

Oregon University Buildings Earthquake Mitigation Program

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The Awareness Problem

- 1987: Oregon's Seismic Hazard recognized Cascadia Subduction Zone fault
- 1993: Seismic Building Code
- 1999: Statewide Damage & Loss study

HAZARD + EXPOSURE = RISK

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The Political Awakening

- 1989: Earthquake Commission by EO
- 1991: School drills in K-8; Site Specific Investigations; Instrumentation
- 1995: Tsunami drills in coastal schools & building restrictions
- 2001: Laws on educational & emergency response buildings; drills large employers
- 2002: Citizens voted for earthquake safety
- 2005: State surveys and grant funds

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The Problem with Oregon University Buildings

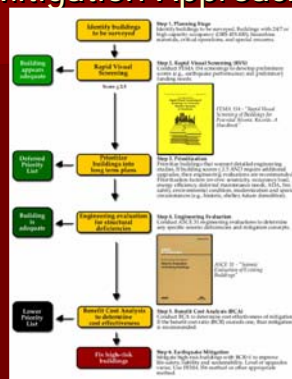
- Old, diverse buildings (URMs) 7 campuses
- Half of State Assets
- **2002: OUS Bob Simonton champion** forms partnership w/DOGAMI
- 2004: \$3.8M FEMA PDM grant
- 2005: \$8M lottery funds & \$2.6M FEMA
- 2007-2009: \$210M request/need

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Mitigation Approach



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Mitigation (2)

- Determine high risk buildings (FEMA RVS)
- Prioritize (developed CODA score method)
- Combine with other needs (energy, ADA)
- Helped establish State Bond Funds (\$1.2B)

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Seismic Rehabilitation Projects of Oregon University Buildings

- Five buildings on four campuses
PSU, OIT, WOU & OSU
- Diverse buildings (URM, concrete, steel)
- Demonstration projects to increase awareness, promote mitigation projects, & disaster preparedness
- GOAL: Safer campuses & communities
- Long term \$\$\$\$ effort

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1966 Ondine Residence Hall Portland State University



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Ondine Residence Hall (15 story soft story) 4 Mitigation Solutions

- 1: Welded rebar in columns
- 2: Added concrete wall (exterior)
- 3: Added 3/8" steel plates (interior)
- 4: New cross-bracing

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Rebar Coupler Problem Discovered



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Installation of Concrete Forms



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Completed Steel Plates Welded Together



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Cross Bracing Installation in Progress



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1916 Montgomery Court: URM Residence Hall



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URM Construction Features



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Tying the URM Wall to a New Roof



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Concrete Ornament Bracing



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Parapet Bracing



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Stairwell Reinforcement



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Snell Hall Administration: Oregon Institute of Technology on fault; 1993 damage



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5 Structural Mitigation Solutions: Directions & Location

Direction	Story	Mitigation Solution
Short	Below grade	1 Add Soil Anchors & Foundation
Short	1st	2 Add Steel Tube Bracing
Long	1st	3 Add Steel Moment Frame
Long	2nd	4 Add diagonal rod bracing
Short	2nd	5 Improved Existing Moment Frame

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Compaction of Foundation Subgrade



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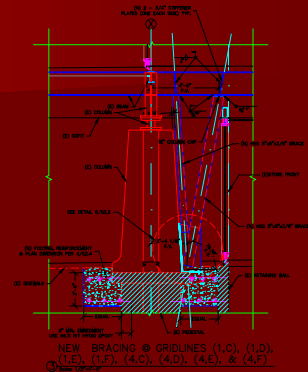


