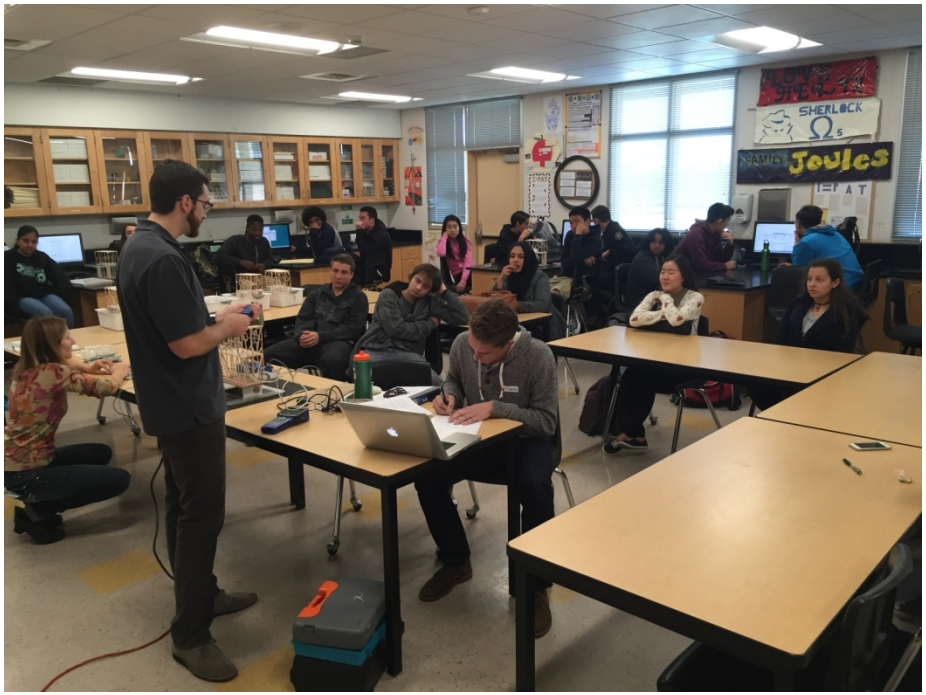
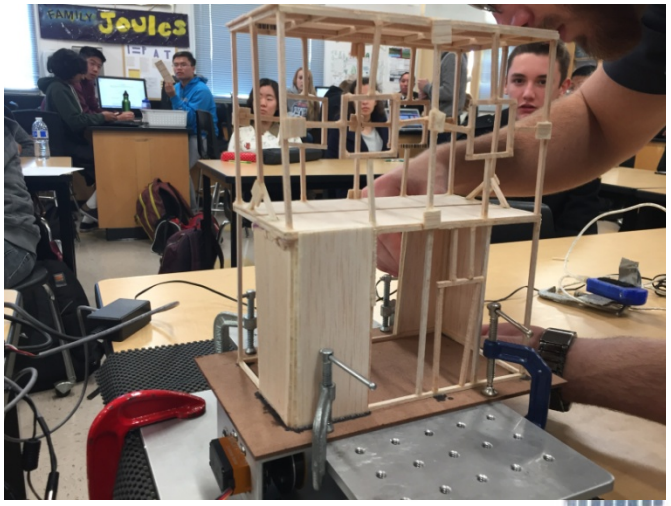
School Earthquake Safety Initiative

Webinar, July 12, 2016

promoting safe buildings for school children

eeri.org/schools



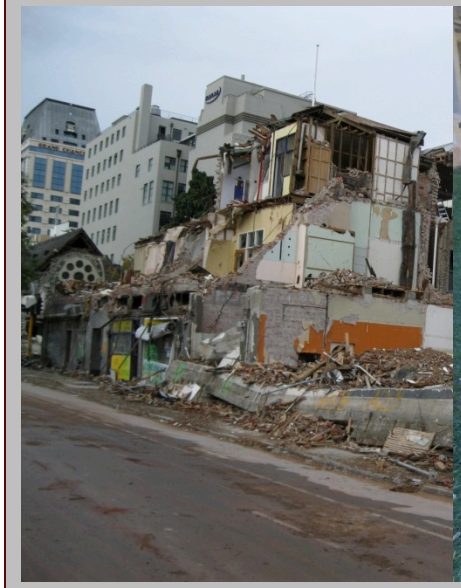


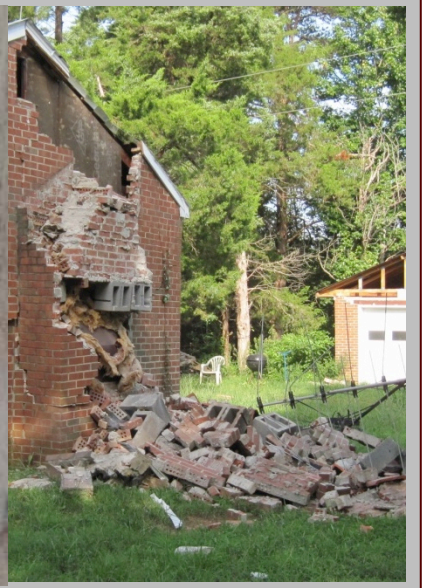




About EERI

- Global earthquake engineering institute
- Nonprofit, technical membership society
- Dedicated to reducing earthquake risk



EERI's Mission

EERI's mission is to reduce earthquake risk by:

1. Advancing the science and practice of earthquake engineering
2. Improving understanding of the impact of earthquakes
3. Advocating comprehensive and realistic measures for reducing earthquake effects







Our Mission, Vision & Goals

What is SESI?

- SESI is a global and collaborative network of diverse, expert, and passionate professionals who are committed to creating and sharing knowledge and tools that enable progressive, informed decision making around school earthquake safety.

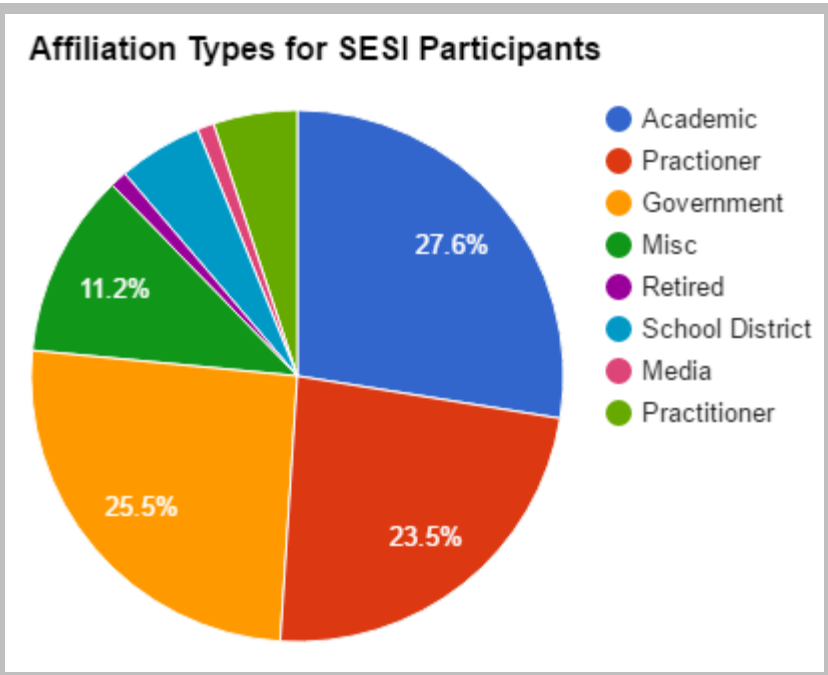
Our Goal:

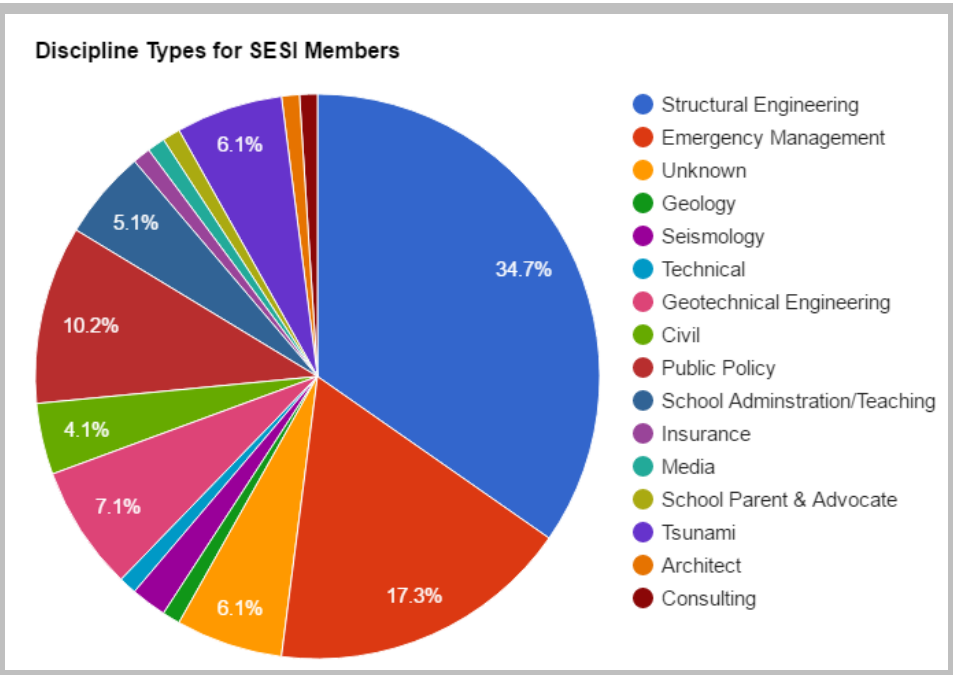
- Leverage our extensive expertise and reputation to conduct regionally appropriate actions that make a tangible and positive difference in communities around the world, by protecting the lives of all who inhabit school buildings.

Our Vision:

- Serving the world as a leader in the science, public policy, and advocacy of school earthquake safety.

The SESI Network

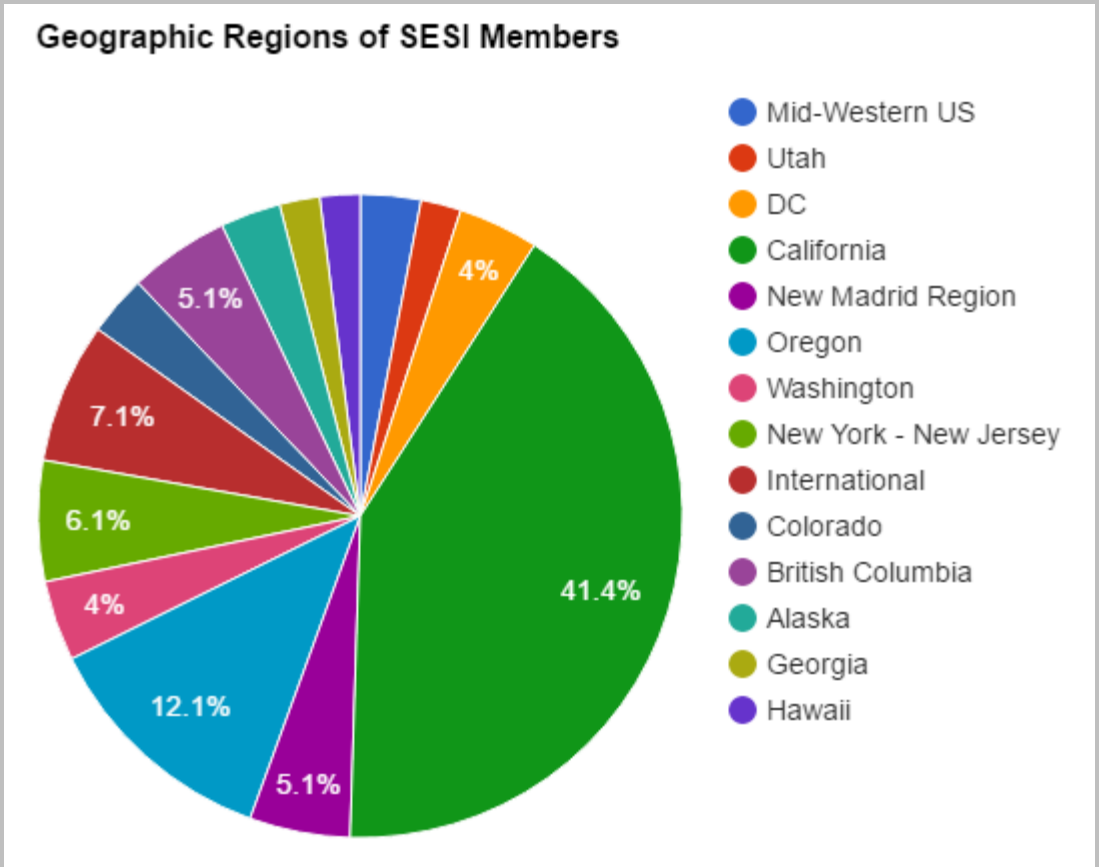




100+

SESI Members as of April 2016

The SESI Network



SESI Subcommittees

- **Safety Screening, Inventory, and Evaluation**

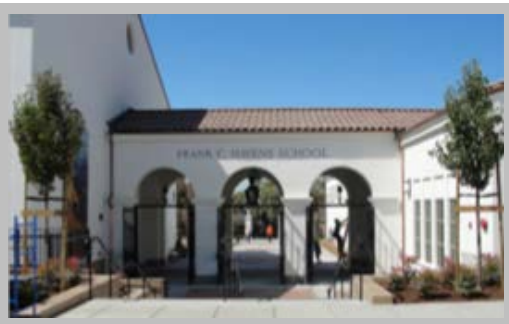
  Chair: *Ken Goettel*

  Charge: Promote use of screening methodologies to efficiently identify school buildings with seismic risk.

- **Code Updating and Improvements**

  Chair: *Rob Jackson*

  Charge: Advocate for code improvements and implementation practices that will enhance school safety.



New Havens Elementary School, Piedmont, California was retrofitted in 2012



Portland, Oregon's Franklin High School will be rebuilt using school bonds approved in 2012.

SESI Subcommittees

- **Classroom Education & Outreach**

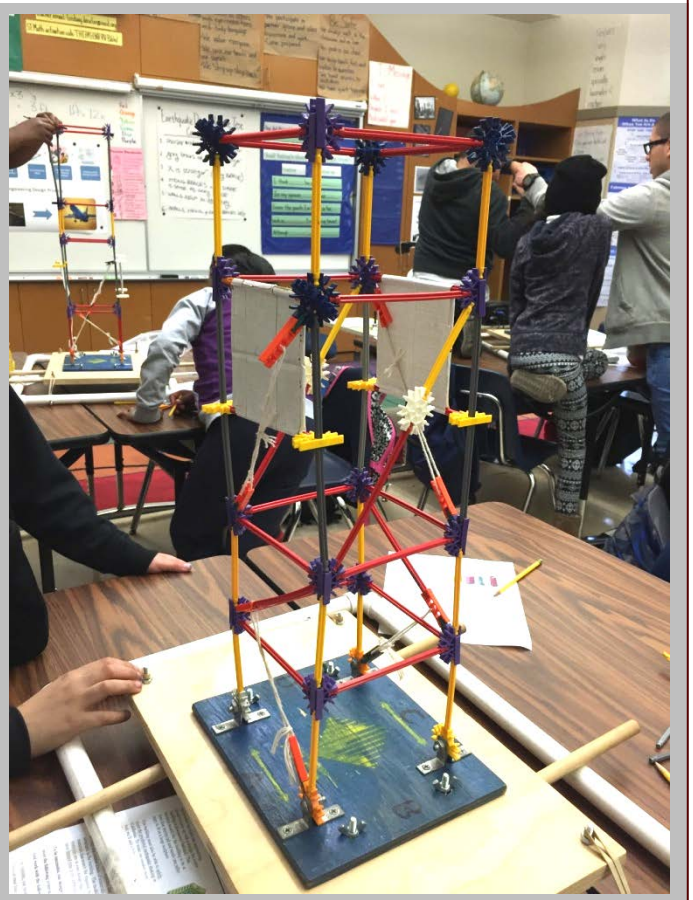
  Chairs: *Lelli Van Den Einde & Thalia Anagnos*

  Charge: Use classroom education to develop advocates for earthquake school safety.

- **Tsunami Mitigation for Schools**

  Interim Chair: *Yumei Wang*

  Charge: Support schools with tsunami hazard by provide them access to experts and sharing best practices for tsunami risk mitigation.



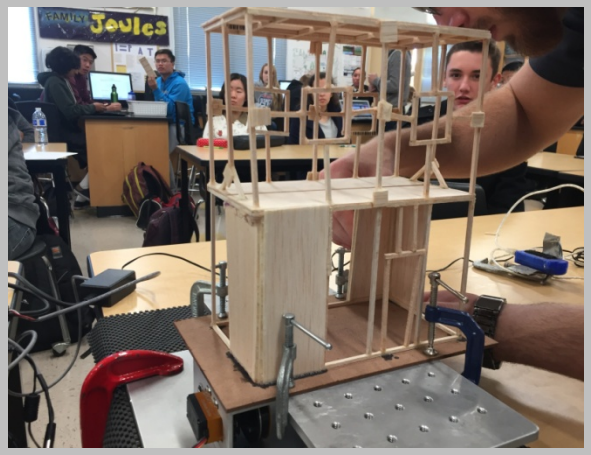
SESI Members teach 4th grade students about earthquake engineering design

2016 Goals & Action Plan

In 2016, SESI will focus on the following key efforts:

1. Establishing funding for ongoing SESI operations
2. Outreach to current SESI members and participants via the Program Committee to increase their involvement.
3. Finalize the SESI working products including screening case studies, classroom curriculum, and guidance documents.
4. Shake-Out involvement.
5. Outreach to stakeholder community.

How Can I Contribute?



- Subscribe to our mailing list to stay up to date with our activities and look out for opportunities to contribute!
- Contact Barry Welliver, Subcommittee Chairs, or Heidi Tremayne to get involved.
- Anyone interested in school earthquake safety is encouraged to participate!
- Visit eeri.org/schools for more info.

Webinar Briefing Speakers & Agenda

1. **Introduction** by Barry Welliver, *Structural Engineer, BHW Engineers*
2. **SESI Subcommittees** by SESI Subcommittee Chairs
   - **Screening, Inventory & Evaluation** – Barry Welliver, *on behalf of Ken Goettel, Goettel & Associates*
   - **Tsunami Mitigation for Schools** –Barry Welliver, *on behalf of Yumei Wang, DOGAMI*
   - **Classroom Education & Outreach** –Lelli Van Den Einde, *Professor, UC San Diego*
   - **Code Updates & Improvements** – Rob Jackson, *Supervising Structural Engineer, AECOM*
3. **Thurston County School Seismic Safety Evaluations** by Cale Ash, *Principal, Degenkolb Engineers*
4. **Partnering to Perform Rapid Visual Screenings of Alaska's Schools** by Laura Kelly, *Alaska Seismic Hazards Safety Commission*
5. Question & Answer Session

SESI Subcommittees: Screening, Inventory & Evaluation of Schools Subcommittee

BARRY WELLIVER, BHW ENGINEERS

(On behalf of Chair Ken Goettel)





Overview & Goals

- Facilitate and encourage implementation of risk reduction measures by developing and helping to carry out stepwise screening methodologies to identify school buildings with the highest seismic risk efficiently while minimizing the effort and expense for school districts.
- Document case studies of best practices in school safety screening and evaluations
- Use these case studies as a base to create EERI's guidelines to new advocates of seismic safety

Action Plan

- The Screening Subcommittee recently completed documenting case studies of screening programs in several US states, including Alaska, California, Oregon, Washington & Utah.
- The next step is to create EERI's specific guidelines for individuals who are new to the field of school seismic safety to facilitate them in making decisions about their own unique situation.
- Continue and expand outreach to school districts and other stakeholders.

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SESI Subcommittees: Tsunami Mitigation for Schools Subcommittee

BARRY WELLIVER

(On behalf of Chair Yumei Wang)



Overview & Goals

- Support schools with tsunami hazard by provide them access to experts and sharing best practices for tsunami risk mitigation.
- Funding provided from the Coastal Zone Foundation
- Phase 1: Identifying Schools with Tsunami Risk has been completed. 190 at-risk schools identified in Alaska, California, Hawaii, Oregon and Washington using ASCE Tsunami Design Zones and local state evacuation maps.
- 2016 Goal: Outreach and mitigation for identified schools at risk.

Tsunami Mitigation Paper

- "Advocacy for tsunami mitigation and preparedness of U.S. schools along the pacific rim" paper submitted to the 16th World Conference on Earthquake Engineering, Chile, 2017.

  - Authors: Zahraa Saiyed, Shizza Fatima, Karen Izumoto, Ian Robertson, Barry Welliver, Heidi Tremayne.
  - The information will be shared with members of the National Tsunami Hazard Mitigation Program this month by Dr. Ian Robertson, University of Hawaii at Manoa.



Google Earth image showing locations of Schools in Huntington/Newport, Southern California

Outreach

- Each state's tsunami leads requested to review the paper and provide feedback to SESI.
- The subcommittee members will work with state's tsunami leads to provide info to schools in tsunami zones, and depending on the state tsunami leads, SESI may work directly with local school districts.
- If you are a tsunami mitigation professional in any of the US West Coast states, and would like to be involved, please contact Shizza Fatima at shizza@eeri.org.

