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Earthquake Hazard and Mitigation in Oregon
Concentrated on Western Oregon - nobody lives in Eastern Oregon

Abbreviations: SJF - San Juan de Fuca
    NA - North American
    EQ - Earthquake

• Tectonic Setting and Earthquake
  • Earthquake source Zones, in the Pacific NW.
    • SJF plate subducting under NA Plates
      • 3 types earthquake
        • Interplate subduction: earthquake 8-9 Richter
        • Intraplate Earthquake up to 7.5 (inside of SJF plate) (no history in Oregon)
          • seen in Puget Sound, severe damage to Seattle/Tacoma
        • Crustal Earthquake to 6.5 (under our feet)
      • Portland Earthquake Sources (Triple Threat)
        • Upper plate (NA) Moderate magnitude
        • Lower plate (SJF) large magnitude
        • Subduction – locked subduction zones
        • Fault zones around Portland (a map)

• Earthquake Hazards
  • Ground Motion (Shaking Hazard)
    • 90% damage caused by ground shaking
    • Willamette HS. (Eugene) took major damage to brick buildings in 1993 Spring Break EQ. (photo of damaged brick building)
    • Had to retrofit Capitol Dome for damage in that EQ.
      • Capitol Building location of State Governor, Senate, House - nothing like slapping a politician in the face with a wet fish to get his attention.
      • Major policy changes came out of that EQ.
  • Liquefaction Hazard
    • always happens during major earthquakes
    • buildings on soil that liquefies, fall over (Taiwan photo).
    • Lateral spreading (this is when Tammy came in the room) everything pulls apart.
  • Landslide Hazard
    • induced by ground shaking
    • sides of hills sunk (photos of Loma Prieta CA coast, Taiwanese hills)
    • ’65 Olympia - railroad embankments collapsed
    • steep slopes fail in land and rockslides. Road cuts are very vulnerable.
  • Tsunami Hazard (Coast)
    • “Tidal Wave”
  • Secondary Hazard
    • Fire
      • think of all the natural gas pipelines busted...
    • Hazmat leakage

• Earthquake Hazard Mapping
  • We aren’t in California - it can happen here, but awareness isn’t there.
• Geology/Geotechnical engineering combines to create hazard maps
• Areas that will get hit hard can be mitigated prior to event
• We saw these maps in class Tuesday

• Ground Shaking Mapping
  • General Ground Shaking Hazard (ground motion on bedrock from all seismic sources)
    • Probabilistic Method - building codes set on this
    • Deterministic Method - used on critical structures to determine max ground shaking hazard would occur.
  • Maps show the recurrence intervals in “probability”
  • Highest ground shaking hazard is on coast due to subduction EQ’s..
  • 500 year recurrence interval... Willamette Valley is about 50% curve
  • Monmouth is at 20-25% on 500 year

• Relative Seismic Hazards Maps
  • Composite maps “relative sense of hazard”
  • Amplification
    • Soil Characterization (SPT, S-wave velocity and thickness)
    • Ground shaking hazard
  • Liquefaction
    • Soil Characterization (SPT, S-wave velocity and thickness)
    • Sandy soil?
  • Induced Landslide
    • Soil and Rock Characterization (cohesion, friction angle, degree of weathering , fracture
    • slope failure potential
  • Liquefaction potential mapping
    • Soil Characterization (SPT, S-wave velocity and thickness)
    • Sandy soil?
  • Landslide mapping
    • Soil and Rock Characterization (cohesion, friction angle, degree of weathering , fracture
    • slope failure potential
  • Tsunami inundation mapping
    • combination of theoretical model and study of past tsunami’s.
    • Look at ground contour
    • Seaside will be underwater... temporarily.

• Earthquake Hazard Mitigation
  • Public Awareness
    • We’ve got the potential, prepare for it
  • Legislation
    • Building Code
      • UBC 97 - good building code, very advanced compared to other states.
    • Regulation
    • Education
      • Mandatory Tsunami drills on a yearly basis at schools in hazard zone
  • Retrofit/Rehabilitation
    • Campbell Hall “shock absorbers”
  • Insurance
    • It’s available, get it.
    • In Portland, ~30% families have it.
  • Emergency Planning and Response
    • use the info we have.
• WOU, Monmouth, Independence - Earthquake Hazard map specific to this area.
• >1000 students in dorms: Butler, Campus Estates...etc..
• This guy was on the team that made the hazard assessment
• Stuff is in GIS - 3D modeling GET THIS!!!
• Combined 3 layers of hazard, assigned numeric hazard assessment.
  • Very general assessment, without specific threats.
  • 1st layer - Ground Motion & Amplification
    • Willamette Silt is what we sit on.
  • 2nd Layer - Liquefaction
    • moderate to low hazard with Willamette Silt (rather surprising)
  • 3rd Layer - Landslides
    • It’s flat here.
• Campbell Hall
  • Seismic retrofit - base isolation
  • Otherwise, brick is a concern

Base isolation -
  when ground shakes, so does building. Base isolation lets the shock absorbers shake instead.

Hazard here:
  Ground shaking: Moderate (D type soil 1.5-1.8 on UBC)
  Liquefaction: Moderate (fine-grained Willamette Silt, water close to surface)
  Too flat for landslide problems.

  Intraplate EQ’s - why not? We don’t have a record, or activity that showed it.