HOME, SAFE HOME. SEISMIC SAFETY & REHABILITATING HISTORIC HOMES

Six webinars. A team of preservation professionals. One goal.

Welcome.

Office of Historic Preservation





HOME, SAFE HOME. SEISMIC SAFETY & REHABILITATING HISTORIC HOMES

Six webinars. A team of preservation professionals. One goal.

SEISMIC RETROFIT BASICS

Workshop #3 | August 30, 2022

Presented by

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HOME, SAFE HOME.

SEISMIC SAFETY & REHABILITATING HISTORIC HOMES

Workshop #1: What Makes My Home 'Historic'? | Thursday, June 23, 2022
Workshop #2: Is 'Compatible' 'Matchy-Matchy'? | Tuesday, July 26, 2022
Workshop #3: Seismic Retrofit Basics | Tuesday, August 30, 2022
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Workshop #5: Keep it Lookin' Great | Tuesday, November 8, 2022
Workshop #6: The Nuts and Bolts of Retrofits | Thursday, December 15, 2022

Program offered by:



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WORKSHOP #3 OBJECTIVES

Following the workshop, you will be able to:

- Understand the types of buildings and building materials that are vulnerable in earthquakes.
- How to identify your home's construction type.
- Be aware of the different regions of California that have different earthquake risks.
- Whether your house is at risk in an earthquake and how it might affect your property.
- Understand how to use the California Historical Building Code.
- Phasing concepts for accomplishing the work



Agenda

- 1. Seismic Vulnerability in California
- Commonly Found Construction Types For Single-Family Houses and How to Identify Them
- Single-Family Home Seismic
 Vulnerabilities
- 4. The California Historic Building Code & Phasing of Seismic Improvements
- 5. Summary & Questions



In what region do you live?



In what capacity are you interested in this topic? As a...?



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Seismic Vulnerability in California

- Northwestern California Eureka
- Sierra Nevada and Lake Tahoe
- San Francisco Bay area
- Bakersfield
- Los Angeles
- San Diego
- San Bernadino & Riverside
- Imperial Valley



Seismic Vulnerability in Eureka, California



Seismic Vulnerability in Tahoe Region California



Seismic Vulnerability in Bay Area, California



Home, Sare Home. Seismic Sarety & Renabilitating Histor Workshop #3: Seismic Retrofit Basics | August 30, 2022

Seismic Vulnerability in Bakersfield, California



Seismic Vulnerability in Los Angeles, California



Seismic Vulnerability in San Diego, California



Seismic Vulnerability in San Bernadino, California



Home, Safe Home: Seismic Safety & Rehabilitating Historic Homes Workshop #3: Seismic Retrofit Basics | August 30, 2022

Seismic Vulnerability in Imperial Valley, California



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Common Construction Types For Single-Family Dwellings -How to Identify Them

How do you know what your wall is made of?

- Tap on the wall how hollow does it sound?
- Find exposed wall in attic or crawlspace or basement
- Exploratory cut or drill a hole
- Research building department records for original drawings and building permits
- Hire a testing company
- Look at lots of images of other similar buildings



Common Construction Types For Single-Family Dwellings: Wood Frame – Light Framing



Common Construction Types For Single-Family Dwellings: Wood Frame – Post & Beam





Source: Pan Abode Cedar Homes

Common Construction Types For Single-Family Dwellings: Wood Frame with Brick Veneer

- Investigating the wall from the interior will reveal whether it is wood stud or full brick construction.
- Drilling into the wall will help determine the construction.



Common Construction Types For Single-Family Dwellings: Masonry Bearing Wall: Brick

- To detect brick, drill a hole through interior plaster to determine dimension to face of brick. Try measuring at a window
- Walls might be visible in attic
- Measure at door or window openings but this may not be accurate with all furring.



