OREGON SEISMIC NEEDS ASSESSMENT:
Education & Emergency Facilities

ANOTHER STEP IS ACHIEVED IN THE TWO DECADE-LONG EFFORT TO INCREASE AWARENESS & MITIGATE SEISMIC RISK IN OREGON

Oregon Earthquake Risk Mitigation Timeline:

- 1991 - OSSPAC formed by Governor
- 1993 - Scotts Mills, Klamath Fall earthquakes. Oregon Building Code seismic zone increased
- 1995 - Tsunami inundation maps for coast released
- 2001 - Boards & Divisions shall provide for seismic safety surveys for education & emergency facilities (SB14, 15)
- August 2005 – DOGAMI to perform Statewide Seismic Needs Assessment (SB 2, 3, 4, 5).
- Nov 2002 – Voters Approve Constitutional Amendment; Allows for Article XI-M and XI-N bonds
- 2022 – Seismic upgrades to Emergency Facilities to be completed
- 2032 – Seismic upgrades to Education Facilities to be completed
RECOGNIZED SEISMIC RISK (2006):

Oregon has relatively high seismic risk


The new study uses HAZUS-MH MR2 and the 2002 US Geological Survey Probabilistic Hazard Maps (which are based on the latest seismological, geophysical, and geological information) to estimate annualized earthquake loss in the U.S. In addition, the 2006 FEMA Annualized Earthquake Losses (AEL) study addresses three important dimensions of earthquake risk analysis: casualties, debris and shelter.

SB 2 (2005): STATEWIDE SEISMIC NEEDS ASSESSMENT
July 2005 - June 2007
Department of Geology Administers

- Develop a Statewide Seismic Needs Assessment Of:
  - Buildings With Capacity of 250 Or More And Routinely Used For Student Activities By K-12, Community Colleges and ESDs
  - Hospital Buildings That Contain An Acute Care Facility
  - Fire Stations
  - Police Stations, Sheriffs’ Offices and Similar Facilities Used By State, County, District and Municipal Law Enforcement Agencies
- The Assessment Shall Consist of Screenings, Ranking Of Screening Results & Development of GIS Databases Of Survey Data

SB 3 (2005): SEISMIC REHABILITATION GRANT PROGRAMS
July 2007 -
Office of Emergency Management Administers

- Director Appoints Grant Committee That:
  - Determines Form and Method of Applying For Grants
  - Determines Eligibility Requirements For Grant Applicants
  - Determines Funding Scoring System Directly Related To Seismic Needs Assessment
  - Additionally, The Grant Process May:
    - Require Applicant Matching Funds
    - Provide Authority To Waive Requirements Based on Special Circumstances
    - Provide Separate Rules For Funding Structural and Non-Structural Building Elements
- OEM Then Requests Financing Of All Or A Portion Of State Share Of Costs

1/5 OF 1% OF TRUE MARKET VALUE OF STATE ASSETS
Approx $725M

NOTE: SB4 INCLUDES UNIVERSITY SYSTEM BUILDINGS

SB 4 (2005):
SEISMIC REHABILITATION
Article XI-M Bonds
Public Education Buildings
July 2007 - Jan 2032
State Treasurer/DAS

1/5 OF 1% OF TRUE MARKET VALUE OF STATE ASSETS
Approx $725M

SB 5 (2005):
SEISMIC REHABILITATION
Article XI-N Bonds
Emergency Services Buildings
July 2007 - Jan 2022
State Treasurer/DAS
**SENATE BILL 2 INSTRUCTIONS:**

- Surveys consist of:
  - **Rapid visual screenings of the buildings specified, in accordance with FEMA-154, or an equivalent standard;**
  - The **ranking** of the rapid visual screening results in risk categories based on:
    - **Need**
    - **Importance** of the building to the community
    - Risk to the building posed by its **location**
    - Risk posed to the community by the **collapse** of the building during a seismic event
    - Projected cost of the necessary rehabilitation
    - **Other categories** determined necessary by DOGAMI
  - The development of **geographic information system (GIS) databases of survey data** and the sharing of that data with interested parties.

---

**Public Education Buildings**

**Define Universe** of k-12 Public Schools & Community College Sites

- Does Site Qualify For Inclusion in SB2:
  - 250 Capacity?
  - Regular Use?
  - 90% of Enrolled in County?
  - In/Near Tsunami Inundation?

- Yes
- No

- Assess Seismic Needs
  - FEMA 154 (RVS)
  - NEHRP Soils

  - Relative Rank From Screening Results
    - New Since 1994 or Already Retrofit
    - RVS Score Results
    - High Need Community?

