

In Harm's Way: School Damage in Recent Earthquakes, and Why the Lessons Are Rarely Applied

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Key Points

School Damage in Recent Earthquakes

Selected 2008-2012 worldwide earthquakes

Problem with dangerous schools in U.S.

Problem will persist without intervention

If school hours, very high consequences

Recommendations by APEC

Our Choice: Apply Lessons or Not?

NEHRP, EERI, locals, parents...

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Earthquake Damage to Schools is Ongoing Worldwide Problem

- **1988 Armenia**
 - >1,000 students dead
- **2003 Algeria**
 - 130 schools
- **2005 Pakistan**
 - 8,000 schools
 - 17k students dead
 - 20k students injured

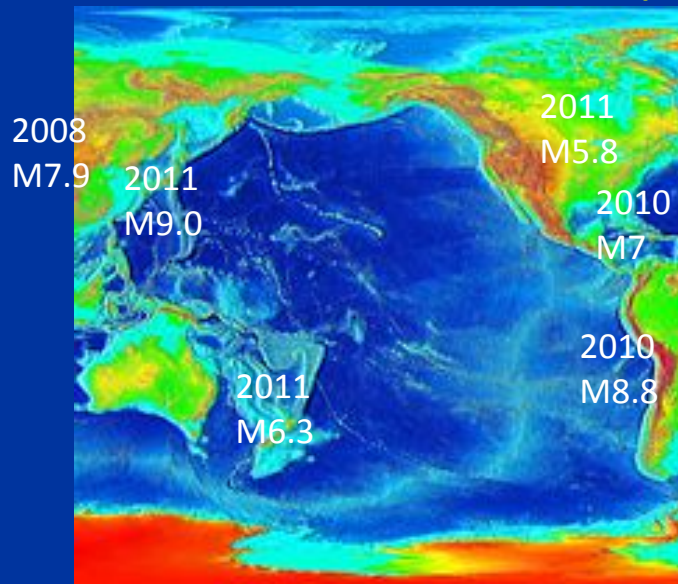


1964 Alaska M9.2 quake
School pulled apart by landslide

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2008-2012 Worldwide Earthquakes



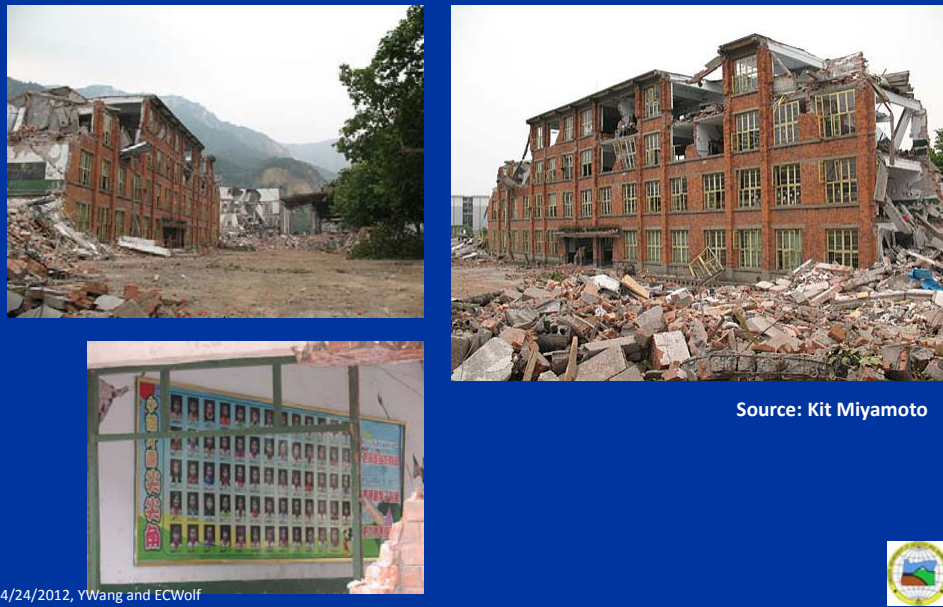
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~19,000 students died in 7,000 schools
2008 Wenchuan China. Xing Fu Primary School



Han Wang Primary School





Yuan Wentin (袁文婷), 26, first grade teacher
 She saved many students
 but then building collapsed on her (upper right)

“Drop, Cover & Hold” does not work if building collapses

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School Damage Statistics

2010 Haiti M7. **1,300** schools destroyed

http://en.wikipedia.org/wiki/2010_Haiti_earthquake

2010 Chile M8.8. **4,000** schools badly damaged or destroyed

<http://en.mercopress.com/2010/03/18/chile-s-quake-death-toll-700-and-economic-damage-18-of-gdp>

2011 Christchurch M6.3. **163** schools impacted. **11** seriously damaged. en.wikipedia.org/wiki/2011_Christchurch_earthquake

2011 Japan M9. **7,800** schools damaged. (Ministry Education, Oct 6, 2011 report)

- ~Good overall performance.
- Total: **635 deaths** (children, students, teachers in tsunami)
- Example: Good performance. Piles at Liquefaction site.
- Example: Bad outcome. 70% fatalities by tsunami.

