State of California

Safety Assessment Program Evaluator Student Manual

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For current SAP information, please visit our website at www.caloes.ca.gov, and do a Search for Safety Assessment.
Contact: sap@caloes.ca.gov with any questions

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Introduction

The Safety Assessment Program (SAP) provides professional resources to local governments to help with the safety evaluation of buildings and infrastructure after a disaster. The goal of the Safety Assessment Program is to perform these safety assessments as quickly as possible. With its origins in the response to the 1971 San Fernando Earthquake, SAP has been successful during more recent earthquakes such as Loma Prieta (1989), Landers – Big Bear (1992), Humboldt (1992), Northridge (1994), Napa (2000), San Simeon (2003), Baja (2010) and the 2014 Napa Earthquake. SAP was also used under the interstate Emergency Management Assistance Compact (EMAC) to help local governments in Louisiana and Mississippi after Hurricane Katrina (2005).

Private industry volunteers, local government mutual aid, and state agency resources are used to provide professional engineers, architects, geologists, and certified building inspectors to help local governments perform safety evaluations of their built environment after a disaster. The California Governor's Office of Emergency Services (Cal OES) manages the Safety Assessment Program, in cooperation with partnering professional organizations.

SAP provides two types of resources: SAP Evaluators, who work in the field performing safety evaluations, and SAP Coordinators, who are local government lead personnel that coordinate the field activities. The Evaluator training is the focus of this manual.

Cal OES is pleased that you are interested in participating in this program as an Evaluator. Your role will be essential in the first days after a destructive event to evaluate the safety of potentially damaged structures. There are also some examples of "best practices" obtained over the years that will be passed on to you. Finally, the information that you gather will be very useful for the recovery of the community you are assisting. We look forward to working with you in this program.

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UNIT 1: SAFETY ASSESSMENT PROGRAM OVERVIEW

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Overview

This unit presents an introduction to the Safety Assessment Program and discusses credentials, how the program is organized, how deployment takes place, liability issues, and workers compensation. It ends with a glossary of common terms used in emergency management and safety assessment.

Training Goal

Provide the participants with a basic understanding of the program so as to see their role in it.

Objectives

At the end of this unit, participants will be able to:

- Understand the liability immunity and workers compensation aspects of this program;
- Know how to be deployed to a disaster;
- Identify where they fit in the overall emergency operation; and
- Know and use the common terms used in emergency management and safety assessment.

1.0 Safety Assessment Program Overview

Safety assessment is the process by which structures and specific lifeline systems and facilities are evaluated for their safety, either for immediate use, conditional use, or disuse. The Safety Assessment Program (SAP) was developed to help local government building departments after a disaster by providing additional architects, civil engineers, and building inspectors to help rapidly complete the surge of safety evaluations made necessary by the event.

The Safety Assessment Program originated in California, and so is a program based on California laws and emergency management processes. Other states are free to adapt this program based likewise on their own laws and processes.

This program had its early beginning with the 1971 San Fernando Earthquake, when private industry volunteers asked to help local governments with the demands caused by the event. It became more formalized after the 1986 Whittier-Narrows Earthquake. The Applied Technology Council of Redwood City, CA was contracted by the State of California to standardize safety assessment methods and forms; they produced ***ATC-20: Procedures for Postearthquake Safety Evaluation of Buildings***, which became available in 1989, three weeks before the Loma Prieta Earthquake struck. The program was revised after Loma Prieta to improve the placards, and was revamped in 2002 to include damage review from windstorms, floods, and fires. In 2005, damage from explosions was included as part of the program. Jim Alexander and Rick Ranous, SE, both of the California Governor's Office of Emergency Services, were early champions of the Safety Assessment Program.

The demands on shelters and other temporary living arrangements can be quickly reduced by the swift evaluation of structures for continued use. The process and procedures found in ATC-20 are **essential** for the safety evaluation of earthquake-damaged structures. More will be said about this in Chapter 2 of this manual.

SAP has the ability to provide evaluations of both building stock and lifeline infrastructure systems. The latter includes airports, roads, bridges, pipelines, pumping stations, water tanks, and treatment plants. City or county building officials have the oversight responsibility for buildings within their jurisdictions, and public works officials likewise have responsibility for their infrastructure within their jurisdictions. Special districts can have both buildings and infrastructure within their responsibility.

1.1 Concept of Emergency Operations

The Incident Command System (ICS) is the foundation of emergency management in California and throughout the United States since the inception of the National Response Framework and the National Incident Management System (NIMS). Under ICS, the lowest level of government closest to the disaster is always responsible for the management of the emergency response within its jurisdiction, with higher levels of government supplying needed personnel and equipment to aid in the response. For a city, the city's emergency services will provide direction to the disaster response; the city building department will be requesting safety assessment assistance in accord with the emergency services direction. It will be likewise the case for a county to work in a similar manner for safety assessment help within their jurisdiction.

The Standardized Emergency Management System (SEMS) is based on ICS, and includes other State of California legal arrangements, such as the Master Mutual Aid Agreement, use of counties as Operational Areas, and the inclusion of five levels of government, as follows:

1. Field or Incident
2. Local Government (city, county, or special district)
3. Operational Area (all local governments within the county included)
4. Cal OES Mutual Aid Region
5. State

All these levels of government are connected during emergency operations by means of an internet-based system called Cal EOC. This allows for the swift exchange of information and reporting throughout the event.

Control of operations starts with the incident commander at the incident, and each succeeding level of government provides support for those locally driven priorities. In a diffused citywide event, the emergency manager at the Emergency Operations Center (EOC) will consolidate the requests of incident commanders, or in their absence may provide overall direction to managing the disaster response.

Under SEMS, counties are considered as local government, and they manage operations in the unincorporated areas. The Operational Area includes the county resources, and the cities and special districts within the county borders; these can all be called upon to respond to an emergency within the Operational Area. (For example, San Mateo Operational Area can call upon the county's own people and equipment, plus the resources of the cities of Brisbane, Redwood City, Half Moon Bay, and Daly City, as necessary.) Cal OES Regions provide mutual aid support from a group of Operational Areas to one another within the Region; and the State supports the Regions. The emergency hierarchy is depicted in Figure 1-1.

The state of California is divided into six mutual aid regions. The purpose of a mutual aid region is to accommodate swift and effective application and coordination of mutual aid personnel and equipment, as well as other emergency-related activities. Cal OES provides oversight over the mutual aid regions through three Administrative Regional Offices. These are located as follows: Mather Airfield near Sacramento (Inland Region); Walnut Creek (Coastal Region); and Los Alamitos (Southern Region). Each of these regional offices set up and maintain a Regional Emergency Operations Center (REOC).

When statewide resources are needed, the Regions forward requests to the State Operations Center (SOC). The SOC then coordinates resources to assist with the request. If needed, the SOC may "mission task" state agencies to fulfill requests for assistance. This can include SAP resources in other State of California agencies and units, such as the Department of General Services/Division of the State Architect, the Department of Transportation (Caltrans), the Department of Conservation, the Office of Statewide Health Planning and Development (OSHPD), or the University of California.

For the purposes of SAP, the Operational Area can request mutual aid SAP resources from the cities and districts within its borders. If more help is needed, the Operational Area must ask the

Region for assistance. The Region will then pass on the request to the State Operations Center for the activation of the Safety Assessment Program.

If assistance is needed from other states, Cal OES can request aid through the Emergency Management Assistance Compact (EMAC). Cal OES can also send aid to other states through this agreement. EMAC is a direct state-to-state mutual aid arrangement. Immunity from liability and workers compensation travels with persons being sent out under EMAC. Also, the professional licenses and certifications accepted in donor states are also accepted in receiving states under Article 5 of EMAC, which is why SAP accepts professional licenses from states other than California. There are hundreds of persons trained in the California Safety Assessment Program who reside in other states, along with numerous SAP-certified trainers. The State of California sent many resources under EMAC, including 86 SAP personnel, to Louisiana and Mississippi in response to Hurricane Katrina in 2005.

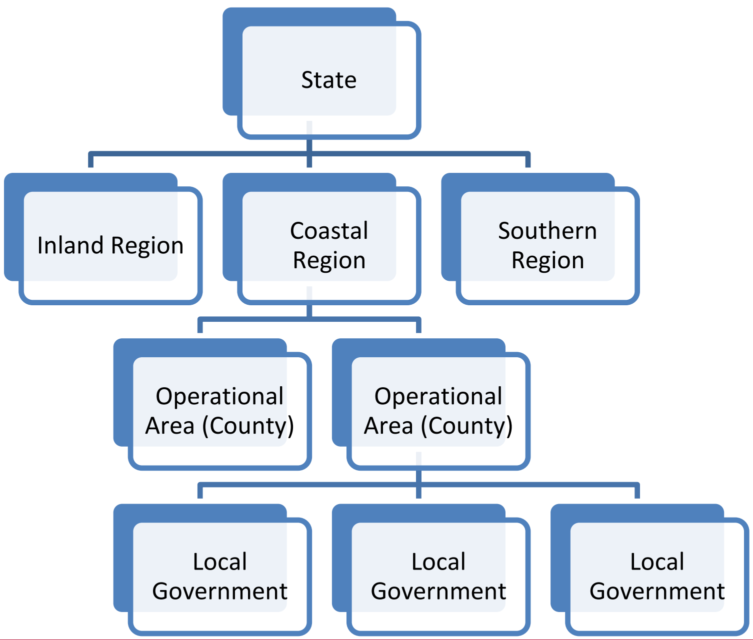

Figure 1-1 – Response Hierarchy

There are over 480 cities and over 2,000 special districts in California making up local governments, 58 counties serving as Operational Areas, and of course, three Cal OES Regions.

1.2 Evaluator Credentials

After the 1994 Northridge Earthquake, local governments expressed concern over the qualifications of SAP evaluators sent out to assess building safety. In order to maintain a high standard, one of the following credentials is required in order for a person to be registered into the statewide SAP cadre:

- Professionally registered civil, structural, or geotechnical engineers (from any state);
- Professionally licensed architects (from any state);
- Professionally registered geologists or engineering geologists;

- Certified building inspectors or officials as follows: Building Inspector (ICC), Building Plans Examiner (ICC), Residential Plans Examiner (ICC), Building Combination Inspector (ICC), Residential Combination Inspector (ICC), Certified Building Official (ICC), Commercial Building Inspector (ICC), Master Code Professional (ICC), Residential Building Inspector (ICC), Combination Plans Examiner (ICC), Building Code Specialist (ICC), Construction Inspector Division II (ACIA), Division of the State Architect Class 1 & 2 Inspectors, and OSHPD Class A Inspector; or
- Certified public works inspectors with a Construction Inspector Division IV certificate (ACIA) or a City of Los Angeles Construction Inspector certificate. *(For a current list of recognized credentials, please visit the SAP web page at the Cal OES website,* www.caloes.ca.gov *).*

CALBO resources must be employed by a local government and be responsible for inspection, plan checking, professional design of facilities, or otherwise engaged in the use of their credentials.

Those not possessing these credentials at the time of the class will receive a class attendance certificate instead of a SAP ID card. When someone obtains one of the approved credentials in the future, Cal OES can then issue a SAP ID card to that person.

Persons with professional licenses from other states can have their licenses temporarily recognized by the State of California for the purpose of the disaster response under Article 5 of EMAC.

Individuals sought for the statewide cadre must also have the following attributes:

- **A general knowledge of construction** – the evaluator must be able to look at any sort of framing system and rapidly identify it, how it works, and the corresponding load path.
- **Professional experience** – the evaluator must have practical experience working with the various framing systems. This experience may come from designing and detailing systems, reviewing the designs and details prepared by others, or inspecting the actual construction of the systems.
- **Good judgment** – above all else, evaluators must be able to look at a damaged or possibly damaged system and make a judgment on the ability of that system to withstand an aftershock of similar magnitude to the original earthquake.

Determining an UNSAFE or an INSPECTED (safe) building condition may be relatively simple in many cases. It is the RESTRICTED USE determinations that normally require the wisdom and understanding of experienced personnel to properly determine.

SAP Evaluators available to help local governments fall into three Disaster Service Worker (DSW) categories:

- **DSW – Volunteer** – individuals from the private sector who are dispatched through volunteer organizations (SEAOC, ASCE, AIA, and ACIA).
- **DSW – Local** – local government personnel deployed through mutual aid or by agreement.
- **DSW – State** – state employees deployed by Cal OES “mission tasking.”

In addition, SAP Coordinators can also be deployed to help affected local governments to request and manage the SAP Evaluator personnel. This is a different training from this SAP Evaluator course.

1.3 Deputizing of Individuals

Duly authorized representatives of a jurisdiction are the only persons who can post the officially adopted placards of that jurisdiction. For that reason, Cal OES strongly recommends that local governments deputize the SAP evaluators sent to them.

Formally adopted placards will have the jurisdictional seal on them, and will have a reference to the adoption ordinance, as well as warnings against unlawful removal if a removal statute has been included in the law. Placards without these features, such as those found in this manual, can be regarded as "generic placards," without the force of law to back them. (Jurisdictions interested in creating their own official placards and adopting them can download .jpg versions of the placards from the SAP website under "SAP Forms" and add the pertinent features.) In general, if the jurisdiction receiving SAP assistance wants to have their official placards used by the responding personnel, they must do one of the following:

- Deputize the responding personnel;
- Send one of their own local building inspectors with each team so that person can post the official placards; or
- Send a building inspector out after the buildings are examined by the responding SAP evaluators to post the buildings based on their recommendations.

The most efficient method among these is the first one, so this is what Cal OES recommends.

Some jurisdictions have expressed concern that they will become liable for worker's compensation if they deputize SAP evaluators, but this is simply not true, as we will see in the section dealing with worker's compensation in this chapter.

1.4 Liability Issues

There is liability protection available for those responding to disasters in the State of California. This is a major issue in other places around the country in regards to post-disaster safety assessment of structures; in California, there are several ways in which protection is afforded to those assisting in the Safety Assessment Program here.

California's **'Good Samaritan' Law** provides general immunity from liability for persons helping others; this law was not intended originally for disaster situations, but nonetheless provides some liability protection.

> 1799.102. (a) No person who in good faith, and not for compensation, renders emergency medical or nonmedical care at the scene of an emergency shall be liable for any civil damages resulting from any act or omission. The scene of an emergency shall not include emergency departments and other places where medical care is usually offered. This subdivision applies only to the medical, law enforcement, and emergency personnel specified in this chapter.

(b) (1) It is the intent of the Legislature to encourage other individuals to volunteer, without compensation, to assist others in need during an emergency, while ensuring that those volunteers who provide care or assistance act responsibly.

Private sector engineers, architects, and building inspectors who are California residents are registered by Cal OES as Disaster Service Workers (DSWs). This liability protection applies when Cal OES officially deploys volunteers into the field. In accordance with the **California Emergency Services Act**, Section 8657:

> "(a) Volunteers duly enrolled or registered with the California Governor's Office of Emergency Services or any disaster council of any political subdivision, or unregistered persons duly impressed into service during a state of war emergency, a state of emergency, or a local emergency, in carrying out, complying with, or attempting to comply with, any order or regulation issued or promulgated pursuant to the provisions of this chapter or any local ordinance, or performing any of their authorized functions or duties or training for the performance of their authorized functions or duties, shall have the same degree of responsibility for their actions and enjoy the same immunities as officers and employees of the state and its political subdivisions performing similar work for their respective entities."

In 1977, the California State Attorney General issued a response to a series of questions presented by Cal OES regarding the liability protection afforded by the **California Emergency Services Act.** The following are extracts of that response:

> *Question:* May structural engineers who are registered as Disaster Service Workers be utilized to assess the extent of damages incurred by buildings in an area struck by earthquakes?
>
> *Answer:* Structural engineers who are registered as Disaster Service Workers may be utilized to perform post-earthquake damage assessments following the proclamation of a State of Emergency or a Local Emergency.
>
> *Question:* Would the appointment of such engineers as Deputy Building Inspectors, without pay, affect their eligibility for state worker's compensation?
>
> *Answer:* The appointment, without pay, of structural engineers who are registered Disaster Service Workers as Deputy Building Inspectors by government entities would not affect the engineer's entitlement to State Disaster Workers' Compensation Benefits, which would remain the exclusive remedy for physical injuries suffered by them while performing related activities.
>
> *Question:* Would such engineers be required to be "fully conversant" with local building safety codes?
>
> *Answer:* Volunteer Engineer/Disaster Service Workers would not be required to be fully conversant with local building and safety codes.

> *Question:* If a local engineer, building inspector, or volunteer engineer certifies a structure is safe for occupancy and, when occupied, it collapses and individuals are injured, would the local entity, the state, or the certifying engineer be liable?
>
> *Answer:* No liability would attach to a public entity, its employees, or a Disaster Service Worker under the circumstances presented.

Additional liability protection exists for California registered architects and engineers through the **State of California Business and Professions Code,** Chapter 30, Section 5536.27 for architects and Section 6706 for engineers (both cited below). After the Loma Prieta Earthquake of 1989, many architects volunteered their services to the City of Oakland, assisting with the safety assessment of buildings there. Concerned about their future liability, they championed Senate Bill 46X that passed in 1990. This legislation modified the Business and Professions Code to provide liability protection for professionally registered engineers and architects.

> *Quotation of Section 5536.27 (architects) for reference:* “(a) An architect who voluntarily, without compensation or expectation of compensation, provides structural inspection services at the scene of a declared national, state, or local emergency caused by a major earthquake, flood, riot, or fire at the request of a public official, public safety officer, or city or county building inspector acting in an official capacity shall not be liable in negligence for any personal injury, wrongful death, or property damage caused by the architect’s good faith but negligent inspection of a structure used for human habitation or a structure owned by a public entity for structural integrity or nonstructural elements affecting life and safety. The immunity provided by this section shall apply only for an inspection that occurs within 30 days of the declared emergency. Nothing in this section shall provide immunity for gross negligence or willful misconduct. (b) As used in this section: (1) ‘Architect’ has the meaning given by Section 5500. (2) ‘Public safety officer’ has the meaning given in Section 3301 of the Government Code. (3) ‘Public official’ means a state or local elected officer.”
>
> *Quotation of Section 6706 (engineers) for reference:* “(a) An engineer who voluntarily, without compensation or expectation of compensation, provides structural inspection services at the scene of a declared national, state, or local emergency at the request of a public official, public safety officer, or city or county building inspector acting in an official capacity shall not be liable in negligence for any personal injury, wrongful death, or property damage caused by the engineer’s good faith but negligent inspection of a structure used for human habitation or owned by a public entity for structural integrity or nonstructural elements affecting life and safety. The immunity provided by this section shall apply only for an inspection that occurs within 30 days of the declared emergency. Nothing in this section shall provide immunity for gross negligence or willful misconduct. (b) As used in this section: (1) ‘Engineer’ means a person registered under this chapter as a professional engineer, including any of the branches thereof. (2) ‘Public safety officer’ has the meaning given in Section 3301 of the Government Code. (3) ‘Public official’ means a state or local elected officer.”

Local government employees who are dispatched to another jurisdiction under the **California Master Mutual Aid Agreement** have their liability protection from their home jurisdiction transferred with them. Once they are **deputized** so they can post locally adopted placards, they also receive the same immunity from liability that employees of the assisted jurisdiction have. This also holds true for volunteers and state workers who are deputized by the assisted jurisdiction. The immunity from liability holds for the length of the deputizing, which is normally up to 30 days from the date of the disaster declaration.

As the California Emergency Services Act states, liability protection also attaches to persons, registered or not, who are "duly impressed into service" by the authorities having jurisdiction. This practice of 'commandeering' dates back to Roman times, and has been used in recent disasters in California as well.

Under the **Emergency Management Assistance Compact (EMAC)**, persons from outside the State of California who are sent through EMAC to help with a disaster in California have whatever immunities from liability that they would have in their home state. Conversely, persons sent by the State of California under EMAC to help communities in other states have the same protections from liability that they enjoy within California under these aforementioned laws and regulations.

Of course, all of these liability protections **do not cover** malicious acts (such as red-tagging a building because the owner is argumentative) or gross negligence (such as green-tagging a building without any assessment).

1.5 Workers' Compensation for California Disaster Service Workers (DSWs)

State of California employees and California local government employees are Disaster Service Workers by definition. State of California employees are covered with workers' compensation from the State of California. Local government employees are covered with workers' compensation from their respective local governments.

As stated in the previously mentioned California Attorney General's Opinion, private sector volunteers are covered for workers compensation by the State of California, and this is the only source of workers' compensation available to them. However, private sector volunteers must become California Disaster Service Workers in order to be eligible for workers' compensation from the State of California. This in accord with Section 8580 of the California Emergency Services Act, which states:

> "The Emergency Council shall establish by rule and regulations various classes of disaster service workers and the scope of the duties for each class. The Emergency Council shall also adopt rules and regulations prescribing the manner in which disaster service workers of each class are to be registered. All of the rules and regulations shall be designated to facilitate the payment of workers' compensation."

Private sector residents of California become Disaster Service Worker volunteers by completing the Loyalty Oath or Affirmation on the SAP Registration Form (hereafter referred to as the "Loyalty Oath").

State of California employees, as well as employees of local governments in California, are not required to sign the Loyalty Oath, as they are already Disaster Service Workers.

Persons who are not residents of California do not need to sign the Loyalty Oath. If they are dispatched to California under EMAC, then they would be covered by whatever workers' compensation arrangement exists for them in their home state.

If an injury occurs to a Disaster Service Worker, the injury must be reported at once to the SAP Coordinator! State and local government Disaster Service Workers must also *report the injury to their regular supervisor at once!* The injured person will need to complete an injury report provided either by the SAP Evaluator, and/or by their immediate supervisor, if they are a government worker.

1.6 Program Registration

Safety Assessment Program evaluators are deployed through one of two ways:

- Through their professional organization; or,
- Through their supervisor, if employed by a State of California agency.

In either case, registered SAP evaluators must meet the minimum requirements previously discussed. In addition, they also must:

- Complete the one-day standardized training presented by a certified SAP trainer;
- Have their photo taken for identification purposes; and
- Be a California Disaster Service Worker (see Section 1.5).

There were a variety of identification cards issued prior to July 2013, when Cal OES was rebranded with its current name. The current identification cards are two-sided and have dark bands on a white background. In the event of a deployment, persons with the older cards will have new Cal OES identification cards made for them, so there is consistency in the field. As was reinforced in the April 2010 Baja Earthquake event that affected Imperial County, identification is essential in order to protect the public from fraudulent individuals seeking to profit from the disaster. Those with older cards will otherwise receive updated identification cards once they recertify.

All SAP identification cards expire five years from the month of the evaluator class. A refresher course is available online to renew one's SAP identification card, and thereby one's standing in the statewide cadre. There is also a half-day SAP recertification class that may be available through some of the certified instructors. Of course, one can also take the regular SAP evaluator class again to renew. **Be certain to store your SAP ID card in a safe place where you can easily find it.**

The back side of the SAP ID cards contains an emergency worker clearance statement that will assist the SAP evaluator in crossing public safety lines. It also has a postage guarantee that allows a lost SAP identification card to be sent back to Cal OES by simply being put into the mail.

Also, SAP coordinators who have the credentials to do field evaluation (see Section 1.2) are issued a card identifying them as a coordinator. This will facilitate their work in the office or field as a lead person. (The SAP coordinator training is different from this evaluator course, and is given as an add-on to the SAP evaluator class. A SAP coordinator who is issued an ID badge also has the credential to perform safety assessments in the field.)

SAP evaluators who reside in states other than California will have their state of residence on their SAP ID card.

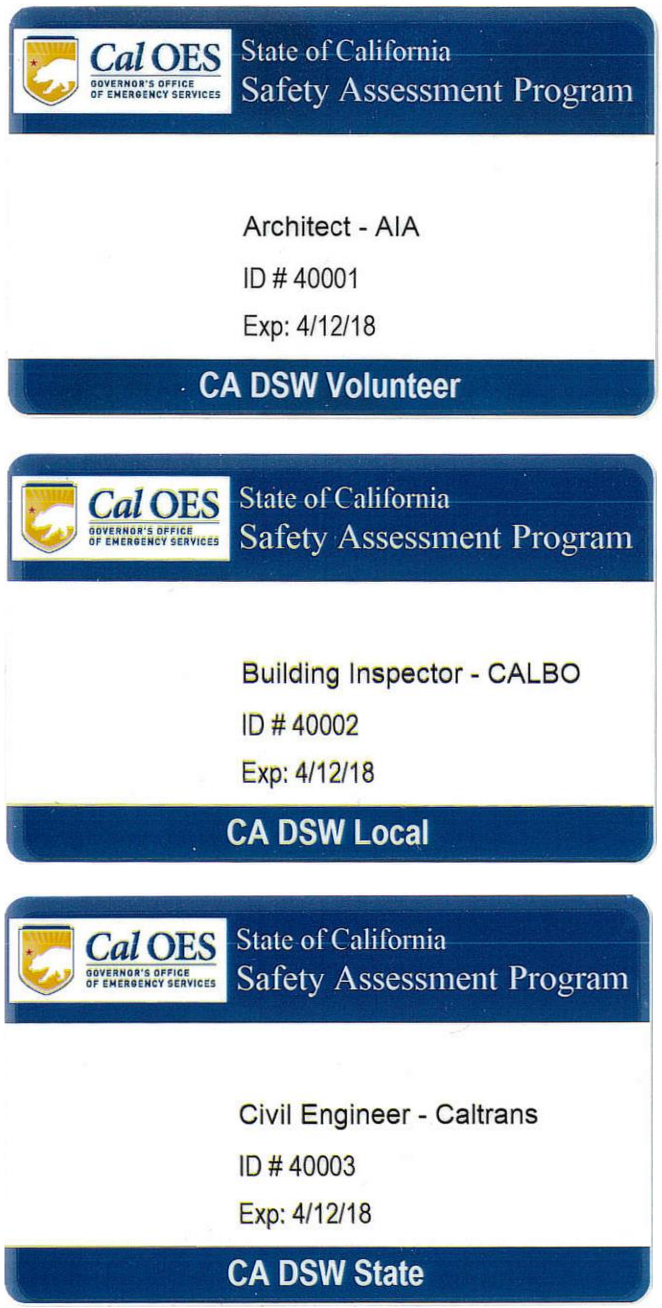

Figure 1-2: SAP Identification Cards for Evaluators

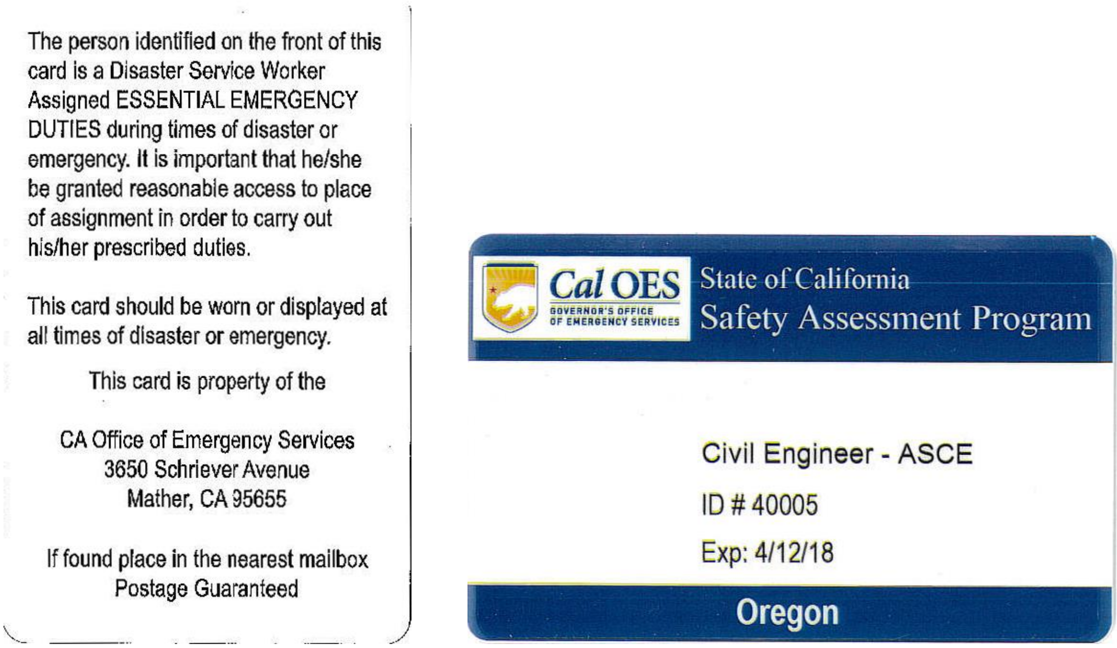

Figure 1-3: SAP Card Back, Other State Card

Figure 1-4: SAP Coordinator Card

1.7 California SAP MOU and Reimbursements

The experiences from the 2014 Napa Earthquake made clear the need to solidify the mutual aid agreements regarding safety assessment, so all parties are aware of their responsibilities, and so eligible reimbursement from state and federal disaster programs for SAP expenses can proceed. Therefore, Cal OES created a Safety Assessment Program Memorandum of Understanding (SAP MOU) that spells out the terms of mutual aid for the Safety Assessment Program, and that also supplies some operational framework for implementing this mutual aid. A copy of the SAP MOU can be found in the Appendix.

Cal OES strongly recommends that local governments have a SAP MOU in place before an emergency happens that requires safety assessment assistance! If no signed agreement is in place when a request for assistance is made, Cal OES will attempt to have the document signed by the Receiving Agency prior to dispatching SAP personnel.

Responding volunteers may have to pay up front for hotel and meal expenses, as well as other reasonable travel costs, but these costs are to be reimbursed by the local government that requested their assistance. Some local governments may have a pre-arrangement with a hotel and restaurant so the out-of-pocket expenses by the volunteers are greatly reduced.

In addition to these things, there are two other reimbursement issues that all should be aware of:

- DSW Volunteers will not be able to receive wages while activated for the Safety Assessment Program. They must be on their own time, either on vacation or on unpaid leave, while working as a volunteer. This is so the workers' compensation coverage from the State of California will apply. (If a company were to pay wages to private sector employees while they worked doing safety assessment, the company would be responsible for the workers' compensation, and would also not enjoy the protection from liability that the State of California provides for volunteers.)
- Local government employees might be operating on their home jurisdiction's funding until the Governor proclaims a state of emergency for the incident. As stated before, these costs can be reimbursed eventually through the state and federal public assistance programs.

1.8 Activation Sequence

Local governments must reasonably commit all their available resources once a local emergency situation occurs. This usually happens early in the disaster response, as many inspectors are sent out to do windshield surveys and initial tagging of essential facilities at once.

After the local building department's personnel are committed, the local government must evaluate their need for additional resources. If the event is beyond their capacity to respond to with their own personnel, the local government should request assistance from the Operational Area.

Operational Areas can draw upon the resources of the County and all the cities and special districts within the County. The County will be the lead agency for the Operational Area. The Operational Area can request under mutual aid the safety assessment resources from all the agencies within its borders to assist with the local emergency response.

If these resources are not enough, and the Operational Area has reasonably committed all available safety assessment resources it can, then the Operational Area will request SAP assistance through the Cal OES Regional Emergency Operations Center (REOC). Since SAP is a state-level resource, the REOC forwards the request to the Operations Chief of the State Operation Center (SOC) and to the Statewide SAP Coordinator. The request will ask for the number and type of personnel being requested (numbers of building inspectors, engineers, and architects), where they are to report to, and when they are needed.

The Statewide SAP Coordinator then (1) confirms that the SAP MOU is in place with the requesting agencies, (2) contacts the appropriate professional organizations to mobilize their members and (3) has them report to the identified staging area for their assignments.

The SAP evaluators must remember to bring their SAP ID card, hard hat, safety shoes, and go-kit (see Chapter 7). Once the SAP evaluators arrive at the staging area, which should be separate from either the local Emergency Operations Center or the local Building Department, the evaluators report to the SAP Coordinator, sign in, and are deputized. They obtain a briefing packet from the SAP Coordinator, and watch a video supplied to the SAP Coordinator by Cal OES that helps remind the evaluators of their responsibilities. The briefing packet needs to have travel expense claim forms, a map, and the phone numbers for the building department, police, fire, haz mat, utilities, and animal control.

Then they receive their assignments as teams. It is important for their own safety that all SAP evaluators work in teams of at least two individuals – no one should ever be allowed to go off by themselves due to the extreme danger that can be encountered in the post-disaster theater! The assignments may be sections of neighborhoods by blocks, or a list of afflicted properties. If the latter is the assignment, it is good if the local government can supply a driver who is familiar with the jurisdiction.

At the end of each day, the SAP evaluators return to the staging area to debrief with the SAP coordinator. The coordinator reviews for completeness the assessment forms that are completed for each property by the teams, and to discuss any safety or program issues that came up in the field. The evaluators sign out for the day and return the next, until their assignment is over. This sign-in and sign-out process by the local government is imperative for safety and accountability of the SAP resources, and reimbursement for costs encumbered by the local government.

1.9 Suggested Evaluator Assignments

Both Cal OES and ATC-20 recommend the following responsibilities for the various disciplines among the SAP evaluators. This is simply guidance in the absence of anything else; the actual assignments of individuals with various skills will be done by the local governments based on their own priorities.

There are two types of evaluations that are done on structures. *Rapid evaluations* are a quick safety review of the building using a one-page form, and usually make up 95% of the building reviews in earthquakes. (Other disasters are likely to have different percentages from that of earthquakes.) *Detailed evaluations* are usually done for buildings that have already been reviewed and tagged; these may be at the request of building owners, or the request of the first SAP evaluator team, if they felt the structure was difficult to call, and a second opinion is warranted. Sometimes a moderately affected local government may request that all evaluations be detailed. Detailed evaluations may take much longer to do than rapid evaluations, and the form is two pages long for buildings. All infrastructure evaluations are detailed. More information on these forms is found in Chapters 2 and 5 of this manual.

- **Building inspectors** perform rapid evaluations of all occupancies. **Building officials** will assist with detailed evaluations also.
- **Structural engineers**, and **civil engineers with a structures background**, perform both rapid and detailed evaluations of buildings and structures. They may also assist certain state agencies with their work, such as the Division of the State Architect (DSA) and the Office of Statewide Health Planning and Development (OSHPD).

- **Civil engineers with a background in infrastructure,** along with **public works inspectors**, perform the detailed evaluation of lifeline infrastructure systems and facilities. They are also available to assist state agencies with their work, such as the Department of Water Resources and the Department of Transportation (Caltrans).
- **Architects** perform rapid evaluations of buildings and structures, and if needed, will also assist with doing detailed evaluations. They can also assist state agencies such as the Division of the State Architect with their work.

For small events, only those individuals within the disaster area or the immediate vicinity thereof will likely be activated. This way, costs will be kept to a minimum, as the SAP evaluators can return home at night instead of staying at hotels.

For large events, persons from within the disaster area will not be activated, as the assumption will be made by Cal OES that these persons are already busy with disaster related duties. Local government building inspectors and engineers will be inspecting buildings within their own jurisdiction and will not be available. Private sector SAP evaluators who are from the affected area will likewise have their own clients who will require assistance. The SAP evaluators who respond to large events will come from outside the affected area, from across the State of California or from across the country through EMAC.

Cal OES works with the five partner organizations (CALBO, AIA, ASCE, ACIA, and SEAOC) through state-level coordinators at these organizations. In turn, the organizations usually have a coordinator at the chapter level that does the actual call-outs in a deployment. State agencies likewise have lead emergency managers who are contacted by Cal OES if the SAP evaluators of their agencies are needed.

Once a volunteer receives a deployment request, they must personally make the decision if they are able to respond or not. There may be times when personal circumstances do not allow them to be activated; if this is the case, it is understandable if they inform the partner organization that they are not available this time, but would like to participate another time.

Both local government and state agency SAP personnel must individually work out their availability with their supervisors.

Volunteer SAP evaluators are activated for 5 working days. Local and State SAP evaluators are also likely to be activated for five days, but may be held over longer if necessary in order to wrap up the field efforts near the end of the deployment, rather than bring in a new wave of personnel for just a few days.

Deployed SAP coordinators should have an overlapping schedule with their incoming replacements so the new SAP coordinator can be briefed on the current situation, effective procedures for this disaster, and to get set up for the next wave of SAP evaluators.

1.10 Safety Assessment Responsibilities for Agencies and Organizations

Governmental entities that regulate building or lifeline construction and/or safety have safety assessment responsibilities. This falls under the role of government to provide for the health and safety of the public.

It is very important after a disaster to quickly identify habitable buildings. Some buildings will be used for urgent medical care, mass shelter facilities, or emergency operations; but most buildings are privately owned and often key to the economy of the affected area. So, clearing private buildings for safety will not only help free up the shelter spaces, but will also help the local economy to get back on its feet, thus help in the overall recovery from the disaster.

The following is a review of the government agencies involved in safety assessments on the structures within their jurisdiction.

<u>Buildings and Structures</u>

- *Local governments* are responsible for their own facilities, all privately owned businesses, private schools, single-family residences, and multi-family residences within their jurisdiction, as well as all structures and lifeline infrastructure not specifically mentioned below.
- *California Department of General Services, Division of the State Architect (DSA)* is responsible for oversight of the new construction of all public schools, community colleges, and state-owned or state-leased facilities. DSA currently does not have oversight responsibility for post-disaster safety assessment of public schools, but nevertheless has had their technical staff trained in safety assessment, and stands ready to assist after a disaster. (The Safety Assessment Program is one resource available to school districts after a disaster. School districts may alternatively set up a Memorandum of Understanding with local building departments for post-disaster safety assessment, or may choose to contract with private engineering or architectural firms to have their safety assessments done.)
- *California Office of Statewide Health Planning and Development (OSHPD)* has oversight for all acute-care hospitals and skilled nursing facilities. OSHPD has also had many of their staff trained in safety assessment.
- *California Office of the State Fire Marshal (SFM)* is the building inspection department for state facilities, including prisons. SFM is responsible for the fire and life safety elements of all state-owned or state-leased facilities as well as non-ambulatory care facilities. (*Fire elements* mean fire suppression systems, alarms, detectors, etc. *Life safety elements* refer to exits, corridors, stairways, etc.)
- *California Department of Housing and Community Development (HCD)* is responsible for most of the mobile homes and manufactured home parks in California.
- *Federal government* is responsible for all federal buildings and installations, no matter where the facilities are located. These safety assessments are usually performed by the U.S. Army Corps of Engineers from the area in which the disaster event occurs.

Lifelines

- *Local government public works departments* are responsible for all of the non-federal aid roads and bridges, along with the storm drains, sewers, etc., which are under the jurisdiction of the particular local government.
- *Special Utility Districts* are responsible for the pipelines and/or transmission lines that they install and/or maintain.
- *California Department of Water Resources, Flood Operations* is responsible for all levees, canals, and state water projects.
- *California Department of Water Resources, Division of Dam Safety* is responsible for all jurisdictional dams, except those owned or operated by the U.S. Army Corps of Engineers, or the U.S. Bureau of Reclamation. (A jurisdictional dam must be taller than six feet and hold back more than 50 acre-feet of water, or be taller than 25 feet and hold back more than 15 acre-feet of water.)
- *California Department of Transportation (Caltrans)* is responsible for state and federal highways in California, along with buildings and other infrastructure essential to the performance of their work.

The process of evaluating or inspecting facilities will not be limited to a local government's building department and any resources that they may request. Many other agencies will be in the post-disaster theater performing such evaluations under their authority. Being prepared for the possibility of many inspectors in the affected area can help reduce or eliminate redundant efforts, and lead to a sharing of information and cooperation between the agencies involved.

In addition to those agencies reviewing infrastructure, the following will also respond to the disaster:

- *American Red Cross (ARC)* will be on the ground within 24 hours of a disaster event to appraise the need for shelters, food, water, and temporary housing. The ARC will then begin identifying shelters and providing assistance to survivors. The urgent need for safe shelter locations is the primary reason why the early safety assessment of potential shelter buildings is essential.
- *California Department of Insurance* will send teams to assist with identifying insurance issues out in the affected areas. These teams are called Insurance Damage Assessment Teams (IDAT).
- *Insurance companies* will have their adjusters in the affected area performing visual inspections once survivors start to file insurance claims.
- *News media* will make their presence felt very soon after the disaster event. Reporters and camera crews will be touring the streets, looking for damage to broadcast and for people to interview. Public officials will be high on their list of interviewees, and SAP evaluators will look very official, so be prepared for the possibility of such an encounter. If the media present themselves to SAP evaluators, the reporters should politely be referred to the Public Information Officer (PIO) at the local Emergency Operations Center (EOC). Each local government will have their own protocol for addressing media questions, and evaluators should not be providing information about the disaster or the response to same without the express approval and consent of the local government.

After a local government officially proclaims a state of emergency and requests state and federal assistance through Cal OES, preliminary damage assessment (PDA) inspectors may be sent by Cal OES to affected local governments to review public facility damage sites and other damage-caused expenses. These will be considered by Cal OES to see if a request for federal assistance is warranted. If it is warranted, then the Federal Emergency Management Agency (FEMA) will be contacted by Cal OES to join in a coordinated State-FEMA PDA. FEMA and Cal OES work with the local governments to develop reasonably accurate estimates of disaster program eligible work. Once the figures are in, they are used by the Governor to request a major disaster declaration from the President.

- *Cal OES Recovery* may be out early after the disaster to perform State PDAs. The inspectors team up with local government representatives and review rough damage assessment estimates. This early assessment may help provide information as to whether or not the State can request assistance from the federal government.
- *FEMA public assistance inspectors* will make contact with the state inspectors and join local government representatives to perform the PDA for public facilities with federal public assistance in mind. In the same manner as the State PDA is done, they will inspect damaged buildings and facilities, and gather cost information related to the emergency response and facility repairs. Once there is a Presidential declaration of a major disaster, these inspectors and their State counterparts will perform more detailed inspections of the damaged facilities in order to develop project worksheets, which are the funding grants for federal disaster assistance.
- *FEMA individual assistance inspectors* will perform the PDA for private homes and businesses along with State inspectors and representatives of the Small Business Administration (SBA). They gather information on the number of homes and businesses with major damage or that are destroyed. These figures are used to request assistance.
- *SBA* can send in inspectors to work with State individual assistance inspectors once there is a Governor's proclamation of a state of emergency. These SBA inspectors evaluate how many homes are either destroyed or have sustained major damage according to their criteria, which can be different from FEMA's. Their inspectors perform verification inspections after applications for SBA loans have been received. SBA can find a county and its surrounding counties eligible for assistance independent of FEMA's findings.

As we can see by the list of agencies involved in the disaster theater, there will be many people milling around the affected area at any given time. Be prepared!

1.11 Evaluator and Local Government Roles and Responsibilities

There are clearly defined roles and responsibilities for the SAP evaluators and local governments throughout the safety assessment process.

Evaluators will:

- First assess the safety of those buildings essential to the management of the disaster. These buildings include police and fire stations, the local Emergency Operations Center, City Hall, and buildings intended for use as shelters, as well as any other facilities locally considered essential to handling the emergency, such as communications or public

welfare buildings, water and wastewater treatment plants, grocery stores, hardware stores, and pharmacies.
- Perform rapid assessments of all other buildings.
- Perform detailed evaluation of questionable buildings, as assigned by the building department.
- Perform detailed evaluations of specified lifeline systems and facilities.

Evaluators will NOT:

- Provide dollar estimates for the buildings they have evaluated. There are two reasons why this should not be done. First, estimating disaster-caused building repair costs is "damage assessment," and is not eligible for direct reimbursement under state and federal disaster grant regulations. Second, building costs can vary widely from one location to another, so it is best left to the local government to arrive at these repair costs. (SAP evaluators may gather non-cost data from the field, however, such as square footage and percentage of damage, that may be used by local government to determine rough estimates of damage.)
- Perform evaluations of compliance of grandfathered conditions to current code. Naturally, as building codes change, older buildings stock fall out of compliance, but are normally allowed to remain as "grandfathered" until sufficient renovations are done to them. For the SAP evaluator, this means that an older building would not be tagged unsafe unless it had actually suffered damage from the event that warranted such. It is entirely possible that unreinforced masonry buildings, for example, may come through an earthquake without a crack, in which case the building could be viewed as safe as it was before the disaster. Life safety issues caused by the event, however, would merit attention from the SAP evaluator and must not be ignored. Also, if a SAP evaluator comes across an unsafe code compliance issue, such as a locked exit door or other dangerous condition, it would be proper to note that condition on the assessment form for further actions by the building department or code enforcement, even if such did not affect the disaster-related safety level of the building.
- Perform escort or property retrieval for owners or occupants of buildings. Local governments can provide fire/rescue or law enforcement personnel to assist with this, and can augment their forces with mutual aid if that becomes necessary. The work of SAP evaluators in clearing homes and businesses for safe use is very valuable and important for the community, and must be kept on track.

The roles and responsibilities of local governments include:

- Appointing a SAP coordinator who will be responsible for managing the program during a response, and who will develop their department's SAP Operations Plan. (Training for SAP coordinators is available, and classes are posted on the Cal OES website.)
- Formally adopting the placards and issuing them to the evaluators as needed.
- Deputizing the responding evaluators. (If an individual local government does not wish to deputize the evaluators, they must be prepared to either send their own staff out to replace the generic placards with official ones, or to assign one of their building inspectors to each of the SAP evaluator teams.)

