



# HOME, SAFE HOME.

## SEISMIC SAFETY & REHABILITATING HISTORIC HOMES

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*Presented by:*



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**CALIFORNIA  
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Office of Historic  
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FEMA



## WORKSHOP 3: SEISMIC RETROFIT BASICS

### I. SEISMIC VULNERABILITY IN CALIFORNIA

- A. There are faults throughout the state of California with very few locations that are not vulnerable to potential earthquake shaking.
- B. Earthquake shaking produces lateral loads on structures which are in addition to the weight of the structure and contents already in place.
- C. Older structures were not necessarily designed and constructed to resist the lateral loads of earthquake shaking.

### II. COMMONLY FOUND CONSTRUCTION TYPES FOR SINGLE-FAMILY HOUSES AND HOW TO IDENTIFY THEM

- a. Light wood framing is by far the most common structural system for California single-family homes. Walls and floors consist of 2x wall studs and floor joists.
- b. Framing can be covered by wood sheathing, plaster, stucco or other materials.
- c. To determine construction tap on the wall for hollow sounds, look in basement, crawlspace or attic, cut an exploratory hole, and/or look for original records.
- d. Wood post & beam consists of larger wood members
- e. Exterior brick walls could be a veneer of brick over light wood framing, or could be full brick walls, usually 2 to 3 layers (wythes) thick
- f. Other wall materials could be concrete masonry units (CMU), Adobe, hollow clay tile (HCT), or stone
- g. Some Steel frame/post & beam structures were popular in 1950's and 1960's





### III. SINGLE-FAMILY HOME SEISMIC VULNERABILITIES

- a. Slab-on-grade foundations: Some framing is not anchored to the slab-on-grade and may slide during shaking, usually not a catastrophic failure.
- b. Stem wall foundations: The wall framing bears on top of the concrete or masonry stem wall and may not be anchored. Might slide off of the top of the stem wall. Could cause some instability to the structure.
- c. Wood cripple walls: Shorter wood stud walls below the floor line and the top of the foundations are susceptible to shaking unless they are braced or sheathed. Failures can be significant if the studs were to topple over.
- d. Brick or stone foundations: Foundations contain no reinforcing bars and can fail in a brittle manner.
- e. Post and beam foundations/hillside homes: The space below the house is open with post. Can topple over if inadequate diagonal bracing is present causing significant damage.
- f. Chimneys in older homes are only lightly reinforced if at all, and usually not well anchored to the structure. Tall chimneys are especially vulnerable. Chimney collapse is a significantly dangerous falling hazard.
- g. Porchers are usually not well-tied to the structure in older homes and can separate and collapse. Could block the exit way.
- h. Heavy walls (masonry, stone, concrete, and HCT) can separate from the floor and roof and fall outward. Can be a falling hazard as well as leave roof and floors unsupported vertically.
- i. Heavy exterior wall veneers (brick or stone) can sometimes lose their anchorage to the walls and fall away from the building.
- j. Non-structural items: Interior furniture and appliances, especially hot water heaters, are susceptible to shaking. Gas hot water heaters could cause a fire.





#### **IV. THE CALIFORNIA HISTORIC BUILDING CODE (CHBC) & PHASING OF SEISMIC IMPROVEMENTS**

- a. The CHBC provides guidance for repair and strengthening of buildings.
- b. It allows a reduced earthquake loads for historic structures. However, even with reduced load or demand, the building will provide life safety.
- c. For archaic materials, such as unreinforced masonry, adobe and stone, hollow clay tile, and unreinforced concrete walls, there is specific guidance for the engineer.
- d. Guidance for iron and steel is provided. Cast iron use is possible but seldom used in dwellings.
- e. Wood is covered in a section since lumber is used for many elements of the building. This includes wood diaphragms and walls, wood lath and plaster, as well as fasteners.
- f. Anchorage of veneer to the substrate is also covered.

#### **PHASING OF WORK**

Since there may be several elements of a building requiring strengthening, a complete single stage project may not be feasible. It may be possible to divide the work into specific activities such as foundation anchorage and cripple work retrofit, chimney bracing or rebuilding, and adding shear walls.