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Classroom Education & Outreach Subcommittee

- Use Education in the classroom to:
  - ***Create ongoing dialog with parents, teachers, and administrators*** about earthquake safety
  - ***Grow advocates*** for school earthquake safety



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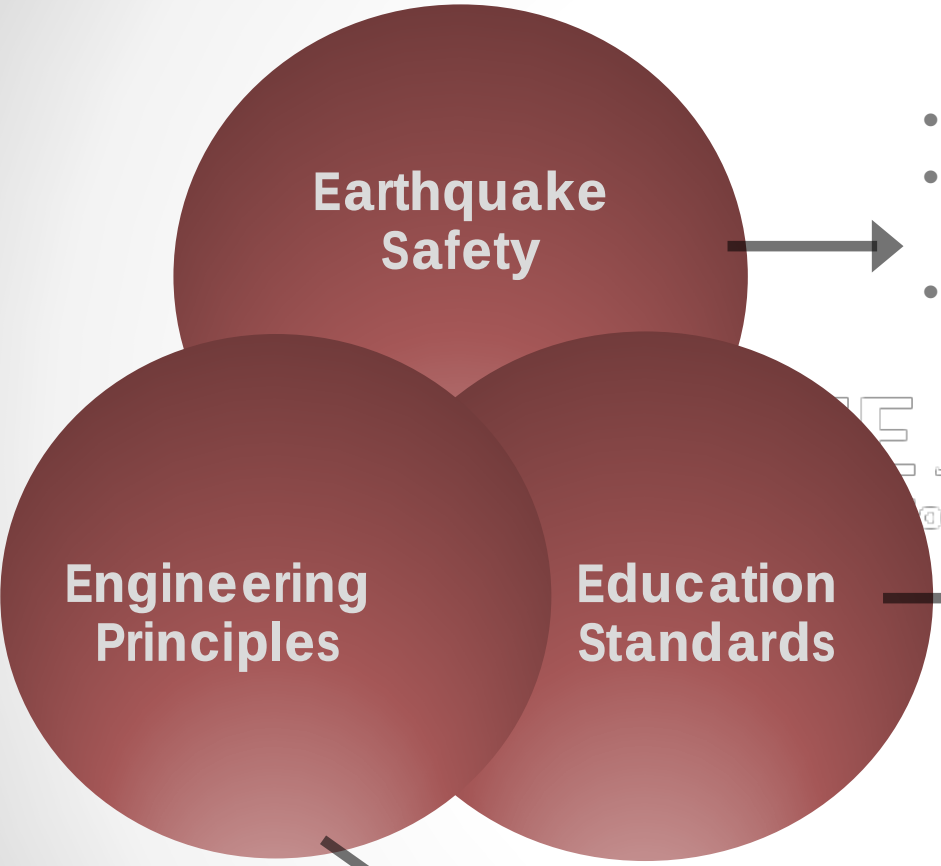
Curriculum Objectives



- "Grassroots" side of SESI.
- Make connections with schools to aid in future efforts.
- Incorporate Earthquake science and safety topics.

- Create a Win-Win situation.
- Give school immediate benefit.
- Satisfy latest education standards including Next Generation Science Standards and Common Core
- Complete curriculum in 2-4 visits.

- Develop exciting, hands-on, project based engineering curriculum.
- Utilize shake table technology to aid instruction.

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4th Grade Curriculum

- Leverages curriculum developed at UC Berkeley under NEES education and outreach program.
- Educational curriculum specialist from local non-profit group provided guidance on appropriate vocabulary, supplemental worksheets, and delivery strategies to optimize implementation in the classroom.
- Curriculum aligned with Next Generation Science Standards (NGSS)
  - For 4th grade specifically suggests designing earthquake resistant buildings as a way to meet standard 4-ESS3-2

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Visit 1: 90 min Lesson

- Introduce earthquakes, engineering process, and design elements
  - Test concepts to develop ideas for strengthening buildings.
  - Scaffolding provided through visuals of vocabulary and demonstrations, using worksheets to help students focus on key observations and develop background knowledge.

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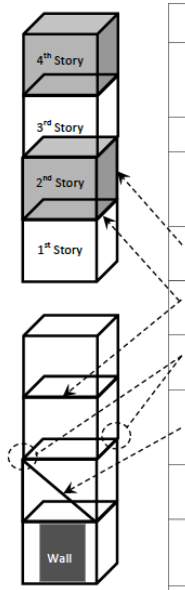
nees@berkeley

Vocabulary List

PEER peer.berkeley.edu



Engineering Term	Definition
Earthquake	A sudden, rapid shaking of the Earth's surface caused by energy released from movement in the Earth's crust
Seismograph	The instrument used to monitor earth movements.
Building Story	Any level space in a building above ground that could be used by people. For example, a two-story building has a first story above the ground and second story below the roof.
Column	Thin vertical elements that help support the weight of a building floor or level.
Beam	Horizontal elements that support the weight of a building floor or level.
Joints	Locations where a column, beam or brace connect together.
Brace	A diagonal building element that extends between two building levels and provides extra stiffness. A brace can be a single diagonal /, V, or X shape.
Wall	A flat vertical element that supports the weight of a building level and provides extra building stiffness.
Shaking Table or Earthquake Simulator	A platform used to test building design and material performance during earthquake shaking.

Group 1: Column and Building Height Tests

DATA TABLE

Test #	Picture or Name	Weakness Notes for Observation Shake *Describe any observed building weaknesses. Where did it move the most (top story, bottom story, side C, etc.)? Did the building twist?*	Failure Notes for Earthquake Shake *Describe the failure mechanism. **How** did the building move during the shake test? **How** did it fail?*
1	Use 4 Yellow, Shorter Rods at top story		
2	Move Yellow Rods to bottom story		
3	Use 4 of longest Grey Rods, Instead of Yellow		
4	Add another red column story		

Visit 2: 90 min Lesson

- Students provided with challenge to design earthquake-resistant building, use data from different design choices to make group decision about final design solution.
  - Students define design problem, develop model & testing plan, test alternate ideas, analyze data and discuss solutions, communicate design solution.
  - Scaffolding provided through visuals of vocabulary and demonstrations, using worksheets to help students communicate testing results and discussion to make evidence-based conclusions.

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4th grade curriculum



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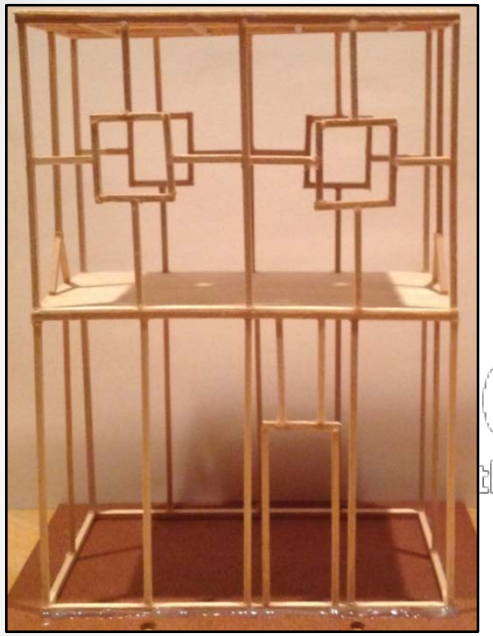
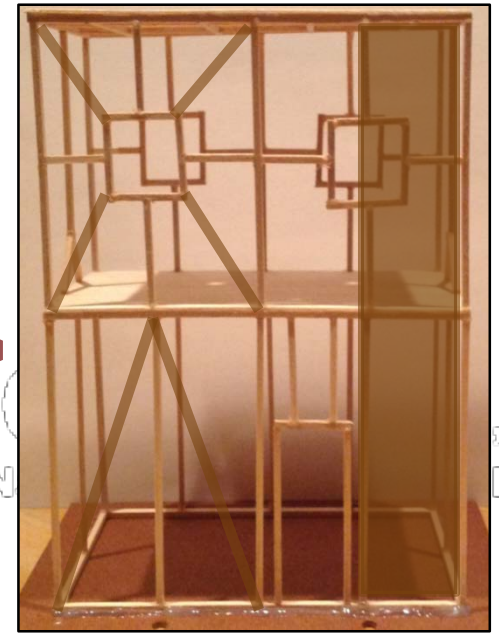
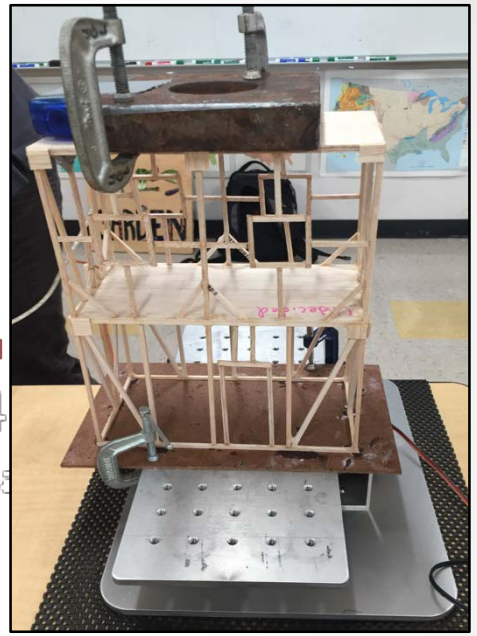
High School Physics Curriculum



Basic Balsa Structure



Retrofit



Structure Testing

Teams compete to maximize a Performance Index (PI) based on weight (W), cost (C), and number of survived tests (N).

$$PI = \frac{25N^{1.5}}{WC^2}$$

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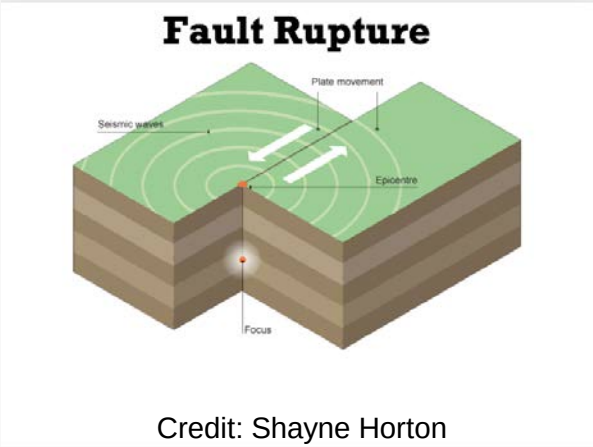
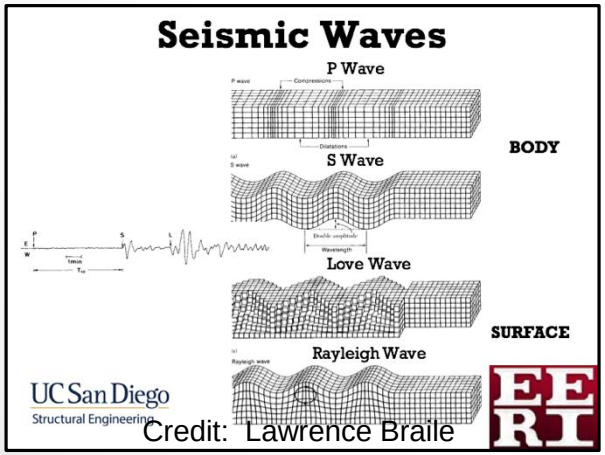
Visit 1

Preliminary Concept Lesson



Credit: Shayne Horton

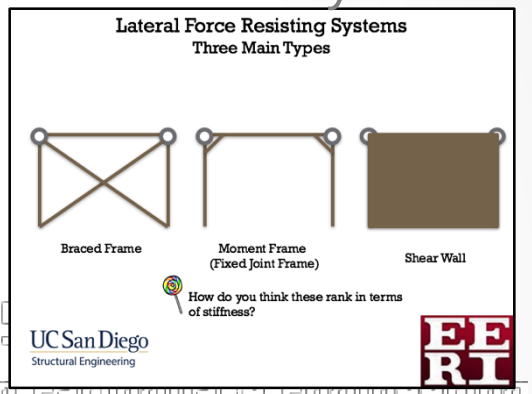


Credit: Lawrence Braile

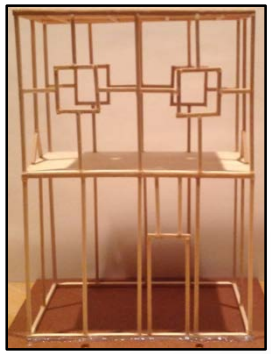
Visit 2

Concept Lesson

Structural Systems



Shake Table Demonstrations





Project Introduction

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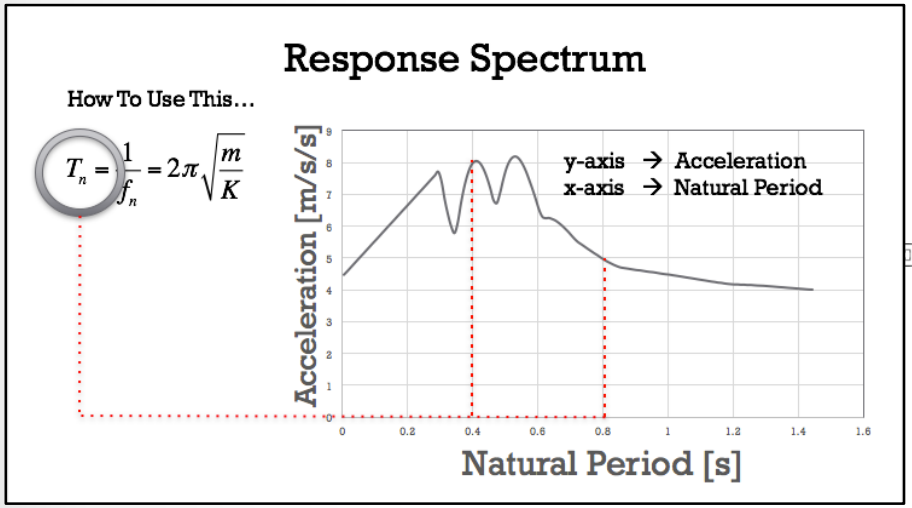
Visit 3

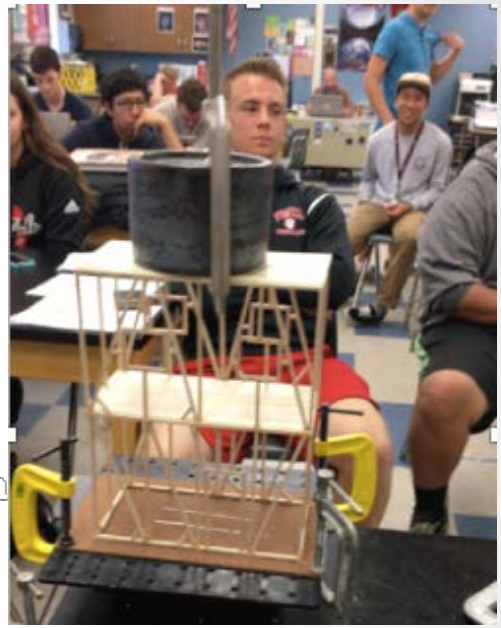
Concept Lesson

Predicting the Behavior of Structures during Earthquakes



Visit 4

Shake Table Testing & Competition Finale





July 21-25, 2014

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Broad Implementation

- Make use of EERI student and professional regional chapter membership to complete lesson delivery
  - > 60 EERI Student and 13 EERI Regional Chapters
  - Student chapters: civil and geotechnical engineering students obtaining undergraduate, masters and PhD degrees.
  - Regional chapters: professional engineers, geoscientists, architects, planners, public officials, and social
  - Use chapter internal organizational structures and annual leadership transfer to facilitate sustainability of program over time.

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Future Work

- Advocating adoption of tool kits by additional chapters
  - Use existing pilot student chapters to train new student chapters on outreach implementation.
  - Work with teachers who can self-deliver lessons.
- A plan for broader dissemination, sustainability, sharing and maintenance of resources will be developed
- Ongoing assessment will occur resulting in improvements to tool kit lessons and delivery strategies.
- Once 4th grade and high school curricula are well developed, a tsunami module developed by NEES@Oregon might be added

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Acknowledgements

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- Work forming basis for this publication was also conducted pursuant to a contract with the Federal Emergency Management Agency (FEMA). Substance of such work is dedicated to the public.
  - The author(s) are solely responsible for the accuracy of statements or interpretations contained in this publication. No warranty is offered with regard to the results, findings and recommendations contained herein, either by the Federal Emergency Management Agency, the Applied Technology Council, its directors, members or employees. These organizations and individuals do not assume any legal liability or responsibility for the accuracy, completeness, or product or processes included in this publication.

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- Thanks also to members of the SESI Classroom Subcommittee who are helping to further launch this curriculum in 2016, including: Eduardo Vega, Vincente Pericoli, Ivan Wong, and Barry Welliver.

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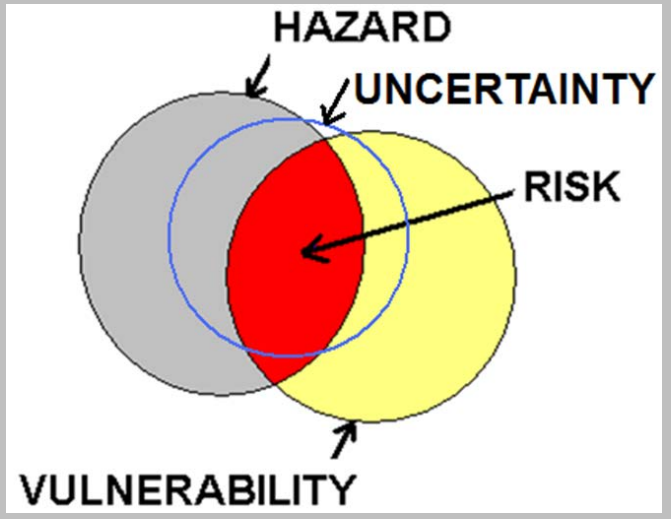
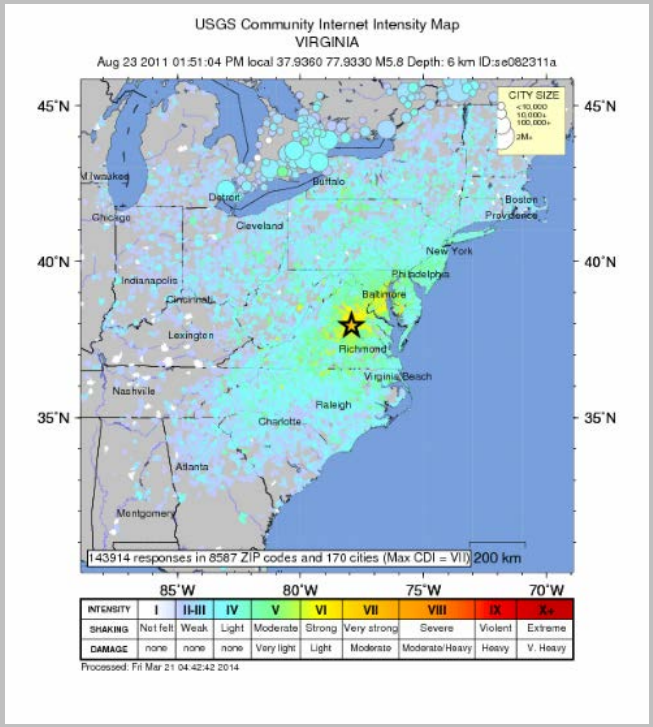
Code Updates and Improvements: Why is this important for schools?

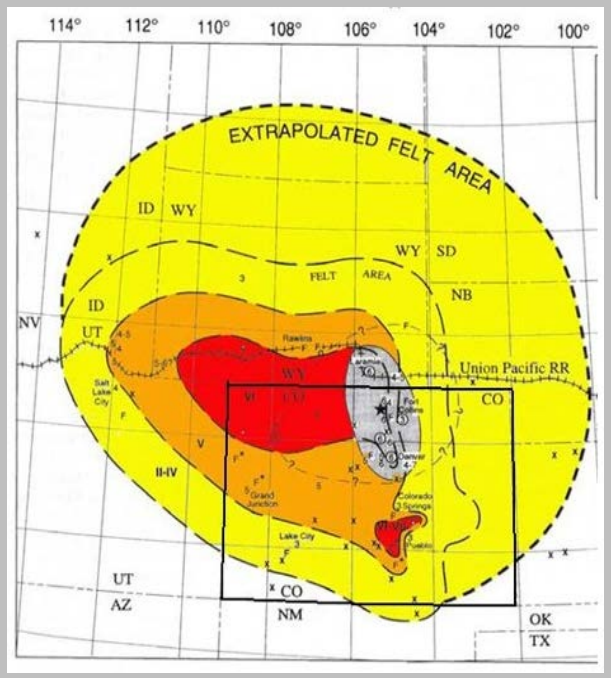
- The most significant code changes are often a result of the earthquakes themselves. These changes may be only in the hazard maps or may extend to the details of design and analysis. But the changes are then "after the fact."
- Schools cannot really afford to have changes implemented "after the fact." As has been stated and written repeatedly, the US has been very fortunate in that earthquakes have been occurring when school is not in session.
- Code changes take years to be created, reviewed, vetted and implemented. Then the code cycle may extend the time even further. Code changes are currently on a six year cycle.



Unexpected earthquakes: actually they are almost all unexpected

- **Risk mitigation.** The hazard maps are only the starting point.





