

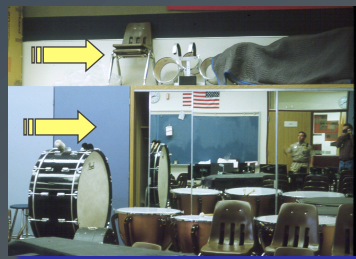
## Nonstructural Seismic Safety Issues in K-12 Public Schools *“Stairs to Nowhere ... Revisited”*



Gary L. McGavin, AIA, Member CA SSC  
for  
SCEC April 10, 2008  
Earthquake Safety and Preparedness

## Seismic Safety Issues in K-12 Public Schools

- Structural Issues Addressed Since 1933
- Nonstructural Building Issues Since 1976
- Owner Supplied Furniture and Equipment  
the Stuff brought to School ... **Almost Nothing**



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# So, Are My Schools Safe?



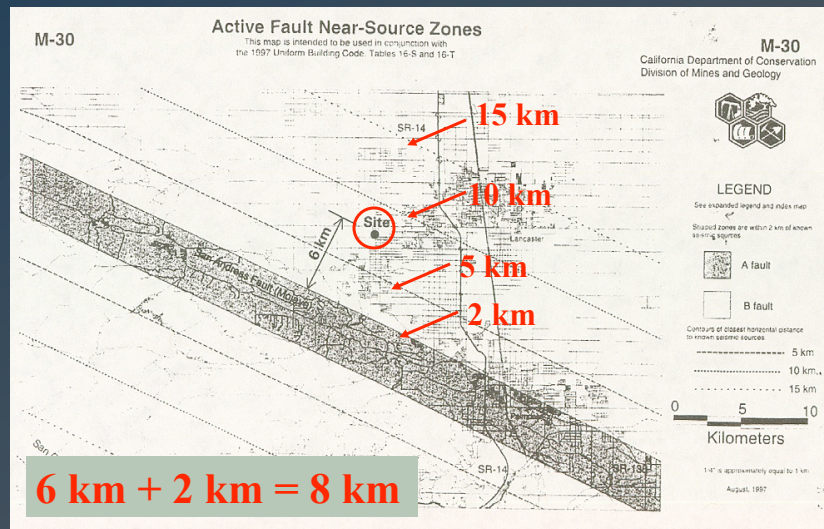
Long Beach 1933



Northridge 1994

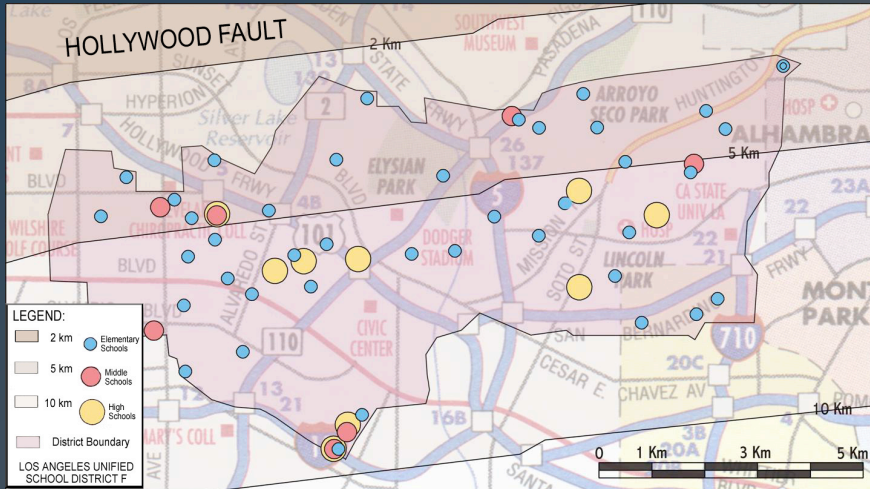
Maybe ... Maybe Not ...

