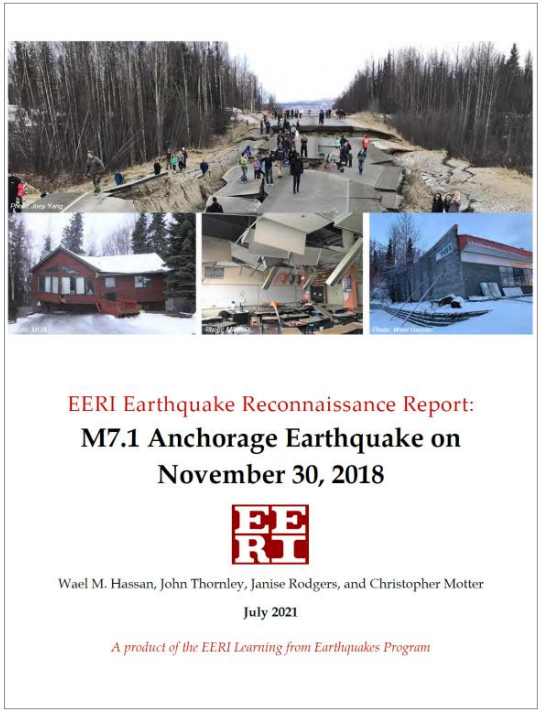
EERI-LFE Program Product

Earthquake Engineering Research Institute
Dedicated to reducing earthquake risk



Sep 2021 Presentation to

Alaska Seismic Hazards Safety Commission

EERI Report: Nov 2018 M7.1 Anchorage, Alaska Earthquake:
Reflections and a Vision for Safer Alaska

Wael M. Hassan, Ph.D., P.E., S.E.

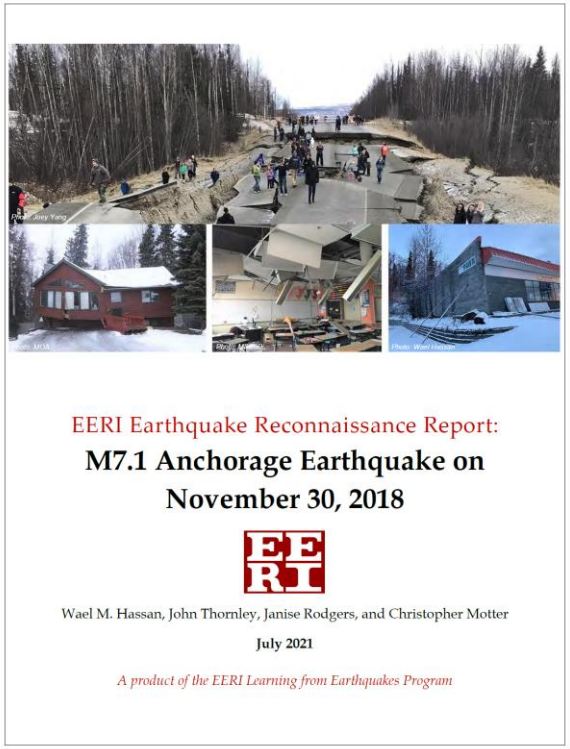
Associate Professor
Structural Earthquake Engineering
University of Alaska, Anchorage

Acknowledging: John Thornley, Janise Rodgers, Chris Motter

Outline

- The EERI Field Reconnaissance Report (new)
- Event Overview
- Building Code Background
- Building Stock Background
- Damage Distribution
- Structural Damage
- Wood Building Deficiencies
- Non-structural Damage
- MEP and Equipment Damage (new)
- Bridge System Damage
- Road Infrastructure Damage
- Insights into Seismic Resilience (new)
- General BIG Lessons Learned (new)
- System-specific Lessons (new)
- Seismic Risk Mitigation Recommendations (new)

EERI Field Reconnaissance Report



Hassan, W. M., Thornley, J., Rodgers, J., Motter, C., 2021

http://www.learningfromearthquakes.org/2018-11-30-anchorage-alaska/index.php?option=com_content&view=article&id=72

Wael Hassan: Report Lead, EERI Team Co-lead, Structural Lead
John Thornley: EERI Team Co-lead, Geotechnical Lead

Event Overview

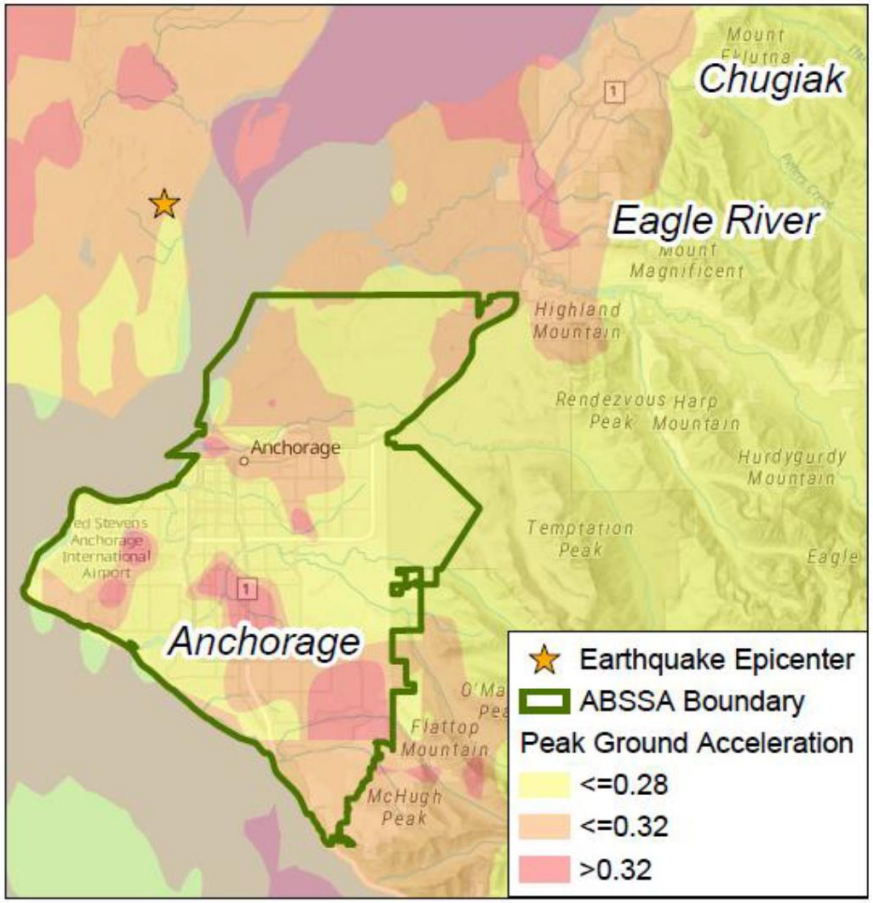
- Shaking intensity was 50-60% Design Earthquake: WE WERE LUCKY
- Minor structural damage (engineered/newer buildings)
- Moderate structural damage (non-engineered/older)
- A few incipient collapse structures (mostly non-engineered/older)
- No full collapses or fatalities. A few serious injuries
- Most serious damage was in Eagle River/Northern Communities
- Shorter period low-rise buildings were more affected
- Geotechnical related damage was very common
- Moderate-heavy non-structural damage, even in some new buildings
- Widespread piping/equipment and water damage and flooding
- Strong aftershocks exacerbated damage (latest 2.5+ years post-event)
- Widespread road infrastructure damage
- Minor damage to bridges (mostly soil related), shaking: 30% DBE in bridges
- Good instrumentation in Anchorage, lacking elsewhere

Building Code Background

- Changes Following 1964 M9.2 Earthquake
- NEHRP 1977
- Seismic details: mid-eighties to 1990 (UBC 1979)
- Currently IBC 2018 (IBC 2012 at the time of Nov 2018 event)
- Local Alaska Building Code Amendments
- Level of enforcement varies
- Construction boom 1975-1987: poor construction allover
- Pre-1990, loose to no code enforcement in Anchorage
- Post-1990: Anchorage Muni Safety Area (ABSSA) enforced
- Outside ABSSA: Applying structural engineering is optional!!!
  (no permit/design/inspection/code required or enforced!)

