State of California
Governor's Office of Emergency Services

Post-Disaster Safety Assessment Program (SAP)

Evaluator Training

Version 8

July 2007

Student Manual

POST-DISASTER SAFETY ASSESSMENT PROGRAM (SAP) TRAINING

FOR

EVALUATOR

Version 8

July 2007

For current SAP information, please visit our website at **www.oes.ca.gov**, *under the "Training" heading*

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Introduction

The Safety Assessment Program (SAP) provides professional resources to local governments, assisting them with the safety evaluation of buildings and infrastructure in the aftermath of a disastrous event. Their goal is help local government perform accurate facility safety assessments as quickly as possible. SAP has been successful in this endeavor during recent major earthquakes such as Loma Prieta (1989), Big Bear-Landers (1992), Northridge (1994), Napa (2000), and San Simeon (2003). It was also used under interstate mutual aid, the Emergency Management Assistance Compact (EMAC) to assist the states of Louisiana and Mississippi in the aftermath of Hurricane Katrina.

Volunteers and mutual aid resources are utilized to provide professional engineers, architects, geologists, and certified building inspectors to assist local governments in safety evaluation of their built environment in an aftermath of a disaster. The Governor's Office of Emergency Services (OES) in cooperation with professional organizations manages the SAP program. SAP produces two resources, SAP Evaluators, described above, and SAP Coordinators, which are local government representatives that coordinate the program. The Evaluator training is the focus of this manual.

OES is pleased that you are interested in participating in this program as an Evaluator. Your role will be essential in the first hours after a destructive event to evaluate the safety of potentially damaged structures. There are also some examples of "best practices" gathered by use of the program over the years that will be passed on to you. Finally, the information you gather will be very useful to emergency managers. We look forward to working with you through this program.

UNIT 1 SAFETY ASSESSMENT PROGRAM OVERVIEW

UNIT 1 – SAFETY ASSESSMENT PROGRAM OVERVIEW

Overview

This unit presents an introduction to the Safety Assessment Program and discusses qualifications, organization, liability issues, workers compensation, and ends with a glossary of common terms associated with safety assessment.

Training Goal

Provide the participants with the basic background of the program to better understand their role as safety evaluators.

Objectives

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

- Identify where they fit in the overall emergency response operation; and
- Know and use the common terms associated with emergency response and safety evaluations.

1.0 Safety Assessment Program Overview

Safety Assessment is the process by which structures of all occupancies and specific lifeline systems and facilities are evaluated for their safety for immediate occupancy or continued use. The Safety Assessment Program (SAP) was developed to meet the needs of local government building departments during an emergency by providing architects, engineers, and building inspectors to assist with safety evaluations.

Through quickly evaluating structures for continued occupancy, we can reduce the demands on shelters and reduce shelter needs. The process of evaluating structures is based on the process and procedures described in the Applied Technology Council publication ATC-20 *Procedures for* ***Postearthquake Safety Evaluation of Buildings*****.**

The Safety Assessment Program has the ability to provide personnel to any level of government to evaluate their building stock and lifeline systems (airports, roads, bridges, pipelines, pump stations, reservoirs [tanks], and treatment plants). City or county building officials have the oversight responsibility for buildings in their jurisdictions, and public works officials likewise are responsible for lifeline infrastructure systems in their jurisdictions. Special districts can include both buildings and lifeline systems within their responsibility.

1.1 Concept of Emergency Operations

During the response to disaster situations, the lowest level of government is always in charge. For a city, this will be the City emergency services, which means that safety evaluations will be performed through the City building department or public works department. For unincorporated areas, this may be County departments. Special districts, such as school or water districts, have their own jurisdictional responsibilities, and can use the Safety Assessment Program independently of the cities or counties.

All jurisdictions within the State of California use the Standardized Emergency Management System (SEMS) to respond to any type of emergency or disaster. SEMS is a management system that allows a jurisdiction to smoothly transition from day-to-day activities to emergency operations.

The basic framework of the Standardized Emergency Management System (SEMS) provides for a five level emergency response organization, activated as needed, to provide effective response to inter-agency, multi-agency and multi-jurisdictional emergencies. The five levels of SEMS are:

1. Field,

2. Local Government,

3. Operational Area,

4. OES Region, and

5. State.

During emergency operations, all levels of government are connected through the Internet with a system known as RIMS (Regional Information Management System). This allows for the swift exchange of information and reports throughout the operation.

Control of operations is always at the lowest level, with each succeeding level of government providing support. In other words, local government determines what they will do, how they will do it, and when they will do it, based on their own priorities.

Under SEMS, counties are considered as local government, and they control the operations within the unincorporated areas. The Operational Area supports local government, Regions support the Operational Areas and the State supports the Regions. The emergency response hierarchy is depicted in Figure 1-1.

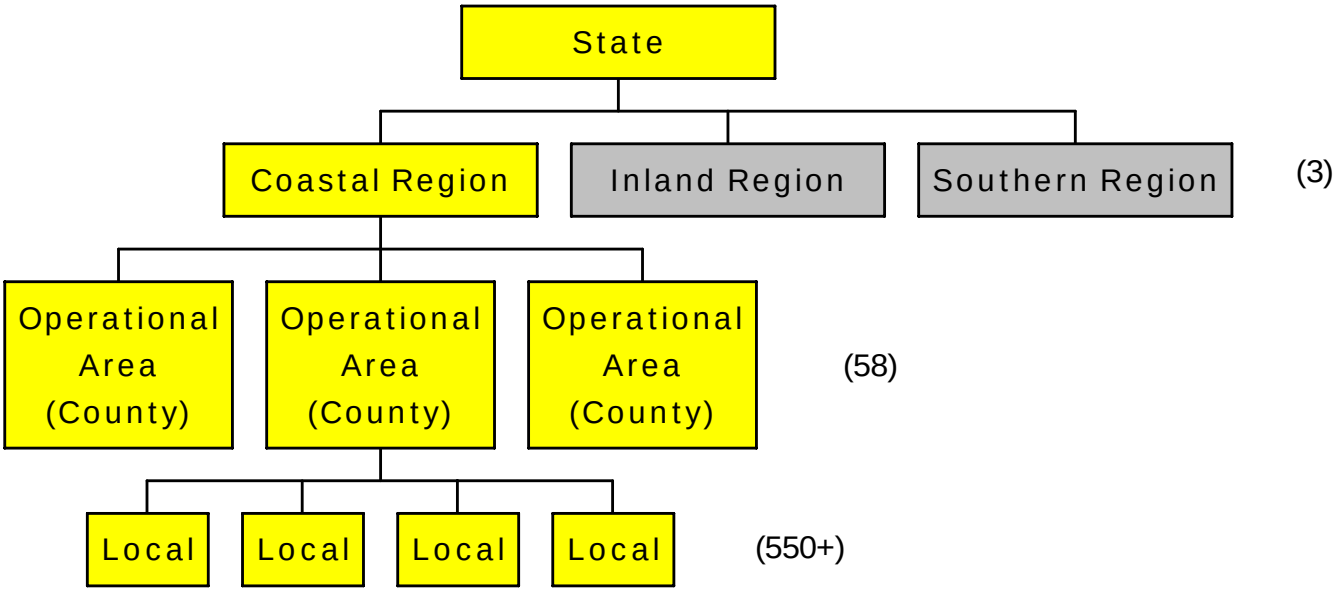


Figure 1-1 – Response Hierarchy

The state of California has been divided into six Mutual Aid Regions. The purpose of a mutual aid region is to provide for the more effective application and coordination of mutual aid and other emergency related activities. The Office of Emergency Services (OES) provides administrative oversight over the mutual aid regions through three Administrative Regional Offices located in the Inland Region at Mather Field, the Coastal Region in Oakland, and the Southern Region in Los Alamitos. These regional offices establish and maintain the Regional Emergency Operations Center (REOC).

1.2 Evaluator Qualifications

Local governments have expressed concern regarding the qualifications of Safety Assessment Program participants performing safety assessment. The following qualifications have been established for individuals to be registered into the program individuals must be:

- Professionally registered civil, structural, or geotechnical engineers,

- Professionally licensed architects,

- Professionally registered geologist or engineering geologist, or

- Certified building inspectors or officials as follows: Building Inspector [ICC], Building Plans Examiner [ICC], Combination Inspector [ICC], Building Official [ICC], Master Code Professional [ICC], Residential Building Inspector [ICC], Residential Combination Inspector [ICC], Combination Plans Examiner [ICC], Building Code Official [ICC], Construction Inspector Division II [ACIA], Division of the State Architect Class 1 & 2, and OSHPD Class A.) *(For a current list of recognized certifications, please visit the SAP web page at the OES website,* www.oes.ca.gov.)

CALBO resources must be employed by a local agency and responsible for plan checking and inspections.

Those not meeting these requirements may be deployed as part of the program, but will serve as assistants to evaluators and coordinators until such time as they secure their professional registration, license or qualifying certification. Their valuable services may include safety watch and on-site data management, and in the case of code enforcement personnel, necessary interactions with distraught members of the public.

Additionally, individuals must have:

- **General knowledge of construction** - the evaluator must be able to look at any particular framing system and rapidly identify the system, know 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 potentially damaged system and, based on their knowledge and experience, make a judgment on the ability of that system to withstand another event of approximately equal magnitude.

Safety Assessment resources available to local government fall into three categories:

- DSW-Volunteer – individuals from the private sector,

- DSW-Local – local government representatives, and

- DSW-State – state employees.

1.3 Issues Surrounding Deputizing Individuals, Liability, and Workers' Compensation

There have been concerns over the issues of deputizing, liability, and worker's compensation since the Safety Assessment Program was first developed. The purpose of this section is to identify and address the main issues regarding these three topics.

1.3.1 Deputizing Resources

There is only one reason why OES recommends that a jurisdiction deputize the responding resources as Deputy Building Inspectors: only authorized representatives of a jurisdiction can post official jurisdiction placards. These are placards that have been formally adopted by the jurisdiction, carry the jurisdiction's seal and the authorizing ordinance number, and carry the weight of law.

Mutual aid resources are not representatives of the jurisdiction, consequently they cannot post official placards. When performing evaluations, the responding individuals can post only generic placards that are simply recommendations. If the jurisdiction wishes to have official placards used, they must either:

- deputize the responding individuals;
- send one of their inspectors with each team who will post the official placard; or,
- send an inspector out to the subject building and replace the generic placard with an official placard.

Some jurisdictions believe that they become financially responsible for Workers' Compensation if they deputize the individuals who respond through mutual aid. This is not true. State resources from the private sector are provided with Workers' Compensation through the State of California, and local government resources receive their protection from their home jurisdictions.

1.3.2 Liability Issues

Liability protection is available to all who respond. These issues are not as prevalent with local government representatives because, as civil servants, they cannot be held personally liable for their actions while performing the responsibilities and duties of their particular department. When individuals are provided by one jurisdiction to another to assist in the time of an emergency, these individuals perform the duties and responsibilities of their particular department. Once the receiving jurisdiction deputizes the individuals, they are protected through the receiving jurisdiction as a representative of that jurisdiction.

Liability protection for the private sector resources is a bit more complicated but just as viable. There is the general protection provided by California's Good Samaritan Law, which provides general immunity for anyone helping during a situation. This law was not really intended for disaster situations, but does provide some immunity nonetheless. Private sector resources are organized and registered by the Office of Emergency Services as Disaster Service Workers. In accordance with the ***California Emergency Services Act*** Section 8657:

"*(a) Volunteers duly enrolled or registered with the 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 State's Attorney General issued a response to a series of questions presented by OES regarding the liability protection afforded by the ***California Emergency Services Act***. The following are extracts of that opinion:

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 workers' 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 licensed architects and registered engineers through the ***State of California Business and Professions Code***, Chapter 30, Section 5536.27 for architects and Section 6706 for engineers. After the Loma Prieta Earthquake in 1989, many architects volunteered their services to the City of Oakland to assist in the safety assessment of buildings. Concerned about future liability, they championed SB46x that passed in 1990. This legislation modified the Business and Professions Code to provide liability protection for professionally licensed architects and registered

engineers. The stipulations are that the:

- evaluations must be performed within the first 30 days after the earthquake;
- services must have been requested by a public official, public safety officer, or city or county building inspector acting in an official capacity;
- no fee is paid or taken.

1.3.3 Workers' Compensation

As can be seen from the above extract from an Attorney General's Opinion, the private sector resources are provided with workers' compensation through the ***California Emergency Services Act***. Section 8580 of the Act states:

> *"The Emergency Council shall establish by rule and regulation various classes of disaster service workers and the scope of the duties of 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 designed to facilitate the payment of workers' compensation."*

CALBO members are covered by their home jurisdiction, and State agency personnel are provided Worker's Compensation through the State.

1.4 Program Registration

Safety Assessment Program evaluators are managed in the program through one of two ways:

- Through their professional organization; or,
- If employed by a State Agency.

In both cases, individuals to be registered by OES must meet the minimum qualifications previously presented. Additionally, to become registered, individuals must:

- Complete the one-day standardized training program presented by a certified trainer;
- Have a digital picture taken for the ID card; and
- Complete and sign the Loyalty Oath.

OES determined that all Disaster Service Worker ID cards issued prior to July 2002 expired in December of 2003. All cards will now expire on a 5-year cycle from the month the training took place, or the refresher course was completed. A refresher course for this program is available on the Internet

(at the SAP web page on the OES website, www.oes.ca.gov) to renew one's ID card and to renew one's standing in the program. Also, a short classroom SAP Evaluator Refresher Course is available. Of course, the SAP Evaluator class can also be taken again in order to renew the ID card.

A new ID card has been designed so all cards will have a similar, identifiable look. Only OES will issue the identification cards.

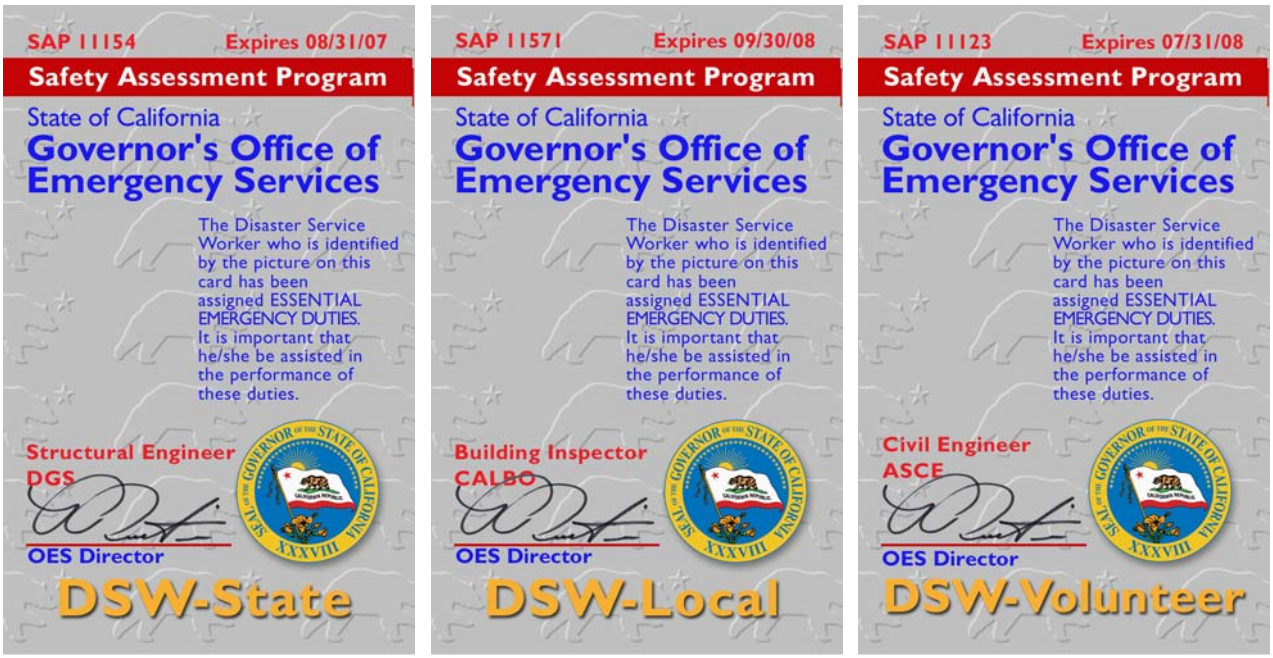


Figure 1-2 – SAP ID Cards

1.5 Reimbursements

All responding individuals will not have to pay for safety evaluation related expenses. They will be reimbursed for all housing, meals, travel and other related expenses. However, there are two reimbursement issues that all should be aware of:

- DSW Volunteers will not be able to receive wages while on a response. If they are paid, they lose their Worker's Compensation coverage through the Emergency Services Act and their employer will be responsible for the coverage. Employees must be on vacation or unpaid leave while working as a volunteer DSW.

- For government employees, in accordance with the Master Mutual Aid Agreement, there is no expectation for reimbursement of salaries while on a response. During past activations of the program, there have been cases where the requesting jurisdiction has reimbursed the providing jurisdiction for their costs.

For requesting jurisdictions, their expenses related to the safety assessment process are eligible for reimbursement under the Public Assistance Program.

1.6 Activation Sequence

Once an event occurs, local government must reasonably commit their available resources to respond. For a building department, this means committing all of their inspection resources. This is usually done very early on, as many inspectors are sent out to do windshield surveys and initial tagging of essential facilities.

After the building department resources are committed, the jurisdiction evaluates their need for additional resources. If the event proves to be beyond their capability to respond to with available resources, they request assistance from the Operational Area.

Operational Areas include the County, all cities within the county, and all special districts. Special districts can include school districts, utility districts, etc. The county will be the lead agency for the operational area unless another arrangement is established by agreement.

Since the Operational Area is a coordinating body, they will request the SAP resources from the OES Regional Emergency Operations Center (REOC). This request is forwarded by the REOC to the State Operations Center where the State SAP Coordinator is located. Knowing the number and classification of individuals that are being requested, the State SAP Coordinator contacts the appropriate organizations to activate them. The organizations then mobilize their members and report to the identified staging area for assignment.

Generally, once arriving at the staging area, the evaluators sign in, report to the SAP coordinator, and are deputized. They obtain their briefing packet from the jurisdiction, and watch a refresher video on the Safety Assessment Program. Then they receive their work assignments as teams. The SAP coordinator provides guidance to the teams, including having all teams assess a structure together as an example. The teams proceed out to the field. At the end of the day, field staff returns to debrief with the SAP coordinator, including review of the assessment forms for completeness and to discuss any field issues. The evaluators sign out for the day and return the next, until they are cycled out to return home.

1.7 Responsibilities

To facilitate activation of the Safety Assessment Program and call-out of the appropriate individuals, the various disciplines have the following recommended responsibilities. In this manner, OES knows which organizations to activate based on the needs of the requesting jurisdiction. This is simply guidance to the jurisdiction and the State for activation and is not intended to limit anyone to certain duties, apart from the limitations of their own qualifications. Actual assignments will be made by the jurisdiction based on their priorities.

By way of explanation, rapid evaluations are a quick safety review of the building, and comprise 95% of the SAP workload in earthquake disasters. (Percentages in flood and windstorm disasters are somewhat different.) Detailed evaluations are usually done after requests from the public or the building department, and are a lengthier, much more detailed review of the facility. Specialized teams are usually sent out to do those. With buildings, 5% of the post-earthquake building evaluations are

detailed; all the infrastructure evaluations are detailed. More information on this is provided in Chapters 2 and 4.

- **Building Inspectors** perform ATC-20 rapid evaluations of all occupancies. They will also assist with detailed evaluations as needed.

- **Structural Engineers and Civil Engineers with a background in structures** perform ATC-20 rapid and detailed evaluations of buildings and structures. They also will assist various state agencies such as the Division of the State Architect and the Office of Statewide Health Planning and Development.

- **Civil Engineers and Structural Engineers with a background in lifelines** perform rapid and detailed evaluations of lifeline infrastructure systems and facilities. They are also available to assist state agencies such as the Department of Water Resources and Caltrans.

- **Architects** perform ATC-20 rapid and detailed evaluations of buildings and structures. They will also assist various state agencies such as the State Fire Marshal's Office and the Division of the State Architect. Figure 1-2 below shows these responsibilities in the form of an organizational chart. This is the type of chart that the OES SOC will use to determine the appropriate disciplines to be activated based on requests for assistance. This is provided for guidance only to the State and local government and is not intended to limit any individual or group to a specific type of evaluation. Such limitations come from the individual's experience and background.

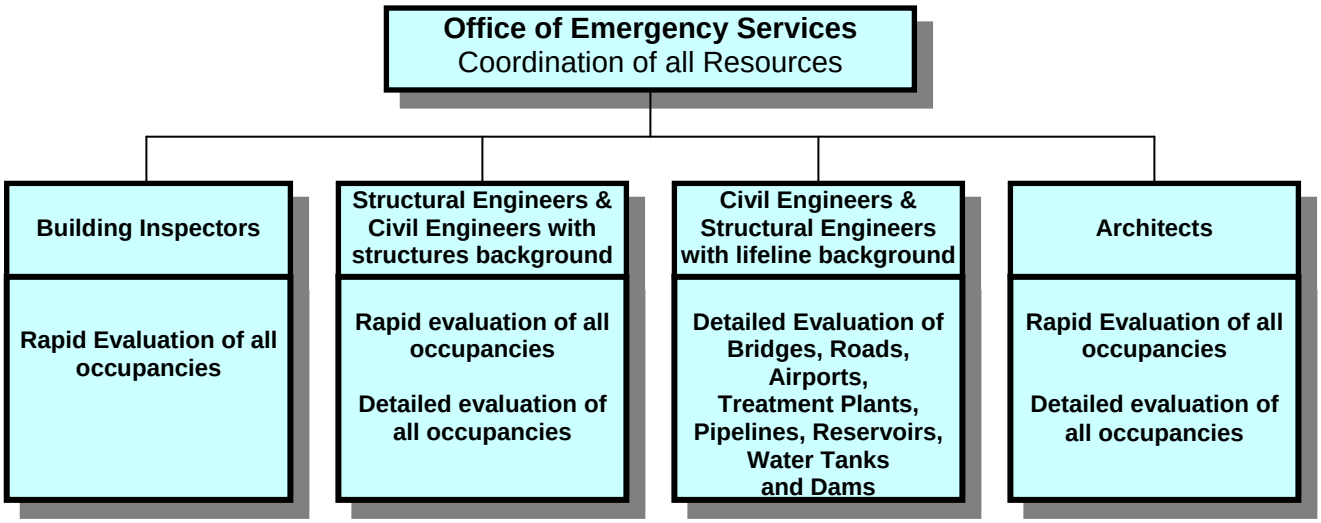


Figure 1-3 Discipline Responsibilities

For small events, only those individuals within the disaster area or immediate surrounding area will likely be activated. In this manner they will not need housing and will be used on a limited basis.

For large events, individuals from within the disaster area will not be activated. Local government building inspectors will be inspecting buildings within their own jurisdiction and will not be available. Private sector individuals will have their own clients who will require assistance. Consequently, the

program will be activated outside the disaster area.

Each professional organization at the state level has appointed a "SAP coordinator" who oversees the safety assessment activities of the individual chapters or sections. Each section or chapter, known as a subdivision, has a "subdivision SAP coordinator" who:

- organizes the call-out procedures for the specific subdivision;
- organizes and arranges training and registration programs; and
- initiates the subdivision's call-out.

During activation, DSW-Volunteers are activated for 5 days. DSW-Local and DSW-State evaluator resources are optimally activated for 5 days as well, but it could be longer. This could lead to a 6 to 7 day involvement, allowing for half to one day each way travel to and from the assignment. Deployed SAP coordinators will usually have an overlapping schedule so as to brief the incoming SAP coordinator on effective procedures for the current disaster, and initially to get set up for the SAP evaluators.

The following chart depicts the organization and the process of activating the Safety Assessment Program.

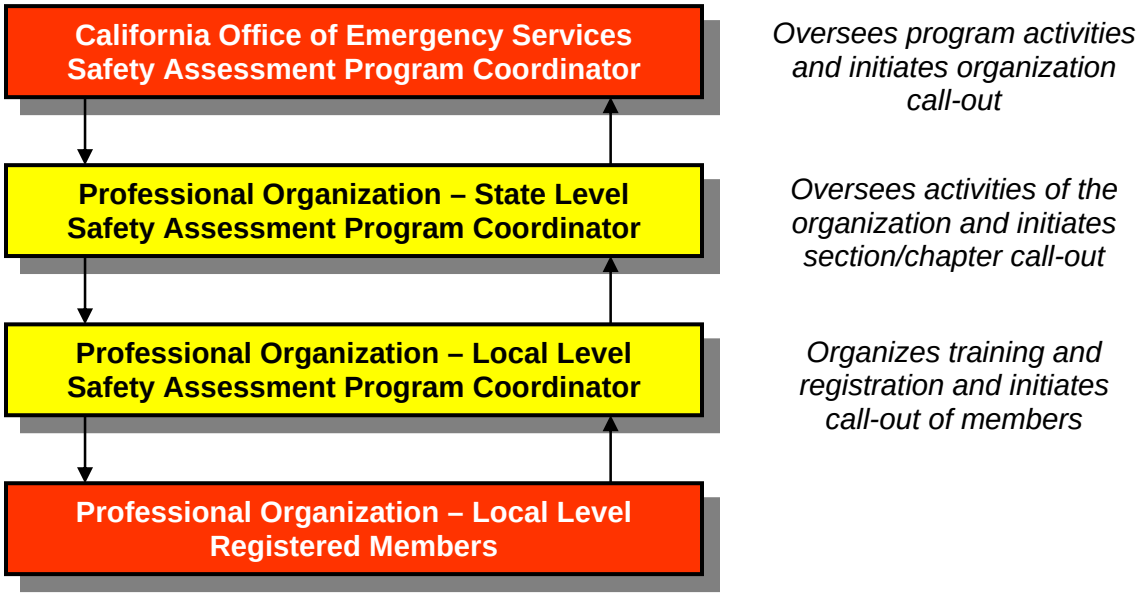


Figure 1-4 Organization of SAP

1.8 Who has Safety Assessment Responsibilities?

Any government entity that regulates building or lifeline construction and is responsible for facility safety has safety assessment responsibilities. This responsibility falls under governments' role of providing for

public health and safety.

In the post-disaster scenario, it is very important that habitable buildings be identified quickly. Some of these buildings will be used for medical care for victims, emergency management operations, and potential mass shelter facilities; but the vast majority of buildings are privately owned and provide a vital role in the economy of the area. Private businesses need to become operational as soon as possible after a disaster to keep the economy moving. The faster the economy of the impacted area returns to normal, the faster the recovery phase of the operation will be completed.

The following is a list of government agencies involved in the performing of safety assessments on the occupancies under their jurisdiction. These agencies will use the resources available in the Safety Assessment Program.

Buildings and Structures

- *Local government* is responsible for their own facilities, all privately owned businesses, single-family residences, and multi-family residences within their jurisdiction as well as all structures and lifeline infrastructure not specifically excluded below.

- *Division of the State Architect, Structural Safety Section* is responsible for oversight of new construction of all public schools (Kindergarten through 12th grade), Community Colleges, and all state-owned or state-leased facilities. DSA will be developing safety assessment response protocols for these jurisdictions, but currently does not have the oversight responsibility for post-disaster safety assessment of schools. The Safety Assessment Program resource is one of the options available for school districts for safety evaluation and tagging of facilities after a disaster.

- *Office of Statewide Health Planning and Development* is responsible for all hospitals and skilled-nursing facilities.

- *State Fire Marshal's Office* 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 refer to fire suppression systems, alarms, detectors, etc. Life-safety elements refer to exits, corridors, stairways, etc.

- *Department of Housing and Community Development* is responsible for over 80% of the mobile home and manufactured home parks in California.

- *Federal government* is responsible for all federal buildings and installations no matter where the facilities are located. These 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* are responsible for the streets, bridges, storm drains, sewers, etc., which traverse the jurisdiction.

- *Special Utility Districts* are responsible for the pipelines and/or transmission lines that they install and maintain.

- *Department of Water Resources, Safety of Dams* is responsible for all dams except those owned or operated by the US Army Corps of Engineers or the Bureau of Reclamation.

- *Department of Water Resources, Flood Operations* is responsible for all levees, canals, and state water projects.

- *Caltrans* is responsible for all Federal in-service roads (those which are part of the national highway system) and all state-owned and state-operated roads, highways, bridges, and overpasses.

The evaluation/inspection process is not limited to the jurisdiction's building department and the additional resources they may request. Many other agencies will be in the area performing various types of inspections and evaluations. Understanding and being prepared for the potentially large number of individuals who will be in the jurisdiction can help eliminate redundant efforts and lead to a sharing of information and cooperation between the agencies.

In addition to those agencies with safety assessment responsibilities, the following agencies and individuals will be in the area performing evaluations or reporting on the damage:

- *Red Cross* **-** within 24 hours of the event, the Red Cross will be in the area performing its preliminary damage assessment, which consists of a windshield survey. This process is followed by a detailed assessment, which will be completed within 72 hours after the event. These inspections assist the Red Cross in determining sheltering, food, and temporary housing needs.

- *State Department of Insurance* - sends a team, which includes state and private insurance representatives, immediately after an event. The team is called the Insurance Damage Assessment Team (IDAT).

- *Insurance Companies* - once individuals begin to file claims with their insurance companies, adjusters will be in the area performing verification inspections.

- *Media - print, radio and television* - their presence will be apparent within minutes of the event. Reporters and camera crews will tour the streets looking for damage to broadcast and damage information from public officials. If the media are encountered while performing evaluations, the evaluators should politely refer them to the building department, or to the EOC Public Information Officer. Each jurisdiction has their own protocol for addressing media questions, and evaluators should not be providing information without the express permission of the building department.