# UBC Sample Near Source Map



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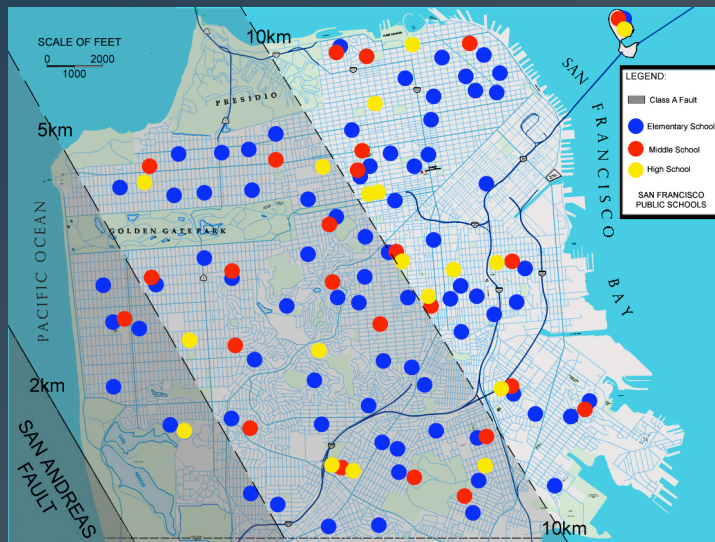
# LAUSD Sub-District District F



Cal Poly Pomona Student Work

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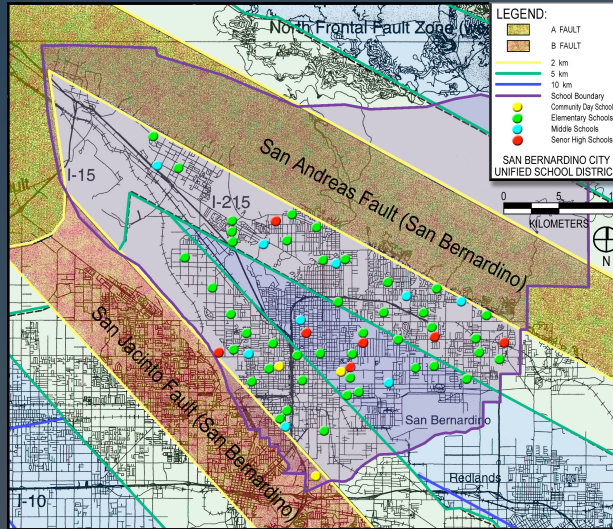
# CA Schools Near Faults ... SF



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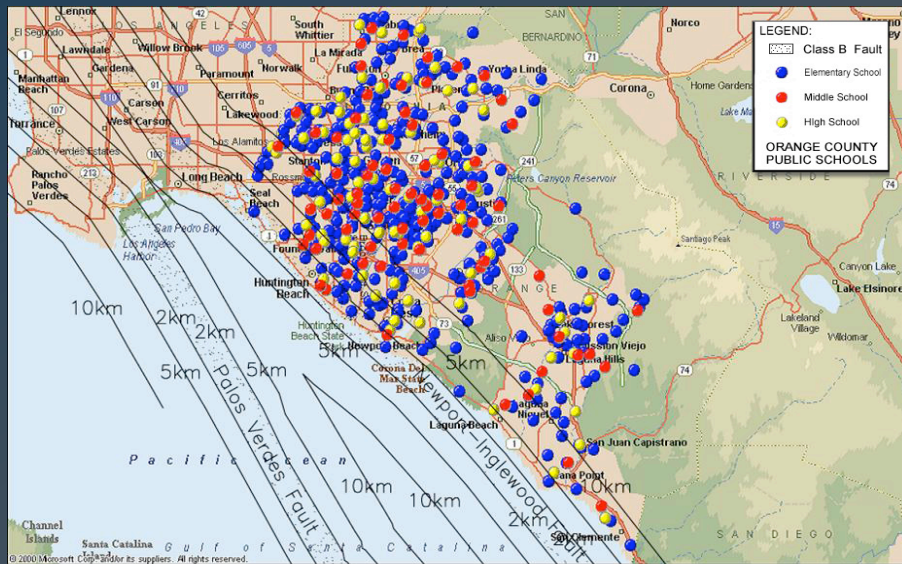
# CA Schools Near Faults ... SB



