

# Strengthening Your Home Against Potential Earthquake Damage

Building Permits & Home Safety Open House

City of San Jose

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Lessons learned from  
previous earthquakes

# 1983 Coalinga Earthquake

- 6.2 magnitude – a “moderate” event
- \$10 million in property damage



# 1994 Northridge Earthquake

- 6.7 magnitude – a “moderate” event
- 57 deaths
- \$13 to \$50 billion in property damage



# 1994 Morgan Hill Earthquake

- 6.2 magnitude – a “moderate” event
- \$7.5 million in damage



# 2014 Napa Earthquake

- 6.0 magnitude – a “moderate” event
- 1 death
- \$400 million in property damage



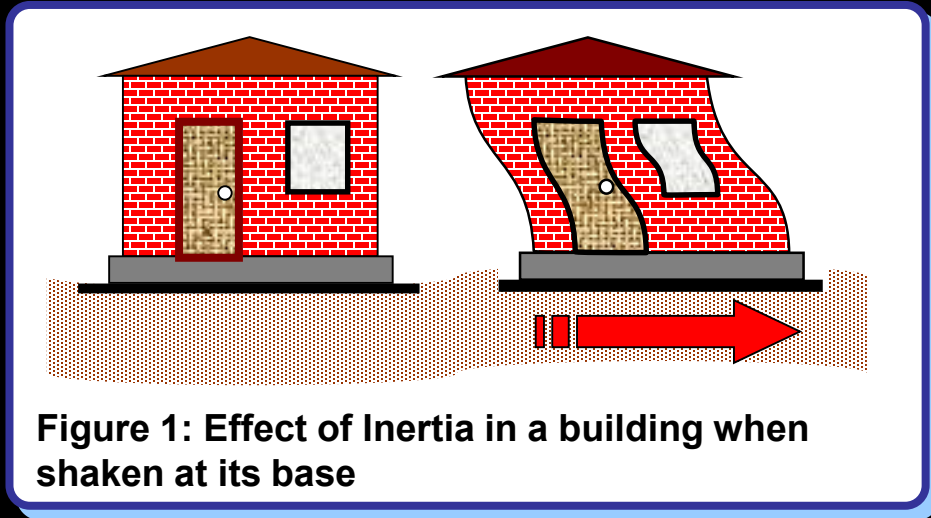
# Earthquakes

Fault ruptures at tectonic plate boundaries



UC Berkeley Seismic Lab

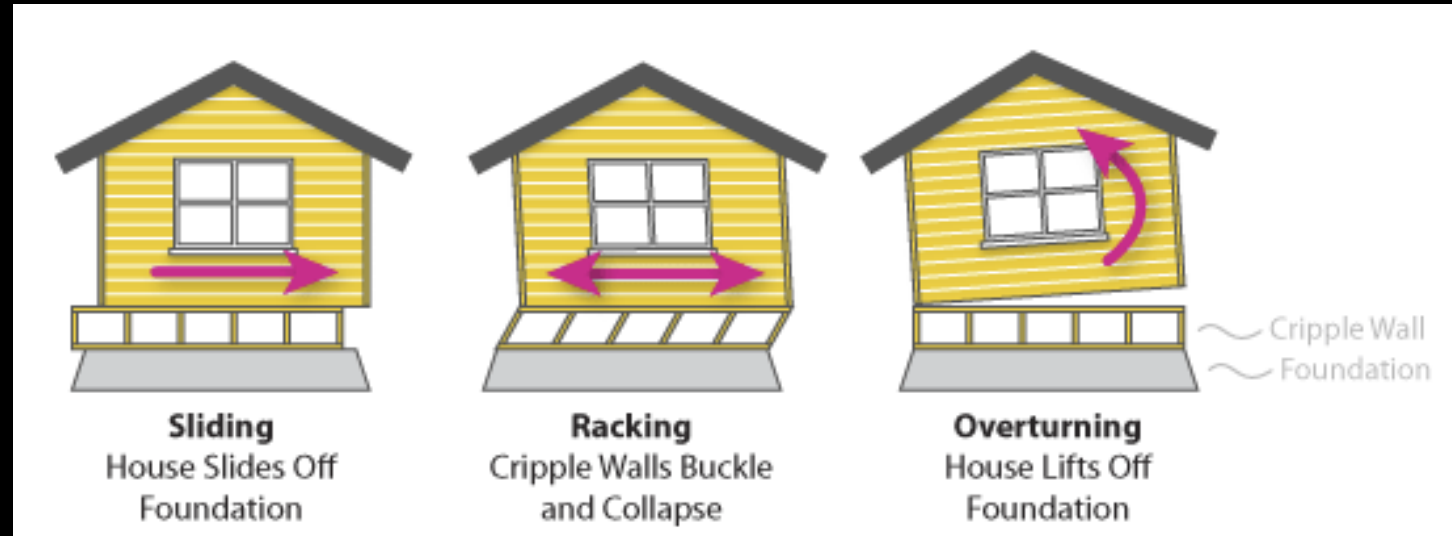
# Earthquake Effects on Residential Buildings