New Steel Reinforcement Rebar



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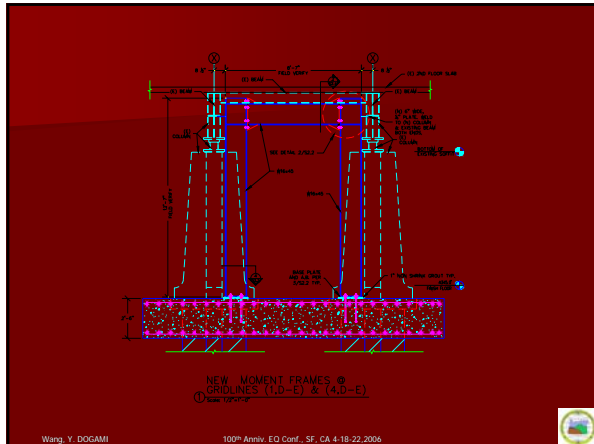
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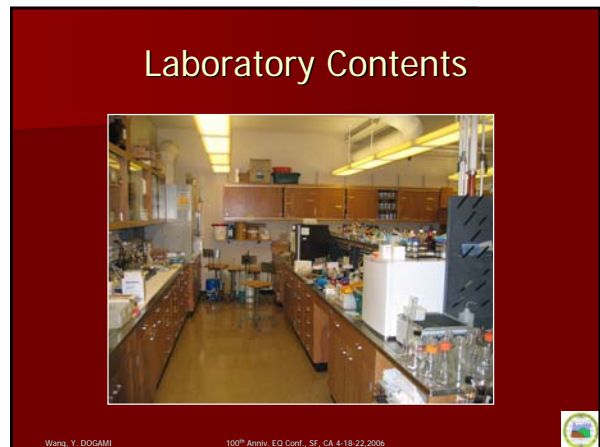
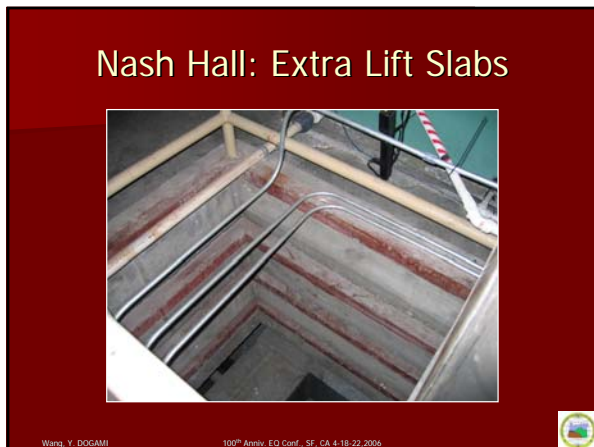
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- ### Major Deficiencies and Issues
- Lift slab construction w/poor connections
 - Two extra slabs under roof
 - Risk for pancake style collapse
 - Biohazards (include. radioactive materials)
 - Heat for several buildings
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Chemical Tanks in Basement

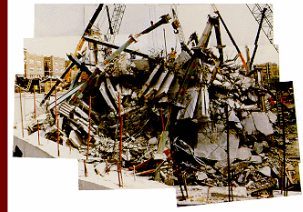


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Pancake Collapse (1987) L'Ambiance Plaza, Bridgeport, CT



- One slab fell & initiated a pancake failure.
- Collapsed in 5 seconds.
- Progressive slipping of rod & nuts initiated collapse.

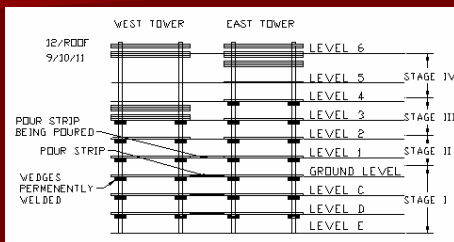
- Stacked floor slabs.
- Seven-inch thick post-tensioned, concrete slabs & steel columns
- Shear walls for lateral support.

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Status of Construction at the Time of the Collapse



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Humanities and Social Science (1964): Western Oregon University



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HSS North/South Classroom Wing



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Soft First Story South Façade (EW Wing)



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Major Deficiencies and Issues

- Severe soft story portion in EW wing
- Little redundancy in electrical system hub (HSS houses the electrical intake that serves 1/3 of the university's electricity)

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HVAC Unit at Roof Level

SPRING ISOLATOR
DEFICIENT



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QUESTIONS

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