 1.5 (one and a half) times the height of such hazards (CALEMA 2012, NIOSH 2009). Such safe distances for initial barricades are generally conservatively set at 1.5 times heights to allow for the possibility that falling items can bounce and shatter, until the nature and extent of building damage can be investigated and shorter safe distances can be justified. Initially, emergency barricades can be as simple as using cars to stop traffic in roadways, installing yellow tape, or erecting folding barricades.

After earthquakes, personnel installing emergency barricades should take into consideration that aftershocks can generate more intense ground shaking as well as shaking in different directions than earlier shaking. Damaged upper portions of unreinforced masonry (URM) walls that may not have collapsed in prior shaking may be prone to collapse in subsequent shaking. Barricades and evacuations of adjacent, lower buildings around complete perimeters of damaged URM and other collapse-prone buildings may also be warranted until such time that building owners and their agents can evaluate and stabilize potential falling or collapse risks.

Agencies may find public safety reasons for establishing block-long barricades, or cordons, around larger areas in a jurisdiction. Cordons involve fencing or other taller barricades with secured gates. Conditions that warrant cordoning may include: 1) Dire falling hazards from single or multiple buildings, including potential for widespread losses from the collapse of one or more tall buildings; 2) Extensive debris on streets and sidewalks that requires the use of large equipment to remove; 3) Demolition activities; 4) Shoring or stabilization that encroaches into the public right-of-way; 5) Security to prevent looting, vandalism, and arson; 6) Non-structural hazards that present a danger to the public, such as widespread hazardous material spills or damaged utility systems; and 7) Unsafe or unstable geological features, such as landslides, rockslides, liquefaction, or sinkholes.

Who is in Charge?

It is vital to establish a Lead Agency among local agencies when vacating premises, establishing temporary safeguards, closing streets and sidewalks, and performing emergency stabilization. Past precedence and local ordinances might designate the Lead Agency that will be responsible for implementing emergency barricading, managing emergency stabilizations, and recovering associated costs. However, if a Lead Agency has not been established by ordinance, the 2013 California Building Code (CBC) Section 3401.6 allows the use of the International Existing Building Code (IEBC) as alternative compliance with the CBC. Section 116 in the IEBC places the Building Official in the lead for these actions described above and requires emergency work to be initially paid by the jurisdiction and later recovered through legal actions against owners. However, some building departments may not be capable of or may not want to take on the role of Lead Agency and carry out responsibilities described in the IEBC, so this is all the more reason to encourage that each Building Official initiate dialogues with other agencies in their jurisdiction and propose clarifying authority by ordinance or inter-agency management agreements. Approaches undertaken by metropolitan jurisdictions will differ from those in unincorporated areas, smaller and rural cities and towns. They must be tailored to local conditions.

In extenuating circumstances, Lead Agencies should consider supplementing available staff and expertise through Mutual Aid to speed emergency response and recovery by expediting barricading, emergency
stabilization and falling hazard removal activities. For example, in major disasters involving widespread damage, Building Officials and their SAP Coordinators should consider establishing Critical Buildings Task Forces pursuant to CA-OES’s recommendations to: 1) Help jurisdictions effectively conduct rapid assessments of complex buildings and others critical to facilitating safe recovery; 2) Manage more detailed investigations of damaged buildings, their potential fall zones, and how they might be prevented from further collapse; and 3) Help refine and confirm safe distances for barricades and cordons. For structures that are at risk of geologic hazards such as land- or rock-slides, Lead Agencies should consider establishing a Geology Task Force. Lead Agencies should enable emergency access to archives of plans for major existing structures for use by building department personnel and ad hoc Task Forces, as a critical source of intelligence even in the first hours after disasters.