It may also be feasible to integrate retrofit work into other building improvements such as adding plywood to existing walls if they are being altered or refinished.





## ADDITIONAL RESOURCES & FURTHER READING

The following is a list of sources referenced in the Workshop 1 presentation. These are good sources of additional information if you would like to learn more about the National Register of Historic Places (National Register), California Register of Historical Resources (California Register), historic significance, historic integrity, and architectural styles.

### National Register Resources

- **National Register Website:** <https://www.nps.gov/subjects/nationalregister/index.htm>
- National Park Service, **National Register Bulletin #15: How to Apply the National Register Criteria for Evaluation** - [https://www.nps.gov/subjects/nationalregister/upload/NRB-15\\_web508.pdf](https://www.nps.gov/subjects/nationalregister/upload/NRB-15_web508.pdf)
  - More information on historic significance and historic integrity
- National Park Service, **Preservation Brief #41: The Seismic Rehabilitation of Historic Buildings**
- National Park Service, **Preservation Brief #17: Architectural Character – Identifying the Visual Aspects of Historic Buildings as an Aid to Preserving their Character** - <https://www.nps.gov/tps/how-to-preserve/briefs/17-architectural-character.htm>
  - More information on character-defining features
- National Park Service, **Preservation Brief #18 – Rehabilitating Interiors in Historic Buildings: Identifying and Preserving Character-Defining Elements** - <https://www.nps.gov/tps/how-to-preserve/briefs/18-rehabilitating-interiors.htm>
  - More information on interior character-defining features
- **National Register of Historic Places Database**
  - Use these websites to find National Register nominations and photographs
  - <https://npgallery.nps.gov/nrhp> - Search by address, keyword, resource name, etc.
  - <https://www.nps.gov/maps/full.html?mapId=7ad17cc9-b808-4ff8-a2f9-a99909164466>
    - Search using geolocated map





## California Register Resources

- **California Office of Historic Preservation Website** - <https://ohp.parks.ca.gov/>
  - Includes information about the California Register, as well as historic context statements, incentives programs such as the Mills Act, and much more.
- **California Historical Building Code**
- California Office of Historic Preservation (OHP), **Bulletin #6: California Register and National Register: A Comparison** - <https://ohp.parks.ca.gov/pages/1069/files/technical%20assistance%20bulletin%206%202011%20update.pdf>
  - While National Register and California Register criteria are very similar, there are some important differences in thresholds for integrity and age-eligibility.
- **California Historical Resources Database** - <https://ohp.parks.ca.gov/listedresources>
  - Database of listed California Historical Landmarks, California Points of Historical Interest, and properties listed in the National Register and California Register.
  - **Note:** This database is not a comprehensive list of resources on the California Register and does not reflect resources listed in the California Register by consensus determination. To obtain a complete list of resources listed in the California Register please contact the appropriate regional Information Center of the California Historical Resources Information System.
- **California Built Environment Resource Directory (BERD)** - [https://ohp.parks.ca.gov/?page\\_id=30338](https://ohp.parks.ca.gov/?page_id=30338)
- **California Historical Resources Information System (CHRIS)** - [https://ohp.parks.ca.gov/?page\\_id=1068](https://ohp.parks.ca.gov/?page_id=1068)
  - The California Historical Resources Information System (CHRIS) maintains a wide range of documents and materials relating to historical resources. The CHRIS operates structurally through the California Office of Historic Preservation (OHP), nine Information Centers (ICs), and the State Historical Resources Commission (SHRC).

## General Resources

- Virginia Savage McAlester, ***A Field Guide to American Houses (Second Edition)***, Knopf (2015) - [https://www.google.com/books/edition/A\\_Field\\_Guide\\_to\\_American\\_Houses/fjbaCwAAQBAI?hl=en&gbpv=0](https://www.google.com/books/edition/A_Field_Guide_to_American_Houses/fjbaCwAAQBAI?hl=en&gbpv=0)
  - More information on identifying and understanding American residential architectural styles and character-defining features. This book is well-illustrated with photographs of houses of various styles from across the country.