After a local government requests that the Governor proclaim a State of Emergency, the Office of Emergency Services will send in damage assessment teams to work with local government to perform preliminary damage assessments (PDA) of those facilities eligible for State financial assistance. PDAs are inspections for developing more accurate repair estimates than the windshield surveys furnish by

rapidly inspecting the facilities for potential repairs. Once the Governor asks the President to declare a major disaster, the Federal Emergency Management Agency (FEMA) sends in damage assessment teams. These are inspections intended to develop more accurate repair estimates by rapidly inspecting the facilities for potential repairs.

- *OES Disaster Assistance* **–** OES usually arrives before FEMA to perform state PDAs. The inspectors team up with local representatives and begin assessing the damage. This early assessment helps provide information as to whether or not the State needs to request assistance from the Federal Government.

- *FEMA - damage assessment for public assistance* - FEMA inspectors will make contact with the State inspectors and join local government representatives to perform the preliminary damage assessment of public facilities for federal public assistance. They inspect damaged buildings and facilities and gather cost information relating to the emergency response, repairs, and the budgets. Once there is a Presidential Declaration, these inspectors perform more detailed inspections of the damaged facilities in order to develop project worksheets, which are the funding grants for Federal financial assistance.

- *FEMA - damage assessment for individual assistance* **-** as with public facilities, FEMA will have inspectors teamed with State inspectors to look at residential areas and the commercial business districts. They gather information and make cost estimates on the potential repairs of these damaged areas. Once a Presidential Declaration is made, the FEMA inspectors perform verification inspections when the property owner has applied for individual assistance.

- *Small Business Administration* - once there is a Presidential Declaration, the Small Business Administration will be in the area providing assistance to businesses and homeowners. Their inspectors perform verification inspections after applications for assistance have been made.

As we can see by the list of agencies involved in various forms of building inspections, there will be a large number of individuals in the area at any given time. Be prepared!

1.9 Roles and Responsibilities

Throughout the safety assessment process, there are clearly defined roles and responsibilities for the evaluator and local government.

Evaluators will:

- Assess the safety of essential services facilities (these are facilities deemed essential to the emergency management effort, not necessarily "essential services facilities" as described in the building code);

- Perform rapid evaluations of all occupancies;

- Perform detailed evaluation of questionable buildings, or as assigned by the building department;

- Perform detailed evaluations of specified lifeline systems and facilities.

Evaluators will NOT:

- Provide cost estimates for the buildings they have evaluated. There are two reasons for this. Estimating disaster-caused building repair costs is "damage assessment," and is not eligible for direct reimbursement under state and federal disaster grant regulations. Also, building costs can be widely different from one location to another, and it is best left to the local entity to derive these repair costs.

- Perform evaluations using code compliance as a criteria;

- Provide escort or property retrieval for owners or occupants of buildings.

Local government's roles and responsibilities include:

- Appointing a SAP Coordinator who will be responsible for managing the program during a response and will develop the Department Operations Plan.

- Formally adopting the placards and issuing them to the evaluators as needed.

- Deputizing the responding evaluators. If they do not wish to deputize the evaluators they must be prepared either to send their staff out to replace generic placards, or assign one of their inspectors to each evaluation team.

- When the evaluators arrive, provide them with a formal briefing on conditions within the City, what they will be doing, and who to report to.

- Provide the evaluators with lodging and meals.

- Ensure that all authorities for the work to be performed are in place and current.

- Provide them with key telephone and address information regarding disaster assistance to provide to the public if asked, along with police, fire, utility, and hazardous materials response telephone numbers for their own use.

1.10 Terminology

The following are key terms or concepts with which the responding safety assessment individuals need to be familiar with:

- **ATC-20 - INSPECTED - Habitable, minor or no damage** - this green placard is used to identify buildings 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.

- **ATC-20 - RESTRICTED USE - Damage which represents some degree of threat to occupants** - Restricted Use is intended for buildings that have been damaged; yet the damage does not totally preclude occupying the structure. It can mean that parts of a structure could be occupied, or it could be used to denote those buildings that can be entered for a brief period of time only to remove possessions. The use of a 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 such a time as the owner can retain an architect or engineer 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 structures with the most serious damage. Typically, these are structures that represent a threat to life-safety should they be occupied. It is important to note that this category does not mean the building must be demolished. This placard carries the statement, "THIS IS NOT A DEMOLITION ORDER" to clarify that the building simply is not safe enough to occupy. In the vast majority of cases, structures posted unsafe can be repaired to a safe and usable condition.

- **Damage assessment** - The process that local and state agencies must perform to determine type and quantity of damage and the cost 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.

- **EOC - Emergency Operations Center** - A local government facility that provides support for all field operations and from which resources are obtained and distributed to various field operations. Additionally, policy decisions are developed and dispersed through the EOC.

- **Mutual Aid** - A process to facilitate assistance to areas stricken by an emergency without the execution of written agreements customarily entered into by public agencies exercising joint powers. Mutual aid is based on the concept of "neighbor helping neighbor" in time of need without the expectation of being compensated. Mutual aid assistance can encompass any type of resource (material, equipment, or personnel) from other jurisdictions, the State, and even the private sector. The State of California Master Mutual Aid Agreement governs California's mutual aid program.

- **Incident Command System (ICS)** – A management tool that is used during emergency response operations. ICS is an organizational structure that encourages communication vertically through the organization as well as laterally between sections. ICS also incorporates incident action planning into operations, allowing for the definition of measurable goals to keep the operation coordinated.

- **Operational Area** – One of the five levels of the Standardized Emergency Management System. Generally speaking, an Operational Area is composed of a county and all cities and special districts within that county. The Operational Area is responsible for supporting all cities and special district tactical operations, and communicating event operational status to the next SEMS level, *i.e.*, the State Regional Emergency Operations Center (REOC).

- **Red Cross Designation- DESTROYED - Not habitable, cannot be repaired** - Red Cross volunteers will perform evaluations for determining sheltering needs immediately after a disaster. These volunteers are seldom individuals with engineering or construction background, and their evaluations are usually limited to subjective visual windshield surveys of damaged areas. The criteria for the various categories are based on flood type damage and have very little comparison to earthquake damage. This designation is used by the Red Cross to help them determine the need for long-term housing.

- **Red Cross Designation - MAJOR - Not habitable, needs extensive structural repair** - This designation is probably closer to being equivalent to the ATC-20 UNSAFE placard. Again, this information is used by the Red Cross to determine sheltering and housing needs only and may have no relation to actual structural condition.

- **Red Cross Designation - MINOR - May be habitable, needs minor repairs and/or clean-up** - This designation falls somewhere between the ATC-20 RESTRICTED USE and the INSPECTED placards.

Participants should keep in mind that only authorized representatives of the jurisdiction or Safety Assessment Program Evaluators who have been deputized as Deputy Building Inspectors are authorized to post official habitability/occupancy placards as designated by the jurisdiction and defined by ordinance.

- **REOC - Regional Emergency Operational Center** - This is the facility operated and maintained by the State of California within the regional area being served. REOCs are located in Los Alamitos for the Southern Region, Oakland for the Coastal Region, and Sacramento County for the Inland Region. It is through these operations centers that the State provides support to the Operational Area, coordinates requests for statewide resources, and provides the communication link between local government and the State of California. REOC operations are under the jurisdiction of the Governor's Office of Emergency Services.

- **Safety assessment** - The process by which buildings of all occupancies and infrastructure lifelines are evaluated for their safety for immediate occupancy or continued use. This process is under the direction of local government through their building and safety or public works departments. During safety assessments, 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.

Notes:

UNIT 2 SAFETY ASSESSMENT PROCESS AND PROCEDURES

UNIT 2 - SAFETY ASSESSMENT PROCESS AND PROCEDURES

Overview

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

Training Goal

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

Objectives

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

- Use the criteria for completing each level of evaluation;
- Properly identify and complete the various forms; and
- Properly identify and use correctly 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 opposite. Historic and geologic records have shown that such movement has been as large as 20 feet horizontally and 10 feet vertically. Few structures located over the fault or just adjacent to the fault can survive this effect.

- **Landslides, rockslides, and mudslides** - have caused great loss of life when entire towns have been buried (Andes Mountains). Automobile-sized boulders have caused great damage (Iran) and great landslides have moved structures hundreds of feet (Alaska).

- **Liquefaction** - occurs in loose deposits of saturated, fine, uniform sands. If such a deposit is subjected to a sudden disturbance or shock, as in an earthquake, the material tends to lose stability under the suddenly developed shear stresses. The soil becomes temporarily transformed into a fluid mass with significantly reduced shear strength, resembling general soil shear failure. In the large earthquake at Niigata, Japan in 1963, the liquefaction of a sand deposit caused a group of concrete apartment buildings to drop suddenly, some as much as one story and to tilt more than 30 degrees. Sand boils and other disruptions of the ground surface also have occurred.

- **Tsunami/Seiche** - can be caused by significant shaking of land beneath and adjacent to large bodies of water. When the wave sweeps ashore, it can devastate all but the heaviest structures. Islands and low-lying coastal areas are most vulnerable, and inlet configuration can cause an amplification of the wave. A tsunami is an ocean occurrence, while a seiche is a wave that forms in a lake or other inland water areas. Earthquakes are not the only causes for a tsunami or seiche. They can be caused by any event that displaces a large volume of water, such as an underwater landslide. A very common cause is volcanic eruptions occurring under water.

- **Shaking** - is the effect that is most commonly experienced by structures and can be felt as far as hundreds of kilometers from the earthquake origin. Near field shaking is what occurs within tens of kilometers from the fault, and the far field effect occurs at distances beyond that.

2.1.1 Effects on Structures

Every structure has a fundamental period of vibration. The period of a one-story structure may be generally stated as 0.1 second or less (10 Hz). Mathematically, the fundamental period may be simply approximated as N/10 seconds where N is the number of stories. A structure's fundamental period will normally decay (become longer) as the structure suffers damage. Earthquake motion is usually rich in frequencies (frequency is simply the reciprocal of the period, 1/period) that are similar to those of structures (0.5 to 10 Hz) and can, therefore, excite and damage structures. (Note that these statements are generalized. For the proper formula for seismic period, see the most current building code.)

As ground waves move farther from the epicenter, the frequency of the available waves decreases due to attenuation (that is the peaks of the waves are farther apart). In the near field, where most frequencies are present in the shaking and the frequencies are high (the peaks of the waves are close together), the most intense effects are felt by shorter, stiffer structures whose periods of vibration are closer to matching the period of the ground waves. As the waves move further away from the epicenter and the period increases, the taller more flexible structure become more susceptible to damage.

In the near field, the strong shaking that is felt by structures will have significant vertical as well as horizontal components. Since the vertical load system of buildings is designed for more than gravity loading, the additional vertical forces from earthquake ground motion are normally not critical. The horizontal shaking subjects structures to shear and overturning forces that require them to be constructed with a complete lateral force resisting system which may be either part of or separate from the vertical load system.

Figure 2-1 - Near Field Effects - Landers/Big Bear Earthquakes, 1992

The next three pictures show the dramatic effects on structures within the near field. The first shows a home (upper right) that was in the near field during the Landers Earthquake of 1992. In the lower left you can see the trace of surface faulting and its location relative to the house. This trace is visible because of an approximately three-foot up thrust or vertical displacement along the trace. The up thrust took place in a matter of seconds as the fault rupture passed through. This is visual evidence of a vertical component to the ground motion that affects structures. The result of the horizontal and vertical motion on the home in the background is shown in the following figures. This is a graphic example of the near field effects on short, stiff structures.

In this particular series of photographs, the subject house was very close to the epicenter of the event. Interestingly enough, structures in the close vicinity of this home suffered only minor damage, where this one was destroyed.

Figure 2-2 - Near Field Effects - Landers/Big Bear Earthquakes, 1992

The home was built on a concrete slab on grade with minimal connections of the sill to the slab. Here we see that the structure physically moved laterally about 6 inches. In order for this to happen, the connections of the wall sill plate to the slab had to fail. In fact, the vertical component of the motion caused the roof and walls to lift and the connections to the slab begin to pull through the sill plate. The simultaneous lateral ground motion caused the ground and slab to move laterally bending the bolts and causing them to pull the rest of way through the sill plate. This type of severe ground movement results in significant levels of damage to the structure and contents.

Figure 2-3 - Near Field Effects Landers/Big Bear Earthquakes, 1992

On the right side of the fracture in the slab at the edge you can see the bent anchor bolt which still has the nut and washer in place. This would indicate that the sill bolt pulled through the sill plate as the structure was thrown upward. In the previous figure (the opposite side of the house) you see that the structure was also displaced laterally. Every sill bolt was pulled through the sill plate. In this view, the entire wall of the home collapsed and fell away from the structure. The large cracks in the floor slab are an indication of the severe ground movement.

In the far field, special effects can occur that will cause severe damage to taller (longer period) structures, since these frequencies are not dampened as greatly as the shorter ones. When the fundamental period of a site matches that of the structure founded on it, earthquake shaking can cause

resonance that amplifies the response. The collapse of 10 and 20 story buildings in Caracas in 1967, and 8 to 12 story buildings in Mexico City in 1985, are unfortunate examples of this effect.

2.2 Windstorm and Flood Effects

Lateral loading of structures is the most common failure mechanism in windstorm and flood damage. This is especially true in the case of unreinforced masonry buildings, which fail catastrophically under hurricane-force winds and in fast-moving flood waters. In floods, it is not uncommon for structures to be removed from their foundations and swept away to new locations. In the most severe cases, it does not matter if the structure is well built and soundly attached to a foundation, since even the foundation elements can be carried off wholesale with the structure. Undermining of foundations by scour effects can contribute to structural damage. In addition, both strong winds and floods can send large projectiles hurtling into structures.

This photo shows a URM garage in the process of failure. Storm surge is primarily responsible for this; note the water line just below the top of the windows.

Figure 2-4 - URM failure in progress, Hurricane Katrina storm surge, 2005

In this photo, the house floated off its foundation and came to rest destructively. This home was not attached to the masonry foundation so as to resist buoyancy.

Figure 2-5 - Wood frame home, Hurricane Katrina storm surge, 2005

This photo shows flood-generated scour under what seems to be a concrete slab foundation. This can cause new stresses on a structure and can contribute to failure.

Figure 2-6 - Foundation scouring, Hurricane Katrina, 2005

This URM parapet was blown off by the strong winds of Hurricane Katrina. Very similar conditions can exist in such cases to those occurring after an earthquake, where still-attached masonry poses a falling hazard to passersby below. In this case, the overhang provides protection to pedestrians.

Figure 2-7 - Parapet blown off, Hurricane Katrina, 2005

2.3 Explosion Effects

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

In 1947, a ship carrying 2,300 tons of ammonium nitrate fertilizer caught fire and exploded in the harbor at Texas City, TX. The official death toll was just under 600, and about 100 of the missing were never found. This explosion in the harbor caused a tsunami that swept other ships inland and caused additional damage. Fiery debris rained down and set off fires in the community. This was the largest explosion disaster in U.S history prior to the September 11, 2001 terrorist attack in New York, NY.

Figure 2-8 - Explosion and fire, Texas City, TX, 1947

2.4 The Safety Assessment Program

Programs must be goal-oriented in order to be successful, and the Post-Disaster Safety Assessment Program is no different. When on a response, evaluators need to know that local government has a specific goal in mind when they begin the safety assessment process. Many evaluators believe the goal of the process is simply to identify damaged structures. This is not the case. Identification of damaged buildings is a by-product of the process, which in itself is very useful to local government. However, in accordance with the ***Post-Disaster Safety Assessment Plan***, the goal is:

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

Evaluating and categorizing buildings and structures to reflect their condition for continued occupancy, which, in turn, assists local government greatly in its recovery and reconstruction efforts, accomplish this goal. The faster we can get people safely back into their buildings, the faster the economic base of the city can recover. Furthermore, the faster people can return safely to their homes, the financial strain on government of maintaining shelters is reduced, as is the emotional strain on the people.

Since 1989, when the Applied Technology Council presented ATC-20 ***Procedures for Postearthquake Safety Evaluation of Buildings*** and the companion field manual ATC-20-1, two additional publications have been developed by ATC: ATC-20-2 ***Addendum to the ATC-20 Postearthquake Building Safety Evaluation Procedures***, and ***ATC-20-3 Case Studies in Rapid Postearthquake Safety Evaluation of Buildings***. In addition, in 2004 the ATC-45 ***Field Manual: Safety Evaluation of Buildings after Windstorms and Floods*** was released. These publications well define the process and procedures for determining the safety of buildings for continued occupancy. As time goes on, the Safety Assessment Program will be activated for any type of event, emergency, or

disaster that impacts the integrity of structures.

In 1992, OES published the state plan on safety assessment known as the ***Post-Disaster Safety Assessment Plan***. Where the ATC-20 publications define the process, procedures, and criteria for safety evaluation, the plan provides local government guidance on how to access the resources of the Safety Assessment Program available to assist in the safety assessment process.

2.5 Placards Used for Safety Assessment

The ATC-20 procedures are based on a three-placard system. These placards are intended to convey to the owner and/or tenants of a building the condition of the building in relation to continued occupancy. The selection of the appropriate placard is determined by performing either a rapid or detailed evaluation with occupancy the main criterion. The evaluation performed as part of the safety assessment process is not sufficient, in most cases, to determine how to repair the observed damage or whether it is economically feasible to repair it. The evaluation is only sufficient to determine whether or not the building can be occupied.

ATC-20 introduced the three original placards: INSPECTED, LIMITED ENTRY, AND UNSAFE, which are also color-coded green, yellow, and red, to easily identify their meaning. These placards were based on the original placards developed by SEAOC and OES in the late 1970s. The first use of the ATC-20 placards was during the Loma Prieta response in 1989 within the San Francisco area. At the same time, the original OES placards were used within the Santa Cruz area. This provided a good test of the two similar sets of placards.

After Loma Prieta there was much discussion on the placards relating primarily to the LIMITED ENTRY concept. This resulted in the Federal government, through FEMA, funding the Applied Technology Council (ATC) to review the placards, forms, and procedures of ATC-20 in light of the experiences of Loma Prieta. ATC was to make modifications as necessary and provide additional information on the process that was not included in the original publication. The main accomplishment of the new publication, ATC-20-2, was the development of new placards which more clearly define the condition of a building for continued occupancy and new evaluation forms intended to provide better information to justify the selection of the appropriate placard.

Due to the fact that the great majority of jurisdictions no longer use or have in stock the old versions of the placards, this course will focus on the use of the new placards.

2.5.1 Inspected (Green)

The following is a representation of the INSPECTED placard.

INSPECTED

LAWFUL OCCUPANCY PERMITTED

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

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to the 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 required;
- Lateral load capacity has not been significantly decreased;
- Vertical load capacity has not been significantly decreased;
- Lawful occupancy is permitted.

In looking at the criteria it needs to be pointed out that "significantly decreased" is a subjective criterion. There is no scale by which to measure "significant." One must use judgment as to the impact of potential damage on the capacity of the lateral force and vertical load systems. Such judgment comes from experience in designing or reviewing designs of the systems.

A Comments Section has been added so that important information can be relayed to the occupant regarding the condition of the structure. This placard does not mean the building was not damaged. It simply means that any damage that occurred does not represent a hazard to the occupants. The Comments Section is intended to provide a means of indicating to the owner that damage which must be repaired. Information that appears in the Comments Section of the placard must also appear in the Comments Section of the evaluation form.

The third revision is the addition of a caution statement relating to aftershocks. This is intended to let the occupant know that the building may have to be re-inspected after a large aftershock. The addition of this caution statement tends to limit the use of the placards to earthquake events only. However, for other types of events, the owner can ignore the caution statement. The final change is a wording change to the bottom of the placard regarding the removal of the placard.

2.5.1.1 Example of the Use of the INSPECTED (Green Placard)

Figure 2-9 - Home - Landers/Big Bear Earthquakes, 1992

This shows a home that has been damaged locally in that the carport has collapsed. There was no damage to the home and no threat to the occupants. The carport represents only a minor hazard in its current condition. The house could be posted **INSPECTED** (or Green) since there is no direct hazard to the occupants. The area around the carport could be posted as an "area unsafe." On the placard, in the Comments Section, a notation that once the carport is taken down the area unsafe condition could be removed would be appropriate. The same notation would also appear on the evaluation form. If, for example, the carport had not fallen but was still marginally attached to the house, the condition of the structure could change to **RESTRICTED USE** (yellow).

The restriction on occupancy would be to not occupy rooms on the carport side of the home until such time as the carport was removed or repaired. The damage to the carport is a falling hazard that poses a threat to anyone in the vicinity of the carport. The hazard would be outside the structure and should be posted as "area unsafe."

2.5.2 Restricted Use (Yellow)

During the development of the publication ATC-20-2, two examples of a RESTRICTED USE placard were developed

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:

_____
_____
_____
_____

Date: _____
Time: _____

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

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Facility Name and Address:

_____
_____

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: _____
_____

Date: _____
Time: _____

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

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Facility Name and Address:

_____

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 present in part of the structure;
- There may be damage to the lateral force and/or vertical load resisting systems, however, they are still able to resist loads;
- Occupancy is permitted in accordance with noted restrictions.

RESTRICTED USE is clearly understood by everyone. The concept behind this placard is that the building has been damaged, but portions of it may be occupied, or the damaged portion is stable and the owner should have free access to retrieve possessions as needed. This placard provides space to briefly explain the damage and then place appropriate restrictions on how the building is occupied. These restrictions may range from allowing entry only to retrieve possessions to restricting occupancy to only certain rooms. During Loma Prieta and more recent events, we found that more yellow placards are posted than **UNSAFE** or red placards. These buildings were not in a "questionable" condition; the damage present was such that full occupancy could not be allowed, but there was no need to totally disallow entry.

The concept of possession retrieval is a major concern. After Loma Prieta some jurisdictions were looking to the safety assessment evaluator to establish time lines for individuals to enter damaged buildings to retrieve possessions. This placed the evaluator in the awkward position of trying to decide if 15 or 30 minutes was an acceptable risk. Now, through the use of **RESTRICTED USE**, we can eliminate that problem by allowing for possession retrieval on the placard. Permission is not needed from the jurisdiction.

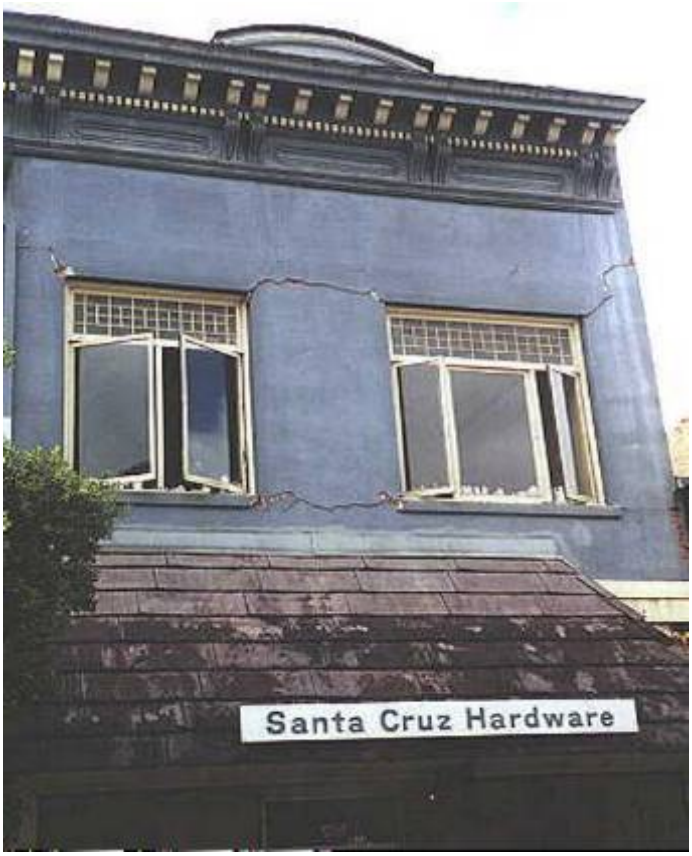


Figure 2-10 - Commercial Building - Loma Prieta Earthquake, 1989

This shows a condition that represents a decrease in the lateral capacity of the wall. However, this condition is not necessarily a significant decrease in that the piers are still able to resist forces without collapsing by rocking on their base. From a safety assessment standpoint, this is a serious condition but not one that would preclude entry to the building for possession retrieval. Consideration should be given to restricting access to this front portion of the building until the wall can be stabilized.

Figure 2-11 - Loma Prieta Earthquake, 1989

This shows damage as a result of pounding of different height buildings. The damage seen in the brick veneer occurs just at and below the floor line. The broken windows are also an indication of the level of motion experienced by the building. If the evaluation were a rapid evaluation (discussed later in this unit) the most appropriate placard would be **RESTRICTED USE**. Due to the potential for damage to the support of the floor framing, initial restrictions on occupancy would be severe in that no entry into the area around the damage would be permitted, and access to other parts of the structure would be for possession retrieval only. A detailed evaluation, where access to the interior would be provided, may show little or no damage to the support of the floor framing. In this case the restrictions could be modified to provide free access, or the condition of the building could change to **INSPECTED**.

This shows damage to a URM from Hurricane Katrina storm surge. This level of damage may not be as significant in this setting due to a lack of repetitive lateral motion, but in an earthquake would not be a safe condition due to the threat of aftershocks. A **RESTRICTED** tag here could in either case prevent persons from use of this part of the building.

Figure 2-12 – URM wall shear failure, Hurricane Katrina, 2005

2.5.3 Unsafe (Red)

The following is a representation of the UNSAFE 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.

Date: _____
Time: _____

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Facility Name and Address:
_____
_____

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 changed from ATC-20. The placard indicates that one or more of these conditions are present:

- There is extreme hazard and the building may collapse;
- There is imminent danger of collapse from an aftershock;
- There is a significant decrease in lateral and/or vertical load capacity; and
- The building is unsafe for occupancy or entry except by authorities. In this case authorities include engineers and contractors who need access to the building to develop stabilization methods as well as repair designs.

Originally, the public believed that an **UNSAFE** placard meant that the building had to be demolished. This is not true. Most buildings can be repaired. The repair-demolition issue usually boils down to one of economics. As an example, San Francisco had 350 red-tagged buildings after Loma Prieta, but only 50 of those buildings were demolished. Most of the demolition resulted as a decision of the owner based on economic reasons. The **UNSAFE** placard is used when there is an immediate risk associated with entry, use, or occupancy.

To clarify matters, this placard has the phrase, "**This placard is not a demolition order**." The placard also indicates that the building has been inspected and found to be unsafe and that a brief description of the damage is required. The placard further requires written authorization from the jurisdiction for the owner or tenant to enter the building. This statement allows entry for possession retrieval when it is deemed appropriate by the jurisdiction. Further, it allows the building owner to mitigate the hazard in a manner acceptable to the local building authority in order to have access to the building.

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

Figure 2-13 - Loma Prieta Earthquake, 1989

The condition shown here can be considered as a significant decrease in lateral capacity. This picture was taken as the building was being repaired and emphasizes the cracks in the wall piers. These cracks are a result of diagonal tension in the pier from in-plane lateral forces the wall was subjected to. This type of cracking is commonly referred to as "shear cracking."

What is important to note is that this is a good example of an **UNSAFE** structure that did not need to be demolished. The **UNSAFE** designation relates solely to continued occupancy of the structure.

Figure 2-14 - Landers/Big Bear Earthquakes, 1992

This shows an obviously **UNSAFE** structure from the Landers/Big Bear earthquakes that experienced a partial collapse of the building wall. This picture also shows significant problems in relation to the pool. This structure is located in Big Bear near the epicenter of the Big Bear earthquake. Vertical ground motion could have pushed the pool upward or sufficient amounts of pool water could have been "sloshed" out of the pool and into cracks in the surrounding slab causing the pool to float and the surrounding slabs to subside.

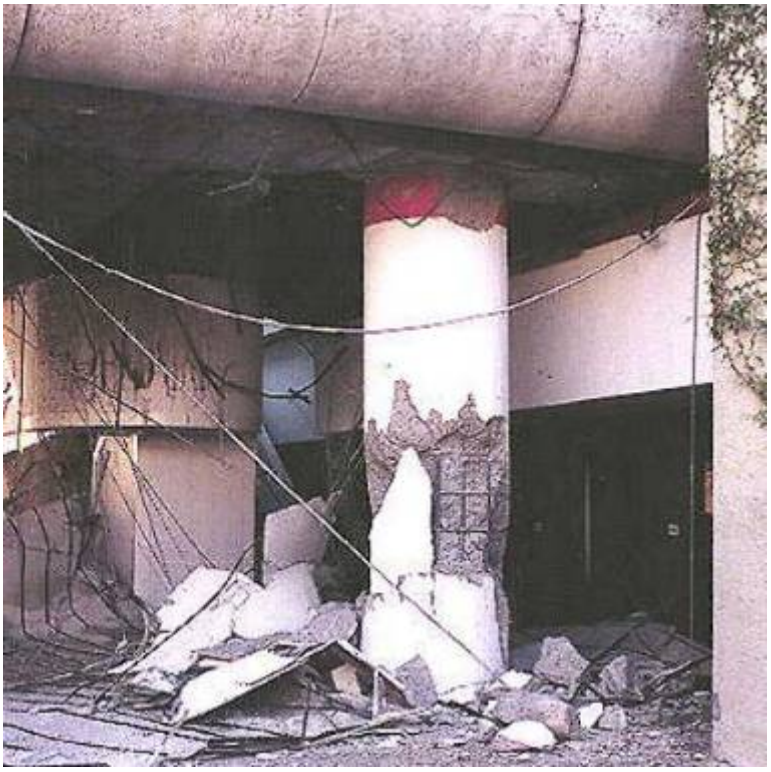


Figure 2-15 - Department Store - Northridge Earthquake, 1994

This shows a large concrete column supporting a bridge between the parking structure and a department store that was damaged by the Northridge earthquake. The plaster soffit has also failed and is lying on the ground blocking easy access to the department store. The damage to the column appears to be spalling of the concrete cover that probably has not significantly reduced the vertical load carrying capacity of the column. Looking at the thickness of the concrete cover, one can conclude that the column size was for appearance, not load capacity. Additionally, the plaster soffit is on the ground so there is no falling hazard. The initial view of the damage could lead one to believe that it looks worse than it really is. Repairs are required, but at first glance there does not seem to be a significant loss of bearing capacity.

