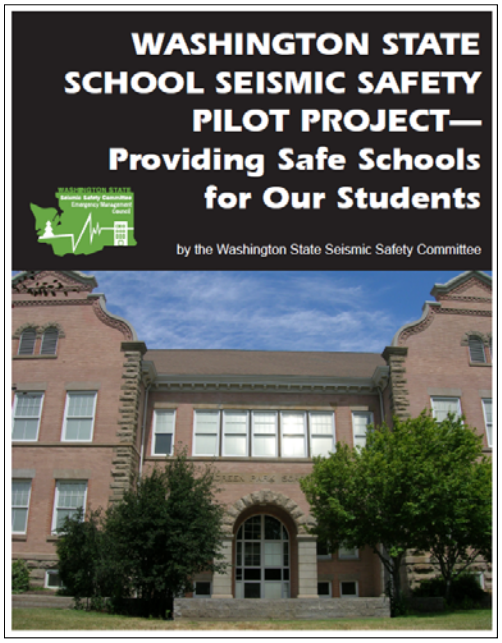
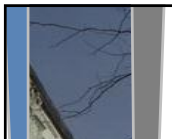
Washington School Seismic Safety Assessment Pilot Project

John D. Schelling
Washington Emergency Management

Cale Ash, P.E., S.E.
Degenkolb Engineers





Why Assess School Buildings?

- Do YOU know how many schools in Washington State are vulnerable to extensive damage or collapse in an earthquake?
- Do YOU know how many kids are at risk?
- Do YOU know which school districts have already retrofitted *all* their buildings?
- **Well, guess what…Neither does anyone else.**
- Also, if scarce resources had to be prioritized to build or retrofit, how would you know where to put them?

Washington Schools have been Damaged in Earthquakes

1949, a large earthquake collapsed the gymnasium roof at Puyallup High School. The earthquake occurred at 11:58 a.m., and the gym had just been vacated by students for lunch.

At Castle Rock High School, however, falling masonry killed the student body president as he tried to escape from the building .

Another student was killed by falling bricks at Lowell Grammar School in Tacoma

In all, thirty schools were damaged in this Nisqually-type earthquake

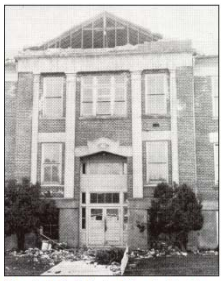
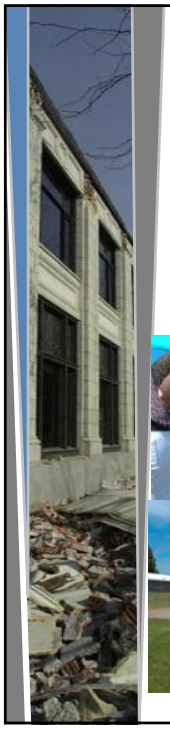


Figure 2. At Castle Rock, a high school student was killed as unanchored gable masonry cascaded to the walk outside the entrance. There could have been more casualties. (From Edwards, 1951.)



School Seismic Needs Assessment

- Pilot Project in the Cities of Walla Walla and Aberdeen
- Leverage volunteer expertise from Structural Engineering Association of Washington (SEAW) to investigate structural issues and Washington Association of Building Officials (WABO) to evaluate non-structural issues.
- Project used ASCE 31: Evaluation of Existing Buildings for structural assessment, VS-30 data for local geology assessment, and HAZUS for modeling of potential losses.
- Intent was to develop a method that can be used statewide to assess all school buildings for seismic safety.