- Upon their arrival, provide a formal briefing to the evaluators of conditions in the jurisdiction, what they will be doing, and who they will be reporting to upon their arrival, along with a briefing packet. The briefing should include watching the SAP Refresher DVD, which is issued to the SAP coordinators as part of their training. The briefing packet should contain a map, any referral info that might be given to residents who want help with property retrieval, and a list of important phone numbers.
- The phone list should include the Building Department (which phone number should be written on the placards as well), police, fire, hazardous materials, utilities, and animal control.
- Provide the evaluators with lodging and meals.
- See if legal authority that allows the work to be performed is in place.

1.12 Terminology

- **ATC-20 – INSPECTED – Habitable, minor or no damage –** This green placard is used to identify facilities that have been inspected but in which no serious damage has been found. These structures are in a condition that allows them to be lawfully reoccupied; however, repairs may be necessary, such as those to stucco or drywall. There are no use restrictions on “green-tagged” buildings as far as the disaster damage is concerned, and the facility may be used in the same manner as it was before the disaster. This does not mean that the facility is cleared against all future damage, however. See more discussion in Chapter 2.
- **ATC-20 – RESTRICTED USE – Damage which represents some degree of threat to occupants –** The yellow Restricted Use placard is intended for facilities that have been damaged, but the extent of damage does not totally preclude using or occupying parts of the structure. It can mean that the building could be used under certain restrictions, or parts of a structure could be occupied. It can also mean that the facility can be only briefly entered to remove important possessions. The use of a “yellow-tagged” Restricted Use placard will minimize the number of buildings which will require additional safety assessments because restrictions can be placed on the use and occupancy of the structure until the owner can hire an engineer or architect to develop the necessary repair program.
- **ATC-20 – UNSAFE – Not habitable, significant threat to life safety –** The red ATC-20 Unsafe placard is used on those facilities with the most serious damage. Typically, these are structures that represent a threat to the life safety of persons occupying them. It is important to note that this category does not mean that the facility so tagged must be demolished. This placard carries the statement, “THIS IS NOT A DEMOLITION ORDER” to simply clarify that the facility is not safe enough to occupy, not that there is a demolition order against it. In the vast majority of cases, structures posted unsafe can be repaired to a safe and usable condition. This designation also includes buildings with a hazardous material spill present, or that are situated in a “collapse zone”, thus threatened by another structure that is unstable. It also includes those buildings that are threatened by unstable ground, whether related to the building foundation or related to a landslide threat from a higher elevation.

- **Damage assessment –** The cost estimating process that local and state agencies must perform to determine the type and quantity of disaster-related damage, and to repair those damages. This work is usually associated with disaster assistance applications from the jurisdiction to the State, or through the State to FEMA. SAP evaluators are not to do damage assessment, but may collect information that assists local governments to do so.
- **EMAC - Emergency Management Assistance Compact –** This is a state-to-state mutual aid agreement that all 50 states and the U. S. territories (such as Guam and Puerto Rico) have entered into. It allows for resources from other states to assist with disasters, and under Article 5 allows for the temporary recognition of professional licenses from other states for the purpose of the disaster. EMAC is arranged for exclusively through the emergency management offices of the states.
- **EOC – Emergency Operations Center –** A local government facility that provides support for all field operations, and through which resources are obtained and distributed to various field operations. Policy decisions related to the disaster are also developed at the EOC and dispersed from there.
- **Mutual Aid –** The process used to facilitate assistance to disaster-stricken communities without the use of the customary written agreements normally entered into by agencies with joint powers. Mutual aid is based on the concept of 'neighbor helping neighbor' in time of need without the expectation of compensation, although there are cases after the first 12 hours of aid when compensation of responding may be sought. Mutual aid assistance can include any type of resource from other jurisdictions, the State, and even the private sector. The State of California Master Mutual Aid Agreement governs California's mutual aid system.
- **ICS - Incident Command System –** A very successful management approach that is used during emergency response operations. ICS is an organizational structure that encourages communication vertically through the layers of the organization as well as laterally between sections in the same layer. ICS also incorporates incident action planning into operations, allowing for the definition of measurable goals to keep the operation coordinated.
- **OA – Operational Area –** One of the five levels of the Standardized Emergency Management System (SEMS). An Operational Area is composed of a county and all the cities and special districts within that county. The OA is responsible for supporting all tactical operations of the cities and special districts within it, and communicating disaster event operational status to the next SEMS level, the State Regional Emergency Operations Center (REOC).
- **REOC – Regional Emergency Operations Center –** This is the facility operated and maintained by the State of California within the mutual aid region being served. REOCS are located in Los Alamitos for the Southern Region, Oakland for the Coastal Region, and Mather (near Sacramento) for the Inland Region. It is through these operations centers that the State provides support to the Operational Areas, coordinates requests for statewide resources, and provides the communication link between local governments and the State of California. REOC operations are under the jurisdiction of the California Emergency Management Agency.
- **Safety assessment –** The process by which facilities of all occupancies and infrastructure lifelines are evaluated for their safety for continued use or disuse. This process is under the direction of local governments through their Building and Safety or Public Works

departments. During safety assessment, the cost estimating process known as 'damage assessment' must not be done.

- **SOC – State Operations Center –** This is the facility operated and maintained by the State of California in Sacramento County from which all requests for assistance are coordinated. All response efforts from State Agencies and state resources are also coordinated and directed from this location. EMAC is coordinated for mutual aid from out of state, and federal agency resources are also requested and coordinated from this location.

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UNIT 2: SAFETY ASSESSMENT PROCESS AND PROCEDURES

UNIT 2 – SAFETY ASSESSMENT PROCESS AND PROCEDURES

Overview

This unit introduces the process and procedures for performing safety assessments on buildings. Participants will review the particular hazards associated with earthquakes, windstorms, floods, and explosions, and how they affect buildings. The remainder of the unit will address the placards, forms, procedures, and criteria used in performing safety assessments.

Training Goal

Participants will become familiar with and understand the different types of evaluations, how to use the forms, and the definitions and uses of the placards.

Objectives

Upon completion of this unit, participants will be able to:

- Use the criteria for completing each type of evaluation.
- Properly identify and complete the various forms.
- Properly identify and correctly use the various assessment placards.

2.0 Safety Assessment Process and Procedures

2.1 Earthquake Effects

Earthquakes can cause several different effects to occur at the same time. These effects are:

- **Faulting –** The movement of ground on one side of the fault relative to the other. Historic and geologic records show that such movement has been as large as 20 feet horizontally and 10 feet vertically. Few structures located over the fault or next to it can withstand this sort of disruption.
- **Landslides, rockslides, and mudflows –** These have caused great loss of life when entire towns have been buried (Andes Mountains). Automobile-sized boulders have caused great damage to structures (Iran, Alaska, New Zealand), and large landslides have moved structures hundreds of feet (Alaska).
- **Liquefaction –** This occurs in loose deposits of fine sand that have a high water table. If such a soil configuration is subjected to a sudden disturbance or shock, as in an earthquake, the soil tends to lose stability under the shear stresses. The soil is temporarily transformed into a fluid mass with greatly reduced shear strength, with a condition resembling general soil shear failure. In the 1963 Niigata, Japan earthquake, liquefaction caused a group of apartment buildings to drop suddenly, some by as much as one story, and to tilt more than 30 degrees. Sand boils and other disruptions of the ground surface have also occurred.
- **Tsunami or seiche –** A tsunami (Japanese for “harbor wave”) is a powerful wave event that is generated in the ocean; a seiche is a similar wave event that occurs in lakes. These are normally caused by seismic events that uplift the underwater terrain, such as in a subduction zone. Such a tsunami normally requires a M 7.2 or greater subduction zone earthquake in order to be generated. Tsunamis also usually involve a series of waves instead of a single wave. When these waves sweep ashore, they can devastate all but the strongest structures. Earthquakes are not the only causes of tsunamis or seiches; they can also be caused by landslides that disrupt a large volume of water, either from above the water or underwater. They can also be generated by underwater volcanic eruptions.
- **Shaking –** This is the most commonly experienced effect of earthquakes. Shaking can be felt hundreds of miles from the earthquake epicenter. There are three types of ground shaking that results from earthquakes; the first two are dampened (or “attenuated”) with distance from the epicenter, and are called ‘near field’ effects for that reason. Pressure waves, or P-waves, travel through the ground at about the speed of sound, and are sinusoidal in one plane. They are precursors to the more damaging (and slower) shear waves, or S-waves, which exert most of the lateral forces in the near field, and are sinusoidal in two planes. Both types of seismic waves have periods less than one second in frequency, and dissipate with distance and geologic resistance from mountains and other features. The long waves with periods of one second or more, often travel throughout the earth’s crust, and can be measured on the other side of the globe. They can also cause damage at a distance if they meet up with buildings of the correct natural period of vibration with enough force.

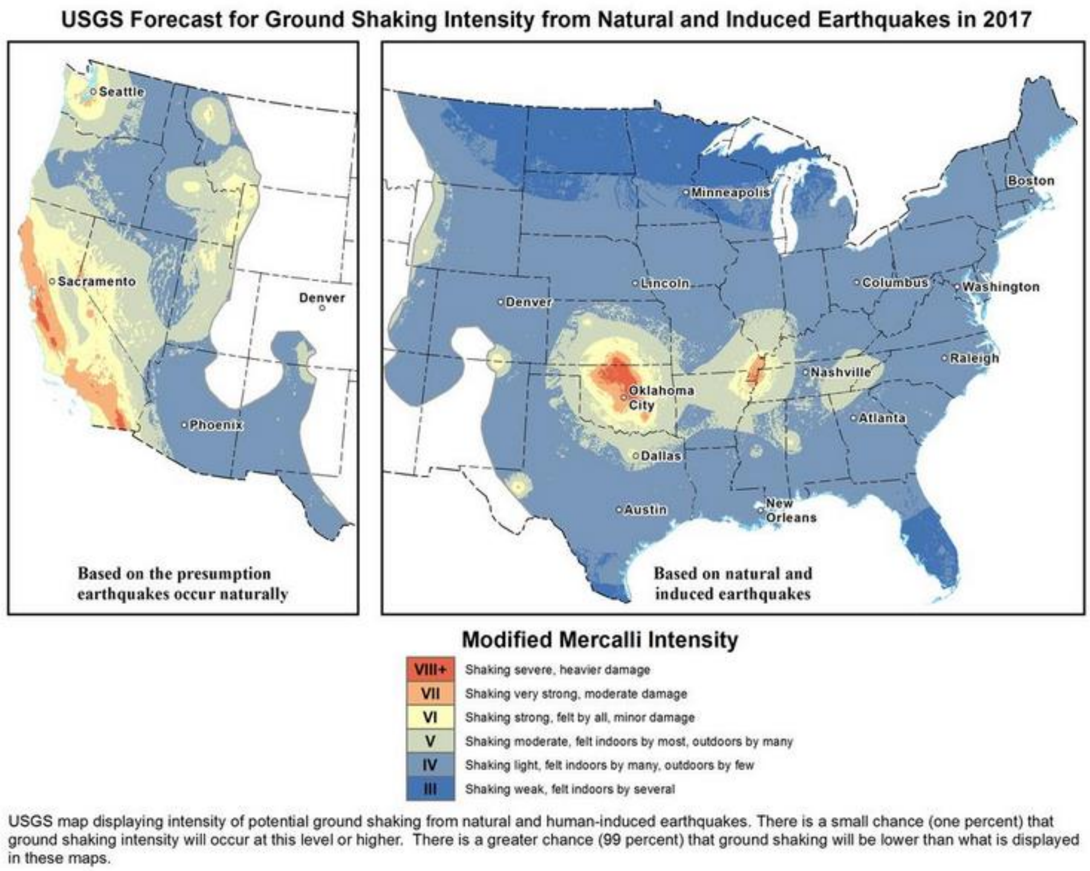


Photo courtesy USGS

Figure 2-1 – USGS Ground Shaking Potential Forecast, 2017 (expressed in Modified Mercalli intensity)

2.1.1 Earthquake Hazards in the United States

Figure 2-1 shows the seismic hazards in the continental United States. Besides the strong hazards found in California, notable features of this map include the Cascadia Subduction Zone in Washington and Oregon, the Wasatch Fault in Utah, the seismic hazards associated with the Yellowstone Caldera feature in Wyoming and the area in central Oklahoma, the New Madrid Fault in the Midwest, and the seismic hazard in the Eastern Tennessee area.

2.1.2 Effects on Structures

Every structure has a fundamental or natural period of vibration, which is a function of the building's mass and stiffness. In a simplified manner, a building's period could be approximated as 0.10 N seconds, where N is equal to the number of stories. Moreover, a structure's fundamental period will normally decay, or grow longer, as the structure suffers damage.

Earthquake motion is generally rich in various frequencies (frequency is the inverse of period, i.e., 1/period) that are similar to those of structures, and therefore can promote structural damage. Note that these statements are greatly simplified; for the proper fundamental period formula, see the most current building code.

As ground waves move further from the epicenter, the shorter frequencies are damped, and the longer waves remain. In the near field, where seismic waves are most intense and the frequencies are shorter, the strongest effects are felt by shorter, stiffer structures whose periods of vibration are closer to matching the period of the ground waves. Taller, more flexible structures will be affected most severely by the long frequencies that will continue out beyond the near field.

In the near field, the strong shaking that is felt by structures will have significant vertical and lateral components. Since the vertical load system of buildings is designed for more than dead load, or gravity load by itself, the additional vertical forces are normally not a threat to the structure. However, lateral shaking from earthquakes subjects structures to both shear and overturning forces. These threats require structures to have a complete lateral force resistance system, which may either be part of the vertical load system, or separate from it.

In the far field, longer seismic waves that are not absorbed by local geology cause unusual effects that can severely damage taller, longer period structures. When the fundamental period of a site matches that of the structure built on it, seismic shaking can cause resonance that amplifies the structure's response. The collapse of buildings between 10 and 20 stories in height in Caracas in 1967, and of 8 to 12 story buildings in Mexico City in 1985, are unfortunate examples of this effect.

Figure 2-2 – Shear cracking

The above photos illustrate classic X-shaped shear cracking that occurs in response to lateral seismic forces.

Photo courtesy FEMA

Figure 2-3 – Soft story failure, San Francisco, 1989 Loma Prieta Earthquake

This building did not have sufficient lateral force resistance in its lowest floor, resulting in this dangerous "soft story" failure.

Photo courtesy FEMA

Figure 2-4 – House off of its foundation

This house did not have enough tie-downs to hold it to its foundation.

Photo courtesy Fred Turner, EERI

Figure 2-5 – Pounding, 2010 Chilean Earthquake

These two buildings were of dissimilar height and stiffness, and were too close together. Their reaction to the seismic waves was different, so they pounded each other.

Photo courtesy Dave Karina, ACIA

Figure 2-6 – Roof-wall connection failure, 2010 Baja Earthquake

Roof diaphragm has failed, so building has lost its lateral load resistance capacity.

Figure 2-7 – Non-ductile concrete wall failure

Insufficient steel reinforcing led to non-ductile failure in this concrete wall.

Photo courtesy Fred Turner, EERI

Figure 2-8 – Collapse of tilt-up walls, 2010 Chilean Earthquake

Tilt-up walls may not have been anchored correctly to roof, leading to this failure.

Photo courtesy FEMA

Figure 2-9 – Ground scarp through building

This building was torn in two by either a fault trace or a settlement scarp.

Figure 2-10 – Partial collapse of structure.

This structure in Japan suffered partial structural collapse.

Figure 2-11 – Soft story racking damage.

Figure 2-12 – Damaged chimneys

Chimney failures are common in areas with moderate ground motion, as chimneys usually are made of unreinforced masonry and are often not braced or reinforced at the roof line. In areas with strong ground motion, the chimneys are often snapped off.

2.2 The Safety Assessment Program

Every successful program has a goal, and the Safety Assessment Program is no exception. It is not simply to identify damaged structures, nor to help out with restoring tax assessment records, or other worthwhile goals, though the information from the program has been used after the fact for such things after the primary goal has been met. Identification of damaged structures and the nature of their difficulties is a by-product of the program, which in itself is very useful to local governments. However, in accord with the 1992 *Post-Disaster Safety Assessment Plan*, the primary goal of the Safety Assessment Program is:

- ***To get as many people as possible back into their buildings as quickly and safely as possible.***

This goal is accomplished by assessing and categorizing structures by their degree of safety. This, in turn, greatly assists local governments in their recovery and reconstruction efforts. The faster that people can be returned to their safe homes and businesses, the faster the economic base of the community will return to some degree of normalcy. Shelters will be reduced in use, and the emotional strain of the survivors will be reduced as well. The community as a whole will benefit from this compassionate and beneficent program.

Not all will appreciate the worthy motives describe above. There will be some who will be greatly displeased with discovering that their home or business has been rendered unsafe by the disaster. As deputized representatives of the local building departments, or as disaster service workers of the State of California, SAP evaluators will need to conduct themselves professionally under all situations and conditions. That may mean making some unhappy in order to make them safe. Assistance from local governments with protection of SAP evaluators and enforcement of their findings will greatly help with these cases.

In 1989, the Applied Technology Council presented ATC-20, *Procedures for Postearthquake Safety Evaluation of Buildings*, and the companion field manual ATC-20-1. Since then, other publications have been released by ATC:

- ATC-20-2, *Addendum to the ATC-20 Postearthquake Building Safety Evaluation Procedures*
- ATC-20-3, *Case Studies in Rapid Safety Evaluation of Buildings*
- ATC-45, *Field Manual: Safety Evaluation of Buildings after Windstorms and Floods*

These publications well define the process and procedures for determining the safety of buildings for continued occupancy. They have essentially been incorporated into the Safety Assessment Program as found in this manual. As time goes on, the Safety Assessment Program will no doubt be activated for any type of event, emergency, or disaster that impacts the integrity of structures.

In 1992, Cal OES published the state plan on safety assessment known as the *Post-Disaster Safety Assessment Plan*. This plan provides local governments guidance on how to access the resources of the Safety Assessment Program so they may receive SAP assistance.

2.3 Placards Used for Safety Assessment

The ATC-20 procedures use a three-placard system. These placards are used to clearly express to the building owner, any tenants, and the public at large the safety condition of the building. A rapid evaluation or detailed evaluation is used by the SAP evaluator to arrive at the correct placard for the building, keeping in mind the overall goal of the program. These evaluations are usually not enough to determine a scope of work for repair, or to see if the repairs are economically feasible. The evaluation is only enough to determine whether or not the building can be occupied, and if so, to what degree.

The history of the placards goes back to the 1970s when Cal OES and the Structural Engineers Association of California developed the original versions. In 1989, ATC-20 introduced the three original color-coded placards based on the earlier versions:

- INSPECTED (green)
- LIMITED ENTRY (yellow)
- UNSAFE (red)

The 1989 Loma Prieta Earthquake was the first time these ATC-20 placards were used. After Loma Prieta, there was much discussion on the placard content, especially the LIMITED USE placard. This resulted in the revision of the placards and the posting process, which was contained in the release of ATC-20-2. The current placards used by jurisdictions, and explained in this publication, are from ATC-20-2.

Because the older placards are no longer in wide use, if at all, among local governments, this course will focus on the use of the most current ATC-20-2 placards.

2.3.1 Inspected (Green)

The following is an example of the INSPECTED placard.

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to local authorities; reinspection may be required.

Inspector Comments:
____
____
____
____

Facility Name and Address:
____
____
____

Date ___________________________

Time ___________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:
____
(Jurisdiction)

Inspector ID / Agency
____
____
____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

The definition of the INSPECTED placard is:

- No apparent hazard found
- Repairs may be still required
- Lateral and vertical load capacities have not been significantly decreased
- Lawful occupancy is permitted

It is clear from this that the expression “significantly decreased” is a subjective one. There is no scale by means of which one can measure “significant.” One must use judgment as to the impact of potential damage from the disaster on the lateral force and vertical load systems. Such judgment comes from experience in either designing or reviewing designs of such structural systems.

An “Inspector Comments” section has been added so that important information can be relayed to the building occupant regarding the condition of the building. This placard does not mean that the building survived unscathed; it may have some minor damage, such as stucco cracks or other such things. The placard means simply that any damage that occurred does not represent a hazard to the occupants. In the “Inspector Comments” section, notes can be made about indicated repairs that the building owner should attend to. Anything written in the “Inspector Comments” section on the placard must also be put in the “Comments” section of the evaluation form, so the building department can follow up.

A statement warning about the effects of aftershocks was added to the placards. This is meant to alert the building occupant that the building may have to be re-inspected after a major aftershock. Obviously, if the placard is used for a non-earthquake event, such as a flood, the placard's reference to aftershocks can be ignored.

The placard also has a statement at the bottom warning not to remove the placard unless duly authorized by the jurisdiction. This statement can be improved upon with local code citations as part of the placard's adoption by the local government. The official seal of the jurisdiction, and the building department's phone number, can also be added to the placard as part of the official adoption of the placard. (This holds true for the other two types of placards as well.)

Keep in mind that an INSPECTED placard has no use restrictions for the structure other than what is already established by law (a house remains a residence, a business remains a business, etc.). A building with an INSPECTED placard can be occupied, no rooms or doorways should be off-limits, no safety issues are present. If a structure has problems that move the SAP evaluator to seek restrictions on its use, the other placards need to be considered.

There will occasionally be a local jurisdiction that has been directed by high officials not to tag buildings that are deemed safe to enter. *Please alert Cal OES if a California jurisdiction has some sort of directive to that effect.* Efforts will be made to correct this from higher up the chain of command. Not only would the public be ill-served, not being sure which homes have been looked at, but also SAP evaluators would be unable to tell what buildings have been examined, and could end up re-examining the same buildings, thus wasting precious time and effort. If SAP evaluators are helping another state through EMAC and are so directed, that is up to that state's directives; in the Hurricane Katrina response, Louisiana officials only wanted the rapid assessment forms completed.

The INSPECTED placard means that the building survived the last incident in usable form. *It does not imply any guarantee that the building will stand up against any or all future events!* The SAP evaluation is not a thoroughgoing structural investigation, but a quick visual inspection. *The responsibility of the continued safe use of the structure rests with the building owner*, who is morally responsible to make sure that the building at least meets the life safety standard found in the most current building codes, or better yet, is fortified beyond code requirements by mitigation.

2.3.1.1 Example of the use of the INSPECTED (Green) Placard

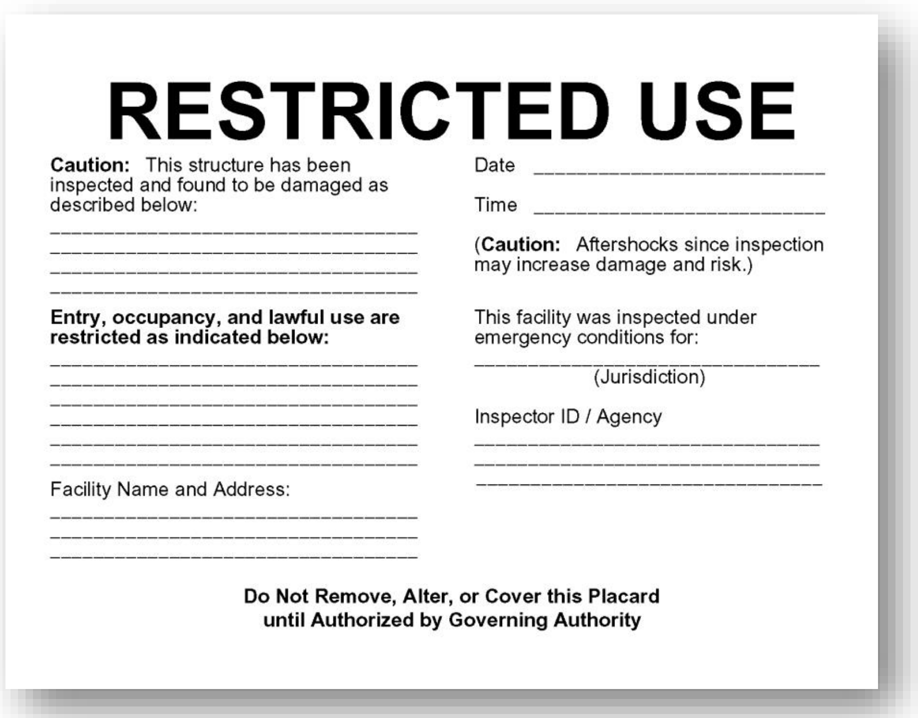
Figure 2-21 shows the Imperial County Emergency Operations Center, which was in the affected area of the M7.2 Baja Earthquake, which occurred on April 4, 2010. (This earthquake has technically been called the El Major – Cucupah Earthquake, but for the sake of brevity will be termed the 'Baja Earthquake' in this manual.) The Emergency Operations Center is a relatively new building with a structural design that anticipated strong ground motion. It was also properly designed as an 'essential facility.' The building had no serious damage, and remained in use as the Emergency Operations Center. It was appropriately tagged INSPECTED.

Photo courtesy Dave Karina, ACIA

Figure 2-13 – Imperial County EOC, 2010 Baja Earthquake

2.3.2 Restricted Use (Yellow)

Two equally viable types of RESTRICTED USE placards were developed under ATC-20-2.



RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:
____
____
____
____

Entry, occupancy, and lawful use are restricted as indicated below:
____
____
____
____
____
____

Facility Name and Address:
____
____
____

Date ________________________

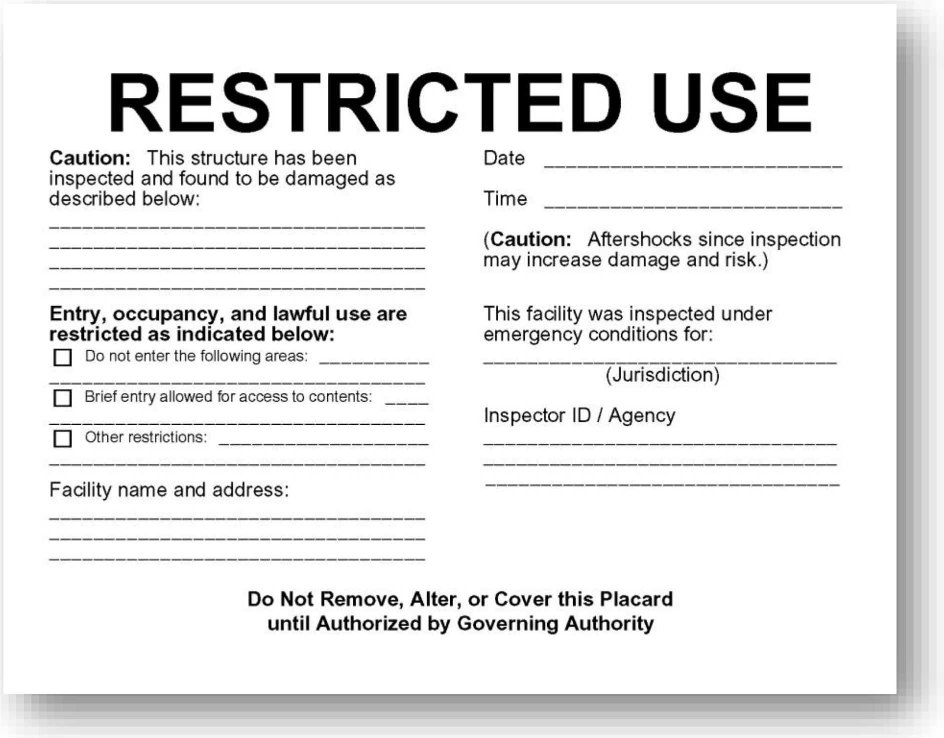
Time ________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:
____
(Jurisdiction)

Inspector ID / Agency
____
____
____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority



RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

Entry, occupancy, and lawful use are restricted as indicated below:

☐ Do not enter the following areas:

☐ Brief entry allowed for access to contents:

☐ Other restrictions:

Facility name and address:

Date

Time

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

(Jurisdiction)

Inspector ID / Agency

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

The criteria for this placard are:

- The building has been damaged but may or may not be habitable
- There may be a falling hazard in part of the building
- There may be damage to the lateral force and/or the vertical load resisting systems, but they are still able to resist load, in the judgment of the SAP evaluator
- Occupancy is permitted in accordance with the noted restrictions

RESTRICTED USE is clearly understood by all. The idea behind this placard is that the building has suffered some damage, but portions of it may be used, or the damaged portion is stable and the occupant can have free access to retrieve possessions as needed. The placard must be filled out to briefly explain the damage and to describe appropriate restrictions on how the building can be used. These restrictions can run from restricting occupancy of certain rooms to forbidding use of certain doorways, to allowing brief entry only to retrieve possessions. During the 1989 Loma Prieta Earthquake and other earthquakes, it was noted that more RESTRICTED USE placards are posted than UNSAFE or red placards. To clarify, these buildings were not in a “questionable” condition, but were damaged to the extent that full occupancy could not be allowed, yet were not so badly damaged as to forbid all entry.

Possession retrieval is a major concern. Some businesses can readily relocate operations if they can only retrieve their computers and key files. Homeowners likewise want to gather important documents, medicines and family photos. The RESTRICTED USE placard allows ready identification of those buildings that are safe enough to quickly do this without further permission or monitoring from the jurisdiction.

Photo courtesy FEMA

Figure 2-14 – Home collapsed on cripple walls, 1992 Humboldt Earthquake

Figure 2-15 – Yellow tagged home, 1994 Northridge Earthquake

2.3.2.1 Examples of the use of RESTRICTED USE (Yellow) Tagging

Figure 2-14 shows an older home that collapsed on its cripple walls in the M7.2 Humboldt Earthquake of 1992, with its epicenter near Petrolia, CA. The home was no longer viable for occupancy, as the cripple wall collapse broke the water and sewer piping. The California Health and Safety Code requires that a building have working water and sewer plumbing and be enclosed from the weather in order to be occupied, and this building's condition violates two of those requirements. However, the house fell as a single unit, and is not racked or otherwise indicating any threat of collapse, so it would be possible for the occupant to go in to retrieve important possessions. A RESTRICTED USE placard would be appropriate here.

Figure 2-15 shows a home with a collapsed porch awning and chimney. Other damages to the home are not discernable from this photo. The house was yellow-tagged with a dual language placard.

2.3.3 Unsafe (Red)

The following is an example of the UNSAFE (red) placard:

UNSAFE

DO NOT ENTER OR OCCUPY
(THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

____
____
____
____
____
____

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:

____
____
____

Date ____________________________

Time ____________________________

This facility was inspected under emergency conditions for:

____
(Jurisdiction)

Inspector ID / Agency

____
____
____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

The criteria for the use of this placard have not substantially changed from ATC-20. This placard indicates that one or more of these conditions are present:

- There is an extreme hazard and the building may collapse
- There is imminent danger of collapse from an aftershock
- There has been a significant decrease in lateral force and/or vertical load capacity
- The building is unsafe and requires the permission of the authority having jurisdiction to enter.

The last bullet covers some additional dangerous conditions, more specifically:

- There is a spill inside the building of an unknown potentially hazardous material, or a known hazardous material
- There is the threat of a taller structure or landslide falling on the building, or of the building collapsing down a hillside.

The initial impression that the public had on seeing the UNSAFE placard in 1989 was that the building had to be demolished. That is not the intent of the placard at all. Most buildings, even heavily damaged ones, can be repaired. When good engineering is at hand, the question of whether to repair a building or demolish it usually comes down to which is more cost-effective. As an example, of the 350 red-tagged buildings in San Francisco after the 1989 Loma Prieta earthquake, only 50 of these buildings had to be demolished. The rest were repaired.

So as to clarify matters, ATC-20-2 added the phrase "THIS PLACARD IS NOT A DEMOLITION ORDER." It is now clear that the UNSAFE placard means that there is an immediate risk associated with entry, use, or occupancy of the structure. Since the use of the placard indicates that the building has been assessed for safety, a brief description of the hazard and/or damage on the placard is required.

The placard further requires written authorization from the jurisdiction for the owner or tenant to enter the building. That includes entry for possession retrieval when deemed appropriate by the jurisdiction. This arrangement also allows the building owner to arrange for professionals to gain permission for entry so that abatement of the hazard by repair or demolition can be accomplished.

2.3.3.1 Examples of the Use of the UNSAFE (Red) Placards

Figure 2-16 – Unreinforced masonry wall failure, 2001 Nisqually Earthquake.

Photo courtesy Fred Turner, EERI

Figure 2-17 – Heavily damaged house, 2010 Baja Earthquake

Photo courtesy ATC

Figure 2-18 – Uplifted pool and damaged URM building, 1992 Big Bear Earthquake

Photo courtesy ATC

Figure 2-19 – Damaged column at department store, 1994 Northridge Earthquake

Photo courtesy ATC

Figure 2-20 – Detail of damaged column showing P-delta effect

Figure 2-21 – Failure of steel gusset plate.

Figure 2-22 – Failure of concrete moment frame.

Figure 2-23 – Failed gusset plates on lateral bracing

Figure 2-16 shows the collapse of an exterior unreinforced masonry wall. Other damage is not readily visible in the photo. Unreinforced masonry buildings are very fragile in earthquakes, having no credible tensile resistance; the building likely has been tagged UNSAFE.

Figure 2-17 shows a house that has a porch with severe damage, and the entire house is racked, as evidenced by the leaning columns on either corner of the house. It does not take much racking for a structure to be pushed into failure mode; this house was correctly tagged UNSAFE.

Figure 2-18 shows an unreinforced masonry building with extensive damage. The question here is, why did the pool come up out of the ground? There could be several reasons; if the pool is sited in sandy soil with a high water table, liquefaction may have caused the pool to simply become buoyant and rise up out of the ground. Another cause may have been a scarp that pushed the pool up. If the latter, it needs to be identified, by a geologist or geotechnical engineer if necessary, and the information supplied to the building department via the assessment form for this building.

Figure 2-19 shows a reinforced concrete column supporting a pedestrian overcrossing that spalled away the concrete cover protecting the rebar. Upon closer examination in Figure 2-20, it is clear that the column is now in a type of failure mode. The rebar is bent, and there is a diagonal crack through the center of the column. These conditions indicate that a P-delta effect is at work that is translating vertical load into lateral movement. The entire area should be barricaded off, and tagged "AREA UNSAFE," using a felt pen to insert the word AREA in front of the word UNSAFE on the placard. The pedestrian overcrossing should also be barricaded at both ends and placarded UNSAFE as well.

Figure 2-21 shows a failed steel gusset plate on a lateral brace.

Figure 2-22 shows first floor racking of a multistory concrete moment frame structure.

Figure 2-23 shows two gusset plates that pulled apart at the top of steel lateral bracing.

2.3.3.2 Discussion of Structural Collapse Hazard Zones

The dangers from weakened structures are not isolated to earthquake disasters. For examples, one of the chief dangers facing fire fighters is the structural collapse that occurs while a structure fire is being fought. The National Institute of Occupational Safety and Health (NIOSH) strongly recommends that fire fighters establish a collapse hazard zone around an unstable structure that is *one and one-half times the height of the building.* While buildings may collapse straight down as opposed to leaning over, there is no guarantee of how a weakened building may collapse, and it is too late to set up the hazard zone when the building starts to fail, so the caution shown by such a collapse hazard zone is definitely appropriate.

In line with this guidance, engineers with the Urban Search and Rescue teams are trained to create a collapse hazard zone one and one-half times the height of the building. So, a weakened building that is 50 feet tall would have a hazard zone 75 feet in radius around it. This allows room for the building to collapse and for the building debris to come to rest. This federally accepted rule of thumb is the one preferred by the Safety Assessment Program.

Obviously, if other buildings are situated within the structural collapse hazard zone (or "collapse zone"), they face the peril of being damaged or destroyed by the collapsing structure. This situation makes it imperative that they be placarded UNSAFE. The danger from the weakened structure is too great to do otherwise. So, in the above example, buildings within the 75 foot radius around the weakened 50 foot high building would be tagged UNSAFE due to the collapse hazard from the tall building nearby.

The following is an example of how these principles were used in the 2010 Baja Earthquake.

Photo courtesy Fred Turner, EERI

Figure 2-24 – 150 foot tall El Centro water tower

Photo courtesy Dave Karina, ACIA

Figure 2-25 – Damage to water tower concrete footing

Photo courtesy Dave Karina, ACIA

Figure 2-26 – Snapped bolt at footing of water tower

Photo courtesy Dave Karina, ACIA

Figure 2-27 – Drawn and snapped connector at footing of water tower, also note footing damage

Photo courtesy Dave Karina, ACIA

Figure 2-28 – Water tower undergoing demolition to abate collapse hazard

The previous photos illustrate how a collapse hazard was identified in the 2010 Baja Earthquake, the safety assessment response to it, and the abatement of the hazard.

The landmark El Centro water tower was 150 feet high, and held only a small quantity of water at the time of the earthquake. As shown in Figures 2-25 through 2-27, the earthquake damaged the concrete footings of the water tower, snapped one anchor bolt, and resulted in another connection being drawn out and broken as well. With the ongoing strong aftershocks, or even with the winds found in the area at times, there was a serious danger of the water tower collapsing in an unknown direction. The tower was tagged UNSAFE.

Within the collapse zone of the water tower were two residences and an 8-unit apartment building. These were all tagged UNSAFE and evacuated due to the clear and present danger from the potential collapse of the neighboring water tower. Within a very short time, the City of El Centro acted to demolish the water tower and remove the hazard (Figure 2-28). Then the UNSAFE tagging of the neighboring residences in the collapse zone could be reassessed and reversed. (Note that, if the neighboring residences had their own safety issues beyond the one posed by the collapse hazard, the new assessments would reflect that in the posting of those residences.)

2.4 Evaluation Process

ATC-20 recognizes three levels in the evaluation process. The Safety Assessment Program will be involved with only the first two of these evaluation levels.

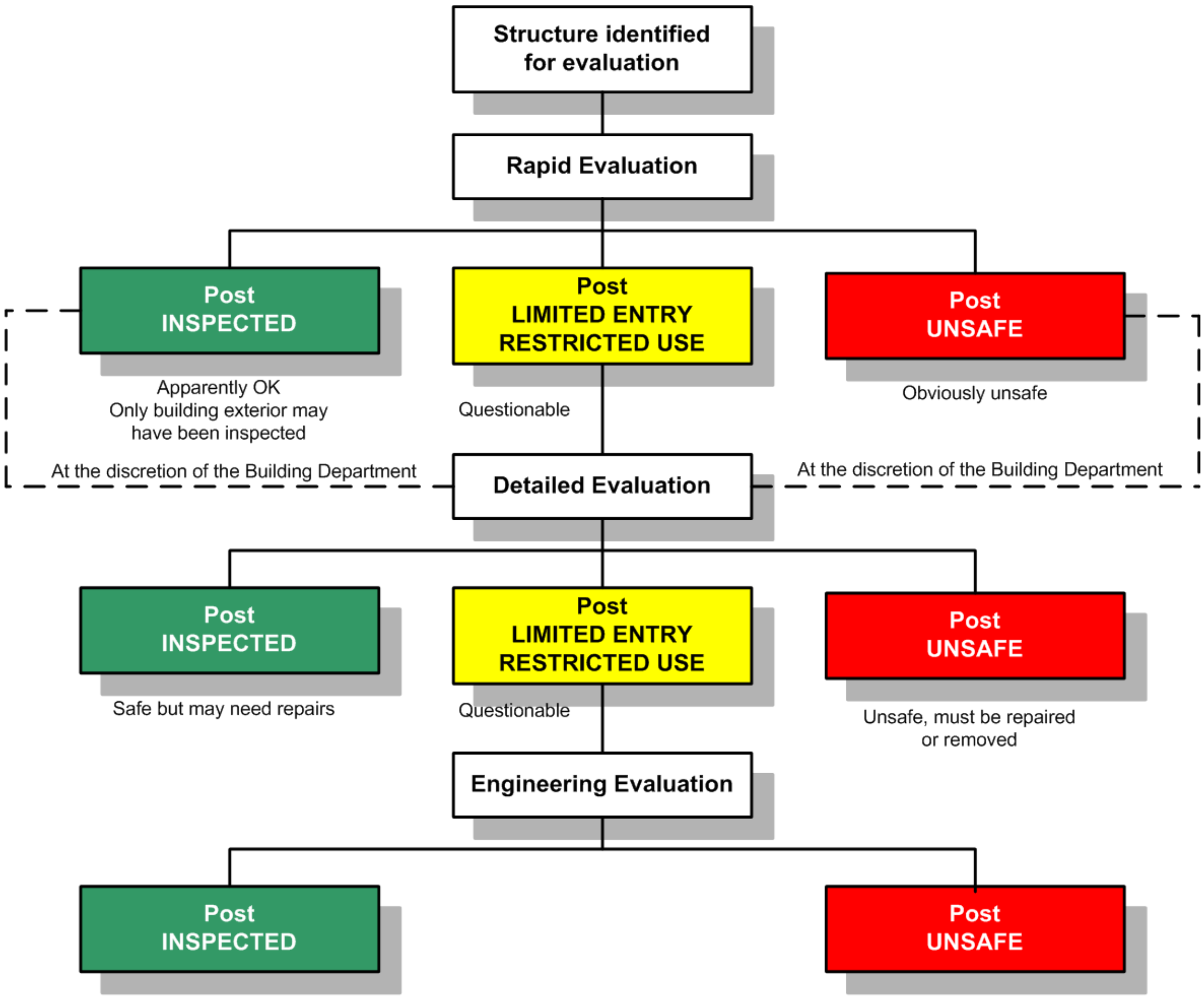


Figure 2-29 – Evaluation flow chart

The three levels or types of evaluations are defined as follows:

- **Rapid Evaluation** – where buildings are rapidly assessed for safety, taking about 10 to 20 minutes per building. The purpose of this type of evaluation is to quickly identify and post the obviously safe or unsafe structures. If access to the interior is available and the building is safe enough, the building can be entered for a quick walk-through to see if there is any potentially serious damage or interior falling hazards inside the building.
- **Detailed Evaluation** – where buildings are assessed more thoroughly, spending more investigation into the structural systems. Detailed evaluations can take anywhere from one to four hours, depending on the size of the building. This level of evaluation is used most often for buildings where the safety of the building is controversial, or is otherwise not clear. However, jurisdictions can ask for all their evaluations to be detailed ones if the damage is relatively slight and the number of buildings affected is low.
- **Engineering Evaluation** – where buildings are inspected carefully, using all available data to find the damage, its cause, and how to repair it. These inspections are engineering investigations performed by architects and/or engineers retained by the building owner.

Engineering evaluations can take anywhere from one full day to a week or more, depending on the size of the building and the type of damage. This level of evaluation is not performed by the Safety Assessment Program.

When these levels of evaluation were first thought out, the initial idea was that rapid evaluations would be done first to identify the obviously safe and unsafe structures, and then detailed evaluations would be done on the structures where the conditions were not so obvious. After all of that, it was up to the building owner to retain an engineer or architect to perform the engineering evaluation and design the repairs.

However, experience shows that, most likely, only one level of evaluation will be done. As said before, in a smaller disaster event the jurisdiction may decide to only have detailed evaluations done. In larger disasters, such as the 1994 Northridge Earthquake, jurisdictions will probably only have rapid evaluations done. The RESTRICTED USE placard has made its way as a routine part of the rapid evaluation process, so there will be less need to do two levels of evaluations on the same buildings in the future. The important thing for a questionable structure is to have the correct limitations or restrictions placed on its use or occupancy. Once that is done, the building owner can retain the services of an engineer or architect to begin the repair process.

It should be noted that no one should be handing out their business cards while on a SAP activation to seek business opportunities. If someone wants to pursue such after their deployment is over and they have returned home, that is up to them, but it would be a conflict of interest to seek business opportunities while on official business for local government, and would lead to being dismissed as a SAP evaluator.

2.4.1 Rapid Evaluations

Early in the initial response to a disaster, local governments are very interested in getting buildings in their jurisdiction evaluated for safety as quickly as possible. The building official is responsible to implement priorities for safety assessment, which should always start with essential services buildings and shelters as established in the operational plan of the jurisdiction. It is most likely that the early evaluations will all be rapid evaluations. Later on in the response, there will be some phone calls into the building department asking for detailed evaluations (in the way of 'second looks' at their buildings), and there will be elected officials seeking to reset priorities to 'take care of their districts.' It is most likely that the number of detailed assessments will increase as these latter activities take place.

After some initial controversy, local governments weighed in to have a method of estimating building damage placed into the ATC rapid and detailed safety assessment forms. This feature allows local governments to come up with a somewhat rational estimate of the damage costs. Safety assessment evaluators are <u>not</u> to come up with dollar amounts, but they can gather the square footage and degree of damage information that allows local governments to apply a cost per square foot figure to the information and arrive at their own rough dollar estimates.

These estimates are useful to provide to Cal OES for Initial Damage Estimate (IDE) purposes. They may also be helpful when the Preliminary Damage Assessment (PDA needs to be done. This is usually a joint Cal OES/FEMA overview of the costs and damages associated with a disaster, the purpose of which is to make a case for a presidential major disaster declaration for the state and the affected counties. It can be done by Cal OES alone to justify a governor's proclamation of a state of emergency. The IDE figures are useful so Cal OES can plan the PDA with enough people in the right locations to see the major damages quickly.

These estimates are also useful to convey to government officials and the public at large the degree of damage the disaster created. A news report that lists 25,000 buildings damaged may not tell the story in a way that is as universally appreciated as saying that the disaster caused $72 million of damages to building inventories.