**Recommended Actions for Local Governments: Building Officials should consider meeting and conferring with Fire, Police, Public Works, and Emergency Management staffs to:**

1. **Pre-identify districts that are most vulnerable to disasters;**
2. **Describe expected disaster and response scenarios;**
3. **Conduct a review of existing ordinances to determine which agencies are responsible for enforcing, installing, and maintaining barricades;**
4. **Determine which agencies will take lead and secondary support responsibilities;**
5. **Clarify how agencies should collaborate effectively and develop a mutual understanding about how transitions from response to recovery will most likely take place;**
6. **Discuss the potential needs for and management of Critical Building Task Force(s) that potentially include a Geology Task Force after earthquakes consistent with the latest CA-OES SAP Coordinator Training guidelines; and**
7. **Conduct table-top exercises to familiarize staff with the challenges and procedures likely to follow disasters using guidance in the Appendices.**

**Transitions to Long-term Barricades**

After buildings with obvious or suspected damage are initially barricaded at safe distances based on the heights of potential falling risks, the Lead Agency should install and maintain long-term barricades, or require building owners to do so. Work can include cordons, transition zones, and signage consistent with applicable regulations including CBC Section 3306 Protection of Pedestrians and the U.S. Department of Transportation Manual on Uniform Traffic Control Devices. Consider marking the locations of such barricades and cordons with spray paint on public rights of way to indicate where they are required to remain until authorized government personnel order their removal so as to discourage the public from altering their locations, or trespassing into zones of controlled access.

The Lead Agency should notify owners of their obligations to evaluate and stabilize buildings. Depending on the extent of damage, efforts to evaluate and stabilize damaged structures, and the risk of aftershocks, the locations of barricades and cordons can be refined as situational awareness improves over time.

The Lead Agency should collaborate with building owners, traffic safety officials, and emergency managers when selecting the choice, height, strength and extent of barriers and cordons, or making demolition decisions that will be suitable for both the public’s safety and the most efficient means to a rapid recovery of community functions. Detailed evaluations ideally should include site observations of
both exterior and interior conditions of buildings, drawing and calculation reviews, and testing of damaged components and critical connections between parts of structural and nonstructural systems before refinements or confirmation of long-term barricade safe distances are approved by authorities.

The Lead Agency should develop informational notices to the public to ensure awareness of the purpose of the barricades, the importance of the public complying with limits to public access in unsafe areas, and procedures on how to gain access to barricaded zones to extricate contents and begin recovery efforts.

The Lead Agency should also establish a monitoring protocol that includes indicator buildings and re-evaluation procedures in the event of aftershocks.

Barricades, cordons and stabilization can remain in place for extended periods of time - potentially for years - until threats to the public are abated. No time limits exist in statutes or regulations, however, authorities can establish such limits and other criteria such as who must pay for the installation and maintenance of barricades, stabilization or demolition. Review and approval decisions are matters of discretion that can vary depending on timing considerations, aftershock probabilities, expediency, other risk tradeoffs and public policy. In many cases, the expected duration of temporary stabilization can influence decisions about design criteria and permit processing. CBC Section 108 states that a structure is temporary when erected for a period of 180 days or less. Permit applications should eventually be submitted by building owners, reviewed by appropriately qualified and independent reviewers, and approved by the Building Official. If emergency conditions and resource constraints for initial actions do not allow for permit applications, they should, as soon as feasible, be submitted for demolitions, long-term barricade locations and stabilizations. They should then be independently reviewed and approved as soon as practicable thereafter. Generally, the longer any stabilization is proposed to be in use, the more comprehensive the design criteria should be, ideally equivalent to that required for existing buildings with case-by-case exceptions where practicalities preclude equivalence.

Decisions to demolish, stabilize or repair are generally based on considerations of safety foremost, as well as economics and construction feasibility accounting for other goals such as historic preservation and minimizing disruption to surrounding property. When a dangerous structure or nonstructural falling risk poses an imminent threat to the public, partial or total demolition may be warranted to save lives or speed recovery (CBC Section 116). Note that falling hazards of qualified historical buildings or property should not necessarily be construed as imminent threats if they can be mitigated by shoring, stabilization, barricades or temporary fences (CA Historical Building Code (CHBC) Section 8-2).