Selection Process

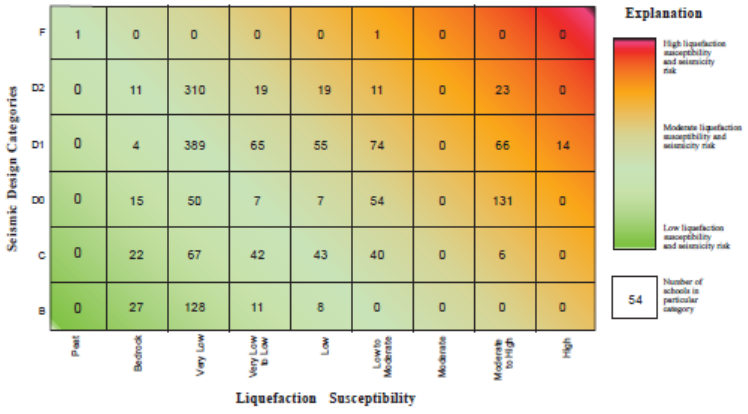
1) Our initial screening was to consider school districts that had high earthquake hazard. We mapped schools on a combination of the seismic design category map and liquefaction susceptibility maps.

2) School districts in both eastern and western Washington that scored high in criterion 1 were plotted.

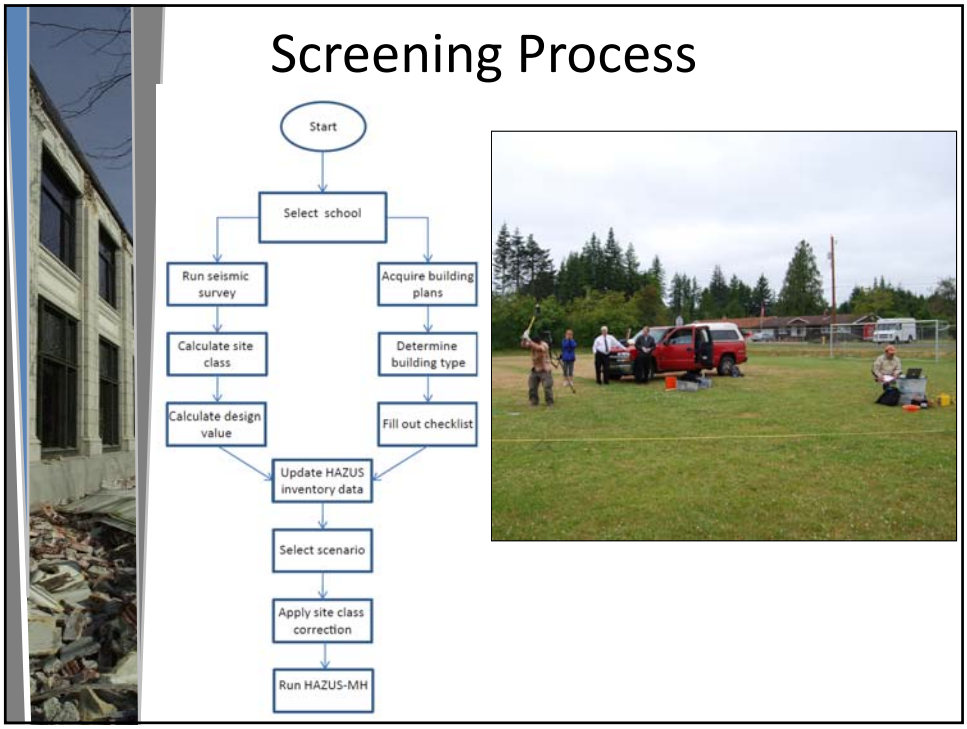
3) The number of schools per district were considered, both to equalize each district and to select a number of school buildings that could be evaluated with the available resources.