However, these estimates are <u>not</u> to be used to define repair schemes, go out to bid for contractors, or inform insurance concerns. They are simply used to convey the degree of damage for official purposes.

An example of how this process may work follows: The SAP evaluator identifies a three-story structure as having a footprint of 2,000 square feet. The building also has damage to the structure of 10% to 30%. The evaluator turns in the assessment form to the SAP Coordinator, who turns it into the jurisdiction. The next day, the jurisdiction's staff checks the type of building, and conclude that the structure's value (from *R. S. Means* or other sources) is $221 per square foot. Entering this information into a spreadsheet with formulas, they end up with a range of cost:

$221/sf x 2,000 sf x 3 stories x 0.10 = $132,600

$221/sf x 2,000 sf x 3 stories x 0.30 = $397,800

The jurisdiction can use the average of these figures to report the damage, or they can choose to go with the high or low ends of the range, at their discretion.

A copy of the rapid evaluation form appears on the next page.

<u>2.4.1.2 Completing the Rapid Evaluation Forms</u>

As with the placards, it is important to be familiar with the evaluation forms. This will greatly assist evaluators when they are activated and respond to a jurisdiction's request for safety assessment assistance.

ATC-20 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID: ____________________ Inspection date and time: ____________ ☐ AM ☐ PM

Affiliation: ____________________ Areas inspected: ☐ Exterior only ☐ Exterior and interior

Building Description

Building name: ____________________

Address: ____________________

____

Building contact/phone: ____________________

Number of stories above ground: ______ below ground: ______

Approx. "Footprint area" (square feet): ____________

Number of residential units: ____________

Number of residential units not habitable: ____________

Type of Construction

☐ Wood frame ☐ Concrete shear wall
☐ Steel frame ☐ Unreinforced masonry
☐ Tilt-up concrete ☐ Reinforced masonry
☐ Concrete frame ☐ Other: ____________

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Government
☐ Other residential ☐ Offices ☐ Historic
☐ Public assembly ☐ Industrial ☐ School
☐ Emergency services ☐ Other: ____________

Evaluation

Investigate the building for the conditions below and check the appropriate column.

Observed Conditions:	Minor/None	Moderate	Severe
Collapse, partial collapse, or building off foundation	☐	☐	☐
Building or story leaning	☐	☐	☐
Racking damage to walls, other structural damage	☐	☐	☐
Chimney, parapet, or other falling hazard	☐	☐	☐
Ground slope movement or cracking	☐	☐	☐
Other (specify) ____________	☐	☐	☐

Estimated Building Damage (excluding contents)

☐ None
☐ 0–1%
☐ 1–10%
☐ 10–30%
☐ 30–60%
☐ 60–100%
☐ 100%

Comments: ____________________

____

Posting

Choose a posting based on the evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Localized *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Post INSPECTED placard at main entrance. Post RESTRICTED USE and UNSAFE placards at all entrances.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ____________________

____

____

Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ____________________

____

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ____________

☐ Other recommendations: ____________________

Comments: ____________________

____

Jurisdictions can develop their own forms, as they do placards. If this is done, they may use the ATC forms as a starting point, then add boxes and lines for the kinds of additional information they are looking for.

Rapid Evaluation Form

The following is a review of the information that should be provided in the Rapid Evaluation.

1. **Inspector ID:** This block is completed using the evaluator's name or SAP ID number. The jurisdiction has the right to obtain the evaluator's name on this form if they have deputized the evaluator. (It's the placard where the SAP ID number should be used, to protect the evaluator from harassment.) Use of one's name does not minimize the evaluator's liability protection.
2. **Affiliation:** This block allows the jurisdiction to keep track of the evaluations done by their own staff and by mutual aid or the State. The evaluator would write in their home jurisdiction if they are from a local government, or would write in Cal OES if they are from the private sector or from the State.
3. **Inspection Date and Time:** This is one of the most important boxes to be filled out on the form. If there is a large aftershock, the jurisdiction can rapidly review the evaluations already done and see which buildings should be re-evaluated.
4. **Areas Inspected:** This lets the jurisdiction to quickly see how thorough the evaluation was. If the evaluation was performed inside as well as outside, obviously the work done was more thorough than if one was only able to look at the outside of the building. Often, the safety of the building overall can be determined from the exterior, and there is no reason to go inside it.
5. **Name:** This is the name of the building, facility, business, or onsite manager, if available. If you cannot find the name of the building, then use the name of the business or the onsite manager. In the case of single-family dwellings, note the name of the owner or tenant. If no information is available as to a name, just leave the line blank.
6. **Address:** Very important, this information should always be provided. If the number is not found on the building, look at adjacent buildings to see if you can find their numbers, and try to ascertain the street address of the building being examined. In residential areas, if the address is not found on the building, look at adjacent homes or on the curb in front of the home.
7. **Building contact/phone:** Getting the phone number of the owner or tenant in the building is very helpful to the jurisdiction so they can easily follow up on repairs to the building. If the person present at the time of evaluation is reluctant to give a number, or if no one is there, simply write "Not Available" in the space provided.
8. **Number of Stories Above and Below Ground:** This helps record the height of the building and helps the jurisdiction devise a cost estimate based on field information.
9. **Approximate "Footprint Area" (in square feet):** This will also help the jurisdiction to arrive at a cost for the damages. The footprint area is the area of the first floor. "Footprint area" is specified to clearly identify what is being supplied, different from gross area or total area.
10. **Number of Residential Units and Number of Units Not Inhabitable:** This allows the jurisdiction to track displaced persons, and to figure out the needs for long-term sheltering or temporary housing.

11. **Type of Construction:** This is supplied to the jurisdiction so they can (1) figure out the cost per square foot to repair, based on standard estimating practices, and (2) for statistical information. In rapid evaluations, this is very general information, and can usually be determined from the exterior of the building.
12. **Primary Occupancy:** This information is also used for cost estimating and statistics. It can also be helpful for an Individual Assistance major disaster declaration from the federal government when supplied to Cal OES.
13. **Observed Conditions:** Under “Minor/None,” “Moderate,” or “Severe,” check off the observed conditions related to each of the issues listed in the form. This quick check will help establish what the safety assessment of the building should be.
14. **Estimated Building Damage:** This is a matter of personal judgment; there is no set formula to calculate this information. This is where one’s years of experience come into play. Fortunately, there is a range of percentages to place it in. This information, plus the footprint area of the building, number of floors, type of construction, and occupancy, allows the jurisdiction to develop a dollar estimate of the damage.

The Posting section is where the final results of the safety assessment is noted. One simply checks the box that represents the placard that was posted. If the building is posted as RESTRICTED USE, note below the check boxes what the damage and restrictions for continued occupancy were. Post the building at each entry point; for residences, post at the front door area, unless the house has an alley access, in which case it would be wise to post there as well.

An example of a completed Rapid Assessment form is found in the Appendix.

2.5 Detailed Evaluation

The next level of evaluation is the Detailed Evaluation. This type of evaluation is a thorough visual examination of the damaged building, usually from the exterior and interior. It is commonly performed on those buildings where the structural safety is not easily ascertained, or where the original Rapid Evaluation posting has stirred controversy. In most cases, a building that has a Detailed Evaluation done on it will be posted RESTRICTED USE or UNSAFE.

Detailed Evaluations are used for matters besides building structure problems. The Geotechnical Evaluation and the wide range of infrastructure evaluations are all Detailed Evaluations. Please see Chapter 4 of this manual for more information.

A copy of the two-paged Detailed Evaluation form is on the next pages.

2.6 Engineering Evaluation

The Engineering Evaluation is the final and most comprehensive of the three evaluation levels. This type of evaluation is <u>not</u> part of the Safety Assessment Program, and is performed by a professional engineer or architect who is retained by the building owner. This evaluation can take anything from one day to several weeks to perform, and will determine both the cause of the damage and an appropriate repair program. This repair program is then submitted to the building department to ensure compliance with the jurisdiction’s repair criteria. Once the jurisdiction approves the proposal for construction, a building permit is issued and the repair work proceeds.

ATC-20 Detailed Evaluation Safety Assessment Form

Inspection

Inspector ID: ____________________

Affiliation: ____________________

Inspection date and time: ____________ ☐ AM ☐ PM

Final Posting
from page 2

☐ Inspected
☐ Restricted Use
☐ Unsafe

Building Description

Building name: ____________________

Address: ____________________

____

Building contact/phone: ____________________

Number of stories above ground: ______ below ground: ____

Approx. "Footprint area" (square feet): ____________

Number of residential units: ____________

Number of residential units not habitable: ____________

Type of Construction

☐ Wood frame
☐ Steel frame
☐ Tilt-up concrete
☐ Concrete frame
☐ Concrete shear wall
☐ Unreinforced masonry
☐ Reinforced masonry
☐ Other: ____________

Primary Occupancy

☐ Dwelling
☐ Other residential
☐ Public assembly
☐ Emergency services
☐ Commercial
☐ Offices
☐ Industrial
☐ Other: ____________
☐ Government
☐ Historic
☐ School

Evaluation

Investigate the building for the conditions below and check the appropriate column. There is room on the second page for a sketch.

	Minor/None	Moderate	Severe	Comments
Overall hazards:				
Collapse or partial collapse	☐	☐	☐	______
Building or story leaning	☐	☐	☐	______
Other ______	☐	☐	☐	______
Structural hazards:				
Foundations	☐	☐	☐	______
Roofs, floors (vertical loads)	☐	☐	☐	______
Columns, pilasters, corbels	☐	☐	☐	______
Diaphragms, horizontal bracing	☐	☐	☐	______
Walls, vertical bracing	☐	☐	☐	______
Precast connections	☐	☐	☐	______
Other ______	☐	☐	☐	______
Nonstructural hazards:				
Parapets, ornamentation	☐	☐	☐	______
Cladding, glazing	☐	☐	☐	______
Ceilings, light fixtures	☐	☐	☐	______
Interior walls, partitions	☐	☐	☐	______
Elevators	☐	☐	☐	______
Stairs, exits	☐	☐	☐	______
Electric, gas	☐	☐	☐	______
Other ______	☐	☐	☐	______
Geotechnical hazards:				
Slope failure, debris	☐	☐	☐	______
Ground movement, fissures	☐	☐	☐	______
Other ______	☐	☐	☐	______

General Comments: ____________________

____

Continue on page 2

ATC-20 Detailed Evaluation Safety Assessment Form — Page 2

Building name: ______________________ Inspector ID: ______________________

Sketch (optional)
Provide a sketch of the building or damaged portions. Indicate damage points.

Estimated Building Damage
If requested by the jurisdiction, estimate building damage (repair cost ÷ replacement cost, excluding contents).

- ☐ None
- ☐ 0–1%
- ☐ 1–10%
- ☐ 10–30%
- ☐ 30–60%
- ☐ 60–100%
- ☐ 100%

Posting
If there is an existing posting from a previous evaluation, check the appropriate box.

Previous posting: ☐ INSPECTED ☐ RESTRICTED USE ☐ UNSAFE Inspector ID: __________ Date: ______

If necessary, revise the posting based on the new evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Local *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Indicate the current posting below and at the top of page one.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

Further Actions Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

☐ Engineering Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: __________

☐ Other recommendations: ______________________

Comments: ______________________

2.7 Evaluation Procedures

2.7.1 Inspection Procedures

The general process for inspecting buildings for safety is described below. Please refer to ATC-20-1 (or ATC-45, in the case of flood and wind damage) for more information. Always have one team member stay at the sidewalk as a safety watch in case something happens to other members of the team; the safety watch can call for help. Credentialed SAP evaluators can trade off this position as work progresses.

Per ATC-20, the one notable exception to the process below is the case of concrete tilt-up construction. Unless an external walk-around reveals obviously that the building is not safe, the safety assessment is not complete until the interior of the building has been accessed and the roof-wall structural connections have been examined. This is due to the older designs having inadequate strength to carry seismic loads properly at that connection; in the past, earthquakes have caused failure of these connections, with roof collapse being the result.

If a safety evaluation of a concrete tilt-up building does not result at once in an obvious UNSAFE finding, but the building is not open for interior review, Cal OES recommends posting the building UNSAFE, and requesting a Detailed Evaluation of the building on the evaluation form.

If one is able to go inside the concrete tilt-up building, examine the roof-wall structural connections as part of the safety assessment and post the building in accord with all findings.

Survey of the building exterior

- **Determine the structural system.** To the extent possible, try to do this from the exterior. This may be fairly simple for shear-wall type structures, but it becomes more difficult with more sophisticated framing systems. Determining the type of framing system at hand may provide a clue as to the types of damage to be expected.
- **Examine the exterior for damage.** Thoroughly examine each wall of the building from the ground to the roof. Look for any damage or hazard that poses a threat to either the building occupants or the general public who might travel past the building. Walk around the building, spending extra time at areas of vertical discontinuity and plan irregularities (see Figures 2-38 through 2-40). These are the locations where damage will most likely be found. Watch also for racking of exterior walls, glass frames, and other similar locations. Racking will indicate that excessive drift has taken place. Make sure to look for potential falling hazards before contemplating entering the building.
- **New damage to foundations.** If portions of the foundation walls are exposed, look for large cracks or evidence of wall movement relative to the foundation, both in-plane and out-of-plane. If the foundation walls are not exposed, look for evidence of foundation damage in the first-story walls. Also look for signs of differential settlement, or other types of ground subsidence.

Examine the site for geotechnical hazards. When performing this part of the evaluation, keep in mind that ground disruption can extend over a wide area and not be obvious or even visible on all affected sites. Consequently, be watchful of conditions at adjacent sites while evaluating a particular building for geotechnical hazards.

- Look around the site for fissures, bulged ground, or vertical ground movement.
- In hillside areas, look for evidence of landslide formation, either at the top or the bottom of the slope. At the top of the slope, look for evidence that a portion of the hillside is separating and sliding. This will usually show itself as surface cracks or a scarp located somewhere on the hillside. Trees or light poles may be leaning over as the slope begins to move. At the bottom of the slope, a rotational slide will cause the slope to bulge. Also be aware of large rocks, boulders, or other debris that the disaster may have loosened. These are significant falling hazards that could render an otherwise undamaged structure UNSAFE.
- If geotechnical hazards are suspected, request a detailed evaluation by qualified persons to make the appropriate determination.

Inspect structural system from inside the building. This should be done in a Rapid Evaluation only if access is available and the building is safe to enter. One should do a quick walk-through to see any significant damage or falling hazards exist inside. It is necessary to enter the building to perform a detailed evaluation, unless the building has been determined by exterior inspection to be unsafe. Before entering the building, make one more check to look for any falling hazards that might block the exits. After determining that the building is reasonably safe to enter, do so cautiously. Be sure to have one of the team remain outside as a safety watch.

- **Do not enter obviously unsafe buildings.** This is basic common sense. There is no need to see the inside of an obviously dangerous building; looking at the interior will not improve the tagging! If the building has not been tagged UNSAFE yet, post it accordingly at this time and complete the evaluation form.
- **Do not perform destructive testing.** Remember that the building belongs to someone else, treat it with respect. SAP evaluators are not authorized to perform destructive testing. If the structural elements are covered, look for evidence of damage by the condition of the covering material. If a reasonable evaluation cannot be made, note on the evaluation form that an Engineering Evaluation should be made.
- **Look in areas where the structural system is exposed.** There are many areas in the average building where the structural system is exposed. Some of the more common places are basements, stairwells, or equipment rooms. The easiest method to see the structure may be to borrow a ladder and look above the suspended ceiling tiles in order to observe the condition of the structural system. Remember to put these back when finished.
- **Identify and examine vertical load system.** Specifically, look for conditions where columns or framing connections have failed, or anything else that leads to the conclusion that the vertical load capacity has been significantly decreased. Also look for evidence that the walls or supporting structural members are pulling away from the framing.
- **Identify and examine lateral load system.** Look to see if the lateral load capacity has been significantly decreased or lost. Also examine to see if the earthquake caused any residual drift, such as racking or P-delta effect. If this is found, evaluate the P-delta effects from the basic gravity loads.
- **Inspect basements.** Look for differential settlement, fractured components, bulges or cracks in the walls that might indicate damage to the foundation system.

- **Examine every floor, including roof and penthouse(s).** Move systematically from the basement to the floor, or roof to basement. Make sure that every floor is adequately investigated before proceeding to the next floor.

Inspect for nonstructural hazards. The safety assessment must not be limited to just the structural elements of the building. This work is not always about structure, but it is about safety! Non-structural elements can also pose a threat to the occupants.

- **Look for damage to nonstructural systems.** Look at ceiling systems, partitions, chimneys, finishes, corridors, and stairways. Damage to these systems can indicate how the structural frame responded to the ground motion.
- **Look for damage to equipment and equipment supports.** In particular, look at large pieces of equipment such as HVAC air handlers, fire suppression and detection systems, ductwork, and water heaters. Be certain to look for damage to ductwork and piping hangers, since unsupported mechanical features can be a significant falling hazard. Also, ascertain the condition of the fire suppression and detection equipment; this may play a large role in determining if the building can be re-occupied. Be aware also of dangers from large unsupported furnishings, such as bookcases.

Inspect for other hazards.

- **Spills or leaks in stored chemicals, or other hazardous or unknown materials.** Be aware that hazardous materials may be encountered in seemingly benign places. Retail stores may have spills of cleaning solutions or pool supplies that result in toxic gases being released. Supermarkets may have been without power for some time before the SAP evaluators arrive, and may have filled with hydrogen sulfide from decaying meat. One might see through the windows of a building that there has been some sort of chemical spill inside. There may even be an illegal lab discovered by the teams, which are especially hazardous! It is not necessary to know the type or chemical nature of the spilled or exposed chemicals. Nor is it the job of the SAP evaluator to get samples or even to be exposed in the least to these substances. Cal OES strongly urges that the SAP evaluators immediately secure themselves from harm, post the building UNSAFE, and alert the local hazardous materials response team at once of the situation. In regards to asbestos, this may be found in older buildings. It is not a given that a building should be posted UNSAFE simply because it might have asbestos in it. However, if there are breaks in pipe insulation, or other evidence that asbestos may be in the air, report it and post the building accordingly.

Complete evaluation forms and post the building. Once the evaluation is completed, fill out the evaluation form after discussion with the rest of the team. The team should come to a consensus on how the building should be posted. If the team finds that the building should be posted RESTRICTED USE, make sure that enough evaluation is done to determine the appropriate restrictions. If there is doubt, err on the side of caution and restrict access to possession retrieval only. Also make sure that the next higher level of evaluation is recommended. Once the posting for the building is agreed upon, finish the evaluation form.

- **Post the structure only if authorized by being deputized.** A SAP evaluator is authorized to post the building with official jurisdiction placards only if they have been deputized by the jurisdiction (see page 11). If not deputized, the SAP evaluator can only recommend a posting and post with generic (unofficial) placards lacking the official seal or authorizing ordinance of the jurisdiction. In such cases, jurisdictions would follow up with their own forces and replace the unofficial placards with official ones.

- **Explain the significance of the placard to the occupants.** This is only necessary if the building is occupied during the investigation. Try not to use technical terminology in the explanation. Also be prepared for the building owner or occupant who tries to convince the SAP evaluators to change the placard to something they like better. This effort may include offered bribes, threats, or use of third parties. If the SAP evaluator team encounters such conditions, they may need to request of the jurisdiction that a uniformed law enforcement officer accompany the team.

While traveling around the building during the investigation, watch for vertical and horizontal irregularities in the building layout. The arrows in Figures 2-38 and 2-39 indicate where damage is most likely to be found.

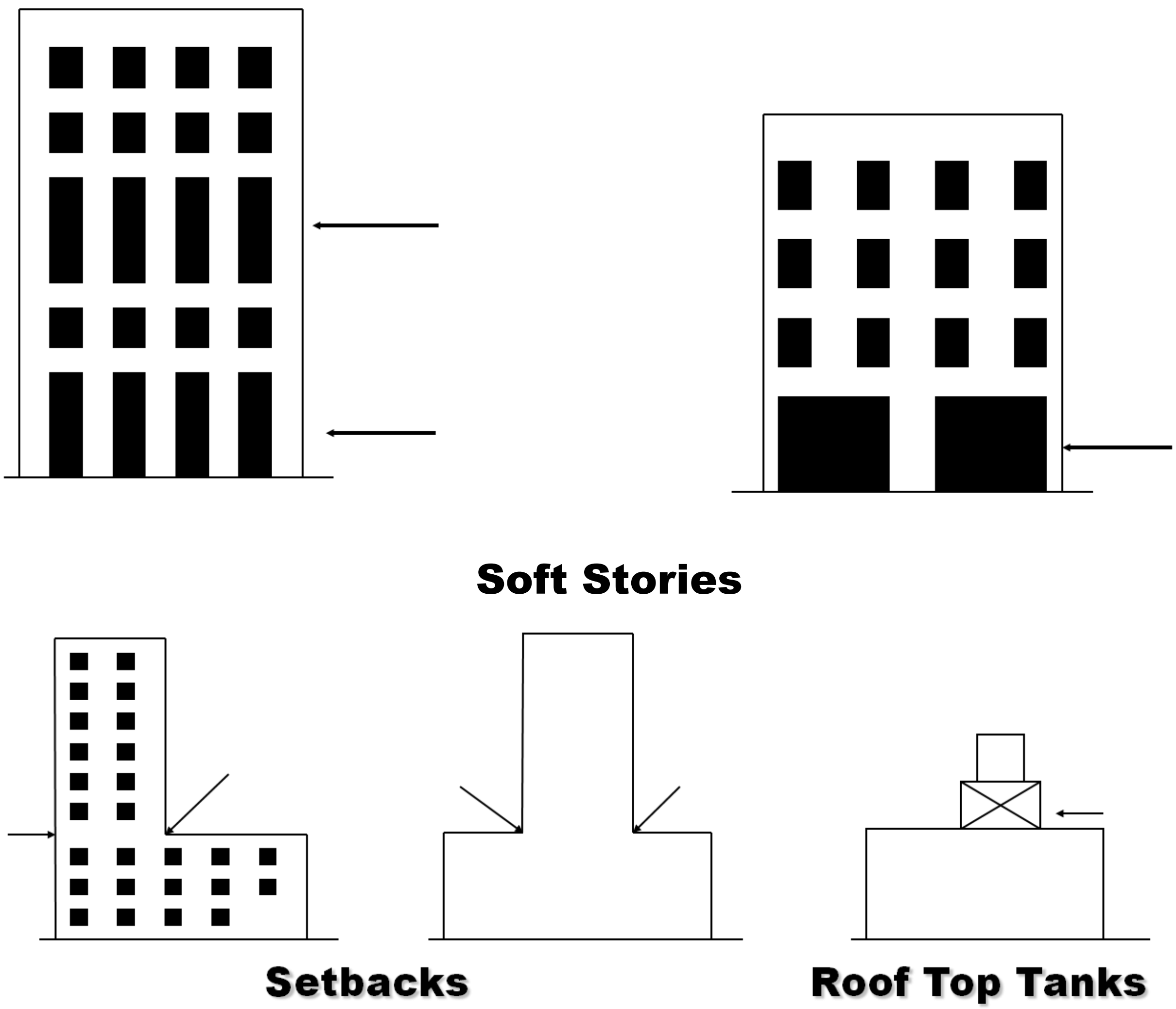


Figure 2-30 – Vertical irregularities

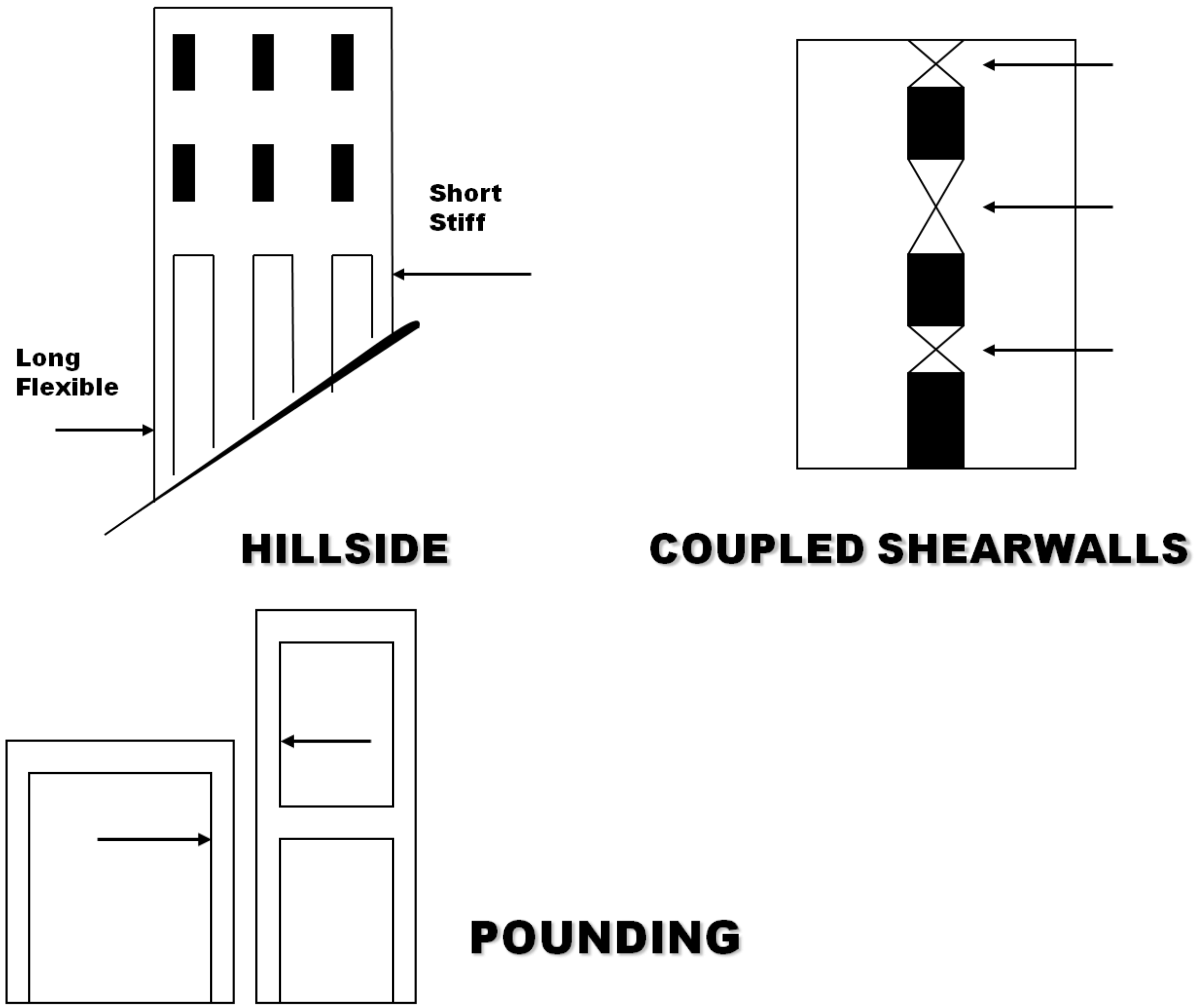


Figure 2-31 – Vertical Irregularities

For the hillside buildings, damage will most likely occur on the uphill side where the columns or panels are much stiffer than the downhill side. Because these elements are stiffer, they will draw more force than the more flexible side. The downhill side should also bear review, as they may receive more damage from excessive deflection.

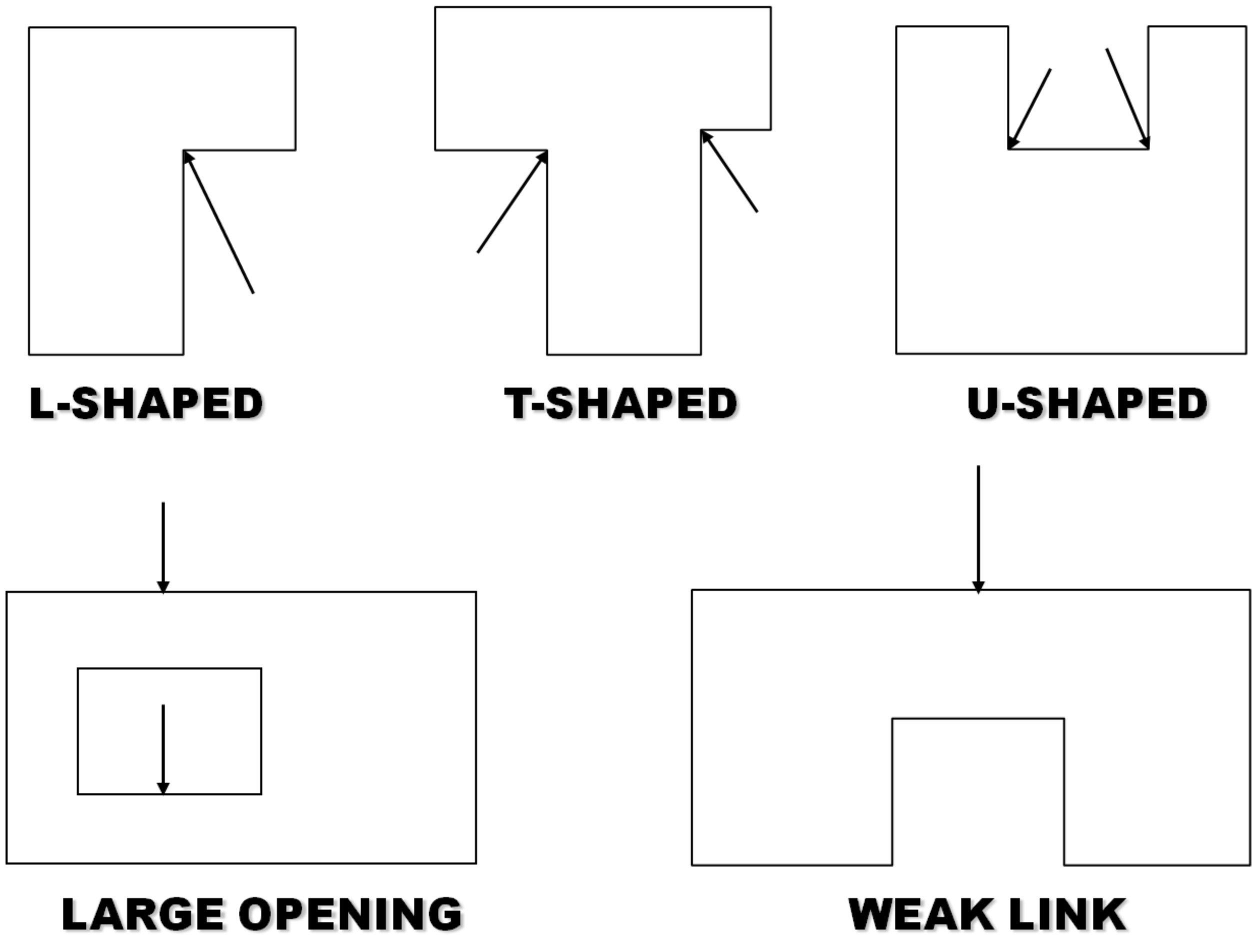


Figure 2-32 – Plan Irregularities

2.7.2 Evaluation Criteria

ATC-20 has recommended criteria to assist evaluators on posting buildings. These conditions listed below are also covered on the evaluation form. The SAP evaluator should look for these conditions during the assessment. However, the evaluator must remember that these are very general criteria and not hard-and-fast rules. One must use experienced judgment when determining how to post a building.

Vertical Load System

- Columns noticeably out of plumb **UNSAFE**
- Buckled or failed columns **UNSAFE**
- Roof or floor framing separation from walls or other vertical supports **UNSAFE**
- Bearing wall, pilaster, or corbel cracking jeopardizing vertical support **UNSAFE**
- Other failure of vertical load carrying elements **UNSAFE**

Lateral Force System

- Broken, leaning, or seriously degraded moment frames **UNSAFE**

- Severely cracked shear walls (greater than 1/8th inch wide) **UNSAFE**
- Broken or buckled frame bracing **UNSAFE**
- Broken or seriously damaged diaphragms or horizontal bracing **UNSAFE**
- Other failure of lateral load carrying element or connection **UNSAFE**

P-Delta Effects

- Multistory frame building with residual drift **UNSAFE**

Degradation of Structural System

- Cracking, spalling, or local crushing of concrete or masonry **UNSAFE**

Falling Hazard

- Falling hazard present, threatening pedestrians or entire building **UNSAFE**

Slope or Foundation Distress

- Base of building pulled apart or differentially settled, fractured foundations, walls, floors, or roof **UNSAFE**
- Building in zone of fault or rupture **UNSAFE**
- Suspected major slope movement **UNSAFE**
- Building in danger from upslope landslide or debris **UNSAFE**

Other Hazards

- Spill of unknown or suspected dangerous material **UNSAFE**
- Other hazard (such as downed power lines) **UNSAFE**

2.7.3 Access to Unsafe Structures

For those buildings determined to be UNSAFE by a rapid evaluation, the detailed evaluation teams will look at the potential access to the building for possession retrieval. The owners and/or occupants of the building will want access to their building to retrieve personal possessions and business records. Please note that the detailed evaluation team would only enter a building tagged UNSAFE only if there was no evidence of unsafe conditions from the exterior. If a collapse hazard is at issue, the team should only enter if the building is made safe through shoring or other means. Please see the information on this in Chapter 6 of this manual.

If the assessment team finds their path through a corridor or other opening blocked by debris, the team should refrain from proceeding beyond that point, and make a note in the evaluation form that the corridor is blocked. Evaluators do not want to end up trapped by debris if an aftershock causes it to settle or sends more debris into the corridor.

As the detailed evaluation team proceeds through the building, they can take note of the following details of the exits, corridors, and stairways:

Exit doors

- **Verify operation of the doors.** Do the doors operate smoothly and easily? Do they open fully, or are there restrictions of any kind?
- **Identify falling hazards.** This includes exterior as well as interior. Are there parapets or ornamentation on the exterior that could block the exit if they fell? Is there masonry or brick veneer around the door opening, what is its condition, and could it block the door if the connections failed? Within the building, has the ceiling fallen or is it threatening to fall? Are there special light fixtures over the door or in the area that could be a hazard, or block the door if they fell? What is their current condition?
- **Verify condition of pathway to and from the exit doors.** Is the area around the exterior of the door clear and free of debris? Is the interior pathway to the remainder of the building free of debris?

Corridors

- **Identify falling hazards.** What is the condition of the ceiling? What is the material? Are there any light fixtures or other ornamentation that could block the exit if they fell? What is the condition of their connections?
- **Verify operation of the doors into other rooms.** Are the doors fully operational? Is the area around both sides of the door clear? Are there potential hazards that could block the door?
- **Note the level of illumination.** Most likely, the electricity will be off in the building. Therefore, one should see if there is natural light to illuminate the corridor, or if artificial light is required.

Stairways

- **Determine if stairs are free of debris or obstacles.**
- **Determine structural condition of the stairs.** This investigation should include treads, stringers, handrails and the connections of the stringers to the landing and the floor. Since no destructive testing can be done by SAP evaluators, this part of the investigation may have to be based largely on opinion and judgment.
- **Determine structural conditions of the stair landings.** Be extremely careful about this, since stairways may respond to earthquakes differently from the building overall, and there might not be a landing where it should be! One evaluator discovered to his shock that what he was about to walk on was only carpet, held by the tack strips at the sides; the landing itself had collapsed beneath him!

The evaluation findings should be noted on the evaluation forms in the Remarks or Comments section, or on a separate piece of paper attached to the form. Be certain that all information conveyed on the forms or in debriefing is factual, as much depends on this information. Since access to UNSAFE buildings must be only with the written permission of the building official, the jurisdiction will have a clear path to the information gathered by the detailed evaluation team on that particular building. When the owner requests permission to retrieve possessions, the building official does not need to conduct a new evaluation in order to respond to the request.

2.8 Use of Drones for Safety Assessment

Drones (unmanned and usually remote controlled flying devices), armed with cameras or LIDAR, are finding increasing use today in construction, surveying, and post-disaster assessment. There are many advantages to using drones. Since drones often have a 3 mile (5 kilometer) range from the operator, a large area can be quickly surveyed for rapid understanding of the extent of damage. Drones can be used to investigate buildings that may be too dangerous for personnel to enter. Drones can also rapidly examine the outside of high rises and other tall structures for extent and nature of damage. Time, efficiency, and greatly reduced exposure of humans to the hazardous post-disaster environment are among the advantages of using drones to support post-disaster operations, including safety assessment.

If a government entity chooses to use drones as part of their post-disaster operations, care must be taken to avoid drone interaction with other types of aircraft. It may be necessary to get clearance from authorities to operate drones for this purpose, and to coordinate drone use with other post-disaster air operations. Privacy laws should also be considered, as well as the safety of personnel on the ground. Operators should be certified to operate drones. It is also best if the model of drone chosen has an "auto-return-home" feature.

Figure 2-33 – Example of a drone with camera

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UNIT 3 NON-EARTHQUAKE HAZARDS

UNIT 3 – NON-EARTHQUAKE HAZARDS

Overview

The Safety Assessment Program can be activated for hazards other than earthquakes. The potential exists for activation following high wind events (hurricane, tornado, and windstorms), flood events, fires, explosions, snow induced structure or roof collapses, and debris flows. In this unit, we will look at these other hazards and how the buildings would be posted.

Goal

Participants will know how to conduct evaluations for other types of hazards. Primarily, this unit will look at using safety assessment principles and personnel to evaluate buildings following high wind events, floods, fires, and explosions.

Objectives

- Respond effectively to non-earthquake types of disasters or emergencies

3.0 Non-Earthquake Hazards

The Safety Assessment Program was originally developed to assist local governments after earthquakes. To this end, the Applied Technology Council developed the process and procedures found in ATC-20 to evaluate the safety of buildings damaged by earthquakes. Since being published in 1989, ATC-20 procedures have been used around the world.

Earthquakes, of course, are not the only events that can damage buildings or require large numbers of evaluators for safety evaluation. The principles of ATC-20 have therefore been expanded to cover other types of hazards. ATC-45 was written to adapt ATC-20 principles to windstorms and floods.

Evaluators must watch for damage from aftershocks in post-earthquake disasters, but with these non-earthquake hazards, once the event is over, there may not be much likelihood of the structure having to survive a similar event before it can be repaired or stabilized.

3.1 Safety Assessment Procedure for Non-Earthquake Hazards

When evaluating structures damaged in non-earthquake events, SAP teams will follow procedures similar to those used to evaluate earthquake damaged structures (as described in Chapter 2 of this manual).

Survey of the building exterior

- Determine the building's structural system
- Examine the exterior for damage
- Look for new damage to foundations

Examine the site for geotechnical hazards

- This step needs to be done if the storm was accompanied by heavy rains and flooding. In these cases, the SAP evaluator would be looking for signs of settlement, slope failure due to oversaturation, or undermining (scouring) of the foundation.

Inspect the structural system from inside the building - enter the building only if needed, and if it has been determined safe to do so.

- Do not enter obviously unsafe buildings
- Do not perform destructive testing
- Look in areas where the structural system is exposed
- Identify and examine vertical loads system
- Identify and examine lateral force resistance system
- Inspect basements. Usually, this only needs to be done if there has been some flooding. The SAP team sees if the basement is flooded, or if the water has receded. If it has receded, then the SAP team examines the basement structure for evidence of failure or other problems.
- Examine every floor, including the roof and penthouse.

- Watch for damage to nonstructural systems. If there has been significant flooding, the ceilings on the lower levels could be saturated and pose a falling hazard.
- Look for damage to equipment and equipment supports

Inspect for other hazards

- Watch for spills or leaks in stored chemicals or other hazardous materials. Once strong winds make their way into a building, they can knock over stored chemicals and materials, leading to much the same situation that lateral shaking from earthquakes can cause.
- Watch for evidence of mold growth

Complete the evaluation forms and post the building

3.2 Windstorms, Hurricanes, and Tornados

Damage from lateral forces due to wind is the most common structure failure mechanism in these types of disasters. Lateral forces from strong winds can be as damaging to a structure as those from earthquake forces. There are recorded examples of hurricane force winds that have destroyed unreinforced masonry buildings, and the violent winds of strong tornados can completely decimate structures.

Hurricanes are a serious threat to coastal communities in the Gulf of Mexico and the East Coast. They combine the damaging effects of both high winds and flooding.

Hurricane force winds (74 miles per hour and above) greatly impact the lateral force resistance system within a building. However, the major damage from a hurricane often comes from the accompanying storm surge or flood. Inland flooding occurs when the hurricane drops excessive rainfall into the watersheds; storm surge occurs due to a combination of wind-driven surface water, and the low pressure drop in the eye of the hurricane. Storm surge is unlikely to affect communities far beyond the coastline.

The storm surge from a hurricane can be devastating. The 2005 Hurricane Katrina was a Category 4 hurricane before it reached landfall as a Category 3. As a result, the wave-driven storm surge was greater than it might have been, reaching over 20 feet high in St. Bernard Parish, Louisiana as the storm passed by on its way to landfall in Hancock County, Mississippi.

Tornados are much smaller than hurricanes, but can be far greater in intensity. Tornados severely damage buildings due to the strong winds (above 200 mph at times) found near their centers. The pressure drop at the center of a tornado is enough to cause damage by itself; buildings containing normal air pressure may find themselves surrounded by the partial vacuum of the tornado’s eye, leading to an explosive disruption of the structure. Tornados can also hurl projectiles and cause significant as well as unusual damage. For example, large pieces of wood can be driven through substantial walls like a missile.

Since tornados are created in large thunderstorm cells, heavy rains may accompany them, but this does not necessarily lead to flooding. The storms can cause some local flooding conditions. Whereas hurricanes cause a great deal of damage with their flooding, tornados cause damage by means of their exceptionally high winds.

Linear wind storms are much more common and troublesome in California than either hurricanes or tornados. Hurricane force winds in excess of 74 mph can be produced by powerful Pacific storms, or by the dry Santa Ana winds common in Southern California at certain times of the year. There are a number of locations in California where building codes require that the structures be designed to withstand winds of 80 mph or above. Even storms of tropical storm strength can wreak havoc, knocking trees down into buildings and downing power poles.

Figure 3-1 shows a reinforced concrete column that suffered some flexure damage due to the high winds of Hurricane Katrina. It is easy to see from this photo that taller buildings without sufficient steel reinforcing could be severely damaged in such storms.

In Figure 3-2, the lower parapet was blown off by hurricane-force winds. The taller parapet with the mall signage was braced from behind with steel bracing; if the lower parapet had been braced as well, it would likely have withstood the damaging winds.

Figure 3-3 shows a wood frame house where the back end and part of the roof was torn off by Hurricane Katrina. The wall of the house is noticeably leaning, indicating that the house is no longer stable.

Photo courtesy Raymond Lui, SEA

Figure 3-1 - Damaged concrete column, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 3-2 – Parapet blown off, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 3-3 – Damaged house, 2005 Hurricane Katrina

Photo courtesy FEMA

Figure 3-4 – Windsor, CO tornado damage, 2008

Photo courtesy FEMA

Figure 3-5 – Damaged neighborhood, Chapman, KS tornado, 2008

Photo courtesy FEMA

Figure 3-6 – Roof torn off elementary school, Chapman, KS tornado, 2008

Figure 3-4 shows a neighborhood damaged by the F3 tornado that struck Windsor, Colorado in 2008. Over 70 mutual aid building inspectors were mobilized in Colorado in response to this disaster to evaluate structures for safety.

Figure 3-5 shows a neighborhood in Chapman, Kansas that was damaged by an F3 tornado in 2008. Note the Urban Search and Rescue (USAR) marking on the wall of one of the damaged homes. This tornado destroyed 65 homes in Chapman and damaged 175 other homes there.

That same tornado caused the damage seen in Figure 3-6. The roof of the Chapman Elementary School was torn off, and the windows were blown out. In the same event, the school administration building, the high school, and the middle school were all destroyed.

As seen in these photos, damage from tornados can be very severe, yet localized to the path of the tornado. Generally, as a tornado moves through a community, the extreme damage will usually be in the middle of the path, with moderate damage on either side, and little to no damage beyond that. Tornados can be cruelly capricious, however, absolutely devastating one block of homes, while leaving the next block with no damage at all.

The safety assessment process may be simplified, as the path of complete devastation could be posted AREA UNSAFE and barricaded off. This may help local governments control entry so only residents with identification can enter <u>under supervision</u> to retrieve possessions.

Photo courtesy Raymond Lui, SEA

Figure 3-7 – Destroyed commercial building, 2005 Hurricane Katrina

Strong winds have been known to damage or destroy unreinforced masonry buildings. Note the building in Figure 3-7; this unreinforced masonry commercial building was practically demolished by Hurricane Katrina. Many of the walls have been debilitated, and the roof is gone. Water from the hurricane reached about seven feet high, and the structure at some point caught fire, burning everything above the water line. It is interesting to note that the door appears to be unscathed through all of this, and likely still works!

3.3 Floods

In floods, it is not uncommon for buildings to be floated off their foundations and swept away. In the most extreme cases, it does not matter if the building is attached firmly to a concrete slab foundation; there are numerous examples from the 2005 Hurricane Katrina event of entire well-built homes being raised out of the ground with their slab foundations by storm surge flooding and pushed some distance from their original location.

Floods can also undermine foundations by scouring the soil out from under them. Additionally, both strong winds and floods can send large objects such as cars, appliances, etc. into buildings and cause additional damage.

There are two types of floods: the slow moving, inundation type of flood, and the fast moving and very dangerous flash flood.