Brick Bearing Walls Construction Details

Masonry bearing wall: Brick

- Perimeter walls consist of brick masonry usually 2 to 3 wythes
- In older homes, walls typically have no embedded reinforcing bars
- Floors and roof are supported directly by the brick "bearing" walls



Masonry bearing wall: Concrete Masonry Units (CMU) /Hollow Clay Tile (HCT)

- To detect, drill a hole through interior plaster to determine dimension to face of CMU or HCT
- Walls might be visible in attic
- Perimeter walls consist of CMU or HCT often in 2 to 3 layers (Wythes)
- HCT walls have no reinforcing bars
- Floors and roof are supported directly by the CMU or HCT "bearing" walls
- HCT is a terra cotta (reddish) material with stucco exterior finish



Masonry bearing wall: Adobe

- Adobe construction was used through the 1950's and used in many area today
- Adobe units are larger than brick or block.
 Walls are thicker than other materials (18"+) and may be one or two wythes thick.
- Floors and roof are supported directly by the adobe "bearing" walls



Masonry bearing wall: Stone

- Stone wall construction is fairly rare
- Units will vary in size
- Usually stone units are visible, and walls are thicker than other materials
- Floors and roof are supported directly by the stone "bearing" walls



Steel frame/post & beam

- Became more popular in mid-Century
- Generally steel framing is visible
- Some "infill" wood stud walls may be present



Fun fact.....

Sears Roebuck & Co. Houses

- Usually wood framed
- Bought out of the catalog
- Look for shipping labels, which can often be found on the back of millwork or moldings. On the shipping label, look for the address, "925 Homan Ave., Chicago, Illinois," the Sears headquarters in the early 1900s
- Foundations can vary in type



Questions?



• What do you think is your house's construction type?



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Foundations: Slab on grade

- No crawlspace, floor is directly on grade
- Can usually tell by stomping or heel-drop.
- Slab is very unforgiving vs wood floor will bounce a little and sound hollow
- Walls and floors are sitting directly on floor slab

Not always bolted in older construction





Foundations: Stem walls

- Wood framed floor over crawlspace
- Look in crawlspace for...
- Concrete or masonry (brick or block) stem walls extend up from foundation to bottom of floor framing
- No vertical wood framing between the foundations and the floor framing

Not always bolted or reinforced



Wood frame foundations: Cripple walls

- Similar to concrete or masonry stem walls except vertical wood framing between the top of foundations and the floor framing
- In older houses, there is typically no sheathing or diagonal bracing of cripple walls between top of foundation and floor framing
- Short studs below the first floor line can topple, causing the house to fall off its foundation or posts.

Not always braced with sheathing and bolted to foundations



Cripple stud bracing - example

Example: wood framed house with retrofitted cripple walls from exterior side.



Wood frame foundations: Brick and Stone foundations

- Look in crawlspace for....
- Brick or stone foundation and stem walls instead of concrete
- In older homes, typically there are no reinforcing bars are embedded in brick or stone



Wood frame foundations: Posts and individual footings

- Post and beam foundations
- Unbraced walls and posts beneath house can lose stability if shaken



Source: California Seismic Safety Commission

Wood frame foundations: Posts and individual footings

- Usually open beneath house
- Used when on a sloped lot or in coastal areas
- Sometimes no lateral bracing to prevent "leaning" of posts
- Individual footings can "drift" if not tied together



Hillside Foundations

- Similar to previous example
- Any building system can be supported by hillside foundations
- Special challenges related to foundation performance
- In older homes, sophisticated geological information may not have been available
- Older foundation systems, not designed to recent codes are vulnerable
- Individual footings can "drift" if not tied together



Chimneys in older houses

- Usually first item to fail
- Usually masonry heavy
- No or only minor reinforcing
- No anchorage to structure at roof level
- Tall and slender shape is subject to lateral loads
- Can resist only minor shaking levels
- Represents a significant falling hazard



Chimneys

Taller chimneys are often ornate and as high as 30 feet above the roof.



Concrete Foundation

- Building has slid off the foundation due to the lack of anchor bolts.
- No anchors between wall and foundation



- Failed masonry foundations
- No reinforcing bars to tie blocks together and resist lateral loading



Stone Foundations

Example: Stone foundations are not reinforced.

There typically not be anchor bolts between the foundation and the floor.

Note: This example has the stone foundation plus a cripple stud foundation.