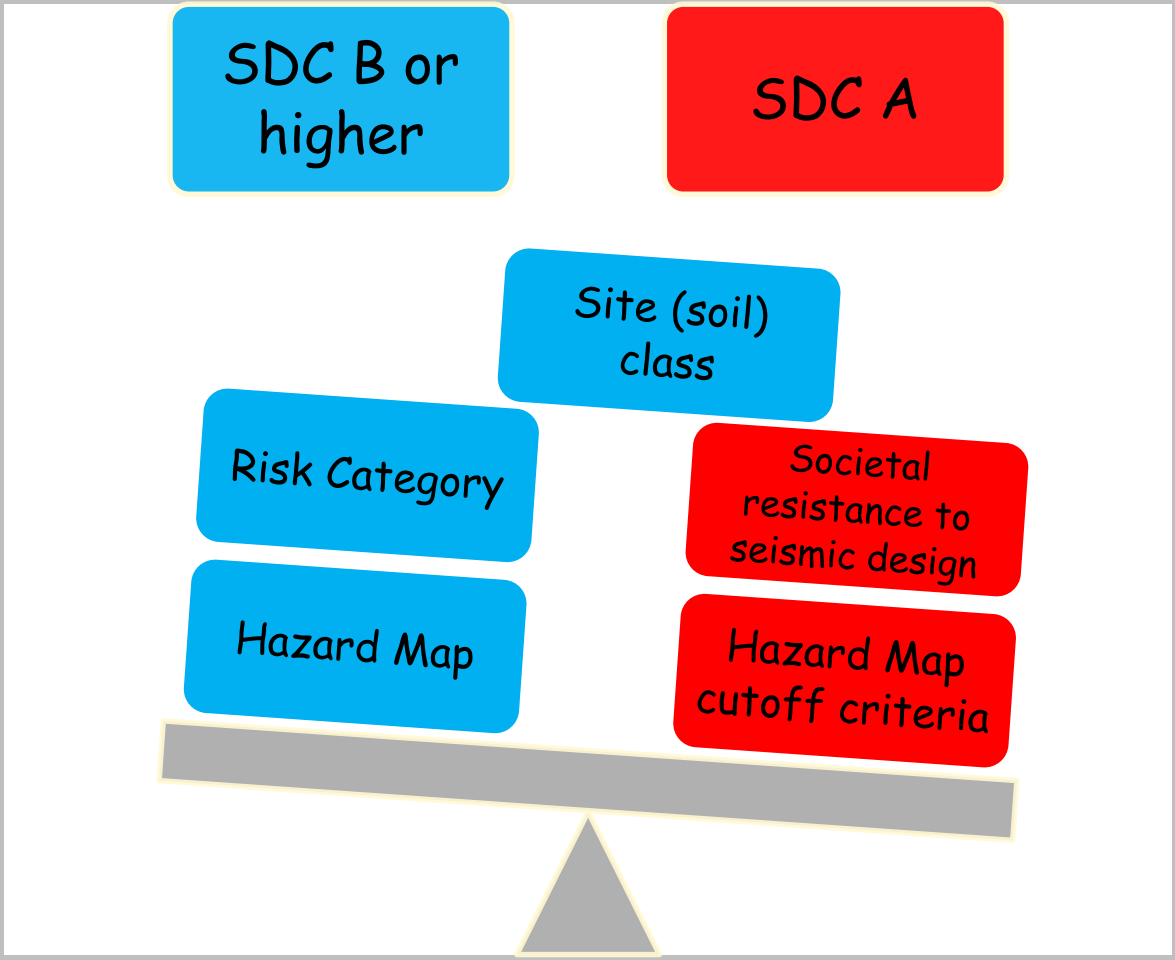
- The 1882 ± 6.6M Colorado earthquake is an example of an historic earthquake that is not heavily weighted in the hazard maps.

Code Updates and Improvements: Discussion and focus items

- A **minimum Seismic Design Category** for schools?
- Risk of potentially life threatening **non-structural hazards** for children sheltering in place
  - ✓Code - suspended ceilings, pendant light fixtures, etc.
  - ✓Non-code – bookcases, file cabinets, TV monitors, etc.
- Identification and **screening** of existing school buildings especially those that are planned for use as post-earthquake public shelters (Risk Category IV).



Factors influencing the choice of Seismic Design Category A



Quotes to ponder

"Civilizations exist based on geologic consent subject to change without notice." - William Durant

"Earthquake mitigation must be perceived as a 'fundamental good.'" - Frank McClure

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THURSTON COUNTY SCHOOL SEISMIC SAFETY EVALUATIONS

Cale Ash, P.E., S.E.
Office Director & Principal
Degenkolb Engineers, Seattle

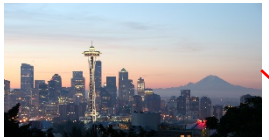
Project Overview

Goal:

1. Assess earthquake risk of schools in Thurston County
2. Develop screening process for "at risk" school buildings in Washington
3. Increase awareness of earthquake risk posed by existing school buildings

Agencies & Organizations Involved:

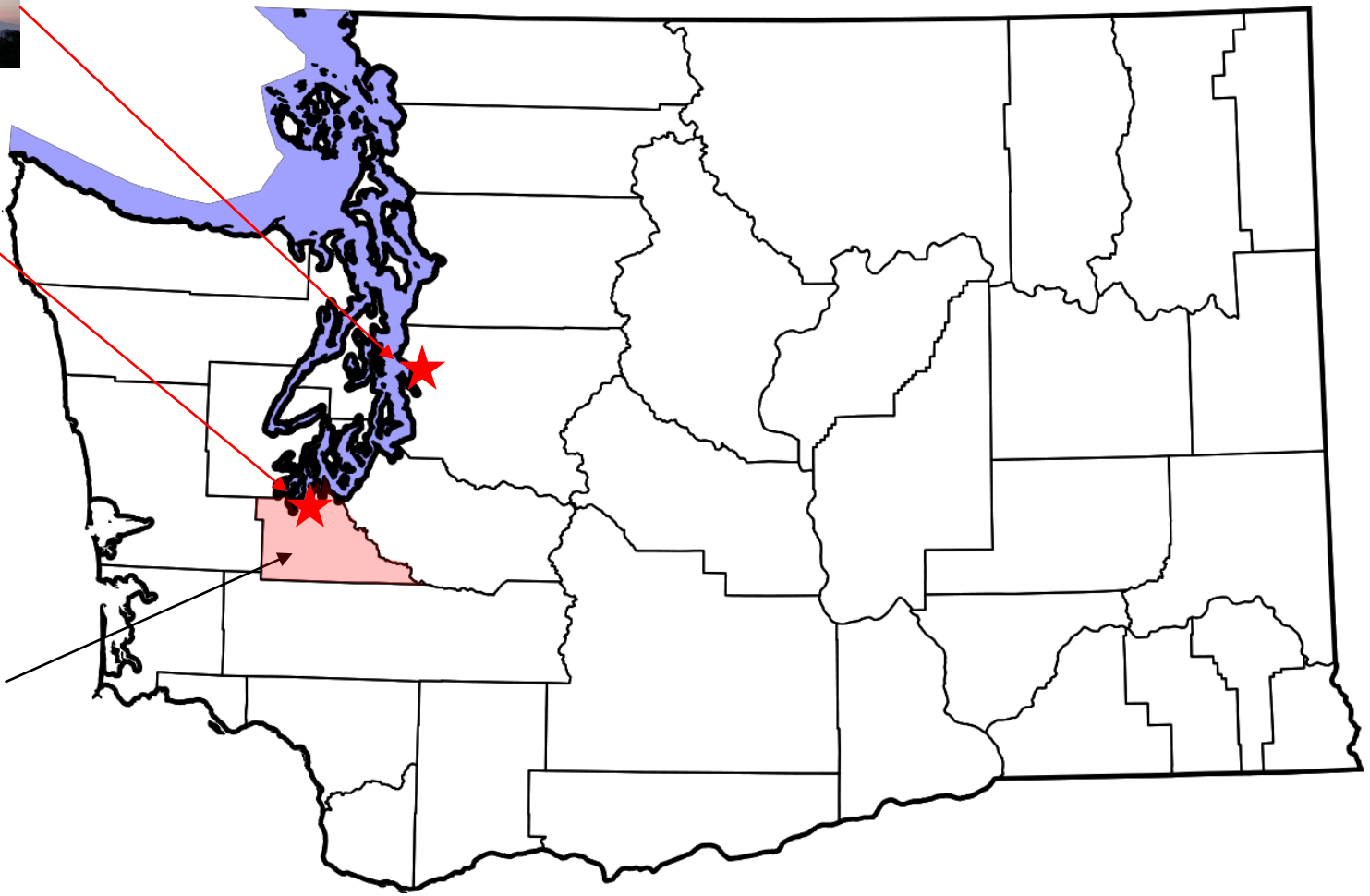
Where is Thurston County?



Seattle



Olympia



Project Overview – Why Washington?

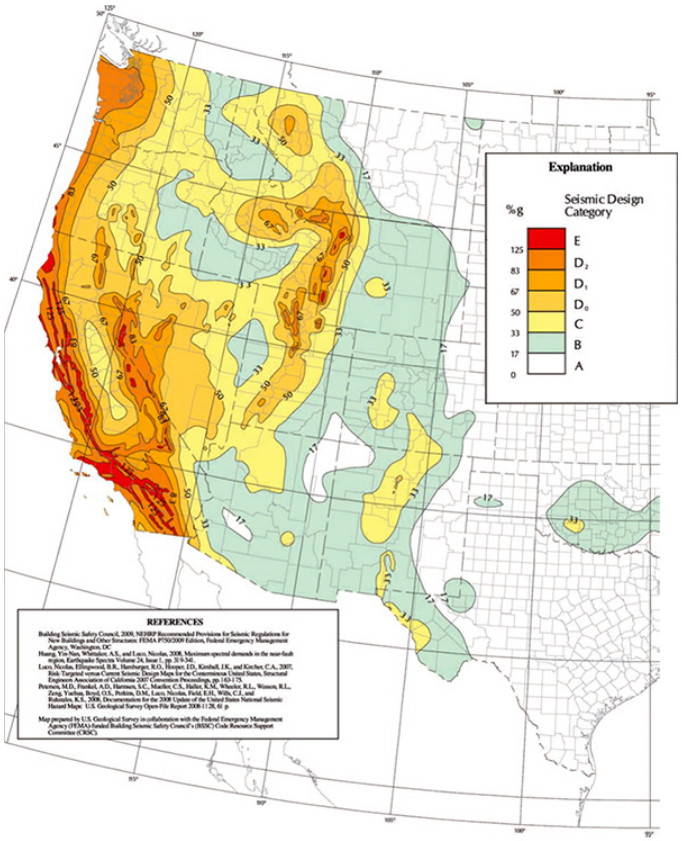


Photo from U.S. Geological Society Design Maps

- Washington state has **second highest** earthquake risk in U.S.
- Increased understanding & awareness of risk
- We are behind & It's time!

Background – Washington State

1949

Damage to ~ 30 schools in Washington

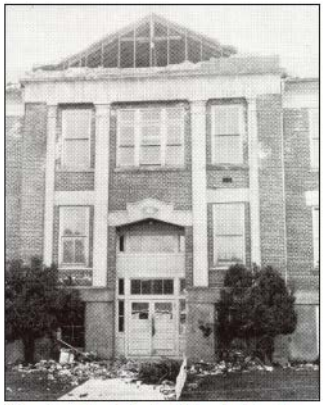


Figure 2. At Castle Rock, a high school student was killed as unanchored gable masonry cascaded to the walk outside the entrance. There could have been more casualties. (From Edwards, 1951.)

1955

RCW 70.86 passed
Schools should be "*designed and constructed to withstand probable earthquake intensities*"

1965

Damage to school in Alki



Damage outside Union Station
Photo by John Vallentyne, Courtesy MOHAI

1974

RCW 19.27 passed
Washington State Building Code Act

2010

School Seismic Safety Pilot Program in Aberdeen and Walla Wala

2011

Resilient Washington State Initiative

2015

School Seismic Safety Pilot Program in Thurston County

School Seismic Safety Assessment Pilot Project

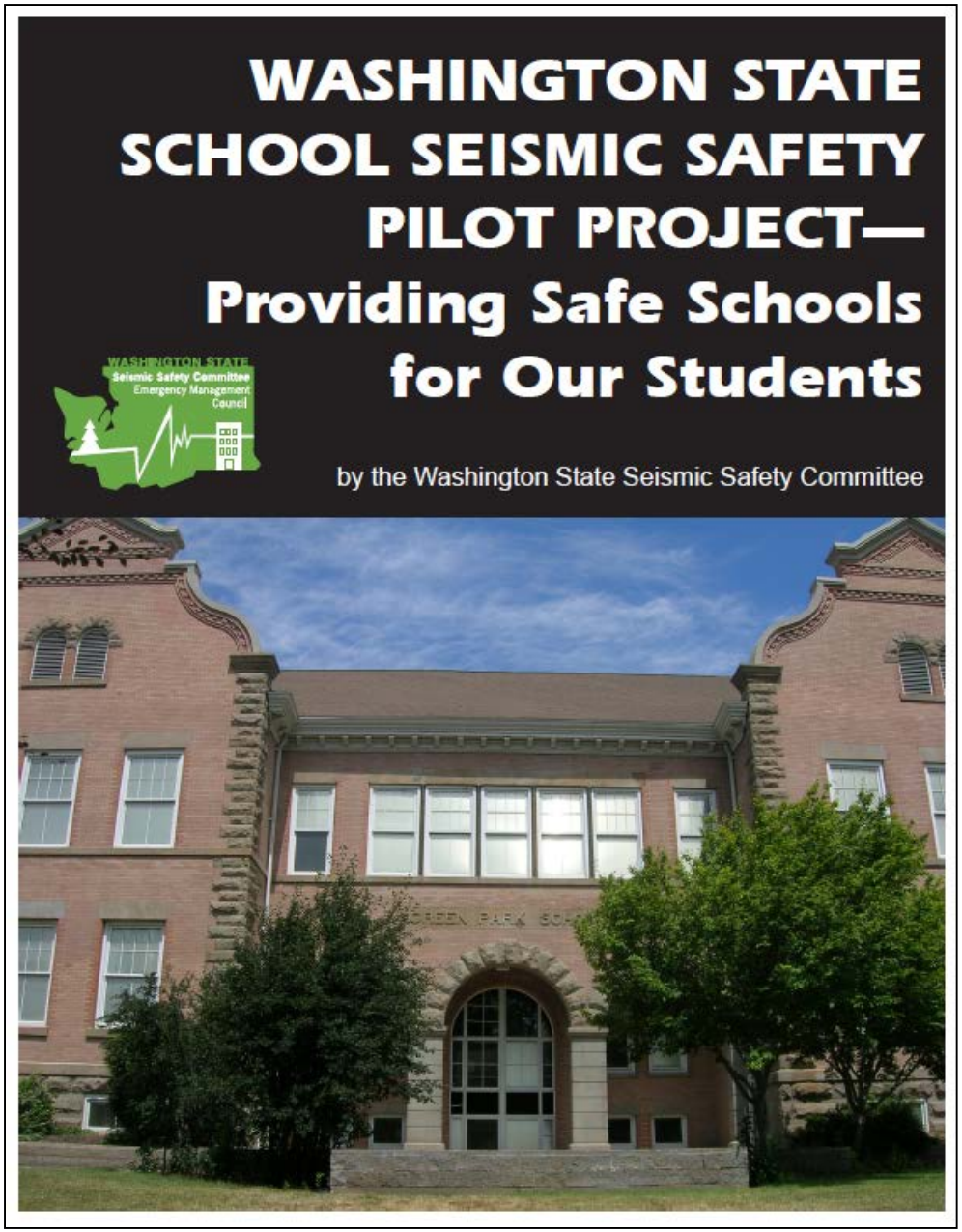
WASHINGTON STATE
Seismic Safety Committee
Emergency Management Council

Washington Military Department
Emergency Management Division

OSPI
Superintendent of Public Instruction

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark • Commissioner of Public Lands

STRUCTURAL ENGINEERS ASSOCIATION
SEA
WASHINGTON



Resilient Washington State Initiative

RECOMMENDATION **1. Make schools resilient: structurally, socially, and educationally.**

TARGET STATES OF RECOVERY: WASHINGTON'S CRITICAL SERVICES SECTOR									
	Event occurs	0–24 hours	1–3 days	3–7 days	1 week–1 month	1–3 months	3 months–1 year	1–3 years	3 + years
Law enforcement				X					
Emergency response				X					
Health and medical care							X		
Education							X		
Mass care					X				
Social services						X			
Food network					X				
Government administration					X				

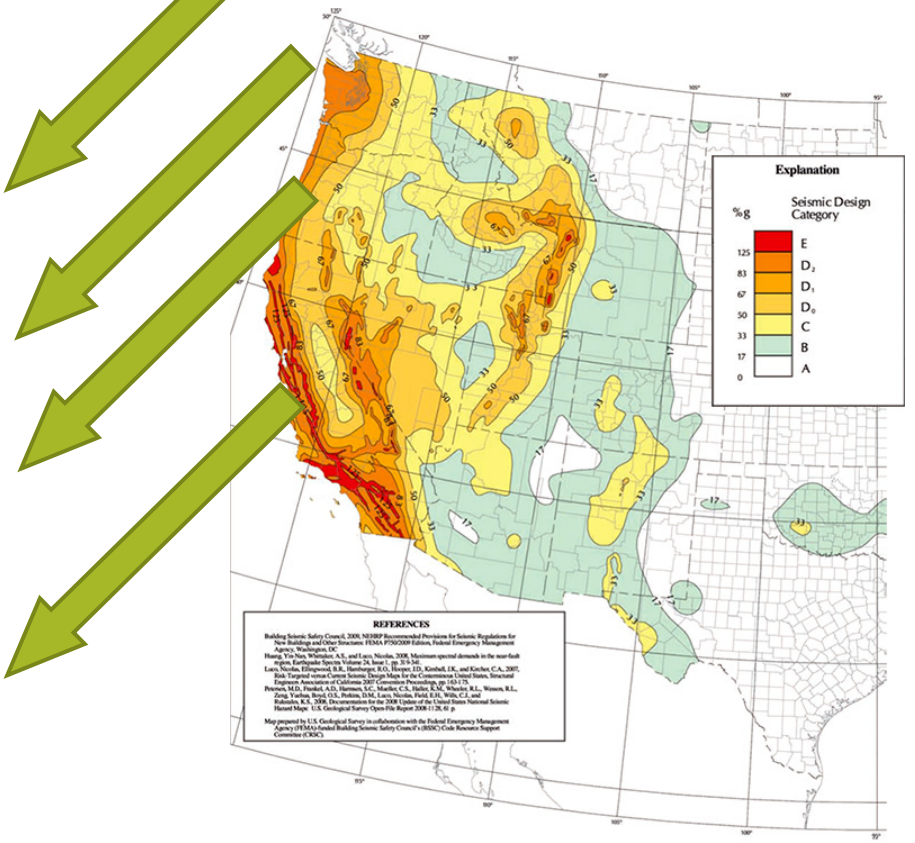
Our Neighbors

<u>BRITISH COLUMBIA (Canada)</u>
$1.5B+ Seismic Mitigation Program[1]

<u>WASHINGTON</u>
?????

<u>OREGON</u>
Seismic Rehabilitation Grant Program[2]
$125m this year

<u>CALIFORNIA</u>
1933 Field Act[3]



[1] http://www2.gov.bc.ca/gov/content/education-training/administration/resource-management/capital-planning/seismic-mitigation-program
[2] http://www.orinfrastructure.org/Infrastructure-Programs/Seismic-Rehab/
[3] CSSC (February 2007), The Field Act and Public School: Construction: A 2007 Perspective, Publication #CSSC 2007:03, California Seismic Safety Commission

School Selection Process

SCHOOL DISTRICTS: YELM, TUMWATER, NORTH THURSTON

- Chose school districts with proximity to state capitol and legislature with a large geographic coverage of Thurston County
- Chose school districts with representative school construction of Thurston County
- Previous OSPI seismic hazard project
- Input from school districts

Project Approach

VOLUNTEER STRUCTURAL ENGINEERS:

Building evaluations



→ > 25 Volunteer Structural Engineers

20 companies
300 volunteer hours
$40,000 of in kind contributions



→ 10 Engineering Students

St. Martins University
Seattle University
University of Washington

Project Approach

<u>GEOLOGISTS/SEISMOLOGISTS:</u>

Site investigations

- Site classification
- Liquefaction potential
- Geological hazards



HAZUS

FEMA

INPUT

- Building area
- Building value
- Year built or renovated
- Number of stories
- Content value
- Latitude and longitude
- City
- Foundation type
- Occupancy type
- Building construction type
- Seismic design level