Figure 2-16 - Department Store - Northridge Earthquake, 1994

Here is a closer look at the column. Now we see two significant items of concern: 1) permanent deformation of the vertical reinforcing; and 2) significant cracks through the core of the column. The deformation in the column shows that a potential P-Delta condition exists which could cause continued damage until such a time as the column is shored. The large crack in the concrete core indicates that there has been a decrease in the lateral capacity of the element. The existence of both of these conditions is sufficient to post the structure as **UNSAFE**.

There are times when a building is obviously unsafe and individuals need to be kept away from the area around the building as well as from the building itself. In this case the **AREA UNSAFE** concept should be used. This photo shows an example of this condition. The building is obviously unsafe as a result of a portion of the wall from the adjacent building falling through the roof. There is no question about the condition of the building. However, the fact that a portion of the wall fell indicates that the rest of the wall is more than likely unstable and could come down during an aftershock. Therefore, the desire is keep people well away from both buildings. Using the **AREA UNSAFE** designation in combination with some form of barricade will provide a reasonable level of protection until the hazard can be addressed.

Figure 2-17 - Loma Prieta Earthquake, 1989

The Landers/Big Bear earthquakes presented geologists and seismologists tremendous opportunities to study surface faulting conditions. From the standpoint of the Safety Assessment Program, surface faulting can constitute an **UNSAFE** condition if the fault trace is "close" to the building, passes under the foundation, or occurs next to a slope. There are no clear criteria for "close;" this will depend on the judgment of the evaluator. Fault traces passing under a building can lead to differential settlement and damage to foundations that is not readily visible. Traces located next to a slope (either at the top or the toe) can lead to a later failure of the slope resulting in a landslide.

Figure 2-18 - Landers/Big Bear Earthquakes, 1992

2.6 Evaluation Process

As discussed with the placards, ATC-20 has defined a three-step evaluation process. The Safety Assessment Program will be involved in only the first two of these evaluations.

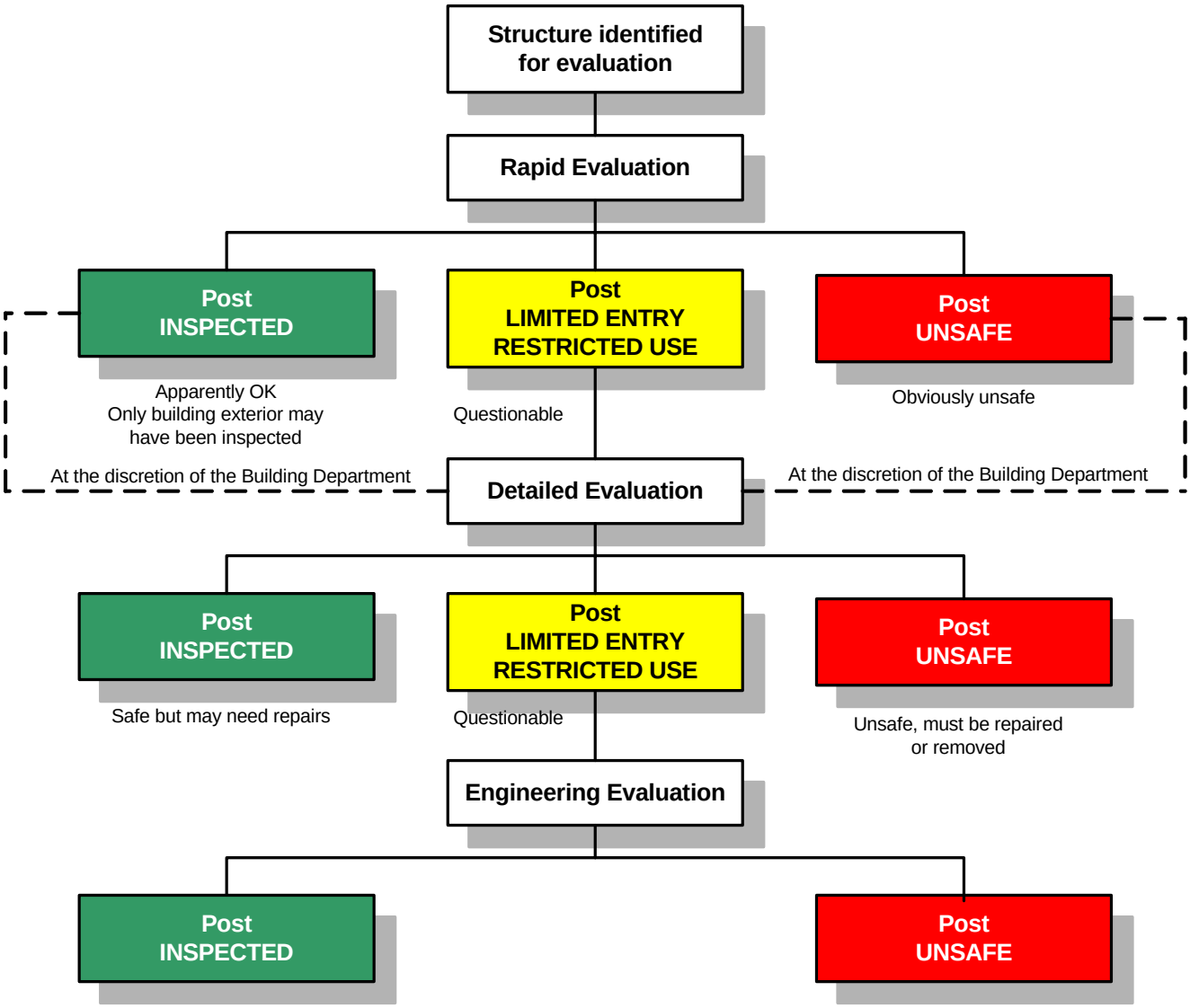


Figure 2-19 - Process Flow Chart

The three types of evaluations are defined as:

- **Rapid Evaluation -** where buildings are rapidly inspected, spending approximately 10 to 20 minutes per building. The intent of this level 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, it should be entered for a quick walk-through. This allows the discovery of any potentially serious damage or falling hazards within the building.

- **Detailed Evaluation** - where buildings are inspected more thoroughly, with more investigation into the framing systems. Detailed evaluations can take anywhere from one to four hours. Usually this level of evaluation is used for buildings in which the condition is not obvious.

- **Engineering Evaluation** - where buildings are inspected using all available data to ascertain the damage, its cause, and how to repair it. This is a detailed engineering investigation performed by architects and engineers retained by the building owner. Engineering evaluations can take anywhere from one full day to seven days or more, depending on the size of the building.

The original idea behind the safety assessment process was to perform rapid evaluation to identify the obviously safe and unsafe structures, and then perform detailed evaluation of those structures where the condition was not obvious. After the detailed evaluations, it was then up to the owner to retain an engineer to perform the engineering evaluation and develop a repair program.

Two important points must be made about the process as originally proposed. First, after the engineering evaluations, engineers will not post buildings. However, if the engineering evaluation shows that a different posting is more accurate, a letter from the engineer to the building official could result in a change of posting. Another option would be to perform enough immediate mitigation of the hazards to warrant changing the posting from **UNSAFE** to **RESTRICTED USE**.

The second point is that experience has shown that most likely only one level of evaluation will be performed. For smaller events (small number of damaged structures) a jurisdiction may decide to perform nothing but detailed evaluations. For larger events, such as the Northridge earthquake, the jurisdiction will most likely elect to perform rapid evaluations only. As there becomes more familiarity with the **RESTRICTED USE** placard, there will be less need to perform two levels of evaluation before turning the structures over to the owner's engineer. For a questionable structure, the importance is to place the correct limitations or restrictions on the occupancy. When that is done, the owner can then retain an engineer to begin the repair process.

2.6.1 Rapid Evaluations

Early in the response phase of a disaster, local government is more interested in getting buildings evaluated as rapidly as possible. It will be in these early days when property owners and elected officials will be concentrating on other areas of the disaster so the building official will not be "swamped" with calls to evaluate specific properties. The building official will implement the priorities, which will always begin with essential service facilities as established in the operational plan. In all likelihood, the evaluations performed at this time will be rapid evaluations where teams will spend 10 to 20 minutes per building, posting as many as possible. Later in the response, there will be many phone calls requesting inspections and involvement of the elected officials in "taking care of their districts." At this time, the methodical approach to safety assessment tends to break down. It will also be during this phase that the likelihood of performing detailed evaluations will increase.

Since the 1989 Loma Prieta earthquake and the first use of the ATC-20 forms, the form contents have been discussed. The most significant discussion centered on the concept of developing dollar estimates of the damage. This was a concept that was part of the original OES form but was dropped by ATC at the request of the engineers who had performed safety evaluations in the past. Local government, on the other hand, wants dollar estimates of the damage. The result of the discussions was to take a compromise position with the revised forms and estimate the percentage of damage (as

was done with the original OES forms).

This controversy needs to be discussed, and the reasons for providing or not providing dollar estimates clearly understood. Speaking from a federal assistance standpoint, FEMA must evaluate the cost of damage against the ability of the jurisdiction to recover. This evaluation is what FEMA uses to make their recommendation to the President. In order to get the cost of damage FEMA performs preliminary damage assessments (PDAs) for public assistance and individual assistance, in conjunction with state OES and the local government. During these PDAs, the inspectors will develop estimates of the cost to repair the damaged facilities. In the case of public assistance, if local government has a rough dollar estimate of the damage before the PDA begins, they are in a better position to have significant influence with the FEMA inspectors on the costs. From an individual assistance standpoint, having locations and extents of the damage gives local government the ability to help speed the process to see if the individual assistance program is activated with a Presidential Declaration.

Developing costs of the damage also provides the jurisdiction with a mechanism of describing the damages to their elected officials. Telling a mayor that there were 25,000 buildings that received some level of damage says very little. Consequently, the way to describe damage to elected officials in a meaningful way is with costs. It is more readily understood to say, "We have suffered approximately $45 million in damage." Additionally, the news media is looking for the same information. Telling their readers or listeners that 25,000 buildings were damaged does not tell them much. However, to report $45 million in damage puts the magnitude into a perspective that is easily understood. These are the main reasons why local government asks for dollar estimates on the damage.

The engineers rightfully believed that they were not spending enough time on each building to provide a dollar damage estimate supported by any degree of accuracy. Further, the way the program is activated, engineers were responding into areas where they did not know the prevailing construction costs. This also made it difficult to be accurate. These engineers were also concerned that the estimates would tend to take on a life of their own and be considered as hard estimates, thereby causing confusion with building owners who may find that actual costs were significantly higher or possibly lower.

To put the discussions into context, the dollar estimates are useful for putting the damages into context that everyone can understand. Order of magnitude estimates are the best that can be expected in the process and all that local government is looking for. The responding safety evaluators need to understand that the initial estimates are used primarily to assist in obtaining financial assistance from the State and Federal governments, not to define repair schemes or to inform insurance companies. Once a PDA has been performed, the initial dollar estimates developed by local government are replaced with the PDA estimates. However, the concept of SAP Evaluators not knowing prevailing construction costs is still very valid.

ATC-20 Rapid Evaluation Safety Assessment Form

Inspection

Inspector ID:_____ Inspection date and time _____ ☐ AM ☐ PM

Affiliation:_____ Areas inspected: ☐ Ext. 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

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Govt.

☐ 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	☐ None
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)

☐ 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: _____

_____

_____

_____

_____

A compromise was reached in the development of the current rapid evaluation forms whereby the evaluators determine a percentage of damage using given ranges. The evaluator can then use whatever procedure they wish to determine the percentage. In conjunction with this, the evaluator will also provide the "footprint" area of the building and the number of stories. One approach local government can use to determine the dollar estimate would be to use the information on the evaluation forms with standard construction cost tables. For example, if the type of construction had a value of $215.00 per square foot; the building had a footprint area of 2,000 square feet; the building height was 3 stories; and there was 10 percent to 30 percent damage, the dollar estimate of the damage would have a range:

$215 x 2,000 x 3 x 0.1 = $129,000

$215 x 2,000 x 3 x 0.3 = $387,000

The jurisdiction could use the mid-point of the range and say there was $258,000 worth of damage, or go with either end, depending on the jurisdiction's wishes.

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

2.6.1.2 Filling Out the Rapid Evaluation Forms

As with the placards, you will need to be familiar with the original evaluation forms as well as the revised forms. Also you need to be prepared for jurisdictions to develop their own forms. When jurisdictions develop their own forms, they usually use the ATC forms as a starting point, and then add boxes and lines for the kinds of additional information that they are looking for. Some jurisdictions will also add information in Spanish or other non-English languages common to their area.

To understand and be familiar with the forms will greatly assist you when you are activated and respond to a jurisdiction's request for safety assessment assistance.

Rapid Evaluation Form

The following is the information that should be provided:

1. **Inspector ID:** As with the original form, this block is filled with either your ID number or your name. Again, if the jurisdiction has deputized you, they have the right to require you to use your name not an ID number. As with the original form, use of your name does not minimize your liability protection.

2. **Affiliation:** This information allows the jurisdiction to keep track of the evaluations that are done by their own staff and from mutual aid resources obtained through OES. As a resource, you would write in your home jurisdiction if you were a part of the CALBO program, OES if you are from the private sector or the State.

3. **Inspection Date and Time:** This is one of the most important boxes to fill out. In the event of a large aftershock, the jurisdiction can rapidly review the evaluations that have been performed and determine which buildings should be re-inspected.

4. **Areas inspected:** This allows the jurisdiction to know at a glance how thorough the evaluation was. Obviously, if the evaluation were performed both inside and outside the building, it will be more thorough than from just the outside. However, many times the condition of the building can be determined from the exterior only, and there is no need to enter the building. As an example the jurisdiction could use this information to prioritize buildings for re-evaluation after a large aftershock. Those that had been evaluated from the exterior only might receive a higher priority for re-evaluation. Again, if there is no need to go inside the building, don't go in.

5. **Name**: This is the name of the building, facility, business, or onsite manager. If you cannot find the name of the building then provide the name of the business or the onsite manager. In the case of single-family residences, note the name of the owner or tenant, or simply leave the line blank.

6. **Address**: To the extent possible, 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 a number and try to determine the street number of the building being evaluated. 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:** If the owner and/or tenant are available when you are performing your evaluation, getting their phone number is advantageous to the jurisdiction. This gives the jurisdiction the ability to easily follow up on the repairs to the building. If the individual who is there when you do your evaluation is reluctant to give you this information, or if no one is there, simply indicate "NOT AVAILABLE" in the space provided.

8. **Number of Stories:** This is simply to record the height of the building. This is information the jurisdiction will use if they wish to place a cost estimate on the damage. In the new form, you now provide the number of levels above grade and the number below grade. For hillside sites, use the same criteria as noted for the original rapid evaluation form.

9. **Approximate "footprint area:"** This is another piece of information that the jurisdiction will use to place costs to the damage. Footprint area is specified so the jurisdiction knows exactly what area is being presented, and to differentiate from gross or total area.

10. **Number of residential units and Number of units not habitable:** This allows the jurisdiction to track displaced persons as well as to determine needs for short-term sheltering of these displaced persons. When the operation changes from response to recovery, this information helps in determining the needs for long-term sheltering or temporary housing.

11. **Type of Construction:** This information is provided to the jurisdiction for two reasons: 1) for use in determining the cost of the damage; and 2) for statistical information. At the rapid evaluation level, this information is very general and usually can be determined from the exterior of the building.

12. **Primary Occupancy:** This information is used primarily for cost estimating and statistics. The actual use of the building does not necessarily have a bearing on the continued occupancy. This is also helpful to the jurisdiction when it comes time to do a preliminary damage assessment to provide information for the Governor to proclaim a state of emergency, or the President to declare a major disaster.

13. **Observed Conditions:** In this case, there is more allowance for judgment in answering the questions. Instead of simply "yes" or "no," we now look at degrees of damage. Answering the questions in this manner becomes a tool for determining the estimated building damage.

14. **Estimated Building Damage:** This is purely a judgmental factor. There is no set methodology to calculate this information. As you can see, the ranges of percentages are rather broad once you reach the 10 percent mark. Probably the easiest method of determining the percentage is to roughly estimate the repair cost excluding contents (to the nearest $10,000 on light damage and to the nearest $100,000 on more heavily damaged structures) and divide it by the replacement cost. Some individuals will feel comfortable in simply "sight" estimating this percentage. This information, plus the footprint area of the building, number of levels, type of construction, and occupancy, allows the jurisdiction to develop a dollar estimate of the damage.

The Posting section places the culmination of the evaluation in one place. Simply check the box that represents the placard you post. If the building is posted as RESTRICTED USE, use the lines provided to record the restrictions on continued occupancy. In the instructions portion is the reminder of where to post the building.

Though laid out slightly differently, the Recommendations section is the same as the Recommendations section on the old Rapid Evaluation form.

2.7 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 for which there are some questions regarding the structural condition. In most cases, the building will have been posted with a **RESTRICTED USE** or **UNSAFE** placard.

Detailed Evaluations may be used for other than structurally related problems with the building. A very common form of Detailed Evaluation would be for geotechnical problems where the expertise of a geotechnical engineer may be needed. In this case, the evaluation would be performed using the Geotechnical Evaluation Form (copy included in appendix A). Another form of detailed evaluation that can be performed is one relating to the potential for hazardous materials. This is an evaluation that can be performed by the local fire department or the building department, or may require the owner to retain a professional consultant and include their report as a part of the Engineering Evaluation.

2.7.1 Evaluation Form

The discussions, revisions, and reasons for modifications to the Detailed Evaluation are the same as for the Rapid Evaluation forms. The main purpose was to provide local governments with more information to allow them to develop dollar estimates of the damage and to provide more historical data on the damaged buildings. The use of these forms will be determined by the jurisdiction in charge of the operation.

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 stores 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 ☐ Govt.
☐ 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 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: _____
_____
_____

ATC-20 Detailed Evaluation Safety Assessment Form Page 2

Building name: _____ Inspector ID: _____

Sketch (optional)
Provide a sketch of the building or damage 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: _____
_____
_____
_____
_____
_____

2.8 Engineering Evaluation

The Engineering Evaluation is the final and most comprehensive of the three levels of evaluation. This level of evaluation is not a part of the safety assessment process, and is performed by a professional engineer or architect retained by the building owner. This evaluation can take anywhere from one to several days 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 make sure it complies with the jurisdiction's repair criteria. Once the jurisdiction agrees with the proposal, a building permit is issued and the repair work proceeds.

2.9 Evaluation Procedures

2.9.1 Inspection Procedures

In this section we will discuss the process of evaluating the structure, filling out the forms, and posting the structure with the appropriate placard. The process for inspecting the building includes:

1. **Survey of the building exterior**

   - **Determine structural system.** To the extent possible, try to accomplish this from the exterior. This is usually fairly easy for shear-wall type buildings but becomes more difficult with the more sophisticated framing systems. Determining the framing system at this point gives you a hint as to the types of damage you might expect to find.

   - **Examine exterior for damage.** Thoroughly look at each wall of the building from the ground to the roof. You are looking for any kind of damage or hazard that poses a threat to either the occupants of the structure or the general public who might be around the building. As you walk around the building, spend extra time at areas of vertical discontinuity and plan irregularities (see figures 2-15 and 2-16). These are the areas where damage will most likely be found. Look also for racking of exterior walls, glass frames and other such areas that will indicate excessive drift. Also, make sure you look for all types of falling hazards before you enter the building.

   - **New damage to foundations.** If portions of the foundation walls are exposed, look for large cracks or evidence of movement of the wall 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 subsidence.

2. **Examine the site for geotechnical hazards.** When performing this part of the evaluation, remember that geological conditions can extend over several sites and not be visible on all the sites. Consequently, you will need to look at adjacent sites as you evaluate the building.

   - Look around the site for fissures, bulged ground, or vertical ground movement.

   - In hillside areas, look for evidence of landslide displacement either at the top or the bottom of the slope. At the top of the slope you will be looking for evidence that a

portion of the hillside is separating and sliding. This will usually manifest itself as surface cracks located back away from the start of the slope. Trees that normally grow straight up may be leaning over. At the bottom of the slope, you will be looking for areas of bulging that will indicate the slope is moving. You also want to be aware of large rocks, boulders, or other types of debris that the event may have loosened. These are significant falling hazards which have the potential of rendering an otherwise undamaged structure **UNSAFE**.

- If geotechnical hazards are suspected, request detailed evaluation by others qualified to make the appropriate determinations.

3. **Inspect structural system from inside building** – This step should be performed during a Rapid Evaluation only if access is available and the building is safe enough to enter. The purpose will be for a quick walk-through to ascertain any significant damage or falling hazard. For detailed evaluations, it is necessary unless you can determine that the building is unsafe solely from an evaluation of the exterior. Before entering the building, take one more look for any falling hazard that might block the exits if the element were to fall. When you determine that it is reasonably safe to enter the building, do so cautiously. Be sure you are able to exit the building. If there are three members to the team, have one individual stay outside to monitor the building and to get help if the other team members become trapped in the building.

- **Do not enter obviously unsafe buildings**. This is basic common-sense safety. There is no need for a detailed evaluation in this case. If the building has not been posted, post it UNSAFE (red placard) at this time and complete your evaluation form.

- **Do not perform destructive investigation.** Once you get inside, remember that the building belongs to someone else. For this level of evaluation, you are not authorized to perform destructive investigation. If the structural elements are covered, look for evidence of damage by the condition of the covering material. If you cannot make a reasonable determination, note on the evaluation form that an Engineering Evaluation should be performed.

- **Look in areas where the structural system is exposed.** There are many areas within a building where the structural framework is exposed. Some of the more common areas are basements, stairwells, or equipment rooms. Sometimes the easiest method is to remove suspended ceiling tiles in order to evaluate the structural system above. Remember to replace the tiles when you have finished your investigation.

- **Identify and examine vertical load system.** You are specifically looking to see if the capacity of the system has been significantly decreased. Look for conditions where columns or framing connections have failed. Also look for evidence that the walls or supporting members are pulling away from the framing.

- **Identify and examine lateral load system.** Again, you are specifically looking to see if the capacity of the system has been significantly decreased. You are also looking to see if the ground motion caused any residual drift. If residual drift 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 roof or roof to basement. Make sure that each floor is adequately investigated before proceeding to the next.

4. **Inspect for nonstructural hazards.** Investigation should not be limited to just the structural elements of the building. Non-structural items can also pose a threat to the occupants.

- **Look for damage to nonstructural systems.** Look at such items as 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.** This focuses mainly on air-handling equipment, the fire-suppression and -detection systems, and water heaters. Make sure you look for damage to ductwork hangers since unsupported ductwork can be a significant falling hazard. Also get as much information as possible regarding the condition of the fire-suppression and -detection equipment. This will play a large role in determining if the building can be reoccupied.

5. **Inspect for other hazards**

- **Spills or leaks in stored chemicals or other hazardous materials**. You are not expected to identify hazardous materials. However, you should be aware of the potential for spills of such materials. Know the occupancy of the building you are investigating. If the occupancy is such that chemicals are used, there is a higher potential for a spill. If you suspect a chemical spill, report it immediately. Another hazardous material to be aware of is asbestos. Older buildings most likely contain some amount of asbestos. This is does not mean that because the building is old it should be posted UNSAFE because of possible asbestos contamination. If during your investigation you find breaks in pipe insulation or other indications that asbestos may be in the air, report it and post the building accordingly.

6. **Complete forms and post buildings**. Once you have completed your inspection, fill out the evaluation form based on the information included on the form and discussion with the rest of the team. As a team, determine an appropriate posting. If you believe the building should be in a **RESTRICTED USE** category, make sure that you have done sufficient evaluation to determine the appropriate restrictions. If you are in doubt, restrict access to removal of possessions only and make sure that you recommend that a higher level of evaluation be performed. In the case of Rapid Evaluations, the building official will decide if a Detailed Evaluation will be performed or if the recommendation to the owner will be to immediately retain an engineer and perform an Engineering Evaluation. Once you agree on an appropriate placard, finish the evaluation form and:

- **Post structure only if authorized.** You are authorized to post the building with official jurisdiction placards only if you have been deputized by the jurisdiction. If you have not been deputized, all you can do is make a recommendation as to which placard the

building should be posted. In this case, it will be up to the jurisdiction to come back and place the appropriate placard. In some cases, jurisdictions will have you place generic placards. These placards are not the official placards of the jurisdiction but will indicate to the occupants the condition of the building. You can post a generic placard if you have not been deputized. Generic placards are those that do not have the jurisdiction seal or indicate an authorizing ordinance.

- **Explain significance of the placard to occupants,** if the building is occupied during your investigation. Try not to use technical terminology in your explanation. Another thing to be prepared for is the owner or occupant who tries to convince you to place a particular category of placard. Do not let these individuals influence your decisions. Using your experience and best judgment, recommend the placard that best represents the condition of the building. On rare occasions, you may encounter physical threats or resistance from occupants. If this happens, calmly refrain from your evaluation on that site and inform local law enforcement about the incident.

As you move around the building while performing your investigation, make sure that you pay particular attention to vertical discontinuities and plan irregularities. The arrows indicate where damage is most likely to be found.

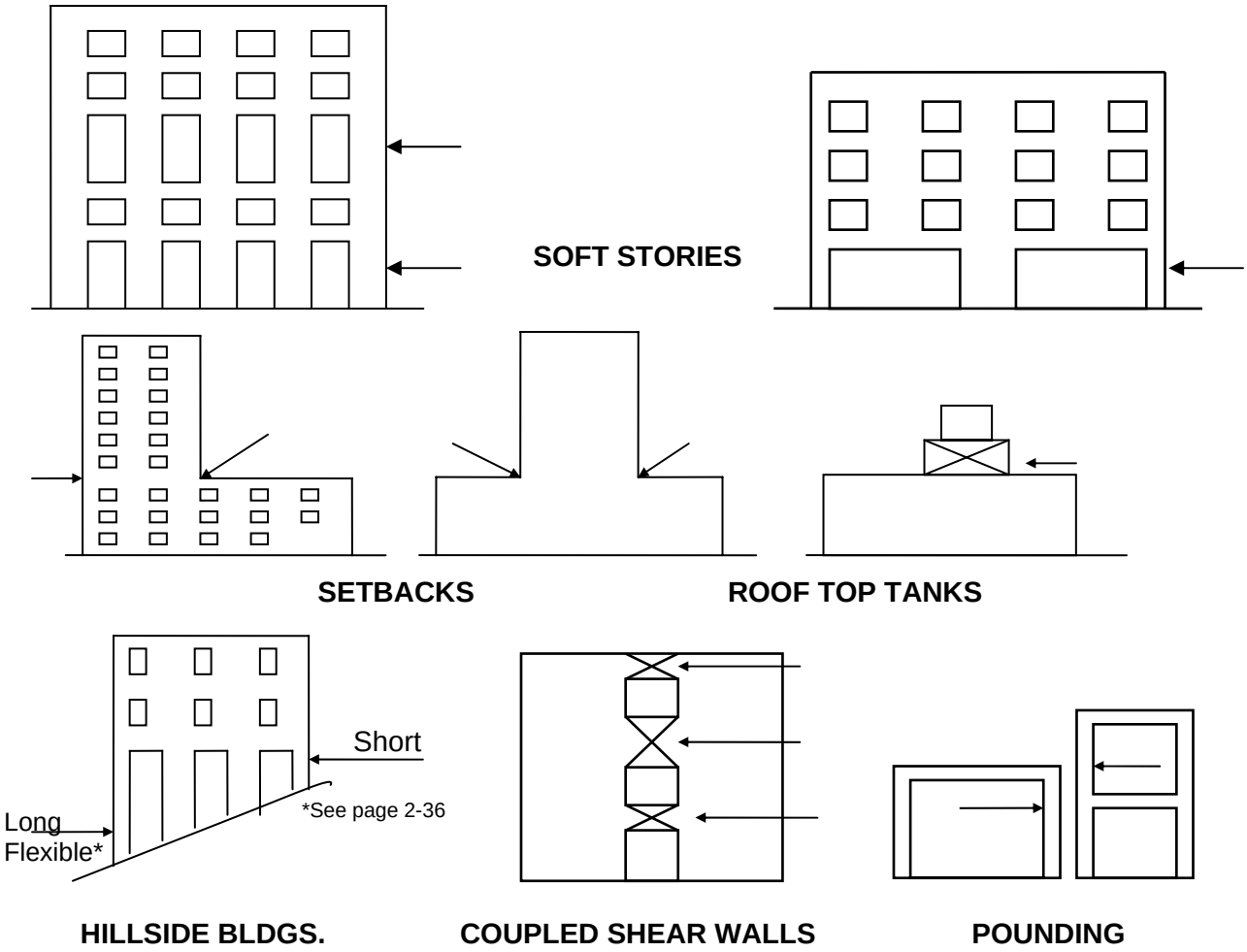


Figure 2-20 - Vertical Discontinuities

For the hillside buildings shown below, damage will most likely occur on the uphill side where the columns or panels are much stiffer than the down hill side. Because these elements are stiffer they will draw more force than the more flexible side. However, the down hill sides should also be reviewed as they may receive damage that would usually be in the mid-height of the element and caused by excessive deflection.