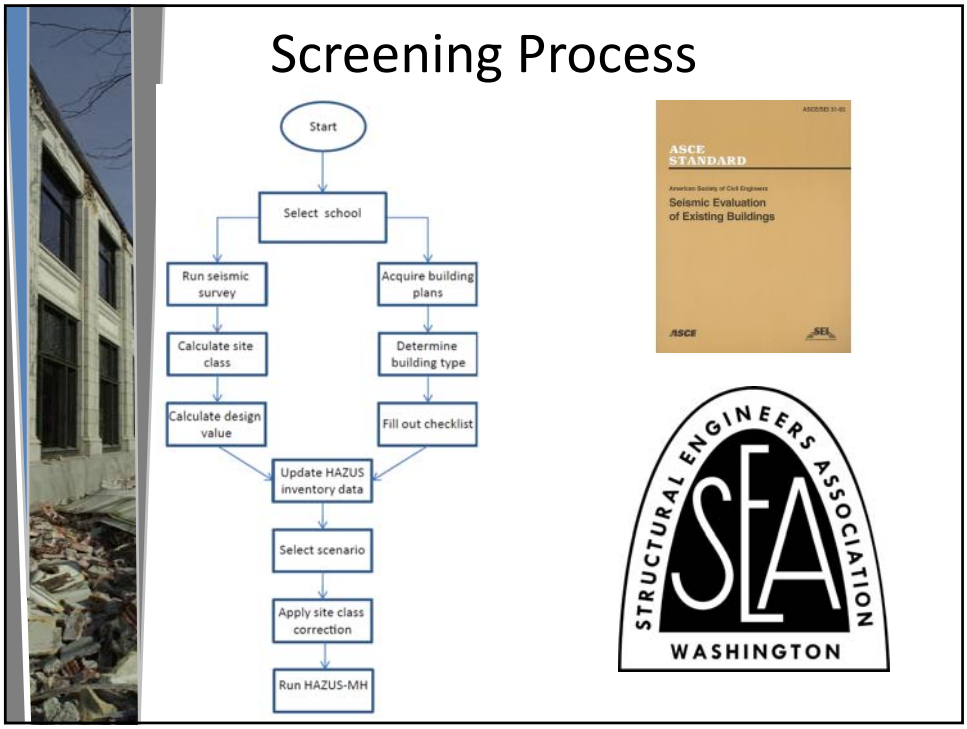
4) A representative of the Office of the Superintendent of Public Instruction then contacted a select number of school districts to determine their willingness to participate.

Selection Process



Note: The seismic design category combines an estimate of the strength of ground shaking at any individual site with the amplification caused by the local geology.





STRUCTURAL ENGINEERS ASSOCIATION
SEA
WASHINGTON

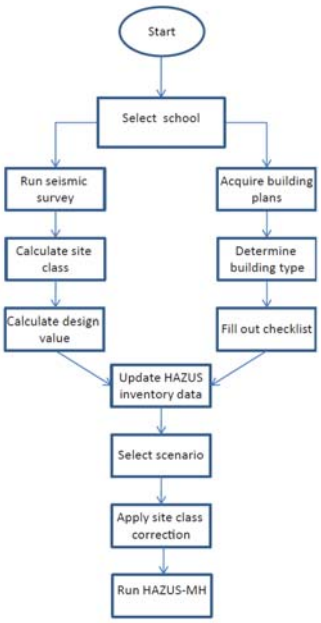
Evaluation Results

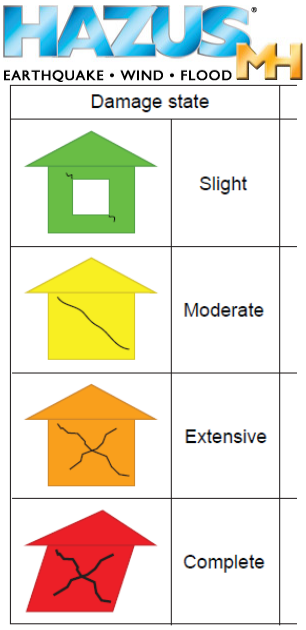
Evaluation Results

Evaluation Results

Evaluation Results

Screening Process





Aberdeen Results

Hazus Damage Probabilities for Aberdeen Schools						
Name	None	Slight	Moderate	Extensive	Complete	Extensive + Complete
A J West Elementary	14.8%	56.1%	28.4%	0.7%	0.0%	0.7%
Aberdeen S Dist Admin Bldg	0.0%	0.0%	0.1%	2.1%	97.9%	99.9%
Alexander Young Elementary	0.0%	0.0%	0.2%	7.6%	92.2%	99.8%
Central Park Elementary	0.0%	0.5%	27.6%	54.4%	17.4%	71.8%
Harbor High School	0.0%	0.0%	0.2%	7.6%	92.2%	99.8%
Hopkins Elementary	0.0%	0.0%	0.2%	7.6%	92.2%	99.8%
J M Weatherwax – Aberdeen HS	41.4%	45.4%	13.0%	0.2%	0.0%	0.2%
McDermoth Elementary	44.7%	42.3%	12.7%	0.4%	0.0%	0.4%
Miller Junior High	0.0%	0.0%	4.6%	42.4%	53.0%	95.3%
Robert Gray Elementary	54.1%	41.0%	4.8%	0.0%	0.0%	0.0%
Sam Benn Gym (Aberdeen HS)	34.1%	53.7%	12.1%	0.1%	0.0%	0.1%
Stevens Elementary	0.0%	0.0%	4.6%	42.4%	53.0%	95.3%
Stewart Bldg – Robert Gray Elm	0.0%	0.0%	2.6%	31.6%	65.8%	97.3%