OUTPUT

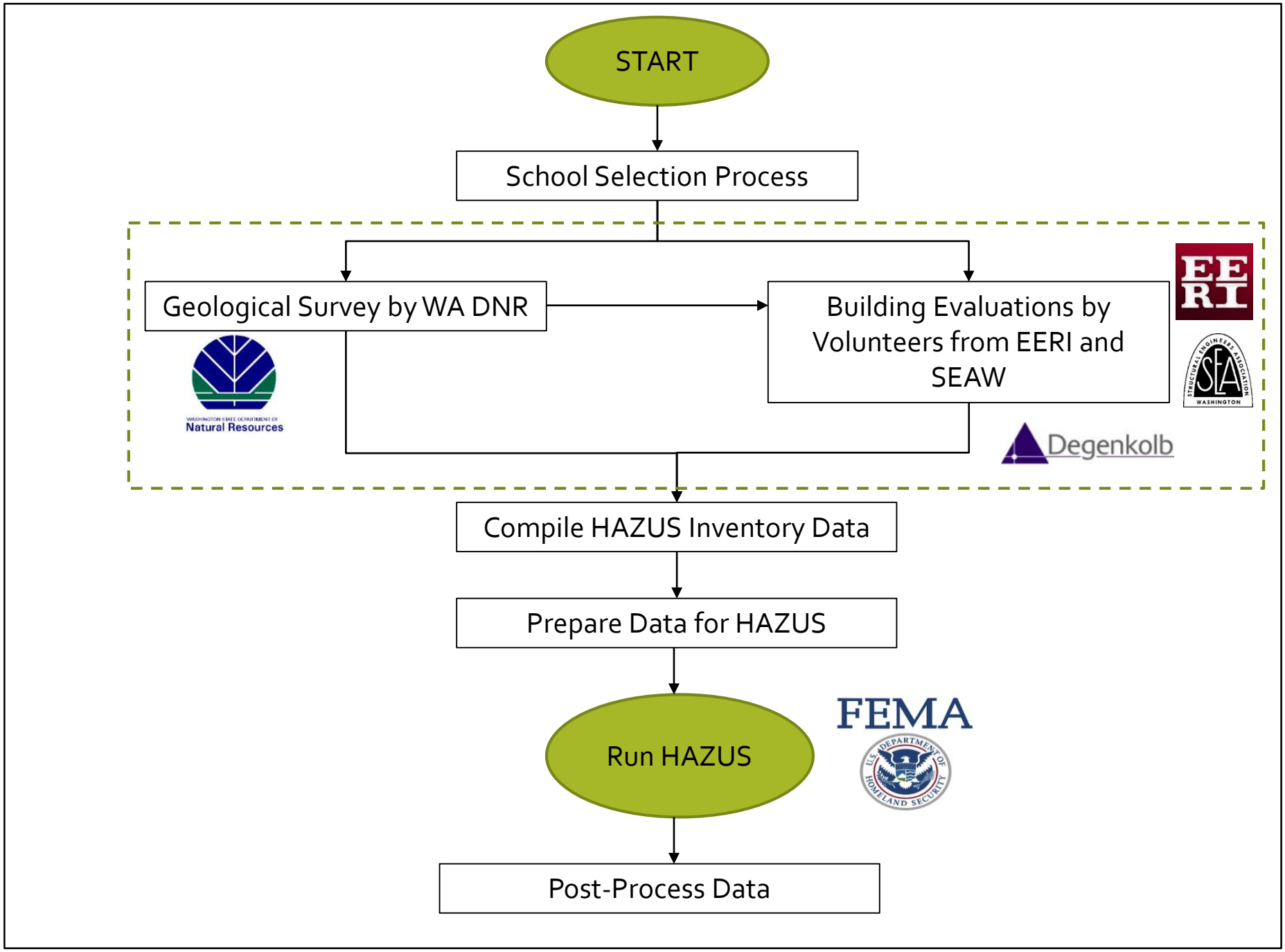
Structural damage

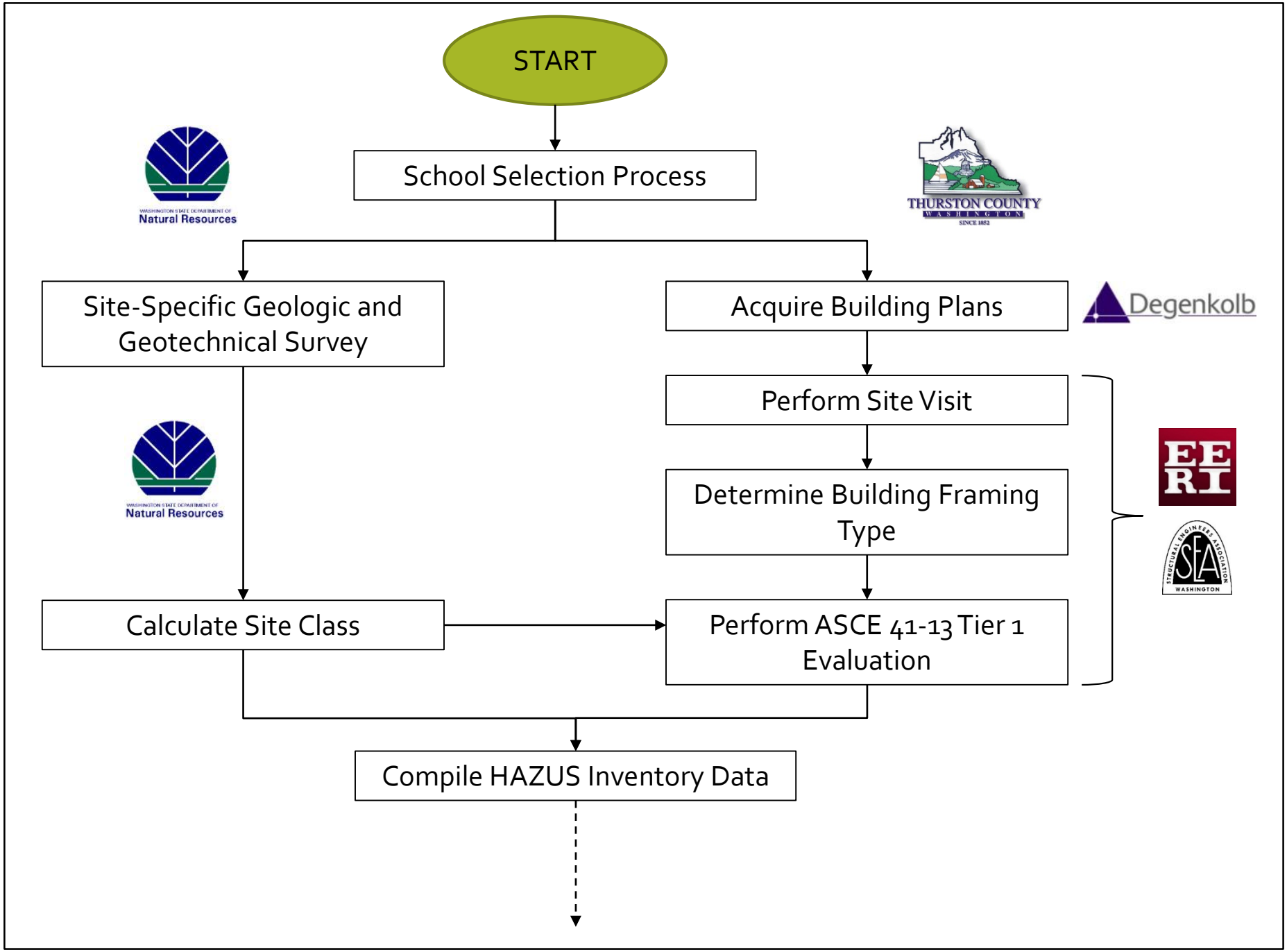
Nonstructural damage

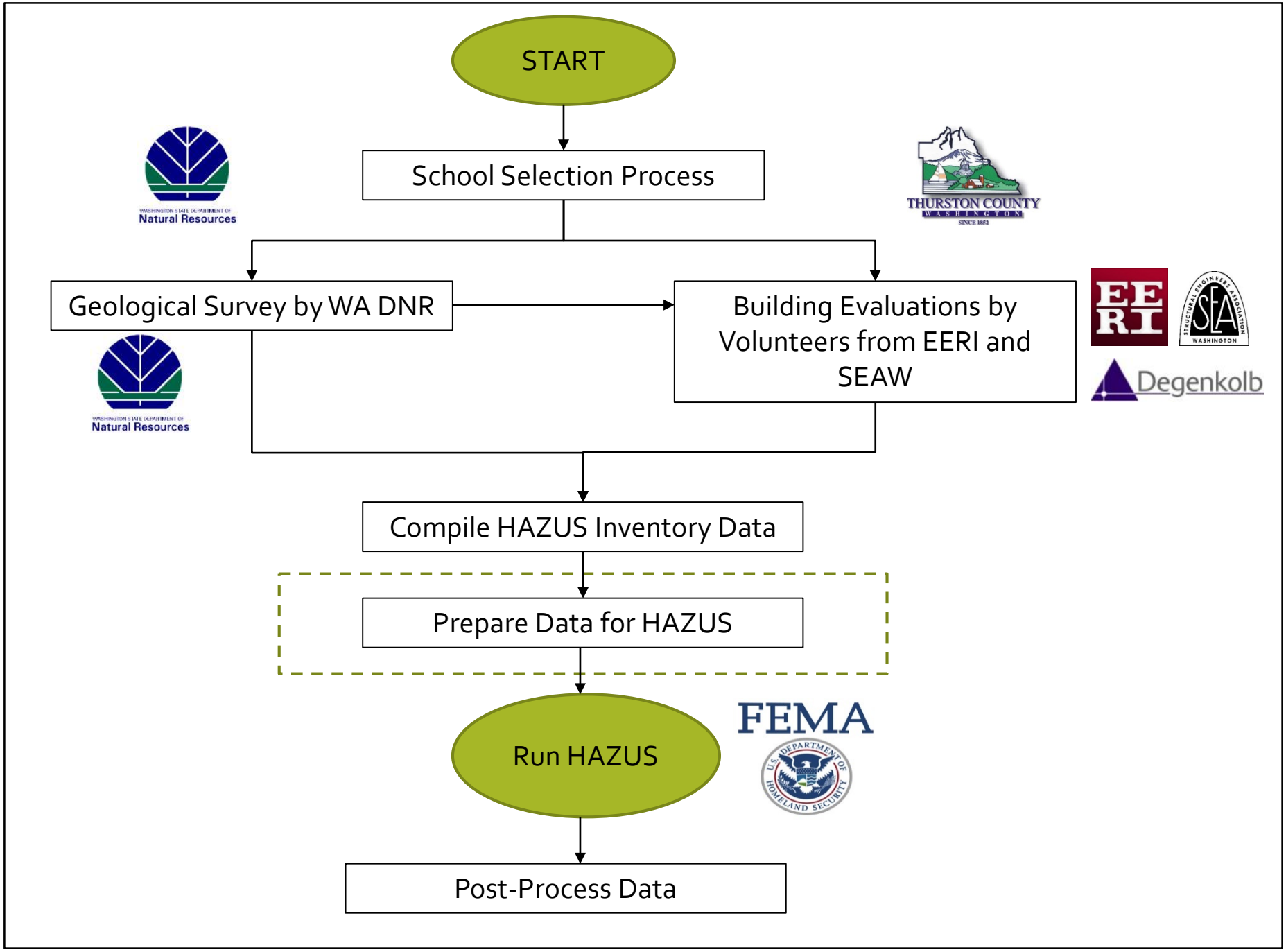
Economic loss estimates

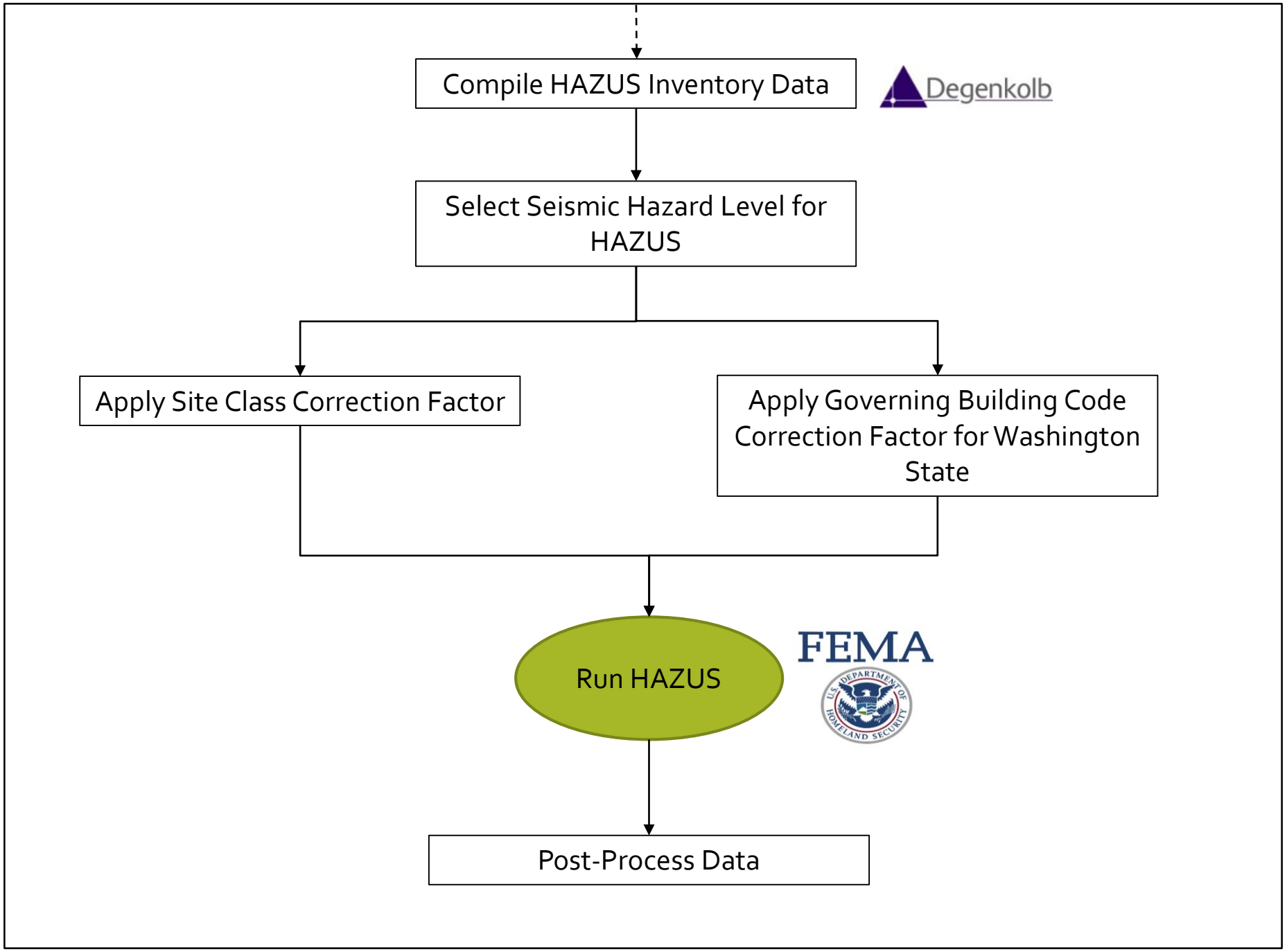
(Recovery Time)

(Casualties)


START
School Selection Process
Geological Survey by WA DNR
Building Evaluations by Volunteers from EERI and SEAW
Compile HAZUS Inventory Data
Prepare Data for HAZUS
Run HAZUS
Post-Process Data
Natural Resources
EERI
SEAW
Degenkolb
FEMA

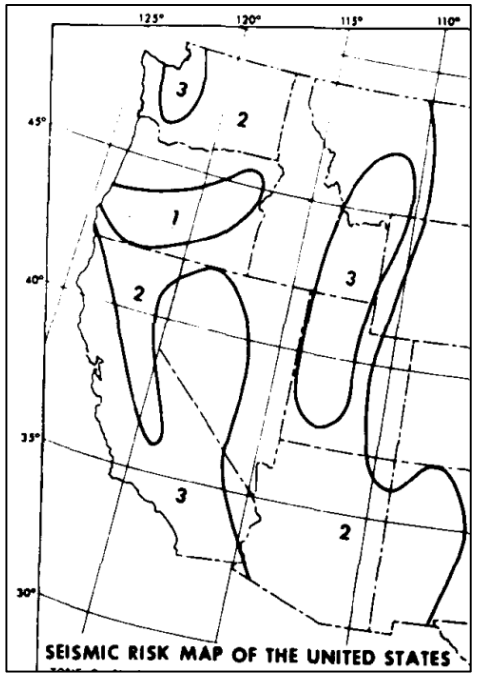

START
School Selection Process
Site-Specific Geologic and Geotechnical Survey
Acquire Building Plans
Perform Site Visit
Determine Building Framing Type
Calculate Site Class
Perform ASCE 41-13 Tier 1 Evaluation
Compile HAZUS Inventory Data
Natural Resources
THURSTON COUNTY
WASHINGTON
Degenkolb
EERI
SEA
WASHINGTON


START
School Selection Process
Geological Survey by WA DNR
Building Evaluations by Volunteers from EERI and SEAW
Compile HAZUS Inventory Data
Prepare Data for HAZUS
Run HAZUS
Post-Process Data
Natural Resources
THURSTON COUNTY
WASHINGTON
SINCE 1852
EERI
SEA
WASHINGTON
Degenkolb
FEMA
U.S. DEPARTMENT OF HOMELAND SECURITY

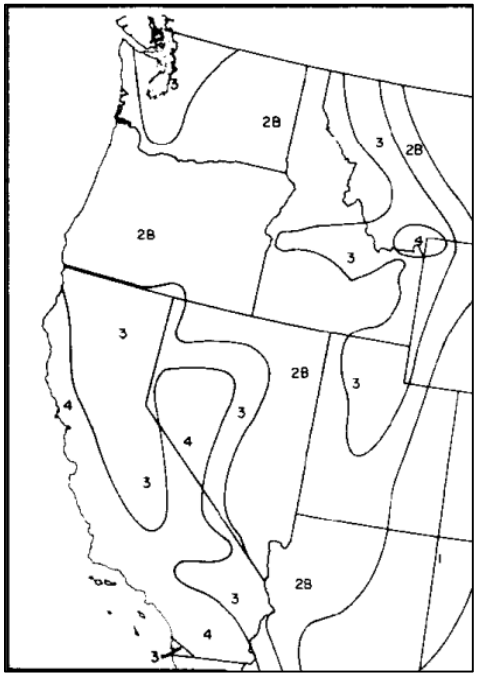

Compile HAZUS Inventory Data
Degenkolb
Select Seismic Hazard Level for HAZUS
Apply Site Class Correction Factor
Apply Governing Building Code Correction Factor for Washington State
Run HAZUS
FEMA
Post-Process Data

Building Code Correction Factor

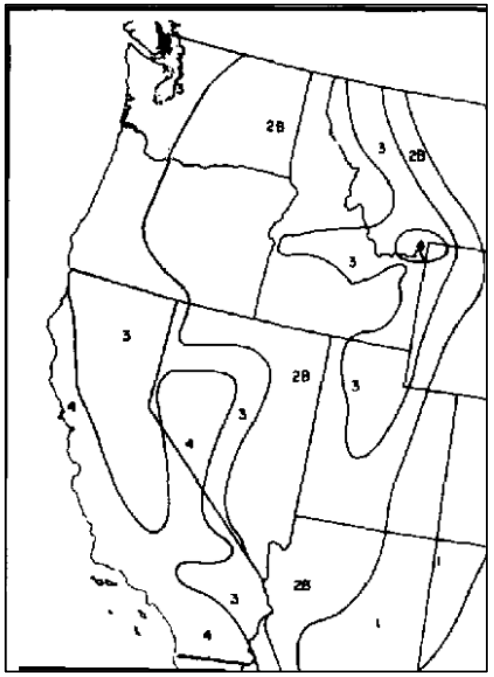
Location	Pre-Code	Low-Code	Moderate Code	High Code
California (Hazus Default)	Pre-1941	1942-1975 (Zone 2)	1942-1975	1975-present
Washington State	Pre-1949	1950-1974	1975-2003	2004-present



1970 UBC



1988 UBC



1994 UBC

ASCE 41-13 Evaluation Results

Common Deficiencies

Common Construction Types

Timber shear walls

Light steel framing

Reinforced masonry walls

Common Structural Deficiencies

Shear stress in shear walls greater than capacity

Unblocked diaphragms

Inadequate wall anchorage





ASCE 41-13 Evaluation Results

Common Deficiencies

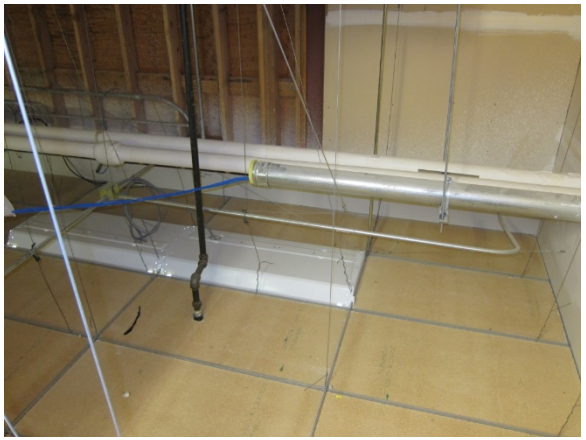
Common Nonstructural Deficiencies

Fire suppression system not braced

Ceilings not braced

Shelves not anchored to walls or floors

Computer equipment not anchored to walls or floors

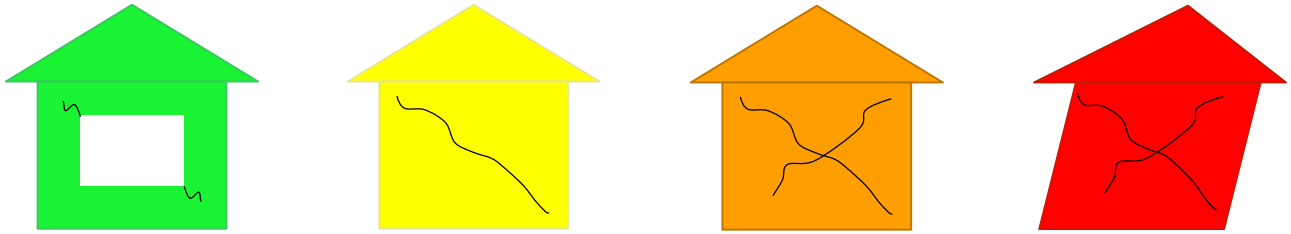




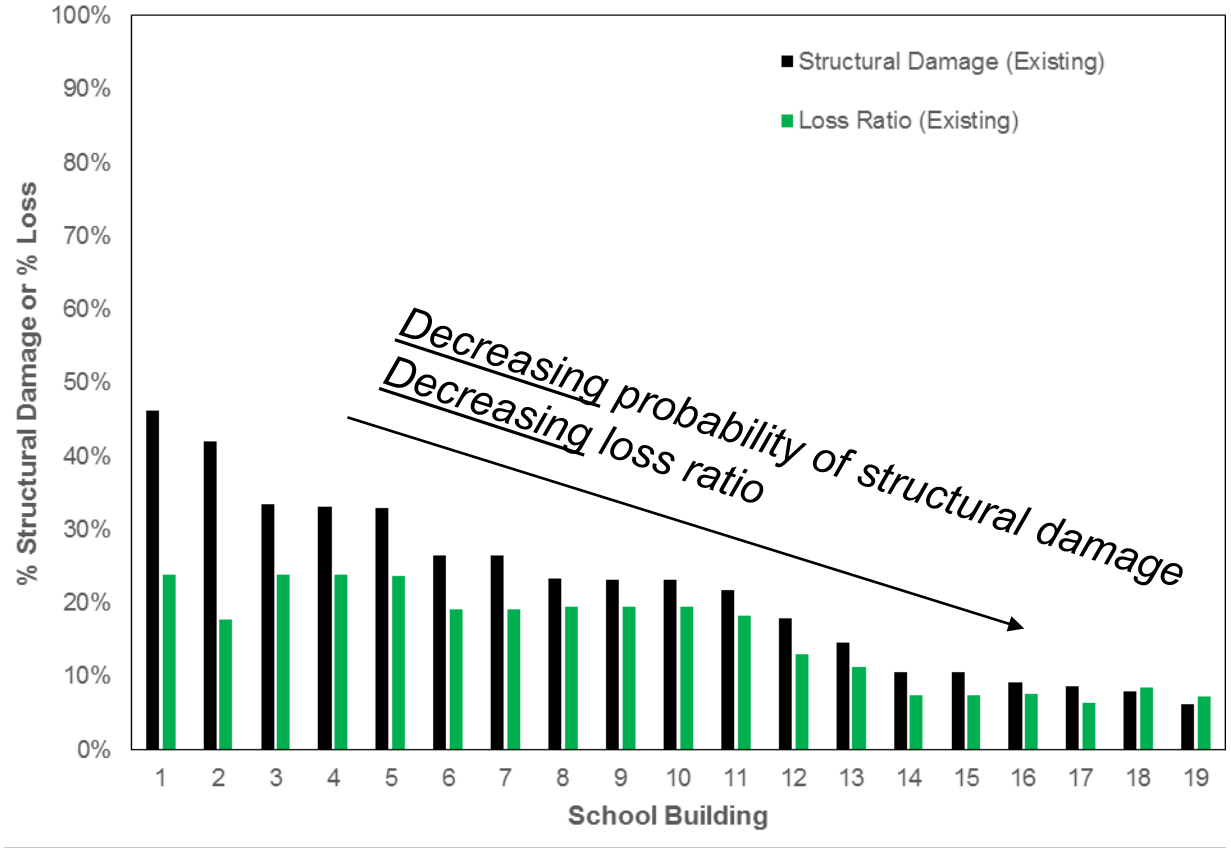
Evaluation Results

Hazus Damage States	Slight	Moderate	Extensive	Complete
ATC-20 Rapid Visual Assessment Tag	Green	Yellow	Yellow/Red	Red