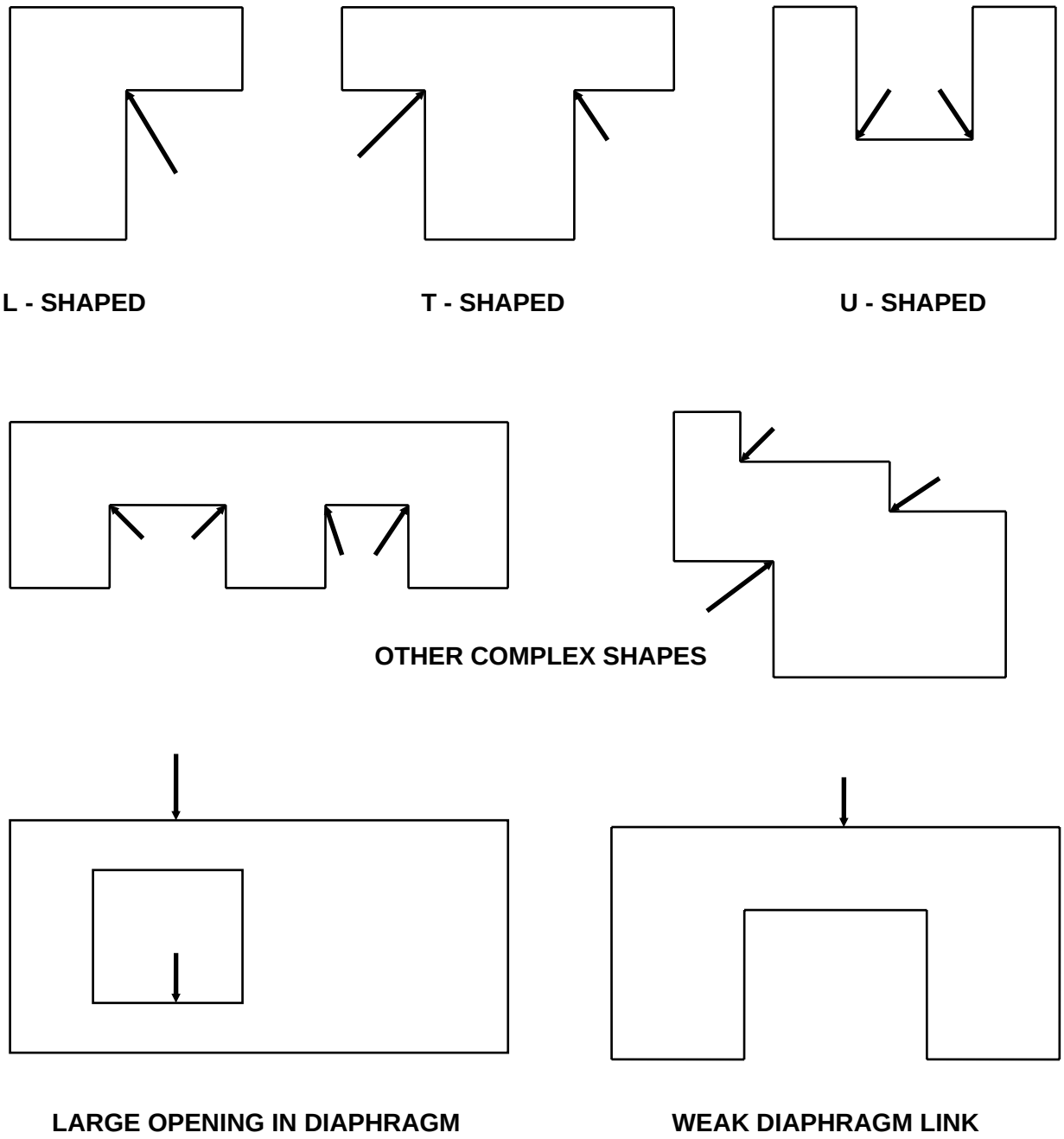


Figure 2-21 - Plan Irregularities

2.9.2 Evaluation Criteria

ATC-20 has recommended criteria to assist you in making your determinations as to how to post a building. These conditions are also covered generally on the evaluation form. These criteria are what you should be looking for during your inspection. However, the evaluator must remember that these are very general criteria and are not hard rules to follow. Judgment must be used when determining how to post a building.

1. **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 that jeopardizes vertical support. **UNSAFE**
- Other failure of vertical-load-carrying elements. **UNSAFE**

2. **Lateral Force System**

- Broken, leaning, or seriously degraded moment frames. **UNSAFE**
- Severely cracked shear walls. **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**

3. **P-Delta Effects**

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

4. **Degradation of Structural System**

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

5. **Falling Hazard**

- Falling hazard present. **UNSAFE**

6. **Slope or Foundation Distress**

- Base of building pulled apart or differentially settled, fractured foundations, walls, floors or roof. **UNSAFE**
- Building in zone of faulting. **UNSAFE**
- Suspected major slope movement. **UNSAFE**
- Building in danger of being impacted by sliding or falling landslide debris from upslope. **UNSAFE**

7. **Other Hazards**

- Spill of unknown or suspected dangerous material. **UNSAFE**
- Other hazard (e.g. downed power line). **UNSAFE**
- This is another area where good judgment must be used upon encountering a potentially toxic spill or asbestos contamination. When you see liquid on the floor, this does not automatically mean that there has been a toxic spill. Make your determination based on the merchandise being sold or stored. Also, there is no basis for assuming asbestos contamination just because a building is old. We know that older buildings contain asbestos, but this by itself is not reason to post the building UNSAFE.

For those buildings that are determined to be **UNSAFE**, the detailed evaluation teams will look at the access to that building for the purpose of possession retrieval.

2.9.3 Access to Unsafe Structures

In the early hours after a damaging earthquake, the owners and/or tenants of buildings will want free access to their building to retrieve personal possessions and business records. Therefore, early

questions to be answered include: who can have access, when, and for how long. In the past, local government has looked to the safety assessment evaluator for the answers. However, this function is not a part of the evaluator's role. The issue has been somewhat diffused through the development and use of the **RESTRICTED USE** category. Many buildings that in the past were tagged **UNSAFE** because the mechanism did not exist to restrict building access will now be tagged **RESTRICTED USE**.

Access to **UNSAFE** structures is a local jurisdiction policy issue. Typically, jurisdictions have not had policies in place before the event and needed to address the issue after the fact. Local government is encouraged to develop basic policies addressing short-term access prior to the event. If this is done, the jurisdiction needs only address the issue of whether or not reasonably safe access exists.

To assist local government, the ***Post-Disaster Safety Assessment Plan*** has added an evaluation of access to the building for those that have been deemed **UNSAFE**. This part of the evaluation is not to determine whether an occupant should be allowed into the building but simply to determine the condition of the access. This is factual information that is passed on to the local officials during the evening debriefing. The intent is to provide the jurisdiction with as much information as possible about the accessibility of the building. This information, combined with the policies established by ordinance, allows the jurisdiction to answer the "who," "when," and "how long" questions themselves.

The evaluating of access to an **UNSAFE** structure will usually be limited for the purpose of conducting a Detailed Evaluation. This is simply because during a Rapid Evaluation the team usually does not spend a sufficient amount of time in the building to gather the information needed. The teams are cautioned that this procedure should be followed only if the team has determined that: 1) they need to enter the building to make the necessary determinations; and 2) the building is safe enough to enter.

The process for evaluating access is similar to the process used by the Detailed Evaluation. Once the general structural and nonstructural condition of the building is determined, a detailed investigation of the access is performed. All members of the Detailed Evaluation team should be involved in this part of the evaluation. Basically, the team looks at the three elements of the access: exits, stairs, and corridors.

When investigating the exits, the team needs to look at all of them. The investigation should:

- **Verify operation of the doors**. Do the doors operate smoothly and easily? Do they open fully, or are there restrictions or obstructions 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? If there is masonry veneer around the door opening, what is its condition, and could it block the door if the connection failed? Regarding the interior, 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?

When investigating the 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 corridor if they fell? What is the condition of their connection?

- **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, the investigation should determine if there is natural light to illuminate the corridor or if artificial light is required.

When investigating stairways:

- **Determine if stairs are free of debris or obstacles.**

- **Determine structural condition of the stairs**. This investigation should include treads, stringers, handrails and connections of the stringers to the landing and floor. This part of the investigation may have to be based on opinion and judgment since volunteers are not to perform destructive investigation.

- **Determine structural condition of landings.**

The findings of your evaluation should be noted on the evaluation forms in the remarks or Comments Section or on a separate piece of paper attached to the form. Since access to **UNSAFE** buildings must be with the written permission of the building official, this allows the jurisdiction to have the information in the file on that particular building. When the owner requests permission to retrieve possessions, the building official does not have to conduct a new evaluation in order to respond to the request.

When entering this information on the forms or relaying it during debriefings, make sure that the information you present is factual. Based on the information you present, the jurisdiction will determine if it is going to require any hazard mitigation before access is allowed to the owner or tenant.

There are several issues relating to possession retrieval in UNSAFE buildings in which the safety assessment teams should not become involved. Teams should not:

- **Provide recommendations relating to possession retrieval.** Beyond evaluating the conditions of access, the team should not provide any recommendation as to the question of access. Since the officials have not seen the building, they want to know if the tenants or owners should be allowed access. They are depending on you to provide them with the answers. As stated before, whether or not access is provided is solely up to the jurisdiction. Safety assessment personnel should assist jurisdiction officials as much as possible by providing them with factual information. Again, remember that the question of access to an **UNSAFE** building is a policy issue for the jurisdiction.

- **Provide escort for owners/tenants**. In past events, safety assessment personnel provided escorts for the owners or tenants to show them the safe access path. This goes beyond the purpose of the Safety Assessment Program. If the jurisdiction requires this type of program, the escorts should be from the local police, fire, or building departments.

- **Retrieve possessions for owners/tenants.** The situation could easily arise in which a tenant may ask you to retrieve something while you are conducting your evaluation. As disaster workers, we all want to assist those impacted by the event in any way we can. The desire will be to retrieve whatever the owner or tenant has asked for. You are cautioned not to do this in any case. The liability you assume by agreeing to such a request is not covered by any of the liability protection you enjoy. If you agree to the request, you personally assume the liability. If a tenant or owner ever asks you to retrieve some possession, simply refer them to the local jurisdictional official who is responsible for the Safety Assessment Program.

To help you make your determinations, remember that your primary function is to evaluate buildings or structures for occupancy. The service we provide for possession retrieval is simply to assist the jurisdiction to institute its policies. To do this, they need to know the condition of the access. You must be prepared to answer questions after you make your report. As with your evaluation report, try to be factual with your answers staying away from recommendations and speculations. Use your best judgment in answering any questions the local officials may ask. If you feel uncomfortable with a question, simply state that you are uncomfortable with the question and would prefer not to answer. If the questions become too technical, simply remind the officials that the evaluation you have performed is not detailed enough to answer very technical questions. The jurisdiction is not purposely trying to put you on the spot. It is simply trying to determine if it should allow people into the **UNSAFE** buildings. Your purpose is to **assist** the jurisdiction in making that decision.

UNIT 3 BUILDING EVALUATION

UNIT 3 – BUILDING EVALUATION

Overview

In this unit, we will expand on the process and procedures from the previous unit through group activities and discussion. This will include evaluating various types of non-residential buildings, evaluation of residential structures; the safety assessment process for mobile homes; and a discussion of historic structures.

Training Goal

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

Objectives

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

- Know what to look for in each type of building;
- Understand the need for reducing shelter demand;
- Know how to evaluate and post mobile homes; and
- Know how to identify and stabilize historic structures.

3.0 Evaluating Buildings

3.1 Small Group Activity Evaluating Buildings

Purpose

The purpose of this activity is to familiarize you with the information provided on 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 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 pictures of the buildings. Each group of pictures includes a complete write-up of additional details needed to evaluate the building. Once your team has carefully read the descriptions and studied the pictures, fill out the evaluation forms and the appropriate placard.

At the end of the exercise, each team will present their conclusions including any discussions they may have had, and how they arrived at their recommendations. You will have 1 hour to work through the exercise.

Notes:

BUILDING NUMBER 1:

Figure 3-1

Description of the Building:

1. This is a private residence with earthquake damage at 1525 Fourth Ave., Pleasant Valley, California.

2. The home is a two-story wood frame structure with a two-car garage that was built in 1963. The home has an upper stairway that provides a second egress from the upper story.

3. Damage to the structure includes racking of the lower floor at the garage. The rear stairs are not damaged, but the stairs have drifted off their original mountings at the lower landing by three inches. The upper bedroom window was broken by a tall lamp that fell through it in the earthquake. The exterior lights are flickering intermittently.

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 ☐ Concrete shear wall
☐ Steel frame ☐ Unreinforced masonry
☐ Tilt-up concrete ☐ Reinforced masonry

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Govt.
☐ 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 hazards has been found.

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

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

Inspector comments:

_____

_____

_____

_____

Date: _____

Time: _____

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

This facility was inspected under emergency conditions for:

_____

(Jurisdiction)

Facility Name and Address:

_____

_____

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.

Date: _____
Time: _____

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Facility Name and Address:

_____
_____

Inspector ID / Agency:

_____
_____

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

BUILDING NUMBER 2:

Figure 3-2

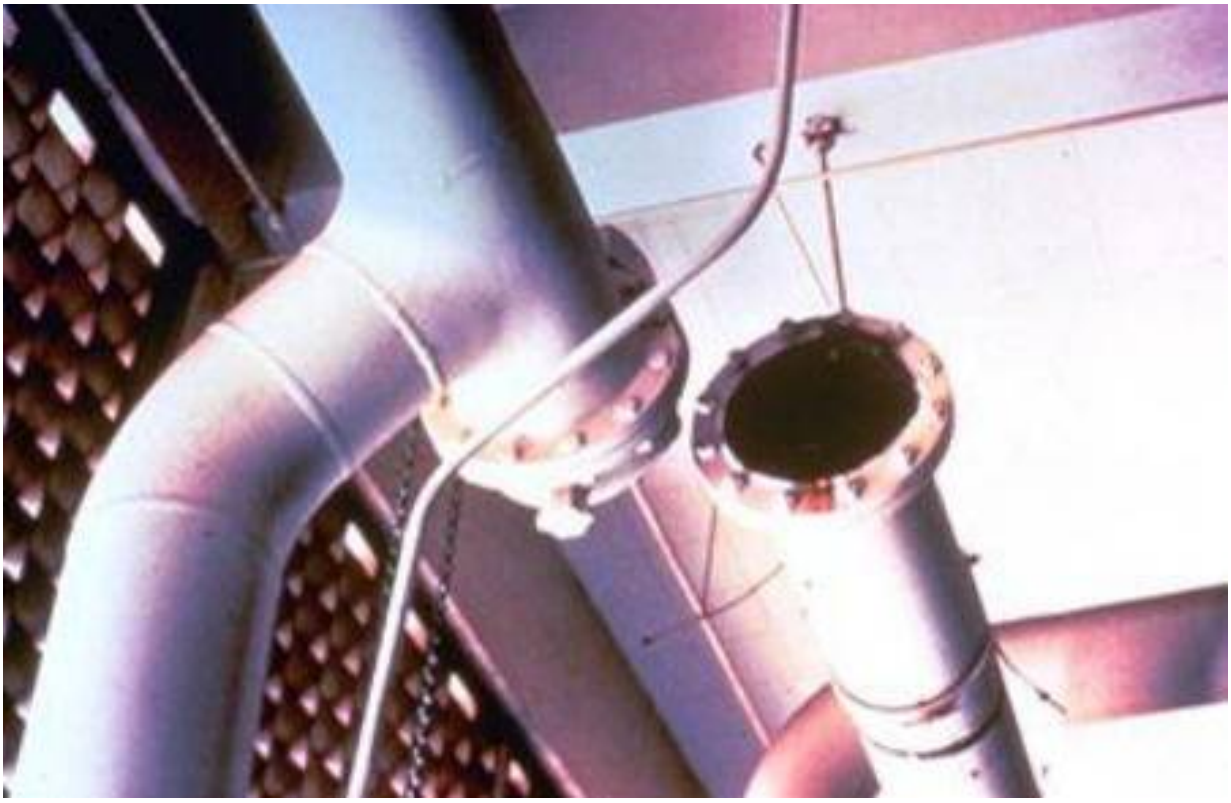


Figure 3-3

Description of the Building:

1. This building is the 7,000 SF Pleasant Valley High School gymnasium that was constructed in the mid 1960's of reinforced concrete and was approved by the Office of the State Architect. The building walls are poured-in-place concrete with no openings up to the underside of the windows. The only openings are these windows that are about 4 feet high to the underside of a reinforced concrete tie beam continuous between each of the columns.

2. Each of these concrete columns supports a long span, steel roof-truss. The diaphragm consists of straight wood sheathing and steel rod bracing connected to the concrete tie beam at the top of each column. The roof supports four space heaters, a fire sprinkler system, and pendant light fixtures. (The pipes that run parallel to the column line in the photo are not structural.)

3. The damage to the building includes cracks in each of the columns at the top of the wall as shown in the picture. There are five of these columns on each side of the gym and each column is cracked as shown. Cracks occur at a cold joint. Other damage included broken windows, several light fixtures which fell to the floor, and a broken pipe within the fire sprinkler system rendering the system inoperable. Beyond what has been noted and shown in the picture, there was no other damage.

   You will be performing a Detailed Evaluation.

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 stores 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 ☐ Govt.
☐ 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 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: _____
_____
_____
_____

Continued 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 damage 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: _____

_____

_____

_____

INSPECTED
LAWFUL OCCUPANCY PERMITTED

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

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to the 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.

Date: _____
Time: _____

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Facility Name and Address:

_____
_____

Inspector ID / Agency:

_____
_____

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

BUILDING NUMBER 3:

Figure 3-4

Figure 3-5

Description of the Building:

1. Long John Silver's Pool Supply located at 1675 Fourth Street, Pleasant Valley, California is a 3500 SF unreinforced masonry building. The pictures show the north and south walls of the long and narrow building. The alley is located on west side of the building and the wall contains a large truck door, a 3'-0" door, and two windows. The east side of the building classifies as an open storefront. The front third of the building contains retail sales with the westerly two-thirds of the building used as warehouse space for pool supplies.

2. The roof spans between the north and south walls and is supported by full size 2x12 rafters with no ceiling. The building has parapet on four sides with the parapet height being 36 inches above the roofline on the north and south walls.

3. The portion of parapet that has fallen extends about 25 percent of the length of the building along the south wall. The fallen portion is lying in the parking lot. There are large cracks in the southwest and northwest corners of the building resulting from excessive diaphragm movement. Inside the building several of the storage racks in the warehouse have fallen dumping the stored materials all over the floor. While inspecting the warehouse through the windows, you see a small puddle of liquid on the floor. There is no other damage to the building.

   You will be performing 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 ☐ Concrete shear wall

☐ Steel frame ☐ Unreinforced masonry

☐ Tilt-up concrete ☐ Reinforced masonry

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Govt.

☐ 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 hazards has been found.

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to the 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.

Date: _____
Time: _____

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Facility Name and Address:

_____
_____

Inspector ID / Agency:

_____
_____

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

BUILDING NUMBER 4:

Fig. 3-6

Description of the Building:

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.

2. The damage to the structure includes being floated off its foundation. The building is slightly racked, and all utilities are disconnected. 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 on the interior walls and furnishings up to the same level.

3. The town of Wonder Creek will not be providing potable water or sanitary facilities to the affected neighborhoods. Also, a ten gallon drum marked "pentachlorophenol" was found in the back yard that must have floated down from the lumber mill upstream. Power lines were also seen in the side yard hanging four feet from the ground.

4. Perform a Detailed Evaluation of this building and identify any additional remarks to be made on the evaluation forms.

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 stores 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 ☐ Govt.
☐ 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 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: _____
_____
_____
_____

Continued 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 damage 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: _____

_____

_____

_____

INSPECTED
LAWFUL OCCUPANCY PERMITTED

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

☐ **Inspected Exterior Only**

☐ **Inspected Exterior and Interior**

Report any unsafe condition to the 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.

Date: _____
Time: _____

This facility was inspected under emergency conditions for:

_____
(Jurisdiction)

Facility Name and Address:

_____
_____

Inspector ID / Agency:

_____
_____

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

3.2 Residential Structures

This section looks at the evaluation of residential structures. There may be very little glamour in the evaluation of single-family residences and only a little more in looking at apartment buildings. However, these types of structures play a major role in the overall recovery from a damaging earthquake or any other type of disaster, therefore, their evaluation is of great importance.

There has been significant discussion within the professions over the advantages and disadvantages of conventional construction techniques in single family residences. This program is not the venue for continuing these types of discussions. What concerns this program is: what makes a house or apartment building not habitable? What are the ramifications of such decisions? How can the public best be served in the evaluation of homes and apartments?

Major studies have been done to anticipate the short- and long-term sheltering needs following a major earthquake in the San Francisco Bay Area. These studies have been very eye-opening. The results indicate that in the event of a major earthquake on the San Andreas or Hayward faults as many as 154,000 individuals could become homeless. Where will they be sheltered for the short-term? How about long-term housing while repairs are being made? These are questions that are far reaching from a public policy standpoint.

To place this into a measurable perspective, more than 114,000 households (single family and apartments) required some form of temporary housing assistance following the 1994 Northridge earthquake. This included both short-term as well as long-term assistance. In some cases, the long-term assistance meant rental assistance for two to three years while the individual's home was being repaired.

Throughout the Bay Area, discussions are taking place to determine how jurisdictions will address these housing needs. A part of these discussions includes approaches for the safety assessment process to minimize the need for short-term sheltering. This unit will look at some of the significant problems related to:

- evaluating residential structures,
- short-term sheltering, and
- continued occupancy within apartment buildings.

3.3 Occupancy to Reduce Shelter Demand

The significant question relating to residential structures (single family residences and apartments) is, "How much damage precludes the home from being occupied after an earthquake or other disaster?" One criterion to look at is the ***State of California, Health and Safety Code***, which states that the minimum requirements for occupancy in a single-family residence includes sanitation and running water.

In the post-disaster theater, we must add to this minimum requirement the threat to the safety of occupants from whatever damage has been sustained. Viewing this in the proper context makes this task considerably easier. As a result of the 1994 Northridge earthquake:

- Approximately 114,000 structures received safety assessments.
- Approximately 98,000 or 86 percent of these structures were residential.
- Approximately 81,000 or 83 percent, of the residential structures were deemed to be safe enough to occupy.
- The remaining 17,000 structures sustained sufficient damage to preclude occupancy entirely (UNSAFE), or to have some form of restriction on the continued occupancy (RESTRICTED USE).

Earlier it was stated that 114,000 households required some form of housing assistance. These were households, not structures. There are multiple households within an apartment building (as noted above), but the building counts as one structure.

One question that building officials must look at is whether or not they have the authority to waive the minimum requirements of the Health and Safety Code in a post-disaster scene. Most building officials believe they have the authority to waive the requirement. Therefore, there could be no minimum criteria for continued occupancy beyond the safety evaluation. So, if the requirement for sanitation and running water is waived, what makes a structure habitable?

We have discussed the issue of re-occupying some structures, specifically single-family residences and apartment buildings. Let's look now at the global issue of occupying damaged buildings in order to reduce the demand on shelters.

Some jurisdiction officials believe that allowing continued occupancy of damaged residential structures would accomplish two things:

- reduce the need for short-term sheltering; and
- encourage these owners to repair their homes more rapidly.

The concerns regarding this sheltering concept center on those structures where the utilities have been damaged and turned off, with no sanitation, electricity, or gas. As noted earlier in this Unit, this means the structure does not comply with the minimum requirements of the ***State of California, Health and Safety Code***.

Structures with significant structural damage that have been deemed to be UNSAFE and those that have been posted INSPECTED are not a part of this discussion. What we are looking at are those structures that have been posted RESTRICTED USE. In accordance with the concepts of safety assessment, damage to these structures is such that there is some degree of hazard to the occupants if the building is occupied on a full-time basis. Further, the RESTRICTED USE tagging encompasses

many conditions that can be easily rectified, which allows a less restrictive set of limitations, or possibly a change from RESTRICTED USE to INSPECTED.

Our focus is on those structures where there are no simple hazard reduction actions that can be easily taken to change the condition of the building. The most notable among these are single-family homes that have "shifted" on their foundations or suffered cripple wall failures. These structures often do not represent a significant threat to occupants, but their damage is such that it will take a major effort to bring them to some state of general compliance with building codes. The significant issue with these structures will be the presence of basic utilities—gas, water, electricity, and sanitation. However, there are other conditions, structural and/or nonstructural, which will fit into this discussion. Typically these will be homes (including apartment buildings) where there is little or no potential for additional damage from aftershocks; or the damage poses no threat to the occupants.

When considered against the specific damage, it could be reasonable to allow full time occupancy for these types of structures. However, this idea needs to be weighed against the hazards that exist when a damaged building is occupied. The following discussion is meant to identify these additional hazards and evaluate them. Though we may have strong opinions as individuals regarding these matters, the decision on whether or not to occupy such structures rests with the local jurisdiction. They will need to evaluate it from many more sides. For example, local government could be willing to provide portable sanitary facilities and fresh water to areas where buildings are resting on the ground with broken utility pipes, but that are otherwise undamaged. Likewise, local government may be unwilling to allow occupancy of such structures without such public amenities being available.

3.4 Mobile Homes/Manufactured Homes

The installation and alteration of mobile homes or manufactured homes is regulated by the State's Department of Housing and Community Development (HCD). Generally, mobile homes can prove hazardous after a disaster because of damaged utilities, damaged support systems, or significantly damaged accessories such as room additions, awnings, carports, porches, etc. However, in many cases heavily damaged mobile homes may continue to be occupied because there is no life safety hazard.

After the 1994 Northridge earthquake, HCD and CALBO began discussions on how to supplement HCD staff in order to ensure that mobile homes were properly evaluated. Out of those discussions came an agreement that gives the local building official the authority to evaluate the safety of mobile homes following an earthquake or other disaster. A stipulation in that agreement requires that OES include a section on mobile homes within this training program.

You may be called upon to evaluate mobile homes as part of your duties. The process and procedure for evaluating mobile homes is the same as for any other structure. However, it is important to remember that many mobile home parks are like small cities, with master gas, water, sewer, and electrical systems. Utilities are often installed under and over mobile homes, creating unique hazards for mobile home occupants and inspectors if there are utility breaks or faults. For example, energized overhead electrical conductors have fallen on metal mobile home roofs, energizing the exterior of the home; gas line breaks underground and under mobile homes pose both a hazard and an access challenge; large waterline breaks within mobile home parks can undermine roadways and deactivate hydrants, creating additional hazards.

The main difference in evaluating mobile homes is that a mobile home can be evaluated more quickly than other types of structures, as most potential damage is readily visible from the exterior. Additionally, the evaluation criteria are very similar to that for single-family residences.

Damage to mobile homes usually falls into one of five basic types that include:

1. the mobile home is partially or totally off its piers, blocks, or jack stands;

2. piers are penetrating the interior floor decking;

3. it is fully or partially burned;

4. the utilities are damaged and/or turned off;

5. water heater movement has affected the water heater vent and/or gas supply; and

6. the mobile home accessories (decks, awnings, carports, garages, etc.) are destroyed or hazardous.

The primary cause of mobile home earthquake damage is easily mitigated by providing seismic bracing under the mobile home, thereby restricting the free movement of the unit on its jack stands. This bracing stabilizes the jack stands and provides a continuation of the load path all the way to the ground. There are many ways in which mobile homes can be braced. The more common bracing 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, OES instituted a program with FEMA support to install seismic bracing under all mobile homes that were damaged by the earthquake. The presence of seismic bracing significantly reduces the potential that these structures would be substantially damaged. However, thousands of units remain throughout California without seismic bracing.

3.4.1 Evaluation Procedures

The evaluation of mobile homes will usually result in either an INSPECTED or RESTRICTED USE posting. Rarely will a mobile home be found to be UNSAFE. The most prevalent condition for posting a mobile home UNSAFE would be if there were an extreme potential for fire. This might be a case of damaged electrical lines with a gas water heater that has tipped over.

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

- stability of the jack stands;

- safety of accessories, awnings, etc;

- condition of utilities;

- home ingress and egress; and
- geotechnical issues

Since mobile homes are so light and usually have steel frame undercarriages, there is usually no problem with the structural system. The mobile home tends to respond as a single unit. However, it is not uncommon during earthquakes for fallen units to sustain steel chassis damage, and in the case of doublewides, centerline connection movement and partial separation. Without seismic bracing or some other method of restraining the lateral displacement of the unit, the movement will cause the jack stands to tip over or collapse. This can include all jack stands, causing the mobile home to fall to the ground; or just some of the jack stands which would place part of the mobile home on the ground and part supported above the ground.

There are several common concerns when evaluating the safety of mobile homes post-earthquake:

- Is the home stabilized on its support system? Is there a potential of it falling further?
- Are accessories such as awnings, decks, room additions stabilized to prevent further falling or aftershock significant movement?
- Are ingress and egress dangerous or significantly impaired due to debris or racking?
- One or more of the jack stands penetrating the floor structure of the unit;
- The potential for fire resulting from broken gas lines;
- Significant area health contamination from displaced sewer connectors; and
- Electrical energizing of accessories or other metal objects due to damaged electrical connections.