Porches

- Often porches topple or lean blocking the exit path from the building
- Significant falling hazard



- Open elevations (soft story) with living space above
- Little resistance in ground level



Masonry wall connections to diaphragms

• Failure usually starts at top and "zips" downward



Gables

- Separation along top edge at roof
- Hinging at wall plate (attic level)



Heavy facades on wood frame

- Anchorage can fail under significant shaking
- Anchorage can lose strength over time with corrosion





Source: Clem Newcamp, Pro Building magazine

Non-structural issues

- Water heaters
- Bookcases and shelves
- Heavy mirrors
- Objects on display



Single-Family Home Seismic Vulnerabilities: Wood Stud Wall Example (Brick veneer over studs)

- Walls must be anchored to the foundations
- 2. Chimneys height excessive and not braced.
- 3. Porch columns collapse potential.
- 4. Re-entrant corner at kitchen
- 5. Interior features Water heater, bookshelves, etc. brace and attach

Single-Family Home Seismic Vulnerabilities: Wood Frame Dwelling Example

- 1. Chimney failure
- 2. Damage to wall, roof, and floor due to chimney
- 3. Porches
- 4. Open front lack of shearwalls

Single-Family Home Seismic Vulnerabilities: Wood Frame Dwelling Wood Shingle Exterior Example

- 1. Possible Chimney failure
- 2. Damage to wall, roof, and floor due to chimney
- 3. Porches Attached?
- 4. Gable end no shear resisting element
- 5. Open front at first floor and left side.
- 6. Building anchored to foundation?

Single-Family Home Seismic Vulnerabilities: Brick Wall Example

- 1. Walls not anchored for out-ofplane loads.
- 2. Chimneys not braced.
- 3. Wall Stability (h/t ratio).
- 4. Porch columns collapse potential.
- 5. Diaphragm stiffness Roof sheathing
- 6. Re-entrant corner at pop-out
- 7. Interior features Water heater, bookcases, etc. brace

The California Historical Building Code

- Intent: The intent of this chapter is to encourage the preservation of qualified historical buildings or structures while providing a standard for a minimum level of building performance with the objective of preventing partial or total structural collapse such that the overall risk of lifethreatening injury as a result of structural collapse is low.
- CHBC is considered "performance based", not prescriptive.

Single-Family Home Seismic Vulnerabilities: Brick Dwelling Example

lssues:

- 1. Gable ends could fall outward
- 2. Walls not anchored for out-of-plane loads.
- 3. Chimneys not braced.
- 4. Wall Stability (h/t ratio).
- 5. Porch has fallen and collapsed
- 6. Diaphragm stiffness Roof sheathing
- 7. Interior features Water heater, bookcases, etc. -brace

Questions?

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The California Historical Building Code

- There are no triggers in the CHBC
- Seismic provisions are only mandatory when triggered by other code issues or ordinances
- When voluntary, partial upgrades are allowed:

"Nothing in this code shall prevent <u>voluntary</u> and <u>partial</u> seismic upgrades when it is demonstrated that such upgrades will improve life safety and when a full upgrade would not otherwise be required." Hindry House, Pasadena ource: Kelly Sutherland McLeod Architects

Retrofit Approach

- Consider range from zero scope to incremental to full scope of retrofit
- Incremental Develop priorities for mitigation measures
- Develop cost estimates for each mitigation item
- Integrate with other alteration projects whenever possible
- Consider financial vehicles

Range of Performance During EQ Shaking

In Workshop #4 we will discuss these topics in more detail, including financial vehicles.

Summary

- Seismic Vulnerability in California not many regions that are not vulnerable
- 2. How to identify commonly found construction types for single-family houses
- 3. Seismic vulnerabilities
- 4. California Historic Building Code provisions
- 5. Potential phasing of retrofit

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Additional Resources & Further Reading

- National Register of Historic Places <u>https://www.nps.gov/subjects/nationalregister/index.htm</u>
- National Register Bulletin #15: How to Apply the National Register Criteria for Evaluation https://www.nps.gov/subjects/nationalregister/upload/NRB-15 web508.pdf
 - More information on historic significance and historic integrity
- NPS Preservation Brief #41: The Seismic Rehabilitation of Historic Buildings https://www.nps.gov/tps/how-to-preserve/briefs/41-seismic-rehabilitation.htm
- NPS 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
- NPS Preservation Brief #18 Rehabilitating Interiors in Historic Buildings: Identifying and Preserving Character-Defining Elements <u>https://www.nps.gov/tps/how-to-preserve/briefs/18-rehabilitating-interiors.htm</u>
- California Office of Historic Preservation <u>https://ohp.parks.ca.gov/</u>
- 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
- 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/fjbaCwAAQBAJ?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.

Find Property/District-Specific National Register and California Register Nomination Documentation:

- National Register of Historic Places Database: <u>https://npgallery.nps.gov/nrhp</u>
- California Historical Resources Database: <u>https://ohp.parks.ca.gov/listedresources</u>

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