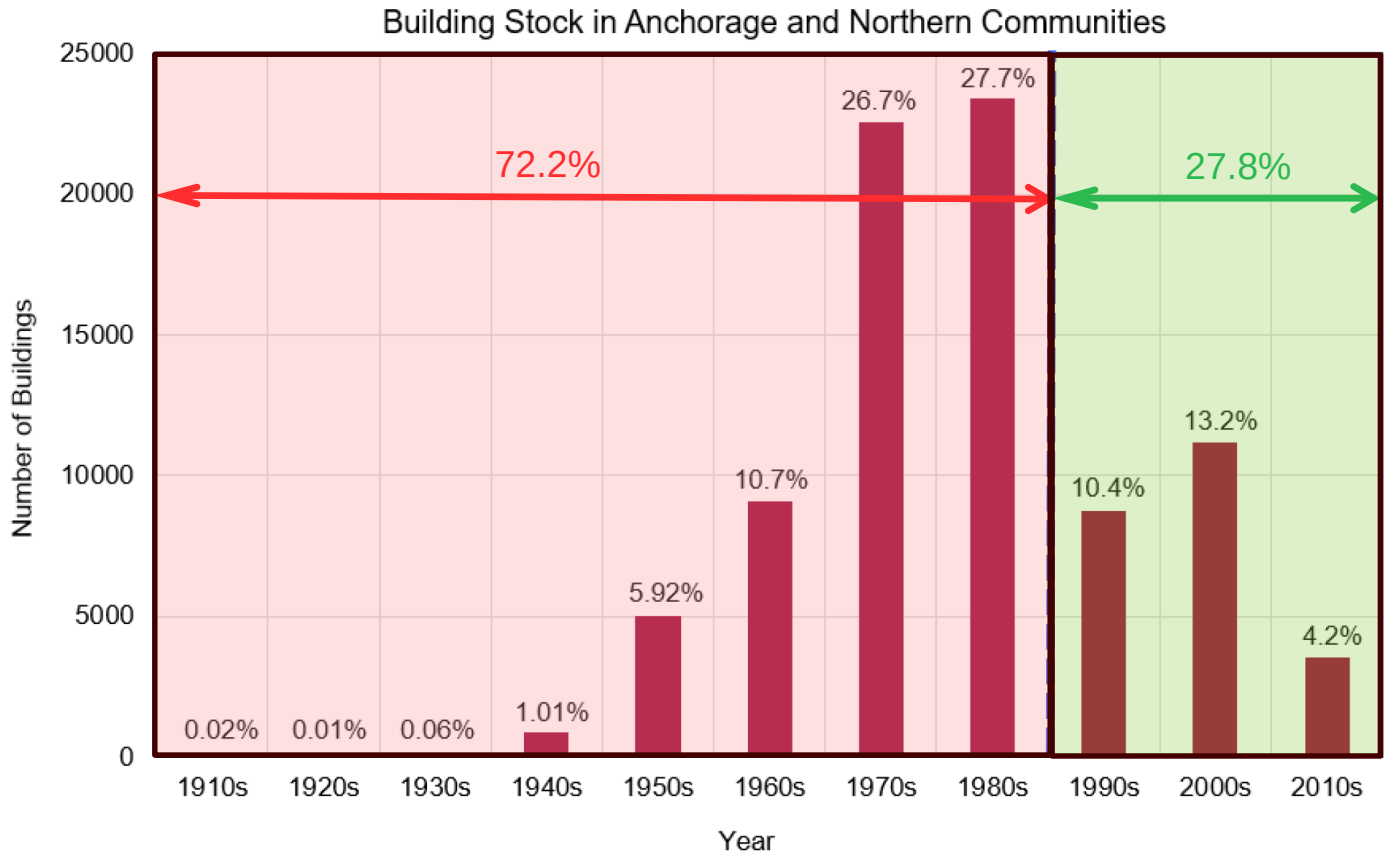
Building Code Background

- Anchorage Area Building Stock



Building Stock Background

- Anchorage Area Building Stock



Damage Distribution

MOA Inspection Data

- **Anchorage:**

Requests: 2228 (2%)

Inspected: 1298 (1.18%)

Red: 28 (0.025%)

Yellow: 606 (0.55%)

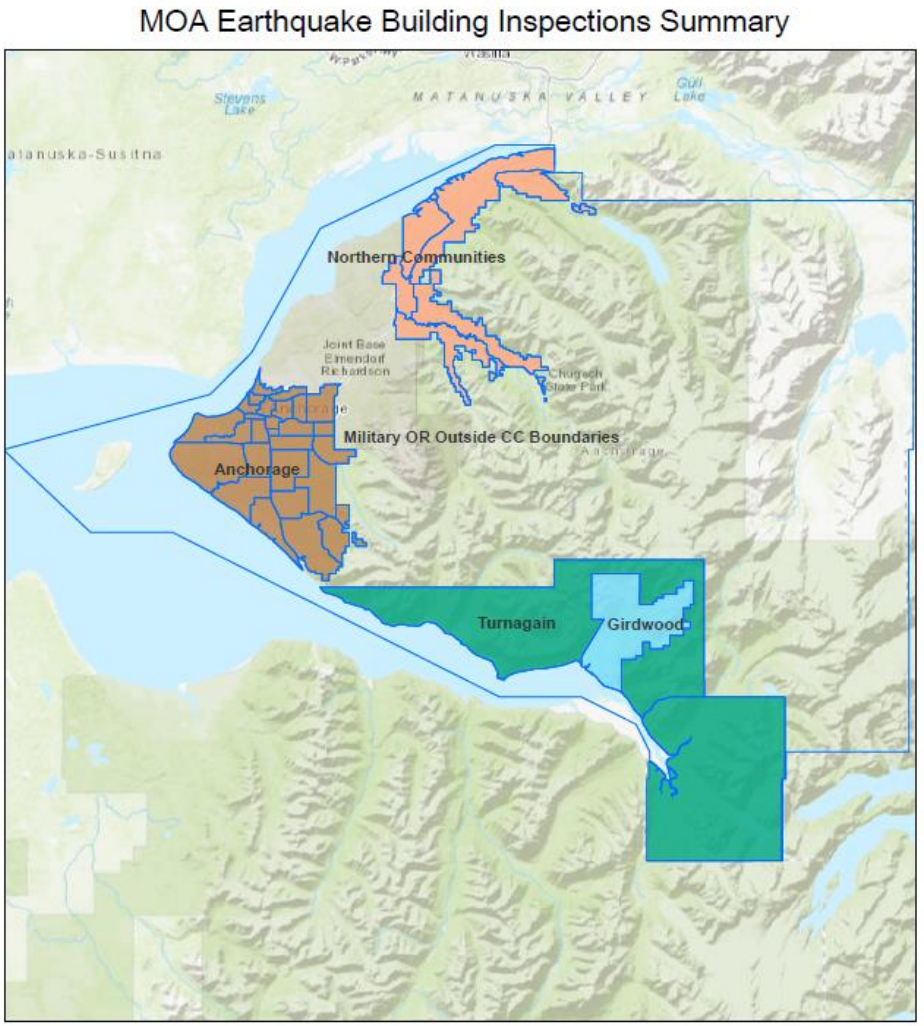
- **Northern Communities: (outside ABSSA)**

Requests: 1068 (7.43%)

Inspected: 851 (5.92%)

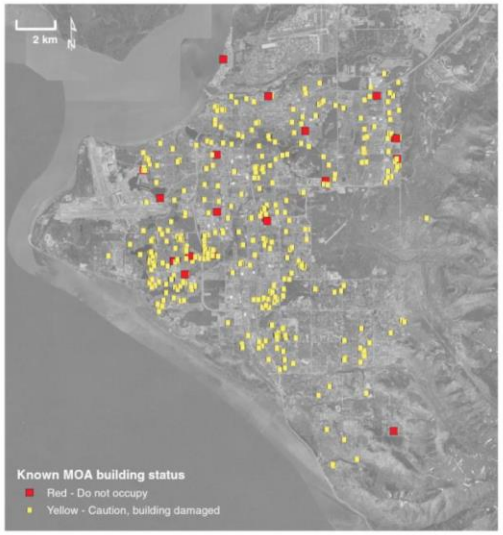
Red: 62 (0.43%) (20 TIMES ANC)