As mobile homes are typically raised several feet above the grade, the condition of utilities is a concern when the unit falls off its jack stands. Most likely, the utility connections will be severely damaged or physically broken. When looking at the utility connections, pay particular attention to water heaters and gas ranges/stoves.

As with any building evaluation, you must look for geotechnical problems. Differential settlement from liquefaction or unconsolidated fill can seriously affect the level of mobile homes and consequently their safety. A mobile home that is seriously out of level could have grounds for a RESTRICTED USE placard.

3.4.2 Posting Mobile Homes

The following pictures illustrate some damaged mobile homes, and discuss how they were posted, and the related issues. This will also give some insight as to how to evaluate mobile homes using the Rapid Evaluation concepts.

After the event itself, the most significant threat to occupants comes from fires. The most common cause of these fires is a combination of a gas leak (usually from a damaged water heater) and active electrical power. Anytime you find a gas leak while evaluating a mobile home, it should be immediately reported to the park manager, who can usually shut off the source and then evacuate the surrounding units. Once the gas has been properly turned off at the source valve, the threat of fire is greatly reduced.

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

Figure 3-7 Mobile home - Landers/Big Bear, 1992

This mobile home has shifted, but has not fallen to the ground. As you can see in the window, the home was posted INSPECTED. The question that needs to be addressed is whether or not there are seismic braces under the unit. If there are seismic braces, then the unit simply shifted sideways and the INSPECTED placard might be appropriate.

If this unit is braced, the fact that it has shifted sideways could lead the evaluator to conclude that the connection of the bracing to the ground may have failed. If it has failed, maybe the more prudent posting would be RESTRICTED USE since aftershocks may cause it to shift even further. If the unit is not braced, then the shifting has caused the jack stands to tip. This unit is highly susceptible to falling even further during an aftershock, and the appropriate placard would be RESTRICTED USE, not INSPECTED.

Figure 3-8 Mobile home - Landers/Big Bear, 1992

This mobile home has moved off its jack stands and is resting on the ground. Considering 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 is stable and will not fall further.

In all likelihood, it has damaged sewer connections, water lines, gas connections, and possibly electrical connections. An additional hazard exists from the awning in the form of a falling hazard that could pose a threat to life safety. Once utilities are turned off, the unit could be accessed for possession retrieval. Full occupancy falls into the same discussion as for single-family residences and recognizing the hazards associated with occupancy. This unit could be posted RESTRICTED USE.

Figure 3-9 Mobile home - Landers/Big Bear, 1992

It is obvious that this mobile home has been destroyed and if posting were necessary it would be UNSAFE. This is an example of the combination hazard of moving off the jack stands and the damaged gas line causing a fire. This slide is presented to illustrate the hazards which impact posting once a unit has moved off its jack stands. With the fire out and the gas and electricity turned off, this unit no longer poses a threat to adjacent units. Until the utilities were turned off, there would have been an AREA UNSAFE posting around the unit.

Figure 3-10 Mobile home - Landers/Big Bear, 1992

In this case, the unit is off its jack stands, down and stable—it won't fall any further. However, a falling hazard exists in that the canopy supports are out of plumb as a result of the mobile home falling off its supports. This could result in the collapse of the awning from an aftershock and, therefore, represents a threat to life safety.

Access to this mobile home would probably be from the other side provided a landing is not in the way. On this side, the landing is blocking the door opening. If both doors are fully blocked, the posting might be UNSAFE until such time as the landings are moved and the canopy is removed or braced. At that time the posting can change to RESTRICTED USE. The issue of allowing full-time occupancy follows with the issues on single-family residences. Policies will have to be issued by the jurisdiction.

Figure 3-11 Mobile home - Landers/Big Bear, 1992

In this case, the mobile home has slid on its brick skirting. Within some parks, brick skirting is common. However, this skirting is not a foundation, and with displacement, as seen in this photo, the unit can be extremely dangerous because the home's weight may now be resting on the non-structural skirting. Looking in the window, we see that the unit was posted UNSAFE. This is a reasonable posting in this case.

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 because much of the structure that is likely to be damaged is readily exposed. We have mentioned seismic bracing of the jack stands, but have not looked at other potential bracing schemes. The most common alternate bracing scheme is the Engineered Tie-down System. This system has been *mandated* for all new mobile home installations since September 1994. Thousands have been installed. They are not seismically rated, but they undoubtedly contribute to mobile home seismic stability. They come in many forms, most of which are

large, extra heavy duty steel jacks with ground anchor rods attached and driven at the four corners of the jack. State and local inspectors will encounter them frequently and commonly.

Remember that when evaluating mobile homes we address the existing damage in relation to continued occupancy—just like any other structure. If a mobile home does not have bracing, but has not been damaged, you have no choice but to post it INSPECTED. That the unit was vulnerable to damage is true. But, there has been no damage, so the safety for occupancy has not changed as a result of the event.

This 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. This mobile home would likely be posted RESTRICTED and possession retrieval would be allowed, but the home is now inadequate for shelter due to its not being weatherproof.

Figure 3-12 Tree in mobile home, Hurricane Katrina, 2005

This mobile home shown here suffered heavy damage from hurricane-force winds, and would likewise be posted RESTRICTED for possession retrieval only. Again, the home is now open to the elements and is not a suitable shelter, and may also have other hazardous damage to its structure.

Figure 3-13 Damaged mobile home, Hurricane Katrina, 2005

Because the State Department of Housing and Community Development (HCD) has primary jurisdiction over mobile home/manufactured homes and home communities it is highly recommended that technical questions and inspection information regarding mobile homes and mobile home support devices be channeled to HCD from any local agency doing mobile home/manufactured home inspections, to avoid duplication of services and inefficiency. HCD inspection offices are located in Sacramento and Riverside, (916) 255-2501 and (909) 782-4420 respectively.

3.5 Historic Structures

This next section discusses evaluating historic structures. These structures have presented unique problems for the safety assessment process. After past earthquakes, some jurisdictions have been accused of using the earthquake as an opportunity to "get rid of" their historic building stock. This was primarily done by posting the buildings UNSAFE and then ordering their demolition. Our place here is not to second-guess or place value judgments on past actions of jurisdictions, but to look at some of the discussions and issues surrounding historic structures.

OES was asked by the historic preservation community to develop evaluation procedures for historic structures that would be different than for other structures to address the demolition issue. OES resisted that effort for the simple reason that the conditions within a structure that restrict or forbid its continued use are not dependent on the age of the structure. Damage that represents a hazard to occupants determines the conditions of continued occupancy. Different evaluation procedures are not necessary. However, awareness of the damage potential for older forms of construction can help in better evaluating these buildings.

The revisions to the original ATC-20 UNSAFE placard have reduced the fears of the preservation community that older buildings will be demolished wholesale following a large earthquake. The addition of the parenthetical phrase, "THIS IS NOT A DEMOLITION ORDER," clarifies that the posting is referring to continued occupancy, not whether or not the building can be repaired. All the basic criteria of ATC-20 apply to historic structures as much as to new construction.

As discussed earlier in this unit, the evaluation team must be careful that the condition of the building, or its particular vulnerability to earthquake damage, is not a primary consideration in their determination of the posting. The pre-event safety of a building refers to its structural integrity, as it exists before. In other words, has it been strengthened?

Using unreinforced masonry as an example, we know that:

- unreinforced masonry that has not been strengthened is a collapse hazard.

- the collapse potential is significantly reduced when the building has been strengthened and proper anchorage installed.

The point here is that the unstrengthened building was technically unsafe prior to the event. However, this idea has nothing to do with a post-disaster safety evaluation. If the building was undamaged by the event, it is as safe now to occupy as it was prior to the event. We do not post an older building with restrictions or as being unsafe simply because it is old.

As with all types and ages of structures, we evaluate the impact of the damage on continued occupancy. Older structures are vulnerable to earthquake damage. However, the actual damage to the particular building should be the main factor used to determine continued occupancy. This is not to say that vulnerability should not be considered at all. The actual damage should be the primary determining factor, with vulnerability used to temper the judgment.

Therefore, a little more time should be spent in the evaluation to make sure there is sufficient information to make a determination. As with any other type of construction, posting consideration deals ONLY with continued entry and occupancy.

3.5.1 What constitutes an historic structure?

Federal regulations state that any structure that is 50 years or older is potentially historical. By this definition, those of you who live in post World War II houses live in potentially historic structures. Historic structures are protected under the National Environmental Protection Act (NEPA). From a standpoint of federal disaster assistance any structure that is 50 years or older must be subjected to a review under NEPA to determine 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, state, or National Register of Historic Places. If not, SHPO must then determine if the structure is eligible for inclusion on the National Register. If all, or parts, of the building are considered to be "eligible for the National Register," the repair work must comply with the Secretary of Interior's standards for historic structures as well as the State Historic Building Code. If the structure is deemed not eligible, then repair falls under the requirements of local building codes even though the building may be more than 50 years old. There are four main issues determining eligibility for the National Register: (1) a place where a historic event took place, or that is associated with a historic person, (2) an example of the work of a master, such as Frank Lloyd Wright (Marin Civic Center) or Julia Morgan (Hearst Castle), (3) an example of a period architecture, such as Craftsman or Art Deco, and (4) a location with cultural or architectural significance.

As you are performing your safety evaluations, you need to remember that any structure built prior to approximately 1955 could be considered as a historic structure. This covers most construction materials.

3.5.2 Stabilization

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

There are many ways in which buildings, or portions of buildings, can be stabilized to reduce the imminent hazard. These methods can be very complicated and involve a significant amount of material and labor to accomplish, or they can be very simple and intended to stop the continued or potential movement of the building. There are several publications that address the specifics of stabilization that include design examples. One such publication is ***Temporary Shoring & Stabilization of Earthquake Damaged Historic Buildings*** by Roy W. Harthorn and is published by the California Building Officials.

This document was developed with a grant from the U.S. Department of Interior administered by the State of California Office of Historic Preservation.

The concept of stabilizing 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 discussed in this section are not necessarily long-term stabilization measures. Most are measures that will address a specific hazard and allow access to a building or an area.

In this picture, we see a common hazard found in most older or historic districts. Unreinforced masonry parapets that have not been anchored or braced are a significant falling hazard. In this particular case, the parapet has fallen to the street, however loose bricks still exist near the roofline, representing a hazard to the public right of way (the sidewalk and street). 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 be developed using sheets of plywood with cable anchored to the roof framing and pulled tight with "come-alongs." This temporary measure would allow the sidewalk to reopen, and potentially allow the storeowner back into the building to retrieve possessions. This also has the ability of protecting the wall from additional damage from aftershocks. Consequently, it could help minimizing the cost to complete repairs.

Figure 3-14 Commercial District - Loma Prieta Earthquake, 1989

Another acceptable measure is to build a canopy across the sidewalk, similar to a construction canopy that would provide protection to pedestrians as they passed by the building. This approach would protect pedestrians, but would not do much to protect the building from additional damage. In both cases, the measures can be implemented 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 Interior's standards and the State Historic Building Code.

Figure 3-15 Commercial District Loma Prieta Earthquake, 1989

As with the last example, this building represents a hazard to the public right of way because of the falling hazard around the window. These loose bricks can fall at any time with or without an aftershock. The front of the building can be easily stabilized through the use of a tieback system. In this case, the connections of the cables 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 stabilization measures can provide the owner more time to fully develop a repair program to encompass historic restoration.

Figure 3-16 Santa Cruz, Loma Prieta Earthquake, 1989

This historic building 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 devised to save the historic character of the building. This is an example of a longer-term, more complicated stabilization procedure that is incorporated within the repair process. The photo on the following page provides more detail into the system.

Figure 3-17 Santa Cruz, Loma Prieta Earthquake, 1989

The City 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 support for the walls for out-of-plane loads. The walls were damaged, but 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 diaphragms are connected to the walls and can provide the lateral support needed. The 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 placed back in operation with an extended useful life.

Sometimes a building can look like a total loss, yet a method of stabilization can be devised which can easily be installed, saving the building from demolition. After the Loma Prieta earthquake, there were a number of apartment buildings in the Marina District that had suffered soft story failures.

Figure 3-18 Marina District, Loma Prieta Earthquake, 1989

stabilized in a fairly easy manner. Large timbers (8x8 or larger) were installed diagonally across the garage openings. At the top of each opening the braces were attached to the header across all the openings. At the base, they were connected to the posts between openings. This process stopped the continued movement that is typical with a structure that is this much out of plumb. Once this continued movement had been stopped, it was possible to allow tenants into the building for brief periods of time to retrieve possessions.

As you can see from this picture, the building is way out of plumb and a potential collapse hazard. Yet this building was

This stabilization process also led to the development of a repair methodology. Cribbing was installed inside the garages to support steel beams. These beams were threaded through the building, and 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 opening were disconnected from the foundations. The buildings were raised and "pushed" back into a plumb position. The jacks were lowered and the buildings were supported on the cribbing until new footings, shear panels, and connections could be installed.

Like repairs, stabilization must be cost-effective and reasonable. Just "sticking up" wood braces does not necessarily provide the required support to reduce the hazard. However, you do not want to spend thousands of dollars on stabilizing a hazard that could be removed for a few hundred dollars. In these next two examples, we will look at inadequate bracing, and a stabilization method that was not reasonable for the particular hazard.

Figure 3-19 Tilt-up Building, Coalinga, 1983

A common hazard with older tilt-up construction is a failure of the ledger in cross-grain bending, leaving the walls without lateral support. The easiest way to brace these walls temporarily is with steel tilt-up wall braces. If the stabilization needs to be installed immediately, and such braces are not readily available, wood braces can be used temporarily, provided they have the capacity to support the walls. In this picture, the braces are too slender to support the wall. They were installed tight, as can be seen by the bow in the braces. Even a moderate aftershock would have the capability to load these braces to a point where they would easily buckle and fail.

Figure 3-20 Sierra Madre Earthquake, 1991

In this final example, we see a case where stabilizing the veneer on this wall may not have accomplished much. It may have been more cost-effective to simply remove the veneer until it could be re-attached. Since the anchorage failed, the veneer must be removed. In this case it has been shored, but the shoring will have to be removed before repairs to the veneer can be made. Removing the veneer rather than bracing would have accomplished the same thing—removal of the potential hazard.

Making recommendations for stabilization is not one of the primary functions of the safety assessment process. However, being familiar with the concepts will allow you to offer opinions to the building department should you be asked. The design and implementation of stabilization measures is ultimately the responsibility of the building owner. On occasion, the building department may have to take action themselves in order to protect adjacent property or the public right of way. In these cases, the building department is responsible for the design and implementation. However, having performed the safety assessment gives you a perspective that the building department may not possess. You have seen the building and, in some cases, been inside. Certainly, offering an opinion, when asked, as to the feasibility and a possible method of stabilization is reasonable and encouraged.

3.6 Individual Activity: Evaluation of Residential Structures

Purpose

This activity has been designed to stimulate thought on both the evaluation of damaged residential structures and the potential for continued use of those structures. These are the types of discussions that should be an on-going part of the evaluation team's work. As with any part of safety assessment, there are often no black or white determinations, only degrees of judgment based on facts, knowledge, and experience.

Instructions

Based on the descriptions of damage, the group will discuss questions related to that particular structure. This is not an exercise to determine if and how the structure can be repaired. The discussions should center on habitability. You will not find the answers in codes or other similar documents. Only your judgment is available to determine habitability. Most likely, there will not be overall agreement within the class. However, all points of view need to be considered. This exercise is to encourage the kinds of discussion that should take place among the evaluation team while determining the appropriate posting for the structure.

Figure 3-21 Home - Coalinga earthquake, 1983

This picture from Coalinga shows a two-story house that has experienced a cripple wall failure. This failure has resulted in extensive damage to the roof over the porch. The main structure will not collapse further as the walls are in good condition as is the second floor framing. The first floor is reasonably level and the door opens smoothly. Therefore, the structure is stable with the porch roof representing a falling hazard. By using the rear entrance, the home could be considered fully accessible. We know that all utility connections were damaged except electrical connections. Damaged utilities have been shut off.

1. Though fully accessible, is this home habitable?

_____

_____

_____

_____

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

_____

_____

_____

_____

_____

_____

Figure 3-22 Home - Landers/Big Bear Earthquakes, 1992

Figure 3-23 Home - Landers/Big Bear Earthquakes, 1992

The Landers/Big Bear earthquakes damaged this home. The home is a two-story structure with a portion of the second story supported by wood posts. This example shows that cripple wall failures are not limited to older construction. The failure of the cripple studs caused the structure to shift to the right, moving off the foundation. The portion of the structure that was two-stories, and supported on wood posts, has been impacted by the cripple wall failure. As the cripple walls of the main portion of the structure failed, and the structure moved off the foundation, the second story portion was pushed out of level since the wood posts were a fixed length.

In this slide, we see why the cripple wall failed. The T111 siding used to resist lateral forces was not nailed to the sill plate. Since this connection was omitted, there was not a complete lateral force resisting system and the structure was free to move laterally. Secondly, we see that the metal straps used as sill anchorage were improperly installed. These straps are intended to come up both sides of the sill plate and nail along the top. In the manner that these straps have been installed, the sill plate is free to tip.

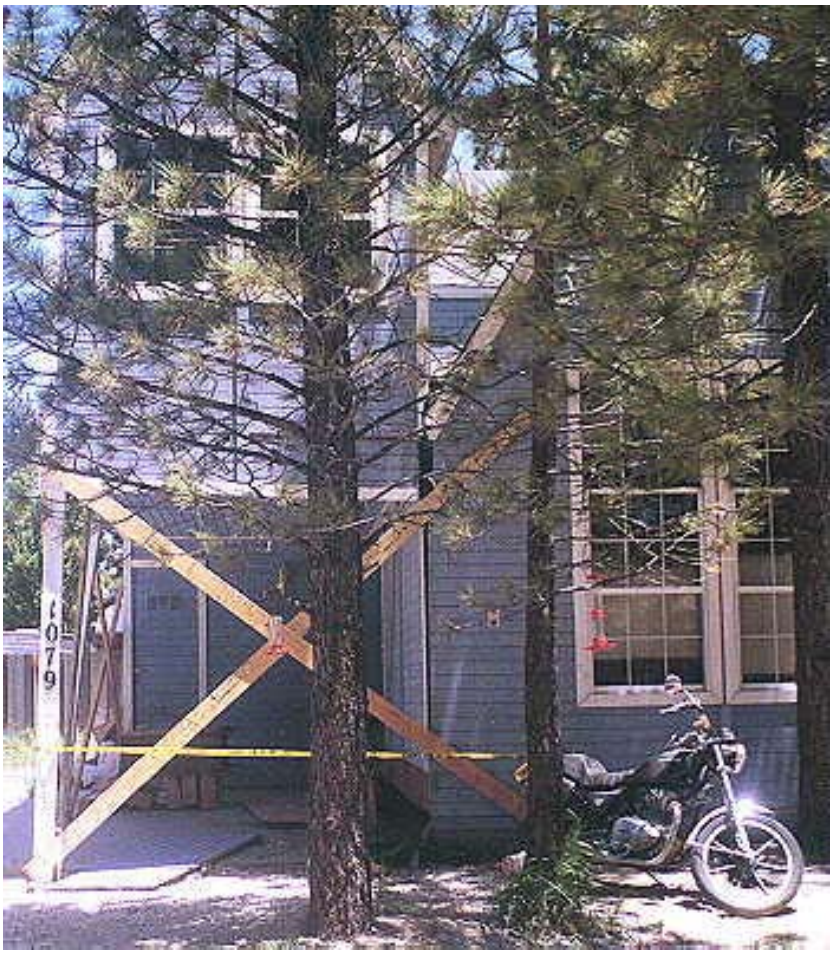


Figure 3-24 Home - Landers/Big Bear Earthquakes, 1992

This photo shows a portion of the second floor that extends over an open area. Looking at the soffit line of the room, we can see that it is not level. The portion of the second floor supported by the posts has remained at the pre-event location, while the opposite side, the exterior wall of the lower portion, has dropped because of the cripple wall failure. This creates conditions that preclude occupancy of this second floor portion. In fact, there was little damage above the first floor line. However, with the bracing in place, the structure is accessible. The bracing for this structure was apparently installed in a hopeful manner by a contractor, or possibly by the homeowners. While stabilizing the second floor for gravity loads, this bracing does little for lateral forces since, at the posts, it is not connected to the ground. This requires that all the lateral force be resisted by the connection of the post to the slab. At the other end the bracing is connected to sheathing that is not connected to the foundation.

1. How would you post this structure? Why? If RESTRICTED USE, what restrictions would you place?

_____

_____

_____

_____

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

_____

_____

_____

_____

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

_____

_____

_____

_____

_____

Figure 3-25 Home - Morgan Hill Earthquake, 1984

The Morgan Hill earthquake seriously damaged this hillside home. As with many homes, the lowest level has the least strength due to the lack of sheathed wall length. This damage was a result, like the previous slide, of inadequate nailing of the sheathing combined with the stiffness difference between the uphill end and the downhill end. The lateral forces tend to be drawn to the stiffer end of the panel thereby overstressing the connection. This can be seen by the loss of sheathing at the uphill end of the wall.

However, this slide also shows the failed porch, a very serious condition that can impact inspectors while determining the safety of the structure. In many cases, framing will not be pulled completely out of the hanger or off their bearing. Only a very small amount of the joist is actually bearing on the support. The porch structure can look perfectly safe, but when it is loaded with one or two inspectors, the weight is enough to cause the porch to collapse.

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

_____

_____

_____

_____

2. How would you post this structure? (See Figure 3-25) Why?

_____

_____

_____

Figure 3-26 Apartment Building - Loma Prieta, 1989

The Loma Prieta earthquake damaged this apartment building. In this 4-story building, the brick veneer has failed. Failure resulted from the in-plane deformation of the panel. This type of damage is typical for both thin set and full thickness brick veneer.

As you can see from the picture, some of the veneer is still hanging on the wall presenting a significant falling hazard. Remembering back to the criteria from earlier in this unit, a falling hazard can be grounds for an UNSAFE Posting. For the purpose of discussion, assume that there is no other damage to the building.

1. As the safety evaluator, how would you post the building? Why?

_____

_____

_____

_____

_____

2. What actions could be taken to address the hazard? Assuming the hazards have been addressed, how would the building be posted now?

_____

_____

_____

_____

_____

3. Would you consider this structure habitable? Why?

_____

_____

_____

_____

_____

3.7 Large Group Discussion: Occupying Damaged Structures

Purpose

Studies in the Bay Area have raised awareness that some type of action needs to be taken to address the demand on short- and long-term sheltering. That discussions are taking place on the issue of occupying damaged buildings does not mean that the decisions have been made. The discussions are taking place in planning meetings to look at options to address the shortage of temporary shelters.

As jurisdictions discuss the topic from their standpoint, we also will discuss the topic to identify if it is feasible from a safety standpoint. As with other issues within safety evaluations, there are no right or wrong answers to these questions. The questions are intended to stimulate discussion and to identify the pros and cons of occupying damaged structures.

Instructions

Each question will be presented to the class to stimulate discussion. Space is provided after each question for you to take notes and record some of the opinions expressed.

Discussion Questions

1. What are some of the additional hazards that appear when a damaged structure is occupied?

_____

_____

_____

_____

_____

_____

_____

_____

2. What are some of the benefits of allowing damaged homes to be occupied?

_____

_____

_____

_____

_____

3. What are some of the problems of allowing families to occupy damaged structures?

4. Is there a way to mitigate these hazards, and if so, how?

UNIT 4 LIFELINE SYSTEMS AND FACILITIES

UNIT 4 – LIFELINE SYSTEMS AND FACILITIES

Overview

In this unit we will use the process and procedures from Unit 2 show the participant how to fill out the evaluation forms for lifeline systems and facilities including: airports, bridges, geotechnical, pipeline, pumping plant, reservoir, roads, wastewater treatment plants, and water treatment plants.

Training Goal

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

Objectives

Upon completion of this unit, participants will be able to: complete the evaluation forms and report their recommendations on the conditions of the lifeline system or facility.

4.0 Lifeline Systems and Facilities

The lifeline systems and facilities discussed in this unit form a critical part of a community's infrastructure. For that reason, **only detailed evaluations will be performed,** and evaluators who have professional training and/or experience in the design and operation of the systems will perform the assessment. It is well beyond the scope of the SAP to teach the concepts and philosophy that are utilized in design of these systems.

Because of the nature of the systems involved in these evaluations, the jurisdiction is encouraged to assign someone from Public Works, Police, or Fire to accompany the SAP team. Information on the condition of many of these systems needs to be conveyed to the proper authorities immediately so the appropriate actions can be taken. For example, a bridge on a main street through the jurisdiction that is deemed to be unsafe needs to be taken out of service immediately. Having a jurisdiction representative with the team allows the information to be transferred to the appropriate department rapidly.

In this class, we will familiarize you with the forms and how to fill them out. The American Society of Civil Engineers, Los Angeles Chapter developed these forms for use by the Governor's Office of Emergency Services in the late 1970s as the Safety Assessment Program was first being developed. These evaluations are not damage assessments and, like building evaluations, are intended to determine the safety of lifeline systems or facilities for continued use. The evaluations are sufficient to determine if a system of facility is safe enough to return to service (INSPECTED or "Green"); should be returned to service with some restrictions (RESTRICTED USE or "Yellow"); or taken out of service until repaired (UNSAFE or "Red").

Only one of these forms, the bridge assessment, has been used in an actual response. This was during Loma Prieta in the City of Santa Cruz. Therefore, as these forms are used in actual assessments, we can assume that they will go through an improvement process similar to the ATC-20 forms.

In Unit 2 we learned that in accordance with the ***Post-Disaster Safety Assessment Plan***, the goal of the Safety Assessment Program 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 that will impact the public at large,** as well as the emergency response. In this unit, we will look at the evaluation forms that will be used for critical infrastructure aimed at rapidly restoring vital services and arteries for the movement of resources around the effected area.

The lifeline systems and facilities that are a part of the Safety Assessment Program include:

- Geotechnical Evaluation (applicable to all)

- Transportation Systems
  - Airports
  - Roads
  - Bridges
- Water/Wastewater Systems
  - Pipeline
  - Wastewater Treatment Plants
  - Pump Station
  - Water Treatment Plants
  - Reservoir

The evaluations that will be performed are classified as detailed evaluations and the placards are the same as the placards used for buildings. When posting placards, care must be taken to use the correct placard for the conditions noted. Posting of facilities will be discussed in detail at the end of the unit.

4.1 Assessment Form Heading

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

All of the lifeline systems forms use the same header, including the geotechnical report. Therefore, the discussion through Section A of the forms will be done once before going into details of each system form.

"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. "Address" is the street address as used by the jurisdiction. "County/City" should be the name of the county or the city depending on who has jurisdiction over the facility or system. "Mo/Day/Yr" refers to the date of the evaluation that is being performed and the "Time" is the time of day the evaluation was performed. Please note that time should be shown using the 24-hour clock. Finally, the "type of disaster" is a reference to the event that caused the need for the evaluation. For example this could be an earthquake, flood, wildland fire, etc. The actual name of the event, if known, could be used.

To the right of the form is the section that identifies who did the evaluation and what supporting documentation was used to develop the assessment. On the first line, the evaluators would enter either their SAP identification number from their ID Card or their names. The jurisdiction responsible for the evaluation will establish their criteria in relation to using names or ID card numbers. As was discussed in Unit 1, originally this was a liability issue and, since liability has been resolved in multiple ways, there is no problem in using the evaluator's name. "Other Reports" relates to safety assessment evaluations or any other type of report that was used in the performance of your assessment. If no other reports were used, indicate "NONE." If other reports were used, indicate "OVER" in the available space and list the reports by title or assessment number.

"No. Photos" relates to the number of photographs that are a part of this evaluation. "No. Sketches" relates to the number of sketches you developed as a part of the assessment. If photographs were taken and/or sketches developed, they need to be stapled to this assessment report. If the photographs require developing, the film should be turned over to the jurisdiction. If the photographs are digital, they need to be downloaded into the jurisdiction's computer system.

"Ref. Dwgs." refers to any drawings that were used in the assessment. If none were used, indicate "NONE" in the available space. If drawings were used, note "OVER" and list the drawings by drawing number on the back of the form.

Unit 2 discusses providing estimates of the damage seen. If you are comfortable estimating the percentage of damage, you may enter it in the space marked "Est. Damage." As Evaluators, do not be overly concerned about providing precise estimates. This information is used by the jurisdiction to assist them in determining the impact of the disaster. These numbers are very preliminary and will change many times before the actual repair work is done.

The final block is "Facility Status." In the large box provided, simply indicate by color the recommended status of the facility as a result of this assessment.

The next two sections provide a safety reminder to the evaluator and a caution statement to the jurisdiction. The first part of the safety reminder applies to all evaluations, while the second portion of the reminder applies only to airports. The caution statement reminds the jurisdiction that the level of assessment you are performing is not sufficient to be used in countering any other engineering opinions that have been developed through more in-depth and thorough evaluations.

Section A of the evaluation is where you indicate what the existing condition of the facility or system was prior to your assessment (i.e., previous assessment where this is a re-evaluation). In the "EXISTING" section check the box that was the recommendation from the previous assessment. If there is no recommendation, or you do not know if another assessment had been performed, check the "NONE" box. The "Recommended" portion of the box is for noting the condition that you are recommending based on your assessment. Again, check the box with the appropriate placard color. The final box is simply a notation of whether or not you physically posted the facility or system following your assessment. In most cases, for these systems, you will not place a placard.

The first page of the form is intended to provide the jurisdiction with a quick overview of the condition of the facility or system. All pertinent information regarding the posting used is contained on the first page. In the remaining sections of this unit, we will look at each form beginning with Section B.