CBC Chapter 33 contains requirements for safeguards during construction including barriers to protect the public and minimum safe distances from construction work, signage, walkways and directional barricades, protection of adjoining property, and provisions for temporary uses of streets, alleys, and public property. However, this chapter assumes that structures are under construction, are stable and undamaged, and that the potential for large items to fall off projects under construction is negligible. Prescriptive barrier configurations specified in Chapter 33 will not necessarily withstand extensive collapse since they are proportioned to protect the public from minor falling hazards associated with stabilized and undamaged construction. So applying Chapter 33 to a damaged building is not appropriate until such time that it can be evaluated and stabilized where warranted. In the meantime, hard barriers that can resist impacts from falling hazards or more conservative safe distances for soft cordons and barricades than those specified in Chapter 33 are generally appropriate until stabilization or removal of
major falling hazards can be completed. Much of the effort during the management, review, installation, and approval of barricading, emergency evaluations, and stabilization of damaged buildings will be focused on making transitions from structures with suspected or unknown extents of damage to structures that are inherently stable, with known risks and safeguards in place consistent with Chapter 33 for existing buildings undergoing repairs in non-disaster-related projects. See sketches depicting some options for placements and types of public protection in Appendix D.

**Recommended Actions for Local Governments:** Lead Agencies and Building Officials should familiarize staff with applicable ordinances, statutes, regulations and reference documents including guidance in Appendix D.

**Staff Qualifications for Barricade and Stabilization Activities**

Decisions regarding the evaluation and stabilization of non-engineered, light frame buildings up to two stories and one basement level can be managed by certified, experienced building inspectors or licensed design professionals (Section 5537 Business & Professions Code). Decisions regarding the evaluation and stabilization of engineered buildings that are not light frame and up to two stories and one basement level must be managed by licensed design professions such as Civil or Structural Engineers with demonstrated competence in such activities. Building Officials should consider requesting Mutual Aid from other jurisdictions to ensure that their departments have appropriately qualified staff to manage the barricading, evaluation, stabilization and approval process. See CalOSHA Regulations referenced in Appendix A for falsework and vertical shoring as well as qualifications for applicants seeking permits for such work, since government regulators should possess comparable qualifications.

**Recommended Actions for Local Governments:** Building Officials should be prepared to assign reviews of barricade locations and signage, emergency seismic evaluations, stabilization plan reviews, and inspections to appropriately licensed, trained, and experienced personnel that are familiar with enforcing applicable statutes and regulations. Building Officials should meet and confer with other jurisdictions likely to provide Mutual Aid.

**Recommended Minimum Strengths for Short-term Stabilization**

Stabilization designs should account for a relatively “short life of temporary structures and interim conditions... Since interim conditions during construction normally exist for hours to perhaps a few years, design criteria based on 50- to 500-year recurrence intervals are usually excessive for setting design loads during construction such as temporary stabilization. Depending on the season of construction, and the duration of interim conditions, some temporary structural configurations have very low risk of extreme exposure for some loads.” (Dusenberry, 2003)

However, the potential for aftershocks should be considered that could generate shaking equal to or even more intense than prior earthquakes as well as shaking in directions that differ from previous earthquakes. In the past, falling hazards have occurred during aftershocks that have damaged partially stabilized structures. Such damage can occur just beyond the extent of partial stabilization in undamaged portions of structures and can be caused by shaking in different directions from earlier shaking. So it is preferable to install stabilization that connects all vulnerable, damaged or undamaged parts of structures to other
stabilized elements with adequate strengths and stiffnesses to create complete load paths that resist shaking in all directions.

Stabilization acting in conjunction with the existing structure should be capable of resisting vertical loads including all dead loads plus effective live loads which are at least 25% of ASCE 7 live loads, but not less than actual live loads (based on ASCE 41-13).

For lateral forces, FEMA Urban Search and Rescue (USAR) training guidelines specify lateral forces at a minimum of 2 percent times the weight (2%W) and ideally 10%W using allowable stresses for emergency access and extrication of victims over short time durations (where W is the tributary weight to be stabilized). Stabilization intended for longer durations should ideally have higher and more comprehensive design criteria. So some structures may have partial stabilization installed by USAR teams, but they may not be adequate for exposure to the public or construction repair crews for extended durations. New Zealand USAR training guidelines recommend a somewhat more sophisticated approach to determining lateral forces based on regional seismicity, the sizes of prior earthquakes, and aftershock probabilities based on an exposure period of 14 days.

The National Standard ASCE 37-13, titled “Design Loads on Structures During Construction” calls for 0.75 times ASCE 7 wind forces for design loads during construction with durations less than 6 weeks and 0.9 times ASCE 7 wind forces for stabilization with durations of up to 5 years. ASCE 37-13 also specifies a minimum of 20 percent of ASCE 7-10 seismic forces. It assumes that short-term stabilization and construction is taking place in a time frame without aftershocks. However, compliance with this standard is discretionary since it is not referenced in the CBC.