Inundation flooding is the most common type of flood in the United States. From the perspective of managing the safety assessment of submerged or affected buildings, there is plenty of time to mobilize SAP evaluators, as safety assessments cannot be performed until the water recedes. It may be weeks in some cases before buildings become accessible.

Inundation flooding damages building elements and contents from submersing them in water. The water in such floods is not safe due to its carrying hazardous materials, coliform bacteria, and other noxious components picked up as the flood water traveled through the community. The flood may have overrun septic tanks, sewage percolation ponds, and chemical or industrial plants on its way, and so many unhealthy or undesirable materials may be in its waters.

Flooding can cause damage to wood floor diaphragms due to warping as the flooring structure dries out. This may mean replacing of the affected flooring is necessary.

In the case of flash floods, the damage is much more catastrophic due to the great amount of force the wall of water will deliver against structures. Such floods can readily cause scour at the foundations of structures, leaving these unsupported and prone to failure. Collapse, partial collapse, or relocation of the structure are all possible in a flash flood. Such floods can lead to an inundation condition for a time, or the water might quickly drain away, allowing SAP evaluators to examine the remaining buildings for safety.

Flood events will present other dangers or issues to the SAP evaluator that may not be found in other disasters. For example, entering an inundated building where the water line is above the electrical outlets will lead to quick electrocution if the power has not been turned off! This is the main reason why people are not allowed into flooded structures until the power is off. Even if the power is deactivated by the utility, it is best if the power is off also at the individual homes, due to the fact that emergency generators being used by homeowners may be feeding power back into the power grid if the homeowner forgot to shut off his own power.

Another common problem is the issue of wild animals reacting to the floods. Poisonous snakes, rats, and other such creatures will be seeking high ground, and may be very defensive.

SAP evaluators must never be out looking at structures while water is still on the ground. One cannot see the condition of the foundation, for example, if it is obscured from view by the murky flood water. It is also dangerous to maneuver in flood water when the ground conditions are not in sight; one could step into a hole or onto a sharp object hidden in the water. The flood water may also be moving, and one could suddenly get swept away by water that does not appear to be moving quickly at all. Flood water itself is laced with contaminants, and so contact with it must be avoided. Then there are the hazards from animals, such as snakes or other creatures swimming in the water. In summary, SAP evaluators must wait for the water to be gone and the ground to be dry before going out to examine the safety of structures.

A common problem also created by floods is black mold, which can proliferate abundantly in the days and weeks after a flood event. Flood water can leave abundant nutrients in everything it soaks into, including the wallboard, carpets, drapes, and furnishings of an inundated home. The warm, dark, damp conditions inside a flooded building are perfect for mold growth.

Mold spores can be resisted by the human immune system in normally encountered quantities, but the quantities encountered after a flood can be dangerously overwhelming. Moreover, mold does not announce whether it is a dangerous variety or not, so the safe thing to do is to treat all mold as risky. This means that the SAP evaluator should be wearing a properly fitted NIOSH (National Institutes of Occupational Safety and Health) N95 filter mask in mold-laden environments to keep the mold spores out of their lungs. Of course, if one is allergic to mold, there is no need for such a person to enter any mold-laden house at all.

The evaluation procedures for floods are the same as for earthquakes and winds, except that the SAP evaluator does not have to consider much in the way of geotechnical problems beyond scour, settlement, or saturated hillside ground. Also, evaluation of floors above the flood line can be done quickly, since the likelihood of damage at these levels is remote.

Photo courtesy FEMA

Figure 3-8 – Inundation flooding, Louisiana, 2001 Hurricane Allison

Photo courtesy Raymond Lui, SEA

Figure 3-9 – Damaged neighborhood, 2005 Hurricane Katrina

As seen in Figure 3-8, the water line from flooding can be seen on the exterior of a building, which will indicate how much of the interior was inundated. In this case, the water line is at the top of the windows. The walls, floors, and contents will be soaked with flood water, and there will be a great deal of work to be done before the building can be inhabited again. However, if there is no other risk such as a hazardous material spill or structural damage, the building can be posted RESTRICTED USE so content removal and repair can begin. If the ceilings have been soaked, the placard should have a caution that the ceilings were soaked and might fall.

Figure 3-9 shows the widespread damage that often results from flooding. The storm surge from a hurricane scatters buildings and debris in its wake. In this case, homes are left sitting in the road, pushed again trees, and half-buried in debris. This photo was taken after the roads were cleared, except for the occasional house still in the road.

Photo courtesy Raymond Lui, SEA

Figure 3-10 – Mold growth, 2005 Hurricane Katrina

As stated before, mold should be treated as risky or hazardous, and protection must be worn before entering a mold spore laden environment. Figure 3-10 shows a relatively mild case of mold in an inundated home. (It can be worse!) Naturally, if a person is allergic to mold, entering a house like this one is not an option!

Figure 3-11 shows what needs to be done as part of the repairs: the wallboard, insulation, and electrical must be stripped out, and even the studs may have to be treated with bleach or fungicide before rebuilding can start.

Photo courtesy Raymond Lui, SEA

Figure 3-11 – Wood frame structure under cleanup, 2005 Hurricane Katrina

Photo courtesy FEMA

Figure 3-12 – Raised house, Louisiana, 2001 Tropical Storm Alison

The house in Figure 3-12 was built on pillars, which allows for good air flow in normal conditions, and allows flood water to flow under the house in a flood. The water line on this home is a few inches below the first floor level, so the flood water never entered the house or affected the utilities. So, safety evaluation of this structure would include examining the foundation pillars to make sure that they were sound, and that there has been no scouring or settlement at the foundation pillars. Of course, this evaluation would be done only after all the water drained away and the ground was dry. The water line indicates that the first floor framing became wet. If warping is not evident at the time of the safety assessment, the house could be posted INSPECTED. A note could be made about potential warping to be watched for on the placard and the evaluation form.

Photo courtesy FEMA

Figure 3-13 – Flash flood debris, 2001 West Virginia flood

Mud and other debris must be considered in safety assessments due to blocked doorways that deny access to buildings. In Figure 3-13, the mud and debris covers about half the door height. Access is not fully available until the debris is removed. If an evaluation was done before the debris was removed, the most likely posting would be RESTRICTED USE, with no access until the debris was removed.

Flash floods and other swift water situations can cause significant structural damage to buildings. This type of flood is extremely hazardous to structures, especially if they are not anchored to foundations or have unbraced cripple walls. The force of swift water striking an unanchored structure will not only take it off its foundation, but float it away downstream.

Photo courtesy FEMA

Figure 3-14 – Garage shed swept away, 2001 West Virginia Flood

In Figure 3-14, a garage shed was swept away and found left resting on a fence downstream somewhere. This building likely was just sitting on sleepers and was never attached to a foundation, so when the flood came, the shed did not stand a chance. The building is a collapse hazard in its present situation, so it should be posted UNSAFE.

Figuring out the address (for the placard and evaluation form) for a building that drifted away from its proper location is next to impossible. In such cases, the best a SAP evaluator can hope for is to use a global positioning system (GPS) unit to find the latitude and longitude for the building in its present location. If there is a personal item attached to the shed, such as an old license plate, the SAP evaluator can put that information in the Comments section of the evaluation form, and perhaps that will help locate the owner and the shed's original location.

Photo courtesy Raymond Lui SEA

Figure 3-15 – Floated home with post-tensioned concrete slab, 2005 Hurricane Katrina

Swift water, such as that found in hurricane storm surges, can also remove well-built homes with their attached concrete foundations and move them downstream. There were more than a few cases of this observed due to Hurricane Katrina in Louisiana and Mississippi. Figure 3-15 shows a modern, well-built home that was solidly attached to its post-tensioned concrete foundation in St. Bernard Parish, Louisiana. The storm surge in this area was well over 20 feet high. This home was not the only one in this subdivision that was floated out of the ground and driven against other structures in the neighborhood. This house would likely be posted RESTRICTED USE for possession retrieval; it is not a collapse hazard, but cannot be lived in.

Coastal flooding and wave action during storms will also lead to hazardous conditions for buildings on coastal cliffs. Figure 3-16 shows a house in Pacifica, California that is cantilevered over the cliff's edge due to erosion of the cliff from storm-driven wave action. This building must receive an UNSAFE posting, and there is absolutely no need for a SAP evaluator to enter this building!

Photo courtesy FEMA

Figure 3-16 – Unsafe house due to cliff erosion, Pacifica, CA, 1998 El Nino Storms

Photo courtesy Raymond Lui, SEA

Figure 3-17 – Flooded URM building, 2005 Hurricane Katrina

In Figure 3-17, this building has suffered some structural damage due to flood forces, but will also have an extensive cleanup effort required in order to become usable again. Flood water carries bacteria and chemicals obtained in its journeys through the community, so occupancy of this building at present is not safe without proper cleanup and repairs. A RESTRICTED USE placard would be appropriate for this structure.

Photo courtesy Raymond Lui, SEA

Figure 3-18 – Unreinforced masonry building failure due to storm surge, 2005 Hurricane Katrina

Figure 3-18 shows an unreinforced masonry garage in the process of failure. Note the water line just below the top of the windows; the force of the water caused the damage shown.

In Figure 3-19, the house floated in the floodwaters of Hurricane Katrina off its foundation and settled unceremoniously into its present position. Note the stairs in the foundation wall in the foreground; there is no corresponding door on the house in the wall closest to the stairs. This house actually does not belong to the foundation it is resting on, but floated there from another place! The house was not attached to its foundation, which is common in some parts of the country.

Figure 3-20 shows how scouring causes damage. Floodwaters managed to work their way under the sidewalk, which ended up unsupported and thereby failed. If this had been a building, the structure would be seriously compromised.

Figure 3-21 shows a wood frame building that suffered racking damage during Hurricane Katrina.

Photo courtesy Raymond Lui, SEA

Figure 3-19 – Wood frame home floated off its foundation, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 3-20 – Scouring under sidewalk, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 3-21 – Racking damage to wood frame building, 2005 Hurricane Katrina

3.4 Debris Flow Effects

Debris flows are usually the by-product of other natural events, but they can add their own level of destruction to structures and infrastructure.

Mud flows usually occur when the soils of steep slopes are oversaturated by excessive rainfall and, in their saturated state, begin moving downhill. These will often carry rocks, boulders, and trees with them, which act like battering rams on structures down below. In addition, the mud flow itself has a great deal of dynamic impact on the structures affected, being entirely capable of heavily damaging or destroying buildings in their path, or burying them entirely.

Mud flows are also one consequence of wild fires. In rugged terrain, wild fires strip all the vegetation and tree canopies that normally slow the progress of water from rainfall down to creeks and rivers. In addition, burning vegetation leaves a waxy deposit on the soil, creating a hydrophobic condition; the ground becomes covered with a water resistant coating, so rain does not soak into the ground, but instead runs unimpeded with increased velocities and erosion to the valley floor. The net result of all this can be catastrophic for structures below these watersheds.

Landslides are unstable rock and soil features on hillsides that are destabilized into movement, usually by earthquakes. As the mass of rocks and soil begin moving downhill, they may lose much of the friction-generating contact with the hillside, cascading rapidly down the slope as if coasting on a cushion of air. Again, structures can be battered or buried by these events.

Lahars are debris flows caused by the melting snow of erupting volcanos. A lahar can quickly become a river of mud, trees, boulders, and infrastructure debris that destroys and buries everything in its path. In California, Mount Shasta and Mount Lassen are both capable of generating lahars. (Mount Shasta's last major eruption was in 1786. Mount Lassen's last major eruption occurred in 1915.)

Figure 3-22 Debris flow damage to house

Figure 3-23 La Conchita Landslide, 2005

Figure 3-24 Chaiten Volcano lahar, Southern Chile, 2008

3.5 Explosion Effects

Explosions from accidental causes are more common than those caused deliberately by terrorists and other criminals, but the effects to structures are the same. Complete destruction or extreme damage can occur to neighboring structures, while other structures in the vicinity will suffer damage in the form of racking and/or damaged windows and building contents. Damage from projectiles launched by the explosion can be extensive over a wide area. Fiery debris will spread fires that will complicate response activities, and fire damaged buildings may be part of the SAP evaluator's work in an explosion incident.

An explosion sends out an initial blast wave that may appear to be supersonic at first. A partial vacuum immediately follows behind this blast wave that causes a damaging rebound of the affected structure.

The blast wave is often strong enough to cause considerable damage, but the heated air mass trailing behind it is also capable of causing destruction due to its inertial force, high velocity, and high temperature. Depending on the explosion, fires can start in a structure due solely to the temperature factor alone.

The distance from the explosion center (the explosion center is also called "ground zero") is an important factor in the damage level that may be found in an affected structure. The force of the explosion observed at a given site is inversely related to the square of the distance from that site to ground zero. For instance, the force observed at distance *2x* from ground zero is 4 times less than the force observed at distance *x*. For this reason, this relationship is often called the "four-square law."

Most explosions historically have been accidental in nature, either occurring from a domestic gas leak or boiler mishap, or in industrial settings in the routine storage and handling of dangerous chemicals. A few explosions have been caused by terrorists and other criminals bent on political or financial gain. Regardless of how explosions may occur, the effects to structures are similar.

Large explosions in urban settings can cause lateral forces to rack nearby buildings, and depending on the degree of force, even at some distance from the center of the explosion (also termed the 'ground zero'). Structures that are not completely destroyed at the ground zero may become very unstable, being unsafe for anyone to approach and subject to imminent collapse. Projectiles can cause damage to other structures and set fires at great distances from the initial blast site. In addition, powerful explosions can generate seismic shock waves; if set off in a body of water, surface waves resembling tsunamis can spread damage to places far removed from the blast site. It is quite likely that there will be much to do for SAP evaluators after an explosion disaster.

Figure 3-25 shows a granary built of reinforced concrete that was blown apart in a dust explosion. Flammable dusts present an explosion hazard when in the right fuel-to-air ratio and in the presence of a spark or flame. Flammable dusts can include flour, paper or wood dust, or even the dusts of certain metals.

Figure 3-25 – Explosion – damaged granary

Granary explosions are historically rather common, and are the chief reason why granaries are built of concrete or masonry instead of wood.

Photo courtesy Texas City Fireman's Union

Figure 3-26 – Explosion and Fire, 1947 Texas City, TX

In 1947, a former Liberty ship was carrying 2,300 tons of ammonium nitrate, which was packed in paper bags and mixed with wax and other materials to help prevent hardening. Another ship in the harbor also carried ammonium nitrate. The first ship caught on fire, and firefighters were unable to put the blaze out. The first ship exploded with such force that two aircraft flying overhead were destroyed, and a steel frame factory building three miles away suffered heavy damage. A surface wave was created by the explosion in the harbor that resembled a tsunami and caused extensive damage there. The explosion also set the other ship in the harbor on fire, and it, too, eventually exploded. The incident killed 600 people, which included the entire Texas City volunteer fire department. One hundred of the casualties were never found. Fiery debris rained down onto the town of Texas City and set off fires. This incident was one of the largest explosion disasters in U. S. history.

Figure 3-28 shows the damage to the Murrah Federal Building in Oklahoma City after a 1.5 ton bomb was set off by terrorists. The building itself suffered extensive damage, and due to loss of lateral load capacity became extremely hazardous to survivors and rescuers alike. At one point, the wind speed increased to the extent that rescuers had to evacuate the building until the winds reduced, due to the building remnants being so fragile. Neighboring buildings suffered racking damage, and one had its concrete roof deck disconnected from the rest of the structure, where it threatened to fail and to pancake the rest of the floors in the building. The destroyed cars in the foreground have been marked with orange paint for tracking purposes.

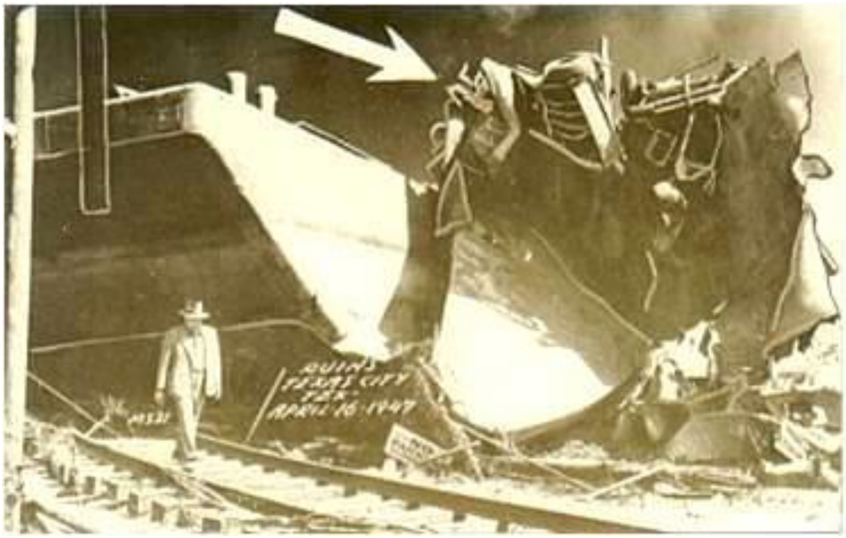

Photo courtesy Texas City Fireman's Union

Figure 3-27 – Barge cast ashore with fire engine debris, 1947 Texas City explosion

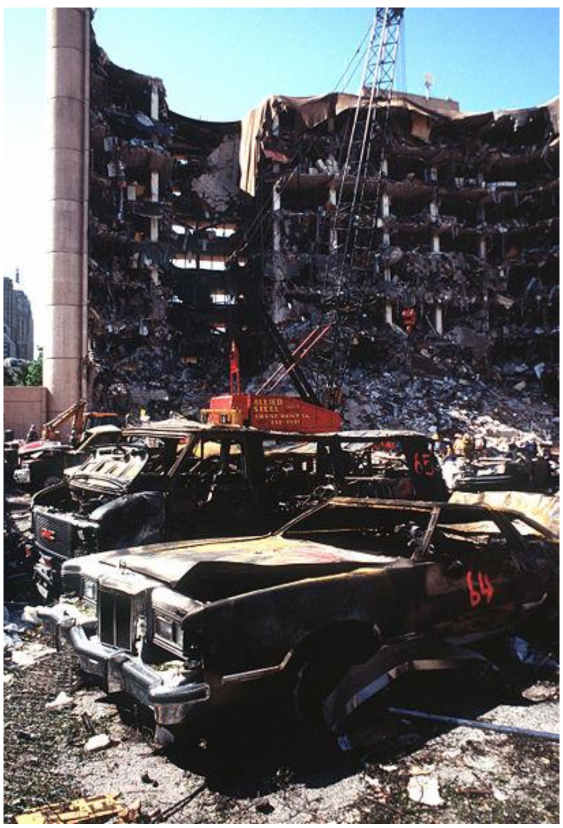

Photo courtesy FEMA

Figure 3-28 – Terrorist bombing, 1995 Oklahoma City, OK

Photo courtesy FEMA

Figure 3-29 – Explosion, 2002 Puerto Rico

Figure 3-29 shows the damage from an explosion at the Humberto Vidal building in Puerto Rico. The explosion caused the collapse of one of the building's lower stories. Natural gas may have been involved in the blast

Figure 3-30 - Damage from West, TX fertilizer plant explosion, 2013

3.6 Fires

Most fire disasters will probably not call for the statewide resources of the Safety Assessment Program, but local building inspectors trained in SAP can use the principles of ATC-20 to evaluate buildings or their remnants for safety.

The 1991 Oakland Hills Fire resulted in the destruction of about 3,000 homes inside the jurisdictions of the cities of Oakland and Berkeley. In this case, structural engineers from the San Francisco Bay Area were used to evaluate the potential re-use of the concrete foundations, so as to speed the reconstruction of the homes.

The reason why statewide SAP resources are not requested for even the vast urban-wild land interface fires in California appears to be the diffused nature of these fires. Even though the firestorms of 2003, 2007, and 2008 covered multiple counties and hundreds or thousands of destroyed homes, there were apparently enough trained building inspectors in each of the affected jurisdictions to go out and evaluate whatever was left by the fires.

When a burned building is evaluated for safety, it is usually not done to evaluate the building's suitableness for re-occupancy, but more likely to see if it is a hazard to people and property if it is left standing while awaiting repair or demolition. Many times, the debris-strewn lot is all that is left to post, and if so, is usually posted UNSAFE so as to keep people from wandering into a dangerous situation from toxics or sharp metals at the burn site.

Photo courtesy FEMA

Figure 3-31 – Burned property, San Bernardino, 2003 Southern California Firestorms

Entire neighborhoods can be burned to the ground. The extreme heat generated by such fires can cause serious damage to concrete or masonry foundation elements; trapped moisture in the cementitous materials can explode, leading to spalling or cracking. However, if firemen were on scene at the time, the heat of the fire may have been reduced enough for the foundation elements to remain usable.

If SAP teams were used to evaluate re-use of concrete foundations, the homeowner would still be well served to hire their own engineer to evaluate the foundations for re-use. The findings of the SAP evaluators should be used as an indicator of the foundation damage, not as the final say for reconstruction.

In wildland fire burn areas, there may be hazards not usually found in other types of disasters. Evaluators should be actively aware of the risks they face when entering this unique type of disaster:

- Poorly secured or fire damaged well and septic tank covers. The plastic covers especially often melt, leaving an opening through which one can fall and suffer injury.
- Carbon monoxide poisoning. Most likely to suffer this when working near smoldering fire or when near operating heavy equipment. Early symptoms include possible headache, nausea, increasing fatigue, poor judgment, and lack of awareness. Get the victim to a clean air area if these symptoms become apparent, and contact medical personnel at once.

- Smoke inhalation is a definite risk to one's health, as it can damage one's lungs and lead to a variety of dangerous medical conditions. Carbon monoxide is also likely to be ambient. Use at least an N95 filter mask if smoke is present to filter out particulates.
- Stumps and tree roots can burn out, causing holes in the earth that are filled with hot embers. Stepping into one of these can lead to serious burns and other injuries.
- Weakened trees can suddenly fall over, and broken heavy limbs caught in trees can break loose and fall to the ground in the wind (the latter have been nicknamed "widow makers").
- Be careful to avoid wet ashes or loose rock, as these are slipping hazards.
- Ashes, especially from house sites, are likely to contain many hazardous materials. Avoid walking through these or disturbing the ashes by keeping at least 10 feet (standoff distance) from them. If asbestos fibers are present, keep in mind that an N95 filter mask will not filter out asbestos fibers. A partial face mask with asbestos rated filter canisters must be used.
- There may be various creatures that survived the blaze and that pose their own risks. Among these could be bees and wasps, and snakes. Be aware of the potential hazards.

Photo courtesy Cal OES

Figure 3-32 – Red-tagged house, 2010 San Bruno Explosion/Fire

Figure 3-33 - Santa Rosa, 2017 Tubbs Fire

3.7 Heavy Snow

New buildings built in areas that routinely experience snow have proper designs to allow for the weight of normal snowfall and to allow snow to shed off the roofs. Such designs include the proper amount of insulation above the ceiling so the attic space does not get warm, and proper venting of the attic to assure that the attic temperature is rather close to the ambient air temperature outside.

However, older buildings may lack these precautions. If the attic is allowed to warm up and is not ventilated properly, the snow on the roof will begin to melt. Water will flow down the heated roof area until it reaches the eaves, which are unheated. The water turns to ice. More melting snow leads to more ice buildup, until an ice dam forms, which prevents snow from shedding off the roof. More snow builds up over time, which can eventually exceed the design load of the roof, and the roof fails. Another more common problem is that water builds up at the ice dam over the heated area of the roof and starts to penetrate into the building, leading to wood rot and other issues.

Heavy, wet snow is dangerous even for modern, well-built structures. Snow density in excess of 20 lbs/cf can occur in warmer storms, and the structural load capacity of roof structures can be exceeded. In addition, snow shedding off of roofs can damage or destroy features below, such as gas meters.

Photo courtesy FEMA

Figure 3-34 - Roof collapse due to snow

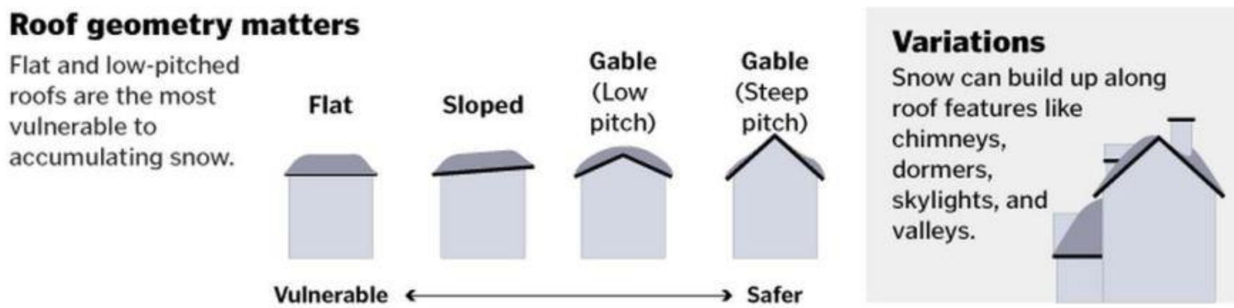

Figure 3-35 – Roof geometry and snow load patterns

Figure 3-36 - Snow-caused roof and structure collapse in Massachusetts.

UNIT 4 BUILDING EVALUATION

UNIT 4 – BUILDING EVALUATION

Overview

In this unit, we will expand on the process and procedures from the previous unit by reviewing various types of structures, including manufactured housing and historic building. We will also review the importance of reducing shelter demand by clearing safe homes for use.

Training Goal

Participants will become familiar with and understand the evaluation of different types of structures and the impacts of disasters on the community.

Objectives

Upon completion of this unit, participants will be able to:

- Understand the need for reducing shelter demand
- Know how to evaluate and post mobile homes
- Know how to identify historic structures, and issues regarding stabilization
- Understand the post-disaster issues of adobe structures

4.0 Evaluating Buildings

4.1 Occupancy of Residential Structures to Reduce Shelter Demand

Residential structures play a major role in the overall recovery from a disaster, therefore their evaluation is of great importance. A major question in allowing habitation of a house or apartment is 'what makes a residence inhabitable?'

Major studies have been done to anticipate the short term and long term sheltering needs following a major earthquake in the San Francisco Bay Area. (As a reminder, the M6.9 Loma Prieta Earthquake affected the Bay Area, but was not technically a Bay Area earthquake in origin, having its epicenter in the Santa Cruz Mountains about 60 miles from downtown San Francisco. A similar magnitude event on one of the Bay Area faults would have far more damaging consequences to the heavily populated San Francisco Bay Area.) The results reveal that as many as 154,000 persons could become homeless as a result of a major earthquake on the Hayward or San Andreas Faults. Questions on how these will be sheltered for the short term, or provided long term shelter while rebuilding is going on, remain difficult questions.

For comparison, the M6.8 Northridge Earthquake damaged residences to the extent that more than 114,000 households required some sort of temporary housing assistance as a result. This included both short term and long term assistance, in some cases rental assistance for two to three years while the individual's residence was being repaired.

Safety assessment can help to reduce the need for short term sheltering. This section will look at some of the significant problems related to:

- Evaluating residential structures
- Short term sheltering
- Continued occupancy within apartment buildings

4.1.1 Requirements for Occupancy

The important question relating to the use of residential structures, both single family dwellings and apartments, is "How much damage prevents the home from being occupied after a disaster?" The California Health and Safety Code has minimum requirements that include enclosure from the elements, running potable water, and working sanitary sewer connections.

The threat from whatever damage the disaster has done to the structure can be added to this in a practical sense. It is useful to consider what happened in the 1994 Northridge Earthquake:

- About 114,000 structures received safety assessments
- About 98,000 of these, or 86 percent of the total, were residential structures
- About 81,000 of the residential structures, or 83 percent of the 98,000 residential structures, were deemed to be safe enough to occupy.
- The remaining 17,000 residential structures sustained sufficient damage to be posted UNSAFE, or to have some form of restriction on their use with a RESTRICTED USE placard.

It was stated earlier that 114,000 households needed some form of housing assistance. These were households, not structures. For instance, there are multiple households within an apartment building, but only one residential structure. (The fact that the number of safety assessments and the number of households needing housing assistance are the same is only a coincidence.)

There are structures that are tagged RESTRICTED USE that reasonably might be occupied, while respecting the restrictions. Some residences suffer cripple wall collapse, and normally they would not be habitable due to the loss of water and sewer connections; but a community could allow occupancy under RESTRICTED USE if potable water and portable toilet stations were provided by the community for those so affected. Other communities will not permit any occupancy of homes damaged in this manner, regardless of the resource made available. This is a local government decision, and whatever decision is made by the local Building Official or others, it must be respected.

4.2 Mobile Homes and Manufactured Homes

The installation and alteration of mobile homes or manufactured homes is regulated in California by the Department of Housing and Community Development (HCD). Mobile homes can be hazardous after a disaster because of damaged utilities, foundational support systems, or accessories such as awnings, carports, porches, and room additions.

After the 1994 Northridge Earthquake, HCD and the California Building Officials (CALBO) began discussions on how to supplement HCD inspectors in order to ensure that mobile homes were evaluated properly. An agreement came out of these discussions that grants the local building officials with the authority to evaluate the safety of mobile homes following an earthquake or other disaster. The agreement stipulated that Cal OES include a section on mobile homes in this training program.

A mobile or manufactured home may be looked at more quickly than other types of structures; this is the main difference in evaluating them, as opposed to other residences. The evaluation criteria are otherwise very similar to that for other single family residences.

Damage to mobile homes or manufactured homes falls generally into these basic types:

- The mobile home is partially or completely fallen off its foundation elements, whether these be piers, blocks, or jack stands
- Piers are penetrating the interior floor decking
- Mobile home is partially or completely burned
- Utilities are damaged and/or turned off
- Water heater movement has affected the water heater vent and/or gas supply
- The mobile home accessories (decks, awnings, carports, garages, etc.) are destroyed or hazardous

After the Landers-Big Bear Earthquakes of 1992, requirements for mobile home foundation construction were improved such that new construction must create a positive foundation connection to the ground. This should work to reduce, if not eliminate, much of the damage from earthquakes for new construction. However, many units remain grandfathered in their prior conditions and remain at risk.

Lateral motion induced failure of mobile home foundations can be easily mitigated by the installation of seismic bracing under the mobile home, thereby restricting the free movement of the unit on its jack stands. Such bracing stabilizes the unit and provides transmission of the lateral force load path into the ground.

There are many ways in which mobile homes can be braced; the more common systems are steel members installed diagonally in two directions under the unit. Another method is to provide a fixed foundation, and anchor the unit to the foundation.

Following the 1994 Northridge Earthquake, Cal OES instituted a program with FEMA support to install seismic bracing under all mobile homes that were damaged by the earthquake.

Seismic bracing significantly reduces the risk of damage to mobile homes caused by earthquakes; however, thousands of units remain throughout California that do not have seismic bracing.

The process and procedure for evaluating mobile homes is the same as for any other structure. However, it is important to keep in mind that mobile home parks may present some unique hazards due to post-disaster damage. Many mobile home parks are like small cities, with master electrical, gas, water, and sewer systems. Therefore, SAP evaluators are encouraged to watch for the hazards that these systems may pose if compromised.

For example, energized overhead electrical systems may fall on metal roofed mobile homes, energizing the entire exterior. Gas line breaks both underground and under mobile homes can pose both an access and a safety problem. Large waterline breaks within mobile home parks can undermine roads and homes, and deactivate fire hydrants, creating an additional fire risk. Care must be taken by SAP evaluators to watch for hazards and avoid dangerous situations.

4.2.1 Evaluation Procedures

When evaluating mobile homes, concentrate efforts in the following areas:

- Stability of the jack stands or other foundation elements
- Safety of the unit's accessories, such as awnings, carports, etc.
- Condition of the utilities
- Home ingress and egress
- Geotechnical issues (liquefaction, lateral spreading, etc.)

Since mobile homes are relatively light and strong, there is usually no problem with the structural system. The mobile home tends to respond as a single unit. However, in an earthquake it is not uncommon for fallen units to sustain chassis damage, and for doublewides to have movement at their centerline connection and even partial separation.

Without any lateral force restraint such as seismic bracing, the movement will cause the foundational jack stands or supports to tip over or collapse. This could be all of the jack stands, causing the mobile home to fall to the ground, or just some of the jack stands, which may leave the mobile home in a partially fallen (and unstable) position.

Photo courtesy Fred Turner, EERI

Figure 4-1 – Jack stand

Some common questions for consideration when evaluating the safety of mobile homes includes:

- Is the home stable on its support system? If fallen, is there a potential of it falling further?
- Are accessories such as awnings, decks, and room additions stabilized to prevent further falling or significant movement from aftershocks or strong winds?
- Are ingress and egress dangerous or markedly impaired due to debris or racking?
- Have one or more of the foundation elements penetrated the floor of the unit?
- Is there a potential for fire resulting from broken gas lines?
- Is there a significant health contamination from displaced sewer connections?
- Is there any electrical energizing of metal coverings or other metal parts due to damaged or fallen electrical utilities or connections?

Since mobile homes are usually several feet above the ground, the utilities are often damaged when the units fall in an earthquake. The water and sewer pipes, and possibly the gas lines, will probably be severely damaged or destroyed when this happens. Watch carefully for the water heaters and gas ranges or stoves when looking at the unit.

Geotechnical issues are also a concern. Differential settlement from liquefaction or unconsolidated fill can seriously affect the level of mobile homes, and as a result, their safety. A mobile home that is seriously out of level could have grounds for a RESTRICTED USE placard.

4.2.2 Posting Mobile Homes

The following examples illustrate some damaged mobile homes and covers how they were posted and/or the relevant issues pertaining to them. These examples should help give some insight as to evaluating mobile homes using the Rapid Evaluation procedures.

As with any structure, the evaluation team must completely fill out the placard and post the mobile home at all access points. The evaluation form should be completely filled out. If the condition is RESTRICTED USE, make sure that the restrictions noted on the placard are also written on the evaluation form.

Figure 4-2 shows a mobile home that has shifted on its supports. The home has been tagged INSPECTED. Although it has moved, the evaluation must have confirmed that the utilities are still operational, and the supports are still upright. There are no falling hazards from the porch awning, and the access is not impaired.

Figure 4-3 shows a mobile home that has moved off its jack stands and is resting on the ground. Looking at the buckled skirt, the level of the door with respect to the landing, and the separation between the landing and the unit, one has an idea of how far the unit moved. The unit will not fall further and is therefore stable.

The unit likely has damaged utilities, and the awning is now a falling hazard. Once the utilities are turned off, the unit could be accessed for possession retrieval. This unit could be posted RESTRICTED USE.

Photo courtesy Global Emergency Management

Figure 4-2 – Mobile home shifted on supports, 1992 Landers/Big Bear Earthquakes

Photo courtesy Global Emergency Management

Figure 4-3 – Mobile home partially fallen, 1992 Landers/Big Bear Earthquakes

Photo courtesy Global Emergency Management

Figure 4-4 – Mobile home burned up, 1992 Landers/Big Bear Earthquakes

The mobile home in Figure 4-4 has been obviously destroyed by fire and has been posed UNSAFE. This is an example of what can happen when a unit falls off its supports and breaches the gas line. With the fire out, and the gas and electricity turned off, this unit is no longer a threat to adjacent units. Entry, of course, is dangerous.

Photo courtesy Global Emergency Management

Figure 4-5 – Mobile home collapsed on supports, 1992 Landers/Big Bear Earthquakes

In Figure 4-5, the unit is off of its supports and is stable on the ground, unable to fall any further. However, the canopy over the side stairs is unstable and a falling hazard. This represents a safety threat from an aftershock or strong wind.

Access to this mobile home would need to be from the other door, and the occupants could go in to get their things. However, the utilities are likely destroyed, so the home cannot be occupied. The RESTRICTED USE placard is appropriate. (If neither door was safe to use, the unit would be tagged UNSAFE until the hazards were abated by removal or by bracing.)

A few mobile homes within mobile home parks, and many on private property, have been placed on approved permanent foundations. In those cases, damage and/or movement is likely to be minimal.

Again, most mobile homes are easy to evaluate for safety because much of the structure that is likely to be damaged is easy to view. Seismic bracing of the support system was discussed earlier, but there are other bracing systems. The most common alternate bracing system is the *Engineered Tie-Down System.* This system has been *mandated* for all new mobile home installations since September 1994. They come in many forms, most of which are large, extra heavy duty steel jack stands with ground anchor rods attached and driven at the four corners of the jack stands. Thousands of these have been installed, and while they are not seismically rated, they undoubtedly will contribute to mobile home stability. State inspectors and SAP evaluators will encounter them often.

Photo courtesy Global Emergency Management

Figure 4-6 – Mobile home rendered unstable, 1992 Landers/Big Bear Earthquakes

This mobile home (Fig. 4-6) is dangerous in a deceptive manner. It appears at first glance to be in fine form, but close examination shows that the steel frame of the unit is resting on the nonstructural, unreinforced, one-brick-thick masonry skirting, which could give way at any time. Further, the marriage line on this double-wide unit is pulling apart at the bottom. This unit is a dangerous collapse hazard, and no one should enter it until it has been made safe. The UNSAFE placard is the right call in this case. Note that barricade tape has been run across the entryway to emphasize the denial of access.

Figure 4-7 shows a large tree that snapped off in the winds of Hurricane Katrina and sliced through an older mobile home. This is a fairly common occurrence in windstorms, and affects buildings of all kinds. This particular mobile home could be posted RESTRICTED USE and the occupants allowed to perform possession retrieval. While a structure open to the elements is generally not useable for occupancy, some jurisdictions might allow occupancy if the opening is waterproofed with a tarp or other covering. The RESTRICTED USE placard would be written up to convey this per the local jurisdiction’s guidance.

Figure 4-8 shows a heavily damaged mobile home that would be posted RESTRICTED USE for possession retrieval only. Again, the home is now open to the elements and not a suitable shelter, and with this level of damage, may have other issues as well.

Photo courtesy Raymond Lui, SEA

Figure 4-7 – Tree in mobile home, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 4-8 – Damaged mobile home, 2005 Hurricane Katrina

Remember that we address the existing damage in relation to continued occupancy, not just in mobile homes but in any other structure as well. For example, if a mobile home does not have seismic bracing, but has not been damaged, it is placarded with an INSPECTED posting; the lack of seismic bracing does not enter into the decision. There has been no change in the safety of the unit *as a result of the event.*

Because the California Department of Housing and Community Development (HCD) has primary jurisdiction over mobile homes, manufactured homes, and home communities, it is highly recommended that technical questions and inspection information regarding these be channeled to HCD from any local agency doing mobile home or manufactured home inspections, so as to avoid duplication of effort and inefficiency. HCD field inspection offices are located in Sacramento [(916) 255-2501] and Riverside [(951) 782-4420].

4.3 Historic Structures

Historic structures present unique problems for the safety assessment process. After some disaster events, some jurisdictions have been accused of using the crisis as an opportunity to eliminate some of their historic building stock. This was allegedly done by posting these buildings UNSAFE and then ordering their demolition. Without weighing in on what may have happened in the past, it is important to examine some of the issues surrounding historic structures.

Cal OES was asked by the historic preservation community to develop evaluation procedures for historic structures that would take into account their particular issues, including the demolition concern. Cal OES resisted that effort because the issues that preclude post-disaster use of a structure are not dependent on the age of the structure. Rather, it is the damage from the event which creates a hazard to the occupants that determines the continued occupancy. Therefore, a different or special set of evaluation procedures are not necessary.

However, these buildings are relatively fragile, and being aware of that will help the SAP evaluator to assess the safety of these buildings properly. The older ones were often built using the varied experiences and training of craftsman rather than any uniform building code, plus have most likely grown more fragile over time. As a result, disasters tend to find and damage them!

There are several factors that set aside a building as historic. It is not unusual to have a building that may be old, but has no historic features at all.

Federal regulations state that any structure that was built 45 years ago or more is potentially historic. (For this edition of the SAP Evaluator manual, that means any structure built before 1974 could be historic.) Historic structures are protected under the National Historic Preservation Act (NHPA); from the standpoint of federal disaster assistance, any structure that is at least 45 years old must be subject to a review under NHPA to determine its historic value, and then the impacts of the repairs.

The first step in the process is to have the State Historic Preservation Officer (SHPO) determine if the structure is on a local or state historic registry, or the National Register of Historic Places. If not, SHPO must determine if the structure is *eligible* for inclusion in the National Register. If all or part of the building is considered to be eligible for the National Register, then the repair work must comply with the Secretary of the Interior's standards for historic structures, as well as the State Historic Building Code. If the structure is not eligible for the National Register, then the repairs fall under the requirements of local building codes, even though the structure is older than 45 years.

There are four main issues that determine eligibility for the National Register. They are:

- A place where a historic event occured, or that is associated with a historic person.
- An example of the work of a master, such as Frank Lloyd Wright (Marin Civic Center) or Julia Morgan (Hearst Castle).
- An example of a period architecture, such as Craftsman, Victorian, or Art Deco.
- A location with cultural or architectural significance.

The revisions to the original ATC-20 UNSAFE placard have reduced the fears of the preservation community that older buildings will face wholesale demolition after a large earthquake. Having the phrase "THIS IS NOT A DEMOLITION ORDER" on the placard clarifies that the posting refers to the use of the building, not its future. All the basic principles of ATC-20 apply to historic structures as much as they do to newer construction.

As discussed earlier, SAP evaluators must be careful that the vulnerability of the inherent pre-disaster condition of the building is not the major concern when posting the building for safety. If the building was undamaged by the disaster, it is as usable after the disaster as it was before. Evaluators do not post an older building with restrictions or as "unsafe" simply because it is old.

4.3.1 Stabilization

Though stabilization is not a part of safety assessment, the time may come when an evaluator is asked for an opinion regarding a building that has been deemed an imminent hazard. Whenever possible, buildings that pose an imminent threat to life safety or to the public right-of-way should be stabilized until the major hazards can be properly addressed. There will be those cases where the only way to address the hazard is to demolish the dangerous structure.

There are many ways in which buildings can be stabilized to reduce the imminent hazard. These methods may be very complex and involve a great deal of labor and material to accomplish, or they can be very simple and intended to arrest the failure of the structure. In any case, *shoring must be designed by an engineer for each individual structure in order to be competent.*

There are several publications that address the details of stabilization and that include design examples. One such publication is *Temporary Shoring & Stabilization of Earthquake Damaged Historic Buildings* by Roy W. Harthorn, published by the California Building Officials. This document was developed with a grant from the U.S. Department of the Interior, administered by the State of California Office of Historic Preservation.

The temporary stabilizing of buildings is not limited to those that pose an imminent hazard to life safety or the public right-of-way. In some cases, portions of buildings can be stabilized to reduce a threat that would allow a sidewalk or alley to reopen, or even to allow owners or tenants to enter the building for possession retrieval. The methods described in this section are usually measures that will allow access to a building or an area by managing a specific hazard, and are not necessarily long-term stabilization measures.

Photo courtesy Global Emergency Management

Figure 4-9 – Santa Cruz Commercial District, 1989 Loma Prieta Earthquake

In Figure 4-9, the parapets have fallen from the older, historic district buildings. This is a common hazard in such areas. Unreinforced masonry parapets that have not been anchored or braced are a major falling hazard. In this case, the parapet has mostly fallen into the street, but loose bricks still remain, constituting a hazard to the public right-of-way. Stabilization in this case may be as simple as removing the loose bricks and providing a temporary tieback system to contain the remaining bricks above the opening. The tieback system could consist of sheets of plywood on the exterior, with cables anchored to the roof framing, and pulled tight with "come-alongs." This temporary measure would allow the sidewalk to reopen, and potentially allow the store owner back into the building to retrieve possessions. This also has the ability of protecting the wall from aftershocks. Consequently, it could help minimize the cost to complete repairs.

Another workable measure would be to build a canopy across the sidewalk, similar to a construction canopy that would protect pedestrians from falling debris as they walk past the building. This approach would protect pedestrians, but would not do much to protect the building from additional damage.

In both cases, the measures could be instituted in a very short period of time. Once stabilized, the pressure for rapid repair or even demolition is reduced or eliminated. This allows for a more thoughtful repair program that can incorporate the requirements of the Secretary of the Interior's standards and the State Historic Building Code.

Photo courtesy Global Emergency Mangement

Figure 4-10 – Santa Cruz Commercial District, 1989 Loma Prieta Earthquake

In Figure 4-10, there is a falling hazard to the public right-of-way because of the loose bricks near the window. These loose bricks can fall at any time, whether there are aftershocks or not. The front of the building can be easily stabilized through the use of a tie back system as described in the last building. In this case, the cable connections would be easier than in the previous example. Using plywood with strong backs, the cables are then passed through the opening and connected to the floor diaphragm. The tie back can be either cable or rods with turnbuckles. This allows the system to be periodically tightened to provide the most protection. Again, once stabilized, the building could be reopened for possession retrieval. As with the previous example, such stabilizations can provide the owner more time to fully develop a repair program that addresses historic restorations well.

Figures 4-11 and 4-12 show a building that was badly damaged by the Loma Prieta earthquake. The floor and roof systems separated from the walls, and were a distinct collapse hazard. After considerable evaluation and discussion, a system was developed to save the historic character of

Photo courtesy Global Emergency Management

Figure 4-11 – Historic building, Santa Cruz, 1989 Loma Prieta Earthquake

Photo courtesy Global Emergency Management

Figure 4-12 – Close up of shoring, Santa Cruz, 1989 Loma Prieta Earthquake

this building. This is an example of a longer term, more complex stabilization procedure that is part of the repair process.