4.2 Geotechnical Evaluation

(Photograph by Robert A. Eplett, California OES)
Figure 4-1 Surface Faulting - Landers/Big Bear Earthquake, 1992

Within this unit, the geotechnical evaluation is the only non-lifeline specific assessment. In this case, a geotechnical evaluation can be requested for any type of facility or assessment where damage has occurred or been exacerbated by soil conditions. Most geotechnical evaluations will be performed on facilities that have already had a facility specific evaluation. Where the forms do not explicitly note geotechnical conditions, it is hoped that the previous evaluation team has noted on their assessment forms the conditions that lead to their recommendation for a geotechnical assessment. This will give the new team a starting point to begin their assessment. The assessment begins at the site in question, and expands outward to determine if subsurface or surface soil conditions pose a threat to the continued use of the facility or system.

Geotechnical failures, particularly liquefaction and associated lateral spreading, have many times caused the most severe damage to lifeline facilities. Pipelines, tanks, and foundations built in or on soil that liquefies move with the soils laterally, settle, or become buoyant. Movement results in severe damage. Liquefaction is most often found adjacent to water bodies where the groundwater table is high with unconsolidated soils. Settlement not related to liquefaction can also occur, although usually is not as severe. Landslides sometimes occur where there is steep topography.

(Photographs courtesy of San Francisco Dept. of Public Works)

Fig. 4-2 Slide near structures, San Francisco **Fig. 4-3 Toe of same slide, San Francisco**

This rock slide initially appears to endanger the high-rise apartments above it. However, the apartments were set back far enough to be unaffected by the slide. The building directly below the slide was damaged by it, which is out of view from these photos.

Fig. 4-4 Slope failure disrupting road, Sonoma County

This slope failure was caused by the "New Years Eve" Storm of December 2005 through January 2006. Excessive soil saturation led to slope failure.

A copy of the evaluation form can be found on the following page.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
GEOTECHNICAL EVALUATION

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.)

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) _____

4.2.1 Filling Out the Geotechnical Evaluation Form

1. **Recommendations** – Many times, damages will be found that on the surface may not be significant enough to take the facility or system out of service. However, over time these damages can become more significant. In this section of the form, the evaluator will note the areas of the facility that need to be **monitored** on some regular basis. Ideally, the evaluator will indicate what needs to be monitored, why, and at what point the condition will cause a change in the posting or the need for another action. The second part of this section allows the evaluator to provide information about the posting decision that would be pertinent for the jurisdiction to know. This section can also be used to elaborate on monitoring requirements.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the evaluator believes needs to be explained. If there is not enough room to write the necessary explanations, simply indicate "OVER" at the bottom of the form and continue on the back side of the form.

3. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

4. **Section D – Observed Geotechnical Conditions with Effect On Facility** – Utilizing the DO, the evaluator will look at all the conditions and describe the extent of the condition. This allows the jurisdiction to understand how bad the geotechnical conditions are at the site. The second part of the assessment describes the impact of that condition. Remember, the two evaluations can have significantly different assessments. For those areas that are not involved in the event (i.e., ash flow for an earthquake event) use the designation NA (Not Applicable).

5. **Section E – Continuing Hazards to Life/Property** – The evaluation team will use this section to verbally describe the conditions at the site that may be a hazard to life safety and to property. This narrative should go into some level of detail relating the geotechnical conditions to the original posting of the facility or structure. Remember, you are not performing an engineering evaluation, so your narrative needs to be commensurate with the assessment performed. Mapping the area that has liquefied showing the size of cracks, location of sand boils, and an estimate of lateral movement is useful, if time permits.

4.2.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended posting. If the facility has been posted with a placard, make sure you update the existing placard with the appropriate information. If your recommendation changes a posting from INSPECTED to RESTRICTED USE or UNSAFE, or from RESTRICTED USE to UNSAFE, change the placard and add the appropriate information explaining the change in condition. If the geotechnical conditions you observe do not have an impact on the site or facility, DO NOT change the existing placard. If there is a comment on the placard regarding the potential hazard from the geotechnical condition, make the appropriate change and add your names to the placard with the new date and time.

4.3 Airports

The large international airports will not be using the SAP to obtain evaluators to assess the safety of the airport for continued use. Because of the volume of traffic at these airports, they will utilize their own engineers to perform the evaluations within minutes following the occurrence of an event. Evaluators from the SAP will be used to evaluate the small, general aviation airports that are located within the community. These will become key facilities for the purpose of receiving and moving resources for the community. In some cases, these airports will also be used as staging areas for the people and equipment that will be assisting the community.

(Photograph from the Denali Collection)
Figure 4-5 Airport Runway, Lateral Spreading

There has been a wide range of earthquake damage to airport facilities. Liquefaction and/or settlement have occurred on runways, rendering them inoperable. Control towers have been damaged because of the seismic amplification occurring between the ground and the roof. Roof structures on control rooms are often damaged because of the poor support provided by the glass walls. Emergency power is often not operable because of the failure of batteries required to start generators, and/or failure of other support systems required to operate the generator.

Fig. 4-6 Damage to Control Tower, Loma Prieta Earthquake

The glass was shattered from this airport control tower due to the earthquake.

A copy of the evaluation form can be found on the following page.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
AIRPORT

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	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 OBSERVATIONS (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. 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 _____

4.3.1 Filling Out the Airport Evaluation Form

1. **Recommendations** – Many times, damage will be found that on the surface may not be significant enough to take the facility or system out of service. However, over time these damages can become more significant. A good example would be a cracked runway from an earthquake. Additional aftershock activity may increase the size of the crack or, in the worse case, begin to separate vertically. In this section of the form, the evaluator will note the areas of the airport that need to be monitored on some regular basis. Ideally, the evaluator will indicate what needs to be monitored, why, and at what point the condition will cause a change in the posting. The second part of this section allows the evaluator to provide information about the posting decision that would be pertinent for the jurisdiction to know. This section can also be used to elaborate on monitoring requirements.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the evaluator believes needs to be explained. In the case where the airport may be posted RESTRICTED USE, it is in this section that the evaluator would note the restrictions. If the airport is to be posted UNSAFE, the reasons for that choice are provided here.

3. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

4. **Surface Displacement** – This section is used to note the vertical and horizontal displacements of various portions of the paved areas of the airport. The first line is to indicate the level of damage using the damage scale. The second and third lines are to record the actual displacements at the time of the assessment. There are times when runways will cross over streets; these overpasses are considered as bridges, and the structure should be evaluated using the Bridge assessment form. The same would apply for pedestrian bridges or overpasses.

5. **Underground Utilities** – For each of the utilities listed, the evaluators will estimate the level of damage using the damage scale. Each of these utilities, if individually damaged, could be grounds for a recommendation of a RESTRICTED USE posting. For example, if the sanitary sewer has failed, the damage may not be sufficient to consider the airport unsafe. However, you do not want people using the restrooms until the sewer is fixed, especially if the airport is being used as a staging area. Your restriction in this case would be to close and lock all restrooms due to the sewer damage.

6. **Buildings** – For each of the buildings, either a Rapid Evaluation or Detailed Evaluation form should be filled out. The results of that assessment will provide the background information for determining the approximate level of damage here. Each building assessment form should be stapled to the airport evaluation form.

7. **Remarks** – This section lets you expand in some detail the results of the assessment of the various components. Further, this is a good place to cross-reference to either the bridge or building evaluation forms if used.

4.3.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended posting of the airport. Once determined, the team should report to the general manager of the airport and relay to them what their recommendations are. Remember that you do not have the authority to post the airport; all you can do is make a recommendation. When you return to whoever assigned you to assess the airport, provide them with your recommendations and as much detail as you can. When your recommendation is to post the airport UNSAFE, you must immediately contact the jurisdiction representative with your recommendation. If the airport does not have a general manager or someone in charge, the jurisdiction will notify the FAA, which will put out a general broadcast indicating the airport is closed.

4.4 Bridges

(Photograph courtesy of FEMA)
Figure 4-7 Olympia, Washington, Nisqually Earthquake, 2001

The major bridges throughout the state are found on the highways and freeways, which are a part of the national highway system. CalTrans will evaluate these bridges immediately following the event. However, the SAP can be used to provide engineers to evaluate bridges that are not a part of the national highway system located within the jurisdiction. These bridges will be important to the jurisdiction for moving resources to where they are needed. SAP engineers evaluated bridges in the City of Santa Cruz following the Loma Prieta Earthquake. This has been the only experience with the forms to date.

Bridges are damaged when support columns (without adequate confinement steel) fail in shear, unable to transfer lateral loading to their foundation. Bridge spans fall off abutments and piers if the seat is too narrow, and they are not otherwise restrained. The most vulnerable bridges are those with multiple spans and those that are at an angle to the obstruction they cross. Bridge approaches sometimes settle, resulting in an offset at the abutment.

Fig. 4-8 Overpass column collapse, Northridge Earthquake

This overpass column was of nonductile concrete design, and failed in the Northridge Earthquake due to insufficient containment.

4.4.1 Filling Out the Bridge Evaluation Form

A copy of the evaluation form can be found on the following page.

1. **Recommendations** – This section shows the typical types of recommendations that would apply to bridges, though not necessarily the only ones. Upon completion of the assessment, your overall recommendations are noted here by checking the appropriate boxes. If the monitor box is checked, make sure that you note in the comments the conditions that need to be monitored and the criteria. Also, include some form of threshold when another action should take place. For the other boxes, add information in the comments section when appropriate. If the shore and brace box is checked, you should note a location. 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.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the evaluator believes needs to be explained. In the case where the bridge may be posted 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 choice are provided here.

3. **Bridge Description** – In this section of the evaluation form, the evaluator will describe the structural system of the bridge, configuration of the bridge, and description of the foundation system. In the spaces where dimensions are requested, these should be either estimated or "paced." Do not take the time to physically measure by tape or chain all the dimensions requested.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
BRIDGE

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

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 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 _____

_____

_____

_____

4. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

5. **Sections E through L** – These are the individual components of the bridge structure and should be assessed in turn. For each component, estimate the level of damage using the damage scale. For areas not seen use the NO (Not Observed) rating. Remember, as with buildings, you are not to perform destructive investigation. You will rate only what you can see by walking around, over, and under the bridge. Keep in mind safety – do not imperil yourself if the bridge is in imminent failure. In Section L, if any one of the noted conditions exists, a geotechnical evaluation should be requested. This can be noted in the remarks section.

6. **Remarks** – This section lets you expand in some detail the results of the assessment 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.

4.4.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended posting. If it is determined that the bridge is so seriously damaged that it needs to be posted UNSAFE and removed from service, the jurisdiction representative with you should be told immediately. They, in turn, will contact either Public Works or the local Police Department to ensure the proper actions are taken. If you do not have a jurisdiction representative with you, use the list of contact numbers provided to you, and call the individual who assigned the bridge to you to report your findings and recommendations. In the case where recommendations are not time sensitive, wait until you return to your staging area to pass on your recommendations. Bridges, like most lifeline systems or facilities, will not be physically posted. The placards are too small for motorists to safely see and understand what the placard says. Barricades are the most likely method to be used for closing bridges.

4.5 Roads and Highways

(Photograph courtesy of FEMA)
Figure 4-9 Road Settlement, Northridge Earthquake, 1994

Like bridges, you will be used to evaluate local streets. Freeways and highways that are a part of the national highway system are rapidly evaluated by CalTrans. Local streets are very important to the jurisdiction, as they are used to transport resources throughout the jurisdiction. As evaluators, remember that local law enforcement and fire are on the streets immediately following the event. Very quickly, they will determine what streets are useable and which are not. You could expect that streets and roads would be some of the last lifeline systems to be formally evaluated. A good example of the type of evaluation would be where the local law enforcement has closed a street and re-routed traffic around the area. As the emergency response period winds down, they need to open those streets as quickly as possible.

Roads can be made impassable (in addition to bridge collapse) as a result of geotechnical failure, or collapse/debris from buildings and bridge overpasses. Roads constructed on liquefiable material can break up, particularly if lateral spreading occurs. Landslides can either cover roads with debris, or the road itself can move. Following the Kobe Earthquake in Japan, and the Coalinga Earthquake in California, debris from collapsed buildings limited emergency response, in particular their ability to respond to fires.

Roads can be greatly affected from storm and flood disasters. Roads along streams or with culvert crossings can be washed out, or in hilly country can fail due to slipouts or even activated slides. Roads with storm drains beneath them can fail if the storm drains blow out and wash out the road. Evaluators should use caution in approaching the edge of any washout, slide or slipout, as the edge could be very fragile and can give way if walked upon, leading to injury or death.

Fig. 4-10 Road slipout, Marin County, 2006

Fig. 4-11 Scarp damage, Marin Co., 2006

Fig. 4-12 Road washout, Hurricane Katrina, 2005

A copy of the evaluation form can be found on the following page.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
ROAD/HIGHWAY

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 Green O Yellow O Red O

Recommended: Green O Yellow O Red O

Posted at this assessment: Yes O No 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.)

	0	1	2-3-4	5	6	NA	NO
Damage Scale:	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 _____

_____

_____

_____

_____

_____

_____

_____

4.5.1 Filling out the Road and Highway Evaluation Form

1. **Recommendations** – This section shows the typical types of recommendations that would apply to roads, though not necessarily the only ones. Upon completion of the assessment, your overall recommendations are noted here by checking the appropriate boxes. If the "Monitor" box is checked, make sure that you note in the comments the conditions that need to be monitored and the criteria. Also include some form of threshold when another action should take place. If the "Traffic in danger due to adjacent unstable/unsound structure" box is marked, make sure you describe the condition in the comments section. 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.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the evaluator believes needs to be explained. In the case where the road may be "posted" 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 choice are provided here.

3. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

4. **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. For areas not seen use the "NO" (Not Observed) rating. Remember, as with buildings, you are not to perform destructive investigation. You will rate only what you can see by walking around and over the roadway. Work safely – do not get too close to the edges of slip-outs or other road section failures where a fall could cause injury.

5. **Section I – Remarks** – This section lets you expand in some detail the results of the assessment 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.

4.5.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended "posting." If it is determined that the road is so seriously damaged that it needs to be posted UNSAFE and removed from service, the jurisdiction representative with you should be told immediately. They, in turn, will contact either Public Works or the local Police Department to ensure the proper actions are taken. If you do not have a jurisdiction representative with you, use the list of contact numbers provided to you, and call the individual who assigned the road to you to report your findings and recommendations. In the case where recommendations are not time sensitive, wait until you return to your staging area to pass on your recommendations. Roads, like most lifeline systems or facilities, will not be physically posted. The placards are too small for motorists to safely see and understand what the placard says. Barricades are the most likely method to be used to close a damaged road.

4.6 Pipelines

Figure 4-13 Streambed Crossing

Pipelines can carry anything from fuel to water to sewage. For the purpose of post-disaster safety assessment, the pipelines most likely to be evaluated will be water and sewage, as they have the most significant impact on the recovery of the community. High and medium pressure natural gas pipelines, and liquid fuel lines can have devastating impacts on communities if they explode or catch fire. These failures are usually very quickly identified and will be the responsibility of the pipeline owner to stabilize (isolate) and repair.

Fig. 4-14 Water and Gas Main Damage, Northridge Earthquake, 1994

In the above photo, seismic waves disrupted both water and natural gas mains. The natural gas found an ignition source and so was on fire above the pool of water from the broken water mains.

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 look at. Therefore, the team should also be prepared to evaluate other facilities that are a part of the system, such as pump stations and reservoirs. The evaluation of buried pipelines will be problematic in that there is not much to see, and you will have to base your evaluation on surface conditions. For exposed pipelines, the evaluation becomes more straightforward. But, as in all of these evaluations, you will not be performing destructive investigations

The most pipeline damage occurs to brittle pipelines (such as cast iron or vitreous clay) buried in liquefiable soils. Some damage will occur due to shaking. Pipelines constructed of ductile materials such as steel or polyethylene (such as for natural gas distribution) are more flexible and will have fewer

failures. Pipelines can fail as a result of shear, joint damage or separation, or can simply burst. For water systems, depending on the number of pipeline failures, entire areas of the system may lose pressure and become non-functional. In many cases, failures of pressurized pipelines, such as those carrying water, will result in water boiling out of the ground. Most sewer pipelines operate by gravity (i.e. are not pressurized). Immediate damage will only be evident if the sewer collapses, causing backup (and possible overflow) of sewage. In liquefiable soils, sewers and manholes will become buoyant, changing their vertical alignment, making them hydraulically inoperable. Identification of these types of failures will only be possible using specialized equipment.

(Photo courtesy of the San Francisco Dept. of Public Works)
Fig. 4-15 Washout at storm drain break, San Francisco

4.6.1 Filling out the Pipeline Evaluation Form

1. **Recommendations** – This section shows the typical types of recommendations that would apply to pipelines, though not necessarily the only ones. Upon completion of the assessment, your overall recommendations are noted here by checking the appropriate boxes. If the "Monitor" box is checked, make sure that you note in the comments the conditions that need to be monitored and the criteria. Also, include some form of threshold when another action should take place. For the other boxes, add information in the comments section when appropriate. If the "Divert Flow" box is checked, you should provide an explanation. 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.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the evaluator believes needs to be explained. In the case where the pipeline may 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 choice are provided here.

3. **Pipeline Description** – In this section of the evaluation form, the evaluator will describe the construction and materials of the pipeline along with the material carried. In the spaces where dimensions are requested, these can be either estimated or measured with a measuring tape.

4. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

(Photo courtesy of San Francisco Dept. of Public Works)

Fig. 4-16 Water main break, Salinas St., San Francisco

A copy of the evaluation form can be found on the following page.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
PIPELINE

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

Provide temporary alternate service___ O

Unblock entrance _____ O

Continue in service _____ O

Install temp. above-ground line____ O

Check water quality/safety _____ O

Divert flow_____ O

_____

_____

_____

_____

_____

_____

C. COMMENTS _____

_____

_____

D. PIPELINE DESCRIPTION

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 None (0%)	1 Slight (1-10%)	2-3-4 Moderate (11 - 40%)	5 Severe (41 - 60%)	6 Total (over 60%)	NA Not Applicable	NA 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 _____

5. **Sections E through R** – These are typical conditions that show the pipeline is damaged. 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, you are not to perform destructive investigation. You will rate only what you can see by walking around, over, and under the pipeline. If the pipeline is buried, look for conditions on the surface that will indicate that these types of damage have occurred. If none is observed, mark the line with NO. In item Q, if leakage is found make your best estimate on the leakage rate. In Section R, the closest manhole can be estimated or paced. Make sure that you indicate somewhere the direction to the nearest manhole.

6. **Remarks** – This section lets you 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.

4.6.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended posting. If it is determined that the pipeline is so seriously damaged that it needs to be removed from service, the jurisdiction representative working with you should be told immediately, who, in turn, will contact Public Works to ensure the proper actions are taken. If you do not have a jurisdiction representative with you, use the list of contact numbers provided to you, and call the individual who assigned the pipeline to you to report your findings and recommendations. In the case where recommendations are not time sensitive, wait until you return to your staging area to pass on your recommendations.

4.7 Pump Station

Figure 4-17 Pump Station

Pump stations may or may not be assigned for evaluation separately. Many times, a segment of pipeline you are evaluating will include a pump station. Where the facility is located above ground in a building, also include a building evaluation to cover the structural and nonstructural components.

Pump stations are found with water, wastewater, natural gas (compressor stations), and liquid fuel pipelines. All but wastewater pump stations are usually at grade, and may have components as deep as 10 feet below grade. The most common type of damage will be loss of power, damage to the emergency power system, fallen electrical and control cabinets, and damage to piping. Building damage is less likely unless the structures are unreinforced masonry. Wastewater pump stations may be many tens of feet deep and are often founded in liquefiable soils. If the soils liquefy, the pump stations can become buoyant, breaking connecting piping.

4.7.1 Filling out the Pipeline Evaluation Form

A copy of the evaluation form can be found on the following page.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
PUMP STATION

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

Brace structure before using_____ O

Check filter basket_____ O

_____

_____

_____

Continue in service_____ O

Check pump-motor alignment_____ O

Recheck after power restored_____ O

_____

_____

_____

C. COMMENTS _____

_____

_____

_____

D. PUMP STATION DESCRIPTION

O Water O Wastewater O Sewage O Other _____

O Wet Well

O Dry Well

	No. Motors			
	Elect	Gas	Gasoline	Diesel
Centrifugal				
Reciprocal				
Horizontal				
Vertical				

No. Operable			
Elect.	Gas	Gasoline	Diesel

Str. Type	Buried	Above Grade
Concrete		
Masonry		
Frame		
Other		

O Building (Building Evaluation Attached O)

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. STRUCTURE

D.O.

_____ Access
_____ Crane runway
_____ Fixed hoist
_____ Floor
_____ Fore bay
_____ Foundation
_____ Roof
_____ Walls
_____ Hatches

F. PUMPS

_____ Anchors
_____ Casing
_____ Connected piping
_____ Supports
_____ Valves

G. MOTORS/ENGINES

D.O.

_____ Anchors
_____ Connected piping
_____ Couplings to pumps
_____ Power supply
_____ Transformer(s)

H. CONTROLS

_____ Internal power
_____ Supports
_____ Wiring
_____ Valves

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

K. EXTERNAL PIPING

	Inlet	Outlet
Piping	____	___
Leaked	o	o
Leaking	o	o

Leakage rate, gpm _____

L. REMARKS _____

_____

_____

_____

_____

1. **Recommendations** – This section shows the typical types of recommendations that would apply to pump stations, though not necessarily the only ones. Blank space is provided to add recommendations that the assessment team feels are appropriate to the facility. Upon completion of the assessment, your overall recommendations are noted here by checking the appropriate boxes. If the "Monitor" box is checked, make sure that you note in the comments the conditions that need to be monitored and the criteria. Also, include some form of threshold when another action should take place. For the other boxes, add information in the comments section when appropriate. If the "Brace Structure" box is checked, you should provide an explanation and location. If there is not enough room for all the comments, simply note "OVER" at the bottom of the form and continue on the backside.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the evaluator believes needs to be explained. In the case where the pump station may 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 choice are provided here. If the station is in an above-ground building, note that a building evaluation is a part of this overall assessment.

3. **Pump Station Description** – In this section the evaluator describes the type of pump, construction, and materials of the station.

4. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

5. **Sections E through K** – These sections provide the assessment of the various components of the station. If the station is above ground and in a structure a small note in this section referencing the building 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, you are not to perform destructive investigation. You will rate only what you can see by walking around the station. In item K, if leakage is found, make your best estimate on the leakage rate.

6. **Section L – Remarks** – This section lets you 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 backside of the form.

4.7.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended posting. If it is determined that the pump station is so seriously damaged that it needs to be removed from service, the jurisdiction representative working with you should be told immediately, who, in turn, will contact Public Works to ensure the proper actions are taken. If you do not have a jurisdiction representative with you, use the list of contact numbers provided to you, and call the individual who assigned the pump station to you to report your findings and recommendations. In the case where recommendations are not time-sensitive, wait until you return to your staging area to pass on your recommendations. If the pump station is in an above-ground building and you have performed a building evaluation as well,

make sure to post the building based on the recommendations of the building assessment. If the building is posted RESTRICTED USE, list the restrictions in the space provided on the placard. If the building is to be posted UNSAFE, note the conditions leading to the unsafe posting.

4.8 Reservoir (Tanks)

(Photograph from the Steinbrugge Collection)

Figure 4-18 – Water Tank, Elephant's Foot

This section refers to "tanks" typically constructed of steel or concrete, rather than impounded waters with dams. Many jurisdictions around the state use water tanks for storing domestic water supplies, and water tanks are highly susceptible to damage from earthquakes. The potential is there to use these evaluations following other types of events or situations, but it will be earthquakes where they are most often used. These become very important components of a jurisdiction's infrastructure in times of emergency, especially when their main water supply has been disrupted. The water that is in these tanks will be needed for firefighting operations as well as for drinking water. Unanchored steel tanks will uplift, breaking connecting piping. When uplift becomes more severe, the tank wall will wrinkle when the tank slams back down, commonly referred to as elephant's foot buckling. In severe cases, the wall-floor seam can burst. Sloshing water can damage the roof, although this is not likely to result in loss of service.

The most significant vulnerability to wire or cable-wrapped concrete tanks is failure of the wrapping as a result of corrosion of inadequate design. Older tanks can theoretically slide off their floor slab foundations, although this has never been documented. Roofs are also vulnerable.

4.8.1 Filling out the Reservoir Evaluation Form

Two types of reservoirs are included in this evaluation form: steel, and prestressed concrete. The evaluation team should immediately define which type of reservoir you will be evaluating and discard the form for the other type. For any part of this form where you are unsure, either note the item as NO (Not Observed) or indicate unsure.

A copy of the evaluation form can be found on the following page.

1. **Recommendations** – This section shows the typical types of recommendations that would apply to pump stations, though not necessarily the only ones. Blank spaces are provided to add recommendations that the assessment team feels are appropriate to the facility. Upon completion of the assessment, your overall recommendations are noted here by checking the appropriate boxes. If the "Monitor" box is checked, make sure that you note in the comments the conditions that need to be monitored and the criteria. Also, include some form of threshold when another action should take place. For the other boxes, add information in the comments section when appropriate. If the "Brace Structure" box is checked, you should provide an

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
RESERVOIR

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 Green O Yellow O Red O

Recommended: Green O Yellow O Red O

Posted at this assessment: Yes O No 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

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 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. 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

_____ Valving

G. _____ Roof

H. _____ Footing

I. _____ Floor

J. _____ Aboveground Piping

K. _____ Underground Piping

L. REMARKS _____

_____

_____

PRESTRESSED CONCRETE RESERVOIR

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 Fill depth _____ Surface usage _____

O Yes O No

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

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

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

_____ Leaks @ rust stains
_____ Major leaks at shell/foundation joint
_____ Unexplained wet spots on adjacent ground
_____ Corrosion at manholes/other penetrations

3. Bar tendons on surface:
   _____ Tendons failed
   _____ Tendons sound loose
   _____ Evidence of rust

Leakage rate _____ gpm

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

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
_____ Valving

U. REMARKS _____

_____
_____
_____
_____
_____
_____
_____
_____
_____

explanation and location. 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.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the evaluator believes needs to be explained. In the case where the pump station may 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 choice are provided here. If the station is in an above-ground building, note that a building evaluation is a part of this overall assessment.

3. **Section D – Description** – This section is used only if the reservoir is of steel construction. In this section the evaluator describes in a fair amount of detail the construction of the steel reservoir. The capacity, height, and diameter should be estimated.

4. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

5. **Sections E through K** – These sections provide the assessment of the various components of the reservoir. Areas where rocking or sliding are noted with direction and distance should be provided 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, you are not to perform destructive investigation. You will rate only what you can see by walking around the station. At the bottom of the page, estimate the leakage rate.

6. **Section L – Remarks** – This section lets you 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 backside of the form.

7. **Section M – Description** – This part of the form is used only if the reservoir is of precast concrete construction. In this section the evaluator describes in a fair amount of detail the construction of the reservoir. The capacity, height, and diameter should be estimated. For the size and strength of the tendons provide the information only if you know. This information can be obtained from drawings if they are available.

8. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluator's use of the scales is based strictly on their professional judgment.

9. **Sections N through T** – These sections provide the assessment of the various components of the reservoir. Areas where displacement is noted should be discussed 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, you are not to perform destructive investigation. You will rate only what you can see by walking around the station. At the bottom of the page estimate the leakage rate.

10. **Section U – Remarks** – This section lets you 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.

4.8.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended posting. If it is determined that the reservoir is so seriously damaged that it needs to be removed from service, the jurisdiction representative working with you should be told immediately, who, in turn, will contact Public Works to ensure the proper actions are taken. If you do not have a jurisdiction representative with you, use the list of contact numbers provided to you, and call the individual who assigned the reservoir to you to report your findings and recommendations. In the case where recommendations are not time-sensitive, wait until you return to your staging area to pass on your recommendations.

4.9 Wastewater Treatment Plants

(Photo courtesy of San Francisco Dept. of Public Works)

Fig. 4-19 Oceanside Wastewater Treatment Plant, San Francisco

Wastewater treatment plants are complex systems made up of many components and systems. Components include buried and above grade pipe, cast-in-placed concrete basins and utilidores (galleries), buildings, chemical, gas, piping, and electrical systems. You should be prepared with building evaluation forms to do a complete assessment of the facility. In evaluating the operation of the treatment plant, it will become easy to forget that you are doing a detailed evaluation, not an engineering evaluation. You will not be doing any destructive investigation. Your goal is to recommend whether or not the facility should remain in operation. The operators will perform any testing of materials or addition of chemicals in accordance with their standard operating procedures and/or state and local standards.

Each category of components has their own damage mechanisms. All types of components have been damaged as a result of liquefaction, settlement, and lateral spreading. Sewer lines have broken off and concrete basins and buildings settled. Expansion joints in concrete basins have failed, allowing sewage to drain into utilidores. Utilidores have flooded as a result of broken piping, also causing secondary damage when electrical equipment is submerged. Baffles in large basins have broken as a result of sloshing sewage. Treatment plant chemical storage and piping systems have been damaged, with gaseous chlorine being potentially the most dangerous chemical. Sludge digesters contain sludge and sludge gas that is explosive. Guides have broken off floating digester roofs, allowing gas to escape. Buildings can be damaged, and unanchored electrical equipment can overturn.

From a systems perspective, the goal is to keep as much of the plant in operation as possible. For example, it would be desirable as a minimum to maintain operation of the headworks, primary sedimentation basins, and chlorine disinfection system, even if the secondary or tertiary systems were heavily damaged and not operational.

4.9.1 Filling out the Wastewater Treatment Plant Evaluation Form

A copy of the evaluation form can be found on the following page.