Earthquake demands on buildings

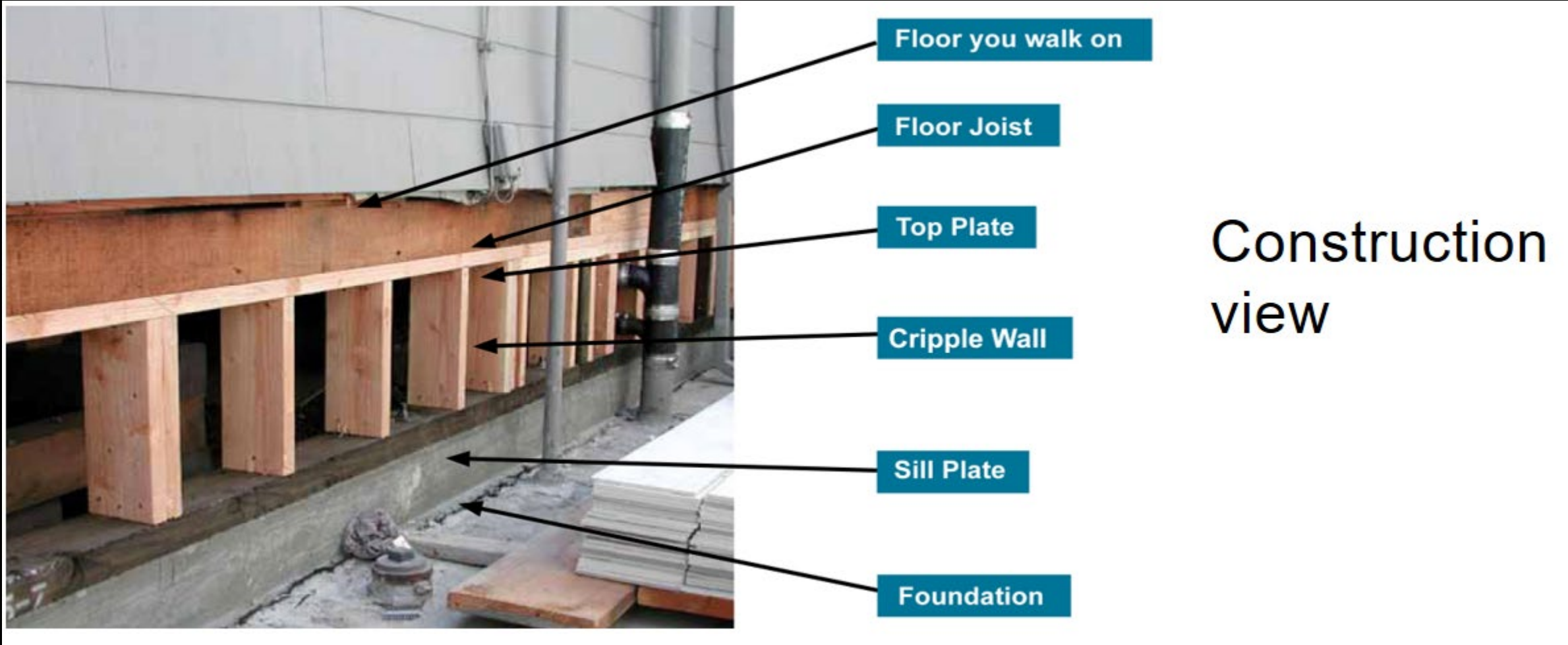
ITT

Typical, older California home construction issues

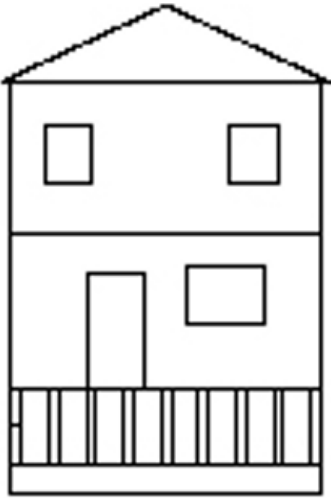




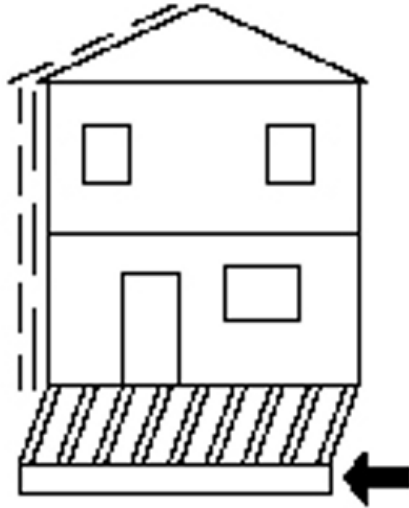
# What Happens?