Cal Poly Pomona Student Work

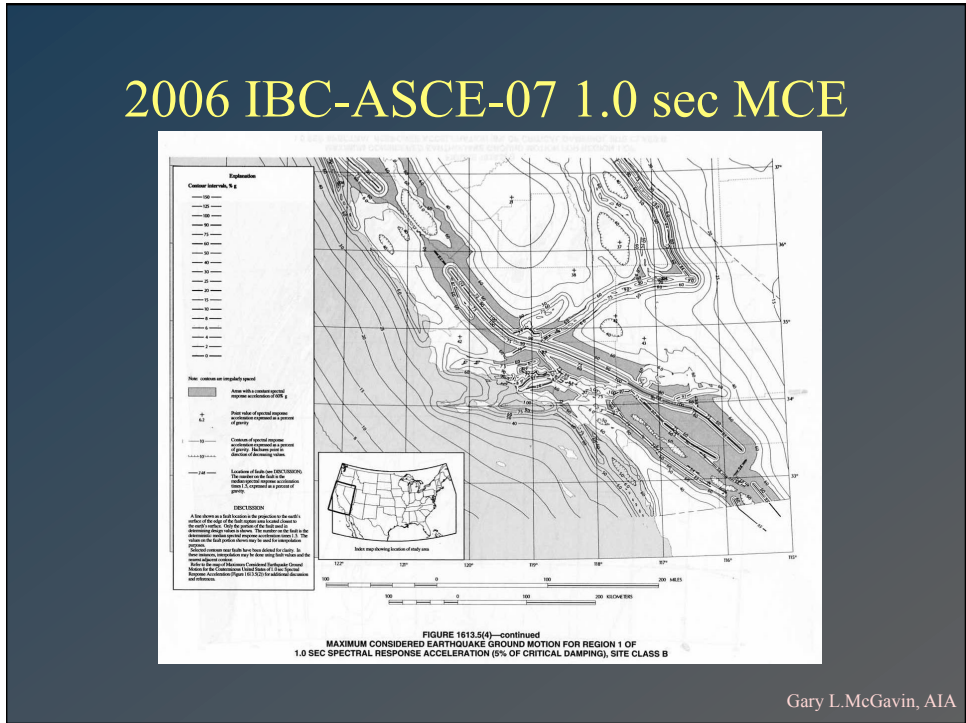
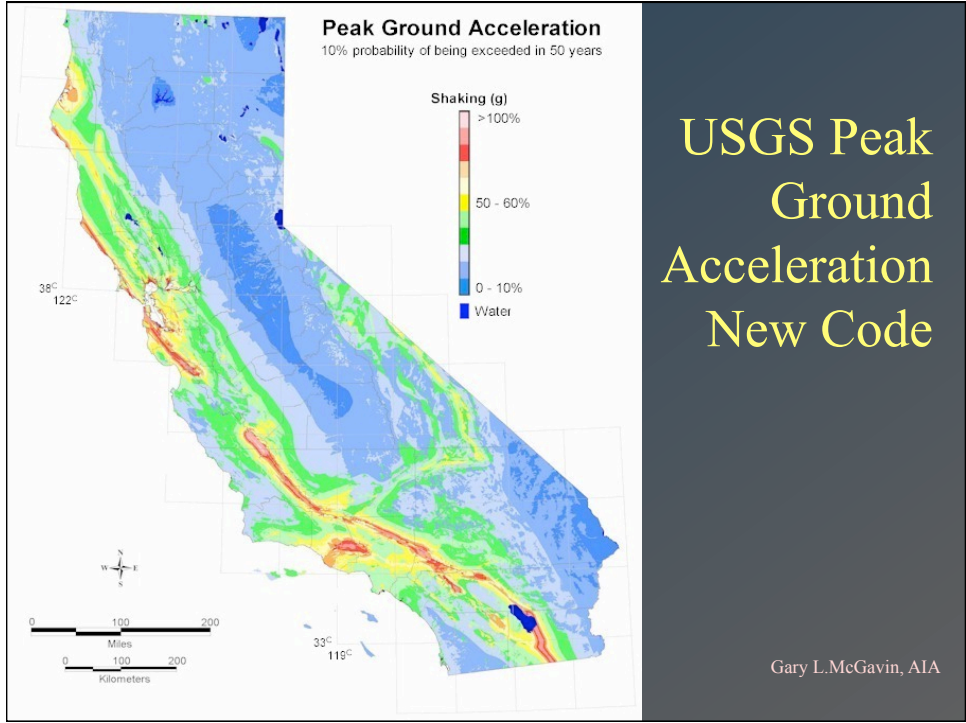
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# CA Schools Near Faults ... OC