1. **Recommendations** – This section shows the typical types of recommendations that would apply to wastewater treatment plants, though not necessarily the only ones. Blank spaces are provided to add recommendations that the assessment team feels are appropriate to the facility. Upon completion of the assessment, your overall recommendations are noted here by checking the appropriate boxes. If the "Monitor" box is checked, make sure that you note in the comments the conditions that need to be monitored and the criteria. Also, include some form of threshold when another action should take place. For the other boxes, add information in the comments section when appropriate. If you check the "Chlorinate and by-pass" or "Check effluent quality/safety" boxes, you are sending a message to the operator that you are recommending this be done. Remember, this is only a recommendation, and the operators will follow their standard procedures. 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.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the team believes needs to be explained. In the case where the plant may be posted RESTRICTED USE, the team will 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 choice are provided here.

3. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluators' use of the scales is based strictly on their professional judgment.

STATE OF CALIFORNIA
SAFETY ASSESSMENT PROGRAM
TREATMENT PLANT
(WASTEWATER)

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).

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

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 _____

_____

4. **Sections D through E** – These sections provide the assessment of the various structural, mechanical, and electrical 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. Remember, as with buildings, you are not to perform destructive investigation. You will rate only what you can see by walking around the plant. Provide the information for Section E only if you have access to the information. If you have no access to the information, note that the information is Not Available. Do not note "NA" as that states the section is Not Applicable.

5. **Section F** - **Tributary Gravity Sewer System** – This section allows the team to summarize their assessment of the condition of the gravity sewer system. This should be a brief statement, as you are not performing an engineering evaluation. However, you can note in this section information you have observed about the system.

6. **Last Page** – This section records your observations regarding overall plant operation in dealing with these processes. At the top of the page is a checklist to help you in performing the evaluation.

4.9.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended "posting." If it is determined that the plant is so seriously damaged that it needs to be posted UNSAFE and removed from service, the jurisdiction representative with you should be told immediately. They, in turn, will contact either Public Works or notify the plant operator to ensure the proper actions are taken. If you do not have a jurisdiction representative with you, use the list of contact numbers provided to you, and call the individual who assigned the wastewater treatment plant to you to report your findings and recommendations. In the case where recommendations are not time sensitive, wait until you return to your staging area to pass on your recommendations.

If you have performed building evaluations at the facility, make sure to post the buildings based on the recommendations of the building assessment. You should have a building assessment form for each building evaluated. If the building(s) is posted RESTRICTED USE, list the restrictions in the space provided on the placard. If the building(s) is to be posted UNSAFE, note the conditions leading to the unsafe posting.

4.10 Water Treatment Plants

The evaluation of water treatment plants will be similar to that of wastewater treatment plants. You should be prepared with building evaluation forms to do a complete assessment of the facility. In evaluating the operation of the treatment plant it will become easy to forget that you are doing a detailed evaluation, not an engineering evaluation. You will not be doing any destructive investigation. Your goal is to recommend whether or not the facility should remain in operation. The operators will perform any testing of materials or addition of chemicals in accordance with their standard operating procedures and/or state and local standards.

The type of damage that has been experienced by water treatment plants is similar to wastewater plants, although less severe. Water treatment plants tend to be constructed on higher ground, away

from liquefiable soil. Damage to baffles due to sloshing water inside basins is common. Unanchored equipment will slide and/or topple. The treatment plant concrete basins, if founded on competent soils, are robust, so limited damage is expected. Water treatment plants also have many treatment chemicals, although many have eliminated gaseous chlorine because it is so dangerous. Of course, unanchored equipment is vulnerable to damage from lateral forces.

4.10.1 Filling out the Water Treatment Plant Evaluation Form

A copy of the evaluation form can be found on the following page.

1. **Recommendations** – This section shows the typical types of recommendations that would apply to wastewater treatment plants, though not necessarily the only ones. Blank spaces are provided to add recommendations that the assessment team feels are appropriate to the facility. Upon completion of the assessment, your overall recommendations are noted here by checking the appropriate boxes. If the monitor box is checked, make sure that you note in the comments the conditions that need to be monitored and the criteria. Also, include some form of threshold when another action should take place. For the other boxes, add information in the comments section when appropriate. If you check the "Chlorinate and by-pass" or "Check effluent quality/safety" boxes, you are sending a message to the operator that you are recommending this be done. Remember, this is only a recommendation and the operators will follow their standard procedures. 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.

2. **Comments** – This space is used to provide explanation on any part of the assessment that the team believes needs to be explained. In the case where the plant may be posted RESTRICTED USE, the team will 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 choice are provided here.

3. **Damage Observation (DO)** – The damage scale is a scale from 0 to 6 used to rate the damages that are found. It will be used in the assessment of the various components of the facility. The damage scale gives the evaluator and the jurisdiction a tool to indicate the level of damage. However, the evaluators' use of the scales is based strictly on their professional judgment.

4. **Sections D through J** – These are the individual components of the plant that should be assessed. For each component estimate the level of damage using the damage scale. For areas not seen use the "NO" (Not Observed) rating. Remember, as with buildings, you are not to perform destructive investigation. You will rate only what you can see by walking around the plant.

5. **Section K – Remarks** - This section lets you expand in some detail the results of the assessment 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.

6. **Last Page** – This section records your observations regarding overall plant operation in dealing with these processes. At the top of the page is a checklist to help you in performing the evaluation.

STATE OF CALIFORNIA

SAFETY ASSESSMENT PROGRAM

TREATMENT PLANT (WATER)

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 Green O Yellow O Red O

Recommended: Green O Yellow O Red O

Posted at this assessment: Yes O No 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. 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 _____

_____
_____
_____
_____
_____
_____
_____

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 _____

_____

4.10.2 Posting

Upon completion of the assessment, the team will arrive at a decision on the recommended "posting." If it is determined that the plant is so seriously damaged that it needs to be posted UNSAFE and removed from service, the jurisdiction representative with you should be told immediately. They, in turn, will contact either Public Works or notify the plant operator to ensure the proper actions are taken. If you do not have a jurisdiction representative with you, use the list of contact numbers provided to you, and call the individual who assigned the water treatment plant to you to report your findings and recommendations. In the case where recommendations are not time sensitive, wait until you return to your staging area to pass on your recommendations.

If you have performed building evaluations at the facility, make sure to post the buildings based on the recommendations of the building assessment. You should have a building assessment form for each building evaluated. If the building(s) is posted RESTRICTED USE, list the restrictions in the space provided on the placard. If the building(s) is to be posted UNSAFE, note the conditions leading to the unsafe posting.

UNIT 5 OTHER HAZARDS

UNIT 5 - OTHER HAZARDS

Overview

The Safety Assessment Program can be activated for hazards other than earthquake. The potential exists for activation following high wind events (hurricane, tornado, and windstorm), flood events, fires, and explosions. 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 personnel to evaluate damaged buildings following high wind events floods, fires, and explosions.

Objectives

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

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

5.0 Other Hazards

The Safety Assessment Program was originally developed to provide additional support to local government following earthquakes, as this is the hazard that usually needs the most assistance. To this end, the Applied Technology Council developed the process and procedures for evaluating buildings based on an earthquake disaster. Since being published and presented in 1989, the ATC-20 procedures have been used on numerous earthquake disasters around the world.

Earthquakes are not the only events that have the potential for damaging buildings, nor are they the only hazard that will use large numbers of evaluators to determine the safety of structures. Therefore, the procedures of ATC-20 are being expanded to cover other hazards such as high winds (including hurricanes and tornados), floods, fires, and explosions.

The evaluation process for these other hazards is, in many respects, easier than working in the earthquake environment. With earthquakes, we need to deal with aftershocks and how they affect already damaged buildings. We look at the ability of the damaged structure to be able to withstand another event of similar size within a short period of time. With these other hazards, once the event is over, there is a much smaller likelihood that the damaged structure will have to survive another event before it can be repaired or stabilized.

5.1 High Winds

When responding to a hurricane, the evaluator must consider the two hazards of high winds and floods. Over the past few years, there have been many examples of hurricane disasters that include flooding. Hurricane winds significantly impact the lateral force resisting system within a building, the roof structure from uplift, and the doors and windows. If the windows and doors on the windward face of the building are blown out or broken from flying debris, the lateral force resisting system will have a sudden change in the forces imposed. Instead of constant force on the windward side of the building and suction on the leeward side, there will suddenly be increased pressure on the interior of the building, with a combination of direct force, suction, and uplift. Many older buildings can resist the direct forces while the windows are intact, but fail when the windows are blown out. However, the major damage resulting from a hurricane is usually a result of the accompanying flood or storm surge. A flooding condition occurs when the severe amounts of rainfall from a hurricane cause the normal flood control systems to be overwhelmed , and this can occur far inland of where the hurricane made landfall. Storm surge, on the other hand, results from a combination of ocean-related effects, and affects coastal communities rather than the interior. The ocean is pulled upward by the interior drop in pressure in a hurricane, and is dragged along onto the land as the hurricane makes landfall. The ocean is also driven at the surface by the powerful winds and mounts up in front of the hurricane, ending up pushed in front of it as the hurricane comes ashore. The storm surge from the 2005 Hurricane Katrina reached about 40 feet high in St. Bernard Parish, the most exposed area in Louisiana to the initial landfall.

Tornados, on the other hand, severely damage buildings as a result of the explosive internal pressures generated by the storm's pressure drop. Structures close to the storm will have a much higher internal pressure than the area around the storm, causing windows to blow out. Additional severe hazards that occur with tornados are projectiles. Large pieces of wood can be driven through substantial walls like a missile. Heavy rains accompany tornados, but usually do not result in heavy flooding. They can cause

some local flooding conditions. Where damages associated with hurricanes come from the flooding, damage from tornados come from the very high winds.

Wind storms in California are far more common and troublesome than either California's hurricanes or tornados. Hurricane force winds are produced by the powerful Pacific storms, forcing building standards in some locations to require that buildings be able to withstand 80+ mph winds. Even storms of tropical storm strength can wreak havoc, knocking trees into structures and downing power poles.

When evaluating structures that have been damaged as a result of high winds, we follow similar procedures as with earthquakes (from Unit 2).

1. **Survey of the building exterior.**

   - Determine structural system.
   - Examine exterior for damage.
   - New damage to foundations.

2. **Examine the site for geotechnical hazards.**

   - This step need only be employed if the storm was accompanied by heavy rains and flooding. In this case, you are looking for signs of settlement as a result of saturated soils or undermining of the footings.

3. **Inspect structural system from inside building** – enter the building only if you need to and you have determined that is safe to do so.

   - Do not enter obviously unsafe buildings.
   - Do not perform destructive investigation.
   - Look in areas where the structural system is exposed.
   - Identify and examine vertical load system.
   - Identify and examine lateral load system.
   - Inspect basements. Usually this only needs to be done if there has been some flooding. In this case you are looking to see if the basement is flooded. If it has been flooded and the water has receded, proceed with your evaluation to determine the condition of framing.
   - Examine every floor, including the roof and penthouse(s).

4. **Inspect for nonstructural hazards.**

   - Look 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.

5. **Inspect for other hazards.**

   - Spills or leaks in stored chemicals or other hazardous materials.

6. **Complete forms and post buildings.**

(Photograph courtesy of FEMA)
Figure 5-1 – Virgin Islands, Hurricane Lenny, 1999

We see in this case that there is substantial damage to the roof. This is one of the more common forms of damage from high winds, especially in single or two-story residential structures. With the roof damaged in this manner, there is a significant amount of damage to the interior from the accompanying rains. From a safety assessment standpoint, there is significant damage to both the vertical and lateral force-resisting systems. However, since the storm is over, the likelihood of another storm occurring before the building can be stabilized or repaired is usually pretty low. This building could be posted as RESTRICTED USE to allow free access for possession retrieval and repair. Without seeing the interior we don't know if there is a falling hazard with all or portions of the ceiling. If that were in fact the condition, then possibly portions of the home could be posted UNSAFE until the falling hazard is removed. The overall posting of the home would be RESTRICTED USE with portions UNSAFE.

(Photograph courtesy of FEMA)
Figure 5-2 – Virginia, Hurricane Floyd, 1999

In this case, we see the force of the wind has blown through the windward side of the building. Once this building was opened like this, the wind blew through the building and the leeward wall was under a suction force as well as a direct force. This could have lead to a failure of the leeward wall and a collapse or partial collapse of the structure. We can assume from the picture that there was no partial collapse. However, the wall framing on the leeward wall could be permanently deformed and bowed. Since light, steel-framed buildings use moment frames and not bearing walls, deformed wall framing is not a significant hazard to occupants. This building could be posted as RESTRICTED USE for possession and stock retrieval and free access for contractors to make the necessary repairs.

Figure 5-3 – Damaged concrete column, Hurricane Katrina, 2005

In this photo, we see a reinforced concrete building that nevertheless suffered some damage due to the high winds from Hurricane Katrina.

The high winds from Hurricane Katrina tore off part of the roof and the back of this wood-frame house. The wall of the house is noticeably leaning, indicating that the structure is no longer stable.

Figure 5-4 – Damaged house, Hurricane Katrina, 2005

(Photograph courtesy of FEMA)
Figure 5-5 – Kansas Tornado, 2001

Damage from tornados can be more severe than that from hurricanes, but it is usually limited to a small area. As tornados move through a community, the extreme damage is on either side of the storm and can absolutely devastate one block of homes and leave the next block with no damage at all, with shades of damage between. The safety assessment process is rather simplified as most structures in the path will be destroyed and the entire area can be posted as AREA UNSAFE as seen in this photograph. By posting the area as UNSAFE, the jurisdiction has a means of controlling access into the area. For example, with identification showing residence or business address the property owner or tenant could have free access to look for and retrieve whatever possessions they can find.

This unreinforced masonry building was practically demolished during Hurricane Katrina. Water filled the building up to about 10 feet, and the structure above the water caught fire. The roof is gone, and most of the structure has been reduced to rubble. It is interesting that the door appears unscathed and likely still works.

Figure 5-6 – Destroyed URM commercial building, Hurricane Katrina, 2005

This four-story URM had debilitating damage to it from hurricane-force winds. It is interesting to observe how bricks were stripped away by the powerful winds.

Figure 5-7 – Damaged four story brick building, Hurricane Katrina, 2005

This is a condition that is quite common with tornados and most likely would be posted as UNSAFE as there has been a partial collapse. However, one could make a reasonable argument that the structure is safe enough to allow the owners inside to retrieve possessions. In this case the structure would be posted as RESTRICTED USE for possession retrieval only.

(Photograph courtesy of FEMA)
Figure 5-8 – Cordell, Oklahoma Tornado, 2001

(Photograph courtesy of FEMA)
Figure 5-9 – Kansas Tornado, 2001

Smaller tornados with lower Fujita ratings may not cause full collapse of structures, but they can cause significant roof damage as can be seen in this school auditorium. It is very likely that the damage shown here would not have been found without entering the building. In this case, there are significant falling hazards, and the particular room would be posted UNSAFE pending the removal of the damaged and hanging framing and ceiling. If this were the only room damaged, the room is posted UNSAFE while the building is posted RESTRICTED USE with no general access to the auditorium. It should be pointed out that roof failures such as this are also a common condition with windstorms that are not hurricanes or tornados.

5.2 Floods

Floods fall into two general categories, these being the slow moving inundation type, and the fast moving flash flood type. The slow moving inundation type of flood is the most common within the United States. From a safety assessment perspective, there is plenty of time to mobilize evaluators, as assessments cannot be performed until such a time as the water level recedes. In some cases, this can take weeks before buildings become accessible. In this type of flood, the damage that occurs is from the submersion in water and is primarily contents-related. When the floor is underwater, the likelihood is that the sub-floor or diaphragm will need to be replaced along with all or a portion of the

floor framing.

In the case of fast moving water, the damage is more catastrophic as there is a significant amount of force behind the wall of water. Fast moving floods can also cause scour around the foundations leading to damage to the foundation and walls. Typical types of damage from this type of flooding are collapse, partial collapse, or moving the structure off its foundation. A fast moving wall of water can result in inundation for a period of time, or it can run off quickly, allowing for a rapid mobilization of evaluators.

Flood events also present additional hazards to the evaluator that are not necessarily common with other hazards. Entering an inundated structure where the water is above the line of the wall outlets and the electrical power has not been turned off is a quick way to electrocution. This is the primary reason that people are not allowed in flooded structures until such a time as the power has been turned off. In cases where the power is off over a large area because of the storm, care must be taken to ensure that power is turned off at the building also to protect against electrocution. Another serious hazard to consider is "black mold." This is especially a problem where the structure has been inundated for a number of days before the water recedes. Black mold is a fungus that can cause severe respiratory problems. In addition, floods carry coliform bacteria and hazardous materials from impacted facilities, such as wastewater treatment plants and industries. This can create serious public health issues.

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

(Photograph courtesy of FEMA)
Figure 5-10 – Louisiana, Tropical Storm Allison, 2001

Much can be told by looking at the exterior of a structure before you enter. In this case, the water line can be seen at the top of the windows. This will tell you that the home was inundated and there will be significant content damage. From the structural standpoint, the floor framing and diaphragm will most likely have to be replaced due to warping as the materials dry out. Does this constitute reason to post the building UNSAFE? No, that is a condition of repair. In most cases, homes subjected to a slow moving flood will be posted as INSPECTED, or possibly RESTRICTED USE. If ceiling materials have been soaked, they do represent a potential falling hazard. This would be sufficient to cause a RESTRICTED USE posting with a caution that ceilings have been soaked and could fall.

This photo shows the widespread damage that often results from flooding. The storm surge from a major hurricane is similar in many ways to other fast-moving floods, in that buildings and debris are left scattered about in its wake. In this photo, homes are left sitting in the road, nestled up against trees, and half-buried in debris. This photo was taken after the roads were cleared, which previously were covered by debris.

Figure 5-11 – Damaged neighborhood, Hurricane Katrina, 2005

This shows a relatively mild case of mold in a completely inundated house. Mold spores are hazardous to SAP evaluators and other potential visitors to such properties, and caution must be exercised to be protected against them.

Figure 5-12 – Mold growth, Hurricane Katrina, 2005

Figure 5-13 – Wood frame wall under cleanup, Hurricane Katrina, 2005

This photo shows how much work is involved when a wood-frame building becomes inundated with toxic flood waters and must be repaired. The drywall or plaster, the insulation, and the electrical system was completely removed, and the wood framing cleaned, before the wall could be restored.

This photo shows how some manufactured homes in the Katrina-ravaged area were installed. The tie straps provide tension restraint; they are imbedded in a perimeter footing. The house is supported by the masonry piers.

Figure 5-14 – Common manufactured home installation, Hurricane Katrina, 2005

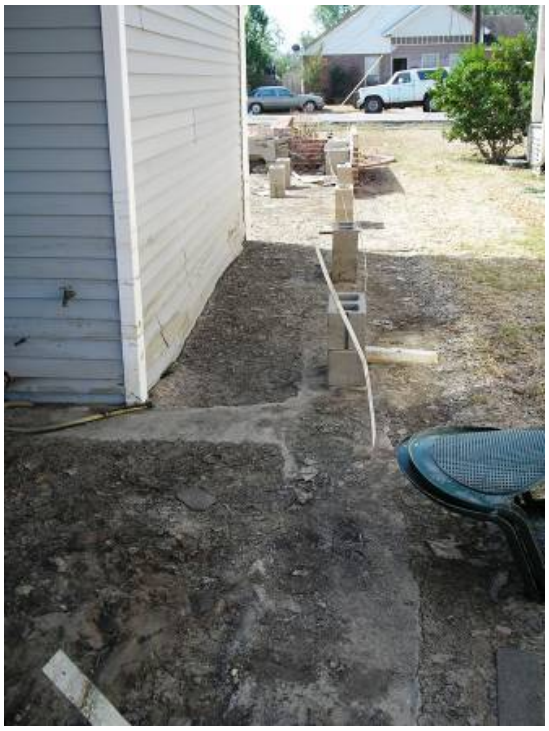


Figure 5-15 – House off its foundation, Hurricane Katrina, 2005

Here we see the results of one such structure after storm surge worked its way on it. The house has now pulled out of its tension strap connections, and drifted off its masonry piers to come to rest on the ground, a few feet from its original moorings. This has resulted in damage to the structure from falling on foundation elements that no longer support it.

(Photograph courtesy of FEMA)
Figure 5-16 – Louisiana, Tropical Storm Alison, 2001

In this situation, the structure has been raised and portions of the foundation wall have been left open to allow for airflow during non-flood conditions, and to allow the water to flow through when flooded. Looking at the picture, we see that the water level did not reach the first floor level. Therefore, evaluation of this property would be primarily around the foundations to ensure that all are sound; there has been no settlement; and no scouring around the corners of the foundation walls. This building could be posted as INSPECTED. You would also look for the high water mark to determine if the framing could have been soaked. Again, wet framing is not grounds for a RESTRICTED USE or UNSAFE posting. However, a comment about potential warping of the framing in the Comments box on the placard and evaluation form would be appropriate.

(Photograph courtesy of FEMA)
Figure 5-17 – West Virginia Flood, 2001

This picture is a good example of the lack of structural damage as a result of slow moving floods. The arrow shows the water line at the time of maximum flood depth. Certainly the finishes will need to be repaired by either cleaning or replacing as necessary, and there is a significant amount of mud and debris on the floor. In this case, the floor is a concrete slab on grade; so warping does not present a problem as it dries out. The water line was above electrical outlets and air duct outlets. This building should be posted RESTRICTED USE and possession retrieval allowed. The posting should not be changed to INSPECTED until adequate cleanup and repair of wetted surfaces, wiring and equipment has been done.

(Photograph courtesy of FEMA)
Figure 5-18 – West Virginia Flood, 2001

Another hazard that accompanies floods and must be considered in a safety evaluation is mud and debris that can block openings, denying access to buildings. In this picture, we see mud and debris covering approximately half the door height. This type of debris build-up precludes access to the building from a strictly practical standpoint. Once the debris is removed, access is fully available. If evaluations were performed prior to the debris removal, the most likely posting for this structure would be RESTRICTED USE, with no access until debris is removed.

Fast moving floods, such as flash floods or flooding in swift streams, can and often do cause structural damage to structures. These types of floods are extremely hazardous to structures that are not anchored to their foundations or have unbraced cripple walls. With earthquakes, these types of buildings often slide on their foundations, or the cripple walls collapse. The same thing can happen with fast moving floods. The force of the water striking an unanchored structure will not only move it off its foundation, but will float it, causing the structure to be swept away with the stream.

(Photograph courtesy of FEMA)
Figure 5-19 – West Virginia Flood, 2001

In this picture, we see a garage that most likely did not have a foundation and was just sitting on the ground. As the floodwaters struck the building, it floated and was deposited downstream onto this fence. This building should be posted UNSAFE, as it is a collapse hazard. The difficulty in filling out the evaluation form and the placard is trying to ascertain the address. This is not uncommon with outbuildings. The best that can be done is to describe the building and where it was found, with the hope that local officials can eventually identify whom it belongs to.

(Photograph courtesy of FEMA)
Figure 5-20 – Hurricane Floyd, North Carolina

Even structures that are connected to their foundations will not always withstand the pressure of fast moving water. These structures are moved off their foundation and move with the water until they come to rest, are destroyed by the flow, or the water level drops, depositing them in some unknown location. In this case, the home was deposited on top of a vehicle. However, vehicles will be swept away much faster than buildings, so we don't know if this vehicle belongs with the structure. For safety evaluation there is no doubt that this would be posted as UNSAFE. Again, the problem comes in tying it to an address. Unless you are familiar with the structure, there is no way you can indicate an address. On the evaluation form, it would be best to simply describe where the building is sitting, using some local landmark or reference point. Use of a global positioning satellite (GPS) device would also be a good idea.

These photos show a post-tensioned concrete slab foundation home that were swept out of its location in St. Bernard Parish and moved by the storm surge, slab foundation and all.

The lower photo is a close up view of the first.

Figure 5-21 – Post-tension slab home, Hurricane Katrina, 2005

Figure 5-22 – Post-tension slab home, Hurricane Katrina, 2005

5.3 Fires

Fires are another hazard that will usually not require activation of the Safety Assessment Program to evaluate buildings. However, the program was used in Oakland following the 1991 Oakland Hills Fire. In this case, structural engineers from the Bay Area were used to evaluate foundations on destroyed homes. The purpose of the evaluation was to rapidly determine which foundations could be re-used during reconstruction of the homes.

Another instance of safety evaluations being performed following fires was during the Civil Unrest in Los Angeles in 1992. Building inspectors from the City of Los Angeles were evaluating the safety of

buildings almost as soon as the fires were put out. In some cases, the building inspectors had to have police escorts to make sure they did not take any sniper gunfire. This was an extreme case, and most likely the program would not be activated in urban fires.

Local building departments usually will evaluate the safety of a building that has burned. This is done primarily to determine if the burned structure is a hazard to people and property if it is left standing until it can be repaired. These types of inspections are not safety evaluations for the purpose of determining if the structure can be re-occupied. In some cases, private engineers are retained by the owners or insurance companies to determine the appropriate method of repair.

The potential does exist that the Safety Assessment Program could be activated following a major urban-wildfire such as the 1991 Oakland Hills or the Southern California Fire Storms of 1993. Since the fires usually burn the structures to the ground, the evaluations would be to rapidly determine the safety of standing structures such as walls, and possibly to determine if foundations could be re-used. The latter condition would be the case where the responsible jurisdiction was preparing their requirements for reconstruction. They may wish to know how many foundations potentially could be re-used.

(Photograph by Robert A. Eplett, California OES)
Figure 5-23 – Southern California Fire Storms 1993, Malibu

As can be seen in this picture, entire neighborhoods were burned to the ground. With the hot debris lying on the slabs, there is a question regarding the potential for re-using these foundations. Should the Safety Assessment Program be activated for this type of evaluation, the determinations would not be final. If the evaluations showed that foundations potentially could be re-used, the homeowner would need to retain an engineer to fully evaluate the footings for heat damage before the foundation could be re-used.

The extreme heat generated by urban-wildland interface fires can cause serious damage to the concrete or masonry in the footings. The expansion of the material from the heat can cause serious cracking and spalling. However, if firefighters were on scene when the structure began to burn and were able to keep the surrounding area cool, there is a possibility that the foundation may be able to be re-used.

If the program were activated, the responding evaluators would report to the staging area where they would wait for assignment. As with other hazards, the evaluators would be under the direction of the building department with jurisdiction over the area. Overall, this will not be a hazard that would likely result in the activation of the Safety Assessment Program.

5.4 Explosions

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

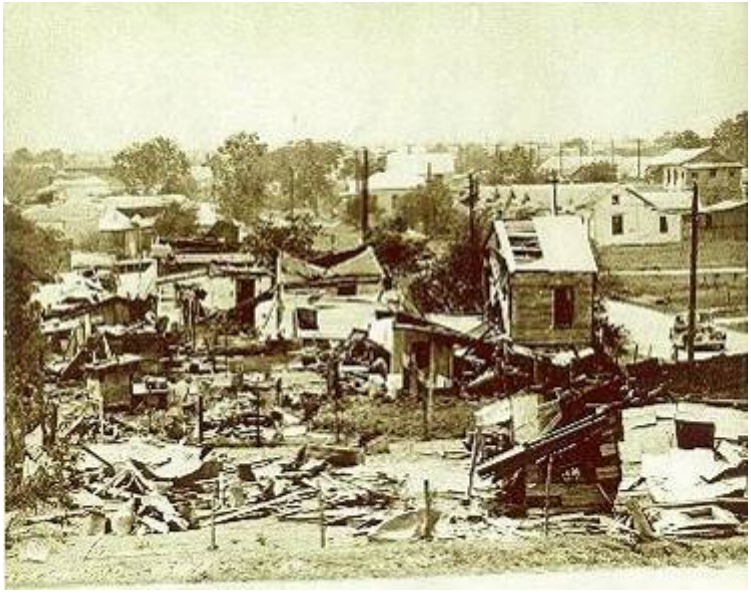
Large explosions in urban settings may cause lateral forces to rack buildings at some distance from the center of the explosion. Structures that are not completely destroyed at the explosion center (ground zero) may be very unstable, being unsafe for anyone to be near and subject to imminent collapse. Projectiles can cause damage to other structures and set fires at great distances from the initial blast. In addition, powerful explosions can generate seismic shock waves, and if set off in a body of water, can create tsunamis that can spread damage at a distance from the blast center. It is quite likely that there will be much to do for SAP evaluators after a disaster involving a powerful explosion.

This photo shows a granary that was destroyed in an explosion. Flammable dusts present their own hazard as to explosions; a fine dispersal of baking flour can explode if exposed to sparks or flames, as can other clouds of flammable dusts, as well as dusts made of certain metals.

Figure 5-24 – Granary damaged in an explosion

The 1947 Texas City ammonium nitrate explosion destroyed or damaged much of that small community. These photos only show small pieces of the incredible overall picture. In this photo, the parapet of this particular building was smashed by the force of the blast. Notice the debris on the sidewalk. This photo was taken after the streets were cleared of debris.

Figure 5-25 – Damaged parapet, Texas City explosion, 1947



This photo shows part of the heavily damaged community in Texas City. Note the building on the right side of the picture that is lying on its side on another building. Several buildings in the foreground are flattened.

Figure 5-26 – Damaged or destroyed homes, Texas City, 1947

Figure 5-27 - Destroyed fire engine

This photo shows the wreckage of a fire engine twisted together with the remnants of a nearby ship. This was near the explosion ground zero.

Finally, this photo shows the extent of the projectile issue in Texas City. It takes between 6 psi and 8 psi of blast force to lift an automobile. These particular cars are shown having no regard for the 'no parking' sign in the foreground.