The City of Santa Cruz deemed this building an imminent hazard. The potential for collapse was great in even a moderate aftershock. Additionally, the building posed a significant threat to the public right-of-way. In this case, the roof and floors were removed, and the walls were stabilized with a system of "raker" shores. These are diagonal members connected together with steel beams at the floor and the roofline. They are intended to replace the diaphragms and provide out-of-plane load support for the walls. The walls were damaged, but were still able to support themselves for in-plane loads. Each of these frames is in an "A" configuration to provide maximum support for the walls. During the repair process, these braces can remain in place until such time as the new diaphragms are reconnected to the walls and can provide the lateral support needed for building stability. The raker shore frames are then removed and the final pieces of the diaphragm are installed. In this case, a building that was on the National Register of Historic Places was saved, and the building was reopened for operation with an extended useful life.

Photo courtesy Global Emergency Management

Figure 4-13 – Marina District, San Francisco, 1989 Loma Prieta Earthquake

Sometimes a building can look like a total loss, yet a simple method of stabilization can be devised which can save the building from demolition. There were a number of buildings in San Francisco's Marina District that suffered soft story failure from the Loma Prieta Earthquake.

The example in Figure 4-13 is definitely a potential collapse hazard, yet it was stabilized in a rather simple manner. Large timbers were installed diagonally across the garage openings. The braces were attached to the header across the top of all the openings. The diagonal braces were then connected also to the base of the posts between the openings. This stabilization design stopped the 'failure mode' P-delta type of continual movement that is typical of a structure that is this far out of plumb. Once this movement was arrested by the shoring, it was possible to allow tenants into the building for brief periods of time to retrieve possessions.

This stabilization arrangement also led to the development of a repair scheme. Cribbing was installed inside the garages to support heavy steel beams, which were threaded through the garage openings into the building. Hydraulic jacks were installed at equal intervals along the length of the beams. The small posts (and in some cases, piers) on each side of the garage openings were disconnected from the foundation. The building was raised and righted back into a plumb position by the hydraulic jacks. The jacks were lowered, and the building supported on the cribbing until new footings, shear panels, and connections could be installed.

This type of stabilization and repair was done a number of times to buildings in the Marina District that suffered soft story failure.

Like repairs, stabilization must be cost-effective and reasonable. Just propping up wood braces does not necessarily provide the required support to reduce the hazard. However, it is not wise to spend thousands of dollars on shoring up a hazard that could be removed and abated for a few hundred dollars. The next two examples will look at inadequate bracing and a stabilization method that was not reasonable for the particular hazard.

Photo courtesy Global Emergency Management

Figure 4-14 – Tilt-up Concrete Wall, 1983 Coalinga Earthquake

As stated before in Chapter 2, older concrete tilt-up wall construction has a problem with failure of the roof-wall connection. The older designs allowed the ledger to which the roof was attached to be split down their length at the through-bolt to the wall in response to lateral forces, resulting in a failed lateral load system. The simplest way to brace these walls temporarily is with steel tilt-up wall braces, similar to those used in the construction of tilt-up walls. If the stabilization needs to be done at once, and such braces are not readily available, wood braces can be used temporarily, provided that they have the capacity to support the walls.

In Figure 4-14, the braces are too slender to support the wall. They were installed tight as well, indicated by the bowing in the braces. Even a moderate aftershock or wind would have the capacity to load these braces to the failure point. If a SAP evaluator finds a situation like this in the field, the collapse zone should be barricaded with barricade tape, tagged AREA UNSAFE, and the building department alerted about this hazard.

Photo courtesy Global Emergency Management

Figure 4-15 – Brick veneer failure, 1991 Sierra Madre Earthquake

Figure 4-15 shows a brick veneer that is no longer well attached to the exterior wall, and an effort to brace it has been done. It would probably be better to simply remove the veneer and store it for re-attachment later, since the anchorages failed and the brick veneer has to be removed anyway. Removing the veneer instead of bracing the veneer accomplishes the same thing – removal of the potential falling hazard.

In summary, making recommendations for stabilization is not the main focus of the safety assessment process. However, being familiar with the concepts of stabilization will allow a SAP evaluator to offer opinions to the building department if asked.

The design and installation of shoring and stabilization measures is ultimately the responsibility of the building owner. Sometimes the jurisdiction will have to take action in the public interest to protect adjacent property or the public right-of-way. In such cases, the local building department is responsible for the design and installation. SAP evaluators having seen the building from their perspective, and in some cases inside the building, may give them a perspective that the jurisdiction may find useful. Certainly offering an opinion, when asked, as to the feasibility and possible methods of stabilization for individual buildings is reasonable and encouraged when the SAP evaluator has the background for it.

Figure 4-16 – Romulo Pico Adobe, Mission Hills, CA

4.4 Adobe Structures

Historically, adobe (usually a mixture of clay and straw formed into bricks and dried in the sun) has had a significant role among the array of materials used for building construction. The oldest adobe structures in California date from the Spanish colonial era, although adobe is still in use for some modern structures.

Adobe is a low-strength building material; it is common in modern adobe buildings to install barbed wire between the brick courses to provide a measure of lateral tensile strength, as seismic forces can easily exceed the tensile strength of adobe. Adobe walls are often built in a thick and

Figure 4-17 – Example of a modern adobe structure

massive manner, and are usually waterproofed with stucco or other cementitious plaster to protect them from water intrusion.

In addition to what is covered in Unit 2 in this manual regarding the post-disaster safety assessment of buildings, adobe buildings have other issues to watch for that can lead to earthquake damage. The most important of these is water damage, which can weaken adobe brick to the point where a wall may be unable to support its own weight. Pre-existing cracks from settlement or from earlier earthquakes can contribute to a weakened structural state that leads to failure during an earthquake. Also, the integrity of the adobe masonry achieved during construction can impact the seismic performance of the structure. A poor bonding pattern in the brick installation, or lack of cohesion in the mortar, will not help the walls to have the monolithic seismic behavior that well-constructed adobe walls will have.

Thick walls in adobe construction generally perform better than slender walls do. A very thick, stout wall with a slenderness ratio (height-to-thickness) of 3.5 or less resists overturning forces well, and is more likely to slide horizontally. Walls with a slenderness ration of 10 or greater are likely to fail by overturning or by mid-height buckling.

Figure 4-16 shows the historic Romulo Pico Adobe building in Mission Hills, CA. Construction began in 1834, and additions were made to the structure up to about 1874. Privately restored and expanded in the early 1930s, it was purchased by the City of Los Angeles in 1965. It was listed on the National Register of Historic Places in 1966. The building was damaged in the 1971 Sylmar Earthquake and afterward repaired.

Figure 4-17 is an example of a modern adobe residence. Figure 4-18 shows adobe brick being dried in the sun.

Figure 4-18 – Adobe bricks being dried in the sun.

4.5 Individual Activity: Evaluation of Residential Structures

Purpose

This activity has been designed to stimulate thinking on both the safety evaluation of damaged residences, and the potential for the continued use of these structures. These are the types of discussions that should be an ongoing part of the evaluation team's work. As with any part of safety assessment, there may well be no black or white determinations, only degrees of judgment based on facts, understanding, and experience.

Instructions

The group will discuss the questions related to the cases shown based on the descriptions of damage. The exercise will focus on habitability of the damaged structure, not how the structure can be repaired. The principles of ATC-20 will be used to determine habitability. Most likely, there will not be consensus on how to handle these cases in the class, but it is important to consider all points of view. The purpose of this exercise is to encourage the types of discussion that should take place within the evaluation team while determining the appropriate posting for the structure.

Photo courtesy Global Emergency Management

Figure 4-19 – House with cripple wall damage, 1983 Coalinga Earthquake

The two-story house in Figure 4-19 has suffered failure of its cripple wall. This failure resulted in damage to the roof over the porch, which has pulled down on one side with the house. The main structure will not collapse further, as the walls and second floor framing are in good shape. Therefore, the structure is stable, with the porch roof remaining a falling hazard. The home could be accessed successfully by using the rear entrance. We know that all utility connections were damaged except the electrical connections. Damaged utilities have been shut off.

Though fully accessible, is this home habitable?

What are the factors relating to the habitability of this structure, and why are they important?

Photo courtesy Global Emergency Management

Figure 4-20 – House with cripple wall failure, 1992 Big Bear Earthquake

Photo courtesy Global Emergency Management

Figure 4-21 – Detail of failed cripple wall, 1992 Big Bear Earthquake

Photo courtesy Global Emergency Management

Figure 4-22 – Collapsed house with failing upper room, 1992 Big Bear Earthquake

The 1992 Big Bear Earthquake caused the cripple wall failure of this newer home, which illustrates that not all cripple wall failures occur in older homes. The home is a two story structure, with a part of the second story supported by wood posts. The failure of the cripple studs caused the structure to shift to the right, moving off the foundation. The upper room above the carport has been shifted down by the cripple wall failure and is in danger of collapsing.

In Figure 4-21, it is clear why the cripple wall failed. The T111 siding that was nailed to the cripple wall studs was not nailed properly, using nails closely spaced at the siding edges. This would have allowed proper transfer of lateral forces from the structure to the sill plate at the foundation. Instead, it simply pulled out. Also, the metal straps that were used to anchor the sill plate were not properly installed. Instead of coming up both sides of the sill plate and nailing across the top, these straps as installed do not prevent the sill plate from tipping.

Figure 4-22 shows the room over the carport leaning against the rest of the house. The bracing was installed in a hopeful manner by either a contractor or the owner. It may help somewhat with keeping the support posts from kicking out due to gravity loads, but does not help much with lateral loads from aftershocks or wind. The brace on the lower left is attached to a vertical support that is not designed for lateral loads, which the brace on the lower right is attached to the house, which now is not attached to the foundation.

How would you post this structure, and why? If RESTRICTED USE, what restrictions would you place?

Assuming that the utilities have been shut off, would you consider the home to be habitable?

What might be some of the structural problems with the portion of the second floor that is out of level?

Photo courtesy Global Emergency Management

Figure 4-23 – Damaged apartment building, 1984 Morgan Hill Earthquake

Some safety notes on Figure 4-23 – never do what the person is doing on the side of this building! This building can be easily assessed for safety without entering it and risking one's life! Also, note the failed porch on the lower story. Is the upper story porch still attached? One should not risk life and limb by walking onto such structures!

As with many hillside homes, the lowest level on this hillside home has the least strength due to the lack of sheathed wall length. This damage likely occurred due to inadequate nailing of the sheathing along with the fact that there is a difference in the structural stiffness between the uphill end and the downhill end. The lateral forces tend to be drawn into the stiffer end of the wall panels, thereby overstressing the connections. This can be seen by the loss of sheathing at the uphill end of the wall.

Prior to beginning an evaluation, what actions can be taken by evaluators to protect them from being involved in the failure of a porch or similar structure?

How would you post the structure in Figure 4-23?

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UNIT 5 SAFETY ASSESSMENT EXERCISE

UNIT 5 – SAFETY ASSESSMENT EXERCISE

Overview

In this unit, we will use the processes and procedures from Chapters 2 and 3 to work in teams and practice arriving at a team consensus on the safety assessment of four buildings.

Training Goal

Participants will become familiar with and understand how to evaluate different types of structures.

Objectives

Upon completion of this unit, participants will be able to:

- Know what to look for when evaluating buildings for safety
- Gain experience in the process of discussing and arriving at consensus on building safety assessment.

Evaluating Buildings

5.1 Small Group Activity Evaluating Buildings

Purpose

The purpose of this activity is to familiarize you with the safety assessment process through hands-on use. Additionally, this exercise will give you experience in working with team members in discussing the condition of buildings.

Instructions

In a few minutes, you will break up into small groups of preferably two to four individuals. Each team will select a spokesperson who will present to the whole group the decisions and discussions of the team. Carefully review the photos of the buildings. Each group of photos includes a complete write-up of additional details needed to evaluate the building. Once your team has carefully read the descriptions and studied the photos, please discuss your observations, fill out the evaluation forms, and the appropriate placard.

At the end of the exercise, each team will present their conclusions, including any discussions that they may have had, and how they arrived at their recommendations. You will have one hour to work through the exercise.

Notes:

<u>Building 1</u>

Photo courtesy Fred Turner, EERI

Figure 5-1

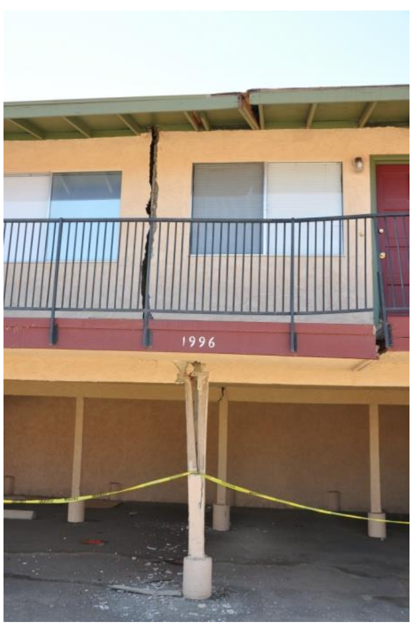

Photo courtesy Fred Turner, EERI

Figure 5-2

Photo courtesy Fred Turner, EERI

Figure 5-3

Photo courtesy Fred Turner, EERI

Figure 5-4

Description of the Building

1. This is a private apartment building with earthquake damage at 1996 River Street in Doverton, CA. There are seven apartment units - five units upstairs and two on the first floor. Footprint area is 4,500 square feet, building is wood frame construction.
2. Earthquake damage is in evidence at this site. Figure 4-1 shows the soft story failure of the ground level parking area. Figure 4-2 shows that a large crack has developed across the middle of the building, and Figure 4-4 shows the rear of the building has racked out of plane. Figure 4-3 shows no damage across the back end of the building.
3. Complete the Rapid Assessment Form adjacent to this building description and prepare the proper placard for this building.

ATC-20 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID: ______________________ Inspection date and time: ______________ ☐ AM ☐ PM

Affiliation: ______________________ Areas inspected: ☐ Exterior only ☐ Exterior and interior

Building Description

Building name: ______________________

Address: ______________________

____

Building contact/phone: ______________________

Number of stories above ground: ______ below ground: ______

Approx. "Footprint area" (square feet): ______________

Number of residential units: ______________

Number of residential units not habitable: ______________

Type of Construction

☐ Wood frame ☐ Concrete shear wall
☐ Steel frame ☐ Unreinforced masonry
☐ Tilt-up concrete ☐ Reinforced masonry
☐ Concrete frame ☐ Other: ______________

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Government
☐ Other residential ☐ Offices ☐ Historic
☐ Public assembly ☐ Industrial ☐ School
☐ Emergency services ☐ Other: ______________

Evaluation

Investigate the building for the conditions below and check the appropriate column.

Observed Conditions:	Minor/None	Moderate	Severe
Collapse, partial collapse, or building off foundation	☐	☐	☐
Building or story leaning	☐	☐	☐
Racking damage to walls, other structural damage	☐	☐	☐
Chimney, parapet, or other falling hazard	☐	☐	☐
Ground slope movement or cracking	☐	☐	☐
Other (specify) ______________	☐	☐	☐

Estimated Building Damage (excluding contents)

☐ None
☐ 0–1%
☐ 1–10%
☐ 10–30%
☐ 30–60%
☐ 60–100%
☐ 100%

Comments: ______________________

____

Posting

Choose a posting based on the evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Localized *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Post INSPECTED placard at main entrance. Post RESTRICTED USE and UNSAFE placards at all entrances.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

____

____

Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

____

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ______________

☐ Other recommendations: ______________________

Comments: ______________________

____

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to local authorities; reinspection may be required.

Inspector Comments:

____

____

____

____

Facility Name and Address:

____

____

____

Date ____________________________

Time ____________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

____

(Jurisdiction)

Inspector ID / Agency

____

____

____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

____
____
____
____

Entry, occupancy, and lawful use are restricted as indicated below:

____
____
____
____
____
____

Facility Name and Address:

____
____
____

Date ____________________________

Time ____________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

____
(Jurisdiction)

Inspector ID / Agency

____
____
____

Do Not Remove, Alter, or Cover this Placard
until Authorized by Governing Authority

UNSAFE

DO NOT ENTER OR OCCUPY
(THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

____
____
____
____
____
____

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:

____
____
____

Date ______________________

Time ______________________

This facility was inspected under emergency conditions for:

____
(Jurisdiction)

Inspector ID / Agency

____
____
____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

<u>Building 2</u>

Photo courtesy Fred Turner, EERI

Figure 5-5

Courtesy Fred Turner, EERI

Figure 5-6

Photo courtesy Fred Turner, EERI

Figure 5-7

Photo courtesy Fred Turner, EERI

Figure 5-8

Photo courtesy Fred Turner, EERI

Figure 5-9

Photo courtesy Fred Turner, EERI

Figure 5-10

1. This is a 1300 square foot adobe unreinforced masonry house at 492 Cypress Street in Doverton, CA.
2. Earthquake damage includes cracking above three of the arches, spalling that reveals the adobe wall, and a wood porch awning that collapsed. The exterior lights are flickering intermittently, and water is also flooding the back yard from a broken pipe.
3. Perform a Rapid Evaluation and post the building accordingly.

ATC-20 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID: ______________________ Inspection date and time: ______________ ☐ AM ☐ PM

Affiliation: ______________________ Areas inspected: ☐ Exterior only ☐ Exterior and interior

Building Description

Building name: ______________________

Address: ______________________

____

Building contact/phone: ______________________

Number of stories above ground: ______ below ground: ____

Approx. "Footprint area" (square feet): ______________

Number of residential units: ______________________

Number of residential units not habitable: ______________

Type of Construction

☐ Wood frame ☐ Concrete shear wall
☐ Steel frame ☐ Unreinforced masonry
☐ Tilt-up concrete ☐ Reinforced masonry
☐ Concrete frame ☐ Other: ______________

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Government
☐ Other residential ☐ Offices ☐ Historic
☐ Public assembly ☐ Industrial ☐ School
☐ Emergency services ☐ Other: ______________

Evaluation

Investigate the building for the conditions below and check the appropriate column.

Observed Conditions:	Minor/None	Moderate	Severe
Collapse, partial collapse, or building off foundation	☐	☐	☐
Building or story leaning	☐	☐	☐
Racking damage to walls, other structural damage	☐	☐	☐
Chimney, parapet, or other falling hazard	☐	☐	☐
Ground slope movement or cracking	☐	☐	☐
Other (specify) ______________	☐	☐	☐

Estimated Building Damage (excluding contents)

☐ None
☐ 0–1%
☐ 1–10%
☐ 10–30%
☐ 30–60%
☐ 60–100%
☐ 100%

Comments: ____

____

Posting

Choose a posting based on the evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Localized *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Post INSPECTED placard at main entrance. Post RESTRICTED USE and UNSAFE placards at all entrances.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

____

____

Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

____

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ______________

☐ Other recommendations: ______________________

Comments: ____

____

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to local authorities; reinspection may be required.

Inspector Comments:

____

____

____

____

Facility Name and Address:

____

____

____

Date ________________________

Time ________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

____

(Jurisdiction)

Inspector ID / Agency

____

____

____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

____
____
____
____

Entry, occupancy, and lawful use are restricted as indicated below:

☐ Do not enter the following areas: __________

☐ Brief entry allowed for access to contents: _____

☐ Other restrictions: _______________

Facility name and address:

____
____
____

Date ________________________

Time ________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

____
(Jurisdiction)

Inspector ID / Agency

____
____
____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

UNSAFE

DO NOT ENTER OR OCCUPY
(THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

____
____
____
____
____
____

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:

____
____
____

Date ______________________

Time ______________________

This facility was inspected under emergency conditions for:

____
(Jurisdiction)

Inspector ID / Agency

____
____
____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

Building 3

Photo courtesy CA OES

Figure 5-11

Photo courtesy CA OES

Figure 5-12

1. Cabana Bob's Pool Supply, located 1675 Fourth Street, Doverton, CA, is a 3500 square foot unreinforced masonry building. The photos show the north and south walls of this long, narrow building. The alley is located on the east side of the building. The west side faces the street and is the storefront to this business. The front third of the building contains the retail sales department, while the back two-thirds (towards the alley) is used as a warehouse for pool supplies.
2. The roof rafters span between the north and south walls. The rafters are full-size 2 x 12s with no ceiling in the warehouse space. The building has a parapet on all four sides, with the parapet height being 3 feet above the roofline on the north and south walls.
3. About 25 percent of the parapet has fallen on the south and north facing walls. There are large cracks in the southeast and northeast corners of the building that resulted from excessive diaphragm movement. While looking through the windows, it is seen that several of the pool supply storage racks have fallen over, and the stored materials are dumped all over the floor. There is also a small puddle of liquid on the floor. There is no other apparent damage to the building.
4. Perform a Rapid Evaluation.

ATC-20 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID: ______________________ Inspection date and time: ______________ ☐ AM ☐ PM

Affiliation: ______________________ Areas inspected: ☐ Exterior only ☐ Exterior and interior

Building Description

Building name: ______________________

Address: ______________________

____

Building contact/phone: ______________________

Number of stories above ground: ______ below ground: ______

Approx. "Footprint area" (square feet): ______________

Number of residential units: ______________

Number of residential units not habitable: ______________

Type of Construction

☐ Wood frame
☐ Steel frame
☐ Tilt-up concrete
☐ Concrete frame
☐ Concrete shear wall
☐ Unreinforced masonry
☐ Reinforced masonry
☐ Other: ______________

Primary Occupancy

☐ Dwelling
☐ Other residential
☐ Public assembly
☐ Emergency services
☐ Commercial
☐ Offices
☐ Industrial
☐ Other: ______________
☐ Government
☐ Historic
☐ School

Evaluation

Investigate the building for the conditions below and check the appropriate column.

Observed Conditions:	Minor/None	Moderate	Severe
Collapse, partial collapse, or building off foundation	☐	☐	☐
Building or story leaning	☐	☐	☐
Racking damage to walls, other structural damage	☐	☐	☐
Chimney, parapet, or other falling hazard	☐	☐	☐
Ground slope movement or cracking	☐	☐	☐
Other (specify) ______________	☐	☐	☐

Estimated Building Damage (excluding contents)

☐ None
☐ 0–1%
☐ 1–10%
☐ 10–30%
☐ 30–60%
☐ 60–100%
☐ 100%

Comments: ______________________

____

Posting

Choose a posting based on the evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Localized *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Post INSPECTED placard at main entrance. Post RESTRICTED USE and UNSAFE placards at all entrances.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

____

____

Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

____

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ______________

☐ Other recommendations: ______________________

Comments: ______________________

____

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

- ☐ **Inspected Exterior Only**
- ☐ **Inspected Exterior and Interior**

Report any unsafe condition to local authorities; reinspection may be required.

Inspector Comments:

____

____

____

____

Facility Name and Address:

____

____

____

Date __________________________

Time __________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

____

(Jurisdiction)

Inspector ID / Agency

____

____

____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

____

____

____

____

Entry, occupancy, and lawful use are restricted as indicated below:

☐ Do not enter the following areas: __________

____

☐ Brief entry allowed for access to contents: ____

____

☐ Other restrictions: ____________________

____

Facility name and address:

____

____

____

Date ______________________________

Time ______________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

____

(Jurisdiction)

Inspector ID / Agency

____

____

____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

UNSAFE

DO NOT ENTER OR OCCUPY
(THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

____

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:

____

Date ____________________

Time ____________________

This facility was inspected under emergency conditions for:

____
(Jurisdiction)

Inspector ID / Agency

____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

Building 4

Photo courtesy Raymond Lui, SEA

Figure 5-13

1. The town of Wonder Creek, CA had a flood that overwhelmed the east portion of the town. The above residence is at 145 Salamander Court, and is a two-story wood frame structure with a footprint area of 850 square feet.
2. The damage to the structure includes being floated off its foundation. The water, sewer, and gas lines have been snapped. The flood line on the house is up to the bottom of the windows, and water has soaked up the interior sheetrock walls to about seven feet above the floor. Mold has been observed growing on the interior walls and the furnishings.
3. A ten-gallon drum marked "pentachlorophenol" was found in the back yard that floated there from upriver. Power lines are also seen hanging about four feet above the ground on the side of the house.
4. Perform a Rapid Evaluation, and complete the appropriate placard for this building.

ATC-45 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID: ______________________ Inspection date: ______________________

Affiliation: ______________________ Inspection time: ______________ ☐ AM ☐ PM

Areas inspected: ☐ Exterior only ☐ Exterior and interior

Building Description

Building name: ______________________

Address: ______________________

____

Building contact/phone: ______________________

Number of stories: ______________________

"Footprint area" (square feet): ______________________

Number of residential units: ______________________

Type of Building

☐ Mid-rise or high-rise ☐ Pre-fabricated

☐ Low-rise multi-family ☐ One- or two-family dwelling

☐ Low-rise commercial

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Government

☐ Other residential ☐ Offices ☐ Historic

☐ Public assembly ☐ Industrial ☐ School

☐ Emergency services ☐ Other: ______________

Evaluation

Investigate the building for the conditions below and check the appropriate column.

Observed Conditions:	**Minor/None**	**Moderate**	**Severe**
Collapse, partial collapse, or building off foundation	☐	☐	☐
Building significantly out of plumb or in danger	☐	☐	☐
Damage to primary structural members, racking of walls	☐	☐	☐
Falling hazard due to nonstructural damage	☐	☐	☐
Geotechnical hazard, scour, erosion, slope failure, etc.	☐	☐	☐
Electrical lines / fixtures submerged / leaning trees	☐	☐	☐
Other (specify) ______________	☐	☐	☐

☐ See back of form for further comments.

Estimated Building Damage
(excluding contents)

☐ None

☐ >0 to <1%

☐ 1 to <10%

☐ 10 to <30%

☐ 30 to <60%

☐ 60 to <100%

☐ 100%

Posting

Choose a posting based on the evaluation and team judgment. Severe conditions endangering the overall building are grounds for an Unsafe posting. Localized Severe and overall Moderate conditions may allow a Restricted Use posting.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

____

____

Number of residential units vacated: ______________________

Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

____

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ______________

☐ Substantial Damage determination recommended

☐ Other recommendations: ______________________

____

☐ See back of form for further comments.

INSPECTED

LAWFUL OCCUPANCY PERMITTED

This structure has been inspected (as indicated below) and no apparent structural hazard has been found.

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to local authorities; reinspection may be required.

Inspector Comments:

____

____

____

____

Facility Name and Address:

____

____

____

Date __________________________

Time __________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

____

(Jurisdiction)

Inspector ID / Agency

____

____

____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

RESTRICTED USE

Caution: This structure has been inspected and found to be damaged as described below:

____

____

____

____

Entry, occupancy, and lawful use are restricted as indicated below:

____

____

____

____

____

____

Facility Name and Address:

____

____

____

Date ________________________________

Time ________________________________

(**Caution:** Aftershocks since inspection may increase damage and risk.)

This facility was inspected under emergency conditions for:

____

(Jurisdiction)

Inspector ID / Agency

____

____

____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

UNSAFE

DO NOT ENTER OR OCCUPY
(THIS PLACARD IS NOT A DEMOLITION ORDER)

This structure has been inspected, found to be seriously damaged and is unsafe to occupy, as described below:

____
____
____
____
____
____

Do not enter, except as specifically authorized in writing by jurisdiction. Entry may result in death or injury.

Facility Name and Address:

____
____
____

Date ______________________

Time ______________________

This facility was inspected under emergency conditions for:

____
(Jurisdiction)

Inspector ID / Agency

____
____
____

Do Not Remove, Alter, or Cover this Placard until Authorized by Governing Authority

UNIT 6 LIFELINE SYSTEMS AND FACILITIES

UNIT 6 – LIFELINE SYSTEMS AND FACILITIES

Overview

This unit will use the process and procedures described in Chapter 2 to evaluate the serviceability of lifeline systems and facilities, including: airports, bridges, roads, pipelines, pumping plants, tank reservoirs, wastewater treatment plants, and water treatment plants. Geotechnical issues will also be discussed.

Training Goal

Participants will know how to use the evaluation forms when conducting safety evaluations of various lifeline infrastructures.

Objectives

Upon completions of this unit, participants will be able to complete the evaluation forms and report their findings on the condition of the lifeline system or facility.

6.0 Lifeline Systems and Facilities

The lifeline systems and facilities discussed in this chapter comprise critical components of a community's infrastructure. For that reason, **only Detailed Evaluations will be performed on lifelines,** and evaluators who have professional training and/or experience in the design and operation of these systems will perform the assessment. It is well beyond the scope of the Safety Assessment Program to teach the principles and procedures that are used in the design of these systems.

Because of the nature of the systems involved in these evaluations, the jurisdiction is encouraged to assign persons from public works, law enforcement, or the fire department to accompany the SAP team. This way, information on the condition of the more critical life safety situations can be rapidly conveyed to the proper authorities, and appropriate steps taken for life safety. For example, a bridge on a major street that is deemed unsafe needs to be taken out of service and barricaded immediately. Having a representative of the jurisdiction with the team allows the information to be transferred at once to the appropriate department for action. *This is especially important since infrastructure is not placarded,* but the jurisdiction is alerted for their immediate action.

This class will familiarize evaluators with the detailed evaluation forms and how to fill them out.

The American Society of Civil Engineers, Los Angeles Chapter developed these forms for use by Cal OES in the late 1970s, in the early days of the Safety Assessment Program. These evaluations are not damage assessments, but are intended to determine the safety of lifeline systems or facilities for continued use. The evaluations are enough to determine if a system or facility is safe enough to return to service (INSPECTED, or "Green"), can be returned to service with some restrictions (RESTRICTED USE, or "Yellow"), or must be taken out of service until repaired (UNSAFE, or "Red").

Only one of these forms, the Bridge Assessment form, has been used in actual responses. This was after the 1989 Loma Prieta Earthquake in the City of Santa Cruz, and after the 2008 hurricane season in the island nation of Haiti. No doubt as these forms are used in actual assessments, there will be input from the field on how they might be improved, in the manner similar to how the ATC-20 forms were adjusted over time.

In Chapter 2, the goal of the Safety Assessment Program, in accord with the ***Post-Disaster Safety Assessment Plan,*** is:

- **To get as many people as possible back into their buildings as quickly and safely as possible.**

We must also look at **rapidly clearing for use vital services and infrastructure that will impact the public at large.** In this unit, the evaluation forms used for critical infrastructure detailed evaluation will be examined. This effort of rapidly clearing vital services and transportation elements will greatly help in the recovery of the damaged community, allowing for the movement of resources in response to the disaster.

The detailed evaluations for infrastructure that are part of the Safety Assessment Program include:

- Geotechnical Evaluation (applicable to both buildings and infrastructure)
- Transportation Systems
  - Airports
  - Bridges
  - Roads
- Water and Wastewater Systems
  - Pipelines
  - Pump Stations
  - Tank Reservoirs
  - Wastewater Treatment Plants
  - Water Treatment Plants

The evaluations that will be performed for these are Detailed Evaluations, and if placards are used, they are the same as those used for buildings. Bridges, roads, and pipelines are not likely to be placarded, but the jurisdiction will be informed at once if the SAP team's findings are RESTRICTED USE or UNSAFE, so proper measures for public safety can be taken. Airports, water treatment plants, and wastewater treatment plants are complex and can have findings on the various features therein, some with placards, some not. Pump stations and tank reservoirs could be placarded. The posting of the various types of facilities is discussed in detail at the end of each of the units. (All Assessment Forms can be found in the Appendix of this manual.)

6.1 Assessment Form Heading

All of the lifeline systems forms use the same header; therefore, Section A of these forms will be reviewed before beginning the discussion on each of the infrastructure forms. See Figure 5-1.

On these forms, *Facility Name, Address,* and *County/City* are self-explanatory. The facility name should be the name provided by the jurisdiction or used by the jurisdiction during day-to-day operations. The address is the street address used by the jurisdiction for the facility. "County/City" should be the name of the county or city, depending on who has jurisdiction over the facility or system.

Mo/Day/Yr refers to the date of the evaluation being performed. *Time* is the time of day the evaluation was being performed. Please note that the time should be shown using the 24-hour clock (examples: "0800" for 8:00 a.m., and "1600" for 4:00 p.m.)

Type of disaster describes the type of event that made the safety evaluation necessary. For example, this could be an earthquake, flood, wild land fire, etc. The actual name of the event could be used if that is known.

At the right top of the form is where the evaluators put in their SAP ID numbers for identification purposes. The jurisdiction that the evaluation is being done for may have its own policy on this, and may ask the evaluator to put their name on the form. That is certainly permissible.

Facility Name: ___________________________________	SAP ID Nos. ___________ __________
Address: _______________________________________	Other Reports ____________________
County/City ____________________________________	No. Photos _____ No. Sketches ______
Mo/Day/Yr ________/______/_______ Time ________ (use 24 hr)	Ref. Dwgs. _______________________
Type of Disaster _________________________________	Est. Damage %____________________
	Facility Status

SAFETY INSTRUCTIONS: The possibility of the presence of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard. ALSO: The FAA is responsible for checking and evaluating damage to control tower equipment, lighting controls, communication systems, navigational aids, and approach light systems. Obtain permission from tower to enter runway. Permission obtained from __________________

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

Figure 6-1 – Assessment Form Heading

Other Reports refers to other safety assessment evaluations that may have been done already, or to any other type of report that was used to help evaluate the overall safety of the infrastructure. If no other reports were used, write "None". If other reports were used, write "Over" and list the reports by title or assessment number.

No. Photos relates to the number of photos that are part of this evaluation.

No. Sketches relates to the number of sketches developed as part of the assessment. If photos were taken and/or sketches developed, they need to be stapled to this Detailed Evaluation. Digital photos need to be downloaded to a media such as a CD or a flash drive and delivered to the jurisdiction, or the photos need to be downloaded directly to the jurisdiction's computer.

Ref. Dwgs. refers to any drawings that were used in the evaluation. If none were used, indicate "None" in the space provided. If drawings were used, write "Over" and list the drawings by drawing number and date on the back of the evaluation form.

Est. Damage % refers to the percentage of damage to the particular item being evaluated. Do not be greatly concerned about providing precise estimates, as this information will be used by the jurisdiction to describe the impact of the disaster to others. These percentages of damage are very preliminary, and will change many times before the actual repairs are done.

Facility Status is used to indicate the recommended status of the facility safety as a result of the evaluation. One could write in INSPECTED, RESTRICTED USE, or UNSAFE, or could write in the colors Green, Yellow, or Red, depending on what the jurisdiction would prefer.

The next two sections provide a safety reminder to the jurisdiction, and a cautionary statement to the jurisdiction.

The first part of the safety reminder applies to all evaluations, while the second part of the safety reminder only applies to airports.

The cautionary statement reminds the jurisdiction that the level of review that the SAP evaluators are providing is not enough to counter any other engineering opinions that have been developed, or that may be developed later, through more in-depth and thorough inspections and analysis. This statement falls in line with the primary purpose of this review, which is simply to see if the infrastructure element can be successfully used to some degree or is unsafe to use.

Section A of the Detailed Evaluation form header is where to show if there was a prior safety assessment before, and if there has been any change to this recently.

In the *Existing* section, check off the recommendation that was made in the prior evaluation. If there was no prior evaluation, check "None."

The *Recommended* section is used to note the findings of the SAP team based on the Detailed Evaluation, the team checking off the appropriate placard color.

At the *Posted at this assessment*, the team checks "Yes" or "No" based on if anything was placarded at the site. As said before, some types of infrastructure will be placarded and some will not.

This header on the Detailed Evaluation forms is intended for providing a quick overview of the condition of the facility or system, all pertinent information on the posting being located here. The remaining parts of this chapter will look at each specific type of evaluation, which gets covered in Section B on the Detailed Evaluation forms.

6.2 Geotechnical Evaluation

The geotechnical evaluation is the only non-lifeline specific evaluation, as it can be requested for any type of facility, whether building or infrastructure, that has been damaged or made worse by geological conditions. Many geotechnical evaluations will be performed on facilities that have already had a safety assessment. Hopefully, the prior SAP team has noted on the evaluation form whatever geologic conditions led them to ask for a geotechnical evaluation. This will give the geotechnical SAP team a starting point to begin their assessment. The new team will start at the site in question and expand its investigation outward to see if either surface or subsurface conditions pose a threat to the continued use of the facility or system.

Photo courtesy FEMA

Figure 6-2 – Surface rupture, 1971 Sylmar Earthquake

Geotechnical failures, particularly liquefaction and lateral spreading, have often caused the most severe damage to lifeline facilities. Pipelines and tanks can become buoyant in liquefiable soils, and all features can be heavily damaged if soils liquefy, spread laterally, or settle. Liquefaction occurs in sandy soils with high water tables. Settlement that is unrelated to liquefaction can also occur, although is not as common as liquefaction. Landslides can occur where there is steep topography.

Photos courtesy San Francisco Department of Public Works

Figure 6-3 – Hillside slide, San Francisco **Figure 6-4 – Toe of slide, San Francisco**

Photo courtesy Cal OES

Figure 6-5 – Block failure of road subsurface, 2005-06 Winter Storms

Figures 6-3 and 6-4 show a landslide that occurred in San Francisco. The rock debris at the toe of the slide damaged a building there.

Figure 6-5 shows a condition called "block failure." Oversaturation of soils on hillsides can lead to the hillside moving in large sections, or "blocks," in this case, taking the roadway with them.

Photo courtesy Dave Swanson, EERI

Figure 6-6 – Scarp through community in China

Photo courtesy Dave Swanson, EERI

Figure 6-7 – Lateral spreading

A copy of the Geotechnical Evaluation form is on the next two pages.

6.2.1 Completing the Geotechnical Evaluation Form

Recommendations – This section of the form can be used to request regular monitoring of the site, to watch for continued ground movement that may cause additional damage to the facility. Ideally, the evaluator will indicate what needs to be monitored, why, and if there is a point where the condition could point to a re-evaluation of the facility for safety, or some other necessary action. The second part of this section allows the evaluator to provide information about the posting decision that would be important for the jurisdiction to know. This section can also be used to elaborate on monitoring conditions.

Comments – This section is used to explain anything that needs additional explanation. If there is not enough room in the provided area on the form, the evaluator can write "Over" in the remaining space and continue on the back of the form.

Damage Observed (DO) – The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

Section D – Observed Geotechnical Conditions with Effect on Facility – Using the Damage Observed, the evaluator will look at all the conditions and describe the effect of the condition. This lets the jurisdiction know how bad the geotechnical conditions are at the site. The second part of the evaluation describes the impact of that condition. Remember, the two evaluations can

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
GEOTECHNICAL EVALUATION

Assessment Report No. ______

Facility Name ______________________

Address ______________________

Co-City-Vic ______________________

Mo/Day/Yr ____/____/____ Time ________ use 24 hr.

Type of Disaster ______________________

SAP ID Nos. ________ ________

Other Reports ______________

No. Photos _____ No. Sketches _____

Ref. Dwgs. ______________

Est. Damage %______________

Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor ______________________

Other ______________________

____

____

____

____

C. COMMENTS ______________________

____

____

____

____

____

DAMAGE OBSERVED (D.O.)

Assessment Report # ____________

Damage Scale:	0 None (0%)	1 Slight (1-10%)	2-3-4 Moderate (11 - 40%)	5 Severe (41 - 60%)	6 Total (over 60%)	NA Not Applicable	NO Not Observed

D. OBSERVED GEOTECHNICAL CONDITIONS WITH EFFECT ON FACILITY

Observed Condition	Extent of Condition D.O.	Effect of Condition D.O.	Observed Condition	Extent of Condition D.O.	Effect of Condition D.O.
Ash flows	______	______	Flooding	______	______
Avalanches	______	______	Landslides/mudslides ..	______	______
Collapsed soils..........	______	______	Lava flows	______	______
Cut........................	______	______	Liquefaction	______	______
Differential settlement..	______	______	Lurching	______	______
Displacement............	______	______	New springs	______	______
Dried springs	______	______	Ponded water	______	______
Erosion	______	______	Sand boils	______	______
Faulting	______	______	Tsunami/seiches	______	______
Fill	______	______	Soil shear failure	______	______

E. CONTINUING HAZARDS TO LIFE/PROPERTY (Please describe) ____________________ be very different. For items not involved in the disaster (such as ash flow in a flood event) write in NA (Not Applicable).

Section E – Continuing Hazards to Life and Property – This section will be used to describe the conditions at the site that may be a threat to life safety and to property. The description should relate some detail on the relationship between the geotechnical conditions and the original posting of the facility, if such exists. Remember, evaluators are not performing an engineering evaluation, so the description should be commensurate with the evaluation performed. Mapping the area of liquefaction is useful, if time permits. Such a sketch would show the location and size of cracks and sand boils, and an estimate of the direction and amount of lateral movement.

Photo courtesy Dave Swanson, EERI

Figure 6-8 – Earthquake-induced settlement (Japan)

6.2.2 - Posting

Upon completing the evaluation, the team will recommend the posting. If the facility is already posted with a placard, the SAP team will update the existing placard with the new information. If the recommendation changes the posting (for example, from RESTRICTED USE to UNSAFE), change the placard and add the appropriate information explaining why the posting changed). If the geotechnical conditions do not have an impact on the facility, DO NOT change the existing placard. If a comment on the existing placard mentions the geotechnical issues, amend the placard with an update and add the SAP team's identification to it. Naturally, if there is no existing placard, then post the facilities and/or alert the jurisdiction as appropriate.

6.3 Airports

The large international airports have licensed professionals on their staff, and so probably will not need to use the Safety Assessment Program to evaluate the airport's features for the safety of continued operation. These airports also have a large volume of tightly scheduled aircraft coming and going from them, so time will be of the essence for them to reopen what can be.

SAP evaluators will be most likely used to evaluate the relatively smaller general aviation airports located in the affected communities. These could become key facilities for moving resources into the disaster theater, and for staging areas for aid to the afflicted region.

Photo courtesy Denali Collection

Figure 6-9 – Airport runway with lateral spreading, 2008 Denali Earthquake, Alaska

Please note in Figure 6-9 the man standing in the large crack. This is another unsafe activity that no SAP evaluator should ever do!

In addition to the earthquake damage to buildings discussed previously, damage can occur to all of the other systems and facilities found in an airport. Liquefaction and/or settlement have occurred to runways, rendering them unusable. Air traffic control towers have been damaged, including damage to the roof structures due to the poor support provided by the heavily windowed walls. Emergency power also may not be operable due to damage to startup batteries or to the panels that support the generator system.

A copy of the two-page Airport Evaluator form can be found on the following pages.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
AIRPORT

Assessment Report No. ____________

Facility Name: ______________________________
Address: ______________________________
Co-City-Vic ______________________________
Mo/Day/Yr ______/______/______ Time ________ (use 24 hr)
Type of Disaster ______________________________

SAP ID Nos. ____________ ____________
Other Reports ______________
No. Photos _____ No. Sketches _____
Ref. Dwgs. ____________________
Est. Damage %________________
Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of the presence of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard. ALSO: The FAA is responsible for checking and evaluating damage to control tower equipment, lighting controls, communication systems, navigational aids, and approach light systems. Obtain permission from tower to enter runway. Permission obtained from ________________

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will no render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
	None O		Green O		Yes O
	Green O		Yellow O		No O
	Yellow O		Red O		
	Red O				

B. RECOMMENDATIONS:

Monitor ______________________________
Other ______________________________
____

C. COMMENTS ______________________________
____
____
____
____
____
____

Assessment Report # ____________

DAMAGE OBSERVATIONS (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

D. SURFACE DISPLACEMENT

	D.O.	Amount in inches Horiz.	Vert.
Runway pavement	_____	_____	_____
Taxiway pavement	_____	_____	_____
Aircraft aprons	_____	_____	_____
Car parking areas	_____	_____	_____
Access roadways	_____	_____	_____
Bridges	_____	_____	_____
Liquefaction	_____		

(Bridge Report Attached o Geotechnical Report Attached o)

E. UNDERGROUND UTILITIES

	D.O.
Water mains	_____
Water services	_____
Gas mains	_____
Sewer	_____
Collapsed o	
Displaced o	
Large storm drains	_____
Aircraft fueling systems	_____
Airfield lighting	_____
Underground electrical	_____

F. BUILDINGS

	D.O.
Control tower structure	_____
Passenger terminal buildings	
Structural	_____
Mechanical	_____
Electrical	_____
Utility plant buildings	
Equipment	_____
Piping	_____
Emergency generator building	
Equipment	_____
Fuel supply	_____

G. REMARKS _______________________________

6.3.1 Completing the Airport Evaluation Form

Recommendations – This section can be used to request monitoring of damaged features and to elaborate on monitoring requirements. For example, a runway with cracks in it may be further damaged over time by repeated aftershocks. The cracks could become wider, or in the worst case scenario, end up separating vertically. The evaluator can describe in this section of the form what features of the airport needs to be monitored, why, and if there is a point where the condition could point to a re-evaluation of the facility for safety, or some other necessary action. The second part of this section allows the evaluator to provide information about the posting decision that would be important for the jurisdiction to know.

Comments – This section is used to explain anything that needs additional explanation. If there is not enough room in the provided area on the form, the evaluator can write "Over" in the remaining space and continue on the back of the form. If the airport needed to be posted RESTRICTED USE, it is here that the evaluator would indicate the restrictions. If the posting is UNSAFE, the reasons for that choice would be provided here.