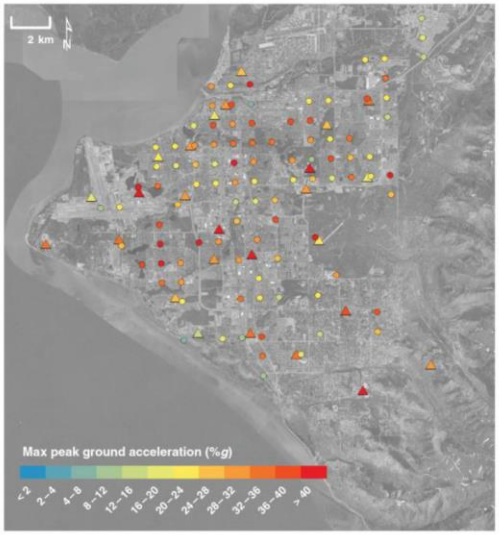
Yellow: 252 (1.75%) (3 times ANC



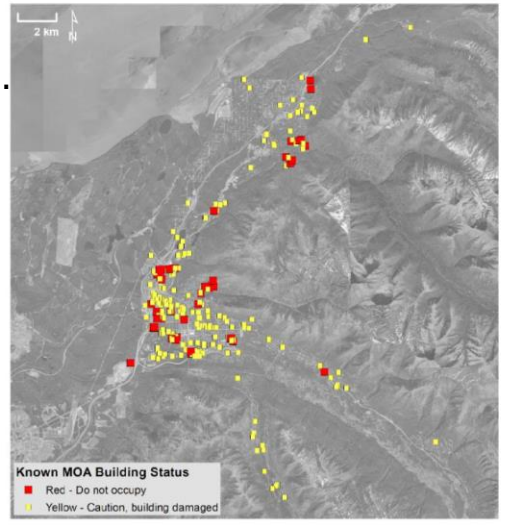
Damage Distribution

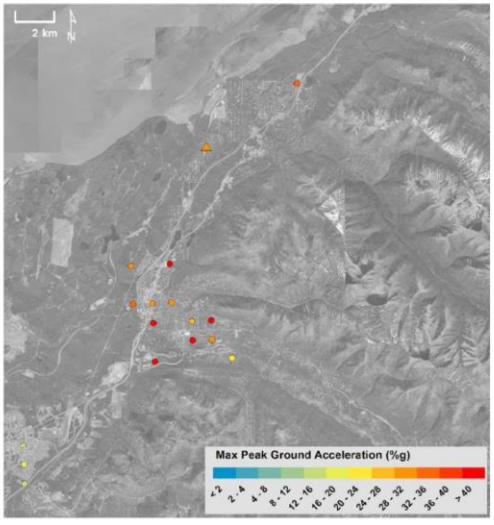
- Anchorage





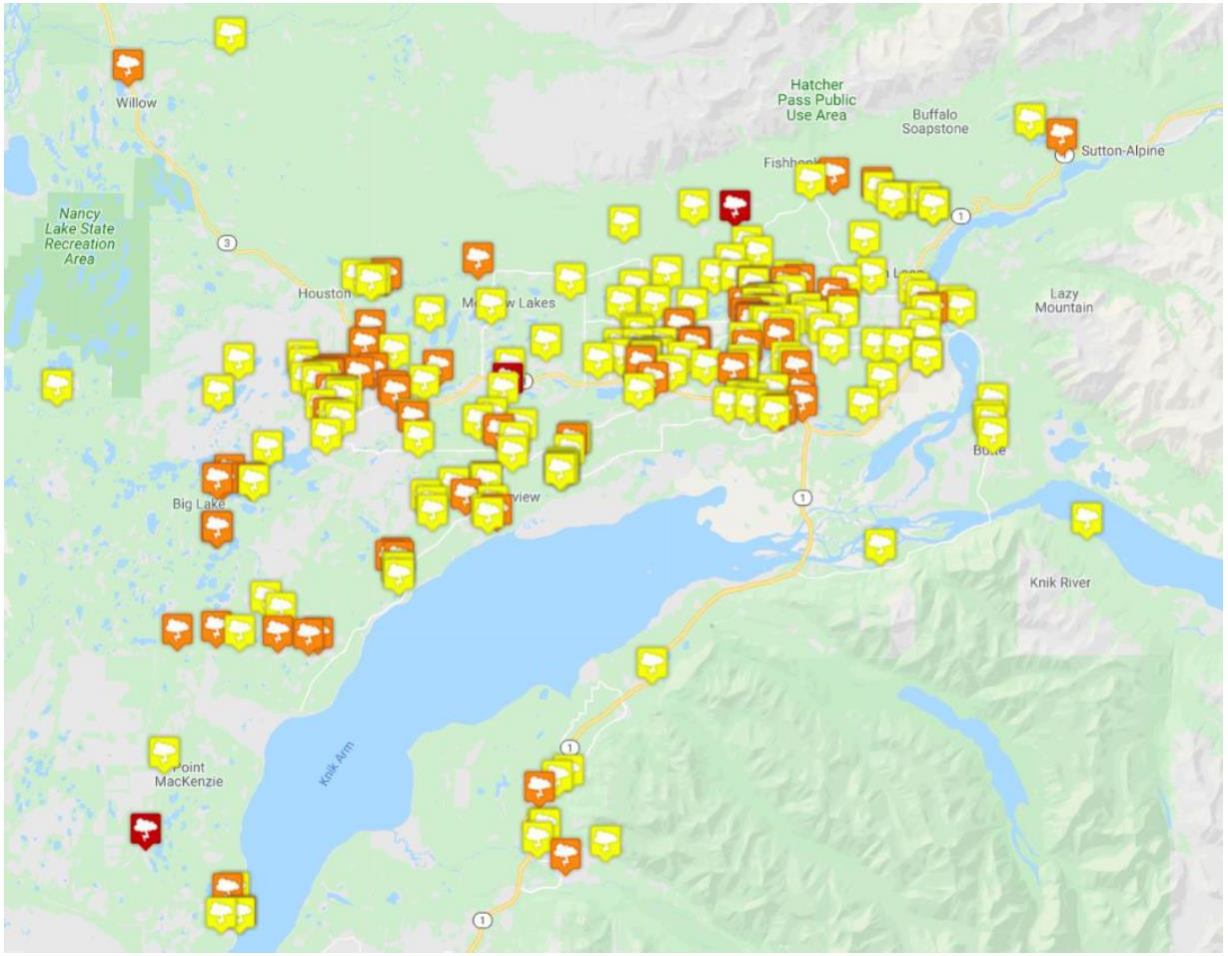
- Northern Comm.





Damage Distribution

- Mat-Su Valley



Structural Damage

- Most serious damage in non-engineered and pre-1990 buildings
- Most damage was in CMU and wood buildings
- Damage was remarkably more severe outside ABSSA
- Widespread soil failure-related structural damage, especially in single-family
- Severe damage/partial collapse: few non-engineered single family houses
- Incipient collapse at a few CMU buildings
- CMU wall-wall and wall-floor connections damage (even in post 1990s)
- Shear cracks in concrete girders, shear walls, slab flexural cracking, PS joint
- Out-of-plane masonry wall buckling/deformation
- CMU wall diagonal cracks and base crushing
- Wood shear wall damage
- Joist unseating in steel and wooden floors off walls
- New concrete and steel buildings did well (minor to negligible cracks, yield)
- All instrumented buildings did not exhibit structural damage

Common Wood Building Deficiencies

- Absence of strapping or bolting of the superstructure to the foundation
- Absence of blockings in floor joists
- Under-design/insufficiency of floor joists
- Uncompacted or poorly compacted fills, leading to differential settlement
- Absence of shear wall nailing or using cheap insufficient nailing or staples
- Under-designed or un-designed shear walls (wall thickness and/or nailing)
- Splitting and separation of sill plates
- Crawl space connection problems
- Absence of defined shear walls to enable installing large windows
- Absence of defined fasteners and tie-backs for ledgers
- Tall foundation walls without restraint
- Variable-height unsupported foundation posts on steep grade parcels
- Buildings on hills and slopes were not designed for the geometry
- Extensive use of staples instead of nailing throughout entire building
- Absence of bracing walls to detached garages

Non-structural Damage

- Sheetrock/Drywall widespread damage even in new buildings (most common and costly to repair)
- Suspended ceiling grid failure and/or tile falling (very common)
- Heavy wood ceiling panels damage/fall especially common (even new buildings)
- Glass and façade damage (mostly in low-rise commercial)
- Masonry veneer cracking/failure (all types of building)
- Widespread partition wall damage
- Lighter nonstructural damage in taller and more flexible newer buildings
- Interface damage to non-structural systems adjacent to ductile structural systems (deformation incompatibility)

MEP & Equipment Damage

- Most common, disrupting and costly: water flooding due to firefighting system damage (sprinklers, piping, tanks), unrestrained water boilers sliding and connection and rigid piping failure, and HVAC glycol leakage
- Post-2003 firefighting systems did better
- Electric panels, wiring, elevators counterweights, unrestrained electric equipment
- Gas lines pipe and connection damage
- HVAC and VAV systems damage was widespread and heavy (especially older and non-engineered buildings)
- Mechanical room equipment damage due to poor or absent seismic restraints
- Lack of code enforcement of tanks and equipment seismic restraints
- Collision of unrestrained orthogonal/different plane systems
- Short stiff pipe restraining effect
- New seismic gas valves are efficient

Bridge System Damage

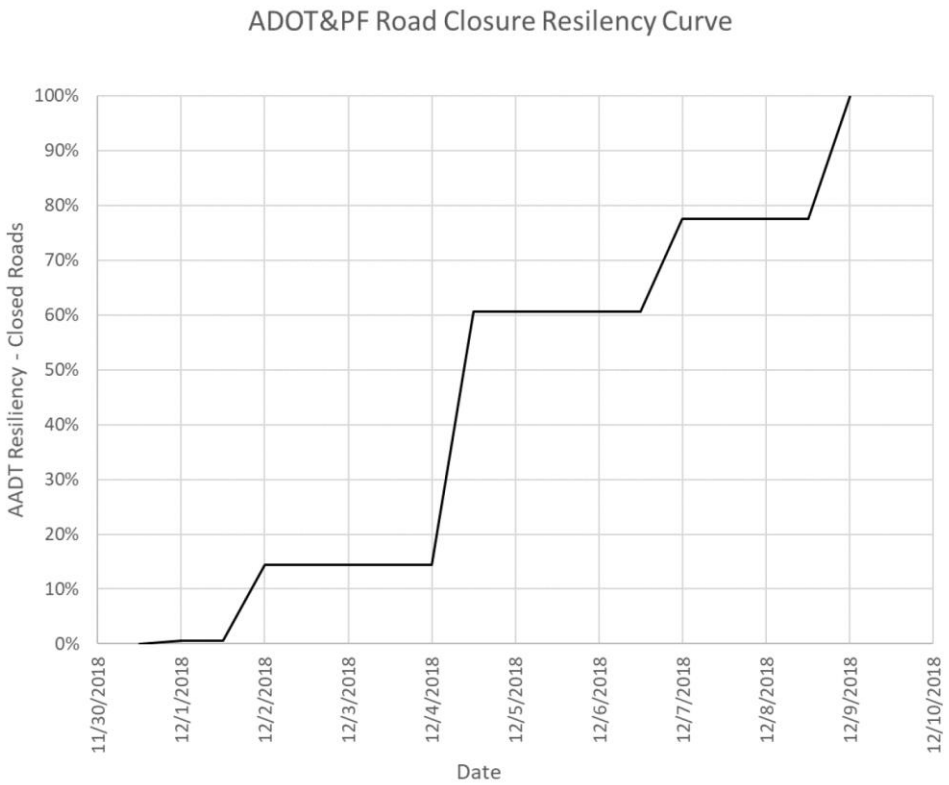
- 9.7% (155 bridges) of the Alaska bridges are deficient, 12 of which are interstate. Of those, 5 aging bridges are heavily-travelled in Anchorage Metro.
- Minor structural damage to Southcentral 243 bridges (mostly soil-failure-related)
- 20 bridges with more significant structural damage needing permanent repairs
- Common structural damage: girder shifting, shear key cracking, light-to-severe cover spalling and damage of shear keys, bent anchor bolts, bearing large deformation, grout pads under bearings, pile cap spalling, wing wall cracks
- Structural and foundation damage caused by ground failure, abutment cracks, approach settlement, settlement of abutments, wing wall settlement, soil cracks, hider wall cracks, culvert failure, rail misalignment, and slope tension cracks.
- Recorded ground acceleration was about 30% of the design acceleration of bridges