Using ASCE 37-13 can be unconservative and result in insufficient stabilization because aftershock hazards can be considerably higher, initially on the order of ten times or more, compared to a region’s pre-mainshock hazard. Aftershock hazards dissipate gradually thereafter. The sizes of aftershocks are independent of the elapsed time after the mainshock, so aftershocks with large magnitudes are still possible a long time after the mainshock. The time it takes aftershock hazards to decrease to the level of pre-mainshock hazards can take several years and can be readily estimated by seismologists. The locations of aftershocks are generally limited to an aftershock zone which depends on the location, magnitude and rupture path of the mainshock. Because of the increased rate of aftershocks, the high variability of ground motions and cumulative damage sustained by structures, aftershocks of smaller magnitude than a mainshock can actually produce more damage than a mainshock. Even structures that have not been damaged in a mainshock can experience damage in aftershocks. Mainshock-damaged structures tend to be more susceptible to incremental damage due to aftershocks than undamaged structures. So while ASCE 37-13 allows reduced seismic design criteria for stabilized, undamaged construction, considerably higher criteria may be warranted to address aftershock risk. (Yeo and Cornell, 2005)

Other considerations for the design of short-term stabilization should be falling hazards and loads from pounding between adjacent buildings, rain, ponding, snow and ice, differential settlement, earth pressures, and differential temperature. In addition, deformation compatibility between the amount of movement that would be needed to engage stabilizing elements and the amount of movement that can be reasonably tolerated by brittle building components such as unreinforced masonry, non-ductile concrete, glass and plaster should be considered. The recommended strength guidelines for short term stabilization in this
section are not specifically referenced in the CBC and are to be submitted to and approved by the Building Official either as a modification (CBC 104.10) or as alternative materials, design and methods of construction (CBC 104.11) within the jurisdiction having authority on a case by case consideration. In addition, Section 3405.1.1 stipulates that: “Regardless of the extent of structural or nonstructural damage the building code official shall have the authority to require the elimination of conditions deemed dangerous.”

Transitioning from emergency response to recovery is not addressed in this guidance, but interim use evaluations of buildings beyond ATC 20 Detailed Evaluations may be warranted to determine if damage makes such buildings unsuitable for occupancy until such time that more detailed engineering evaluations can be completed. (Refer to CA-OES Safety Assessment Program Manuals, ATC 20 Manuals, ASCE 41, and SESOC-NZ 2012)

**Liability Aspects of Barricading and Emergency Stabilization**

Building owners are principally responsible for providing and maintaining safe buildings in accordance with Common Law.

Local governments are generally immune from liability except if the conduct of government personnel is found negligent. Governments can have affirmative duties generally measured by what a reasonable person would do under the circumstances. Governments have sovereign immunity from tort liability, but courts have ruled that governments do have specified mandatory, public duties (ABAG, 1989).

Civil and Structural Engineers retained to investigate the integrity of a building have a duty to warn occupants and local building officials if an imminent risk of serious injury exists pursuant to the Attorney General’s Opinion 85-208.
**Appendix A - Applicable Statutes and Regulations**

**California Building Code (CBC):** 1) Chapter 1 – Administration, Section 1.8.9 Unsafe Buildings, Section 108 Temporary Structures of 180 days or less must comply with full code, Section 116 Unsafe Structures and Equipment – take down, remove, make safe, secure, repair; 2) CBC Chapter 33 – Safeguards During Construction, Signage walkways and directional barricades in Section 3306, protection of adjoining property in Section 3307, temporary use of streets, alleys, and public property in Section 3308; 3) CBC Chapter 34 – Existing Structures, provisions for repair and alterations, triggers for Substantial Structural Damage.