60% with extensive damage or greater (Life Safety)

Walla Walla Results

Hazus Damage Probabilities for Walla Walla Schools						
Name	None	Slight	Moderate	Extensive	Complete	Extensive + Complete
Berney Elementary	52.8%	22.1%	20.2%	4.4%	0.6%	5.0%
Berney Elementary Gym	52.8%	22.1%	20.2%	4.4%	0.6%	5.0%
Blue Ridge Elementary	61.7%	23.7%	12.2%	2.4%	0.0%	2.4%
Edison Elementary	60.9%	20.1%	16.4%	2.5%	0.2%	2.7%
Garrison Middle School	64.4%	26.3%	8.8%	0.6%	0.0%	0.6%
Green Park Elementary (additional)	64.4%	26.3%	8.8%	0.6%	0.0%	0.6%
Green Park Elementary (original)	39.3%	25.9%	23.7%	8.9%	2.2%	11.1%
Lincoln Alternative HS	39.3%	25.9%	23.7%	8.9%	2.2%	11.1%
Lincoln Alternative HS Annex	61.8%	27.3%	9.7%	1.1%	0.1%	1.2%
Pioneer Middle School	64.4%	26.3%	8.8%	0.6%	0.0%	0.6%
Prospect Point Elementary	28.5%	15.4%	31.4%	21.9%	2.8%	24.7%
Sharpstein Elementary (gym and lunchroom)	68.9%	15.8%	12.5%	2.7%	0.1%	2.8%
Sharpstein Elementary	51.2%	28.4%	19.2%	0.9%	0.3%	1.2%
Walla Walla HS (academic)	60.8%	18.4%	16.5%	4.1%	0.1%	4.2%
Walla Walla HS (auditorium)	41.6%	26.1%	28.0%	4.0%	0.3%	4.3%
Walla Walla HS (commons)	28.5%	15.4%	31.4%	21.9%	2.8%	24.7%
Walla Walla HS (large gym)	60.8%	18.4%	16.5%	4.1%	0.1%	4.2%
Walla Walla HS (library)	47.7%	22.8%	24.0%	5.1%	0.5%	5.6%
Walla Walla HS (music)	31.8%	21.0%	36.4%	8.9%	2.0%	10.9%
Walla Walla HS (science)	28.5%	15.4%	31.4%	21.9%	2.8%	24.7%
Walla Walla HS (small gym)	28.5%	15.4%	31.4%	21.9%	2.8%	24.7%
Walla Walla HS (vocational)	47.7%	22.8%	24.0%	5.1%	0.5%	5.6%

20% with moderate damage or greater (Shelter)

ASCE 31+HAZUS vs. FEMA 154

- More detailed evaluation, future mitigation work more clearly defined.
- Nonstructural hazards explicitly assessed.
- False positives and false negatives virtually eliminated.
- Modest investment required (~$3,500 per building).

Next Steps

- Continue to ensure local school districts are participating in & party to the local jurisdictions' FEMA-approved Hazard Mitigation Plan.
  - Provides eligibility for FEMA Pre-Disaster Mitigation and Hazard Mitigation Grant Program funds to retrofit deficient buildings
- Potential to create a state matching fund to leverage federal & local resources applied to retrofitting/construction.
- Washington State agencies (Natural Resources, Superintendent of Public Instruction, Emergency Management) discussing long-term funding options using the Common School Construction Fund.
- Solidify this new approach as a statewide standard and track results and progress.
- Integrate and support this effort through the 'Resilient Washington State Initiative'.