Road System Damage

- Widespread damage to roads and highways.
- 58 damage locations on the road system (8 of which were most severe)
- Liquefaction-induced settlement of roadways was not common but did occur
- Several significant slope failures occurred.
- Major slope failures from the 1964 Great Alaska Earthquake did not remobilize
- Several other slope failures: near Milepost 24 Glenn HW, Milepost 50 Seward HW, slopes near Alaska Railroad tracks near Rabbit Creek/South Anchorage.
- Spring thawing slumped embankments → pavement damage & road settlement.
- Minnesota Drive northbound in Anchorage and Vine Road in Wasilla.

Insights into Seismic Resilience

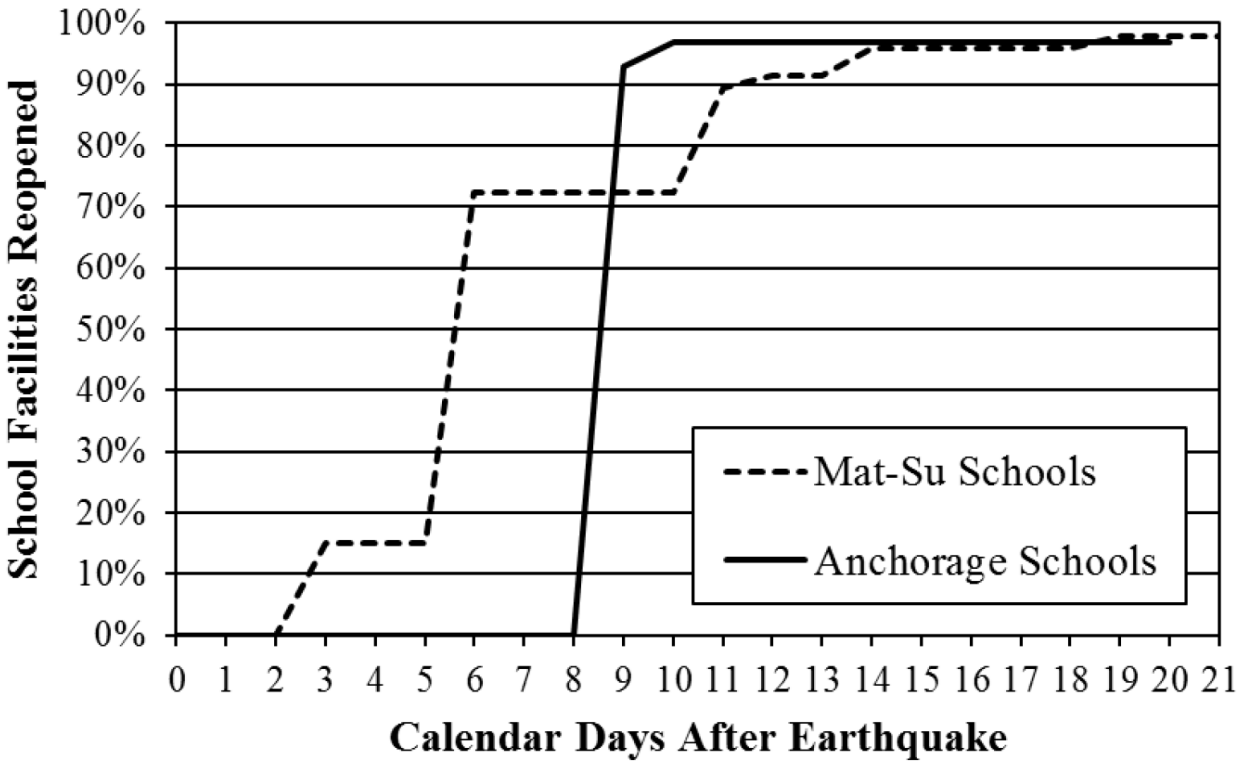
- **Roads and Bridges**



AK DOT&PF

Insights into Seismic Resilience

- **Schools**

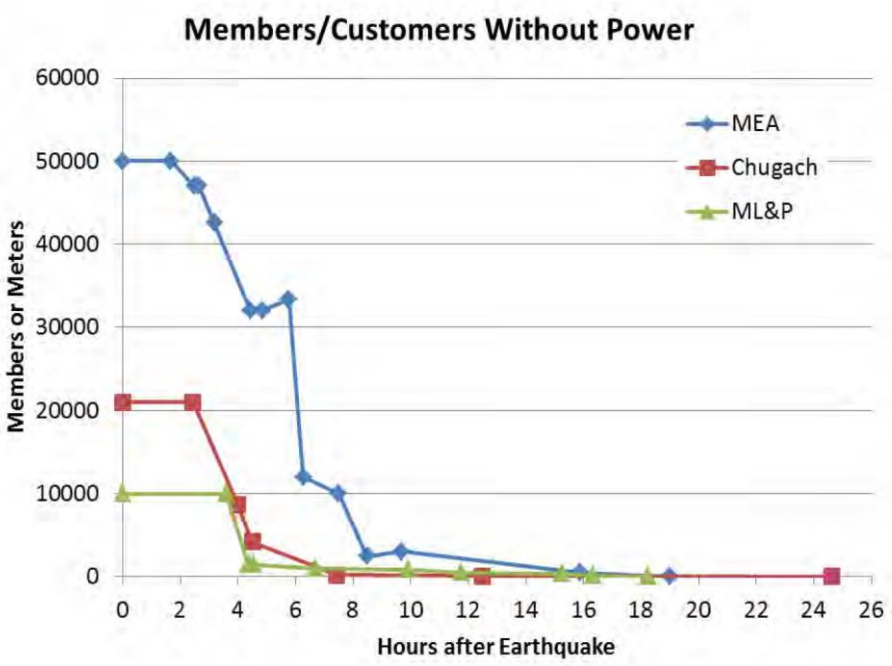


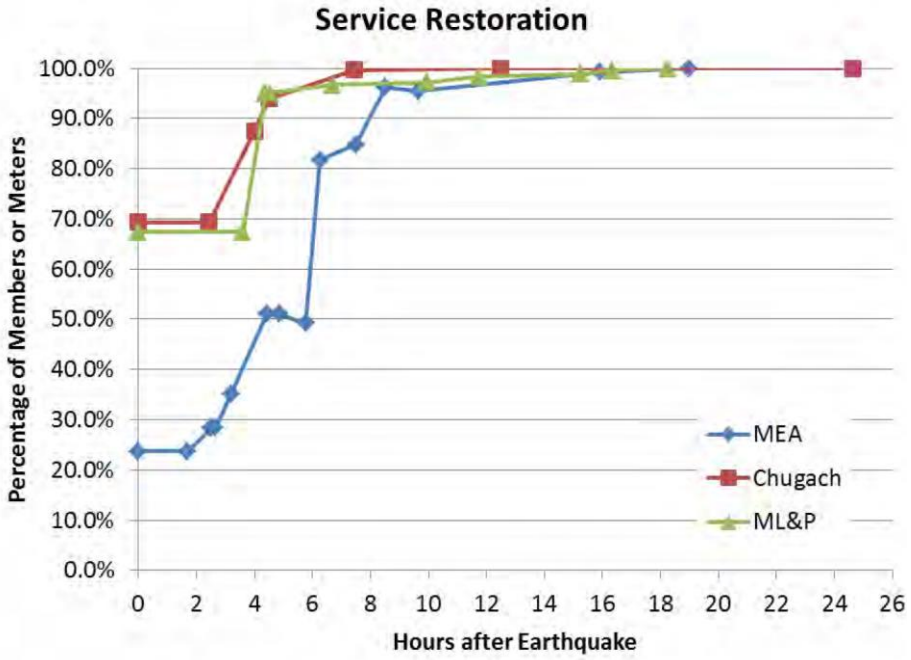
Hassan et al. 2021

Gruening Middle just opened Sep 2021

Insights into Seismic Resilience

- **Lifelines**





Hassan et al. 2021

General **BIG** Lessons Learned

- **We were lucky this time!**
- **Alaska may not be that prepared for the "Big One."**
- It was only 60% DBE: Don't get a false feeling of seismic safety!
- Enforcing building codes saves life and limb, **SHOULD NEVER BE OPTIONAL!!**
- School safety program seems working, but their buildings should be reviewed.
- Geotechnical related damage is overlooked in building and bridge design.
- Pre "1990" buildings and non-engineered buildings: **TICKING BOMBS**.
- CMU wall connections: revise/check even post 1990 construction.
- Non-seismically restrained/designed non-structural systems very vulnerable.
- Research studies needed for existing buildings' seismic vulnerability in Alaska.