**Health and Safety Code Sections 17910 to 17920 of the State Housing Law, Substandard Building Definition:** - Structural hazards shall include, but not be limited to, the following: 1) Deteriorated or inadequate foundations; 2) Defective or deteriorated flooring or floor supports; 3) Flooring or floor supports of insufficient size to carry imposed loads with safety; 4) Members of walls, partitions, or other vertical supports that split, lean, list, or buckle due to defective material or deterioration; 5) Members of walls, partitions, or other vertical supports that are of insufficient size to carry imposed loads with safety; 6) Members of ceilings, roofs, ceilings and roof supports, or other horizontal members which sag, split, or buckle due to defective material or deterioration; 7) Members of ceiling, roofs, ceiling and roof supports, or other horizontal members that are of insufficient size to carry imposed loads with safety; 8) Fireplaces or chimneys which list, bulge, or settle due to defective material or deterioration; 9) Fireplaces or chimneys which are of insufficient size or strength to carry imposed loads with safety.

**Health and Safety Code Section 19851:** Building records including plans shall be made available by authorities having jurisdiction to the public for viewing with certain restrictions. Duplication of plans requires written permission from the design professional and owner, or court order or upon request by any state agency.

**California Historical Building Code (CHBC), July 1, 2012 Supplement or later edition:** 1) Specifies reduced loads and material values for archaic materials for qualified historical buildings; 2) Section 8.2 defines Imminent Threat except where it can be mitigated by shoring, stabilization, barricades or temporary fences.

**International Existing Building Code,** 2012 or latest edition as potentially acceptable alternatives: 1) Alternative compliance specified through 2013 CBC Section 3401.6; 2) IEBC Section 116 Emergency Measures including imminent danger, temporary safeguards, street closures, emergency repairs, costs of emergency repairs, and hearings; 3) Provisions for repair and alterations, triggers for Substantial Structural Damage; 4) Commentary with many references to other resources; 5) Construction Safeguards in Chapter 14 are identical to those in CBC Chapter 33; 6) Appendix Chapters A1 – URM, A2 – Concrete and Masonry buildings with flexible diaphragms, A3 – Wood Dwellings, A4 – Multi-unit wood buildings with soft, weak, or open-front walls; and A5 – Concrete Buildings include retrofit provisions for generally undamaged buildings.

**U.S. Department of Transportation Manual on Uniform Traffic Control Devices, 2009 or later edition:** 1) Signage, buffers and tapers, references to ADAAG; 2) Definitions for temporary traffic zones of Short duration = 1 hour; 3) Short term = 1 day; 4) Intermediate term – 3 days for nighttime work lasting more than 1 hour; 5) Long-term stationary work lasts more than 3 days.

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CalOSHA Regulations Title 8, Subchapter 4, Article 29, Section 1717(b)(1) Falsework and Vertical Shoring: 1) Design loads for shoring and formwork; 2) Minimum licensure requirements for a Contractor, Manufacturer's authorized representative or Civil Engineer; 3) Design calculations, drawings and inspections required by Civil Engineer.

U.S. Dept of Labor Occupational Safety and Health Administration (OSHA), Safety and Health Regulations for Construction: 1) Section 1926.451(h) Falling Object Protection, scaffolding canopies; 2) Section 1926.700 Limited Access Zone; 3) Section 1926.701 et seq Concrete and Masonry Construction; 4) Section 1926.706 Limited Access Zone is wall height plus four feet for masonry construction.

CA Business and Professions Code Section 5537 – Architect’s Act, Section 6700 – Professional Engineers Act, 7000 – Contractors Act: Specifies work for which design professionals are required.

ASCE 7 – Minimum Design Loads for Buildings and Other Structures, 2010 or latest version: 1) Risk Category I Structures, Table 1.5-1, Low Risk to Human Life in the Event of Failure; 2) Commentary C1.5, Issue of public policy rather than a technical one, negligible risk to the public should they fail; 3) Importance Factors, Table 1.5-2, I = 1.0 for Seismic, I = 0.8 for Snow; 4) Wind Occupancy Category I Buildings and Other Structures, Mean Recurrence Interval 300 years

Seismic Evaluation and Retrofit of Existing Buildings, ASCE 41-06, 2007 Supplement: 1) Referenced in IEBC Section 101.5; 2) Provides reduced seismic forces and a variety of seismic performance objectives as alternatives. The more recent edition can be a generally acceptable alternative: ASCE 41-13: 1) An update of ASCE 41-06, Supplement in ’07 that is referenced in Chapter 34 of the CBC, 2) Provides reduced seismic forces and a variety of seismic performance objectives as alternatives; 3) Does not address repair, with a few exceptions such as for pointing of unreinforced masonry mortar.