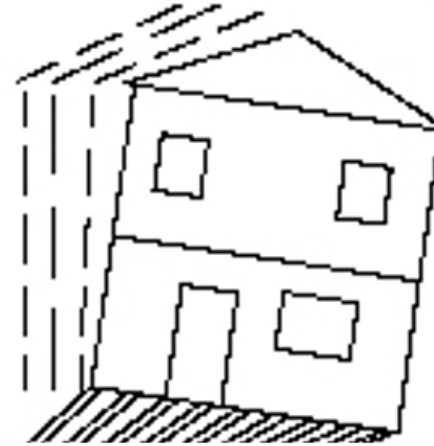
# Cripple Walls



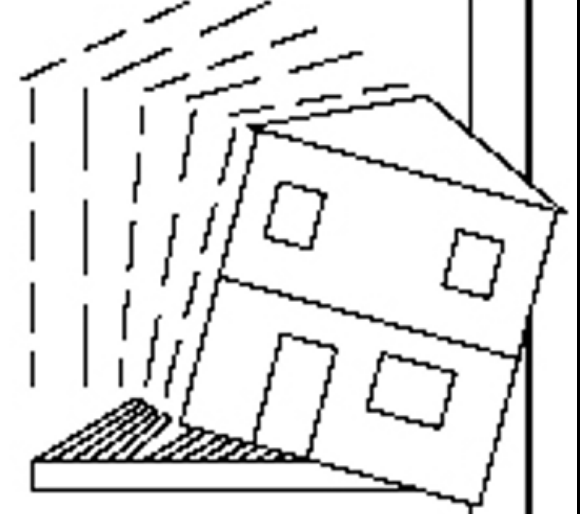
House is supported on cripple walls



Earthquake moves the foundation



House rocks on the cripple walls  
**THE CRIPPLEWALL**



House falls when cripple wall collapses