Figure 5-28 – Car projectiles, Texas City explosion, 1947

UNIT 6 SAFETY

UNIT 6 - SAFETY

Overview

Safety evaluators need to know how to conduct their evaluations safely. This includes basic field safety when entering damaged buildings, taking care of yourself mentally and emotionally while in the disaster area, and being able to identify hazardous materials that are in the area.

Training Goal

Participants will know how to conduct themselves safely while they complete their work. Additionally, participants will be better able to protect themselves from exposure to 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 theater;
- Read the hazardous materials placards; and
- Be able to request additional evaluations for hazardous materials, and what that evaluation may mean to the building owner.

6.0 Safety

The topic of personnel safety is one of the most important topics that will be discussed in conjunction with post-disaster safety assessment. When not on a response and in a secure setting such as a classroom, many of the ideas and requirements of a sound safety program probably appear to be obvious. However, during a response we all tend to get "caught-up" in the action and excitement of the time and forget these basic safety rules. At the end of this unit you will find the "Building Assessment Safety Checklist." We have provided two copies: one to remain in the student manuals; and one that has been reduced to a size that can be added to your ATC-20-1 Field Manual and easily referred to during a response.

6.1 During Inspections

There was not a single serious injury related to the safety assessment process between the beginnings of the program from 1978 to mid-1992. Although the individual injured was not a safety assessment volunteer, the injury occurred during an assessment of a damaged building. In this particular case, an assessment team entered a YELLOW tagged home on an unstable hillside and proceeded out onto a patio deck overlooking a small ravine behind the home. Before they went on the deck they did not verify the current conditions. While on the deck, it collapsed and one of the individuals suffered a broken back. We cannot emphasize enough the importance of being aware of your surroundings and determining whether it is safe to enter a building or portion of a building before doing so.

There are general safety rules that apply at all times while performing safety assessments. They are:

- **Be aware and cautious.** Be aware of where you are and what is in the area around you. The built environment has changed, and features that appear stable might not be. You can easily be impacted by conditions around the site in which you are working. This is also important should you need emergency assistance. Most likely, you will be working in an area that you are not familiar with, and when you call for assistance it will be necessary to provide at least the cross streets where you are working.

- **Always work in teams of at least two individuals.** Evaluation teams will always be established with at least two individuals. Never split up in order to cover the area more quickly. Keep together so you always know where the other member(s) of your team is. For Detailed Evaluation teams, where it is required to enter buildings, evaluation teams will be composed of three individuals whenever possible so that one can remain outside the building while the other two enter. If you are on a team composed of two individuals such as a Rapid Evaluation team, do not enter buildings unless you absolutely have to, and then only if it is safe to do so.

- **Always wear a hard hat and safety shoes.** There is a hazard from falling items any time you are working in or around a damaged or potentially damaged building. Hard hats are also a protection from low- hanging exposed electrical wires. Individuals without hard hats will not be assigned to an evaluation team. In addition, proper footwear is a must.

As you begin your safety assessment work, realize that many times you will be the first individuals around or in most of the buildings that you evaluate. Consequently, you have no idea of the magnitude of the hazards you will encounter. Assume the worst and be prepared.

- **Do not enter obviously unsafe buildings.** For the most part, obviously unsafe buildings are those that have suffered full or partial collapse. However, there are other conditions that fall into this category. For example, any building that is leaning or significantly out of plumb should automatically be considered unsafe to enter, not only for the occupants but for the evaluation team as well. From the exterior, look for indications of separation between walls and framing before entering. If you determine that such separations are localized, and decide to enter the building, do not enter the rooms where the separation has occurred.

- **Do not enter buildings, or access appendages of buildings, located on potentially unstable slopes.** If a slope has become unstable as a result of an earthquake, there is no way of determining when, or if, the slope will fail. This condition becomes more hazardous if the slope is continuing to move after the event. As the slope moves, the support conditions for the building or its appendages can change. What was deemed relatively safe 10 minutes earlier might be unsafe now. If entry or access is deemed necessary, make sure that the structure will support the added weight of the evaluation team. If you cannot make such a determination, do not enter the building or any part of the building.

- **Do not enter buildings where falling hazards exist that can block exits.** Falling hazards can take many forms. Loose bricks represent a degree of hazard similar to that of a parapet or ceiling. However, the condition where the hazard falls while you are in the building and blocks your safe exit from the building is a real concern. Individual bricks or ornaments falling represent a hazard to the individual's safety but usually do not block an exit. Be aware of all falling hazard potentials while entering or exiting a building.

- **If the building to be evaluated is leaning excessively or is significantly out-of-plumb, do not enter**. Stay on the side of the building away from the direction it is leaning. This condition definitely represents an obviously unsafe building. However, the idea of "leaning excessively" or "significantly out-of-plumb" cannot be quantified. This is left up to the judgment of the evaluation team. It is important to recognize the potential for collapse of a leaning building. Even if you determine that you can enter the building to complete your evaluation, minimize your exposure to the hazard. Whenever possible, stay on the high side of the building and be aware of the potential hazard.

- **Before entering any building, make sure exit doors are fully operable. Make sure that exit pathways are clear and there are no falling hazards that could obstruct the pathway**. While you are in a building, if it becomes necessary to rapidly evacuate the building and the exit door is stuck, you have exposed yourself to an unnecessary hazard. Before you enter the building, make sure that all the exit doors are fully operable. Also, make sure there is nothing on the interior that can fall and block access to the exit. When you enter a building, make sure that you stay within fairly direct access to those exits that are fully operable.

- **Be aware of hanging or exposed electrical wires.** Always assume that electrical wires are fully charged. Don't touch wires unless you absolutely must. There should be virtually no case in which you would need to move an electrical wire.

After the initial round of evaluations there may be a need for subsequent assessments. These assessments may be Detailed Evaluations, or evaluations needed because of aftershock activity. While the safety rules we have already discussed are still valid, some additional ones must be considered.

If an unsafe building must be entered that has not been braced, shored or otherwise stabilized, take the following steps:

- **Visually assess the damage from the exterior and evaluate the potential for collapse.** Again, the basic concept is, do not enter an unsafe building. However, conditions may arise that might overrule this concept. In that case, it is very important to first satisfy yourself that the building is not in a condition of imminent collapse. No matter the reason, evaluation teams should never enter a building that is in an imminent collapse condition. Once you have determined that you can enter the building, stay away from open areas and rooms. If at all possible, perform the necessary work from near an interior partition where, if a collapse were to occur, there would be a good chance of voids being formed.

- **One member of the team is to remain outside to monitor the building while the other members are inside.** Only Detailed Evaluations require the team to enter buildings. Before team members enter the building, the individual who will remain outside should know exactly where the team members are. While in the building, if the strategies need to change, the person outside must be told immediately. This way, if assistance is needed, the individual outside will be able to secure the necessary assistance and be able to tell the rescuers where the individuals are within the building.

- **To the extent possible, verify stability of every room or part of the structure before entering.** This allows you to determine those portions of the building you can enter. If there is any indication of instability that represents an imminent collapse potential, do not enter that portion of the building. Once you are inside, verify the stability of each room before you enter. Again, if there is any indication that there is an imminent collapse potential for any portion of that room, do not enter.

- **Do not enter a building in which a hazardous material spill or release has occurred.** Since you are not hazardous materials experts, this may be hard to do. Before you enter a building, particularly in an industrial area, look around the exterior for a warning placard of hazardous materials being stored on the premises. The next section of this unit will discuss the warning placards. If you find the colored, diamond-shaped placard, be aware of the potential of a spill. If you see suspicious liquids on the floor or smell anything unusual when you enter a building, consider the potential before you continue. Any building that smells of natural gas should be vacated immediately. Also be aware of the potential for asbestos, especially in older buildings.

These safety rules are basic and simple common sense rules. However, during a response, we become so concerned with the concept of helping people we forget the basic and obvious rules. Insert this checklist into your field manual and refer to it frequently while you perform your duties.

Beware of disease-carrying flies and other vermin! In many disasters, there are a great many dead animal and even fish carcasses, and the flies can multiply out of control. Be sure to bring and use insect repellant, and to be careful about hygiene. There may be other types of population explosions in the local animal species that creates problems after a disaster; stay informed on local conditions, and be prepared.

Figure 6-1 – Flies, Hurricane Katrina, 2005

Be careful on how you inspect unstable or precariously perched structures!

Figure 6-2 – Shed on fence, Hurricane Katrina, 2005

Avoid walking under stranded vehicles also! The eaves, roofs and walls of these homes are not designed for these types of loads, so safety would be a serious question upon entering them to do evaluations. Avoid the walls that these vehicles are now imparting loads to!

Figures 6-3 & 6-4 – Stranded vehicles on roofs, Hurricane Katrina, 2005

Be careful about what you are sitting under. It is easy to assume that all will go well, and this time it did. It doesn't always work that way!

Figure 6-5 – Roof fragment, Hurricane Katrina, 2005

Many disasters create breathing hazards. The terrorist attack on the World Trade Center in 2001 put many harmful chemicals in the air. Floods will promote the growth of mold, causing spore concentrations inside buildings. The proper breathing equipment must be used for such conditions; in cases where mold is rampant, a medical-grade air filter is appropriate.

Figure 6-6 – Mold damage, Hurricane Katrina, 2005

Always be careful where you step! Floods will leave thick layers of muck and silt, sometimes laden with pollutants. Severe injuries can occur from slipping and falling. Likewise, earthquakes can leave sharp pieces of brick, boards with nails, and other impalement implements. Inside structures, earthquakes can cause shelves and files to fall over, spilling books and papers, and creating a slippery surface to walk on. Avoid stepping onto any and all dangerous surfaces.

Figure 6-7 – Mud slipping hazard, Hurricane Katrina, 2005

6.2 Critical Incident Stress Disorder

Critical Incident Stress Disorder (CISD) is something that affects many emergency workers after working long hours over a number of days. To help combat the effects of stress on safety assessment personnel, the program limits the time the evaluators will be on site to 5 days. However, the building department personnel you will be working with have been at it since the event. Knowing the causes and symptoms will help you to better understand what they are feeling and possible recognize it in yourself.

Critical Incident Stress Disorder is usually caused by:

- Long hours - working 12 to 14 hour or longer shifts or performing heavy manual work for long periods.
- Emotional turbulence - all around you people are frightened, exhibiting high emotional states, and within yourself are the same high level of emotions.
- Loss - a sense of loss as you look around the area and take stock of the damage. Will the community ever recover?
- Destruction - the sense of utter devastation associated with large events like an earthquake.
- Injuries and death - working and dealing with a large number of injured or dead is a constant reminder of the incident. This can lead to feelings of futility, guilt, and frustration.

- Lack of sleep or food - probably the most common cause of CISD. As we get involved in the operation we forget to eat. At the end of the shift we are still keyed up and it is difficult to sleep.

- Separation from family and setting aside one's own needs – Putting aside of one's needs is probably more prevalent in municipal emergency workers or those involved directly with care and sheltering. However, separation from one's family could be applicable to your recovery operations. This would most likely occur if you were unable to travel to home at the end of your shift and had to stay on site.

6.2.1 Symptoms

CISD will manifest itself in any one of the following ways and quite possibly in more than one:

- Inability to make decisions - individuals are looking to you to make a decision and tell them what to do and where to go. Your mind is "blank," and you simply don't know what to do.

- Slowness of thought and confusion - information comes to you and you don't have a clue what it is. All you see are words, and you really don't know what to do with the information.

- Inability to express one's self - you know what you want to say but you can't put it into words. This leads to frustration.

- Depression, irritability, and anxiety - can result in the feeling of futility. Why am I doing this? What difference does it make anyway?

- Exhaustion, loss of energy - The stress generated can take its toll physically as well as mentally. You feel physically ill, you have no energy to do anything. It is an effort to force yourself to continue with your duties. There is no desire to eat; the thought of food is almost too much. In many cases, it becomes difficult to sleep. All you can think about is sleep, yet when you try you are wide-awake, thinking and worrying about the operation.

Since your operations are going to be more focused on evaluating buildings and will only be working for 3 days, you will be less likely to suffer drastic affects of CISD. However, working long hours, not eating regularly, and lack of exercise can have an affect on you.

6.2.2 Stress Relieving Measures

There are several simple steps that you can take to protect yourself from suffering the effects of CISD. Some are a simple repeat of basic safety measures that were discussed in the previous section. The following are some of the measures that you can take:

- Take frequent breaks – pace yourself so you work at a constant level.

- Eat good meals at regular times – stay away from the junk food and eat well. Schedule time for several good meals a day.

- Drink plenty of fluids – keep yourself hydrated. You might even consider carrying a canteen or water jug with you. Avoid alcoholic beverages during your deployment, as they dehydrate the body.

- Freely talk about your experiences – after your shift, join with your co-workers and freely discuss what you have seen and how you feel about it. In turn, be a good listener.

- Get plenty of sleep – don't stay up all night talking. Set a time for sleep and keep to it. Again, minimize the intake of alcohol, as it interferes with a good night's sleep.

Awareness is one of the key preventative measures for yourself as well as your co-workers. Watch for the signs and then take action to minimize the impact. If you see one of your co-workers exhibiting the symptoms of CISD, take him or her aside and take a break. Try and get them to talk about their feelings.

6.3 Hazardous Materials

We live surrounded by hazardous materials that are more or less restrained or contained properly. Disasters have the potential of releasing these materials into the environment, exposing disaster workers and the populace at large to their dangerous effects. Floods can carry toxins and corrosives in solution for great distances, while earthquakes, fires, and explosions can disable containment and cause a release in that manner. Moreover, hazardous materials can react together once released in ways never intended by their users. Your awareness of these risks can truly improve your safety profile.

In this section, we will look at some basic information regarding the posting of hazardous materials that you can use to increase your safety while evaluating damaged buildings. The purpose of this information is strictly for your safety. You should never be asked to identify hazardous materials. By understanding the placard system for both the building and the individual containers, you will have a better ideal of what kinds of materials you are dealing with from a very general sense. One of the first rules to remember is, don't necessarily believe what the placards are telling you. In other words, leave containers well enough alone. What these placards do not tell you is what can happen if the stored materials become mixed. The level of hazard can significantly change when containers are leaking and the materials come together.

Ideally, hazardous materials will be labeled to disclose their identity and associated hazards. However, this will not always be the case, since labels are not always required for containers with hazardous materials, labels may not be properly placed, and hazardous materials labeling regulations may not always be enforced. Mislabeling also may occur, so be cautious of even benignly labeled substances.

There are more hazardous materials labeling conventions in use than can be presented within the scope of this chapter. We will look at three labeling systems that are commonly used throughout the United States. They are: 1) the National Fire Protection Association 704M system used for materials within facilities that manufacture, process, use, or store hazardous materials; 2) the Department of Transportation system used to label hazardous materials during transport; and 3) the National Paint and Coatings Association system used to label hazardous materials within manufacturing plants and facilities.

The *Emergency Response Guidebook*, which covers the hazardous material designations used throughout North America, can be downloaded from the website:
http://hazmat.dot.gov/pubs/erg/gydebook.htm

6.3.1 National Fire Protection Association System

This system is intended to provide basic information to fire fighting, emergency, and other personnel, enabling them to make decisions whether to evacuate an area or commence 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 that is used is shown in Figure 5-1 on the following page. The color-coding on the placard is consistent and does not relate to the particular level of hazard. "Blue" denotes the health hazard, "red" denotes the fire hazard or flammability hazard, "yellow" denotes the reactivity of the materials, and "white" denotes the specific hazard. All but the specific hazard are rated by a numerical system of 0 to 4, with 4 being the worst hazard, and the level of hazard decreasing as the number decreases.

6.3.2 Department of Transportation System

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 hazardous materials that are transported. The placards are classified by hazard class names, hazard class numbers, associated color, identifying pictographs and an identification number. Figure 5-2 on page 5-9 outlines these categories and Figure 5-3, also on page 5-9 is an example of the placard. 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.

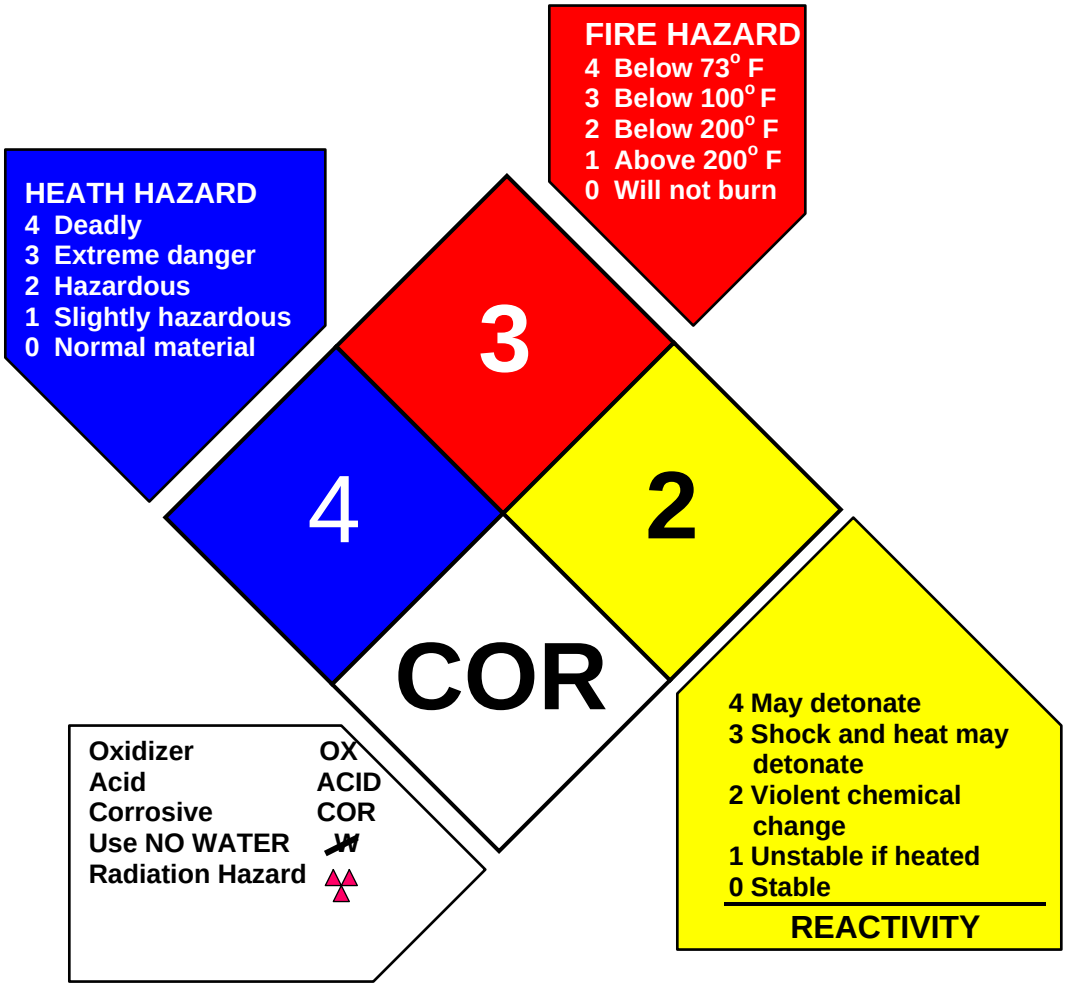


Figure 6-7 – NFPA Hazardous Materials Classification

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
Poison liquids	6	White
Radioactive substances	7	Yellow/white
Corrosives	8	Black/white
Miscellaneous hazardous materials	9	

Figure 6-8 - Department Of Transportation Hazardous Materials Classification

Figure 6-9 - Examples of DoT Placards

This figure provides some examples of the placards used in the DoT system. Additionally, containers with materials that have multiple classifications would have a placard for each classification. As with the building placards, remember that these placards indicate what is supposed to be in the container. Just because a placard indicates some rather benign materials, you cannot guarantee that the container actually contains that particular material.

6.3.3 National Paint and Coatings Association System

The National Paint and Coatings Association has developed a Hazardous Materials Information System (HMIS) for employers to use to comply with the California hazard communication system. The labels are divided into four: health, flammability, reactivity, and personal protection. Figure 6-4 on the following page shows what the placard looks like and includes OSHA's designation for a potentially infectious material.

Figure 6-10 – National Paint and Coatings Association HMIS and OSHA Placards

6.4 US&R Marking System

Urban Search and Rescue (US&R, aka USAR) teams are generally on site prior to safety assessment evaluations being initiated. As a result, SAP Evaluators may encounter markings on buildings that were placed by USAR teams. In order to be familiar with such markings, they are being presented here. SAP Evaluators are not to place such marking on buildings.

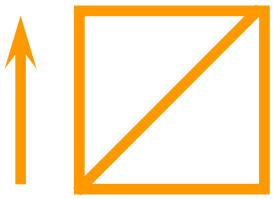
6.4.1 Structure / Hazards Mark

The structural and hazardous material specialists make a 2' x 2' box on the building adjacent to accessible entry. This is done after the USAR team completes hazard assessment and fills out the Structure/Hazards Evaluation form. Generally, the box is sprayed painted in international orange color.

This box represents a relatively safe structure.

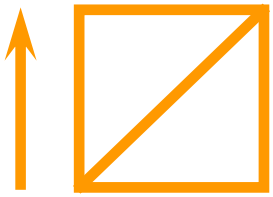
This box shows that the structure has been significantly damaged. While some areas may be safe, others may need shoring, bracing, removal and/or monitoring of hazards.

This box indicates that the structure is not safe and may suddenly collapse. (If a building you find has such a marking, do not enter it! Verify its condition as UNSAFE and tag it accordingly.)



An arrow next to the marking box indicates the direction of the safest entry into the structure.

The HM indicates a hazardous material condition in or adjacent to the structure.

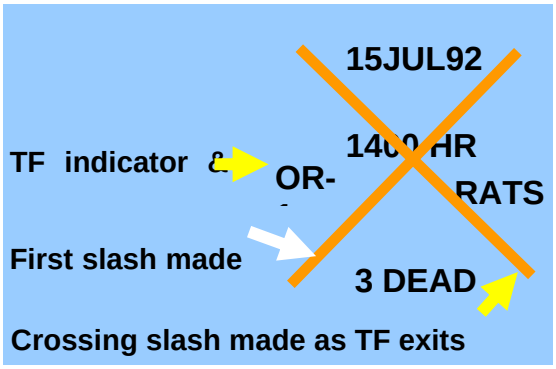


These markings indicate that entry is forbidden until the gas has been turned off. When this has been done the HM will be lined out and a new date will be added.

15JUN92
HM NATURAL GAS
OR-1

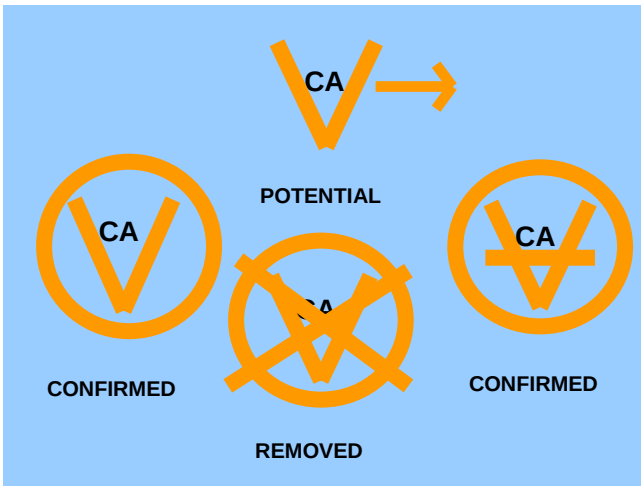
6.4.2 Search Assessment Marking

During a search and rescue operations, the following markings shown below may be found near each entry. This provides information regarding any hazards found and if there were victims inside the structure.



6.4.3 Victim Location Marking

In order to provide a quick status of the victims in a particular structure, the following markings are used may be found.



Notes:

6.5 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 That 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 from the building.
- ☐ 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 that 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:
  - Visually assess the damage from the exterior and evaluate the potential for collapse.
  - One member of the team is to remain outside to monitor the building while other team members are inside.
  - 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.

APPENDIX A - EVALUATION FORMS

JOB AID - Safety Assessment Program Evaluator

ACTIONS AFTER REGISTRATION BY CA OES - PRIOR TO DEPLOYMENT

- ❑ Ensure that your professional organization has your correct phone numbers, mailing address, and email address. Your professional organization is identified on your SAP ID card. It is helpful if State OES has this information also.
- ❑ Prepare go-kit (most items will fit all disasters, some items depend on the type of disaster or field conditions, if hotel rooms are available or if tents are being used, etc. Please use your good judgment):

Protection and safety items

- ❑ Cellphone with charger
- ❑ Dust masks or respirator
- ❑ Earplugs
- ❑ Gloves
- ❑ Flashlight w/ extra batteries
- ❑ Hand sanitizer or hand wipes
- ❑ Hard hat
- ❑ Insect repellant
- ❑ Magnetic compass
- ❑ Rain gear, rubber boots
- ❑ Safety glasses
- ❑ Safety shoes
- ❑ Safety whistle
- ❑ Small first aid kit
- ❑ Sunscreen
- ❑ Water container or canteen
- ❑ Water purification tablets (depending on conditions)

Field work items

- ❑ Lockable backpack (most things can be stored in this)
- ❑ Clipboard
- ❑ Field manuals (ATC-20-1 and ATC-45 – if you do not have these, obtain from the Applied Technology Council, www.atcouncil.org)
- ❑ Paper or notebook
- ❑ Professional ID card
- ❑ SAP identification card w/lanyard
- ❑ SAP identifying clothing, if available
- ❑ Waterproof marking pens
- ❑ Waterproof writing pens or pencils

Necessary personal items

- ❑ Credit card, traveler's checks, and/or cash, including phone change
- ❑ Extra clothing, towels
- ❑ Personal hygiene supplies
- ❑ Personal identification (driver's license is OK)
- ❑ Prescription medication for at least the length of stay + 2 days.
- ❑ Sleeping bag and inflatable mattress, depending on conditions

Suggested items (things you may want to consider)

- ❑ Binoculars (to observe conditions too high or remote to see easily)
- ❑ GPS unit w/charger and batteries
- ❑ Knee pads
- ❑ Reading materials (for after-hours)
- ❑ Reflective safety vest
- ❑ Shower slippers, if in camp setting
- ❑ Small battery-powered radio w/batteries (for after-hours)
- ❑ Swiss army knife or multi-tool
- ❑ Tape measure
- ❑ Waterproof paper or notebook
- ❑ Contact your professional organization to let them know you are available for deployment after you hear about an event.

DURING DEPLOYMENT

When you are contacted by a professional organization, or by your CA State supervisor if you are a CA employee, and you agree to be deployed:

- ❑ Provide cellphone number and other means for you to be contacted.
- ❑ Write down the information: date, time, location, and contact person.
- ❑ Obtain maps and other pertinent information on the area from the Internet or a library.
- ❑ Check Deployment Updates link at SAP website at **www.oes.ca.gov** for ongoing updates and recommendations.
- ❑ Wear identifying clothing while on deployment.
- ❑ Travel safely to location. Be prepared to show your SAP identification at 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 team assignment with other Evaluators and/or local building inspectors. Do not go into the field alone!
- ❑ Obtain official placards, Assessment Forms, Briefing Packet, placard fasteners, caution tape, and other equipment from local officials.
- ❑ Obtain assignment for your team.
- ❑ Travel to assignment. Do 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 of how the structure should be posted.
- ❑ Write all pertinent information on the placards and post the structure at each door.

- ❑ Write the identical information on the Assessment Form 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 debriefing with other team members and local officials, review the Assessment Forms for completeness, and give them to local government officials.
- ❑ Sign out at the end of your work day.
- ❑ If you are needed the following day, proceed to your evening arrangements and return the next day to obtain your assignments and more materials 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 safety permits.

AFTER DEPLOYMENT

- ❑ Submit to the local government the travel expense paperwork for unreimbursed meals and travel, using the form provided in the Briefing Packet and/or during demobilization.
- ❑ Respond to 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, if necessary, 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: ☐ Ext. 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

Primary Occupancy

☐ Dwelling ☐ Commercial ☐ Govt.

☐ 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: _____

_____

_____

_____

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 stores 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 ☐ Govt.
☐ 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 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: _____
_____
_____
_____
_____

Continued 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 damage 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: _____

_____

_____

_____

Assessment Report No. _____

ATC-20 FIXED EQUIPMENT CHECKLIST

Facility:
Name: _____
_____
Address: _____
_____
_____

INSPECTOR:
Inspector ID _____
Affiliation _____
INSPECTION DATE:
Mo/day/year _____
Time _____ am pm

CHECKLIST: **Equipment Damaged**

General Items:	No	Yes Operable	Yes Inoperable	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: _____
_____
_____
_____

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:	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 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

	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 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: None O Green O Yellow O Red O

Recommended: Green O Yellow O Red O

Posted at this assessment: Yes O No 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.)

	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. 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.)

	0	1	2-3-4	5	6	NA	NA
Damage Scale:	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
Remove from service_____ O
Brace structure before using_____ O
Check filter basket_____ O
_____
_____
_____

Continue in service_____ O
Check pump-motor alignment_____ O
Recheck after power restored_____ 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			
	Elect	Gas	Gasoline	Diesel
Centrifugal				
Reciprocal				
Horizontal				
Vertical				

No. Operable			
Elect.	Gas	Gasoline	Diesel

Str. Type	Buried	Above Grade
Concrete		
Masonry		
Frame		
Other		

O Building (Building Evaluation Attached O)

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. 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: 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_____ 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 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. 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 Fill depth _____ Surface usage _____

O Yes O No

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

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.)

	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

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 _____

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).

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

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.)

	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. 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 _____

_____

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APPENDIX B – SLIDE HANDOUTS