General **BIG** Lessons Learned

- MCE Resilience studies/upgrades of essential/emergency facilities needed.
- Most building stock in Southcentral Alaska may be earthquake vulnerable.
- Buildings outside the Anchorage ABSSA are especially dangerous.
- We need not re-invent the wheel: Can use other states' mitigation experience.

System-specific Lessons Learned: EERI Report

- Geotechnical: Chapter 3
- Structural (RC, URM, CMU, Steel, Wood): Chapter 4
- Instrumented Buildings: Chapter 4
- Non-structural: Chapter 5
- Schools: Chapter 6
- Hospitals: Chapter 7
- Bridges and Road Infrastructures: Chapter 8
- Lifelines: Chapter 9
- Summary of Lessons Learned and Mitigation Recommendations: Chapter 11

Seismic Risk Mitigation Recommendations

Policy Legislations Needed NOW!

Short term

A. <u>ALL</u> New Construction and Upgrades:

- ✓ Mandatory building permit, design/inspection legislation, **allover Alaska**

EX: State of Washington State Building Code Act(RCW 19.27): "Adoption of building codes initially was the discretion of individual cities and counties Passage of the State Building Code Act in 1974 mandated the use of 1973 UBC building codes throughout the state. Since this time, local jurisdictions can make amendments to the code but changes cannot diminish code requirements."

- ✓ All Upgrades/Additions must conform to IBC 2018
- ✓ Mandatory geotech. reports and soil improvement
- ✓ Independent plan review and inspection (funded through permits)
- ✓ Seismic design required of non-structural components in essential facilities
- ✓ Seismic restraint of heavy equipment/water boilers enforced

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

B. <u>Existing Non-engineered Publicly Accessible Buildings</u>:

- ✓ Serious Public Safety Hazards
- ✓ Immediate legislation: mandatory seismic structural assessment & retrofit

  Can be phased and tiered using FEMA P-154 and ASCE 41-17

  Tier 1 and Tier 2: Owner's expense

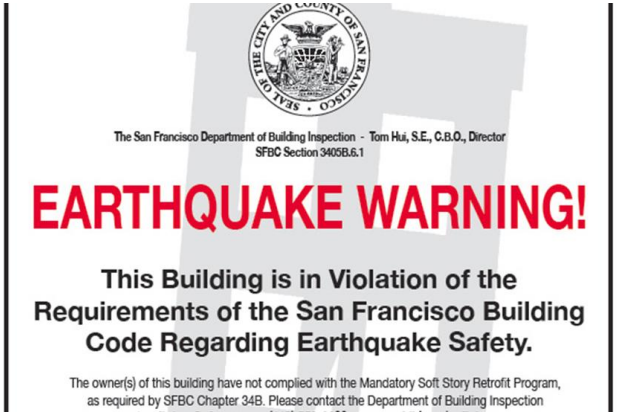
  Tier 3: Partially subsidized by State or federal.
- ✓ Retrofit those at risk

  at owner's expense (encouraged by state or federal subsidy/tax incentive **<u>OR:</u>**
- ✓ Mandatory Visible Posting

  "Building Prone to Seismic Collapse, Enter at Own Risk"
- ✓ Within One year of ordinance: submit adequate safety assessment report

  <u>OR:</u> Retrofit or Demolition plan timeline

Seismic Risk Mitigation Recommendations



Seismic Risk Mitigation Recommendations

Rich Literature on Ways to Encourage the Public:

Motivating Private Precaution with Public Programs:
Insights from a Local Earthquake Mitigation Ordinance

By

Sharyl Jean Marie Rabinovici

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

Berkeley 2012

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

C. <u>Existing Non-engineered (OR pre-UBC 1979) Single Family Houses</u>

- ✓ Encourage using homeowner seismic safety guides (e.g. FEMA 530)
  Through public awareness, outreach, education, Muni assessment help
- ✓ Encourage simple inexpensive retrofit measures.
  Munis facilitate expedited permits for these retrofits and inspect them
  State and federal subsidies and tax incentives
- ✓ Tie future federal and state earthquake assistance to retrofitted buildings

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

D. <u>Existing Pre-UBC 1997 Older Engineered Essential Facilities and "Alaska Critical Infrastructure"</u>

- ✓ 80% of Anchorage Bowl building stock was constructed before 1997.
- ✓ Alaska currently has only three legislations for seismic hazard mitigation.

  none for risk mitigation in existing structures vulnerable to seismic collapse
- ✓ Emergency planning/loss scenarios under the MCE, current seismic vulnerability of essential/emergency facilities/publicly owned old buildings

  Pre-Northridge steel, gravity RC columns, URM, non-ductile concrete, non-ductile CMU, soft/weak story
- ✓ Includes all "Alaska Critical Infrastructure"

  Public schools, educational facilities, hospitals with acute care units, fire and police stations, law enforcement agencies, high-occupancy buildings, airport and port facilities, Risk Category III or IV structures

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

D. Existing Pre-UBC 1997 Older Engineered Essential Facilities and "Alaska Critical Infrastructure"

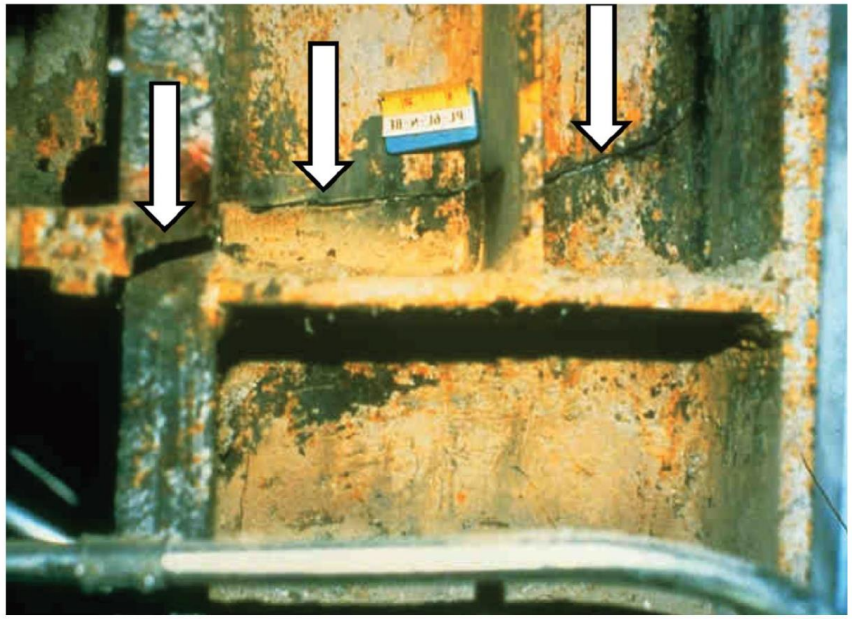
Pre-Northridge: RC SMRFs with Gravity Column non-seismic details

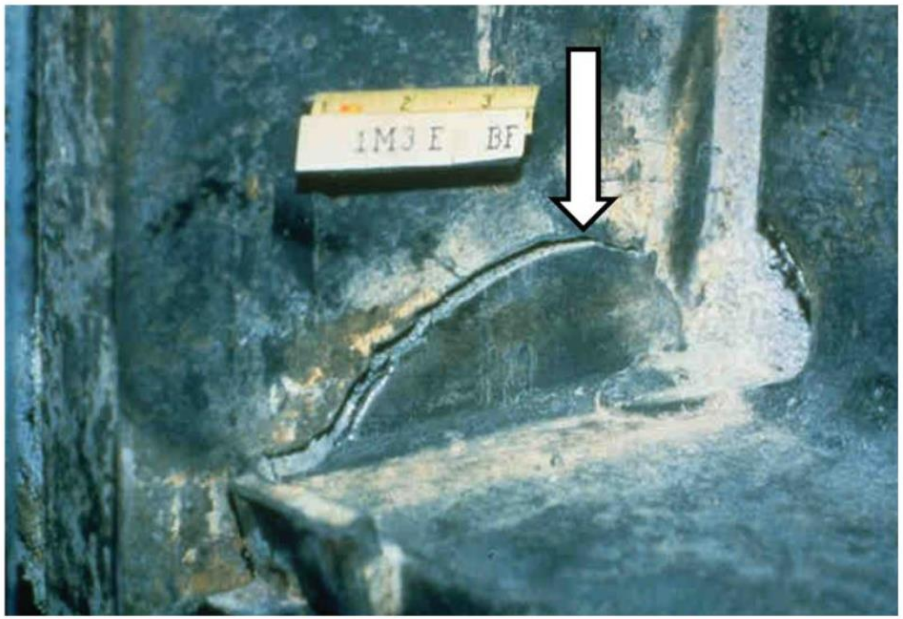
Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

D. <u>Existing Pre-UBC 1997 Older Engineered Essential Facilities and "Alaska Critical Infrastructure"</u>





<u>Pre-Northridge: Steel SMRFs welded connections</u>

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

D. <u>Existing Pre-UBC 1997 Older Engineered Essential Facilities and "Alaska Critical Infrastructure"</u>

<u>Non-ductile concrete</u>

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

D. Existing Pre-UBC 1997 Older Engineered Essential Facilities and "Alaska Critical Infrastructure"

Soft-story partial collapse (not only in wood buildings!)

