Performance of Single Family Wood Homes During the 11/30/18 Earthquake

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Overview of PDC Residential Inspections

- PDC has inspected more than 200 homes since the earthquake; most were in the Anchorage and Eagle River Area.
- Most of the homes that PDC inspected inside of Anchorage’s Building Safety Service Area (ABSSA) performed well, with the exception of a few geotechnical failures.
- Houses that PDC inspected outside of the ABSSA did not perform as well. There were significantly more failures observed due to structural deficiencies.
- Many Green-tagged homes were still observed to have structural deficiencies. While they survived this earthquake, we anticipate damage in future earthquakes of similar or larger magnitude.
  - Analysis and lateral upgrades were recommended for many of these homes even though they were green-tagged.
- Most homes observed to meet code requirements performed well in the earthquake.
Types of Observed Residential Failures

- Local ground failure due to improper compaction or liquefacction
  - Most of the failures PDC observed were likely due to improperly placed fill materials or insufficient compaction during construction.

- Crawl Space Connections
  - Posts not connected to support beams.

- Shear Wall Failures
  - Improper lateral system design
  - Improper shear wall construction
  - Lack of inspection during construction
Shear wall failures

- Shear walls, when properly nailed, keep a home’s walls secure
- Too few nails or improper design can allow a wall to warp/fail prematurely during an earthquake
House #1: Shear Wall Damage, Eagle River AK

- Home Constructed in 2000
- Constructed as part of a large neighborhood development.
• SHEAR WALL DEFLECTION OF OVER 2 INCHES IN 10FT.
Cause of Failure

• Inadequate nailing of the west basement shear wall and inadequate shear wall design.

Repair Solution

• Temporally shore house
• Re-Level House
• Replace Damaged Shear Wall
• Add interior Shear Walls to reduce stress in the wall.
• Repair cost over $100,000
House #2: Shear Wall Failure, Eagle River AK

- Constructed in 1983 As part of a Large Development.
- Owned by Military Family and was being rented during the earthquake.
- Tenants moved out due to the house being uninhabitable. The owner lost more than 3 months of rent revenue in addition to costly repairs.
Shear wall construction was grossly inadequate, resulting in a shear wall failure on the west wall of the house.

Staples were placed at 16” on center at the edge of the T1-11 shear wall panels resulting in gross failure during the earthquake. At a minimum this wall should have had 8D nails at 6” OC or staples at 2-4” on center.

Interior garage support walls were also inadequately braced.

Shear wall failure allowed house to slide on its foundation.
Results of the shear wall failure

- Sill plate separation in the crawl space
- Shear wall failure allowed house to slide on its foundation.
- In our opinion, a second earthquake or aftershock of a similar magnitude would have caused this home to collapse.
Repairs

▪ Realigned exterior shear walls and replaced broken shear wall elements.
▪ Nailed the T1-11 on the entire house properly.
▪ Estimated damages and lost rent: More than $50,000
5 similar houses on the same street
Does the entire neighborhood have the same issue?
House #3: Incomplete Lateral System Eagle River AK

- House Built in 2013
- Little to no shear wall on the west side of the home.
- West shear walls deflected in the earthquake causing extensive damage throughout the home.

![Diagram of house with labeled sections: House, Sheet Rock Shear Wall, Attached Garage, and West.]

- Properly Constructed Plywood Shear Wall
- Improperly Constructed Sheet Rock Shear Wall
What went wrong?

- Plans were purchased by owner online and modified by contractor and owner
- Garage was expanded, shortening the exterior shear walls on either side
- Contractor built the house
- House inspected by private inspector
- No one caught shortcomings of lateral system until after the earthquake damaged the home.
- No one intended to build a laterally deficient home.
- No one involved in the design or construction of this house was qualified to design a seismic-resilient structure.

- Properly Constructed Plywood Shear Wall
- Improperly Constructed Sheet Rock Shear Wall
Inspection findings from the Municipality of Anchorage (MOA) Building Official

Inside of the ABSSA (Anchorage Area):
- Red: 8
- Yellow: 367
- Green: 1272
- Total # of Homes: 45,153

Outside of the ABSSA (Eagle River & Chugiak):
- Red: 34
- Yellow: 163
- Green: 804
- Total # of Homes: 10,722

*Muni Building Official #s as of September 2019
Earthquake Resiliency & Code Enforcement

- The IRC recommends that the local government appoint a building official to enforce the building code through preconstruction plan review and inspection during construction.

- In the ABSSA the IRC is well-enforced by the local government through the appointed building official.
  - Plans are reviewed by the building official
  - Construction is inspected by the building official

- Areas outside of ABSSA (Eagle River & Chugiak): the IRC is not enforced by a building official, due to lack of jurisdiction.
  - Plans are not reviewed by a building official.
  - Construction is either not inspected, or is inspected by a private inspector (often hired by the contractor).
Recommendations

- Adopt the International Residential Code (IRC) statewide and encourage local building officials to enforce the plan review and inspection duties outlined in the IRC.
  - Currently the State of Alaska has not adopted the IRC
- Add inspection requirements for any soil placed below a structure.
- Extend the Building Safety Service Area (ABSSA) to the entire Municipality of Anchorage.
Questions?

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