OUTLINE

- Overall Project Goal
- What is the Vision of CEA/FEMA
- Past Residential Damage
- Typical Deficiencies
- Prescriptive vs. Engineered Approach
- What we have now ... Codes, Standards and Plan Sets
- Next Steps
OVER-ARCHING GOAL

- National Pre-Standard and eventually Standard which will specifically address the seismic rehabilitation of one and two family residential dwellings (R3)
## ATC -110 PROJECT TEAM

### Project Technical Committee

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## ATC-110 PROJECT TEAM

### Project Steering Committee

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WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- National Standard to Address most Residential Construction
  - Cripple Wall Buildings
  - Slabs on Grade
  - Pole Type Foundations, Pier and Beam Systems
  - Hillside Homes
  - House over Garages
WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- Focus on Prescriptive Approaches
  - Embed the Engineering
  - Make Implementation Simple & Effective
WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- Streamline an Engineered Approach
- Create Design Tools and Detail Libraries to assist Engineers.
WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

➢ To Answer other important Questions
  ➢ When does a certain vulnerability become an elevated concern?
  ➢ When does the slope of a particular site warrant additional design or rehabilitation measures
  ➢ Can the rehabilitation of Hillside Homes follow prescriptive Standards.
  ➢ How do we address the variance of construction practices
WHAT IS THE VISION OF THE CEA/FEMA SEISMIC RETROFIT STANDARD?

- To Address other important Goals
  - Can we develop a better idea of expected drift, the onset of damage and possible collapse for specific structures types and materials.
  - Cost to Benefit Indicators for Retrofits
PAST RESIDENTIAL DAMAGE

1983 Coalinga Earthquake - M 6.3

- Almost destroyed - 309 single-family homes
- Major damage - 558 single-family homes
- Minor damage - 811 single-family homes

1. A disaster assessment by the American Red Cross
1989 Loma Prieta Earthquake -M 6.9

- Older homes that were not bolted to their foundations or which lacked properly braced cripple walls accounted for over 2,800 of the 16,000 or 17.5% of all housing units made uninhabitable. ¹

- In Watsonville 10-20% of all pre-1940 residences suffered cripple wall damage. Some blocks suffered nearly 100% ²

1. “Preventing the Nightmare” 2003- Report by ABAG
WHAT’S DEFICIENT?

- The lack of continuous concrete or reinforced masonry footings at the perimeter,
- Cripple walls with inadequate bracing,
- Minimal or no attachment between the floor framing and the top of cripple wall or mudsill,
- The lack of appropriate anchorage between the mudsill and foundation system.
WHAT’S REALLY DEFICIENT?

➢ Lack of redundancy below first floor
MUDSILL ATTACHMENTS
MUDSILL ATTACHMENTS
CRIPPLE WALL FAILURES
INADEQUATELY SHEATHED CRIPPLE WALLS
WHAT DOESN’T WORK?

- Horizontal Wood Sheathing/Shingles
- Stucco/Plaster ?
- T1-11 Siding ?
- Let in Bracing
WHAT DOES WORK?

- Plywood
- OSB (oriented strand board)
- Diagonal Wood Sheathing
FLOOR TO CRIPPLE WALL ATTACHMENTS
FLOOR TO CRIPPLE WALL ATTACHMENTS

Movement prevented by shear transfer ties.

Photos Courtesy By Area Retrofit
FLOOR TO MUDSILL ATTACHMENTS

- floor joists
- muscles
- end joist
- framing anchors
- rim joist
- floor you walk on
- framing anchors
- foundation
WHAT DOCUMENTS DO WE HAVE

- FEMA P-50, P50.1
- IEBC A3
- Plan Set A
- City of LA - DBS Anchor Bolt Plan (2009)
- Simpson Strong-Tie
- Plan Set B ?? - (Standard Plan B)
PREScriptive STANDARDS

- Engineering Intent “Embedded”
- Developed for Specific “Most Typical Conditions”
- Use in Manner Consistent with Details
ENGINEERED SOLUTION

- Required when building falls outside of Scope (Example-A301.2)
- When the existing detailing falls outside of the “Most Typical Conditions”
- 75% of Code Design Forces
WHAT MAKES THESE DOCUMENTS DIFFERENT?