Damage Observed (DO) – The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

Surface Displacement – This section is used to note the vertical and horizontal displacement of the various parts of the airport's paved areas. The first line is used to indicate the level of damage using the Damage Observed scale. The second and third lines are used to record the actual displacements measured at the time of the evaluation. There are rare occasions when runways pass over streets; these structures are considered bridges, and the Bridge Evaluation form should be used for these. The same holds true for pedestrian bridges, viaducts, or overpasses. If Bridge Evaluation forms are used, they should be attached to the Airport Evaluation form.

Underground Utilities – For each of the utilities listed, the SAP team will estimate the level of damage using the Damage Observed scale. If any of these utilities are damaged, it could constitute grounds for a RESTRICTED USE posting for the airport. For example, if the sewer system has failed, the damage might not be enough to warrant an UNSAFE posting, but there would certainly be restrictions on using the airport restrooms until the sewer system was fixed. This would especially be a concern if the airport was being used as a disaster response staging area. In this case, the restrooms would be closed and locked, and portable toilets brought in if necessary, until the sewer system was repaired.

Buildings – For each of the buildings, either a Rapid Evaluation or a Detailed Evaluation form should be filled out. The results of those assessments will be used to provide more background information on determining the overall level of damage and use of the airport. The building evaluation forms should be attached to the Airport Evaluation form.

Remarks – This section of the form allows for expanding upon the safety assessment results of the various parts of the airport facility. Further, this is a good place to cross-reference to either the Bridge or the building evaluation forms, if these are used.

Photo courtesy FEMA

Figure 6-10 – Damaged airport control tower

6.3.2 Posting

Upon completing the evaluation, the team will recommend the posting. This finding should be reported to the general manager of the airport. Remember that evaluators do not have the authority to close the airport, but can only make recommendations to the general manager, who does have said authority. If the SAP team recommends to post the airport UNSAFE, immediately contact the general manager, or the jurisdiction if the airport does not have a general manager. If the airport does not have a general manager, the jurisdiction will notify the Federal Aviation Administration, which will put out a general broadcast indicating that the airport is closed.

Once the SAP team returns to meet with the SAP coordinator, provide the coordinator with all the information you have gathered, and your recommendations as a result of your evaluation.

6.4 Bridges

The major bridges throughout the state are found on the federal and state highways and freeways, which are part of the Federal Highways Administration federal aid system. The California Department of Transportation (Caltrans) will evaluate these bridges for safety immediately following a major disaster.

The Safety Assessment Program can be used to provide engineers to evaluate bridges that are not on the federal aid system. These local bridges will be important to the jurisdiction for moving resources to respond to the disaster, and eventually as part of the overall recovery.

This form was used after the 1989 Loma Prieta earthquake to look at bridges within the City of Santa Cruz, and also used in 2008 in Haiti to look at damaged bridges there.

Some of the damages that can occur to bridges include failure of the support columns. This is often due to inadequate confinement steel in the column. Other damage includes bridge spans falling off their supports. This can happen if the spans are not restrained, and/or if the seat for the span is too narrow. The most vulnerable bridges for this are those with multiple spans, and those that are set at an angle to the obstruction that they cross. Finally, the approaches to bridges can settle, creating a dangerous situation for traffic attempting to cross the bridge. Traffic ends up encountering a concrete wall instead of a reasonable ramp to the bridge surface. This has proved to be a rather common problem observed after strong earthquakes.

Photo courtesy Dave Swanson, EERI

Figure 6-11 – Bridge with fallen span (China)

6.4.1 Completing the Bridge Evaluation Form

A copy of the two-page Bridge Evaluation form begins on the next page.

Recommendations – This section shows the typical recommendations that would apply to bridges, though not necessarily the only ones. The overall recommendations of the SAP team are noted here by checking the appropriate circles, after the evaluation is complete. If the monitor circle is checked, the evaluator must be sure to note in the Comments section the

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
BRIDGE

Assessment
Report No. ________

Facility Name ____________________	SAP ID Nos. __________ __________
Address ____________________	Other Reports ____________________
Co-City-Vic ____________________	No. Photos ______ No. Sketches ______
Mo/Day/Yr ____/____/____ Time ________ use 24 hr.	Ref. Dwgs. ____________________
Type of Disaster ____________________	Est. Damage %____________________
	Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor ____________	O	Use for emergency vehicles ________	O
Use for public transportation ______	O	Close to truck traffic ____________	O
Use for pedestrians ____________	O	Use for private passenger vehicles only___	O
Use for two-way traffic __________	O	Use for one-way traffic __________	O
Use off-site detour ____________	O	Use for on-site detour ____________	O
Use underpass only ____________	O	Use overpass only ____________	O
Barricade ____________	O	Shore and brace ____________	O

C. COMMENTS ____

____

____

D. BRIDGE DESCRIPTION Assessment Report # __________

1. Type

	MATERIAL				
	Concrete Prestr.	Concrete Reinf.	Steel	Composite	Timber
Arch	O	O	O	O	O
Box	O	O	O	O	O
Cantilever	O	O	O	O	O
Girder	O	O	O	O	O
Slab	O	O	O	O	O
Suspension	O	O	O	O	O
Truss	O	O	O	O	O
Other	O	O	O	O	O

2. Foundation: Caisson O Pile O Spread footings O

3. Internal support

	Number of spans One	Two	No.	Height (ft)
Bents (frames)	O	O	_____	_____
Columns	O	O	_____	_____
Piers	O	O	_____	_____

4. Abutments High _______ ft.
   Low _______ ft.

5. Road Dimensions Length _______ ft.
   Curb to curb _______ ft
   Walks _______ft

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

E. FOUNDATION

D.O.
____ Earth movements/gaps
Piles at:
____ a) abutments
____ b) Piers
Spread footings at:
____ a) Abutments
____ b) Piers

F. ABUTMENTS

_____ Disturbance or erosion
_____ Wall movement (____in)
_____ Backfill settlement (____in)

G. WINGWALLS

_____ Damage
o Movement
o Separation

H. APPROACHES

D.O.
____ Damage
o Operational
o Roadway settled (___in)
o Off bridge seat

I. BEARINGS

____ Integral
____ Contact
____ Rocker
____ Elastomeric Pad

J. INTERMEDIATE SUPPORTS

____ Settlement
____ Damage
o Near top
o Near bottom
o Near middle
o Moment failure
o Shear failure
o Compression failure
o Support lost

K. SUPERSTRUCTURE

D.O.
____ Girder
o Shear cracks
o Moment cracks
____ Deck
o Long. joints enlarged
o Expansion joints
____ Truss
o Upper chord
o Lower chord
o Diagonals
____ Suspenders

L. GEOTECHNICAL

____ Liquefaction
____ Landslide
____ Faulting
____ Other

REMARKS ____

Photo courtesy Cal OES

Figure 6-12 – Freeway overpass column collapse, 1994 Northridge Earthquake

conditions that need to be monitored and the criteria. Also, if another action must be taken when a threshold is reached during the monitoring, that must be noted as well. For the other recommendations, add information in the Comments section when appropriate. If the "shore and brace" circle is checked, add the location for this action in the Comments section.

Comments – This section is used to provide explanations regarding any part of the evaluation that the SAP team believes requires an explanation. When a bridge will be identified for RESTRICTED USE, the evaluator would note the restrictions if they are not checked off in the Recommendations section. If the bridge is to be posted UNSAFE, the reasons for that posting are provided here. If there is not enough room for all the comments, simply note "Over" at the bottom of the form and continue on the back side.

Bridge Description – In this section of the form, the evaluator will describe the structural system of the bridge, its configuration, and the description of the foundation system. Dimensions asked for on the form should be either estimated or paced off; the evaluator should not take the time to tape measure or chain all the dimensions requested on the form.

Damage Observed - The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

Sections E through L – These sections are for the individual components of the bridge structure. For each component, the evaluator must estimate the level of damage using the damage scale. For areas not seen, write in NO (Not Observed). Remember, as with buildings, do not perform destructive investigation. The SAP team must evaluate based on what they see by walking around, over, and under the bridge, if it is safe to do so. The SAP team must remember not to endanger themselves if the bridge is in imminent failure! In Section L, if any one of the noted conditions exist, a geotechnical evaluation should be requested. This can be noted in the Remarks section.

Remarks – This section allows for further remarks on the details of the evaluation. As with the Comments section, if there is not enough room, simply mark "Over" at the bottom of the section and continue on the back side of the form.

6.4.2 Posting

Upon completing the evaluation, the team will recommend the posting. If it is found that the bridge is seriously damaged and needs to be removed from service, the jurisdiction needs to be informed at once. The jurisdiction will then send either their public works or law enforcement staff to barricade the road and redirect traffic. If no jurisdiction representative can be quickly located, the SAP team must contact the SAP coordinator to report their findings. In cases where recommendations are not time sensitive, the team can wait until they turn in their findings to the SAP coordinator in the evening.

Bridges will not be physically posted. The placards are too small for motorists see or to understand as they approach a bridge. Barricades are the best and most likely method to be used for closing bridges.

6.5 Roads and Highways

Photo courtesy Fred Turner, EERI

Figure 6-13 – Road damage, 2010 Baja Earthquake

A copy of the two-page Roads/Highways Evaluation form begins on the next page.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
ROAD/HIGHWAY

Assessment Report No. ________

Facility Name ______________________________
Address ______________________________
Co-City-Vic ______________________________
Mo/Day/Yr _____/_____/_____ Time __________ use 24 hr.
Type of Disaster ______________________________

SAP ID Nos. __________ __________
Other Reports __________________
No. Photos _____ No. Sketches _____
Ref. Dwgs. __________________
Est. Damage %__________________
Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

Existing barricades in position O

B. RECOMMENDATIONS

Monitor____________________ O
Ok for emergency vehicles____________ O
Ok for public transportation_______ O
Ok for private vehicles______________ O
Ok for pedestrians_____________ O
Ok for one-way traffic______________ O
Ok for two-way traffic___________ O
Install barricades________________ O
Use detour(s)________________ O
Aftershocks potentially dangerous to traffic_ O
Traffic in danger due to adjacent unstable/unsound structure__________O

C. COMMENTS ____
____
____
____

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None	Slight	Moderate	Severe	Total	Not	Not
	(0%)	(1-10%)	(11 - 40%)	(41 - 60%)	(over 60%)	Applicable	Observed

D. ROADBED

D.O.		Location	Extent
_____	Fills	____________	____________
_____	Cuts	____________	____________
_____	Subgrade	____________	____________
_____	Slip-outs	____________	____________
_____	Slides	____________	____________
_____	Washouts		

E. PAVEMENTS

D.O.

_____ Longitudinal cracks

_____ Transverse cracks

_____ Vertical displacement

Amount ______________

Side up (N, S, E, W) _______

Pavement type: O AC O PCC O Other

Describe ____________________________

F. TRAFFIC CONTROL FACILITIES

D.O.

_____ Condition

o Operating

o Critical regulatory signs standing

Exceptions and conditions: ____________________

____

____

____

G. UTILITIES

D.O.

_____ Drainage

_____ Gas lines

_____ Petroleum lines

_____ Underground power lines

_____ Aboveground power lines

_____ Sewers

_____ Water lines

_____ Other ___________

H. OBSTRUCTION/HAZARDS

D.O.

_____ Bridges

_____ Buildings/structures

_____ Debris

_____ Joint poles

_____ Mud

_____ Power lines

_____ Rocks

_____ Trees

_____ Water

_____ Other ___________

I. REMARKS ____

____

____

____

____

____

____

____

____

The major highways and freeways throughout the state are part of the Federal Highways Administration federal aid system. The California Department of Transportation (Caltrans) will evaluate these roads for safety immediately following a major disaster.

The Safety Assessment Program can be used to provide engineers to evaluate bridges that are not on the federal aid system. These local roads will be important to the jurisdiction for moving resources to respond to the disaster, and eventually as part of the overall recovery.

It is likely that law enforcement and fire personnel will be the first to discover which streets are usable and which are not, because of having tried to use them on the way to provide assistance. Other input on road damage will, of course, come from the roads or public works department of the jurisdiction.

Roads can be made impassable as a result of geotechnical failure, or from debris caused by the collapse of buildings or bridge overpasses. Roads constructed on liquefiable material can break up, especially if lateral spreading occurs. Following the Kobe Earthquake in Japan, and the Coalinga Earthquake in California, debris from collapsed buildings limited emergency response.

Photo courtesy Cal OES

Figure 6-14 – Road slipout

Photo courtesy Cal OES

Figure 6-15 – Scarp damage

Photo courtesy FEMA

Figure 6-16 – Road washout, 2005 Hurricane Katrina

Roads can also be damaged or destroyed from storm and flood disasters. Roads along streams, or with culvert crossings, can be washed out. In hilly country, roads can fail due to slip outs or activated slides. Evaluators should use caution in approaching the edge of any washout, slide, or slip out, as the edge could be very fragile and can give way if walked upon, leading to injury or death.

Completing the Roads and Highways Evaluation Form

Recommendations - This section shows the typical recommendations that would apply to roads, though not necessarily the only ones. The overall recommendations of the SAP team are noted here by checking the appropriate circles, after the evaluation is complete. If the monitor circle is checked, the evaluator must be sure to note in the Comments section the conditions that need to be monitored and the criteria. Also, if another action must be taken when a threshold is reached during the monitoring, that must be noted as well. If the "Traffic in danger due to adjacent unstable/unsound structure" circle is marked, the SAP team must make sure to describe the condition in the comments section.

Comments – This section is used to provide explanations regarding any part of the evaluation that the SAP team believes requires an explanation. When a road will be identified for RESTRICTED USE, the evaluator would note the restrictions if they are not checked off in the Recommendations section. If the road is to be posted UNSAFE, the reasons for that posting are provided here. If there is not enough room for all the comments, simply note "Over" at the bottom of the form and continue on the back side.

Damage Observed - The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

Sections D through H – These are the individual components of the road that should be assessed. For each component, estimate the level of damage using the damage scale; use the 'NO" (Not Observed) rating for areas not seen. Remember, as with buildings, do not perform destructive investigation. Evaluate only what can be seen by walking around and over the roadway. Work safely – do not get too close to the edges of slip-outs or other road failures where a fall could cause injury.

Section I – Remarks – This section lets the evaluator expand in some detail on the damage assessment of the various road components. As with the comments section, if there is not enough room, simply mark "Over" at the bottom of the page and continue on the back side of the form.

6.5.2 - Posting

Upon completing the evaluation, the team will recommend the posting. If it is found that the road is seriously damaged and needs to be removed from service, the jurisdiction needs to be informed at once. The jurisdiction will then send either their public works or law enforcement staff to barricade the road and redirect traffic. If no jurisdiction representative can be quickly located, the SAP team must contact the SAP coordinator to report their findings. In cases where recommendations are not time sensitive, the team can wait until they turn in their findings to the SAP coordinator in the evening.

Roads will not be physically posted. The placards are too small for motorists to see or to understand as they approach an unsafe road. Barricades are the best and most likely method to be used for closing roads.

6.6 Pipelines

Pipelines can carry anything from fuel to water to sewage. The pipelines most likely to be evaluated in post-disaster safety assessment will be water and sewage. These are owned by public entities, and have the most significant impact on the recovery of the community.

High and medium pressure natural gas and liquid fuel lines can have devastating effects on the community, as evidenced by the 2010 San Bruno natural gas explosion and fire. These failures will be the responsibility of the pipeline owner to isolate, stabilize, and repair.

How pipelines are evaluated will be up to the jurisdiction. In most cases, the evaluation team will be given a segment of the system to assess. This may include pump stations and tank reservoirs as part of the pipeline segment.

The evaluation of buried pipelines will be problematic in that there is not much to directly see. The SAP team will need to base their evaluation on surface conditions, that is, if there is any evidence at the surface to indicate that there is damage to the subsurface pipeline. For exposed pipelines, the evaluation of course becomes more straightforward. As in all the evaluations for safety performed in the Safety Assessment Program, evaluators will not perform destructive testing.

Brittle piping, such as cast iron or vitreous clay, suffers the most in earthquakes, especially in liquefiable soils. Pipelines constructed of ductile and flexible materials, such as steel, ductile iron, or PVC, are more flexible and will likely have fewer failures.

Pipelines can fail as a result of shear, joint damage or separation, or may simply burst. Pressurized water systems can lose pressure and become inoperable if there are enough pipeline failures. In many cases, pressurized water systems will reveal their damage locations by completely washing away the road or terrain above, leaving a gaping chasm in the earth and/or water bursting out of the ground.

Most sewer pipelines operate with gravity feed, so damage from a disaster will only be obvious if the sewer line collapses, which leads to backup and overflow of sewage. In liquefiable soils, sewer lines and manholes will become buoyant, changing their vertical alignment, making their gravity feed inoperable. Identification of these types of failures will only be possible with specialized equipment, such as pipe cameras.

Photo courtesy Global Emergency Management

Figure 6-17 – Water and gas main breaks, 1994 Northridge Earthquake

In Figure 5-17, seismic disturbance disrupted both water and natural gas mains. The natural gas main found an ignition source, catching fire above the pool of water.

6.6.1 Completing the Pipeline Evaluation Form

A copy of the two-page Pipeline Evaluation form begins on the next page.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
PIPELINE

Assessment Report No. ________

Facility Name ______________________________

Address ______________________________

Co-City-Vic ______________________________

Mo/Day/Yr ______/______/______ Time ____________ use 24 hr.

Type of Disaster ______________________________

SAP ID Nos. __________ __________

Other Reports ______________________

No. Photos ______ No. Sketches _____

Ref. Dwgs. ______________________

Est. Damage %__________________

Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor ____________	O	Continue in service ____________	O
Remove from service ____________	O	Install temp. above-ground line ____	O
Provide temporary alternate service ___	O	Check water quality/safety _______	O
Unblock entrance ____________	O	Divert flow ____________	O

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

C. COMMENTS ______________________________

____

____

____

D. PIPELINE DESCRIPTION Assessment Report # ____________

1. Type of pipeline: Pressure O Gravity O Storm Drain O
   Water O San. Sewer O Other O ____________

2. Pipe nominal diameter: ______ 3. Proximity to water/sewer/gas line: ______________

	AC	CI	CMP	DI	PVC	RC	STEEL	VC	WI	Other	Unknown
Bell & Spigot											
Butt											
Caulked											
Comp. Ring											
Riveted											
Welded											
Unknown											

4. Describe the failure mode:
   - O Circumferential crack
   - O Burst pipe barrel
   - O Sheared pipe barrel
   - O Sheared service connection
   - O Pulled joint
   - O Broken joint
   - O Other ____________________________
   - O Liquefaction Describe ____________________

____

____

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NA
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

SURFACE OBSERVATIONS

D.O.

E. ____ Ground surface disturbed

F. ____ Visible leakage

G. ____ Service connection broken

H. ____ Headwall damaged

I. ____ Endwall damaged

J. ____ Manhole damaged

D.O.

K. ____ Soffit damaged

L. ____ Invert displacement

M. ____ Horizontal displacement

N. ____ Trash-rack blocked/damaged

O. ____ Leakage at valves

P. ____ Leakage continuing

Q. ____ Leakage rates _____ _____

R. Nearest valve/MH (if less than 1/4 mile) ______________________________

S. Remarks ______________________________________

Recommendations - This section shows the typical recommendations that would apply to pipelines, though not necessarily the only ones. The overall recommendations of the SAP team are noted here by checking the appropriate circles, after the evaluation is complete. If the monitor circle is checked, the evaluator must be sure to note in the Comments section the conditions that need to be monitored and the criteria. Also, if another action must be taken when a threshold is reached during the monitoring, that must be noted as well. If the “Divert Flow” circle is marked, the SAP team must make sure to describe the condition in the comments section.

Comments – This section is used to provide explanations regarding any part of the evaluation that the SAP team believes requires an explanation. When a pipeline will be posted RESTRICTED USE, the evaluator would note the restrictions if they are not checked off in the Recommendations section. If the pipeline is to be posted UNSAFE, the reasons for that posting are provided here. If there is not enough room for all the comments, simply note “Over” at the bottom of the form and continue on the back side.

Damage Observed - The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator’s use of the scales is based strictly on their professional judgment.

Pipeline Description – In this section of the evaluation form, the evaluator will describe the construction and materials of the pipeline, along with the materials carried. The dimensions requested can be either estimated, or measured with a measuring tape.

Sections E Through R – These are typical conditions that show the pipeline is damaged. For each element, the SAP evaluator must estimate the level of damage using the damage scale. For areas not seen, use the NO (Not Observed) rating. As with the rest of the Safety Assessment Program, do not perform destructive investigation. Evaluate only what can be seen by walking around, over, and under the pipeline. If the pipeline is buried, look for conditions on the surface will indicate that these types of damage have occurred. If none are observed, mark the line with NO. In item Q, if leakage is found, make the “best estimate” on the leakage rate. In Section R, the closest manhole can be estimated or paced. The evaluator can indicate somewhere on the form the direction to the nearest manhole.

Remarks – This section lets an evaluator expand in some detail the results of the evaluation. As with the Comments section, if there is not enough room, simply mark “Over” at the bottom and continue on the back side of the form.

Photo courtesy Global Emergency Management

Figure 6-18 – Streambed crossing

Photo courtesy San Francisco Public Works Department

Figure 6-19 – Sink hole at storm main break

6.6.2 - Posting

Upon completing the evaluation, the team will recommend the posting. If it is found that the pipeline is seriously damaged and needs to be removed from service, the jurisdiction needs to be informed at once. The jurisdiction will then contact Public Works to ensure that the proper actions are taken. If no jurisdiction representative can be quickly located, the SAP team must contact the SAP coordinator to report their findings. In cases where recommendations are not time sensitive, the team can wait until they turn in their findings to the SAP coordinator in the evening.

6.7 Pump Stations

Pump stations may be assigned for evaluation separately, or as part of a segment of pipeline. When the pump station is located above ground in a building, the SAP team needs to include a building Rapid or Detailed Evaluation form to cover the structural and nonstructural components of the building.

Pump stations are part of water, wastewater, natural gas, and liquid fuel systems. All but wastewater pump stations are usually at grade, and may have components as deep as 10 feet below grade. The most common types of damage will include damage to the electrical power and control systems, fallen electrical cabinets, and damage to piping. Building damage is less likely unless the structure is unreinforced masonry.

Wastewater pump stations may be many tens of feet deep and are often found in liquefiable soils. Such are called "lift stations." If the soil liquefies, the pump stations can become buoyant, breaking the connecting piping.

A copy of the two-page Pump Station Evaluation form begins on the next page.

Photo courtesy Global Emergency Management

Figure 6-20 – Pump station

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
PUMP STATION

Assessment Report No. ________

Facility Name ______________________	SAP ID Nos. ________ ________
Address ______________________	Other Reports ______________
Co-City-Vic ______________________	No. Photos _____ No. Sketches _____
Mo/Day/Yr ____/____/____ Time ________ use 24 hr.	Ref. Dwgs. ______________
Type of Disaster ______________________	Est. Damage %____________
	Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor______________	O	Continue in service__________	O
Remove from service__________	O	Check pump-motor alignment_____	O
Brace structure before using________	O	Recheck after power restored_____	O
Check filter basket__________	O		
______________		______________	
______________		______________	
______________		______________	

C. COMMENTS ______________________________

____

____

____

D. PUMP STATION DESCRIPTION Assessment Report # ______________

O Water O Wastewater O Sewage O Other ________________

O Wet Well

O Dry Well

	No. Motors				No. Operable			
	Elect	Gas	Gasoline	Diesel	Elect.	Gas	Gasoline	Diesel
Centrifugal								
Reciprocal								
Horizontal								
Vertical								

Str. Type	Buried	Above Grade
Concrete		
Masonry		
Frame		
Other		

O Building (Building Evaluation Attached O)

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None	Slight	Moderate	Severe	Total	Not	Not
	(0%)	(1-10%)	(11 - 40%)	(41 - 60%)	(over 60%)	Applicable	Observed

E. STRUCTURE
D.O.
_____ Access
_____ Crane runway
_____ Fixed hoist
_____ Floor
_____ Fore bay
_____ Foundation
_____ Roof
_____ Walls
_____ Hatches

F. PUMPS
_____ Anchors
_____ Casing
_____ Connected piping
_____ Supports
_____ Valving

G. MOTORS/ENGINES
D.O.
_____ Anchors
_____ Connected piping
_____ Couplings to pumps
_____ Power supply
_____ Transformer(s)

H. CONTROLS
_____ Internal power
_____ Supports
_____ Wiring
_____ Valving

K. EXTERNAL PIPING

	Inlet	Outlet
Piping	____	____
Leaked	o	o
Leaking	o	o

Leakage rate, gpm _________

I. EXTERNAL POWER
D.O.
_____ Electrical continuity
_____ Fuel lines
_____ Fuel storage

J. AUXILIARY EQUIPMENT
_____ Charts
_____ Lighting, exterior
_____ Lighting, interior
_____ Meters & gauges
_____ Overhead crane
_____ Small diameter piping
_____ Electrical Cabinets

L. REMARKS ____

____

____

6.7.1 Completing the Pump Station Evaluation Form

Recommendations - This section shows the typical recommendations that would apply to pump stations, though not necessarily the only ones. The overall recommendations of the SAP team are noted here by checking the appropriate circles, after the evaluation is complete. If the monitor circle is checked, the evaluator must be sure to note in the Comments section the conditions that need to be monitored and the criteria. Also, if another action must be taken when a threshold is reached during the monitoring, that must be noted as well. If the "Brace Structure" circle is marked, the SAP team must make sure to describe the condition in the comments section. For other circles, add information in the Comments section when appropriate.

Comments – This section is used to provide explanations regarding any part of the evaluation that the SAP team believes requires an explanation. When a pump station will be posted RESTRICTED USE, the evaluator would note the restrictions if they are not checked off in the Recommendations section. If the pump station is to be posted UNSAFE, the reasons for that posting are provided here. If there is not enough room for all the comments, simply note "Over" at the bottom of the form and continue on the back side.

Pump Station Description – In this section, the evaluator describes the type of pump, and the construction and materials of the station.

Damage Observed - The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

Sections E through K – These sections provide the evaluation of the various components of the station. If the station is above ground and inside a structure, a small note in this section regarding the building safety assessment would be appropriate. For each element, estimate the level of damage using the damage scale. For areas not seen, use the "NO" (Not Observed) rating. Remember, as with buildings, do not do destructive testing. In Item K, if leakage is found, make a "best estimate" on the leakage rate.

Section L – This section allows the SAP team to expand in some detail the results of the assessment. As with the Comments section, if there is not enough room, simply mark "Over" at the bottom and continue on the back side of the form.

6.7.2 Posting

Upon completing the evaluation, the team will recommend the posting. If it is found that the pump station is seriously damaged and needs to be removed from service, the jurisdiction needs to be informed at once. The jurisdiction will then contact Public Works to ensure that the proper actions are taken. If no jurisdiction representative can be quickly located, the SAP team must contact the SAP coordinator to report their findings. In cases where recommendations are not time sensitive, the team can wait until they turn in their findings to the SAP coordinator in the evening. If the pump station is in an above ground building and a building evaluation has been performed as well, the building must be posted based on the *building's safety assessment.* If the building itself has a RESTRICTED USE or UNSAFE posting placed on it, the evaluator is to note on the placard the reasons for the posting.

6.8 Reservoirs (Tanks)

This section refers to steel or reinforced concrete tanks, commonly referred to as ‘reservoirs.’

Many jurisdictions around the state use water tanks for storing domestic water supplies. These tanks are highly susceptible to damage from earthquakes. It is possible that safety evaluations may be performed on tank reservoirs after other types of disasters, but it is most likely that tanks will be evaluated for safety after a strong earthquake.

Because the water in these tanks is used to fight fires as well as to drink, they are very important to local governments after a disaster, especially when the local government’s water mains have been disrupted.

Some of the types of damage that may occur to unanchored steel tanks include uplift of the entire tank, leading to the connecting piping being damaged or broken. When ground motions become strong and the tank walls are forced into resisting overturning and bending forces, the tank wall will buckle at the base, leading to the condition called ‘elephant’s foot.’ In severe cases, the floor to roof seam will burst open. Sloshing water can also damage the roof of the tank.

Concrete tanks with steel cable reinforcing can slide off their foundations and suffer roof damage from sloshing as well. They can also suffer damage from failure of the reinforcing if the design was not adequate for the seismic forces being resisted.

Photo courtesy Steinbrugge Collection

Figure 6-21 – Steel water tank with ‘elephant’s foot’ buckling

6.8.1 Completing the Reservoir Evaluation Form

A copy of the four-page Reservoir Evaluation Form begins on the next page.

Two types of reservoir tanks are included in the evaluation form: steel, and reinforced concrete. The SAP team should identify at once which type of reservoir being evaluated, and disregard or discard the form used for the other type. If the team is unsure about any part of this form, the item should be noted "NO" (Not Observed) or indicate unsure.

Recommendations - This section shows the typical recommendations that would apply to reservoirs, though not necessarily the only ones. The overall recommendations of the SAP team are noted here by checking the appropriate circles, after the evaluation is complete. If the monitor circle is checked, the evaluator must be sure to note in the Comments section the conditions that need to be monitored and the criteria. Also, if another action must be taken when a threshold is reached during the monitoring, that must be noted as well. For other circles, add information in the Comments section when appropriate.

Comments – This section is used to provide explanations regarding any part of the evaluation that the SAP team believes requires an explanation. When a reservoir will be posted RESTRICTED USE, the evaluator would note the restrictions if they are not checked off in the Recommendations section. If the reservoir is to be posted UNSAFE, the reasons for that posting are provided here. If there is not enough room for all the comments, simply note "Over" at the bottom of the form and continue on the back side.

Section D – Description – This section is only used if the reservoir is of steel construction. In this section, the SAP team describes in a fair amount of detail the construction of the steel reservoir. The capacity, height, and diameter of the tank should be estimated if not known.

Damage Observed - The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

Sections E through K – These sections are where the safety assessments of the various components of the reservoir are recorded. Areas where rocking or sliding exist are noted, with the direction and distance noted in the Remarks section. For each element, estimate the level of damage using the damage scale. For areas not seen, use the "NO" (Not Observed) rating. Remember, as with buildings, do not perform destructive testing. Rate only what can be seen by walking around the reservoir. If there is a leak, provide an estimate of the leakage rate at the bottom of the page.

Section L – Remarks – This section allows the SAP team to expand upon the results of the evaluation. As with the Comments section, if there is not enough room, simply mark "Over" at the bottom of the page and continue on the back side of the form.

Section M – Description – This part of the form is only used if the reservoir is of concrete construction. In this section, the evaluator describes the construction of the reservoir in a fair amount of detail. The capacity, height, and diameter should be estimate if not known. Provide

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
RESERVOIR

Assessment Report No. ________

Facility Name ______________________________
Address ______________________________
Co-City-Vic ______________________________
Mo/Day/Yr ______/______/______ Time ________ use 24 hr.
Type of Disaster ______________________________

SAP ID Nos. __________ __________
Other Reports ____________________
No. Photos _____ No. Sketches _____
Ref. Dwgs. ____________________
Est. Damage %____________________
Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
	None O		Green O		Yes O
	Green O		Yellow O		No O
	Yellow O		Red O		
	Red O				

B. RECOMMENDATIONS

Monitor________________________ O
Remove from service______________ O
Continue in service_______________ O

Continue in service, repair ASAP________ O
Drain and repair______________________ O
Lower water level and continue service____ O
_________ ft

______________________________ ______________________________
______________________________ ______________________________
______________________________ ______________________________

C. COMMENTS ____
____
____

STEEL RESERVOIR Assessment Report # __________

D. RESERVOIR DESCRIPTION

Capacity ______ MG Wall Height ______ ft O/S Diameter ______ ft

Roof Type O Wood O Steel O Flat O Conical O Knuckled Edge

Shell O Welded O Bolted O Riveted

Floor support O Footing ring O Oiled sand O A.C. O Other ________________

Footing O Concrete ring O Other ______________ O None

Pipe connection O Rigid O Flexible

Anchorage to foundation _____ Dia. __________ Spacing

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

E. SHELL

D.O.

_____ Elephant's foot

a. Height ______ ft

b. Circumferential extent ______ft

_____ Other buckling

_____ Horizontal joints broken

_____ Vertical joints broken

_____ Plate split

_____ Seismic anchors

_____ Rocking of reservoir evidenced

_____ Sliding of reservoir evidenced

_____ Leaks evident. Rate ________ gpm

_____ Unexplained wet spots on adjacent ground

_____ Shell penetrations damaged

_____ Other attachments to shell damaged

_____ Pipe Connections to Tank

F. VALVE PIT

D.O.

_____ Access

_____ Control Piping

_____ Gauges

_____ Hatches

_____ Inlet-outlet piping

_____ Pit flooded

_____ Roof

_____ Walls

_____ Charts

_____ Valves

G. _____ **Roof**

H. _____ **Footing**

I. _____ **Floor**

J. _____ **Aboveground Piping**

K. _____ **Underground Piping**

L. REMARKS ____

____

____

____

PRESTRESSED CONCRETE RESERVOIR Assessment Report # __________

M. RESERVOIR DESCRIPTION:

Wire or Strand Wrapped	Buttress Type using individual Tendons, usually inside wall	Bar Tendons on Tank Surface
TENDONS:		
O 220 ksi - 0.142" or 0.172" dia	O Strands O Wires O Bars	O Bars with prop. couplers
O 270 ksi - 3/8" dia		
WALL CONSTRUCTION:		
O Cast-in-place	O Cast-in-place	O Cast-in-place
O Shotcrete	O Precast	O Shotcrete
O Shotcrete w/ steel diaphragm		
O Precast		
O Precast w/ steel diaphragm		

TENDON PROTECTION SYSTEMS:

O Shotcrete   O Corrosion inhibiting grease   O Galvanizing protected by plastic sheath

O Grout

Tank Restraints O Seismic cables O Curb (restraining sliding)

Capacity _______ MG Wall height ______ ft O/S diameter ______ ft

Roof Type: O Flat O Dome Exposed O Yes O No O Fill depth _______ Surface usage _____________

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None	Slight	Moderate	Severe	Total	Not	Not
	(0%)	(1-10%)	(11 - 40%)	(41 - 60%)	(over 60%)	Applicable	Observed

N. SHELL

D.O.

_____ Shell or shotcrete cracked
_____ Vertical cracks more than 2 feet long
_____ Unexplained excessive loss of contents
_____ Bulging observable
_____ Visible construction joints
_____ Wall leaking
_____ Wet spots
_____ Spouts
_____ Horizontal cracks more than 25% of perimeter
_____ Corrosion at horizontal cracks
_____ Shotcrete delaminated at cracks
_____ Attachments to shell loose
_____ Leaks @ rust stains
_____ Major leaks at shell/foundation joint
_____ Unexplained wet spots on adjacent ground
_____ Corrosion at manholes/other penetrations

Leakage rate ______ gpm

O. HORIZONTAL PRESTRESSING

D.O.

1. Wrapping:
   _____ Corrosion
   _____ Corrosion at horizontal cracks
2. Individual tendons:
   _____ Corrosion products
   _____ Leaks @ tendon locations
   _____ Leaks @ tendon anchorages
   _____ Tendon anchorage distressed
   _____ Tendon anchorage disrupted/loose
   _____ Cracking in vicinity of tendon anchorage
   _____ Tendon location visually observable
   _____ Discoloration of concrete in line w/tendons
3. Bar tendons on surface:
   _____ Tendons failed
   _____ Tendons sound loose
   _____ Evidence of rust

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None	Slight	Moderate	Severe	Total	Not	Not
	(0%)	(1-10%)	(11 - 40%)	(41 - 60%)	(over 60%)	Applicable	Observed

P. ROOF

D.O.

Flat or conical

_____ Displaced with respect to wall
_____ Sagging
_____ Cracked at edges
_____ Cracked at interior supports
_____ Supporting column spalled

Dome Shell

O Shotcrete O CIP concrete

O Precast concrete

_____ Construction joints
_____ Cracks

O Show reinforcement/corrosion

O Increasing with time

_____ Delaminating
_____ Misalignment of surface
_____ Rust lines @ top of soffit over rebars
_____ Dome Ring
_____ Corrosion
_____ Distress @ shell/ring juncture
_____ Shotcrete loose/hollow-sounding
_____ Vertical cracks
_____ Wire (strand) exposed/corroded

D.O.

Q. _____ **FOOTING**

R. _____ **FLOOR**

S. _____ **ABOVEGROUND PIPING**

T. VALVE PIT

_____ Access
_____ Control piping
_____ Gauges
_____ Hatches (equipment)
_____ Inlet-outlet piping
_____ Pit flooded (depth _____ ft)
_____ Roof
_____ Walls
_____ Charts
_____ Valves

U. REMARKS ____________________

____
____
____
____
____
____
____
____
____

the size and strength of the steel tendons only if this information is known. This information about the steel tendons can be found on construction drawings if these are available.

Sections N through T - These sections are where the safety assessments of the various components of the reservoir are recorded. Areas where rocking or sliding exist are noted, with the direction and distance noted in the Remarks section. For each element, estimate the level of damage using the damage scale. For areas not seen, use the "NO" (Not Observed) rating. Remember, as with buildings, do not perform destructive testing. Rate only what can be seen by walking around the reservoir. If there is a leak, provide an estimate of the leakage rate at the bottom of the page.

Section U – Remarks - This section lets an evaluator expand in some detail the results of the evaluation. As with the Comments section, if there is not enough room, simply mark "Over" at the bottom and continue on the back side of the form.

6.8.2 Posting

Upon completing the evaluation, the team will recommend the posting. If it is found that the reservoir is seriously damaged and needs to be removed from service, the jurisdiction needs to be informed at once. The jurisdiction will then contact Public Works to ensure that the proper actions are taken. If no jurisdiction representative can be quickly located, the SAP team must contact the SAP coordinator to report their findings. In cases where recommendations are not time sensitive, the team can wait until they turn in their findings to the SAP coordinator in the evening.

6.9 Wastewater Treatment Plants

Photo courtesy San Francisco Department of Public Works

Figure 6-22 – Oceanside Wastewater Treatment Plant, San Francisco

Wastewater treatment plants are complex systems made up of many components. These include buried and above ground piping, concrete basins and galleries, buildings, chemical piping, and electrical control systems. Be prepared to not only complete the Wastewater Treatment Plant forms, but also the Rapid Assessment or Detailed Assessment forms for the buildings associated with the plant.

The goal with this is to recommend whether or not the facility should remain in operation. With the level of complexity involved, it could be easy to forget that the SAP team is to remain focused on this goal. As with the rest of the safety assessments, do not perform any destructive testing. The facility operators and staff will perform any testing or addition of chemicals in accord with standard operating procedures and/or state and local regulations.

In a wastewater treatment plants, widespread damage can occur due to liquefaction, lateral spreading, and settlement. Among the many types of damage are these:

- Sewer lines broken
- Concrete basins and buildings settling
- Failed expansion joints at basins, allowing sewage to flow into galleries
- Galleries flooded from broken pipes
- Flooding from broken pipes submerging electrical controls
- Baffles in large basins broken as a result of sloshing sewage
- Chemical storage and piping systems being broken, including that for chlorine gas
- Guides on floating digester roofs breaking, allowing sludge gas (methane) to escape and possibly explode or catch on fire.
- Unanchored electrical equipment can overturn
- Buildings can be damaged or destroyed

Along with evaluating if the plant should remain in operation, the next goal is to keep as much of the plant in operation as possible. It would be desirable to maintain operations of the headworks, primary sedimentation basins, and chlorine disinfection system as a minimum, even if the secondary or tertiary systems were heavily damaged and not operational.

6.9.1 Completing the Wastewater Treatment Plant Evaluation Form

A copy of the three-page Wastewater Treatment Plant Evaluation form begins on the next page.

Recommendations - This section shows the typical recommendations that would apply to wastewater treatment plants, though not necessarily the only ones. The overall recommendations of the SAP team are noted here by checking the appropriate circles, after the evaluation is complete. If the monitor circle is checked, the evaluator must be sure to note in the Comments section the conditions that need to be monitored and the criteria. Also, if another action must be taken when a threshold is reached during the monitoring, that must be noted as well. For other circles, add information in the Comments section when appropriate. If the “Chlorinate and by-pass” or “Check effluent quality/safety” circles are checked, these instructions are directed to the plant operator. These are only recommendations, and the plant operators will follow their standard operating procedures.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
TREATMENT PLANT (WASTEWATER)

Assessment Report No. _________

Facility Name ________________________________

Address ________________________________

Co-City-Vic ________________________________

Mo/Day/Yr ______/______/______ Time ____________ use 24 hr.

Type of Disaster ________________________________

SAP ID Nos. __________ __________

Other Reports ____________________

No. Photos _____ No. Sketches _____

Ref. Dwgs. ______________________

Est. Damage %__________________

Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor__________________________ O

Remove from service_______________ O

Chlorinate and by-pass_____________ O

Continue in service_____________ O

Check effluent quality/safety______ O

________________________________ ________________________________

________________________________ ________________________________

C. COMMENTS: ________________________________

____

____

____

____

____

DAMAGE OBSERVED (D.O.)

	0	1	2-3-4	5	6	NA	NO
Damage Scale:	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

D. PROCESS COMPONENT (D.O.)

	Structural	Mechanical	Electrical
Screening/grinding	______	______	______
Influent pumping	______	______	______
Grit removal	______	______	______
Primary treatment	______	______	______
Secondary treatment	______	______	______
Tertiary treatment	______	______	______
Quaternary treatment	______	______	______
Effluent disinfection	______	______	______
Solids digestion	______	______	______
Solids dewatering	______	______	______
Solids disposal	______	______	______

E. TRIBUTARY PUMPING PLANTS/FORCE MAINS

Pumping Plant Name			
______	______	______	______
______	______	______	______
______	______	______	______

F. TRIBUTARY GRAVITY SEWER SYSTEM

Briefly summarize your assessment of the condition of the gravity sewer system (recognizing the limitations of time and resources during this initial inspection period).

____

____

____

____

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____

____

Assessment Report # ____________

Check:	Electrical power (control panel, emergency generator) Telemetry Disinfection process (chemical containers, feeder, piping) Broken pipes, flooding, leaking Chemical feed (spills) Unit Processes

	OBSERVATIONS
RAW SEWAGE	____________________
SCREENING/GRINDING	____________________
INFLUENT PUMPING	____________________
GRIT REMOVAL	____________________
PRIMARY TREATMENT	____________________
SECONDARY TREATMENT	____________________
TERTIARY TREATMENT	____________________
QUATERNARY TREATMENT	____________________
EFFLUENT DISINFECTION	____________________
SOLIDS DIGESTION	____________________
SOLIDS DEWATERING	____________________
SOLIDS DISPOSAL	____________________

Comments – This section is used to provide explanations regarding any part of the evaluation that the SAP team believes requires an explanation. When a plant will be posted RESTRICTED USE, the evaluator would note the restrictions if they are not checked off in the Recommendations section. If the plant is to be posted UNSAFE, the reasons for that posting are provided here. If there is not enough room for all the comments, simply note "Over" at the bottom of the form and continue on the back side.

Damage Observed - The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

Sections D and E – These sections provide the evaluation of the various structural, electrical, and mechanical components of the plant. For each element, estimate the level of damage using the damage scale. For areas not seen, use the "NO" (Not Observed) rating. As with buildings, SAP evaluators are not to perform destructive testing. Provide the information for Section E only if the SAP team has access to the information. If there is no access to the information, note that the information is Not Available. Do not use "NA," as that can mean that the section is Not Applicable.

Section F – Tributary Gravity Sewer System – This section allows the team to summarize their evaluation of the condition of the gravity sewer system. This should be a brief statement, as the team is not performing an engineering evaluation.

Last Page – This section records the team's observations regarding overall plant operation in dealing with these processes. At the top of the page is a checklist to assist with performing the evaluation.

6.9.2 Posting

Upon completing the evaluation, the team will recommend the posting. If it is found that the plant is seriously damaged and needs to be removed from service, the jurisdiction needs to be informed at once. The jurisdiction will then contact Public Works to ensure that the proper actions are taken. If no jurisdiction representative can be quickly located, the SAP team must contact the SAP coordinator to report their findings. In cases where recommendations are not time sensitive, the team can wait until they turn in their findings to the SAP coordinator in the evening.

If the team has performed building evaluations at the facility, the team must be certain to post the buildings accordingly. If the buildings are posted RESTRICTED USE, list the restrictions on the space provided on the placard. If the buildings are posted UNSAFE, note the conditions leading to the UNSAFE posting. The SAP team must attaché the Rapid or Detailed (building) Evaluation forms to the Wastewater Treatment Plant form accordingly.

Figure 6-23 – Water treatment plant

6.10 Water Treatment Plants

Water treatment plants will be evaluated for safety much the same as wastewater treatment plants are. These facilities likewise include many complex systems and elements. These include buried and above ground piping, concrete basins and galleries, buildings, chemical piping, and electrical control systems. Be prepared to not only complete the Wastewater Treatment Plant forms, but also the Rapid Assessment or Detailed Assessment forms for the buildings associated with the plant.

The goal with this is to recommend whether or not the facility should remain in operation. With the level of complexity involved, it could be easy to forget that the SAP team is to remain focused on this goal. As with the rest of the safety assessments, do not perform any destructive testing. The facility operators and staff will perform any testing or addition of chemicals in accord with standard operating procedures and/or state and local regulations.