# Cripple Walls



# Cripple Walls



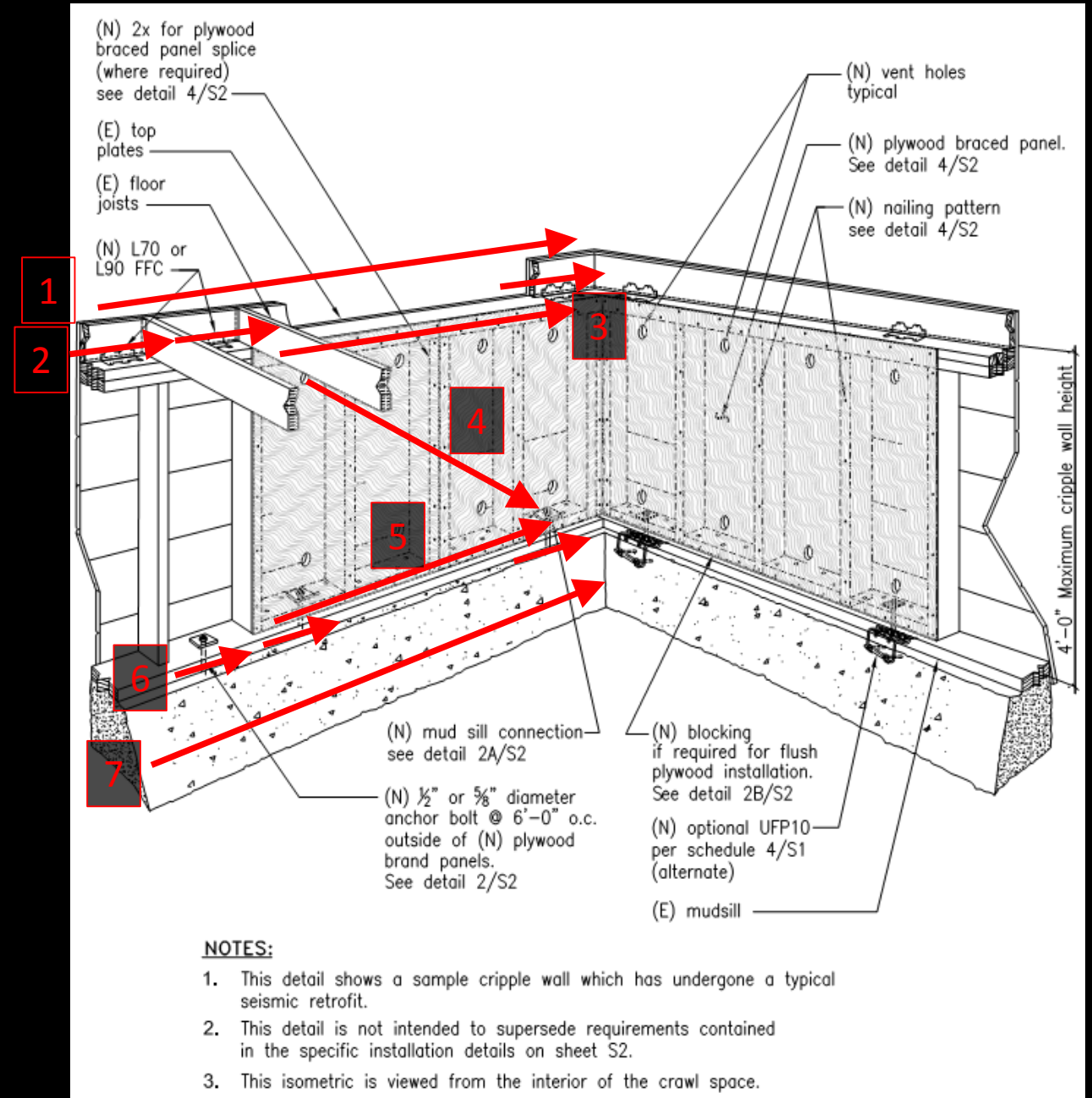
# Take-aways

- The damage shown likely resulted in a “write-off” of the buildings.
- Most of the residential damage was reasonably preventable.