- Developed for Homeowners, Contractors, & Engineers
- Focus on “Critical Risk”
- Recipe of “Prescriptive Requirements & Details”
WHAT IS “CRITICAL RISK”

Unknown

Strengthened

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ZFA Structural Engineers
IEBC A3 & WHERE DOES IT APPLY?

- Residential Buildings of Light Frame Construction (R-3)
- Not More than Four Dwelling Units
- 16 or fewer Primarily Permanent Occupants
- Cripple Walls Less Than 4’ in Height
WHERE DOES IEBC A3 APPLY?

- Homes with post & pier and URM Foundation Systems
- Engineering Assessment or Prescriptive Foundations
WHERE DOESN’T A3 APPLY?

- Cripple walls over 4’ in Height
- Homes with Pole Foundations
- Buildings Exceeding Three Stories in Height
- Buildings With Slabs on Grade
WHERE DOESN’T A3 APPLY?

Steinbrugge Collection EERC, UCB
Homeowner’s Guide to Earthquake Retrofit

Wall Stud Movement

Cut-Off Height

January 16-17, 2014 - University of California, Los Angeles

ZFA Structural Engineers
WHERE SHOULD YOU APPLY IEBC A3 WITH CAUTION?

- Sloping Sites
- Long - Rectangular Homes
- High Seismicity \((CS > 0.192g, SDS > 1.25)\)
- Split Levels
- Homes with Heavy Finishes
- Unusual Configurations & HOG
OTHER PRESCRIPTIVE METHODS

- Plan Set A - (Standard Plan A - 2008)
- City of LA - DBS Anchor Bolt Plan (2009)
- Simpson Strong-Tie
- Plan Set B ?? - (Standard Plan B)
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PROS & CONS OF IEBC A3

- Pro’s
  - Adopted into the Code/ National Presence
  - Regularly Updated
  - Coordinated with Other Codes
  - Broad applicability with engineered design
  - Standardized and prescriptive details
PROS & CONS OF IEBC A3

- Con’s
  - Does not easily Produce Plans and Details
  - Not easily available
  - Limited prescriptive details
PROS & CONS OF PLAN SETS

Pro’s

- Developed for Home Owners and GC’s
- Consistent notes, detail, procedures
- Formatted for Construction
- Easy to Follow
PROS & CONS OF PLAN SETS

- **Con’s**
  - No Official Update Process
  - Limited Applicable Details/ Conditions
  - More Limited Applicability
  - No Direct Engineered Approach
CONTRIBUTORS TO SUCCESS

- Regulatory Agencies
- Embrace the Program
- Quality Control and Quality Assurance of Program
NEXT STEPS

- Review all Current Data
- Study & Define the Opportunities
- Develop & Prioritize Realistic Goals
- Implement - Anticipated 5 year Program
Thank you
1994 Northridge Earthquake- M 6.7

- 48,000 residential units made uninhabitable.

- Only 439 of the 48,000 or slightly less than 1% had cripple wall failures. \(^1\)

- Difference due to newer homes, slab on grade construction, or homes retrofitted after 1971 San Fernando EQ. \(^1\)

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1. “Preventing the Nightmare” 2003- Report by ABAG
WHAT’S REALLY DEFICIENT?

- Cripple Walls Below First Floor
  - Sheathed one side
  - Stucco, horizontal sheathing

- Walls Above First Level
  - Covered both sides
  - Lathe & plaster, button board & plaster, gypsum board
T1-11 siding failure at edges

T1-11 & Channel Groove

Note:
Nailing of both panel edges along shiplap joint is recommended. The "double nailing" is required when wall segment must meet wall bracing or engineered shear wall requirements.
MUDSILL ATTACHMENTS

- Anchor Size & Spacing
- Use of Existing Anchors?
- Check for Sound Concrete

Movement prevented by bolts.

bolts with mudsill plates