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

D. Existing Pre-UBC 1997 Older Engineered Essential Facilities and "Alaska Critical Infrastructure"

- ✓ Mandatory RVS with FEMA P-154 → Pass: OK, OR Fail: ASCE 41 Tiers
- ✓ How to fund RVS and Tier Evaluation?

  State for state-owned buildings, owner (with subsidies) for private ones
- ✓ Non-structural systems seismic resilience assessment under MCE is needed
- ✓ Follow other states' experience in Seismic Rehabilitation

  Oregon Statewide Seismic Needs Assessment Using (RVS), [St. Bill 2 (2005)]

  Oregon companion bills to fund grants [Senate Bills 3, 4, and 5 (2005)]

  California Earthquake Safety and Public Buildings Rehabilitation Bond Act (passed in 1990 (Prop. 122and Government Code §§ 8878.50-8878.52))
- ✓ Consult Established Policy Recommendations

  WSSPC, EERI, NEHRP, FEMA

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Short term

E. Existing Older Engineered EQ-Vulnerable Private Structures

- ✓ Pre- UBC 1979 buildings and Pre-UBC 1997 steel buildings, other than above

  Commercial, residential, sport, office, etc.

- ✓ Seismic Vulnerabilities?

  non-ductile concrete, non-ductile CMU, pre-Northridge welds, URM, soft /weak story, gravity system detailing, structural irregularities

- ✓ A bill/ordinance to enforce seismic assessment (and later retrofit)

- ✓ Can follow: **City of Los Angeles, 2015 Ordinance No. 183893**

  enforced assessment/retrofit of all pre-1978 **15,000 soft story** wood-frame buildings and **1,500 non-ductile** concrete buildings.

- ✓ In two years: owners submit assessment report

- ✓ Funding?

  Assessment at owner's expense with state and federal subsidies as needed.

Seismic Risk Mitigation Recommendations

NSF-NEES Grand Challenge Research Project ($3.6M)

Mitigation of Collapse Risk of Older Concrete Buildings, 2007-2014

PI: Jack Moehle, UC Berkeley

PhD researcher/Post-doctor: Wael Hassan, UC Berkeley

- UC Berkeley (Inventory, BC Joints tests & models, Fragility)
- UCSD (Floor membrane tests and models)
- UCLA (Field tests, SFSI)
- SJSU, U Washington (Inventory, Loss estimation)
- Purdue (Column tests and models)
- University of Kansas (Column tests and models)
- University of Puerto Rico (Joint shear models)
- 10 co-PIs, 30 PhDs and post-docs)

Seismic Risk Mitigation Recommendations

NSF-NEES Grand Challenge Research Project

Mitigation of Seismic Collapse Risk of Older Concrete Buildings, 2007-2014

2015

Los Angeles Times

Los Angeles will have the nation's toughest earthquake safety rules

ORDINANCE NO. 183893

An ordinance amending Divisions 93 and 95 of Article I of Chapter IX of the Los Angeles Municipal Code to establish mandatory standards for earthquake hazard reduction in existing wood-frame buildings with soft, weak, or open-front walls and existing non-ductile concrete buildings, and amending Sections 152.02, 152.04, 152.05 and 152.08 of Article 2 of Chapter XV of the Los Angeles Municipal Code to grant authority to the Rental Adjustment Commission to modify Tenant Habitability Program requirements for purposes of implementing seismic retrofit mandates.

THE PEOPLE OF THE CITY OF LOS ANGELES
DO ORDAIN AS FOLLOWS:

Section 1. Division 93 of Article 1 of Chapter IX of the Los Angeles Municipal Code is amended in its entirety to read as follows:

ARTICLE 1, DIVISION 93

MANDATORY EARTHQUAKE HAZARD REDUCTION IN EXISTING WOOD-FRAME BUILDINGS WITH SOFT, WEAK OR OPEN-FRONT WALLS

Seismic Risk Mitigation Recommendations

Definitions

Non-Ductile Concrete Building:

A concrete building having concrete floors and/or roofs, either with or without beams, supported by concrete walls and/or concrete columns, and/or concrete frames with or without masonry infills, or any combination thereof, built pursuant to a permit application for a new building that was submitted before January 13, 1977.

Retrofit:

An improvement to a building by altering or adding structural elements to mitigate the deficiencies of these existing buildings.

Financial Help by PACE Program

What is PACE (Property Assessed Clean Energy)?

PACE allows for commercial and residential property owners to obtain financing for seismic retrofit improvements in addition to energy efficiency, water conservation, and renewable energy improvements.

Property owners participating in PACE receive financing through the PACE provider and repay the investment as an assessment added to the property tax bill.

How does PACE work?

To schedule a one-on-one meeting or to speak with someone to learn more about your options, call (877)785-2237 or email info@lapace.org.

http://lapace.org

Retrofitting Resources

LADBS Non-Ductile Concrete Retrofit Program:

http://ladbs.org/non-ductile

Ordinances:

Non-Ductile Concrete Retrofit Ordinance eff. 11/22/15 Ord. 183893:

http://clkrep.lacity.org/onlinedocs/2014/14-1697-S1_ord_183893_11-22-15.pdf

Substantial Structural Damage Ordinance eff. 5/11/16 Ord. 184169:

http://clkrep.lacity.org/onlinedocs/2014/14-1697_ord_184169_5-11-16.pdf

Structural Engineers Association of Southern California (SEAOSC) Find an Engineer:

http://www.seaosc.org/find-an-engineer

For additional information, please contact:

CITY LA DBS
DEPARTMENT OF BUILDING AND SAFETY

Non-Ductile Concrete Retrofit Unit
201 N. Figueroa St., Suite 880
Phone: (213)978-4475
Email: ladbs.nonductileconcrete@lacity.org

Office Hours:
7:30 am – 4:30 pm M, T, Th, F
9:00 am – 4:30 pm W
http://ladbs.org/non-ductile

For Tenant Habitability Plan and Cost Recovery Guide, contact the Housing and Community Investment Department (HCIDLA):

Los Angeles HOUSING+COMMUNITY Investment Department

Tenant Habitability Program Unit
(213) 252-1464
hcidla.code.seismic@lacity.org
http://hcidla.lacity.org/tenant-habitability-program

Cost Recovery Applications & RSO Information
(866) 557-RENT (7368)
hcidla.rso@lacity.org
http://hcidla.lacity.org

CITY OF LOS ANGELES FOUNDED 1781

Los Angeles Non-Ductile Concrete Retrofit Program

Property Owner's Guide

CITY LA DBS
DEPARTMENT OF BUILDING AND SAFETY

https://www.ladbs.org/services/core-services/plan-check-permit/plan-check-permit-special-assistance/mandatory-retrofit-programs/non-ductile-concrete-retrofit-program

Seismic Risk Mitigation Recommendations

Non-Ductile Concrete Retrofit Program

What is this program about?
The purpose of the program is to reduce the risk of injury or loss of life that may result from the effects of earthquakes on non-ductile concrete buildings. Non-ductile concrete buildings are a major contributor to earthquake losses around the world. In California, those constructed to building code standards earlier than the code improvements in 1976 are at particular risk for collapse and could pose significant life safety hazards. Non-ductile reinforced concrete buildings are brittle and have a limited capacity to absorb the energy of strong ground shaking beyond their limited elastic range, causing the likelihood of collapse and mortality for inhabitants. The program provides a guide for property owners and minimum standards to improve the performance of these buildings.

Why is my building affected?
LADBS has determined that your building meets all the following criteria:

- Building has concrete floors and/or roofs, either with or without beams, supported by concrete walls and/or concrete columns, and/or concrete frames with or without masonry infills, or any combination thereof; and,
- Built pursuant to a permit application for a new building that was submitted to the Department before January 13, 1977.

Exception: The program does not apply to detached single family dwellings or detached duplexes.

LADBS Services

Please visit the LADBS Non-Ductile Concrete Retrofit website at http://ladbs.org/non-ductile for the following information:

- Frequently Asked Questions
- LADBS Non-Ductile Concrete Building Checklist
- Plan Requirements

Property Owner's Responsibility

What do I need to do first?
The property owner must hire an engineer licensed by the State of California to:

- Evaluate the building, complete the LADBS "Non-Ductile Concrete Building Checklist", and submit it with the supporting documents required by the checklist to LADBS Non-Ductile Concrete Retrofit Unit within three years from the date of the "Order to Comply" letter.

What do I do next?
Within 10 years from the date of the "Order to Comply" letter, submit proof of previous retrofit in conformance with Chapter 85 or former 95 of the Los Angeles Building Code, a structural analysis showing compliance with the retrofit ordinance, structural analysis and plans to retrofit, or plans to demolish the subject building(s) to the LADBS. Plans and calculations will be checked for compliance with the Non-Ductile Concrete Retrofit Ordinance. LADBS will provide guidance for all necessary steps to obtain the retrofit permit, which includes obtaining clearances from pertinent agencies.

The property owner must notify the residential tenants of the building in writing per HCIDLA regulations prior to issuance of the building permit for the building retrofit.