Potential Building Damage



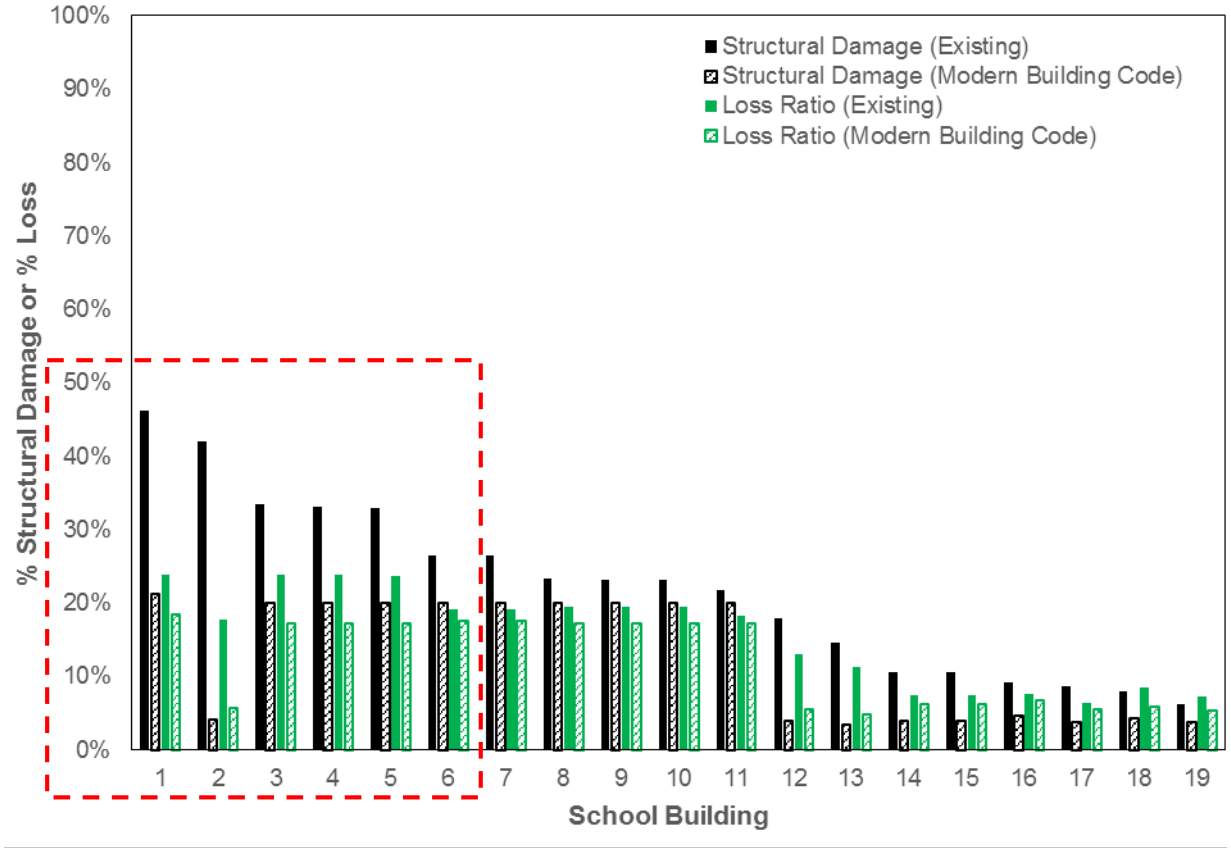
Evaluation Results



Prob. Structural Damage (Extensive + Complete)

Loss Ratio (Cost of Repair/Cost of Building)

Evaluation Results



Prob. Structural Damage (Extensive + Complete)

Loss Ratio (Cost of Repair/Cost of Building)

Evaluation Results

(500-year Earthquake/Code level shaking)

School No.	Construction Type	Structural Damage (Existing)	Structural Damage (New Equivalent)
1	1985 Steel Light Frame	46%	21%
2	1975 Concrete Shear Walls	42%	4%
3	2008 Wood Light Frame	33%	20%
4	1985 Steel Light Frame	33%	20%
5	1998 Wood Light Frame	33%	20%
6	1998 Reinforced Masonry Bearing Walls	27%	20%

Evaluation Results

(500-year Earthquake/Code level shaking)

School No.	Construction Type	Loss Ratio (Existing)	Loss Ratio (New Equivalent)
1	1985 Steel Light Frame	24%	18%
2	1975 Concrete Shear Walls	18%	6%
3	2008 Wood Light Frame	24%	17%
4	1985 Steel Light Frame	24%	17%
5	1998 Wood Light Frame	24%	17%
6	1998 Reinforced Masonry Bearing Walls	19%	18%

Next Steps

Develop recommended thresholds for different damage states ("high", "moderate", and "low" risk)

What is an acceptable loss ratio? What is "unsafe"?

At what probability of structural damage do schools need seismic retrofits?



Damaged School from 1933 Long Beach Earthquake

Photo courtesy of USGS

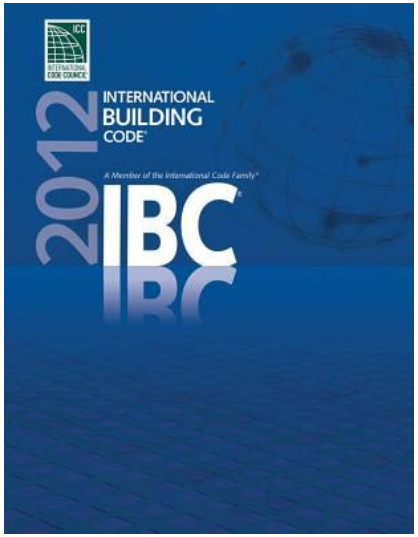
Next Steps

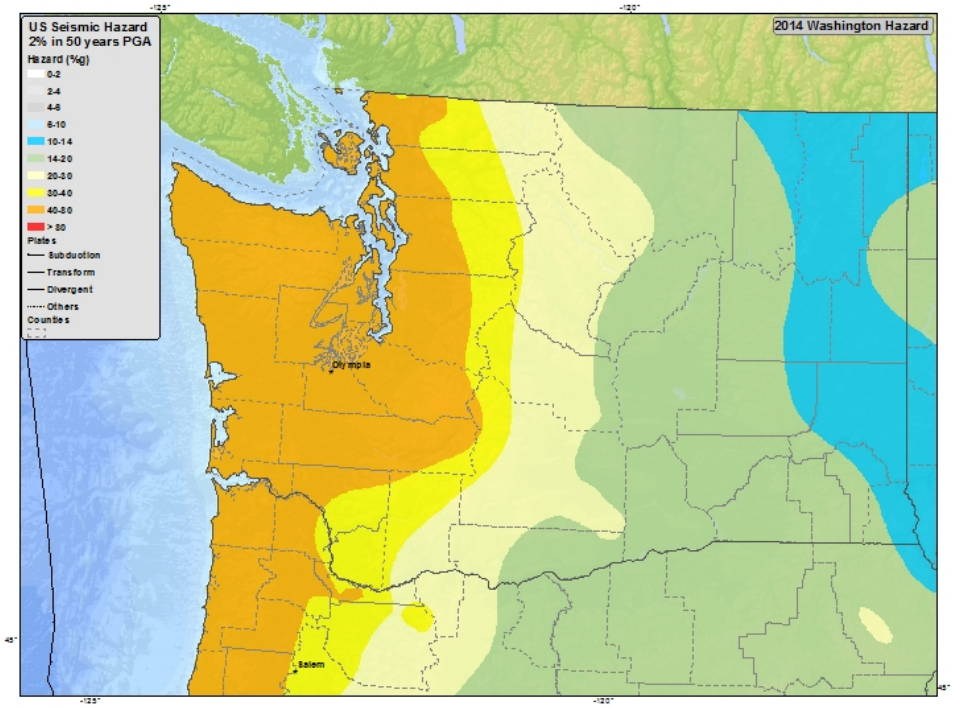
Incorporate more data into the evaluation of seismic risk

Adjust Hazus input for specific structural irregularities

Refine results based on WA state code adoption history

SBCC Washington State Building Code Council





Next Steps

Incorporate other functional considerations

- **Planned renovations**
- **Condition of building systems**
- **Security concerns**
- **Sustainability**



Outreach !!

Webinar Briefing Speakers & Agenda

1. **Introduction** by Barry Welliver, *Structural Engineer, BHW Engineers*
2. **SESI Subcommittees** by SESI Subcommittee Chairs
   - **Screening, Inventory & Evaluation** – Barry Welliver, *on behalf of Ken Goettel, Goettel & Associates*
   - **Tsunami Mitigation for Schools** –Barry Welliver, *on behalf of Yumei Wang, DOGAMI*
   - **Classroom Education & Outreach** –Lelli Van Den Einde, *Professor, UC San Diego*
   - **Code Updates & Improvements** – Rob Jackson, *Supervising Structural Engineer, AECOM*
3. **Thurston County School Seismic Safety Evaluations** by Cale Ash, *Principal, Degenkolb Engineers*
4. **Partnering to Perform Rapid Visual Screenings of Alaska's Schools** by Laura Kelly, *Alaska Seismic Hazards Safety Commission*
5. Question & Answer Session

PARTNERING TO PERFORM RAPID VISUAL SCREENINGS OF ALASKA'S SCHOOLS

Laura W Kelly, PE

USCG D17 Supervisory Engineer, CEU Juneau, AK – 2015-Present
US Coast Guard, Civil Engineer, Kodiak, AK – 2000-2014
Alaska Seismic Hazards Safety Commission, School Committee Chair, 2005-Present
e-mail: Laura.W.Kelly@uscg.mil



EERI SESI Safety Screening Inventory & Evaluation Subcommittee
July 12, 2016

Timeline

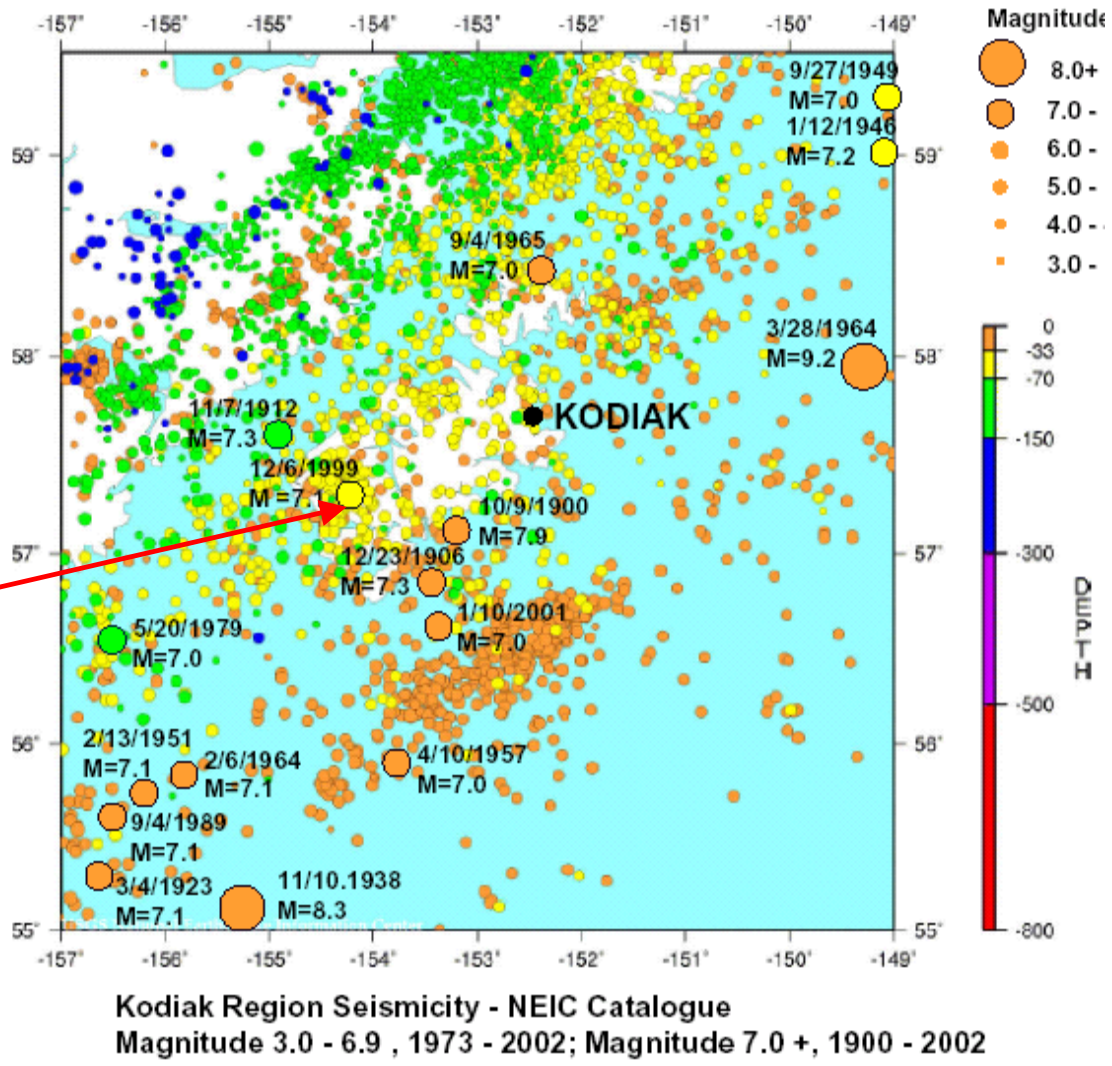
Year	*US Coast Guard (USCG)*	*Kodiak Island Borough (KIB)*	*Alaska Seismic Hazards Safety Commission (ASHSC)*
1999	LKelly moves to Kodiak, experiences first earthquake. Mw 7.0, 2 pm, Dec. 6th (weekday, school in session). (Local ground forces greater than 1964 earthquake.)		
2000	LKelly starts work in Kodiak Facilities Engineering Division as Federal Employee. Largest USCG Base with 75 commercial facilites, 2000 residents, water/wastewater/steam plants/hangars/piers.		
2001	Meet with Gary Carver, & invite him to present to USCG April, 2002.		
2002	USCG contracts Gary Carver for Hazard Identification Project. (Ground shaking, active faults, liquefiable soils, slope and ground failure, tsunami indundation.) Completed Spring 2003. Numerous problems identified. Nov. 3, 2002 Denali earthquake, M7.0	Carver/Kelly notify Borough of Peterson Elementary findings. (Carver discovers LKelly rec'd Alaska PE, and encourages proactive involvement.) Carver meets regularly with Borough, PTA, and School Boards with LKelly attending critical meetings.	House Bill 53 Establishes ASHSC.
2003	New active fault identified at Spruce Cape LORAN site near State Rocket Launch Facility.	LKelly volunteers in High School earth science classes. Meet with students to discuss seismic risk, careers associated with risk mitigation, and help assess local schools using RVS.	
2004		Local bond narrowly passes by 11 votes to evaluate schools for seismic risk. Staffing and PDM applications made with Legislative Approval, 2004-2006.	
2005		School Seismic Vulnerability Assessment, William Lettis & Associates, G&E Engineering (John Eidinger) and Goettel & Assoc. (Ken Goettel)	Official appointment of 9 members to ASHSC by Gov. Murkowski. First meeting October, 2005. Original members include 3 from Kodiak (Carver, Kelly, and Kodiak City Mngr-Freed).
2006	RVS for all USCG structures (non-residential) in Kodiak. Incorporated with Mission Dependency Indexing. All waterlines now being replaced with HDPE to improve performance in event of an earthquake.	RFP for Seismic Upgrades (Kodiak Middle School and High School), $2.1 Million. Five school retrofit projects continue through 2009.	ASHSC extended to 2012, added language to include tsunamis, added two more members (11 total) - funding remains $10K per year. Standing committees include focus on schools. Write white paper on School Seismic Safety Legislation.
2007			Draft Map - At-Risk Schools in Alaska. Presentation "Successful Implementaiton of Seismic Mitigation for Schools, Sept., 2007"
2008		Peterson Elementary retrofitted.	Contact Commissioner Larry LeDoux, Alaska Dept. of Education & Early Develoment (ADEED). Request appointment of representative (Sam Kito III) to ASHSC. Year of May 12, 2008 Sichuan China Mw 7.9 earthquake.
2009	LKelly, USCG Engineer of the Year; award includes recognition for seismic vulnerability studies and serving on the ASHSC.	KIBSD receives WSSPC Overall Award in Excellence for seismic mitigation of schools, Feb., 2009.	Utah State Office of Education, School Finance Director, Larry Newton – Jan 7, 2008 (presents Legislation model) Kito, ADEED, joins ASHSC School Committee. Obtain data base of schools and year of construction. John Aho/Sam Kito presentation to the State of Alaska Senate Education and Finance Committees, Junueau, AK. Map discussed.
2010		New police station construction completed. Old fire station remains concern.	Collaboration with ADEED results in developing new capital improvement project application form that specifically addresses seismic issues. Enters trial period. Yumei Wang, Oregon DOGAMI, presents information on Oregon's Seismic Rehabilitiation Grant Program. Publish map of Public Schools and Earthquake Hazards in Alaska in ASHSC Annual Report, Feb., 2010.

Timeline

2010		New police station construction completed. Old fire station remains concern.	Collaboration with ADEED results in developing new capital improvement project application form that specifically addresses seismic issues. Enters trial period. Yumei Wang, Oregon DOGAMI, presents information on Oregon's Seismic Rehabilitiation Grant Program. Publish map of Public Schools and Earthquake Hazards in Alaska in ASHSC Annual Report, Feb., 2010.
2011		Bud Cassidy, KIB, joins ASHSC.	
2012	USCG supports LKelly participation in revision of FEMA 154 RVS as part of working group/review panel. 2012-2013. Final release ATC-71, Fall, 2014.		--Recommended ADEED CIP changes formally implemented. Dr. Christine Theodoropoulos, Univ. of Oregon speaks to ASHSC about Oregon's achievements regarding seismic risk mitigation for schools and emergency facilities. -- Meet with Alaska PTA. --Kito leaves ADEED.
2013	USCG supports LKelly transfer to Juneau. In close proximity to other USCG engineers, ADEED, Prof. Engineering organizations, and Legislature.		Apply for HMPG funding for RVS of schools -- funding cut. PTA adds concern to Legislative Issues, stating their support for structurally sound school buildings throughout the state of Alaska, for the safety of our children, parents, teachers and community members.
2014	Seismic awareness in Kodiak results in complete retrofit of 4 Barracks buildings, an RFP for retrofitting the most critical building on base (ComSta), and backlog of other mitigation projects - improperly braced overhead steam pipes in Hangars, replace cast iron waterline crossings, strengthen piers, etc. Bowling alley structurally retrofitted during energy upgrade.		--ASHSC extended to 2020. Kito joins AK House of Representatives. --Working with EERI on pilot program for RVS screening of Alaska schools. Modeling Utah's "Schools at Risk" RVS program. --Suggest policy recommendation to incorporate RVS into Univ. of Alaska Engineering curriculum.
2015	Lkelly promoted GS-13 Supervisory Engineer, CEU Juneau for maintenace of USCG shore facilities, from Ketchikan to Kotzebu.	Bud Cassidy, KIB, retires. Gary Carver retires from private sector, but remains on ASHSC.	--UAF: AK's Next Big Earthquake workgroup. --Final Report - Pilot Study-Matanuska-Susitna School Dist- Feb, 2016. 17 bldgs/10 recommended for further review. (Cost $18,500 - BBFM paid $8500, donated $10,000) --Final Report-RVS Study- Kenai Peninsula Borough- Dec 2015: 15 Schools, 47 structures,19 recommended for further review. $21,250, $500/$700 per school.
2016	USCG implements RVS for CA, OR, WA and remainder of AK, using Kodiak as example.	Duane Dvorak, KIB, joins ASHSC.	Preparing to screen Fairbanks. Hoping to partner with UAF, and include campus facilities.

Kodiak Region Seismicity

Mw 7.1, 2 pm,
Dec. 6th, **1999**



Kodiak Region Seismicity - NEIC Catalogue
Magnitude 3.0 - 6.9 , 1973 - 2002; Magnitude 7.0 +, 1900 - 2002

Summer 1999, LKelly moves to Kodiak, & soon experiences first earthquake.
Mw 7.1, 2 pm, Dec. 6th, **1999**, weekday, school in session. (Local ground forces greater than 1964 earthquake.) Start working for USCG Facilities Engineering Division, Feb., **2000**.

2001-2003,
Dr. Gary Carver, paleo-seismologist/ geologist works with USCG to identify local seismic hazards.



Figure 7. Hydraulic fill (dashed red lines) at the upper end of Womens Bay.