Water treatment plants might be constructed far from liquefiable soils, and if so, are less likely to suffer damage than the wastewater treatment plants are. Sloshing water inside basins can damage baffle plates. Unanchored equipment will slide or topple over. The concrete basins may have limited damage if they are built on competent soil. There are many chemicals used in water treatment, including possibly gaseous chlorine, although some facilities have eliminated this chemical from use due to its hazardous nature.

6.10.1 Completing the Water Treatment Plant Evaluation Form

A copy of the three-page Water Treatment Plant Evaluation form begins on the next page.

Recommendations - This section shows the typical recommendations that would apply to water treatment plants, though not necessarily the only ones. The overall recommendations of the SAP team are noted here by checking the appropriate circles, after the evaluation is complete. If the monitor circle is checked, the evaluator must be sure to note in the Comments section the conditions that need to be monitored and the criteria. Also, if another action must be taken when a threshold is reached during the monitoring, that must be noted as well. For other circles, add information in the Comments section when appropriate. If the “Chlorinate and by-pass” or “Check effluent quality/safety” circles are checked, these instructions are directed to the plant operator. These are only recommendations, and the plant operators will follow their standard operating procedures.

Comments – This section is used to provide explanations regarding any part of the evaluation that the SAP team believes requires an explanation. When a plant will be posted RESTRICTED USE, the evaluator would note the restrictions if they are not checked off in the Recommendations section. If the plant is to be posted UNSAFE, the reasons for that posting are provided here. If there is not enough room for all the comments, simply note “Over” at the bottom of the form and continue on the back side.

Damage Observed - The damage observed scale runs from 0 to 6, and is used to rate the damages that are found. Damage rates run from 0=None, to 3=Moderate, to 6=Total. This scale gives the evaluator and the jurisdiction a toll to indicate the level of damage. However, the evaluator’s use of the scales is based strictly on their professional judgment.

Sections D through J – These are the individual components of the plant that should be evaluated for safety. For each component, estimate the level of damage using the damage scale. For areas not seen, use the “NO” (Not Observed) rating. As with buildings, the evaluators are not to perform destructive testing. Rate only what can be seen by walking around the plant.

STATE OF CALIFORNIA

SAFETY ASSESSMENT PROGRAM

TREATMENT PLANT (WATER)

Assessment Report No. __________

Facility Name ________________________________

Address ________________________________

Co-City-Vic ________________________________

Mo/Day/Yr ______/______/______ Time ____________ use 24 hr.

Type of Disaster ________________________________

SAP ID Nos. __________ __________

Other Reports ____________________

No. Photos _____ No. Sketches _____

Ref. Dwgs. ____________________

Est. Damage %____________________

Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor______________________ O

Remove from service______________ O

Chlorinate and by-pass____________ O

Continue in service______________ O

Check effluent quality/safety_________ O

____

____

C. COMMENTS:

____

____

____

____

____

____

Assessment Report # ______________

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

D. PRETREATMENT

D.O.

_____ Raw water channels
_____ Aerators
_____ Rapid mix
_____ Flocculation
    _____ basins
    _____ baffles
    _____ paddles
    _____ scrapers
_____ Sedimentation
    _____ basin
    _____ troughs
    _____ scrapers

E. FILTRATION

_____ Structure
_____ Troughs
_____ Beds
_____ Backwash system
_____ Surface wash system

F. CHEMICAL TREATMENT

_____ Chlorine piping
_____ Chlorine cylinders
_____ Chlorine feeders
_____ Other chemical piping
_____ Other chemical feeders
_____ Other chemical storage

G. CONTROL SYSTEMS

_____ Mechanical
_____ Electrical
_____ Pneumatic
_____ Hydraulic
_____ Manual
_____ Automatic

H. HEAD HOUSE

D.O.

_____ Bearing walls
_____ Nonbearing walls
_____ Frame (general condition)
_____ Structural members
    _____ Structural connections
    _____ Roof
    _____ Floors
    _____ Stairs
_____ Elevators
_____ Glass
_____ Mechanical equipment
_____ Electrical equipment
_____ Filter gallery
    _____ Piping
    _____ Pipe gallery

I. CLEARWALL

_____ Tank-type (use Reservoir Assessment Form)
_____ Containment structure
_____ Influent piping
_____ Effluent piping

J. WASHWATER RECLAMATION

_____ Settling basin
_____ Mechanical equipment
_____ Electrical equipment
_____ Piping
_____ Detention basin
_____ Sludge discharge

K. REMARKS ______________________________

____
____
____
____
____
____
____

Assessment Report # ____________

Check:

Electrical power (control panel, emergency generator)
Telemetry
Disinfection process (chemical containers, feeder, piping)
Broken pipes, flooding, leaking
Chemical feed (spills)
Unit Processes

OBSERVATIONS

RAW WATER ____________________
____

PRECHLORINATION ____________________
____

AERATION ____________________
____

RAPID MIX ____________________
____

FLOCCULATION ____________________
____

SEDIMENTATION ____________________
____

FILTRATION ____________________
____

DISINFECTION ____________________
____

FLUORIDATION ____________________
____

CLEARWELL ____________________
____

DISTRIBUTION SYSTEM ____________________
____

Section K – Remarks – This section lets the team expound in some detail on the evaluation of the various components. As with the Comments section, if there is not enough room, simply mark "Over" at the bottom and continue on the back side of the form.

Last Page – This section records the team's observations regarding overall safety of the plant. At the top of the page is a checklist to assist with this effort.

6.10.2 Posting

Upon completing the evaluation, the team will recommend the posting. If it is found that the plant is seriously damaged and needs to be removed from service, the jurisdiction needs to be informed at once. The jurisdiction will then contact Public Works to ensure that the proper actions are taken. If no jurisdiction representative can be quickly located, the SAP team must contact the SAP coordinator to report their findings. In cases where recommendations are not time sensitive, the team can wait until they turn in their findings to the SAP coordinator in the evening.

If the team has performed building evaluations at the facility, the team must be certain to post the buildings accordingly. If the buildings are posted RESTRICTED USE, list the restrictions on the space provided on the placard. If the buildings are posted UNSAFE, note the conditions leading to the UNSAFE posting. The SAP team must attaché the Rapid or Detailed (building) Evaluation forms to the Water Treatment Plant form accordingly.

UNIT 7 FIELD SAFETY

UNIT 7 – FIELD SAFETY

Overview

Safety assessment evaluators need to know how to conduct their evaluations in a safe manner. This includes basic field safety and equipment, safe conduct around and when entering damaged buildings, being mentally and emotionally prepared for working in the disaster theater, and being able to identify (and stay away from) hazardous materials that are in the area.

Training Goal

Participants will know how to conduct themselves safely while they complete their work. They will also be able to protect themselves from critical incident stress and hazardous materials.

Objectives

Upon completion of this unit, participants will be able to:

- Take appropriate steps to protect themselves and their team members from potential hazards while working in the disaster area
- Read the hazardous materials placards
- Read Urban Search and Rescue tagging

7.0 Field Safety

Safety in the field is one of the most important topics to be discussed in safety assessment training. In the classroom, most safety concepts will seem entirely reasonable and even ‘common sense.’ However, once in the field, it is easy to become overly enthusiastic and forget these basic safety rules.

At the end of this chapter is the “Building Assessment Safety Checklist.” There are two copies, one to remain in the student manual, and one that has been reduced in size so it can be copied, cut out, and inserted in the ATC-20-1 Field Manual, so it can be easily referred to during a response.

7.1 During Inspections

The importance cannot be emphasized enough of being aware of one’s surroundings, and determining if it is actually safe to enter a building or part of a building before doing so.

These are general safety rules that apply at all times while performing safety assessments.

- **Be aware and cautious.** An evaluator must be aware of what the dangers are in the vicinity. The built environment has changed as a result of the disaster, and features that might appear to be stable could be on the edge of failure. Keep in mind that SAP evaluators might be the first persons to face dangers around these damaged buildings. No one else may know the hazards that the SAP teams may be walking into. Evaluators should therefore assume the worst and be prepared.
- **Always work in teams of at least two individuals.** No one must be allowed to go out into the field by themselves; they might not come back! Evaluation teams must always be established with at least two individuals. Never split up in order to cover the area more quickly. Always use the ‘buddy system’ and know where the other members of the team are. One of the team members remains outside the building waiting for the other to return; if there is trouble, the one outside the building can call immediately for help. For Detailed Evaluation teams, where it is necessary to enter damaged buildings, evaluation teams must be composed of three individuals, wherever possible, so one team member can remain outside the building while the other two enter it. If a Rapid Evaluation team is composed of only two individuals, they should not enter a building unless absolutely necessary, and then only if it is safe to do so.
- **Always wear a hard hat and safety shoes.** Falling hazards abound around damaged structures, so it is imperative to wear a hard hat. Hard hats can also protect from low-hanging exposed electrical wires. Safety shoes likewise are essential to protect from dangerous conditions in the field. Individuals without these personal protection items must not be allowed to work in the field. In addition, one must not assume that the local government being assisted will provide any of these things to SAP evaluators.
- **Beware of hidden holes around the property.** In wildland fires, manholes and septic tanks can have damaged covers, which can trap SAP evaluators and cause injury. Be very aware of where one steps; always step on solid ground.
- **If an injury occurs…** Alert 911, let them know the location of the injured person in terms of cross streets and address, if available.

- **Do not enter obviously unsafe buildings.** This seems like common sense, but it may be easy to forget when observing building after building in the field that has not collapsed yet. For the most part, unsafe buildings are those that have suffered partial or complete collapse. A building that is racked should automatically be considered unsafe to enter, not only for the occupants, but also for the SAP team. The team should also look for evidence of separation between walls and framing before entering a building. If such exists, and the team needs to enter the building, the areas near the separated walls must be avoided.
- **Do not enter buildings or part of buildings located on potentially unstable slopes.** The condition found in Figure 6-19 is a good example of this; there is simply no reason to enter such a dangerous building. If a building is sited on an unstable slope, it is not known when the slope will give way. With aftershocks especially, the conditions can rapidly change, and what seemed stable a few minutes ago may not be stable now. Basically, the SAP team must make sure that the building's foundation and soils can support the added weight of the team; if there is any question at all about this, the team must not enter the building.
- **Do not enter buildings where falling hazards exist that can block exits.** The condition where a length of parapet or other feature falls and blocks the building exits while evaluators are in the building is a real concern. The team must be aware of the potential for falling hazards before entering or exiting a building.
- **If the building being evaluated is leaning excessively or is significantly out of plumb, do not enter.** Both of these conditions represent a racked condition, which easily can place the building in a 'failure mode.' It is only a question of time before such a building collapses due to P-delta effects, or lateral loading from wind or aftershocks. It does not take much racking to place a building into a collapse hazard. Whenever possible, stay on the high side of the building (opposite direction of the racking) and be aware of the potential hazard.
- **Before entering any building, make sure exit doors are fully operable, pathways are clear, and there are no falling hazards that could obstruct the pathway.** If pathways are blocked by debris, do not bother to enter! A SAP evaluator can end up in danger if sudden evacuation becomes necessary due to an aftershock, and the pathway is blocked by debris that may move and become impossible to get past. Also, before entering a building, the SAP evaluator must make sure that the exit doors work, and that there are no falling hazards *inside* the building (such as cabinets or shelves) that can block doors and prohibit exiting. When entering a building, make sure to keep in fairly direct access to those exits that are operational.
- **Be aware of hanging or exposed electrical wires.** Always assume that electrical wires are alive! There should be virtually no case where one needs to move an electrical wire. If one does have to be moved, take every reasonable precaution! There is an increasing likelihood of on-site power generation; not only from diesel generators, large and small, but also from solar panels, which are increasingly common.

After the Rapid Evaluations, there may be a need for subsequent evaluations. These may be Detailed Evaluations, or more Rapid Evaluations needed because of aftershock activity. If an unsafe building must be entered that has not been braced, shored, or otherwise stabilized, the following steps must be taken:

- **Visually assess the damage from the exterior and evaluate the potential for collapse.** If the building appears to be facing imminent collapse, *do not enter!* No matter the issues, SAP teams must never enter a building that is facing imminent collapse. Such a structure must be braced, shored, or otherwise stabilized before *anyone* goes inside. Once you are able to enter the building, stay away from weaker open areas or rooms.
- **Do not enter a building in which a hazardous material spill or release has occurred.** Before entering a building, observe the warning placard on the outside of the building that describes the hazardous materials hazard. (The hazardous materials placards will be discussed in Section 7.3.) If there is a hazardous materials spill potential, be aware of this before seeking entry to the building. If the SAP evaluator observes through windows suspicious liquids spilled onto the floor, or opens the door and finds an unusual or obnoxious smell present, the building should be posted UNSAFE (if it has not been already) and the hazardous materials response team notified at once. The SAP evaluator should not linger to try to figure out the nature of the spill; such a decision could be deadly.
- **One member of the team must remain outside to monitor the building while the other members are inside.** The team member outside the building must know where the other team members are. If the situation becomes dire inside the building, the team member outside the building must be told immediately so the necessary assistance can be requested from first responders.
- **To the extent possible, verify the stability of every room or part of a structure before entering.** Determine those parts of the building that can be entered safely. If there are any indications of instability contributing to an imminent collapse hazard, do not enter that portion of the building. Verify the stability of each room before entering. If there is any indication of an imminent collapse hazard for any part of a structure, do not enter it!

These are basic safety rules that are 'common sense' when dealing with dangerous conditions. However, it is very easy during a SAP response to get wrapped up in the cause of safety assessment and helping others, and forget the safety rules that will protect the individual from harm. SAP evaluators are urged to insert the safety checklist in the back of this manual into the ATC-20-1 field manual, and refer to it frequently while performing safety assessments.

Figure 7-1 is a startling photo of a swarm of flies encountered by SAP evaluators while responding to Hurricane Katrina. This is not the only photo available of such swarms from that response. Flies, mosquitoes, ticks, rats, and snakes can become very troublesome after a disaster, and can present health and safety hazards to SAP evaluators in the field. SAP evaluators are encouraged to bring and use insect repellant, and to be careful about hygiene in the field. There may be other explosions in animal species that creates problems after a disaster; stay informed on local conditions, and be prepared.

Figure 7-2 shows a shed that floated onto a fence; the SAP evaluator is getting a little too close to this! SAP evaluators are encouraged to be careful when evaluating unstable structures not to get too close.

Figures 7-3 and 7-4 show some vehicles stranded onto buildings. SAP evaluators must avoid walking under these sorts of things! The roofs are not designed for these types of loads!

Photo courtesy Raymond Lui, SEA

Figure 7-1 – Swarm of flies, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 7-2 – Shed on fence, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 7-3 – Stranded cars, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 7-4 – Stranded motor home, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 7-5 – Roof fragment falling hazard, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 7-6 – Mold growth, 2005 Hurricane Katrina

Photo courtesy Raymond Lui, SEA

Figure 7-7 – Mud slipping hazard, 2005 Hurricane Katrina

7.2 Critical Incident Stress Disorder

Critical Incident Stress Disorder (CISD) can affect emergency workers after working long hours over a number of days. SAP evaluators are only deployed for five days in the field so as to reduce exposure to this problem. However, the local government staff have been working the disaster since it started, and they may be exhibiting symptoms of CISD. This disorder can also creep into the mindset of SAP evaluators also, if stress relieving measures are not taken. Knowing the causes and symptoms will help SAP evaluators to better understand what others are feeling. This will also help SAP evaluators to avoid getting CISD themselves.

Critical Incident Stress Disorder can be caused, in whole or in part, by the following:

- Long hours, working 12 to 14 hour shifts (or longer), or performing heavy manual work for long periods of time.
- Emotional turbulence incurred in dealing with the disaster. People encountered in the disaster are frightened, exhibiting high emotional states, encouraging the same high level of emotions in the disaster workers.
- Loss – a sense of loss when looking around and taking stock of the damage. ‘Will the community ever recover?’
- Destruction – the sense of utter devastation associated with large events such as powerful earthquakes.

- Injuries and death – working with and dealing with a large number of injured or dead is a constant reminder of the horrific incident. This can lead to feelings of futility, survivor's guilt, and frustration.
- Lack of sleep or food – this is probably the most common cause of CISD. The mind and body are starved as dedicated staff work single-mindedly on the disaster, forgoing proper food and rest. At the end of the shift, disaster workers are still keyed up, and it is difficult to sleep.
- Separation from family and setting aside one's own needs – this is probably more prevalent among local government emergency workers, or those who are directly involved in care and shelter. However, separation from one's family could affect an evaluator if one is worried about issues at home, especially if home life was affected by the same disaster the SAP evaluator is responding to.

7.2.1 Symptoms

CISD will manifest itself by any one or more of the following symptoms:

- Inability to make decisions – One's mind is blank, and the 'deer in the headlights' syndrome is in evidence, despite how many people are waiting for a decision.
- Slowness of thought and confusion – One doesn't have a clue as to what the information or data coming in means, and doesn't know what to do with the information.
- Inability to express one's self – frustration arises as evaluators try to speak, but can't say what they mean.
- Depression, irritability, and anxiety – these can result in feelings of futility, such as 'why am I doing this?' or 'what difference does this make, anyway?'
- Exhaustion, loss of energy – The stress generated by working the disaster can take its toll physically as well as mentally. Persons can feel physically ill, with no energy to do anything. It becomes an effort to continue with one's duties. There is no desire to eat; the thought of eating food becomes almost too much to contemplate. In many cases, sleep eludes persons, who continue worrying about the operation despite being exhausted.

7.2.2 Stress Relieving Measures

There are several simple steps that can be taken to be protected from suffering the effects of CISD, as follows:

- Take frequent breaks – pace oneself so as to be working at a constant level.
- Eat good meals at regular times – stay away from junk food and eat well, the mind and body need it! Schedule time for several good meals a day.
- Drink plenty of fluids and keep hydrated. Consider carrying a canteen or water jug. Avoid alcoholic beverages during the deployment, as they dehydrate the body and interfere with deep sleep.
- Freely talk about the experiences encountered. After work, join with fellow SAP evaluators and freely discuss the things seen and heard that day, along with how it made one feel. In turn, be a good listener.
- Get plenty of sleep, do not stay up all night talking. Set a time for sleep and keep to it.

Awareness of CISD is one of the key preventative measures for avoiding CISD for oneself and others. Watch for the signs and take action to minimize the impact. If CISD symptoms are observed in a fellow SAP evaluator, take him or her aside and take a break. Try to get them to rest, drink water, and talk about their feelings.

7.3 Hazardous Materials

The world we live in is surrounded by hazardous materials that are properly contained. Disasters have the potential to release these dangerous materials into the environment, exposing disaster workers and the populace to their often deadly effects. Floods can carry toxins and corrosives in solution for great distances, while earthquakes, fires, and explosions can disable containment and cause releases. Moreover, released chemicals can react with one another in ways never dreamed of by their day-to-day users. Awareness of these risks can truly improve one's safety profile and prolong life!

This section will look at some basic information regarding the posting of hazardous materials that can be used to increase safety while evaluating building damage. This information is strictly to help improve the safety of SAP evaluators, and is not intended to make anyone an expert in this difficult field.

Understanding the hazardous materials placard systems for buildings and for individual containers will give evaluators a better idea of the kinds of materials being dealt with in a very general sense. One of the first rules to remember is to use one's common sense; it is possible, for example, for a building to have a changed use, but the new owners forgot to take down the old hazardous material diamond-shaped placard when they changed the use of the building. A drum of material may have had its contents changed to something else, and no one bothered to change the hazardous material sticker on the drum. This can lead to situations that are less dangerous or more dangerous than the placards may indicate.

The placards also don't say what can happen if the stored materials become mixed. The level of hazard can become significantly greater when containers are leaking and the materials come together.

One should never be asked to identify hazardous materials; leave this work for those specially trained and equipped to do so.

There are more hazardous materials labeling systems than can be presented in the scope of this manual. Three labeling systems that are commonly used throughout the United States are mentioned here. They are:

- National Fire Protection Association (NFPA) 704M system used for identifying hazards of materials within facilities that manufacture, process, store, or use hazardous materials.
- Federal Department of Transportation (DOT) system used to label hazardous materials during transport.
- American Coatings Association's Hazardous Materials Identification System (HMIS) used to label hazardous materials within manufacturing plants and facilities.

The *Emergency Response Guidebook (ERG)* covers the hazardous materials designations as applied to transported hazardous materials in North America and their hazards. It can be downloaded for free as a .pdf file from the following website, as of this June 2016 version:

http://phmsa.dot.gov/staticfiles/PHMSA/DownloadableFiles/Files/Hazmat/ERG2016.pdf

The Federal Department of Transportation website for the ERG in general is found at:

http://phmsa.dot.gov/hazmat/outreach-training/erg

ERG number designations are found on DOT placards in addition to the information shown in Figure 7-10. For example, gasoline's ERG number is 1203, and this is seen clearly on the placards on the back of gasoline tanker trucks. These numbers key into information found in the ERG on how to handle these materials and what their risks are.

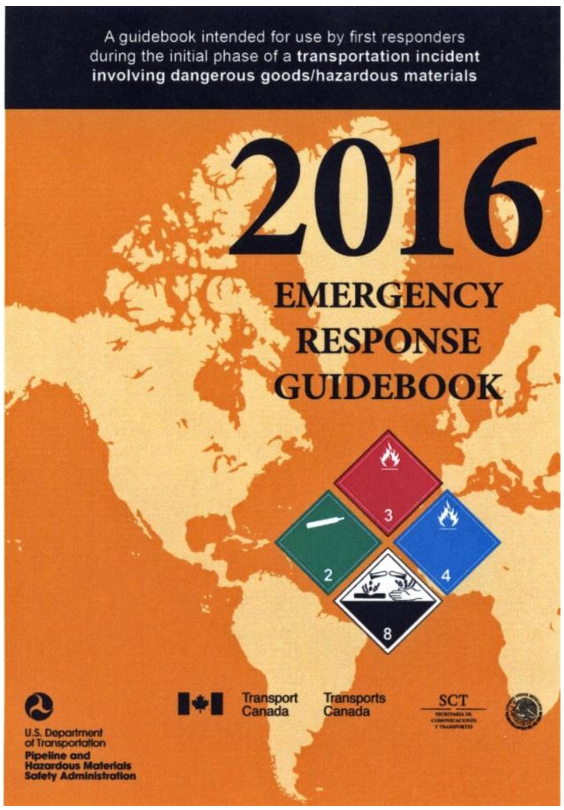


Photo courtesy DOT

Figure 7-8 – Emergency Response Guidebook

7.3.1 National Fire Protection Association (NFPA) Placard System

This system is intended to provide basic hazardous materials information on chemicals found within a structure so fire fighters, police, and other emergency personnel can make decisions whether to evacuate an area, or commence with emergency control procedures. This system of placard is voluntary unless it is adopted into local codes.

The NFPA system identifies materials by their health hazard, fire hazard, reactivity, and specific hazard. The placard used is shown in Figure 7-9 on this page. The color coding is consistent and does not relate to the particular level of hazard; the numbers in the color coded areas relate to the level of hazard.

Blue denotes the health hazard, **red** denotes the fire or flammability hazard, **yellow** denotes the reactivity of the materials, and **white** denotes the specific hazard. All except the specific hazard are rated by a number system of 0 to 4, with 4 being the worst hazard and 0 being the least.

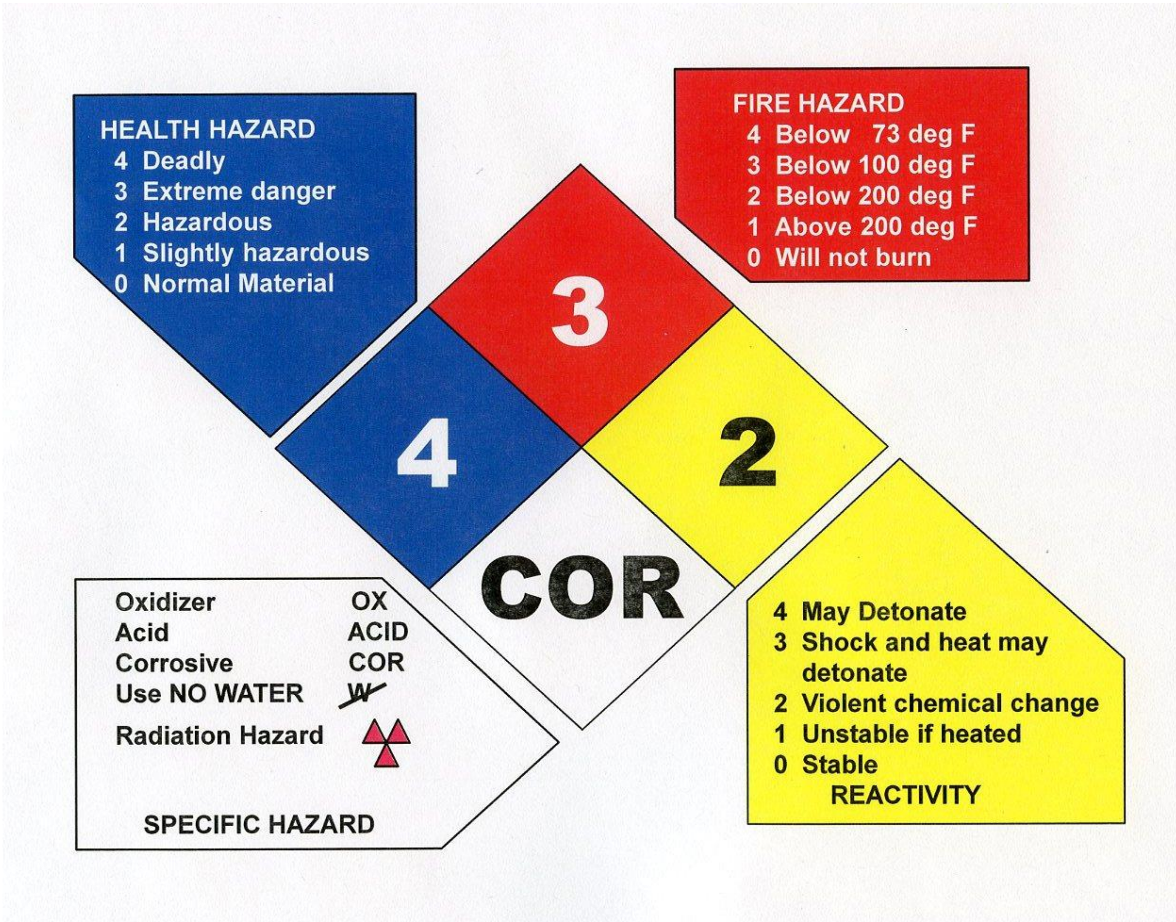


Photo courtesy NFPA

Figure 7-9 – NFPA Hazardous Materials Classification System

7.3.2 Department of Transportation (DOT) Placard System

Federal DOT regulations define a hazardous material as *"a substance or material, including a hazardous substance, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated."*

The DOT system is primarily used for labeling containers of transported hazardous materials. The placards are classified by hazard class names, hazard class numbers, associated color, identifying pictographs, and an identification number (found in the Emergency Response Guidebook, as per the previous discussion on that). Figure 7-10 outlines these categories, and Figure 7-11 shows examples of the placards.

The pictographs are commonly used symbols for various hazards; for example, flames indicate fire hazard, a skull and crossbones indicates poisonous material. The identification number on the placards indicates the primary hazard class of the hazardous material contained.

HAZARD CLASS NAME	HAZARD CLASS NUMBER	COLOR
Explosives	1	Orange
Poisonous gases	2	White
Compressed gases	2	Green
Flammable gas	2	Red
Flammable liquids	3	Red
Flammable solids (dangerous when wet)	4	Blue/red/white
Oxidizers	5	Yellow
Poisonous liquids	6	White
Radioactive substances	7	Yellow/white
Corrosives	8	Black/white
Miscellaneous hazardous materials	9	

Figure 7-10 – DOT Hazardous Materials Classification System

Figure 7-11 shows some examples of the DOT placards. In addition to these, containers with materials that have multiple classifications will have a placard for each classification. As with the building placards, remember that these placards indicate what is supposed to be in the container, not what may actually be in it. A placard showing a benign chemical could be inaccurate!

7.3.3 American Coatings Association Placard System

The American Coatings Association has developed a Hazardous Materials Information System (HMIS) for use in the manufacturing industries. This system complies with the California hazards communication system. The labels are divided into four categories: health, flammability, physical hazard, and recommended personal protection. Note that these designations are <u>different</u> from the NFPA hazard designations. Figure 7-12 shows what this placard looks like.

For reference, the HMIS numbering system is explained on page 222.

Figure 7-11 – Examples of DOT Placards

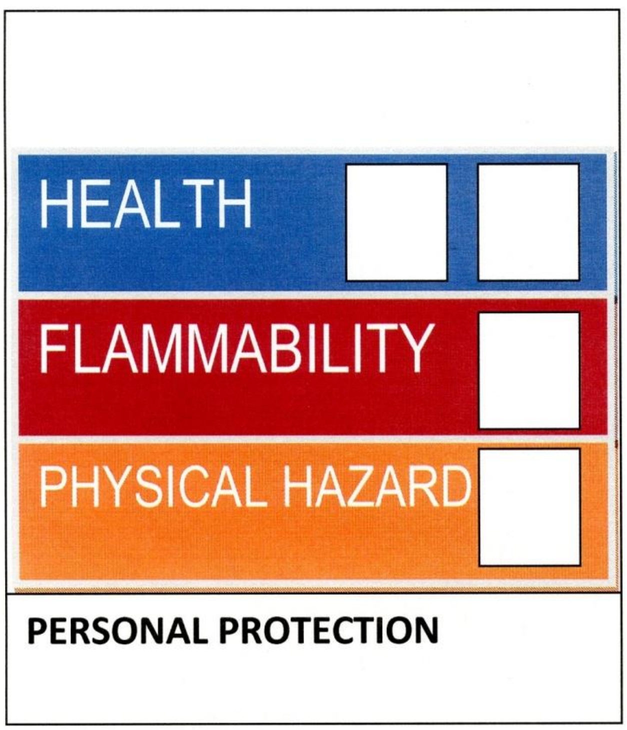


Figure 7-12 – Sample of HMIS Placard

The HMIS placard system uses the following designations:

Health (blue field)

- Two boxes are in the Health field. If the first box has an asterisk (*), then the chemical in the container can lead to a serious chronic health hazard over long-term exposure.
- **4** – Life threatening, major or permanent damage may result from single or repeated overexposures.
- **3** – Major injury likely unless prompt action is taken and medical treatment is given.
- **2** – Temporary or minor injury may result.
- **1** – Irritation or minor reversible injury possible.
- **0** – No significant risk to health.

Flammability (red field)

- **4 –** Flammable gases or volatile liquids with flash points below 73 degrees F., may ignite spontaneously with air.
- **3 –** Materials capable of ignition under almost all normal temperature conditions, including liquids with flash points below 100 degrees F.
- **2 –** Materials which must be moderately heated or exposed to high ambient temperatures before ignition will occur. Includes liquids with flash points from 100 degrees to 200 degrees F.
- **1 –** Materials which must be preheated before ignition will occur; includes materials with flash points above 200 degrees F.
- **0 –** Materials that will not burn.

Physical Hazard

- **4 –** Materials readily capable of explosive water reaction, explosion, or self-reaction at normal temperature and pressure.
- **3 –** Materials that may form explosive mixtures with water, and are capable of detonation or explosion in the presence of a strong initiating source. Have a moderate risk of self-detonation at normal temperature and pressure.
- **2 –** Materials that are unstable and may undergo violent chemical changes at normal temperature and pressure with a low risk for explosion. Materials may react violently with water or form peroxides upon exposure to air.
- **1 –** Materials that are normally stable but can become unstable (self-react) at high temperatures and pressures. May react non-violently with water or undergo hazardous reactions in the absence of inhibitors.
- **0 –** Materials that are normally stable, even under fire conditions, and will not react with water or self-react. Non-explosives.

Personal Protection

HMIS uses a letter code to key to the personal protection needed (safety goggles, gloves, etc.) to handle the material. Pictographs are also used, sometimes in conjunction with the lettering.

7.3.4 Occupational Safety and Health Administration (OSHA)

OSHA released the Biohazard symbol, which is used to signify a dangerous biohazard in a container or room. SAP evaluators should regard this signage with great respect, as it is quite possible to imperil life and health by exposure to pathogens from these sources. It would be best to avoid all contact with the contents of containers or of rooms that are marked with this symbol (Figure 7-13).

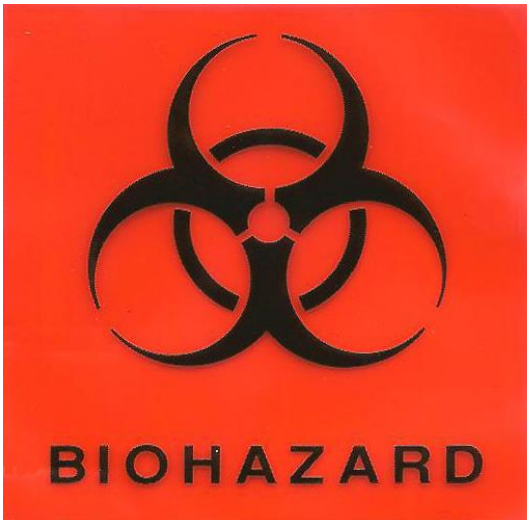


Figure 7-13 – OSHA Biohazard Symbol

7.4 Urban Search and Rescue (USAR) Marking System

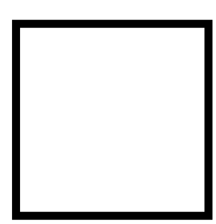
Urban Search and Rescue (USAR) teams are multi-discipline task forces that are sent out to rescue persons trapped in heavy debris. These teams of 70 persons include fire rescue and medical personnel, search dogs, and engineers, among others, and are dispatched by FEMA to serious disasters throughout the country. California has eight USAR teams.

USAR teams are usually on site before SAP evaluations are carried out. As a result, SAP evaluators may encounter markings on buildings that were placed there by USAR teams. The markings will be discussed herein so SAP evaluators are familiar with what these markings mean. SAP evaluators are not to place such markings on buildings.

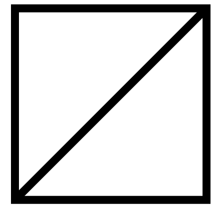
7.4.1 Structure/Hazards Mark

The structural and hazardous materials specialists on the USAR team complete their assessments and complete the Structure/Hazards Evaluation form. Generally, the specialists then spray paint a two foot by two foot box on the outside wall (in International Orange) and complete the symbol as shown in the following examples.

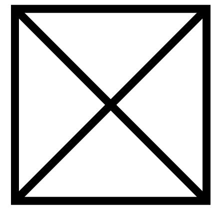
This box represents a relatively safe structure.



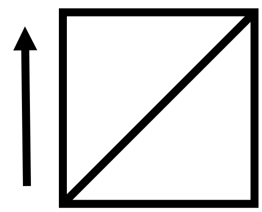
This box represents a structure that is significantly damaged. Shoring of some areas may be needed.



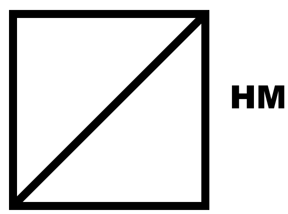
This box indicates that the building is a collapse hazard. Do not enter! Verify its condition as UNSAFE and post it.



An arrow next to the box shows the safest path of travel into the building.



"HM" indicates a hazardous material condition in or near the structure.



The above symbol means that entry is forbidden until the natural gas is turned off. Then the "HM NATURAL GAS" will be lined out and a new date put in. "OR-1" means Oregon Team 1 placed this symbol on the wall.

7.4.2 Search Assessment Marking

The following figures show the symbols that may be found near the building entry point as a result of the search and rescue effort. This provides information regarding any hazards found, and if there were victims located inside the structure. (Note: "TF" means "Task Force.")

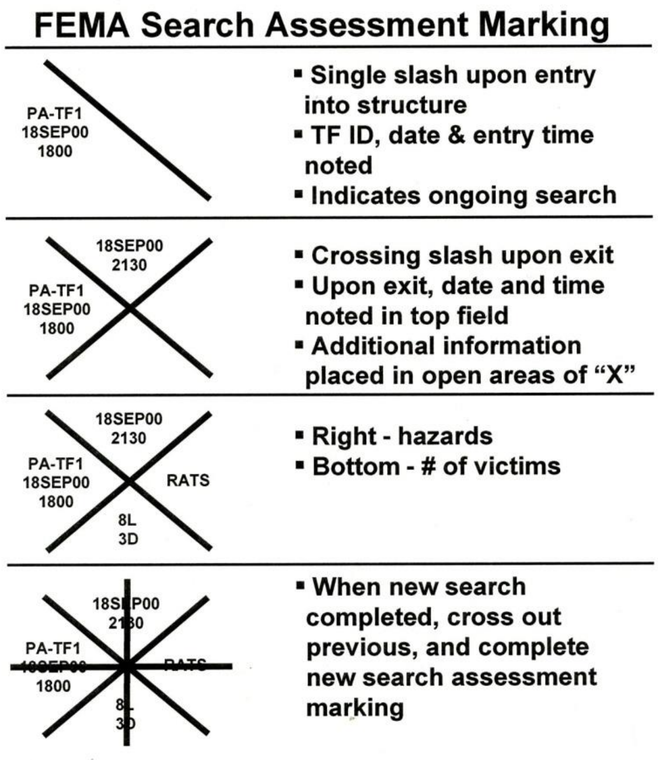


Figure 7-14 – Search Assessment Markings

The third symbol from the top of Figure 7-14 is the completed search assessment marking. The last symbol is used when the previous assessment is replaced by a new assessment.

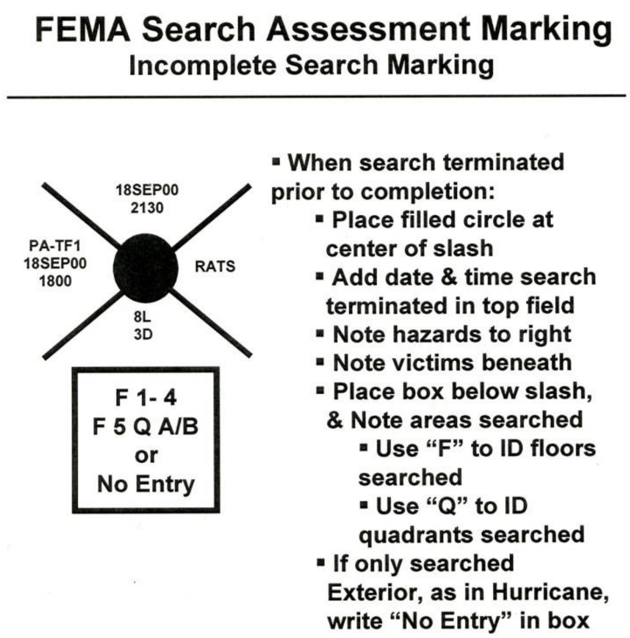
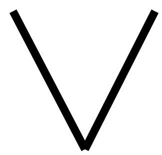


Figure 7-15 – Incomplete Search Assessment Marking

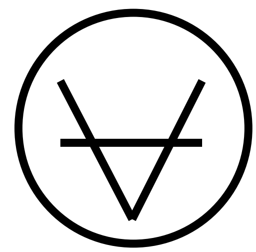
The symbol with the large dot is used when a task form team is not able to complete their work, and must mark the building to indicate what has been done.

7.4.3 Victim Location Marking

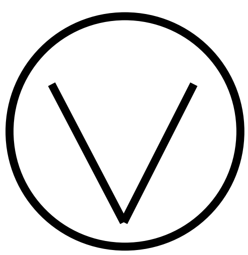
In order to provide a quick status of the victims in a particular structure, the following markings are used. The USAR Task Force symbol goes in the top of all of these.



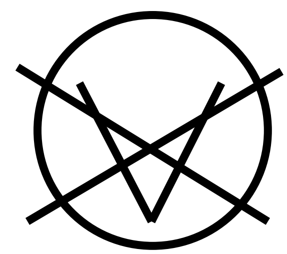
Potential



Confirmed Dead



Confirmed Alive



Victim Removed

7.5 Building Assessment Safety Checklist

General

- ❑ Be aware and cautious.
- ❑ Always work in teams of at least two individuals
- ❑ Always wear a hard hat and safety shoes.

Initial Assessment of Building that is Not Posted

- ❑ Do not enter obviously unsafe buildings.
- ❑ Do not enter buildings or access parts of buildings located on potentially unstable slopes.
- ❑ Do not enter buildings where falling hazards exist that could block building exits.
- ❑ If the building is racked, leaning, or out-of-plumb, do not enter unless it is absolutely necessary to determine the appropriate posting. Try to stay on the side of the building away from the direction it is leaning.
- ❑ Before entering any building, make sure that exit doors are fully operable and one can leave quickly.
- ❑ Make sure that exits are clear and there are no falling hazards that could obstruct the pathway.
- ❑ Be aware of hanging or exposed electrical wiring.

Subsequent Assessments

❑ If an unsafe building must be entered which has not been stabilized, take the following steps:

- ❑ Visually assess the damage from the exterior and evaluate the potential for collapse. If it is unsafe, do not enter unless the building has been stabilized.
- ❑ One member of the team remains outside to monitor the building while other team members are inside. If necessary, the team member outside calls for help.
- ❑ To the extent possible, verify stability of every room or part of the building before entering it.

❑ Do not enter a building where a hazardous materials spill or release has occurred.

❑ Do not enter buildings, or enter parts of buildings, located on a hillside known to be moving, or where a slide potential exists.

APPENDIX A – JOB AID, EVALUATION FORMS

JOB AID – Safety Assessment Program Evaluator

ACTIONS AFTER REGISTRATION WITH CAL OES, PRIOR TO DEPLOYMENT

- ❑ Ensure that Cal OES and your professional organization has your correct contact information, including cell phone, email address, and mailing address. Your professional organization is identified on your SAP ID card.
- ❑ Be sure to have available your hard hat and safety shoes for the field.
- ❑ Prepare a go-kit; most items in the list below will be useful in all sorts of disasters, while some may not be necessary. For example, there may be hotels available to stay in, or the rooming arrangements might involve tents. Please use your good judgment.
- ❑ Contact your professional organization, or your State of California agency, if you hear about an event and wish to be deployed. You may also contact Cal OES directly by email. In any case, knowing there are willing persons ready and able to assist will be useful.

Go-kit items

Protection and safety items

- ❑ Cell phone with charger
- ❑ NIOSH N-95 masks, or respirator
- ❑ Earplugs
- ❑ Gloves
- ❑ Flashlight with extra batteries
- ❑ Hand sanitizer or hand wipes
- ❑ Hard hat
- ❑ Safety shoes
- ❑ Insect repellant
- ❑ Magnetic compass
- ❑ Rain gear and rubber boots (if rain and mud are issues)
- ❑ Safety glasses
- ❑ Safety whistle (wear around neck)
- ❑ Small first aid kit
- ❑ Sunscreen
- ❑ Water container or canteen
- ❑ Water purification tablets (only if there is a 'boil water' notice for potable water – do not try to purify flood water with these!)

Field work items

- ❑ Backpack with lock (most things can be put in this)
- ❑ Clipboard
- ❑ ATC-20-1 and ATC-45 field manuals (if you do not have these, they may be purchased from the Applied Technology Council, www.atcouncil.org.)

- ❑ Paper or notebook
- ❑ Professional ID card
- ❑ SAP ID card with lanyard
- ❑ Waterproof marking pens
- ❑ Waterproof writing pens or pencils

Necessary personal items

- ❑ Credit card, traveler's checks, and/or cash, include change for pay phones
- ❑ Extra clothing and towels
- ❑ Personal hygiene supplies
- ❑ Personal identification (driver's license is OK)
- ❑ Prescription medication for at least the length of stay plus two days
- ❑ Sleeping bag and inflatable mattress, depending on whether tents will be used or not.

Suggested items that may be considered

- ❑ Binoculars (to observe conditions too high or remote to see easily)
- ❑ Global positioning system (GPS) unit with charger and/or batteries
- ❑ Knee pads
- ❑ Reading materials for after-hours
- ❑ Small battery-powered radio for after-hours
- ❑ Reflective safety vest
- ❑ Shower slippers, if in a tent or camping setting
- ❑ Swiss army knife or multi-tool
- ❑ Tape measure
- ❑ Waterproof paper or notebook

DURING DEPLOYMENT

When you are contacted by a professional organization, or by your California state agency supervisor if you are a state employee, and you agree to be deployed:

- ❑ Provide your cell phone number and other means for you to be contacted.
- ❑ Write down the information on where you are going, when, and the contact person and their phone number.
- ❑ Obtain maps and other pertinent information on the area from the Internet or a library.
- ❑ Wear identifying safety vest or other clothing while deployed.
- ❑ Travel safely to destination. Be prepared to show your SAP identification card at all official road stops.
- ❑ Sign in at deployment center, check in with SAP Coordinator, and attend initial briefings.
- ❑ Become deputized, if local officials are deputizing SAP evaluators.
- ❑ Obtain field assignment with other SAP evaluators and/or local building inspectors. Never go into the field alone!
- ❑ Obtain official placards, Evaluation Forms, briefing packets, placard fasteners (might be staple guns, clear packing tape, etc.), caution tape, and other equipment from local officials.
- ❑ Obtain assignment for your SAP team.