## What to do?

# Load Path

1. Building forces into floor
2. Into clip angles
3. Into top plate and nails in plywood
4. Through plywood
5. Nails in plywood to bottom plate/mudsill
6. Bolts in mudsill
7. Into foundation



# Anchor Bolts

- Access and space to work
- Mud sill
- California Building Code:
  - 5/8" or 3/4" diameter (A307 or A36)
  - At least 7" embedment into foundation
  - Spaced not more than 4' apart
  - Minimum of 2 bolts per sill piece
    - One bolt located not more than 12", and not less than 5 1/2", from each end of the sill piece



# Sill Bolting (Wide Mud Sill)

- Wide Mud Sill
- Add New Sill Pieces
- Nail each new sill to mud sill w/ 6-10d Common Nails
- Anchor bolt thru both sills





# Strengthen Cripple Walls

A cripple wall:

- Generally the **weakest** part of older building because it has **insufficiently strong** sheathing materials.
- Can cause **full or partial collapse** in an earthquake.
- Can be **strengthened for relatively low cost** by correctly applying **plywood sheathing** to the cripple walls



# Plywood Guidelines at Cripple Walls

- ½” thick, C-DX or Structural I plywood
- Minimum 4’ long wall segments, longer segments better
- Distribute along all cripple walls, all sides of house. Cover corners.
- Use 8d or 10d COMMON nails (3” long), not box, sinkers, or 1 ½” shorts
- Galvanized nails best
- Nail all edges of plywood – 4” or 6” o.c. Add blocking.
- Vent holes



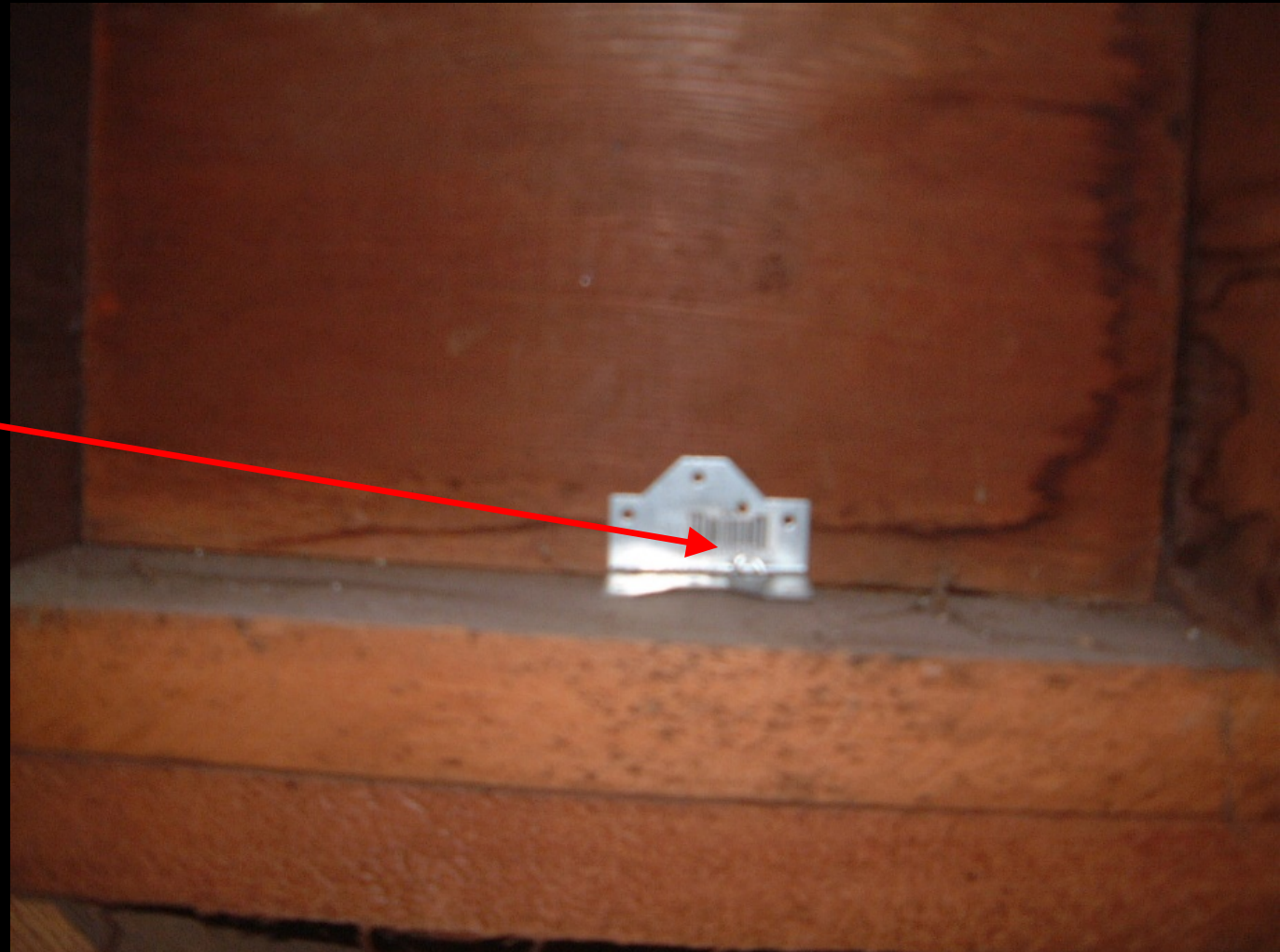
# Plywood Guidelines (cont)