Hydraulic Fill Area, USCG Base Kodiak

(Hazard analysis reveals that recent seismic retrofits did not take liquefiable soils into consideration)



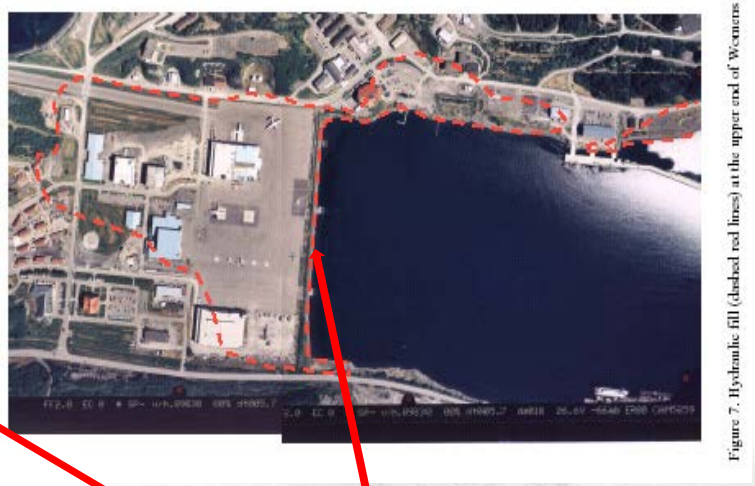
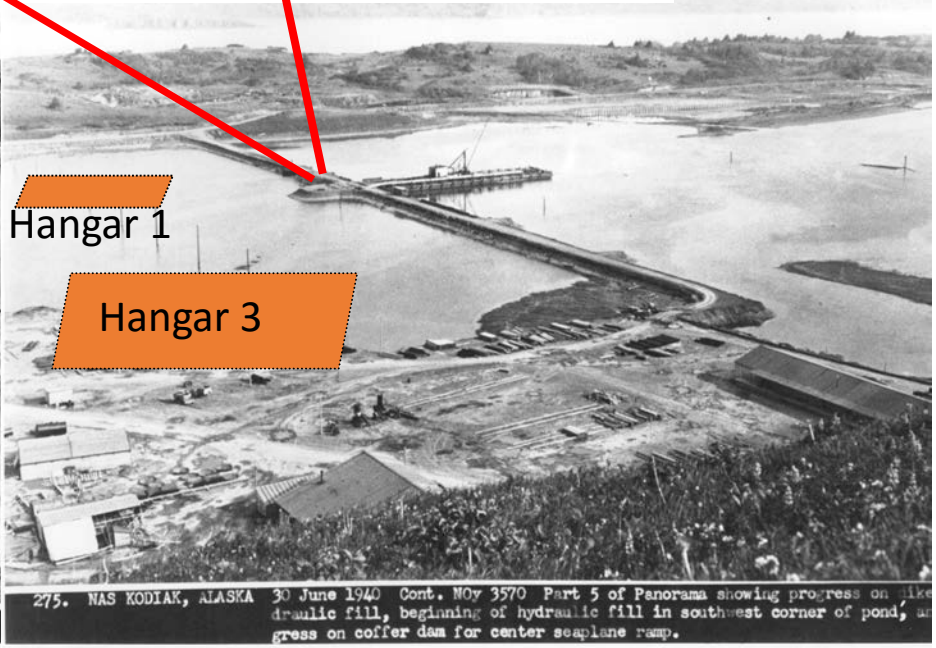


Figure 7. Hydraulic fill (dashed red lines) at the upper end of Womens Bay.





Historical Panoramic Photograph of Womens Bay, Kodiak, June 1940.

2003 Report to USCG

Gary Carver/William Lettis & Associates formally identify active fault at LORAN Station, Narrow Cape, Kodiak Island (Fault changes predicted ground motions in IBC).

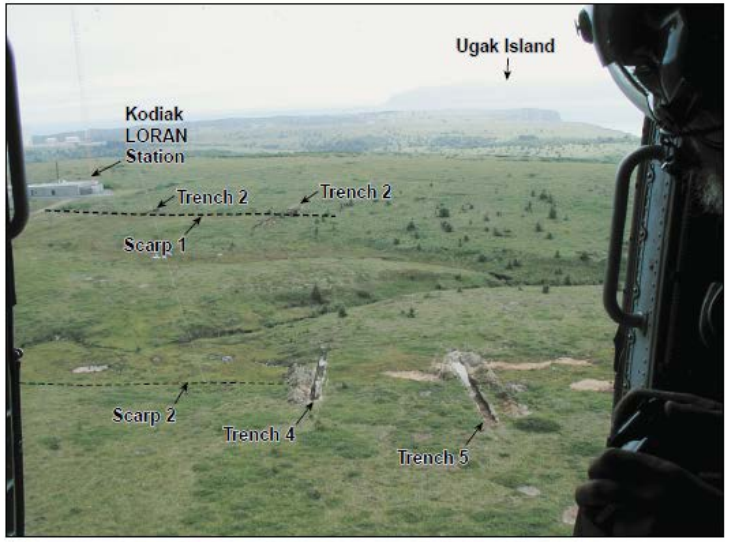


Photo 2. Oblique aerial view of Kodiak LORAN Station and trenches excavated across scarps 1 and 2. Trench 3, located immediately northeast (left) of Trench 1, was excavated after the aerial reconnaissance of the site.

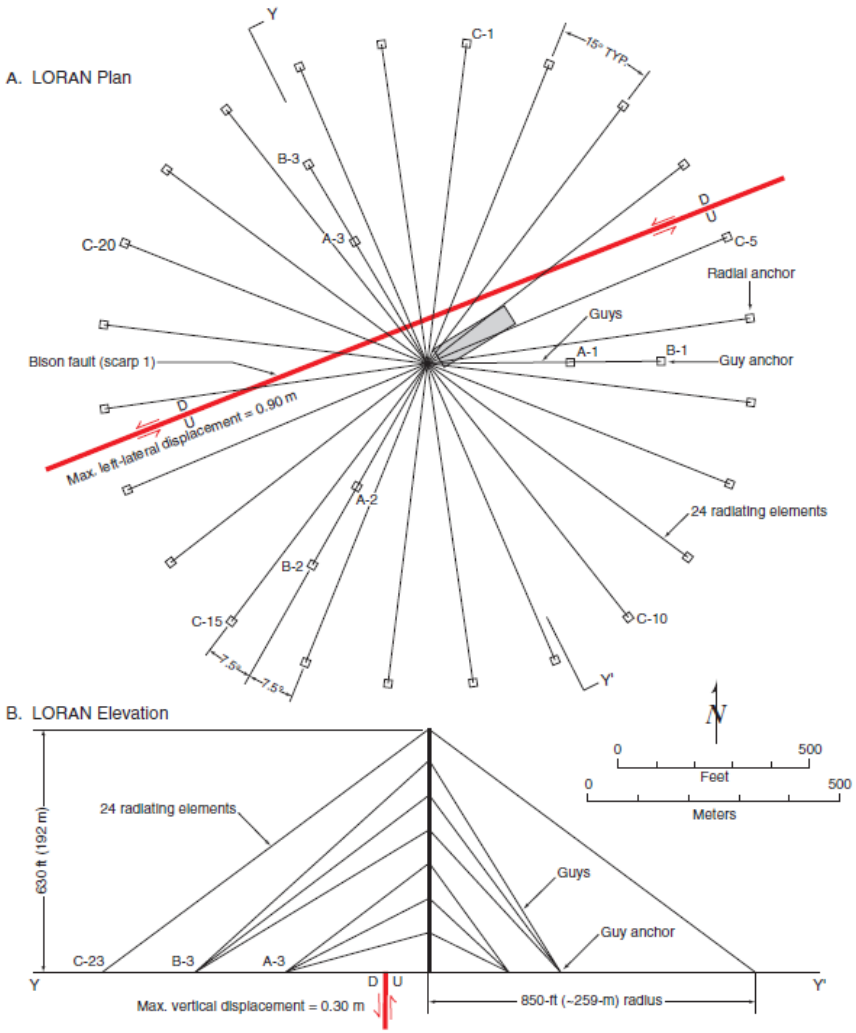
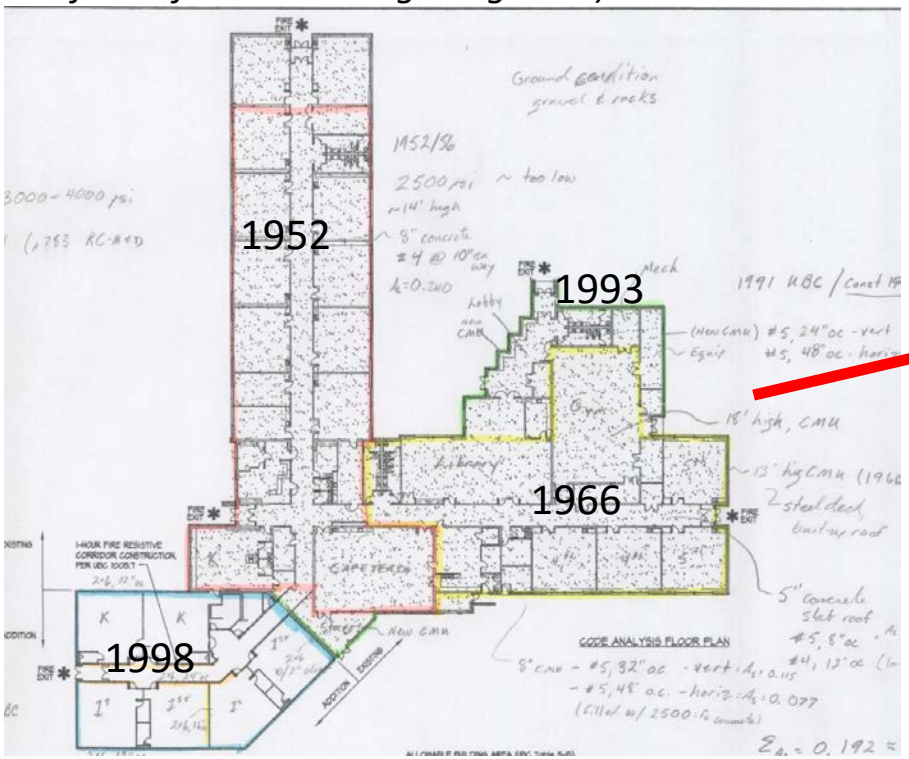


Figure 14. Plan and elevation designs for Kodiak LORAN guy and radial array and anchor system showing location of the Bison fault (scarp 1). Based on paleoseismic trenching of scarp 1, the maximum lateral component of slip (A) assuming a lateral-to-vertical slip ratio of 3:1 is 0.90 m. The maximum vertical component of slip (B) expected is 0.30 m (Table 3).

Lettis & Associates later become involved with school hazard identification in Kodiak. Revised ground forces from LORAN project quantified and incorporated into school analysis.

1499b Kodiak

*(Information excerpted from report to USCG, **2003**.*
Structural Engineer later examines Navy drawings of 1952 school, and identifies flaws in wood ledger board connecting concrete walls to roof.
Formal meeting held to notify school board and PTA, after confirming lack of retrofit with Borough Engineer.)





Peterson Elementary:
280 Students, 40 Staff

(Approx. 200 occupants are USCG family members.)

Peterson Elementary (Borough Property)

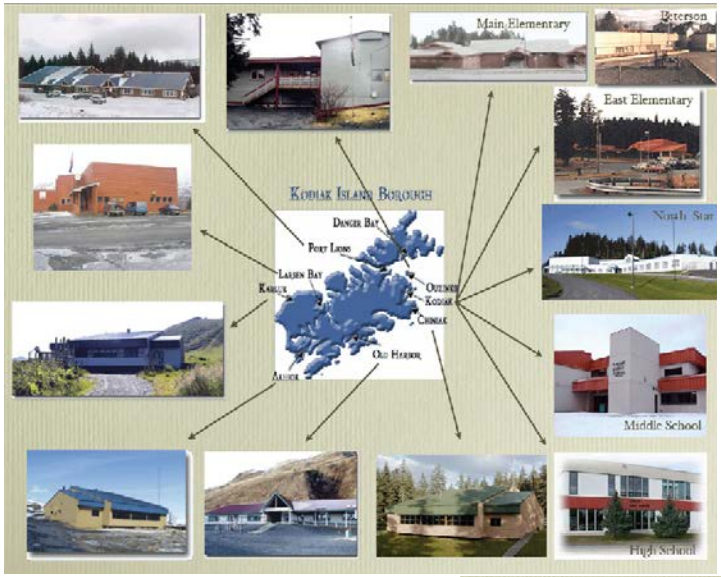
Age - This building was constructed by the Navy in the 1950s, and modified by 1966/1993/1998 additions which did not address structural rehabilitation of the original structure that comprises 45% of the total square footage of the building.

Tsunami is a minor threat with a foundation elevation of 48 feet. It was not inundated in 1964.

2004-2009
KIBSD Seismically Retrofits Five Schools

2009 Kodiak Island Borough receives WSSPC Overall Award in Excellence for seismic retrofit of schools.

"Kodiak has done a truly exceptional job for a small community, from funding the bond to doing the risk assessment to developing a robust hazard mitigation plan, identifying the schools as a priority and then going forth and fixing the major problems - all in an exceptionally short time. I don't know of any community, of any size, that has done a better job and certainly none that has done more or even anywhere near as much on a per capita basis."
-Ken Goettel, Goettel & Associates, Inc., Oct. 10, 2008



Life Safety Risk

Hazard	Deaths per 1,000,000 people	Statistical Average Deaths Per Year
Vehicle Accident	186	
Middle School	469	0.100
Peterson School	400	0.021
Ouzinkie School	293	0.010
KHS Library	238	0.053
KHS Gym	30	0.001

Similar risk correlation to be added to revised FEMA 154 RVS (ATC-71, Fall 2014)

Life Safety Risk

Hazard	US Deaths per Year	Deaths per 1,000,000 people
Tornado	44	0.18
Lightning	90	0.36
Flood	97	0.39
Assault by knife	2,074	8
Fire	3,380	14
Assault by firearm	11,829	47
Falls	16,257	65
Vehicle Accident	46,466	186

Middle school (old wings) Earthquake Life Safety Risk	
School day occupancy	213
Statistical Deaths per Year	0.0998
Deaths per 1,000,000	469
About 2.5 times vehicle death rate	

Key Findings

School	Cost	Benefits	BCR
Middle	$1,192,000	$8,010,000	6.72
Ouzinkie	$149,000	$975,000	7.55
Peterson	$509,000	$1,862,000	3.66
HS Library	$465,000	$4,453,000	9.59
HS Gym	$410,000	$417,000	1.02
Non-Structural	$363,000	-	
Total	**$3,088,000**	**$15,717,000**	**5.09**

ASHSC Alaska Seismic Hazards Safety Commission

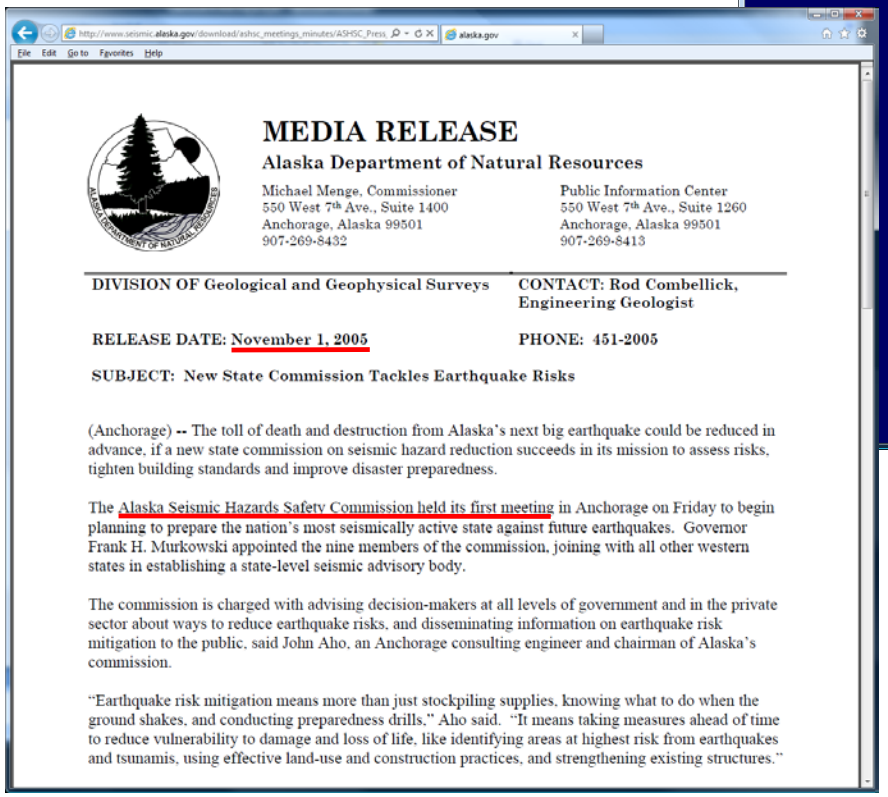
Fall 2005

First meeting held by the ASHSC.

www.seismic.alaska.gov

(11 Members, budget $10K/year)





MEDIA RELEASE

Alaska Department of Natural Resources

Michael Menge, Commissioner
550 West 7th Ave., Suite 1400
Anchorage, Alaska 99501
907-269-8432

Public Information Center
550 West 7th Ave., Suite 1260
Anchorage, Alaska 99501
907-269-8413

DIVISION OF Geological and Geophysical Surveys

CONTACT: Rod Combellick, Engineering Geologist

RELEASE DATE: November 1, 2005

PHONE: 451-2005

SUBJECT: New State Commission Tackles Earthquake Risks

(Anchorage) -- The toll of death and destruction from Alaska's next big earthquake could be reduced in advance, if a new state commission on seismic hazard reduction succeeds in its mission to assess risks, tighten building standards and improve disaster preparedness.

The Alaska Seismic Hazards Safety Commission held its first meeting in Anchorage on Friday to begin planning to prepare the nation's most seismically active state against future earthquakes. Governor Frank H. Murkowski appointed the nine members of the commission, joining with all other western states in establishing a state-level seismic advisory body.

The commission is charged with advising decision-makers at all levels of government and in the private sector about ways to reduce earthquake risks, and disseminating information on earthquake risk mitigation to the public, said John Aho, an Anchorage consulting engineer and chairman of Alaska's commission.

"Earthquake risk mitigation means more than just stockpiling supplies, knowing what to do when the ground shakes, and conducting preparedness drills," Aho said. "It means taking measures ahead of time to reduce vulnerability to damage and loss of life, like identifying areas at highest risk from earthquakes and tsunamis, using effective land-use and construction practices, and strengthening existing structures."



1/5 the size of the "Lower 48"

Pop. 735,000
25% under age 18

49th State, 1959

2006: Formal RVS of all USCG critical structures.

Liquefiable soils and tsunami inundation lines clearly mapped.

2014 USCG Base Kodiak has retrofitted 4 Barracks, demolished one and is rebuilding another.

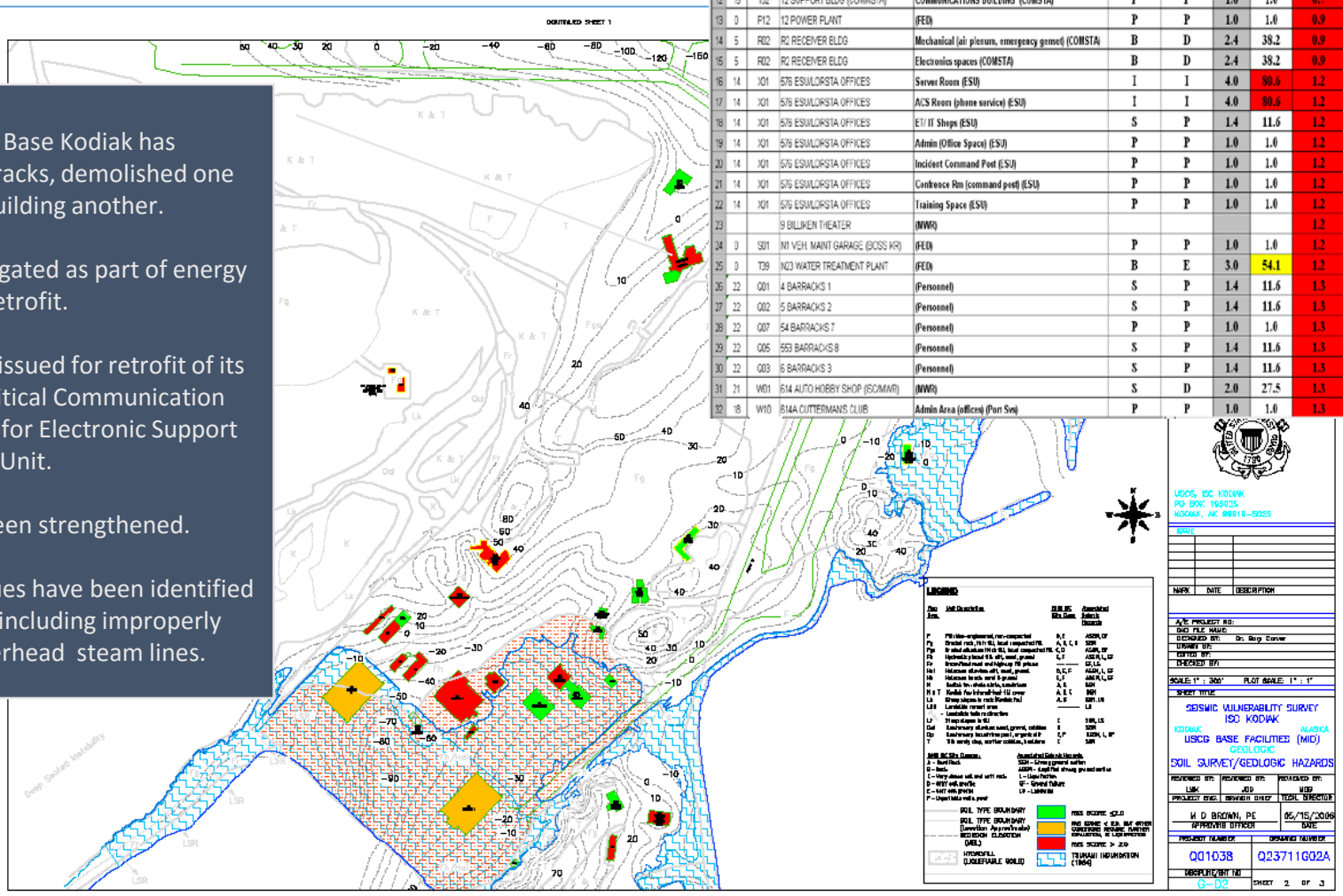
Bowling Alley mitigated as part of energy retrofit.