What do I do after a permit is issued?
Begin construction and request inspections at the required phases of construction at: http://ladbs.org/

How do I find ...
An Engineer? Please visit the State of California's Board for Professional Engineers, Land Surveyors, and Geologists for information regarding licensed engineers: http://bpelsg.ca.gov
An Architect? Please visit the California Architects Board for information regarding licensed architects: http://cab.ca.gov
A Contractor? Please visit the Contractors State License Board for information regarding hiring a contractor and to verify if a contractor is licensed and insured: http://cslb.ca.gov

Compliance Requirements

How soon do I have to comply?

3 years
from the date of the Order to Comply
Submit completed LADBS Checklist along with the supporting documents required by the checklist.

↓

10 years
from the date of the Order to Comply
Submit:
- Proof of previous retrofit, or
- Structural analysis and detailed plans showing full compliance with the retrofit ordinance, or
- Plans to retrofit, or
- Plans to demolish.

↓

25 years
from the date of the Order to Comply
Complete construction and obtain Certificate of Compliance.

Submittal Package

What should I submit to LADBS?
The documents required for submittal are:

- Structural analysis/calculation package
- Architectural plans
- Structural plans and construction details

For more details, see the LADBS Information Bulletin for Submittal Requirements.

Appeal Process

What should I do if I think my building is exempt from the program?
The owner of the building can appeal within 60 days of the service date of the "Order to Comply" letter by submitting a written request to the Board of Building and Safety Commissioners. The request shall include supporting documents such as building permits for original construction or a building permit and final inspection approval for a prior retrofit that complies with the Non-Ductile Concrete Retrofit Ordinance.

What information do I need to provide to show my building is not subject to the Non-Ductile Concrete Retrofit Ordinance?
The following documents may be used:

- Provide building permit of the original (new) building showing plans were submitted to LADBS on or after January 13, 1977, or
- Provide proof that the building was previously retrofitted in full conformity with all the provisions in the 2017 LABC Chapter 85 or former Chapter 95 (Ordinance No. 171,260; No. 179,324; No. 172,592; and No. 182,850), or
- Provide a copy of the original building plans showing building construction is not of concrete construction.

Specific areas of the building construction will need to be verified by non-destructive testing or visual exposure and inspections made and approved by LADBS to verify the building construction is consistent with the plans.

The provided construction plans, test reports, and other supporting documentation shall be submitted to LADBS and a plan check fee will be required to review the provided documentation.

Seismic Risk Mitigation Recommendations

Definitions

Soft-Story Building:

A structure that has a weaker first floor and is unable to carry the weight of the stories above during an earthquake. The first floor generally has large openings in the perimeter walls such as garages, tuck-under parking or even large windows.

Retrofit:

An improvement to a building by altering or adding structural elements.

Tuck-Under Parking:

Parking that is beneath the second floor.

For additional information, please contact:

CITY LA DBS
DEPARTMENT OF BUILDING AND SAFETY

Soft-Story Retrofit Unit
201 N. Figueroa St., Suite 890
(213) 482-SOFT (7638)
soft-storyretrofit@lacity.org

Office Hours:
7:30 am – 4:30 pm M, T, Th, F
9:00 am – 4:30 pm W

http://ladbs.org/soft-story

For Tenant Habitability Plan and Cost Recovery Guide, contact the Housing and Community Investment Department (HCIDLA):

Los Angeles HOUSING+COMMUNITY Investment Department

Tenant Habitability Program Unit
(213) 252-1464
hcidla.code.seismic@lacity.org

http://hcidla.lacity.org/tenant-habitability-program

Cost Recovery Applications & RSO Information
(866) 557-RENT (7368)
hcidla.rso@lacity.org

http://hcidla.lacity.org

CITY OF LOS ANGELES FOUNDED 1781

Los Angeles Soft-Story Retrofit Program

Property Owner's Guide

CITY LA DBS
DEPARTMENT OF BUILDING AND SAFETY

https://www.ladbs.org/services/core-services/plan-check-permit/plan-check-permit-special-assistance/mandatory-retrofit-programs/soft-story-retrofit-program

Seismic Risk Mitigation Recommendations

Soft-Story Program

What is this program about?

The purpose of this program is to reduce the risk of injury or loss of life that may result from the effects of earthquakes on wood frame soft-story buildings. In the Northridge Earthquake, many wood frame soft-story buildings caused loss of life, injury, and property damage. This program creates a guide for property owners to strengthen their buildings to improve performance during an earthquake.

Why is my building affected?

LADBS has determined that your building meets all the following criteria:

- Two or more stories wood frame construction;
- Built under building code standards enacted before January 1, 1978,
- Contains ground floor parking or other similar open floor space that causes soft, weak or open wall lines.

Exception: The program does not apply to residential buildings with 3 or less units.

Property Owner's Responsibility

What do I need to do first?

The property owner must hire an engineer or architect licensed in the state of California to evaluate the strength of the building. The engineer or architect must then develop plans for the building's seismic strengthening in compliance with this program. The owner must notify tenants in writing per HCID-LA regulations.

How do I find ...

An Engineer?

Please visit the State of California's Board for Professional Engineers, Land Surveyors, and Geologists for information regarding licensed engineers:

http://bpelsg.ca.gov

An Architect?

Please visit the California Architects Board for information regarding licensed architects:

http://cab.ca.gov

A Contractor?

Please visit the Contractors State License Board for information regarding hiring a contractor and to verify if a contractor is licensed and insured:

http://cslb.ca.gov

What do I do next?

Submit proof of previous retrofit, plans to retrofit, or plans to demolish to the Department of Building and Safety. Plans and calculations will be checked for compliance with the retrofit ordinance. LADBS will provide guidance for all necessary steps to obtain the retrofit permit, which includes obtaining clearances from all pertinent agencies.

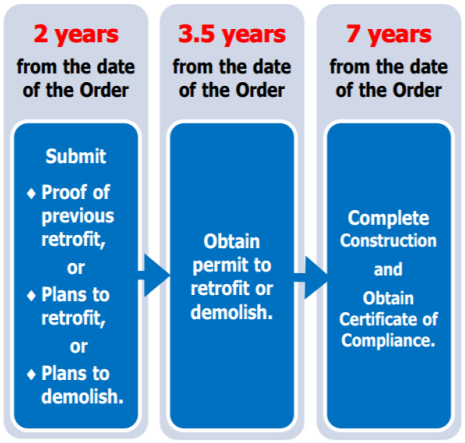
What do I do after a permit is issued?

Begin construction and request inspections at:

http://ladbs.org/

Compliance Requirements

How soon do I have to comply?



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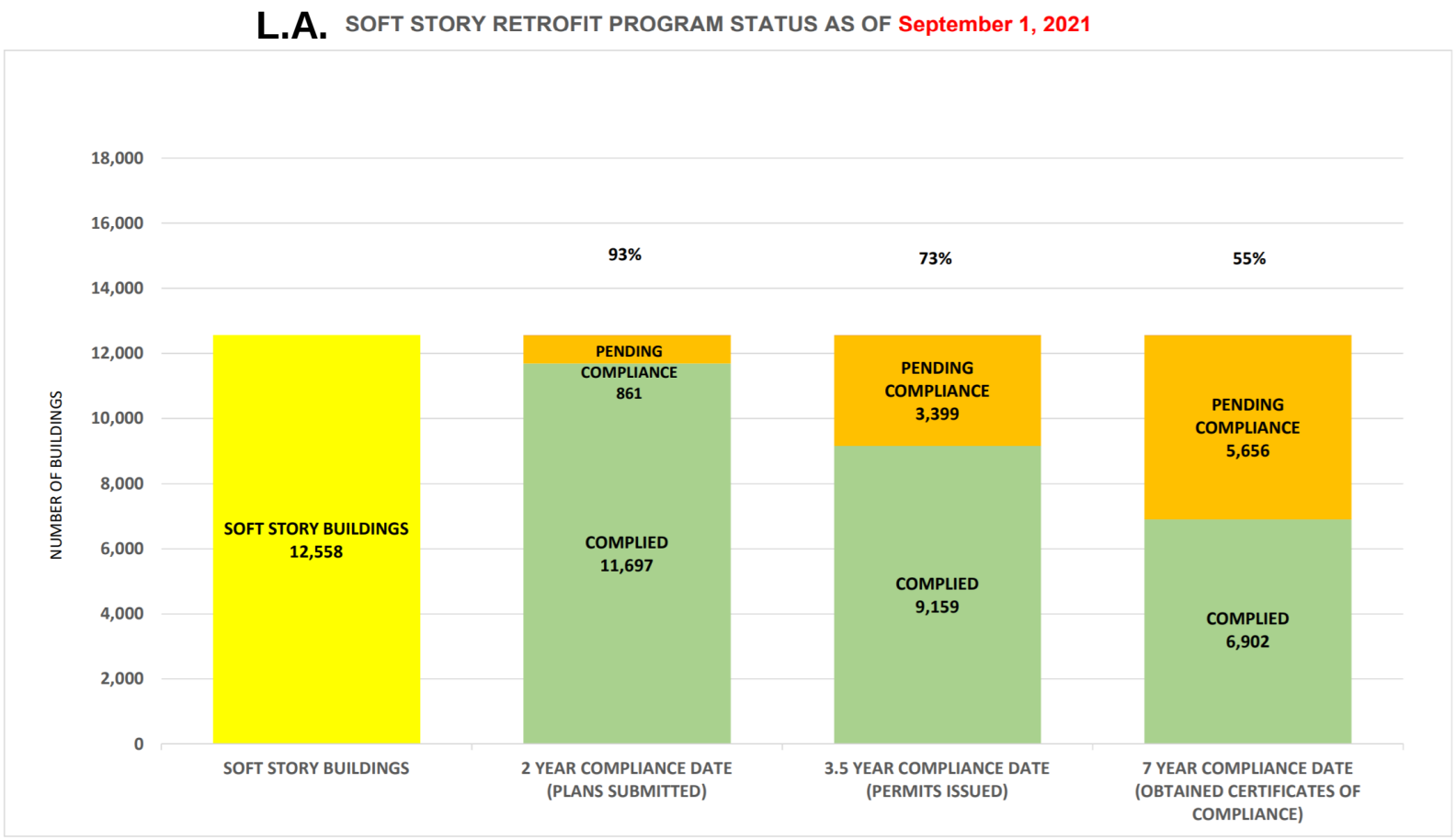
Seismic Risk Mitigation Recommendations



https://www.ladbs.org/services/core-services/plan-check-permit/plan-check-permit-special-assistance/mandatory-retrofit-programs/soft-story-retrofit-program

Seismic Risk Mitigation Recommendations

SO!