- Install plywood sheets horizontally or vertically, but all the same way
- Install plywood from sill all the way up to wall top plate; no gaps; no partial height
- Nail plywood to mudsill, top plate and studs
- No gaps in the plywood sheathing between sill and top plate
- Add horizontal blocking at any horizontal plywood panel edges



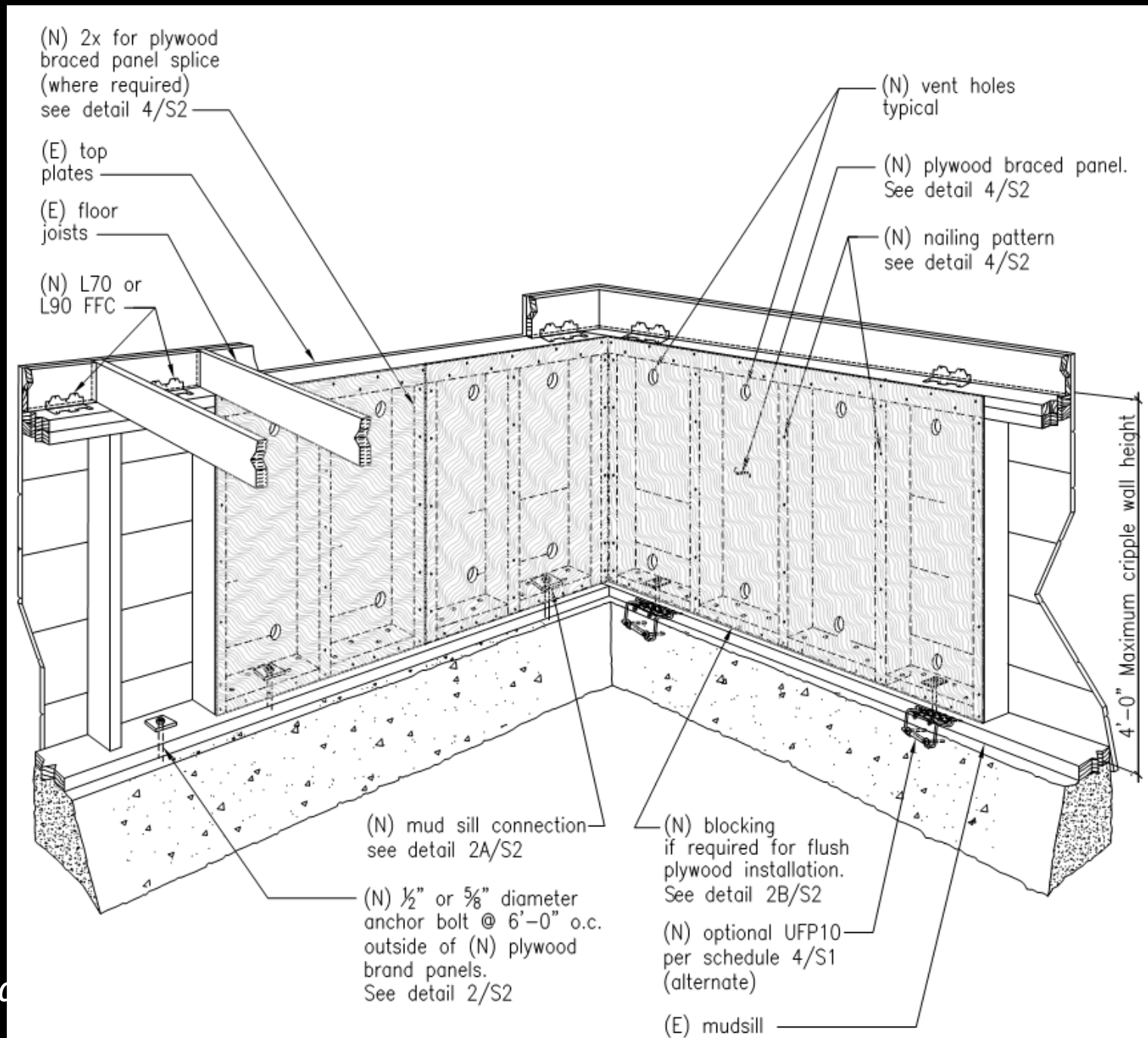
# Plywood Guidelines (cont)

- Add clips between rim blocking and top plate
- Clip @ 12" o.c. ("on center," or "center-to-center spacing"), or minimum one clip at each rim block



# Summary:

- Clip floor to top plate
- Bolt/attach mudsill to foundation
- Plywood over cripple wall



# Nonstructural Items can cause damage, too!

- Water heaters
- Chimneys
- Appliances
- Lighting fixtures
- Wall hangings
- Furniture