  - Low Need
  - Low Risk

- Highest Risk & Highest Need

---

**SB 3: SEISMIC REHABILITATION GRANT PROGRAMS**
2007 - Office of Emergency Management Administers

- Application Process
  - Qualifying Applicant?
  - Detailed Engineering Report?
  - Matching Funds Required/Available?
  - 30-Year Use Demonstrated?

- Oregon University System

---

**SB 4: SEISMIC REHABILITATION Article XI-M**
Bonds
Public Education Buildings
July 2007 - Jan 2032
State Treasurer/DAS
FEMA 154-What it is:

- **Rapid Visual Screening**
  - Developed for a broad audience
  - Creates building inventory

- Purpose is to identify:
  - Older buildings
  - Buildings on soft or poor soils
  - Buildings “having performance characteristics that negatively influence their seismic response”
FEMA 154—What it is **not:**

- RVS 154 known as “Sidewalk Surveys”
  - Medical Analogy: “Judging health based upon general factors like family history”
- Are **Not** Engineering Studies
  - (as are FEMA 178 or ASCE 31)
  - “Chemical analyses & physical examination by qualified professional”
- **Does Not Involve Invasive Tests**
  - (as does FEMA 356)
  - “Exploratory surgery performed by qualified and experienced surgeon”

SEISMIC RISK (**FEMA 154**):

Five Key Factors Drive Building **Collapse** Potential

1. **Seismicity Zone** (USGS Ground Motion, %g)
2. **Building Structural Type** (15 FEMA possibilities)
3. **Building Irregularities** (Plan and Vertical)
4. **Original Construction Date** (vs. Building Codes)
5. **Soil Type** (A to F; amplify motion up to 10x)

Oregon Seismic Risk Awareness Increased in Past 20 Years:
- Impacts Building Code for Many Structural Types
- Engineering Design Follows Building Code Modifications
- Code Exceptions Cause Other Issues (**RM may be URM**)
SEISMICITY ZONES (for FEMA 154, after USGS):

Note: “Very High” zone is scored same as “High”

FEMA 154 Building Types & Benchmark Dates:

- **W1**: Wood Frame (<5,000 sq ft) - 1979
- **S3**: Light Steel Frame - NA
- **S4**: Steel Frame with Concrete Shear Walls - >3:1979 & <3:1990
- **C1**: Concrete Moment Frame - 1994
- **C2**: Concrete Shear Wall - >3:1979 & <3:1990
- **PC1**: Concrete Tilt-Up - 1999
- **RM1**: Reinforced Masonry (flexible diaphragm) - 1999
- **URM**: Unreinforced Masonry - 1993
Vertical & Plan Irregularity

- Setbacks
- Hillside
- Soft Story
- Short Column

Hillside
Setbacks
L-Shaped
T-Shaped
U-Shaped
Large Opening
Weak Link

Building Construction Dates

Education & Emergency Facility Construction Dates

- K-12 (n=2187)
- Fire & Police (n=882)
- Community College (n=181)

Median Age K12
Median Age Fire & Police
Median Age CC
Building Code Soils

Basic RVS Scores Assume a Rock Foundation; Soils C, D and E amplify ground motion (lowers RVS score)

Rapid Visual Screening Scoring

Example of Calculating a FEMA 154 RVS Score:

Seismicity Zone: High
Precode: 1941

<table>
<thead>
<tr>
<th>Primary Choice</th>
<th>Secondary</th>
<th>Tertiary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood (&lt;5,000 sq ft)</td>
<td>Correte (Shear Wall)</td>
<td>Reinforced Masonry</td>
</tr>
<tr>
<td>Building Type</td>
<td>W2</td>
<td>C2</td>
</tr>
<tr>
<td>Year Constructed</td>
<td>1986</td>
<td>1986</td>
</tr>
<tr>
<td>Basic Score</td>
<td>3.8</td>
<td>2.8</td>
</tr>
<tr>
<td>Pre-code Modifier</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Plan Irregularity Modifier</td>
<td>(0.5)</td>
<td>(0.5)</td>
</tr>
<tr>
<td>Vertical Irregularity Modifier</td>
<td>(2.0)</td>
<td>(1.0)</td>
</tr>
<tr>
<td>Post-Benchmark Year for Code</td>
<td>1979</td>
<td>1990</td>
</tr>
<tr>
<td>Post-benchmark Modifier</td>
<td>2.4</td>
<td>0</td>
</tr>
<tr>
<td>Soil Type E Modifier</td>
<td>(0.8)</td>
<td>(0.8)</td>
</tr>
<tr>
<td>Final RVS Score</td>
<td>2.9</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Lowest Score Selected

Oregon Structural Type Frequencies:

<table>
<thead>
<tr>
<th>W1</th>
<th>W2</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
<th>S4</th>
<th>S5</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>PC1</th>
<th>PC2</th>
<th>RM1</th>
<th>RM2</th>
<th>URM</th>
</tr>
</thead>
<tbody>
<tr>
<td>K12 Schools</td>
<td>68</td>
<td>563</td>
<td>4</td>
<td>27</td>
<td>22</td>
<td>3</td>
<td>2</td>
<td>38</td>
<td>409</td>
<td>9</td>
<td>90</td>
<td>6</td>
<td>668</td>
<td>3</td>
</tr>
<tr>
<td>Community College</td>
<td>2</td>
<td>19</td>
<td>1</td>
<td>5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>30</td>
<td>20</td>
<td>-</td>
<td>3</td>
<td>17</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>Fire &amp; Police</td>
<td>160</td>
<td>100</td>
<td>1</td>
<td>2</td>
<td>136</td>
<td>2</td>
<td>-</td>
<td>21</td>
<td>58</td>
<td>2</td>
<td>12</td>
<td>1</td>
<td>241</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>230</td>
<td>692</td>
<td>6</td>
<td>34</td>
<td>104</td>
<td>7</td>
<td>4</td>
<td>89</td>
<td>437</td>
<td>11</td>
<td>105</td>
<td>24</td>
<td>539</td>
<td>9</td>
</tr>
</tbody>
</table>
Seismic Risk Assessment: RESULTS

Summary of Seismic Risk for all Qualifying Sites & Buildings

<table>
<thead>
<tr>
<th>Seismic Needs Assessment District</th>
<th># of Districts</th>
<th># of Schools</th>
<th># of Buildings</th>
<th>FEMA 154-Based Collapse Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community College Districts</td>
<td>17</td>
<td>179</td>
<td>194</td>
<td>Very High: 20</td>
</tr>
<tr>
<td>Sum Education</td>
<td>187</td>
<td>1280</td>
<td>2366</td>
<td>Very High: 294</td>
</tr>
</tbody>
</table>

| Emergency:                                | # of Districts | # of Buildings | FEMA 154-Based Collapse Potential |
| City Districts (Police & Fire Departments)| 143            | 327           | Very High: 26 | High: 78 | Moderate: 75 | Low: 148 |
| County Sheriff's Offices                  | 34             | 73            | Very High: 5  | High: 24 | Moderate: 18 | Low: 26 |
| Oregon State Police                       | 1              | 28            | Very High: 0  | High: 5  | Moderate: 4  | Low: 17 |
| Port of Portland                          | 1              | 1             | Very High: 0  | High: 0  | Moderate: 0  | Low: 1 |
| Acute Care Hospitals                      | 58             | 116           | Very High: 10 | High: 26 | Moderate: 10 | Low: 70 |
| Sum Emergency                             | 428            | 983           | Very High: 54 | High: 195 | Moderate: 169 | Low: 567 |
| SUM ALL                                   | 3349           | 348           | 1013           | 699     | 1289          |

<table>
<thead>
<tr>
<th>Probability of Collapse Due to MCE Ground Motions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High: 10%</td>
</tr>
</tbody>
</table>

Presentation to Committee on Emergency Preparedness & Ocean Policy
Oregon Seismic Risk Assessment:

Number of Buildings Assessed

- Low
- Moderate
- High
- Very High

Oregon Districts

- K-12 Public School Districts & ESD
- Community College Districts
- City Districts (Police & Fire Departments)
- Rural Fire Protection Districts
- County Sheriff's Offices
- Oregon State Police
- Acute Care Hospitals

193 Schools (81,300+ enrolled)

Oregon Relative Seismic Risk – Building Collapse Potential

Relative Collapse Potential
- Very High (100%)
- High (>10%)
- Moderate (>1%)
- Low (<1%)

Urban Growth Boundary
Oregon Seismic Risk Assessment:

Rough Estimate of Seismic Rehabilitation Cost for Very High Seismic Risk Buildings Only

<table>
<thead>
<tr>
<th>Category</th>
<th>Cost (Millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-12 Public School Districts &amp; ESD</td>
<td>$200</td>
</tr>
<tr>
<td>Community College Districts</td>
<td>$150</td>
</tr>
<tr>
<td>City Districts (Police &amp; Fire Departments)</td>
<td>$100</td>
</tr>
<tr>
<td>Rural Fire Protection Districts</td>
<td>$50</td>
</tr>
<tr>
<td>County Sheriff's Offices</td>
<td>$20</td>
</tr>
</tbody>
</table>

193 Schools (12.0 Million Sq Ft)
Objective: Provide Data For Grant Award Committee Prioritization

HIGHEST NEED & HIGHEST RISK

HIGHEST NEED

HIGHEST RISK

RELATIVE SEISMIC RISK

RELATIVE FISCAL NEED

LOWEST NEED & LOWEST RISK

LOW

MEDIUM

HIGH

OREGON SEISMIC NEEDS ASSESSMENT

School District Relative Fiscal Need – 3 Methods

Absence of Need:

Method 1: Property Tax/student
- Use Oregon Dept of Rev Report
- ‘05-’06 Property Tax Imposed
- Compare with ‘05-’06 Enrollment
- High Value/student = Low Fiscal Need

Method 2: % Students in Poverty
- Use US Census SAYPE
- # Age 5-17 in Poverty
- Compare with total Age 5-17
- High % Poverty = High Fiscal Need

Method 3:
Compiled statistics on 92 Districts’ Bonding during 1997-2006; compared to enrollment

Presence of Need:

Or Ave: $2,643
Range: $479-$8,622

Or Ave: 14.2%
Range: 2.7-26.9%

Absence of Need: Presence of Need:

Correlation = -62%
(% in Poverty versus Prop Tax/student)

Largest 43 School Districts Only (77% of Enrolled in State)
Other Categories of Risk: Tsunami Inundation

Example: Cannon Beach Area

Bridge Destroyed in 1964 Tsunami

Computer Model (results not final)
Tsunami Inundation Frequency
(all tsunamis = 100%,
largest tsunami = 0% line)

Elementary school
City Hall
Fire Station

High Tsunami Risk
100%
Moderate Tsunami Risk
50%
Low Tsunami Risk
0%

Map Locations of Sites at Moderate & High Risk

Other Risk Categories - Tsunami Inundation

10 K12, 3 CC, 1 Hospital,
24 Fire & 10 Police
Stations at Moderate to
High risk of tsunami
inundation

Plus Another:
• 33 K12, 2 CC, 7
Hospitals, 28 Fire & 11
Police
that are at Lower Risk of
Inundation
### Search Information Online

http://www.oregongeology.org/projects/rvs/site_search.html

### Statewide Seismic Needs Assessment

**Using Rapid Visual Screening (RVS)**

[Oregon Senate Bill 223 (ORS 095)]

Use this form to search for individual site reports in PDF format. You need the free Adobe PDF Reader to view PDF files. You can download the reader from [Adobe](http://www.adobe.com).

#### Site Summary Report Search

- **By City:**
  - Portland

- **By Facility Name:**
  - [Examples: Benson Police or Mult]

- **By County:**
  - [Baker]

- **By Facility Type:**
  - [Blant/Middle/High School]

---

### Search Results – Tables & Site Reports

#### Search Results for “Portland” Search

<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Site Type</th>
<th>Address</th>
<th>County</th>
<th>Year Built</th>
<th>Story</th>
<th>Foundation Type</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy Valley Elementary School</td>
<td>School</td>
<td>8160 SE 172nd Ave, Portland</td>
<td>Clackamas</td>
<td>1954</td>
<td>2 Story</td>
<td>Stone Foundation</td>
<td>C</td>
</tr>
<tr>
<td>Westside Elementary School</td>
<td>School</td>
<td>2601 SW Roosevelt Rd, Portland</td>
<td>Clackamas</td>
<td>1956</td>
<td>2 Story</td>
<td>Stone Foundation</td>
<td>D</td>
</tr>
<tr>
<td>Columbia Elementary School</td>
<td>School</td>
<td>4705 SW 72nd Ave, Portland</td>
<td>Multnomah</td>
<td>1954</td>
<td>2 Story</td>
<td>Stone Foundation</td>
<td>C</td>
</tr>
<tr>
<td>Sunset Elementary School</td>
<td>School</td>
<td>1600 SE 39th Ave, Portland</td>
<td>Multnomah</td>
<td>1958</td>
<td>2 Story</td>
<td>Stone Foundation</td>
<td>C</td>
</tr>
<tr>
<td>Willow Elementary School</td>
<td>School</td>
<td>3000 SE 42nd Ave, Portland</td>
<td>Multnomah</td>
<td>1953</td>
<td>2 Story</td>
<td>Stone Foundation</td>
<td>C</td>
</tr>
<tr>
<td>Roosevelt Elementary School</td>
<td>School</td>
<td>6555 SE 172nd Ave, Portland</td>
<td>Clackamas</td>
<td>1955</td>
<td>2 Story</td>
<td>Stone Foundation</td>
<td>C</td>
</tr>
</tbody>
</table>

---

Presentation to Committee on Emergency Preparedness & Ocean Policy
RECOMMENDATIONS

• Form Seismic Rehabilitation Grant Committee
  – Establish Qualifications
  – Determine Application Requirements
    • Engineering Feasibility Study
• Districts Hire Seismic Rehabilitation Consultants to Test & Confirm Findings, and Perform More Detailed Evaluations
• Compare and Contrast Cost of Rehabilitation versus Benefit of Reconstruction