# HOME, SAFE HOME. SEISMIC SAFETY & REHABILITATING HISTORIC HOMES

JUNE 23, 2022 | WORKSHOP 1 SUPPLEMENTAL INFORMATION







## GLOSSARY OF HISTORIC RESOURCE TERMINOLOGY

The following is a glossary of common terminology related to the seismic retrofitting of historic resources.

**Anchor Bolt** – A fastener connecting a foundation (concrete, brick, etc.) and the building structure.

**Beam** – Typically a horizontal element supporting building and live loads

**Bearing Wall** – A wall supporting weight beyond its own self weight.

**Brick** – A manufactured product that is assembled into walls and other building features. Bricks bear on mortar joints. Bricks may be used in a bearing wall or as a veneer.

**Building** – As related to historic property types, a building is used primarily to shelter human activity. Examples of buildings include: house, carriage house, garage, store, school, hotel, church, shed, stable, barn, theater, train station, post office, fort, dormitory, courthouse, city hall.

**Character-Defining Feature** – For a property to be eligible for national, state, or local designation under criteria related to type, period, or method of construction, the essential physical features that enable the property to convey its historic identity must be evident. These distinctive character-defining features are the physical traits that commonly recur in property types and/or architectural styles. To be eligible, a property must clearly contain enough of those characteristics, and these features must also retain a sufficient degree of integrity. Characteristics can be expressed in terms such as form, proportion, structure, plan, style, or materials.

**Concrete Masonry Unit (also CMU)** - Manufactured units of various sizes that are assembled into walls.

**Condition** – Condition refers to the material and structural appearance, quality, and working order of a resource. Condition is not the same as historic integrity. A building in poor condition may still retain historic integrity if it retains enough of its character-defining features to convey its significance.

**Cripple Wall** - Used to indicate a wall shorter in height than the building's standard wall.





**Design** – As related to historic integrity, design is the composition of elements, including form, plan, structure, style, and organization of spaces, scale, etc.

**Foundation** – The lowest element of a structure and bears on earth. Footings may be continuous or as square/rectangular pads or piers

**Lateral** - A horizontal force or load acting on a building. This may be seismic (earthquake) or wind.

**Local Register** – Many local jurisdictions (towns, cities, counties, etc.) maintain their own registers of historic resources. Typically, a local ordinance will include criteria for inclusion in the register, as well as a process for designating properties and local review process for certain types of projects that involve locally listed historic resources. Local registers may include individual historic resources (sometimes referred to as “landmarks”) and/or historic districts.

**Masonry** – See BRICK or CMU

**Materials** – As related to historic integrity, materials are the physical elements that form a historic property.

**Office of Historic Preservation (OHP)** – The California Office of Historic Preservation, a division of the California state government, administers federal- and state-mandated historic preservation programs to further the identification, evaluation, registration, and protection of California's irreplaceable resources, including managing the California Register of Historical Resources.

**Object** – As related to historic property types, an object is a term used to distinguish from buildings and structures those constructions that are primarily artistic in nature or small in scale. Examples include: a boundary marker, fountain, milepost, monument, sculpture, statue.

**Post and Beam** – Construction where the columns/posts and beams are left exposed as an architectural feature.

**Seismic Loads** – The loads imparted to the building as it's mass is moving due to seismic activity.

**Shear wall** – A wall that resists lateral (seismic) forces in a plane parallel to the wall. Shear walls may be wood, concrete, masonry, and other materials.





**Sill Plate (also Mud Sill, or Bottom Sill)** - A wood plate bearing on the foundation. Typically treated to reduce the potential for biological activity, such as termites.

**Structure** – As related to historic property types, a structure is a term used to distinguish buildings from those functional constructions made usually for purposes other than human shelter. Examples include: airplane, apiary, automobile, boat, bridge, canal, dam, earthwork, fence, gazebo, grain elevator, highway, lighthouse, railroad grade, tunnel, windmill.

**Stem Wall** – A wall extending from the foundation to the first-floor line. Stem walls vary in height depending on the site.

**Wood Frame** - A type of construction with wood vertical and horizontal elements.

**Workmanship** – As related to historic resources, workmanship is the physical evidence of the crafts of a culture in a particular time period.