SF DBI

# Water Heaters

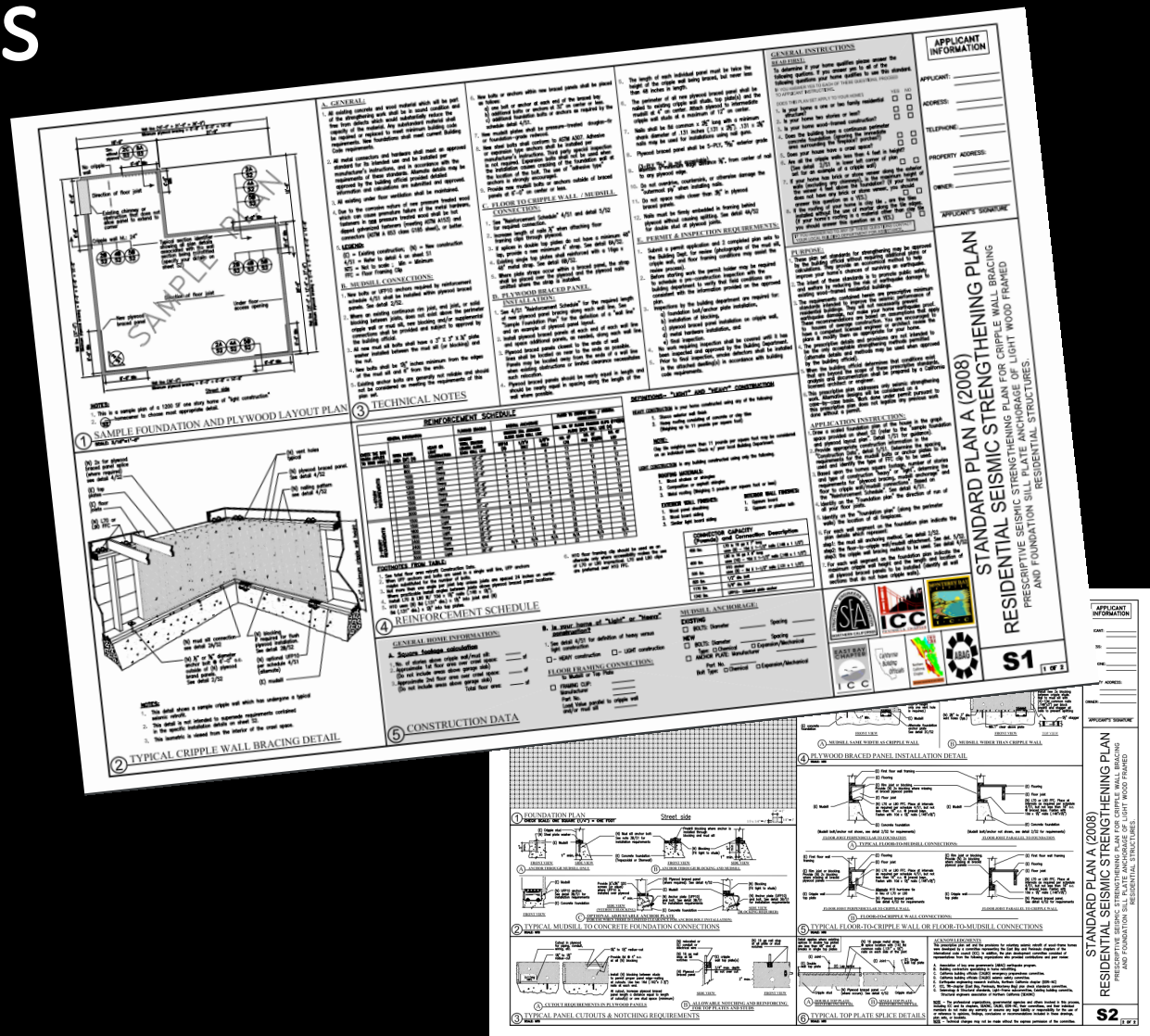
- Earthquake strap your water heater – it's the law!
- 2 metal straps
- 1/3 points
- Anchor to studs, not just drywall
- Elevate



# Standard Plans and Details

Endorsed by:

- Structural Engineers Association of Northern California (SEAONC)
- International Code Council (ICC)
- California Building Officials
- California Earthquake Authority
- Earthquake Engineering Research Institute (EERI)
- Association of Bay Area Governments (ABAG)



• <https://www.earthquakeauthority.com/Prepare-Your-House-Earthquake-Risk/Structural-Risks>



# Helpful References

- San José Building Division – [www.sanjoseca.gov/building](http://www.sanjoseca.gov/building)
- San Francisco Department of Building Inspection (SF DBI) - <https://sfdbi.org/earthquake-preparedness#PP>
- California Earthquake Authority - [www.earthquakeauthority.com](http://www.earthquakeauthority.com)
- US Geological Survey – <https://earthquake.usgs.gov/learn/preparedness.php>
- FEMA 526 Earthquake Safety Checklist - [www.fema.gov](http://www.fema.gov)
- Association of Bay Area Governments (ABAG) – [www.quake.abag.ca.gov](http://www.quake.abag.ca.gov)

Thank you!