An RFP has been issued for retrofit of its most mission critical Communication Station structure for Electronic Support Unit.

Piers have been strengthened.

Non-structural issues have been identified in the Hangars, including improperly supported overhead steam lines.

Site	RPFN	Facility Name	Functional Element	Question 1 (I,B,S,P)	Question 2 (I,E,D,P)	Matrix Score	MD_W	Seismic Score If < 2.0, Needs Eval.	
	W05	PIER FUEL (S40)	Shore Power (Port Svs)	S	E	2.6	43.5	1.0	
	W05	PIER FUEL (S40)	Ships Berthing (Port Svs)	S	E	2.6	43.5	1.0	
13	W05	PIER FUEL (S40)	Loading/Unloading (Port Svs)	P	E	2.2	32.8	1.0	
13	W05	PIER FUEL (S40)	Refueling (Port Svs)	S	P	1.4	11.6	1.0	
13	S39	N45 Ready Crew Bldg		P	P	1.0	1.0	0.5	
18	W02	PIER CARGO (613)	Loading/Unloading (Port Svs)	B	E	3.0	54.1	0.5	
18	W02	PIER CARGO (613)	Shore Power (Port Svs)	S	E	2.6	43.5	0.5	Not OK
18	W02	PIER CARGO (613)	Ships Berthing (Port Svs)	S	E	2.6	43.5	0.5	Not OK
19	S27	27 DRY STORAGE WAREHOUSE	Storage Area (Commissary)	S	P	1.4	11.6	0.6	Not OK
15	T02	T2 SUPPORT BLDG (COMMSTA)	COMMUNICATIONS BUILDING (COMSTA)	P	P	1.0	1.0	0.7	
0	F12	12 POWER PLANT	(FED)	P	P	1.0	1.0	0.9	
5	R02	R2 RECEIVER BLDG	Mechanical (air plenum, emergency genset) (COMSTA)	B	D	2.4	38.2	0.9	
5	R02	R2 RECEIVER BLDG	Electronics spaces (COMSTA)	B	D	2.4	38.2	0.9	
14	X01	576 ESWLORSTA OFFICES	Server Room (ESU)	I	I	4.0	80.6	1.2	
14	X01	576 ESWLORSTA OFFICES	ACS Room (phone service) (ESU)	I	I	4.0	80.6	1.2	
14	X01	576 ESWLORSTA OFFICES	ET/ IT Shops (ESU)	S	P	1.4	11.6	1.2	
14	X01	576 ESWLORSTA OFFICES	Admin (Office Space) (ESU)	P	P	1.0	1.0	1.2	
14	X01	576 ESWLORSTA OFFICES	Incident Command Post (ESU)	P	P	1.0	1.0	1.2	
14	X01	576 ESWLORSTA OFFICES	Conference Rm (command post) (ESU)	P	P	1.0	1.0	1.2	
14	X01	576 ESWLORSTA OFFICES	Training Space (ESU)	P	P	1.0	1.0	1.2	Not OK
		9 BILLIKEN THEATER	(MWR)					1.2	Not OK
0	S01	N1 VEH. MAINT GARAGE (BOSS KR)	(FED)	P	P	1.0	1.0	1.2	Not OK
0	T39	N23 WATER TREATMENT PLANT	(FED)	B	E	3.0	54.1	1.2	Not OK
22	Q01	4 BARRACKS 1	(Personnel)	S	P	1.4	11.6	1.3	Not OK
22	Q02	5 BARRACKS 2	(Personnel)	S	P	1.4	11.6	1.3	Not OK
22	Q07	54 BARRACKS 7	(Personnel)	P	P	1.0	1.0	1.3	Not OK
22	Q05	553 BARRACKS 8	(Personnel)	S	P	1.4	11.6	1.3	
22	Q03	6 BARRACKS 3	(Personnel)	S	P	1.4	11.6	1.3	Not OK
21	W01	614 AUTO HOBBY SHOP (ISO/MWR)	(MWR)	S	D	2.0	27.5	1.3	
18	W10	614A CUTTERMANS CLUB	Admin Area (offices) (Port Svs)	P	P	1.0	1.0	1.3	Not OK



Why Identify and Mitigate????

Proof that Modern Seismic Codes in Schools Can Save Lives:

2008 China Sichuan Earthquake, Mw 7.9 (69,000 deaths, 7,000 schools collapsed)

These two modern school buildings performed well. All occupants survived.

Fault Surface Rupture

(Note buildings in background collapsed into rubble.)



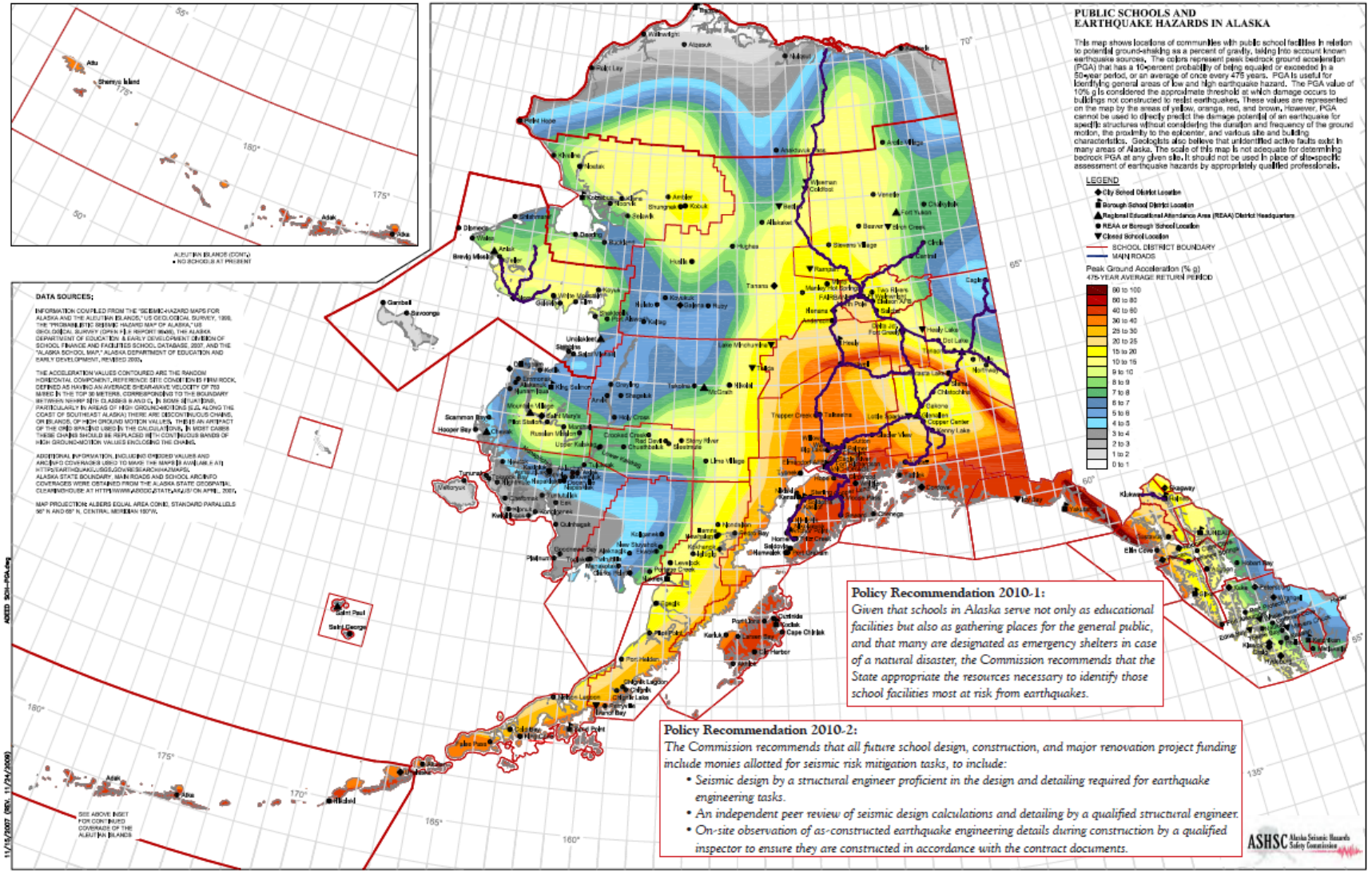
Diligence Building – almost completely intact
(5-10 year old construction)



Learning Building – basically intact
(10-15 year old construction)



2010 Map of Schools and Earthquake Hazards appear in ASHSC Annual Report. Presented to members of Legislature by John Aho (ASHSC) and Sam Kito (ADEED)

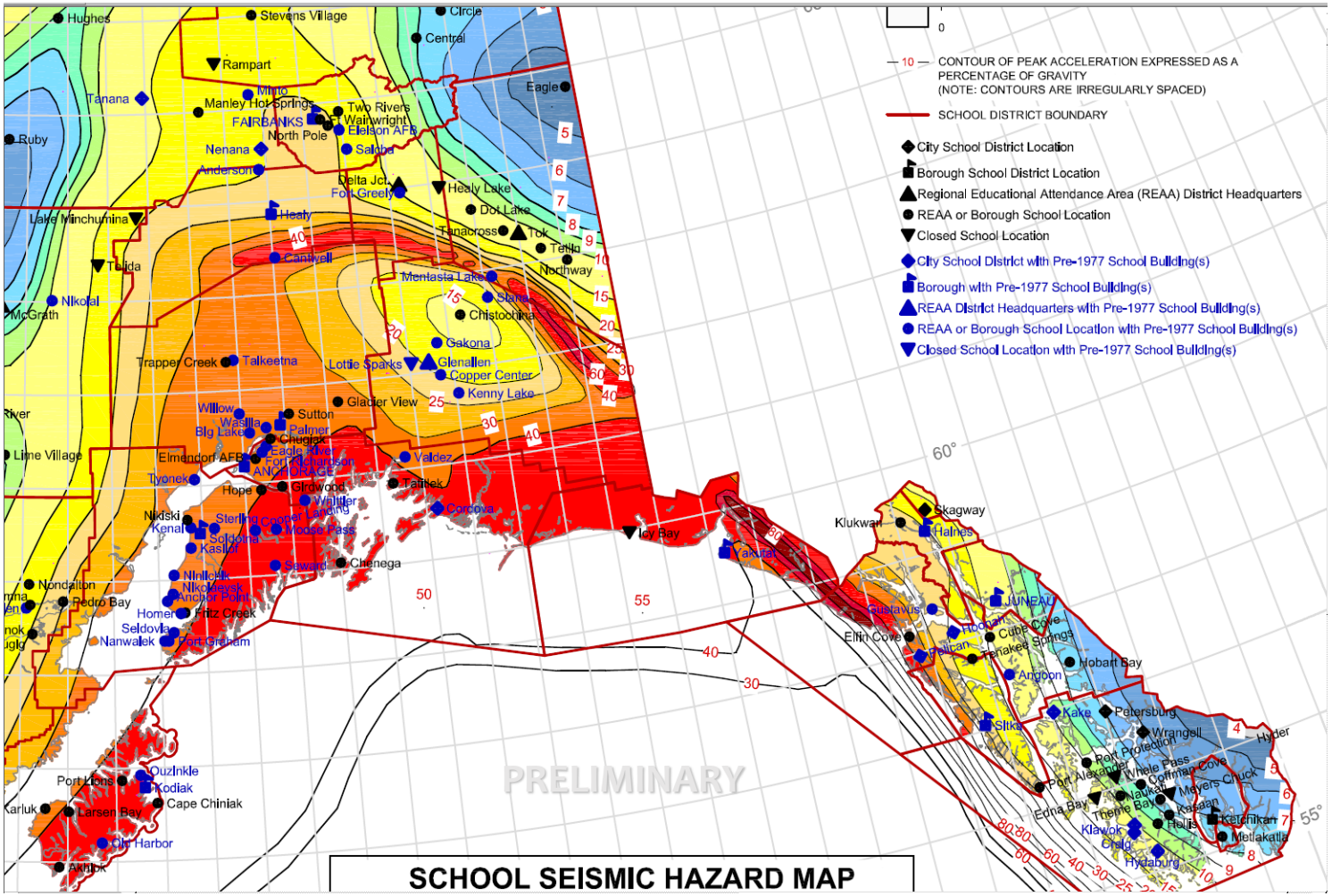


ASHSC Alaska Seismic Hazards Safety Commission

DETAILS OF REGION WITH HIGHEST SEISMIC HAZARDS, AND ASHSC PLAN FORWARD

- Recognition of Problem
- Identification of Structures at Risk
- Prioritization of Mitigation
- Final Determination of Remediation Projects

Communities with Highest Potential Peak Ground Acceleration & Educational Facilities Built Prior to 1976



Spring 2011
Mw 9.0 Earthquake and Tsunami in Japan



"High dwellings are the peace and harmony of our descendants," the stone slab reads. "Remember the calamity of the great tsunamis. Do not build any homes below this point." - 600+ year old marker, ANEYOSHI, JAPAN

Through history, this community elected to not allow construction below this marker. Consequently, their homes were spared by the March 11, 2011 tsunami.

In a neighboring community, a school had been constructed 500 feet from the ocean's edge… the children attending that school were not found.

NOTE: In some communities these markers were submerged.

2012 – After trial period, ADEED officially incorporates seismic work as a line item for school improvement projects.
(Result of partnership of ASHSC/ADEED from 2009-2012)

Alaska Department of Education & Early Development

Application for Funding
Capital Improvement Project by Grant
or
State Aid for Debt Retirement

FY 2016

For each funding request submit one original and three complete copies of this application and two copies of each attachment.

For instructions on completing this application, please refer to the department's Capital Project Information and References website at:

http://education.alaska.gov/facilities/FacilitiesCIP.html

(Note: The department will only score ten projects from each district during a single rating period)

School District: _____

Community: _____

School Name: _____

Project Name: _____

TYPE OF PROJECT AND FUNDING REQUEST

1. Type of funding requested *(Choose only one funding source.)*
   ☐ Grant Funding ☐ Aid for Debt Retirement (Bonding)

2a. **Primary** purpose of project *(Choose only one category, per AS 14.11.013 for grant projects, or AS 14.11.100(j)(4) for debt retirement projects). The department will change a project category as necessary to reflect the primary purpose of the project.*[1]

School Construction:	Major Maintenance:
☐ Health and life-safety (Category A, this category is not available for debt retirement)	☐ Protection of structure (Category C, this category is not available for debt retirement)
☐ Unhoused students (Category B; Category A for debt retirement)	☐ Building code deficiencies (Category D; Category B for debt retirement)
☐ Improve instructional program (Category F; Category D for debt retirement)	☐ Achieve operating cost savings (Category E; Category C for debt retirement)

b. Phases of project to be covered by this funding request *(Indicate all applicable phases)*
   ☐ Planning (Phase I) ☐ Design (Phase II) ☐ Construction (Phase III)

[1] The department's authority to assign a project to its correct category is established in AS 14.11.013(c)(1) and in AS 14.11.013(a)(1) under its obligation to verify a project meets the criteria established by the Bond Reimbursement & Grant Review Committee under AS 14.11.014(b)

Alaska Department of Education & Early Development

COST ESTIMATES

18. Complete the following tables using the Department of Education & Early Development's 13th **Edition** Cost Model or an equivalent cost estimate. Completion of the tables is **mandatory**. (30 points possible)

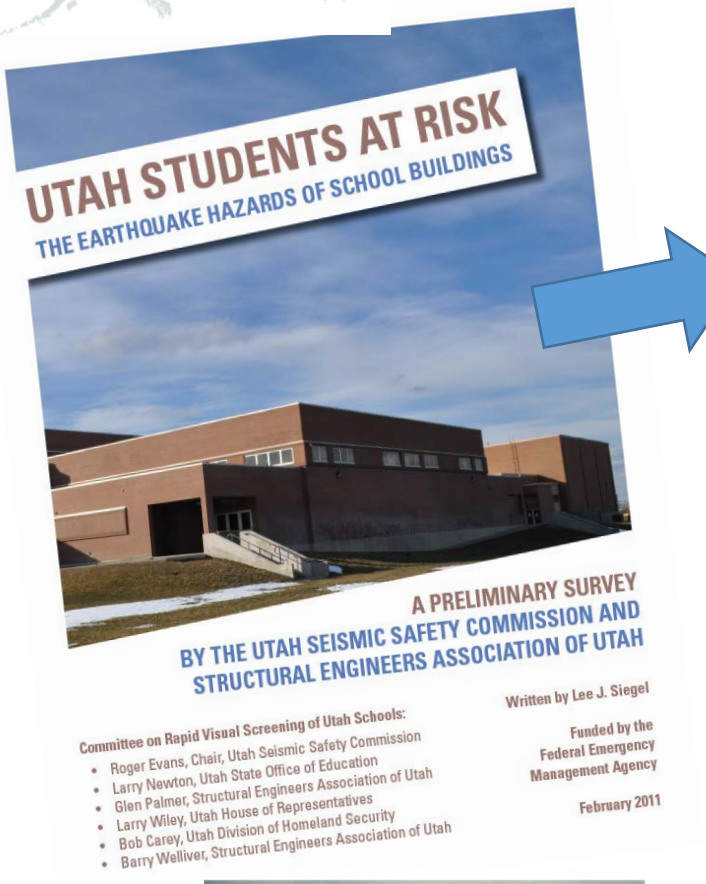
(Percentages are based on construction cost. See Appendix C for additional information. If your project exceeds the recommended percentages, you must provide a detailed justification for each item exceeding the percentage. The total of all additive percentages should not exceed 130%, if the additive percentages exceed 130% a detailed explanation must be provided or the department will adjust the percentages to meet the individual and overall percentage guidelines)

Table 1. TOTAL PROJECT COST ESTIMATE

Project Budget Category	Maximum % without justification	I Prior AS 14.11 Funding	II Current Project Request	III % of Total Construction Cost	IV Project Total
CM - By Consultant [1]	2 - 4%				
Land [2]					
Site Investigation [2]					
Seismic Hazard [7]					
Design Services	6 - 10%				
Construction [3]					
Equipment & Technology [2,5]	up to 10%				
District Administrative Overhead [4]	up to 9%				
Art [6]	0.5% or 1%				
Project Contingency	5%				
Project Total					

1. *Percentage is established by AS 14.11.020(c) for consultant contracts (Maximum allowed percentage by total project cost: $0-$500,000 – 4%; 500,001- $5,000,000 – 3%; over $5,000,000 – 2%).*
2. *Include only if necessary for completion of this project. Amounts included for Land and Site Investigation costs need to be supported in the Project Description (Question 17), and supporting documentation should be provided in the attachments.*
3. *Attach detailed construction cost estimate and life cycle cost if new-in-lieu-of-renovation.*
4. *Includes district/municipal/borough administrative costs necessary for the administration of this project; This budget line will also include any in-house construction management cost.*
5. *Equipment and technology costs should be calculated based on the number of students to be served by the project. See the department's publication, Guidelines for School Equipment Purchases for calculation methodology (2005). The department will accept a 5% per year inflation rate (from the base year of 2005) added to the amounts provided in the Guideline. Technology is included with Equipment.*
6. *Only required for renovation and construction projects over $250,000 that require an Educational Specification (AS 35.27.020(d)).*
7. *Costs associated with assessment, design, design review, and special construction inspection services associated with seismic hazard mitigation of a school facility. This amount needs to be provided by a design consultant, and should not be estimated based on project percentage.*

ASHSC Alaska Seismic Hazards Safety Commission





Government Hill Elementary School after the 1964 Earthquake

Alaska Seismic Hazards Safety Commission- Pilot Program: Rapid Visual Screening of Alaska School Buildings

Summer 2014

Alaska Seismic Hazards Safety Commission- Pilot Program: Rapid Visual Screening of Alaska School Buildings

Alaska Seismic Hazards Safety Commission		Earthquake Engineering Research Inst.	
Address:	PO Box 25517 Juneau, AK 99802	**Address:**	499 14th St, Suite 220 Oakland, CA 94612-1934
Contact:	Laura W. Kelly, PE	**Contact:**	Jay Berger, Executive Director
Phone:	(907) 463-2424	**Phone:**	(510) 451-0905
E-Mail:	Laura.W.Kelly@uscg.mil	**E-Mail:**	JBerger@eeri.org

Project Name:	**ASHSC Pilot Program: Rapid Visual Screening of Alaska School Buildings**		
Effective:	6/2/2014	**Ending:**	1/2/2015
Description:	The Alaska Seismic Hazards Safety Commission (ASHSC) respectfully requests the Earthquake Engineering Research Institute (EERI) to hire a consultant with an Alaska PE license to set up and implement a pilot program for conducting Rapid Visual Screenings (RVS) of Alaska schools using FEMA 154/ROVER. As part of a pilot study, identify and work with a supportive school district in or near Anchorage, AK, and screen as many at-risk schools as feasible (approximately 5-10) within allotted budget. Develop protocol for collecting, managing, and reporting final results. Make recommendations for implementing on a district-by-district basis, and potentially at the state-wide level.		

Project Scope/Deliverables

1. Work with the ASHSC to identify a school district willing to participate in a RVS pilot study. The school district must be located in Anchorage or on the adjoining road system in order to minimize travel & per diem costs. Though not required, it is preferred that as-built drawings for the school buildings be available in advance, to improve speed and reliability of screening. Upon request, the ASHSC can provide a map of Alaska school districts and seismic hazards, student attendance numbers, and database of school building information sorted by local peak ground motions, and year of construction.
2. Purchase a laptop and/or mobile device for installation, operation, collection and management of FEMA 154/ROVER software/data. Provide to ASHSC upon completion of pilot study for future use and data collection/management. FEMA ROVER software is free of cost. Upon request, the ASHSC can provide information describing ROVER software applications.
3. Perform RVS of approximately 5-10 schools considered at-risk. If schools are newly constructed and meet modern seismic code, do not screen. Screener shall have an Alaska Professional Engineering license and a strong background in structural and earthquake resistant design. Experience with RVS/ROVER preferred.
4. Compile results in a final report. Final product shall serve as a Proof of Concept, and establish protocols and a cost basis for future work. Refer to the Utah Seismic Safety Commission's pilot test in Salt Lake City as a model. Intent is to utilize final product as an example for justifying and performing RVS in other Alaska school districts. Final report may also be used to persuade state legislators to fund a RVS program on a state-wide basis, or to obtain future grant funding. See Attachment 1, "Utah Students at Risk" by the Utah Seismic Safety Commission.