- ❑ Travel to assignment.
- ❑ Review a structure together as a group, and discuss the issues and procedures in order to get everyone ‘on the same page.’
- ❑ For each structure, follow the procedure for safety evaluation, and arrive at a team consensus on how the structure should be posted.
- ❑ Write all pertinent information on the placards and post the structure.
- ❑ Write the same information on the Assessment Form that is on the placard for each structure, and retain the form for the local jurisdiction’s records.
- ❑ Upon completion of the assignment, return to the designated deployment center.
- ❑ Attend daily debriefing with SAP coordinator, review the Assessment Forms for completeness, and give them to the SAP coordinator.
- ❑ Sign out at the end of the work day.
- ❑ If you are needed the following day, proceed to your rooming arrangements, and return the next day to obtain your next assignment and more placards, Assessment Forms, etc. as needed.
- ❑ If you are no longer needed, proceed with demobilization.
    - ❑ Hand in all local government equipment and materials.
    - ❑ Complete any leftover issues at your final debriefing.
    - ❑ Round up all personal items and receipts.
    - ❑ Understand the procedure for travel and other extraordinary expense reimbursements.
    - ❑ Return home as safely as possible.

AFTER DEPLOYMENT

- ❑ Submit to the local government the travel expense claim forms and receipts for unreimbursed meals and travel, using the form provided in the Briefing Packet or during demobilization.
- ❑ Respond to Cal OES requests for improvement suggestions or other After Action information.
- ❑ Examine your go-kit and re-stock any depleted items.
- ❑ Contact your professional organization’s contact person to inform them of your deployment completion, and your redeployment availability in the aftermath of a large disaster event.
- ❑ Continue to ensure that your professional organization has your updated contact information at all times.

BUILDING ASSESSMENT SAFETY CHECKLIST

GENERAL

- ☐ Be aware and cautious.
- ☐ Always work in teams of at least 2 individuals.
- ☐ Always wear a hard hat and safety shoes.

INITIAL ASSESSMENT OF BUILDING, WHICH IS NOT POSTED

- ☐ Do not enter obviously unsafe buildings.
- ☐ Do not enter buildings or access appendages of buildings located on potentially unstable slopes.
- ☐ Do not enter buildings where falling hazards exist that could block exits.
- ☐ If the building is leaning or out-of-plumb, do not enter unless it is absolutely necessary to determine the appropriate posting. When inside or outside try to stay on the side of the building away from the direction it is leaning.
- ☐ Before entering any building make sure exit doors are fully operable and you can leave quickly.
- ☐ Make sure that exits are clear and there are no falling hazards, which could obstruct the pathway.
- ☐ Be aware of hanging or exposed electrical wires.

SUBSEQUENT ASSESSMENTS

- ☐ If an unsafe building must be entered which has not been stabilized, take the following steps:
  1. Visually assess the damage from the exterior and evaluate the potential for collapse.
  2. One member of the team is to remain outside to monitor the building while other team members are inside.
  3. To the extent possible, verify stability of every room or part of the structure before entering.
- ☐ Do not enter a building where a hazardous materials spill or release has occurred.
- ☐ Do not enter buildings, or access any appendage of a building, located on a hillside known to be moving or where slide potential exists.

ATC-20 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID: ______________________ Inspection date and time: ______________ ☐ AM ☐ PM

Affiliation: ______________________ Areas inspected: ☐ Exterior only ☐ Exterior and interior

Building Description

Building name: ______________________

Address: ______________________

____

Building contact/phone: ______________________

Number of stories above ground: ______ below ground: ______

Approx. "Footprint area" (square feet): ______________

Number of residential units: ______________

Number of residential units not habitable: ______________

Type of Construction

☐ Wood frame ☐ Concrete shear wall
☐ Steel frame ☐ Unreinforced masonry
☐ Tilt-up concrete ☐ Reinforced masonry
☐ Concrete frame ☐ Other: ______________

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Government
☐ Other residential ☐ Offices ☐ Historic
☐ Public assembly ☐ Industrial ☐ School
☐ Emergency services ☐ Other: ______________

Evaluation

Investigate the building for the conditions below and check the appropriate column.

Observed Conditions:	Minor/None	Moderate	Severe	Estimated Building Damage (excluding contents)
				☐ None
Collapse, partial collapse, or building off foundation	☐	☐	☐	☐ 0–1%
Building or story leaning	☐	☐	☐	☐ 1–10%
Racking damage to walls, other structural damage	☐	☐	☐	☐ 10–30%
Chimney, parapet, or other falling hazard	☐	☐	☐	☐ 30–60%
Ground slope movement or cracking	☐	☐	☐	☐ 60–100%
Other (specify) ______________	☐	☐	☐	☐ 100%

Comments: ______________________

Posting

Choose a posting based on the evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Localized *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Post INSPECTED placard at main entrance. Post RESTRICTED USE and UNSAFE placards at all entrances.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ______________

☐ Other recommendations: ______________________

Comments: ______________________

ATC-20 Detailed Evaluation Safety Assessment Form

Inspection

Inspector ID: ____________________

Affiliation: ____________________

Inspection date and time: ____________________ ☐ AM ☐ PM

Final Posting
from page 2

☐ Inspected
☐ Restricted Use
☐ Unsafe

Building Description

Building name: ____________________

Address: ____________________

____

Building contact/phone: ____________________

Number of stories above ground: ______ below ground: _____

Approx. "Footprint area" (square feet): ____________________

Number of residential units: ____________________

Number of residential units not habitable: ____________________

Type of Construction

☐ Wood frame
☐ Steel frame
☐ Tilt-up concrete
☐ Concrete frame
☐ Concrete shear wall
☐ Unreinforced masonry
☐ Reinforced masonry
☐ Other: ____________________

Primary Occupancy

☐ Dwelling
☐ Other residential
☐ Public assembly
☐ Emergency services
☐ Commercial
☐ Offices
☐ Industrial
☐ Other: ____________________
☐ Government
☐ Historic
☐ School

Evaluation

Investigate the building for the conditions below and check the appropriate column. There is room on the second page for a sketch.

	Minor/None	Moderate	Severe	Comments
Overall hazards:				
Collapse or partial collapse	☐	☐	☐	______
Building or story leaning	☐	☐	☐	______
Other ______	☐	☐	☐	______
Structural hazards:				
Foundations	☐	☐	☐	______
Roofs, floors (vertical loads)	☐	☐	☐	______
Columns, pilasters, corbels	☐	☐	☐	______
Diaphragms, horizontal bracing	☐	☐	☐	______
Walls, vertical bracing	☐	☐	☐	______
Precast connections	☐	☐	☐	______
Other ______	☐	☐	☐	______
Nonstructural hazards:				
Parapets, ornamentation	☐	☐	☐	______
Cladding, glazing	☐	☐	☐	______
Ceilings, light fixtures	☐	☐	☐	______
Interior walls, partitions	☐	☐	☐	______
Elevators	☐	☐	☐	______
Stairs, exits	☐	☐	☐	______
Electric, gas	☐	☐	☐	______
Other ______	☐	☐	☐	______
Geotechnical hazards:				
Slope failure, debris	☐	☐	☐	______
Ground movement, fissures	☐	☐	☐	______
Other ______	☐	☐	☐	______

General Comments: ____________________

____

Continue on page 2

ATC-20 Detailed Evaluation Safety Assessment Form Page 2

Building name: ______________________ **Inspector ID:** ______________________

Sketch (optional)

Provide a sketch of the building or damaged portions. Indicate damage points.

Estimated Building Damage

If requested by the jurisdiction, estimate building damage (repair cost ÷ replacement cost, excluding contents).

- ☐ None
- ☐ 0–1%
- ☐ 1–10%
- ☐ 10–30%
- ☐ 30–60%
- ☐ 60–100%
- ☐ 100%

Posting

If there is an existing posting from a previous evaluation, check the appropriate box.

Previous posting: ☐ INSPECTED ☐ RESTRICTED USE ☐ UNSAFE Inspector ID: __________ Date:______

If necessary, revise the posting based on the new evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Local *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Indicate the current posting below and at the top of page one.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

____

____

Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

____

☐ Engineering Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ____________

☐ Other recommendations: ______________________

____

____

Comments: ______________________

____

ATC-20 Fixed Equipment Checklist

Building Description

Building name: ____________________

Address: ____________________

____

Inspection

Inspector ID: ____________________

Affiliation: ____________________

Inspection date: ____________________

Inspection time: __________ ☐ AM ☐ PM

Checklist

	Equipment Damaged			
Overall hazards:	Minor/None	Moderate	Severe	Comments
Main boilers	☐	☐	☐	______
Chillers	☐	☐	☐	______
Emergency generators	☐	☐	☐	______
Fuel tanks	☐	☐	☐	______
Battery racks	☐	☐	☐	______
Fire pumps	☐	☐	☐	______
On-site water storage	☐	☐	☐	______
Communications equipment	☐	☐	☐	______
Main transformers	☐	☐	☐	______
Main electrical panels	☐	☐	☐	______
Elevators (traction)	☐	☐	☐	______
Other fixed equipment				
______	☐	☐	☐	______
______	☐	☐	☐	______
______	☐	☐	☐	______
______	☐	☐	☐	______
______	☐	☐	☐	______
______	☐	☐	☐	______
Special concerns for hospitals and other health care facilities				
Radiation equipment	☐		☐	______
Toxic chemical storage				
______	☐	☐	☐	______
______	☐	☐	☐	______
______	☐	☐	☐	______
______	☐	☐	☐	______
Liquid oxygen tanks	☐	☐	☐	______
Other: ______	☐	☐	☐	______
______	☐	☐	☐	______

Recommendations/Comments: ____________________

____

____

____

____

____

____

ATC-45 Detailed Evaluation Safety Assessment Form

Inspection

Inspector ID: ____________________ Inspection date: ____________________

Affiliation: ____________________ Inspection time: __________ ☐ AM ☐ PM

Final Posting
from page 2

☐ Inspected
☐ Restricted Use
☐ Unsafe

Building Description

Building name: ____________________

Address: ____________________

____

Building contact/phone: ____________________

Number of stories: ____________________

"Footprint area" (square feet): ____________________

Number of residential units: ____________________

Type of Building

☐ Mid-rise or High-rise ☐ Pre-fabricated
☐ Low-rise multi-family ☐ One- or two-family dwelling
☐ Low-rise commercial ☐ Other: __________

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Government
☐ Other residential ☐ Offices ☐ Historic
☐ Public assembly ☐ Industrial ☐ School
☐ Emergency services ☐ Other: __________

Evaluation

Investigate the building for the conditions below and check the appropriate column. There is room on the second page for a sketch.

	Minor/None	Moderate	Severe	Comments
Overall hazards:				
Collapse or partial collapse	☐	☐	☐	________
Building or story lean or drift	☐	☐	☐	________
Fractured or displaced foundation	☐	☐	☐	________
Structural hazards:				
Failure of significant element/connection	☐	☐	☐	________
Column, pier, or bearing wall	☐	☐	☐	________
Roof/floor framing or connection	☐	☐	☐	________
Superstructure/foundation connection	☐	☐	☐	________
Moment frame	☐	☐	☐	________
Diaphragm/horizontal bracing	☐	☐	☐	________
Vertical bracing	☐	☐	☐	________
Shear wall	☐	☐	☐	________
Nonstructural hazards:				
Parapets, ornamentation	☐	☐	☐	________
Canopy	☐	☐	☐	________
Cladding, glazing	☐	☐	☐	________
Ceilings, light fixtures	☐	☐	☐	________
Stairs, exits, access walkways, gratings	☐	☐	☐	________
Interior walls, partitions	☐	☐	☐	________
Mechanical & electrical equipment	☐	☐	☐	________
Elevators	☐	☐	☐	________
Building contents, other ________	☐	☐	☐	________
Geotechnical hazards:				
Slope failure, debris impact	☐	☐	☐	________
Ground movement, erosion, sedimentation	☐	☐	☐	________
Differential settlement	☐	☐	☐	________

Continue on page 2

ATC-45 Detailed Evaluation Safety Assessment Form Page 2

Building name:____________________ Inspector ID:____________________

Sketch

Make a sketch of the damaged building in the space provided. Indicate damage points.

Posting

If there is an existing posting from a previous evaluation, check the appropriate box.

Previous posting: ☐ INSPECTED ☐ RESTRICTED USE ☐ UNSAFE Inspector ID: __________ Date:______

If necessary, revise the posting based on the new evaluation and team judgment. *Severe* conditions endangering the overall building are grounds for an Unsafe posting. Local *Severe* and overall *Moderate* conditions may allow a Restricted Use posting. Indicate the current posting below and at the top of page one, whether the posting has been revised or not.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ____________________

Number of residential units vacated:____________________

Further Actions Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas:____________________

☐ Engineering Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other __________

☐ Other recommendations:____________________

ATC-45 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID: ______________________ Inspection date: ______________________

Affiliation: ______________________ Inspection time: ______________ ☐ AM ☐ PM

Areas inspected: ☐ Exterior only ☐ Exterior and interior

Building Description

Building name: ______________________

Address: ______________________

____

Building contact/phone: ______________________

Number of stories: ______________________

"Footprint area" (square feet): ______________________

Number of residential units: ______________________

Type of Building

☐ Mid-rise or high-rise ☐ Pre-fabricated
☐ Low-rise multi-family ☐ One- or two-family dwelling
☐ Low-rise commercial

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Government
☐ Other residential ☐ Offices ☐ Historic
☐ Public assembly ☐ Industrial ☐ School
☐ Emergency services ☐ Other: ______________

Evaluation

Investigate the building for the conditions below and check the appropriate column.

Observed Conditions:	Minor/None	Moderate	Severe
Collapse, partial collapse, or building off foundation	☐	☐	☐
Building significantly out of plumb or in danger	☐	☐	☐
Damage to primary structural members, racking of walls	☐	☐	☐
Falling hazard due to nonstructural damage	☐	☐	☐
Geotechnical hazard, scour, erosion, slope failure, etc.	☐	☐	☐
Electrical lines / fixtures submerged / leaning trees	☐	☐	☐
Other (specify) ______________	☐	☐	☐

☐ See back of form for further comments.

Estimated Building Damage
(excluding contents)

☐ None
☐ >0 to <1%
☐ 1 to <10%
☐ 10 to <30%
☐ 30 to <60%
☐ 60 to <100%
☐ 100%

Posting

Choose a posting based on the evaluation and team judgment. Severe conditions endangering the overall building are grounds for an Unsafe posting. Localized Severe and overall Moderate conditions may allow a Restricted Use posting.

☐ **INSPECTED** (Green placard) ☐ **RESTRICTED USE** (Yellow placard) ☐ **UNSAFE** (Red placard)

Record any use and entry restrictions exactly as written on placard: ______________________

____

____

Number of residential units vacated: ______________________

Further Actions

Check the boxes below only if further actions are needed.

☐ Barricades needed in the following areas: ______________________

____

☐ Detailed Evaluation recommended: ☐ Structural ☐ Geotechnical ☐ Other: ______________

☐ Substantial Damage determination recommended

☐ Other recommendations: ______________________

____

☐ See back of form for further comments.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
GEOTECHNICAL EVALUATION

Assessment Report No. ______

Facility Name ______________________

Address ______________________

Co-City-Vic ______________________

Mo/Day/Yr ____/____/____ Time ________ use 24 hr.

Type of Disaster ______________________

SAP ID Nos. ________ ________

Other Reports ______________________

No. Photos _____ No. Sketches _____

Ref. Dwgs. ______________________

Est. Damage %______________________

Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:	None O	Recommended:	Green O	Posted at this assessment:	Yes O
	Green O		Yellow O		No O
	Yellow O		Red O		
	Red O				

B. RECOMMENDATIONS

Monitor ______________________

Other ______________________

____

____

____

____

C. COMMENTS ______________________

____

____

____

____

____

DAMAGE OBSERVED (D.O.) Assessment Report # ____________

Damage Scale:	0 None (0%)	1 Slight (1-10%)	2-3-4 Moderate (11 - 40%)	5 Severe (41 - 60%)	6 Total (over 60%)	NA Not Applicable	NO Not Observed

D. OBSERVED GEOTECHNICAL CONDITIONS WITH EFFECT ON FACILITY

Observed Condition	Extent of Condition D.O.	Effect of Condition D.O.	Observed Condition	Extent of Condition D.O.	Effect of Condition D.O.
Ash flows	______	______	Flooding	______	______
Avalanches	______	______	Landslides/mudslides ..	______	______
Collapsed soils..........	______	______	Lava flows	______	______
Cut........................	______	______	Liquefaction	______	______
Differential settlement..	______	______	Lurching	______	______
Displacement...........	______	______	New springs	______	______
Dried springs	______	______	Ponded water	______	______
Erosion	______	______	Sand boils	______	______
Faulting	______	______	Tsunami/seiches	______	______
Fill	______	______	Soil shear failure	______	______

E. CONTINUING HAZARDS TO LIFE/PROPERTY (Please describe) ____________________

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
AIRPORT

Assessment Report No. ___________

Facility Name: ______________________________
Address: ______________________________
Co-City-Vic ______________________________
Mo/Day/Yr _______/______/_______ Time ________ (use 24 hr)
Type of Disaster ______________________________

SAP ID Nos. ____________ __________
Other Reports ______________
No. Photos ____ No. Sketches _____
Ref. Dwgs. ______________________
Est. Damage %________________
Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of the presence of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard. ALSO: The FAA is responsible for checking and evaluating damage to control tower equipment, lighting controls, communication systems, navigational aids, and approach light systems. Obtain permission from tower to enter runway. Permission obtained from __________________

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will no render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing: None O, Green O, Yellow O, Red O

Recommended: Green O, Yellow O, Red O

Posted at this assessment: Yes O, No O

B. RECOMMENDATIONS:

Monitor ____

Other ____

____

C. COMMENTS ____

____

____

____

____

____

____

Assessment Report # _____________

DAMAGE OBSERVATIONS (D.O.)

Damage Scale:	0 None (0%)	1 Slight (1-10%)	2-3-4 Moderate (11 - 40%)	5 Severe (41 - 60%)	6 Total (over 60%)	NA Not Applicable	NO Not Observed

D. SURFACE DISPLACEMENT

	D.O.	Amount in inches Horiz.	Vert.
Runway pavement	______	______	______
Taxiway pavement	______	______	______
Aircraft aprons	______	______	______
Car parking areas	______	______	______
Access roadways	______	______	______
Bridges	______	______	______
Liquefaction	______		

(Bridge Report Attached o Geotechnical Report Attached o)

E. UNDERGROUND UTILITIES

	D.O.
Water mains	______
Water services	______
Gas mains	______
Sewer	______
Collapsed o	
Displaced o	
Large storm drains	______
Aircraft fueling systems	______
Airfield lighting	______
Underground electrical	______

F. BUILDINGS

	D.O.
Control tower structure	______
Passenger terminal buildings	
Structural	______
Mechanical	______
Electrical	______
Utility plant buildings	
Equipment	______
Piping	______
Emergency generator building	
Equipment	______
Fuel supply	______

G. REMARKS ______________________

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
BRIDGE

Assessment Report No. __________

Facility Name ______________________________
Address ______________________________
Co-City-Vic ______________________________
Mo/Day/Yr _____/_____/_____ Time ____________ use 24 hr.
Type of Disaster ______________________________

SAP ID Nos. ____________ ____________
Other Reports ______________________________
No. Photos ________ No. Sketches ________
Ref. Dwgs. ______________________________
Est. Damage %______________________________
Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor ______________	O	Use for emergency vehicles ______________	O
Use for public transportation ______________	O	Close to truck traffic ______________	O
Use for pedestrians ______________	O	Use for private passenger vehicles only___	O
Use for two-way traffic ______________	O	Use for one-way traffic ______________	O
Use off-site detour ______________	O	Use for on-site detour ______________	O
Use underpass only ______________	O	Use overpass only ______________	O
Barricade ______________	O	Shore and brace ______________	O

C. COMMENTS ____

____

____

D. BRIDGE DESCRIPTION Assessment Report # ________

1. Type

	Concrete Prestr.	Concrete Reinf.	Steel	Composite	Timber
Arch	O	O	O	O	O
Box	O	O	O	O	O
Cantilever	O	O	O	O	O
Girder	O	O	O	O	O
Slab	O	O	O	O	O
Suspension	O	O	O	O	O
Truss	O	O	O	O	O
Other	O	O	O	O	O

2. Foundation: Caisson O Pile O Spread footings O

3. Internal support

	Number of spans One	Two	No.	Height (ft)
Bents (frames)	O	O	_____	_____
Columns	O	O	_____	_____
Piers	O	O	_____	_____

4. Abutments High _______ ft.
Low _______ ft.

5. Road Dimensions Length _______ ft.
Curb to curb _______ ft
Walks _______ ft

DAMAGE OBSERVED (D.O.)

Damage Scale:	0 None (0%)	1 Slight (1-10%)	2-3-4 Moderate (11 - 40%)	5 Severe (41 - 60%)	6 Total (over 60%)	NA Not Applicable	NO Not Observed

E. FOUNDATION
D.O.
____ Earth movements/gaps
Piles at:
____ a) abutments
____ b) Piers
Spread footings at:
____ a) Abutments
____ b) Piers

F. ABUTMENTS
_____ Disturbance or erosion
_____ Wall movement (____in)
_____ Backfill settlement (____in)

G. WINGWALLS
_____ Damage
o Movement
o Separation

H. APPROACHES
D.O.
____ Damage
o Operational
o Roadway settled (___in)
o Off bridge seat

I. BEARINGS
____ Integral
____ Contact
____ Rocker
____ Elastomeric Pad

J. INTERMEDIATE SUPPORTS
____ Settlement
____ Damage
o Near top
o Near bottom
o Near middle
o Moment failure
o Shear failure
o Compression failure
o Support lost

K. SUPERSTRUCTURE
D.O.
____ Girder
o Shear cracks
o Moment cracks
____ Deck
o Long. joints enlarged
o Expansion joints
____ Truss
o Upper chord
o Lower chord
o Diagonals
____ Suspenders

L. GEOTECHNICAL
____ Liquefaction
____ Landslide
____ Faulting
____ Other

REMARKS ____

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
ROAD/HIGHWAY

Assessment
Report No. ________

Facility Name ______________________________
Address ______________________________
Co-City-Vic ______________________________
Mo/Day/Yr _____/_____/_____ Time ___________
use 24 hr.
Type of Disaster ______________________________

SAP ID Nos. __________ __________
Other Reports ________________
No. Photos _____ No. Sketches _____
Ref. Dwgs. ____________________
Est. Damage %________________
Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

Existing barricades in position O

B. RECOMMENDATIONS

Monitor____________________ O
Ok for public transportation________ O
Ok for pedestrians______________ O
Ok for two-way traffic____________ O
Use detour(s)________________ O

Ok for emergency vehicles____________ O
Ok for private vehicles______________ O
Ok for one-way traffic________________ O
Install barricades__________________ O
Aftershocks potentially dangerous to traffic_ O

Traffic in danger due to adjacent unstable/unsound structure__________O

C. COMMENTS ____

____

____

____

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None	Slight	Moderate	Severe	Total	Not	Not
	(0%)	(1-10%)	(11 - 40%)	(41 - 60%)	(over 60%)	Applicable	Observed

D. ROADBED

D.O.		Location	Extent
______	Fills	______	______
______	Cuts	______	______
______	Subgrade	______	______
______	Slip-outs	______	______
______	Slides	______	______
______	Washouts		

E. PAVEMENTS

D.O.

______ Longitudinal cracks
______ Transverse cracks
______ Vertical displacement
Amount ______
Side up (N, S, E, W) ______

Pavement type: O AC O PCC O Other

Describe ______

F. TRAFFIC CONTROL FACILITIES

D.O.

______ Condition

o Operating

o Critical regulatory signs standing

Exceptions and conditions: ______

______

______

______

G. UTILITIES

D.O.

______ Drainage
______ Gas lines
______ Petroleum lines
______ Underground power lines
______ Aboveground power lines
______ Sewers
______ Water lines
______ Other ______

H. OBSTRUCTION/HAZARDS

D.O.

______ Bridges
______ Buildings/structures
______ Debris
______ Joint poles
______ Mud
______ Power lines
______ Rocks
______ Trees
______ Water
______ Other ______

I. REMARKS ______

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
PIPELINE

Assessment Report No. ________

Facility Name ______________________________

Address ______________________________

Co-City-Vic ______________________________

Mo/Day/Yr _____/_____/_____ Time __________ use 24 hr.

Type of Disaster ______________________________

SAP ID Nos. __________ __________

Other Reports ______________________________

No. Photos ______ No. Sketches ______

Ref. Dwgs. ______________________________

Est. Damage %______________________________

Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor______________	O	Continue in service ______	O
Remove from service______	O	Install temp. above-ground line____	O
Provide temporary alternate service___	O	Check water quality/safety ______	O
Unblock entrance __________	O	Divert flow__________	O

______________________________ ______________________________

______________________________ ______________________________

______________________________ ______________________________

C. COMMENTS ______________________________

____

____

____

D. PIPELINE DESCRIPTION

Assessment Report # ____________

1. Type of pipeline: Pressure O Gravity O Storm Drain O
   Water O San. Sewer O Other O ______________

2. Pipe nominal diameter: ______ 3. Proximity to water/sewer/gas line: _______________

	AC	CI	CMP	DI	PVC	RC	STEEL	VC	WI	Other	Unknown
Bell & Spigot											
Butt											
Caulked											
Comp. Ring											
Riveted											
Welded											
Unknown											

4. Describe the failure mode:
   - O Circumferential crack
   - O Burst pipe barrel
   - O Sheared pipe barrel
   - O Sheared service connection
   - O Pulled joint
   - O Broken joint
   - O Other ______________________________
   - O Liquefaction Describe ____________________

____

____

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NA
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

SURFACE OBSERVATIONS

	D.O.			D.O.	
E.	____	Ground surface disturbed	K.	____	Soffit damaged
F.	____	Visible leakage	L.	____	Invert displacement
G.	____	Service connection broken	M.	____	Horizontal displacement
H.	____	Headwall damaged	N.	____	Trash-rack blocked/damaged
I.	____	Endwall damaged	O.	____	Leakage at valves
J.	____	Manhole damaged	P.	____	Leakage continuing
			Q.	____	Leakage rates _____ _____

R. Nearest valve/MH (if less than 1/4 mile) ________________________________

S. Remarks ____

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM

PUMP STATION

Assessment Report No. ________

Facility Name ______________________________
Address ______________________________
Co-City-Vic ______________________________
Mo/Day/Yr _____/_____/_____ Time __________ use 24 hr.
Type of Disaster ______________________________

SAP ID Nos. ________ ________
Other Reports ______________
No. Photos _____ No. Sketches _____
Ref. Dwgs. ______________
Est. Damage %______________
Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor__________	O	Continue in service__________	O
Remove from service__________	O	Check pump-motor alignment______	O
Brace structure before using______	O	Recheck after power restored______	O
Check filter basket__________	O		
__________		__________	
__________		__________	
__________		__________	

C. COMMENTS ______________________________

____
____
____

D. PUMP STATION DESCRIPTION

Assessment Report # ______________

O Water O Wastewater O Sewage O Other _______________

O Wet Well

O Dry Well

	No. Motors				No. Operable			
	Elect	Gas	Gasoline	Diesel	Elect.	Gas	Gasoline	Diesel
Centrifugal								
Reciprocal								
Horizontal								
Vertical								

Str. Type	Buried	Above Grade
Concrete		
Masonry		
Frame		
Other		

O Building (Building Evaluation Attached O)

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

E. STRUCTURE

D.O.

_____ Access
_____ Crane runway
_____ Fixed hoist
_____ Floor
_____ Fore bay
_____ Foundation
_____ Roof
_____ Walls
_____ Hatches

F. PUMPS

_____ Anchors
_____ Casing
_____ Connected piping
_____ Supports
_____ Valving

G. MOTORS/ENGINES

D.O.

_____ Anchors
_____ Connected piping
_____ Couplings to pumps
_____ Power supply
_____ Transformer(s)

H. CONTROLS

_____ Internal power
_____ Supports
_____ Wiring
_____ Valving

K. EXTERNAL PIPING

	Inlet	Outlet
Piping	____	____
Leaked	o	o
Leaking	o	o

Leakage rate, gpm _________

I. EXTERNAL POWER

D.O.

_____ Electrical continuity
_____ Fuel lines
_____ Fuel storage

J. AUXILIARY EQUIPMENT

_____ Charts
_____ Lighting, exterior
_____ Lighting, interior
_____ Meters & gauges
_____ Overhead crane
_____ Small diameter piping
_____ Electrical Cabinets

L. REMARKS ____

____

____

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
RESERVOIR

Assessment Report No. ________

Facility Name ______________________
Address ______________________
Co-City-Vic ______________________
Mo/Day/Yr ____/____/____ Time ________ use 24 hr.
Type of Disaster ______________________

SAP ID Nos. ________ ________
Other Reports ______________
No. Photos _____ No. Sketches _____
Ref. Dwgs. ______________
Est. Damage %______________
Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor______________ O
Remove from service______________ O
Continue in service______________ O

Continue in service, repair ASAP________ O
Drain and repair______________ O
Lower water level and continue service____ O
________ ft

______________________ ______________________
______________________ ______________________
______________________ ______________________

C. COMMENTS ______________________

____
____

STEEL RESERVOIR Assessment Report # ________

D. RESERVOIR DESCRIPTION

Capacity ______ MG Wall Height ______ ft O/S Diameter ______ ft

Roof Type O Wood O Steel O Flat O Conical O Knuckled Edge

Shell O Welded O Bolted O Riveted

Floor support O Footing ring O Oiled sand O A.C. O Other ______________

Footing O Concrete ring O Other ____________ O None

Pipe connection O Rigid O Flexible

Anchorage to foundation _____ Dia. __________ Spacing

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

E. SHELL

D.O.

_____ Elephant's foot

a. Height ______ ft

b. Circumferential extent ______ft

_____ Other buckling

_____ Horizontal joints broken

_____ Vertical joints broken

_____ Plate split

_____ Seismic anchors

_____ Rocking of reservoir evidenced

_____ Sliding of reservoir evidenced

_____ Leaks evident. Rate ________ gpm

_____ Unexplained wet spots on adjacent ground

_____ Shell penetrations damaged

_____ Other attachments to shell damaged

_____ Pipe Connections to Tank

F. VALVE PIT

D.O.

_____ Access

_____ Control Piping

_____ Gauges

_____ Hatches

_____ Inlet-outlet piping

_____ Pit flooded

_____ Roof

_____ Walls

_____ Charts

_____ Valves

G. _____ **Roof**

H. _____ **Footing**

I. _____ **Floor**

J. _____ **Aboveground Piping**

K. _____ **Underground Piping**

L. REMARKS ____

____

____

____

PRESTRESSED CONCRETE RESERVOIR Assessment Report # __________

M. RESERVOIR DESCRIPTION:

Wire or Strand Wrapped	Buttress Type using individual Tendons, usually inside wall	Bar Tendons on Tank Surface
TENDONS:		
O 220 ksi - 0.142" or 0.172" dia	O Strands O Wires O Bars	O Bars with prop. couplers
O 270 ksi - 3/8" dia		
WALL CONSTRUCTION:		
O Cast-in-place	O Cast-in-place	O Cast-in-place
O Shotcrete	O Precast	O Shotcrete
O Shotcrete w/ steel diaphragm		
O Precast		
O Precast w/ steel diaphragm		

TENDON PROTECTION SYSTEMS:

O Shotcrete O Corrosion inhibiting grease O Galvanizing protected by plastic sheath

O Grout

Tank Restraints O Seismic cables O Curb (restraining sliding)

Capacity _______ MG Wall height ______ ft O/S diameter ______ ft

Roof Type: O Flat O Dome Exposed O Yes O No O Fill depth _______ Surface usage _____________

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

N. SHELL

D.O.

_____ Shell or shotcrete cracked
_____ Vertical cracks more than 2 feet long
_____ Unexplained excessive loss of contents
_____ Bulging observable
_____ Visible construction joints
_____ Wall leaking
_____ Wet spots
_____ Spouts
_____ Horizontal cracks more than 25% of perimeter
_____ Corrosion at horizontal cracks
_____ Shotcrete delaminated at cracks
_____ Attachments to shell loose
_____ Leaks @ rust stains
_____ Major leaks at shell/foundation joint
_____ Unexplained wet spots on adjacent ground
_____ Corrosion at manholes/other penetrations

Leakage rate ______ gpm

O. HORIZONTAL PRESTRESSING

D.O.

1. Wrapping:
   - _____ Corrosion
   - _____ Corrosion at horizontal cracks
2. Individual tendons:
   - _____ Corrosion products
   - _____ Leaks @ tendon locations
   - _____ Leaks @ tendon anchorages
   - _____ Tendon anchorage distressed
   - _____ Tendon anchorage disrupted/loose
   - _____ Cracking in vicinity of tendon anchorage
   - _____ Tendon location visually observable
   - _____ Discoloration of concrete in line w/tendons
3. Bar tendons on surface:
   - _____ Tendons failed
   - _____ Tendons sound loose
   - _____ Evidence of rust

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

P. ROOF

D.O.

Flat or conical

_____ Displaced with respect to wall
_____ Sagging
_____ Cracked at edges
_____ Cracked at interior supports
_____ Supporting column spalled

Dome Shell

O Shotcrete O CIP concrete

O Precast concrete

_____ Construction joints
_____ Cracks

O Show reinforcement/corrosion

O Increasing with time

_____ Delaminating
_____ Misalignment of surface
_____ Rust lines @ top of soffit over rebars
_____ Dome Ring
_____ Corrosion
_____ Distress @ shell/ring juncture
_____ Shotcrete loose/hollow-sounding
_____ Vertical cracks
_____ Wire (strand) exposed/corroded

D.O.

Q. _____ **FOOTING**

R. _____ **FLOOR**

S. _____ **ABOVEGROUND PIPING**

T. VALVE PIT

_____ Access

_____ Control piping
_____ Gauges
_____ Hatches (equipment)

_____ Inlet-outlet piping

_____ Pit flooded (depth _____ ft)
_____ Roof
_____ Walls
_____ Charts
_____ Valves

U. REMARKS ____

____
____
____
____
____
____
____
____
____

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
TREATMENT PLANT (WASTEWATER)

Assessment Report No. __________

Facility Name ______________________	SAP ID Nos. __________ __________
Address ______________________	Other Reports ______________________
Co-City-Vic ______________________	No. Photos _____ No. Sketches _____
Mo/Day/Yr ______/______/______ Time __________ use 24 hr.	Ref. Dwgs. ______________________
Type of Disaster ______________________	Est. Damage %__________________
	Facility Status

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:	None	O	Recommended:	Green O	Posted at this assessment:	Yes O
	Green	O		Yellow O		No O
	Yellow	O		Red O		
	Red	O				

B. RECOMMENDATIONS

Monitor__________________________ O
Remove from service_______________ O
Chlorinate and by-pass_____________ O
Continue in service_____________ O
Check effluent quality/safety______ O

C. COMMENTS: ____

DAMAGE OBSERVED (D.O.)

	0	1	2-3-4	5	6	NA	NO
Damage Scale:	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

D. PROCESS COMPONENT (D.O.)

	Structural	Mechanical	Electrical
Screening/grinding	______	______	______
Influent pumping	______	______	______
Grit removal	______	______	______
Primary treatment	______	______	______
Secondary treatment	______	______	______
Tertiary treatment	______	______	______
Quaternary treatment	______	______	______
Effluent disinfection	______	______	______
Solids digestion	______	______	______
Solids dewatering	______	______	______
Solids disposal	______	______	______

E. TRIBUTARY PUMPING PLANTS/FORCE MAINS

Pumping Plant Name			
______________	______	______	______
______________	______	______	______
______________	______	______	______

F. TRIBUTARY GRAVITY SEWER SYSTEM

Briefly summarize your assessment of the condition of the gravity sewer system (recognizing the limitations of time and resources during this initial inspection period).

____

____

____

____

____

____

____

____

____

____

____

Assessment Report # ____________

Check:

Electrical power (control panel, emergency generator)
Telemetry
Disinfection process (chemical containers, feeder, piping)
Broken pipes, flooding, leaking
Chemical feed (spills)
Unit Processes

	OBSERVATIONS
RAW SEWAGE	____________________
	____________________
SCREENING/GRINDING	____________________
	____________________
INFLUENT PUMPING	____________________
	____________________
GRIT REMOVAL	____________________
	____________________
PRIMARY TREATMENT	____________________
	____________________
SECONDARY TREATMENT	____________________
	____________________
TERTIARY TREATMENT	____________________
	____________________
QUATERNARY TREATMENT	____________________
	____________________
EFFLUENT DISINFECTION	____________________
	____________________
SOLIDS DIGESTION	____________________
	____________________
SOLIDS DEWATERING	____________________
	____________________
SOLIDS DISPOSAL	____________________
	____________________

STATE OF CALIFORNIA

SAFETY ASSESSMENT PROGRAM

TREATMENT PLANT (WATER)

Assessment Report No. ________

Facility Name ______________________________

Address ______________________________

Co-City-Vic ______________________________

Mo/Day/Yr _____/_____/_____ Time __________ use 24 hr.

Type of Disaster ______________________________

SAP ID Nos. __________ __________

Other Reports ____________________

No. Photos _____ No. Sketches _____

Ref. Dwgs. ____________________

Est. Damage %____________________

Facility Status [ ]

SAFETY INSTRUCTIONS: The possibility of toxic gases in confined spaces or of fuel leaks should be recognized as a potential hazard.

CAUTION: The primary purpose of the report is to advise of the condition of the facility for immediate continued use/occupancy. REINSPECTION OF THE FACILITY IS RECOMMENDED. AFTERSHOCKS MAY CAUSE DAMAGE THAT REQUIRES REINSPECTION. The conclusions reached by engineers who re-examine the facility later should take precedence. The assessment team will not render further advice in the event of conflict of engineering recommendations.

A. CONDITION:

Existing:		Recommended:		Posted at this assessment:	
None	O	Green	O	Yes	O
Green	O	Yellow	O	No	O
Yellow	O	Red	O		
Red	O				

B. RECOMMENDATIONS

Monitor____________________ O

Remove from service______________ O

Chlorinate and by-pass______________ O

____

____

Continue in service______________ O

Check effluent quality/safety__________ O

____

____

C. COMMENTS:

____

____

____

____

____

____

Assessment Report # ______________

DAMAGE OBSERVED (D.O.)

Damage Scale:	0	1	2-3-4	5	6	NA	NO
	None (0%)	Slight (1-10%)	Moderate (11 - 40%)	Severe (41 - 60%)	Total (over 60%)	Not Applicable	Not Observed

D. PRETREATMENT

D.O.

_____ Raw water channels
_____ Aerators
_____ Rapid mix
_____ Flocculation
    _____ basins
    _____ baffles
    _____ paddles
    _____ scrapers
_____ Sedimentation
    _____ basin
    _____ troughs
    _____ scrapers

E. FILTRATION

_____ Structure
_____ Troughs
_____ Beds
_____ Backwash system
_____ Surface wash system

F. CHEMICAL TREATMENT

_____ Chlorine piping
_____ Chlorine cylinders
_____ Chlorine feeders
_____ Other chemical piping
_____ Other chemical feeders
_____ Other chemical storage

G. CONTROL SYSTEMS

_____ Mechanical
_____ Electrical
_____ Pneumatic
_____ Hydraulic
_____ Manual
_____ Automatic

H. HEAD HOUSE

D.O.

_____ Bearing walls
_____ Nonbearing walls
_____ Frame (general condition)
_____ Structural members
    _____ Structural connections
    _____ Roof
    _____ Floors
    _____ Stairs
_____ Elevators
_____ Glass
_____ Mechanical equipment
_____ Electrical equipment
_____ Filter gallery
    _____ Piping
    _____ Pipe gallery

I. CLEARWALL

_____ Tank-type (use Reservoir Assessment Form)
_____ Containment structure
_____ Influent piping
_____ Effluent piping

J. WASHWATER RECLAMATION

_____ Settling basin
_____ Mechanical equipment
_____ Electrical equipment
_____ Piping
_____ Detention basin
_____ Sludge discharge

K. REMARKS ______________________________

____
____
____
____
____
____
____

Assessment Report # ____________

Check:

Electrical power (control panel, emergency generator)
Telemetry
Disinfection process (chemical containers, feeder, piping)
Broken pipes, flooding, leaking
Chemical feed (spills)
Unit Processes

OBSERVATIONS

RAW WATER ____________________

____

PRECHLORINATION ____________________

____

AERATION ____________________

____

RAPID MIX ____________________

____

FLOCCULATION ____________________

____

SEDIMENTATION ____________________

____

FILTRATION ____________________

____

DISINFECTION ____________________

____

FLUORIDATION ____________________

____

CLEARWELL ____________________

____

DISTRIBUTION SYSTEM ____________________

____

APPENDIX B – SAP MEMORANDUM OF UNDERSTANDING (MOU)

MEMORANDUM OF UNDERSTANDING

Between

The California Governor's Office of Emergency Services (Cal OES)

And

____

WHEREAS, the safety of the people of the State of California is of the utmost importance at all levels of state and local government;

WHEREAS, the State of California and the Federal Emergency Management Agency (FEMA) recognize the importance of written mutual aid agreements to facilitate response, recovery, and reimbursement;

WHEREAS, the Safety Assessment Program (SAP) utilizes volunteers and mutual aid resources to provide professional engineers and architects and certified building inspectors to assist local governments in safety evaluation of their built environment in the aftermath of a disaster;

WHEREAS, SAP is intended to help local governments perform facility safety evaluations as quickly as possible;

WHEREAS, the California Governor's Office of Emergency Services (Cal OES) and the above-titled Requesting Jurisdiction, hereinafter referred to as Parties, seek to enter into a Mutual Aid and Operational Agreement in order to use the Safety Assessment Program's (SAP) resources and personnel in the event of a local disaster or other emergency;

THEREFORE, the Parties agree as follows:

1. The Requesting Jurisdiction will be responsible for reasonable travel and per diem costs for meals not provided of the volunteer SAP personnel deployed by Cal OES in response to the disaster or emergency, if applicable.
2. The Requesting Jurisdiction will be responsible for the hourly wages and overtime of local government SAP personnel deployed by Cal OES in response to the disaster or emergency, in addition to their reasonable travel and per diem costs, if applicable.
3. Requesting Jurisdiction will not be required to reimburse State SAP personnel.
4. The Requesting Jurisdiction will provide Cal OES with the number of SAP evaluators it is requesting and their preferred expertise, such as the number of licensed civil, structural, or geotechnical engineers, licensed architects, or certified building inspectors being requested.
5. The Requesting Jurisdiction will provide Cal OES with the number of days the SAP personnel will be needed, the date and time of arrival, and reporting location.
6. The SAP personnel will be under the authority of the Requesting Jurisdiction once deputized by the Requesting Jurisdiction as deputy building inspectors, after which time

the SAP personnel will be permitted to post official placards under the authority of the local jurisdiction.

7. The Requesting Jurisdiction agrees to the following:
    a. Utilize SAP personnel only to evaluate building and/or infrastructure viability;
    b. Not use SAP personnel to estimate building damage repair costs;
    c. Not use SAP personnel for possession retrieval from private homes or from public buildings; and
    d. Maintain daily attendance rosters of all who are participating in the SAP deployment, including time of arrival and time of departure for the duration of the deployment.
    e. Provide copies of the attendance rosters to the state and federal disaster recovery specialists upon request.
    f. Track and document the SAP deployment costs.
    g. Upon completion of the SAP mobilization, all SAP personnel will be safely demobilized in accord with standard emergency management best practices.
    h. Upon completion of the SAP mobilization, pay all outstanding costs.
8. The Requesting Jurisdiction may choose to use the donated labor of SAP volunteers to offset their non-federal cost share. To do so, the Requesting Jurisdiction must keep records of the hours that the volunteers spent in the field, the normal hourly wage of each volunteer, and the volunteers' names.
9. To the extent permitted under California law, State SAP personnel and volunteers will be covered for worker's compensation by the State of California worker's compensation law, and local jurisdiction SAP personnel will be covered for worker's compensation through their own jurisdiction.
10. To the extent permitted by law, SAP personnel may have immunity from liability in accord with the California Emergency Services Act Section 8657(a), the California Business and Professions Code Sections 5536.27 and 6706. SAP personnel will also obtain immunity from liability by virtue of being deputized by the Requesting Jurisdiction. Nothing in this section shall provide immunity for intentional acts, gross negligence or willful misconduct, or any conduct outside the course and scope of official duties, or wherever else immunity is prohibited under California law.
11. Cal OES agrees to make reasonable efforts to provide SAP personnel to the Requesting Jurisdiction.
12. This Agreement will commence upon approval of the Parties and the binding signatures of the officials with authority for Cal OES and the Requesting Jurisdiction. This agreement will be in effect until such time as the Agreement is terminated by one or both Parties. Either Party may terminate this agreement by providing written notice of its intention to terminate no less than thirty calendar days prior to the effective termination date.
13. The Parties shall comply with all applicable federal, state, and local statutes, regulations, rules and ordinances.
14. Each Party has read, agreed to, and executed this Agreement on the date(s) indicated below.

_______________________________ _______________________

(Requesting Jurisdiction) (Signed)

_______________________________ _______________________

(Printed name) (Date signed)

California Governor's Office of Emergency Services _______________________

(Signed)

_______________________________ __________

(Printed name) (Date signed)