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Japan 2011 Liquefaction Mitigation



Bridge on Kitakami River, Japan with Okawa Elementary school in background



Tsunami hit Okawa Elementary School

74 of 108 students died
10 of 13 teachers and staff



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"The question is why, again and again, even in developed nations, with a wealth of engineering expertise, schools would collapse in earthquakes

Every, that is EVERY school should be inspected and where necessary reinforced.

This is so basic to risk mitigation in a seismically active area, it seems foolish to have to write it down." (Ben Wisner)



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Problem with dangerous schools in U.S.

- Built to inadequate seismic zoning
- Built to inadequate building codes
- 1,000s school buildings high risk of collapse in major U.S. e-quakes
- Millions vulnerable students
- If school hours, high consequences
- Problem persist w/o intervention
- Recommendations by APEC (GHI)

2011 Virginia M5.8
2 schools damaged

www.ncthrp.gov/pdf/ACIHRNov2011_Harris_Mahoney.pdf

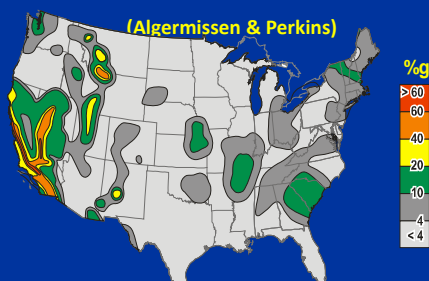


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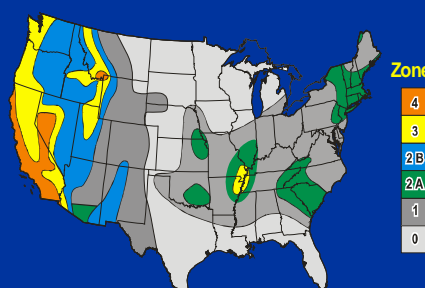


OLDER SEISMIC HAZARD ZONING & INADEQUATE BUILDING CODES

1976
(10% PE in 50 yrs)



1994
(UBC Map)



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Asia-Pacific Economic Cooperation (APEC, 2011)

Safe@School Principles (paraphrase):

- 1. EVERY CHILD HAS A RIGHT TO ATTEND SCHOOL IN SAFE BUILDINGS**
- 2. GOVERNMENTS AND EDUCATION LEADERS ARE RESPONSIBLE FOR THE SAFETY OF SCHOOLCHILDREN**
- 3. GOVERNMENTS AND EDUCATION LEADERS MUST FULFILL THAT RESPONSIBILITY**
- 4. EFFECTIVE SCHOOL SAFETY PROGRAMS MUST BE DESIGNED AND IMPLEMENTED**

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8 Activities to Implement Principles

- 1. IDENTIFY AND MAP HAZARDS**
- 2. PREPARE LONG-TERM RISK REDUCTION PLAN**
- 3. ASSIGN RESPONSIBILITY FOR PLAN**
- 4. ENFORCE BUILDING CODE FOR SCHOOL BUILDINGS**
- 5. IMPROVE PROFESSIONAL STANDARDS**
- 6. CONDUCT PREPAREDNESS PROGRAMS**
- 7. IMPLEMENT NATURAL HAZARDS CURRICULA**
- 8. ESTABLISH AND PRACTICE OVERSIGHT**

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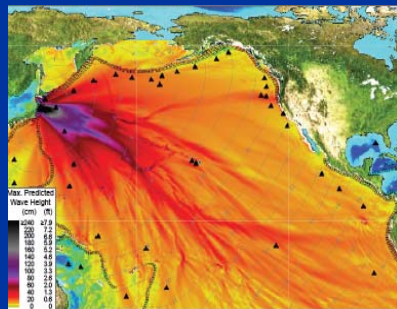
Our Choice: Apply Lessons or Not? Who Will Build “Safe Schools” Programs in US?

NEHRP agencies role?
 -NSF Grand Challenges
 -NIST (eg, Fire Life Safety Program)
 -USGS Scenarios
 -FEMA State Programs
 EERI members, districts, parents...?
Safe Schools Action Plan?

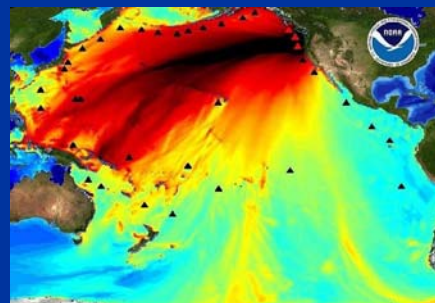
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Japan & Cascadia “Mirror Images”



March 11, 2011 Japan Tsunami



Hypothetical Cascadia Tsunami

(Source NOAA)

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RikuzenTakata, BEFORE TSUNAMI



RikuzenTakata, AFTER TSUNAMI



Seaside High School, Oregon