Estimated Budget	Terms	Cost
Consutlting (including travel & per diem)	40 hours @ $150/hr	$6,000
Hardware (laptop computer/portable device/setup)	1 lump sum	$1,000
Software (ROVER) - Free from FEMA	No Cost	$0
Final Report	5 Hard Copies, 1 Digital CD	$500
	Total Cost:	**$7,500**

ASHSC Alaska Seismic Hazards Safety Commission

Pilot RVS – Mat-Su School District (14% of Alaska's student base)

February 2015


BBFM Engineers Inc.

510 L Street Suite 200
Anchorage, AK 99501-1949
(907) 274-2236
(907) 274-2520 Fax
www.bbfm.com

Identifying Potential Earthquake Dangers To Alaska's Students and Schools

A Pilot Project Screening Matanuska-Susitna School District Buildings
February 6, 2015

Study Conducted by: BBFM Engineers, Inc.
Sponsored by:

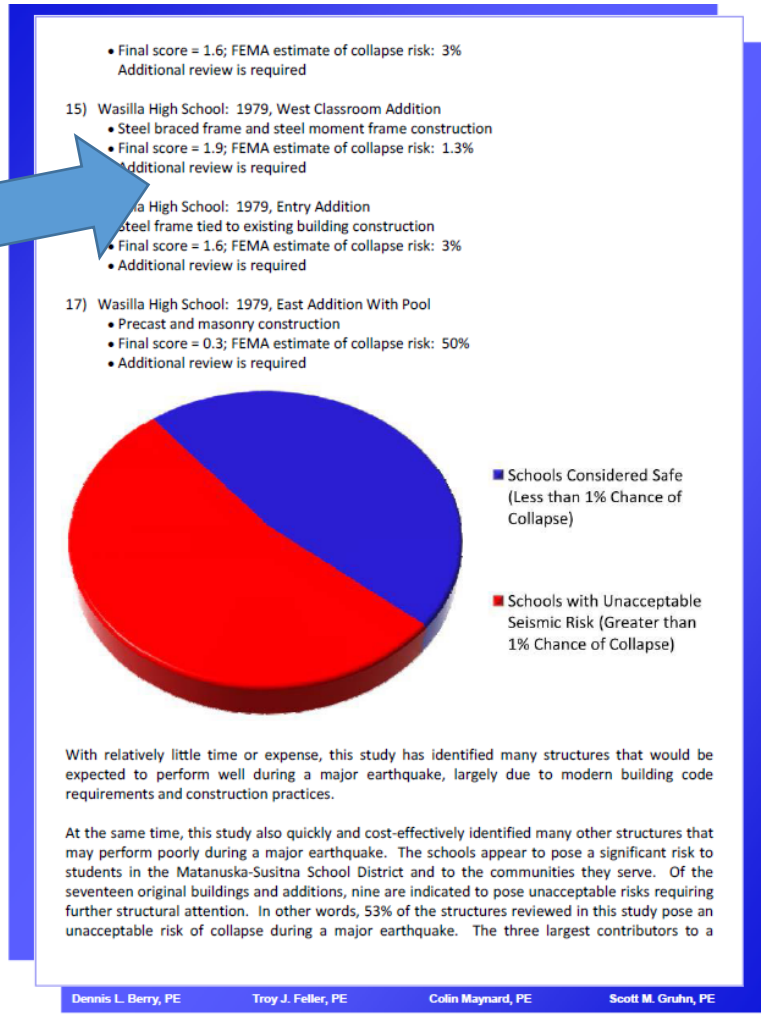
FEMA — The Federal Emergency Management Agency (FEMA)
The Department of Homeland Security (DHS)
EERI — The Earthquake Engineering Research Institute (EERI)
ASHSC — The Alaska Seismic Hazards Safety Commission (ASHSC)

Alaskan Seismicity:
Alaska is among the most seismically active areas on Earth. Over the past 50 years, the United States Geological Survey (USGS) recorded in the United States more than 3,000 earthquakes more powerful than magnitude 5, with approximately 80% of these occurring in Alaska. Further, of the twelve most powerful earthquakes America has ever experienced, ten were situated in Alaska. These include the 1964 Great Alaska Earthquake, which remains the second most powerful ever measured on Earth.

Sites of major earthquakes in the US

Alaska's intense seismicity is a result of plate tectonics. The Pacific Plate, moving north 2" to 3" per year, slides below the North American Plate at a fault called the Aleutian Megathrust. This tectonic collision and subduction is able to produce an earthquake up to magnitude 9.2, according to the Federal Emergency Management Agency (FEMA). Many other faults occur around the state, and

Dennis L. Berry, PE | Troy J. Feller, PE | Colin Maynard, PE | Scott M. Gruhn, PE
BBFM Engineers | Earthquake Danger to Alaska's Students and Schools | Page 1


- Final score = 1.6; FEMA estimate of collapse risk: 3%
  Additional review is required

15) Wasilla High School: 1979, West Classroom Addition
- Steel braced frame and steel moment frame construction
- Final score = 1.9; FEMA estimate of collapse risk: 1.3%
- Additional review is required

[illegible]a High School: 1979, Entry Addition
[illegible]teel frame tied to existing building construction
- Final score = 1.6; FEMA estimate of collapse risk: 3%
- Additional review is required

17) Wasilla High School: 1979, East Addition With Pool
- Precast and masonry construction
- Final score = 0.3; FEMA estimate of collapse risk: 50%
- Additional review is required

With relatively little time or expense, this study has identified many structures that would be expected to perform well during a major earthquake, largely due to modern building code requirements and construction practices.

At the same time, this study also quickly and cost-effectively identified many other structures that may perform poorly during a major earthquake. The schools appear to pose a significant risk to students in the Matanuska-Susitna School District and to the communities they serve. Of the seventeen original buildings and additions, nine are indicated to pose unacceptable risks requiring further structural attention. In other words, 53% of the structures reviewed in this study pose an unacceptable risk of collapse during a major earthquake. The three largest contributors to a

Dennis L. Berry, PE | Troy J. Feller, PE | Colin Maynard, PE | Scott M. Gruhn, PE
BBFM Engineers | Earthquake Danger to Alaska's Students and Schools | Page 8

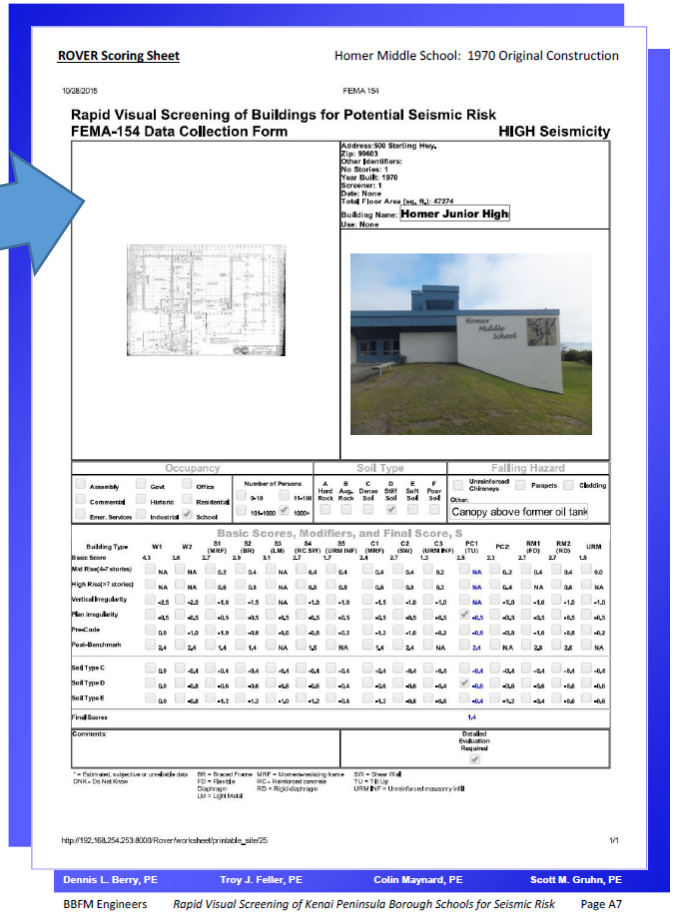
Cost of this Study:
The total cost of this study was approximately $18,500. Of this, BBFM Engineers was paid $8,500 for their work, resulting in a donated effort of approximately $10,000. Of this, $4,275 was spent on setting up the server and becoming acquainted with the software. Another $8,145 was spent reviewing drawings, visiting the schools, and entering data into the server. Finally, a little over $6,000 was spent preparing this report.

Pilot study proved that an RVS for a school structure in Alaska could be performed for approximately $600 to $800 per original structure or addition, plus costs associated with transportation.

2015 RVS – Kenai Peninsula Borough School District (7% of Alaska's student base)

October, 2015





Cost of this Study:
The total cost of this study was $21,250, at a cost of performed for just $500 to $700 per structure.

Schools located in Anchor Point, Cooper Landing, Homer, Kenai, Moose Pass, Nikolaevsk, Ninilchik, Homer, Kenai, Seward, Soldotna, Sterling, Seldovia, Kasilof.

In total, we reviewed 15 schools comprised of 47 structures, including original construction and additions. Nineteen of the 47 warrant a more detailed evaluation, while further review of the remaining 28 schools is not indicated.
In other words, 40% of the structures reviewed in this study may pose an unacceptable risk of at least partial collapse during a major earthquake.

ASHSC Alaska Seismic Hazards Safety Commission

What CA school retrofits prevented during a M6 EQ.

February 2015



Napa earthquake damage to a building without seismic retrofit



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Identifying Potential Earthquake Dangers To Alaska's Students and Schools

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Sites of major earthquakes in the US

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Dennis L. Barry, PE — Trey J. Feller, PE — Colin Maynard, PE — Scott M. Girdner, PE
BBFM Engineers — Earthquake Danger to Alaska's Students and Schools — Page 1

Recent example of a successful school retrofit program was demonstrated during the magnitude 6 earthquake that struck Napa, California in 2014, producing peak ground accelerations of 60% to 100% as strong as the acceleration due to gravity. The earthquake and its aftershocks injured 90 people and caused approximately $1 billion of damage.

Engineering News-Record reported on September 3, 2014:
The epicenter of the American Canyon quake was at the heart of the Napa school district's 30 campuses. Subsequently, three architectural and engineering teams assessed "every room in every school" and observed no structural damage following the quake, says Mark Quattrocchi, principal of Kwok Quattrocchi Architects and one of the survey team members… The schools performed so well because they are built or retrofitted according to much stricter seismic codes than commercial and residential buildings.

"There was no structural damage to any school in the district, even the ones built to older codes in the 1940s, 1950s and 1960s," says Quattrocchi. "Part of this is because seismic upgrades at the schools are treated the same as building an entirely new facility," he adds. Schools fared well for three reasons: seismic building codes that are more stringent than those for commercial buildings, methodical reviews by the Division of the State Architect and "full-time" state inspection on school construction sites, Quattrocchi says."

ASHSC Alaska Seismic Hazards Safety Commission

LESSONS LEARNED:

Earthquakes remain our greatest teacher and exert the most influence. Human nature allows us to rapidly forget; natural disasters spur short periods of action. Clearly document information & efforts – easy to forget.

Hidden seismic hazards exist, many of which have yet to be identified – especially in Alaska.

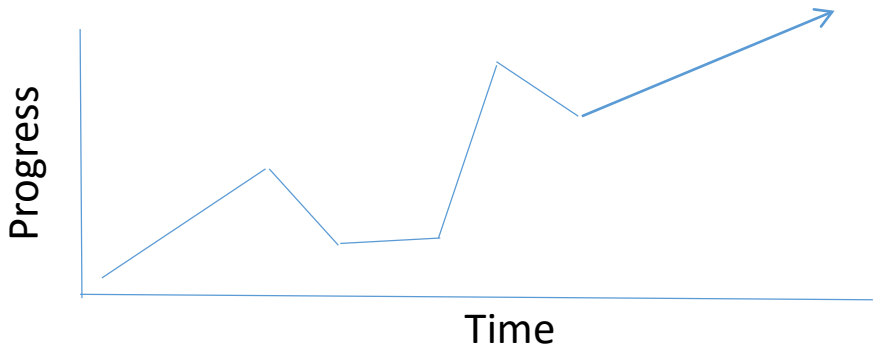
Foster and maintain professional relationships. Encourage professional development and dialog. Encourage inter-agency and cross-state communication.

The average US citizen thinks they don't need to worry about the next earthquake – they assume our codes and engineers have already made everything safe.

Do not underestimate the ability of others to help (or occasionally hinder). Educators, eager students and pro-active PTA members are great allies. Understand that some upper-level leaders will cite concerns over wide-spread alarm and unfunded mandates. Partner with the Departments of Education and School Districts.

The path to success is not always upward or linear. Anticipate sudden successes, unforeseen set-backs, and seeming lack of progress. Be persistent; a worthy idea will succeed over time.



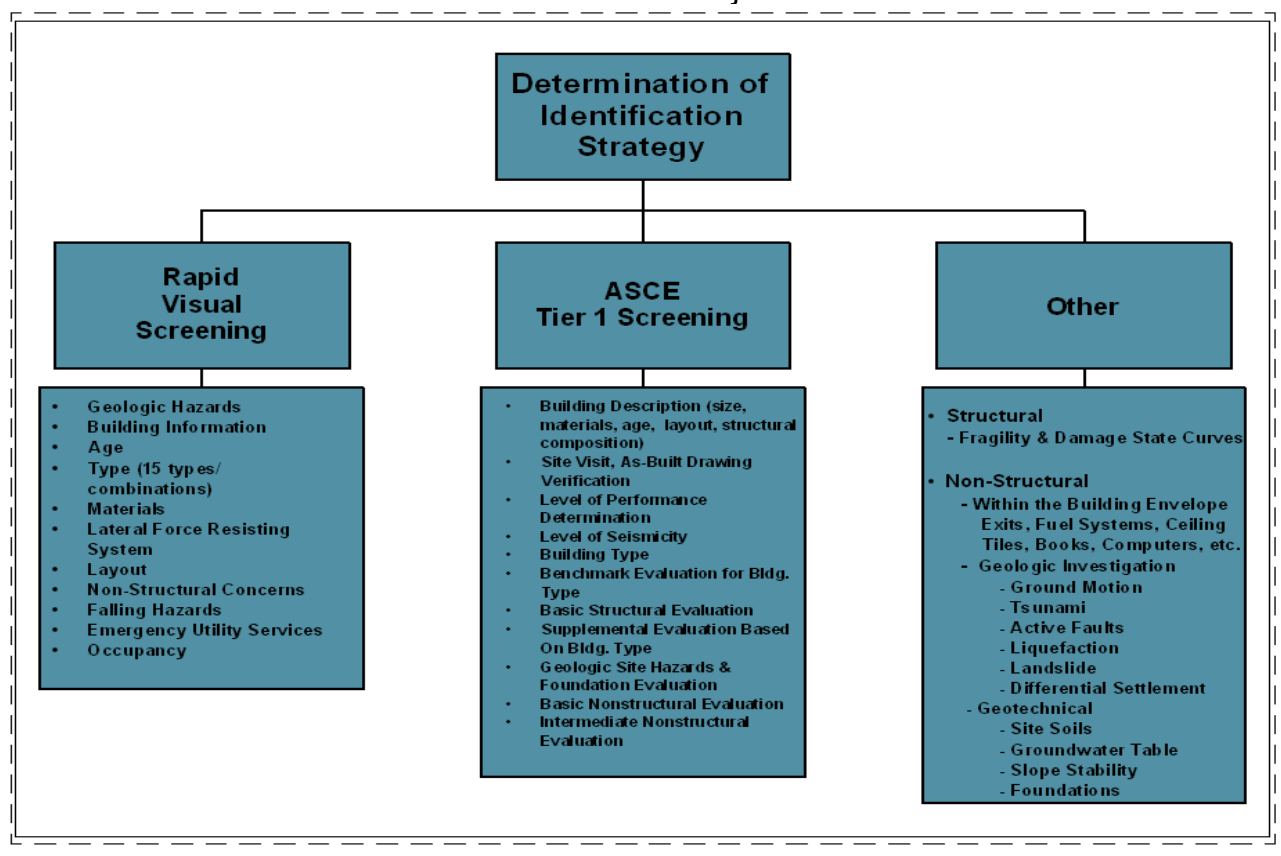


ASHSC Alaska Seismic Hazards Safety Commission

Identification, Funding, Staffing & Project Implementation

IDENTIFICATION

- Recognition of Problem
- Identification of Structures at Risk
- Prioritization of Mitigation
- Final Determination of Remediation Project



ASHSC Alaska Seismic Hazards Safety Commission

Identification, Funding, Staffing & Project Implementation

FUNDING

- Federal
  - FEMA Hazard Mitigation Grant Program (HMGP) – Post Disaster

    Federal HMGP funds made available following a disaster can provide a federal share of up to 75% of the costs of an approved project.
    The remaining 25% must be met through non-federal funds such as local government funds, community development block grants, etc.
  - FEMA Pre-Disaster Mitigation Program (PDM)
    - » Mitigation planning: $1M cap on Federal share, not to exceed 3 years
    - » Mitigation projects: $3M cap on Federal share, not to exceed 3 years
    - » Information dissemination activities not to exceed 10%, must directly relate to planning or project sub-application
    - » Applicant management costs not to exceed 10%
    - » Sub-applicant management costs not to exceed 5%
  - US Senators
  - US Representatives
- State
  - School Facilities Capital Improvement Project Grant (Dept. of Education)
  - State Capital Projects
    - » State Senators
    - » State Representatives
  - Governor
- Local
  - Bonds
  - Maintenance
  - Special Capital Projects/Special Funds (Sale of Shuyak Island)
  - General Fund (Mill Rate/Property Taxes/Severance Taxes/Intergovernmental Sources)
  - Local Government Representatives
  - Local Government Employees
- Private (In-Kind Donations)
  - Services
  - Materials/Supplies
  - Benefactors

ASHSC Alaska Seismic Hazards Safety Commission

Identification, Funding, Staffing & Project Implementation

STAFFING

- **Local Government**
  - Credentials
  - Time Commitment
  - Specialized Hire Considerations
  - Points of Contact
    - » Finance
    - » Record drawings (digital?)
    - » Building Access
    - » Public Meetings & Outreach
    - » Project Management (Identification, Mitigation Grants, Construction)
- **Municipal/School Building Managers**
  - Engineers (Large Districts)
  - Architects (Large Districts)
  - Finance
  - Maintenance
- **Private Contract**
  - Evaluation
    - » Geologic
    - » Geotechnical
    - » Structural
  - Grant Application
  - Design
  - Construction
  - Inspection

ASHSC Alaska Seismic Hazards Safety Commission

Identification, Funding, Staffing & Project Implementation

PROJECT IMPLEMENTATION

- **Seismic Only**
- **Combined**
  - Maintenance Upgrade (Roof, Mechanical, Electrical)
  - Energy Efficiency
  - Expansion
- **Phased/Unphased**
- **Unanticipated Issues**
  - Existing Conditions
    - » Lead (paint, plumbing, etc.)
    - » Asbestos (flooring, insulation, roofing, etc.)
    - » Non-Code Compliant Electric, Plumbing, Fire, Fuel/Heat
    - » Unknown Existing Conditions (Structural/Non-Structural)
  - Funding Difficulties
    - » Long Stretches of Time between Identification & Construction
    - » Multiple Agencies
    - » Rising Construction Costs
    - » Unaccounted Local Cost Factors

Item No. **3.B**

Kodiak Island Borough

AGENDA STATEMENT

Special Meeting of June 26, 2007 **Contract No. FY2007-50**

Authorizing the Manager to Execute Contract No. FY2008-01 for Phase I of the Seismic Upgrades to the Kodiak Middle School.

Kodiak Island 3.16.020 "Limitation on Manager's Authority" states that a contract exceeding $25,000 requires Assembly approval.
This Contract is for work at the Kodiak Middle School shown on the construction documents prepared by Jensen Yorba Lott, Inc. titled "Kodiak Middle School Seismic Upgrade", dated April 27, 2007, and includes structural, mechanical, electrical, and architectural work. The construction documents, bid documents and associated addendum are available for review on the KIB website. The work will be phased over two (2) years.

The Project is funded in part by monies from a FEMA PDM-c Grant; Bond Projects for Floor Covering Replacement and KHS/KMS Roof Upgrade; and Legislative funds. Additional funding sources are to be identified.

Bids received in response to KIB's Invitation to Bid dated April 2007 are:

	Base Bid Phase 1	Alt Bid 1 Phase 2	Total
Brechan Enterprises	$2,340,000	$3,175,000	$5,515,000
F & W Construction	$2,469,667	$3,011,917	$5,481,584
Engineers Estimate			$3,465,000
% Difference			58% Over

The E/F Department has reviewed the bids and, as both bids received are substantially higher than the engineers estimate, recommends that a Contract for Seismic Upgrades at the Kodiak Middle School be awarded to Brechan Enterprises, Inc. in an amount not to exceed $2,340,000 for Phase 1 work only. Phase 2 is to be re-bid at a later date.

Fiscal Notes:	☐ n/a	Acct No.	420 515 452 150 05014 6 410 523 452 150 05022 5 410 531 452 150 07015 6
Expenditure Required: $	☐ n/a	Amount Budgeted:	☐ n/a

APPROVAL FOR AGENDA:

Recommended motion: Move to authorize the manager to execute Contract No. FY2007-50 with Brechan Enterprises, Inc of Kodiak in an amount not to exceed $2,340,000.

Thank You!





Artwork by

Eustace Ziegler (1881-1969), Alaskan Frontier Artist

(My great grandfather's brother.)

Note: Numerous pieces of his artwork were lost in the 1964 Valdez tsunami. Some of his surviving works can be seen at the Anchorage Museum and the State Capitol Building in Juneau.

Questions? E-mail: Laura.W.Kelly@USCG.MIL



QUESTIONS & ANSWERS SESSION

THANK YOU!

More info:
eeri.org/schools