Seismic Evaluation of Existing Buildings; ASCE 31-03: 1) Referenced in IEBC Section 101.5; 2) Evaluation-only procedures for evaluating undamaged buildings, not for repairs or retrofits; 3) A more recent edition may be a generally acceptable alternative published in ASCE 41-13.

Attorney General’s Opinion 85-208, 1985: A Civil or Structural Engineer retained to investigate the integrity of a building who determines, based on structural deficiencies in violation of applicable building standards, that there is an imminent risk of serious injury to the occupants thereof, and who is advised by the owner that no disclosure or remedial action is intended and that such determinations are to remain confidential, has a duty to warn the identifiable occupants, or if not feasible, to notify the local building officials or other appropriate authority for such determinations.

Attorney General’s Opinion 84-802: Local law enforcement officers have independent emergency powers to restrict entry to an area damaged by an earthquake while a threat exists to public health and safety as reasonable determined on a case-by-case basis. State officials performing official duties (as well as volunteer sent by tc perform official duties) on behalf of the state and, in general, representative of the news media may not be denied access.

CALBO Barricading Guidance November 2013
Appendix B - Other Reference Documents for Barricading, Signage, Evaluating and Stabilizing, and Retrofitting of Buildings – Many available online through detailed searches

CA-OES Safety Assessment Program Coordinator Student Manual - January 2012 or more current version: 1) Examples of barricades including use of containerized cargo units as strong barricades; 2) Describes concepts for Critical Buildings Task Forces; 3) Recommendations and guidance on barricading, cordonning and shoring.

CA-OES Safety Assessment Program Evaluator Training Manual: 2011 or more current version contains guidance for when and how SAP evaluators should recommend barricades to authorities.

Applied Technology Council ATC 20-1 Field Manual: Post-Earthquake Safety Evaluation of Buildings, Second Edition or more current version:

National Institute of Occupational Safety and Health, 2009 NIOSH Alert “Preventing Deaths and Injuries of Fire Fighters When Fighting Fires in Unoccupied Structures,” NIOSH recommends a collapse zone be equal to the height of the building plus allowance for scattering debris – usually at least 1.5 times the height of the building (Fire Fighters Handbook 2000).

ASCE 37-02 Design Loads on Structures During Construction: 1) Out of date and based on old ASCE 7-95, but still informative for establishing reasonable factors for reduced loads for temporary stabilization; 2) Seismic Factor 0.2x.Aa = 0.08 times tributary weight using allowable stress for high seismic regions; 3) Wind Factor 0.75 for periods less than 6 weeks and 0.9 for up to 5 years; 3) Snow load factor 0.8; 4) Thermal, Rain, Ice and other considerations.

FEMA National Urban Search and Rescue (USAR) National Response System Shoring Basics Module 2a, Shoring Construction Module 2b: 2000 or more current version 1) Common shoring techniques; 2) Advice on providing emergency lateral bracing of 2 percent of the weight tributary to the brace minimum and 10 percent optimum.

New Zealand and Australia Urban Search and Rescue Level 2 USAR Student Manual, March 2009 or later edition: 1) Up to 14 day exposure period; 2) 3 stories or less; 3) Approximate lateral force analysis method to determine a reasonable strength of stabilization based in part on regional seismicity and chances of aftershocks within a prescribed duration of 14 day of use.

New Zealand Canterbury Earthquakes Royal Commission Recommendation 109, accepted in April 2013 by the Minister for Building and Construction, calls for identifying critical non-ductile weak links in load paths that may result in rapid deterioration in strength during an earthquake.

Structural Engineering Society of New Zealand’s (SESOC-NZ) 2012 “Guidance on Detailed Engineering Evaluation of Earthquake-Effect ed Non-residential Buildings” recommends scopes of work for Interim Use Evaluations to establish whether a building has significant structural damage that may make it unsuitable for occupation until such time as a Detailed Engineering Evaluation can be completed.


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Fall Protection Hazard Awareness Guide, Electronic Library of Construction Occupational Safety & Health: Guidance for Safety monitoring systems, continuous fall protection & controlled access zones

Standard Practice for Bracing Masonry Walls Under Construction, BIA, 2001: 1) Safe Distance for barricade of wall height plus four feet when subject to the effects of a wall collapse; 2) Wind speed monitoring system and avoidance of fall zone in stronger winds.