Prior to/In Parallel to Policy Legislations:

Short term

F. RESEARCH NEEDED

✓ **FUND RESEARCH: PRIORITIZE AND CATEGORIZE BUILDINGS**

- Cheaper
- More efficient
- Don't need RVS and ASCE 41 TIER in ALL buildings, just the vulnerable

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Long term

A. New Construction and Upgrades

- ✓ Must follow IBC 2021 by the end of 2022, **allover Alaska**

State/city councils/communities should utilize the new FEMA Building Resilient Infrastructure & Communities (BRIC) program to regulate the new legislations.

B. Existing Non-engineered Publicly Accessible Buildings

- ✓ Tax incentives, state/federal assistance programs, FEMA BRIC program, a special seismic retrofit grant (similar to Oregon's), or permit fees
- ✓ Partial subsidy for long-term retrofit plans
- ✓ By 2028, seismic retrofit or demolition of should be completed.

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Long term

C. <u>Existing Non-engineered (OR pre-UBC 1979) Single Family Houses</u>

- ✓ By 2023: State legislation to enforce seismic assessment should be issued.
- ✓ By 2026: Owners should submit structural plans/assessment reports with adequate capacity, or seismic retrofit or demolition plans.
- ✓ Assessment and Retrofit Funding?

  Tax incentives, state/federal assistance programs, FEMA BRIC program, special seismic retrofit grant, permit fees: partial retrofit subsidy
- ✓ By 2033: all seismic retrofits or demolitions should be completed.

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Long term

D. <u>Existing Pre-UBC 1997 Older Engineered Essential Facilities and "Alaska Critical Infrastructure"</u>

- ✓ Tailored state seismic retrofit plan: <u>(MUST BE INFORMED BY RESEARCH)</u>
  Prioritize retrofit based on seismic risk, budget, impact of building failure
- ✓ Can be implemented incrementally over 2022-2030.
  An example: FEMA 395, Incremental Seismic Rehabilitation of Schools
- ✓ By 2030, retrofit to achieve Life Safety performance,
  or change use: no longer an essential facility or Alaska Critical Infrastructure.

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Long term

E. <u>Existing non-engineered/Older Engineered Private Buildings</u>

- ✓ Based on new legislation for (pre- UBC 1979 buildings and pre- UBC 1997 steel buildings), a seismic retrofit plan should be implemented

  (CAN BE INFORMED BY RESEARCH)

  Prioritize retrofit based on seismic risk, occupancy, impact of building failure
- ✓ Can be implemented incrementally over 2022-2033.

  An example: FEMA 395, Incremental Seismic Rehabilitation of Schools
- ✓ By 2033, 80 percentile most vulnerable should be retrofitted or demolished

Seismic Risk Mitigation Recommendations

- **General Existing Buildings Issues:**

✓ All CMU connections inspected/reviewed

✓ Known structural deficiencies (non-ductile, soft/weak story, URM, pre-Northridge welds, etc.)

✓ Equipment/Liquid storage units restraints code provisions update

✓ Problematic soil issues/ liquefaction maps

✓ Pre-1990 non-seismic details city vulnerability studies

✓ Non-structural issues

✓ Post-earthquake thorough structural assessment triggers (age, PGA, soil, etc)

✓ Non-engineered buildings: (Staged Improvement)

Homeowner/contractor seismic safety improvement leaflet

Seismic review/upgrade incentives/tax relief/subsidies

Seismic upgrade funds

Seismic upgrade ordinance: enforced by 2030-2033

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Recommendations to Improve Transportation Seismic Safety/Resilience

- ✓ Alaska should invest in seismic upgrade of critical/aging roads and bridges (prioritize seismic retrofit based on risk, budget, and projected impacts)
- ✓ Uncompacted/poorly compacted fill problems: identify and fix.
- ✓ Need informed decisions in emergency planning under the MCE on the seismic vulnerability of essential/critical roads and bridges designed with old codes
- ✓ Alaska is encouraged to follow other states experience in transportation seismic risk mitigation policy.
- ✓ Consult policy recommendations by WSSPC, EERI, NEHRP, and FEMA
- ✓ Seismic retrofit plan can be incremental based on budget over the period of 2021-2035. An example incremental seismic retrofit plan is FEMA 395
- ✓ By 2030, transportation should be upgraded to an acceptable seismic safety level.
- ✓ Transportation system redundancy is a critical need for some parts of SC Alaska.
- ✓ DOT is encouraged to utilize novel bridge materials/systems such as self-centering bridges, base-isolation, UHPC, and shape-memory alloys.

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Recommendations to Improve SCHOOL Seismic Safety/Resilience

- ✓ Older schools must be seismically evaluated and strengthened or replaced if needed
  Tools such as FEMA P-154 RVS, ASCE 41 Tiers and FEMA 395 can be used
- ✓ The State should seismically upgrade all older schools built prior to IBC-2000.
- ✓ Upgrading pre-UBC 1979 schools and pre-UBC 1997 steel frame schools is essential to avoid catastrophic losses during future strong earthquakes.
- ✓ Schools identified as post-earthquake shelters for the public must be updgraded to essential facilities seismic performance level
- ✓ More attention must be paid to nonstructural components seismic design.
  The majority of damage and most injuries were due to nonstructural failures.
- ✓ Nonstructural damage even below 60% of the DBE may not be "Life Safe."
  Examples: CMU blocks dislodged. Heavy ceiling tiles falling from high elevations.
- ✓ Seismically designed/upgraded schools reduce 3Ds (damage, downtime and death)
- ✓ Anchoring heavy shelving and furniture should be required in all schools.
- ✓ All schools should have preparedness programs, tested with drills.

Seismic Risk Mitigation Recommendations

Policy Legislations Needed

Recommendations to Improve HOSPITAL Seismic Safety/Resilience

- ✓ Very heavy nonstructural/water damage under MCE event seems a serious concern
- ✓ Serious structural damage in older hospitals is a concern during an MCE scenario.
- ✓ Functionality of all region's ERs after an MCE event is a concern.
- ✓ Follow-up hospital earthquake impact surveys are still needed to be performed.
- ✓ Hospital interviews did not imply the presence of full-functioning post-earthquake response plans. Chile's hospital earthquake response procedure is recommended.
- ✓ Backup communication plans that assume network failures do not seem to be in place in every major hospital.
- ✓ Mat-Su Regional Medical Center is not redundant. Post-earthquake communication and patient and medical supply transport plans should be in place.
- ✓ All hospital response plans should consider severe weather conditions in the winter.
- ✓ To improve hospital seismic performance, Alaska can use:

NIST Special Publication 1224	California (OSHPD) guides
Oregon Resilience Plan 2013	Several FEMA hospital earthquake safety guides

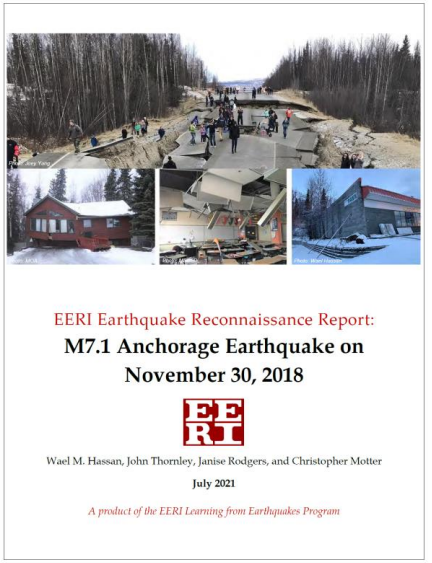
Seismic Risk Mitigation Recommendations

- **Need more details and insights?**

- **EERI Field Reconnaissance Report, *Hassan et al. 2021***

https://www.researchgate.net/publication/353958714_EERI_Earthquake_Reconnaissance_Report_M71_Anchorage_Earthquake_on_November_30_2018

http://www.learningfromearthquakes.org/2018-11-30-anchorage-alaska/index.php?option=com_content&view=article&id=72



- Earthquake Spectra Papers:
  Schools → *Rodgers et al. 2021*
  Structural → *Hassan et al. 2021*
  Non-structural → *Hassan et al. 2022*
- Contact me: **Dr. Wael Hassan,** wmhassan@alaska.edu

ACT NOW BEFORE THE BIG ONE

Thank You