Temporary Shoring and Stabilization of Earthquake Damaged Historic Buildings, Harthorn 1998: 1) A focus on appropriate applications for historical buildings; 2) Examples and pictures of stabilization and shoring projects.


Guidance for Monitoring and Reviewing Barricades, Christchurch City Council, 2010 or latest version: 1) Four factors determining the necessary clearance are: a) 1.5 times building height for total building potential failure; b) 1.5 times top story height for top story only potential failure; c) 2.2 yards outside veranda fascia or 10 feet from building for parapet only potential failures; and d) Add the estimated width of the base of a potential material pile to the above distances to account for the mass of potential failures.

Procedure for Permitting the Removal of Temporary Fencing/Barricades from Around Damaged Buildings, Christchurch City Council, 2010 or latest version.

Quick-curing Concrete for Infrastructure, Mining Disaster Recovery, Homeland Sec. News Wire.


State of California Multi-Hazard Mitigation Plan, 2010 or latest version, and corresponding local government and special district hazard mitigation plans. Types and locations of vulnerable structures, mitigation progress, and their effectiveness.

Crack Repair of Unreinforced Masonry Walls with Grout Injection, Los Angeles Department of Building and Safety, Information Bulletin.


Appendix C - Recommended Building Department Ten-Point Checklist

☐ 1. Train personnel with courses about the Incident Command System (ICS) and the Standardized Emergency Management System (SEMS).

☐ 2. Train and certify field and plan review personnel as Safety Assessment Program (SAP) Evaluators.

☐ 3. Train and certify at least two principal personnel as Safety Assessment Program Coordinators.

☐ 4. Obtain and maintain current copies of the criteria and other reference documents listed above for barricading, signage, evaluating, stabilizing and retrofitting buildings.

☐ 5. Building Officials should be prepared to assign reviews of barricade locations and signage, emergency seismic evaluations, stabilization plan reviews, and inspections to appropriately licensed, trained, and experienced personnel that are familiar with enforcing applicable statutes and regulations.

☐ 6. Meet and confer with Fire, Police, Public Works, and Emergency Management staffs to:
   ☐ a) Pre-identify districts that are most vulnerable to disasters;
   ☐ b) Describe expected disaster and response scenarios;
   ☐ c) Conduct a review of existing ordinances to determine which agencies are responsible for enforcing, installing, and maintaining barricades;
   ☐ d) Discuss which agencies will take lead and secondary support responsibilities;
   ☐ e) Clarify how agencies should collaborate effectively and develop a mutual understanding about how transitions from response to recovery will most likely take place;
   ☐ f) Discuss the potential needs for and management of Critical Building Task Force(s) that potentially include a Geology Task Force after earthquakes consistent with the latest CA-OES SAP Coordinator Training guidelines; and

☐ 7. Establish the Lead Agency responsible for labor and materials for barricades, cordons, and emergency stabilization.

☐ 8. Establish the Lead Agency which is initially liable for the associated costs and define how the costs are to be recovered from building owners or others.

☐ 9. Meet and confer with other jurisdictions likely to provide Mutual Aid to your jurisdiction.

☐ 10. Conduct table-top exercises to familiarize staff with applicable ordinances, statutes, regulations and referenced documents as well as the challenges and procedures likely to follow disasters.
Plan View

Initial Soft Barrier

Damaged Building in Unstabilized Condition

D = 1.5H

Controlled Access Zone

D = 1.5H

Initial Soft Barrier

Public Access Area

Initial Barricade Safe Distances With Soft Barriers
Initial Barricade Safe Distances With Hard Barriers

Damaged Building or Structure Evaluated and in Stabilized Condition
Table 3306.1 Condition A

Table 3306.1 Condition B
Table 3306.1 Condition C
Damaged Building Evaluated and in Stabilized Condition

- Barrier & Covered Walkway
- 8 Feet Minimum
- Lot Line
- D ≥ 5 Feet & D ≤ H/4
- Controlled Access Zone
- D ≥ 5 Feet & H/4 < D < H/2
- Barrier only if D < H/2
- 8 Feet Minimum
- Public Access Area
- Public Access Area

**Table 3306.1 Condition D**

**Table 3306.1 Condition E**

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