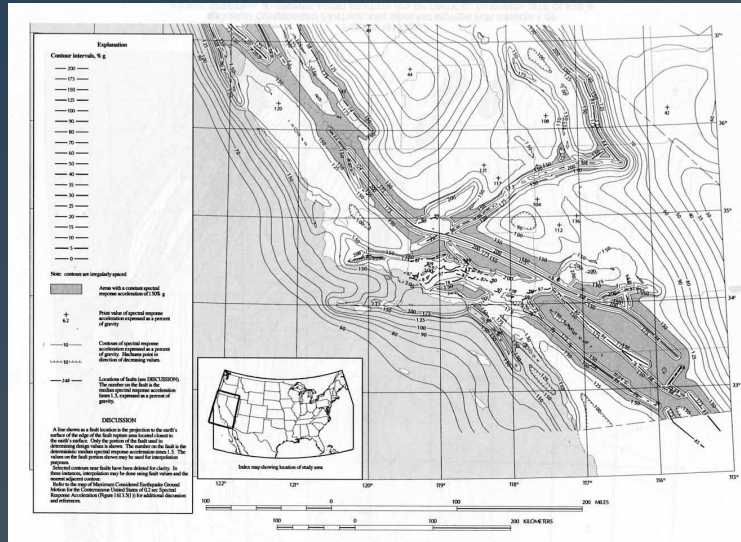


Cal Poly Pomona Student Work

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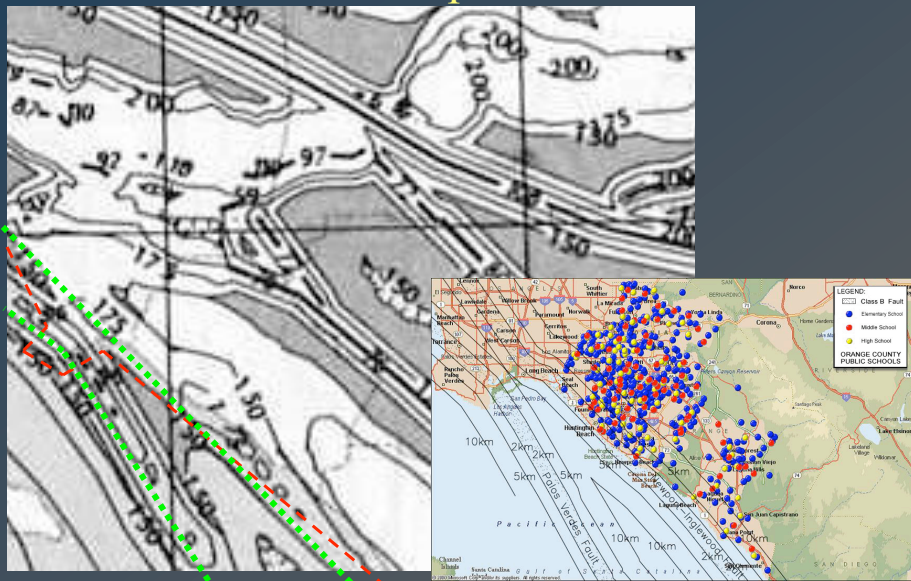


# 2006 IBC – ASCE-07 0.2 sec MCE



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# OC Schools Example w/0.2 sec MCE



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The Good News is ...

## The Field Act Works Pretty Well



0.4 mi from 4'-8' of surface rupture

Minor Ceiling Damage, Water Heater Damage (installation problems) and Owner Supplied Contents Problems ... but, Occupied immediately following the 1992 Landers Earthquake



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## Nonetheless ... Concerns Remain for Public Schools

- ☛ Older Schools in High Ground Acceleration Areas (including Near Source)
  - Nonductile Reinforced Concrete Schools
  - Older Tilt-up Schools
  - Schools with Poor Deferred Maintenance
- ☛ Older Nonstructural Issues
- ☛ Owner Supplied F&E (even modern)
- ☛ Early Warning Systems (p wave detection) were determined by SSC in the 1990's as a worthwhile direction for CA Schools ... NONE are Deployed in K-12 Public Schools

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## Senator Greene's Concern for K-12 Public School Safety

- ☛ “Nonstructural Issues will likely cause most injuries and death to school children if a Major Damaging Earthquake occurs during school hours ...”
- ☛ Owner Supplied Equipment and Practices will be the cause of most of these injuries and deaths.
  - These items are OUTSIDE of the Code
  - Education and Common Sense have NOT worked ...

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## Common Sense is Vital

## However, Common Sense is Commonly Nonsensical



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## Owner Supplied Equipment Sometimes Lacks Common Sense



Unsecured Bookshelves WILL fall on work stations ... the weight of the books will NOT keep the shelf upright.

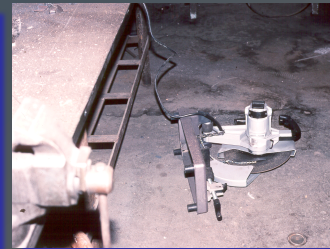
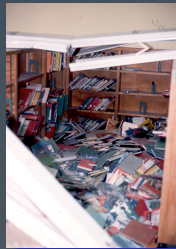
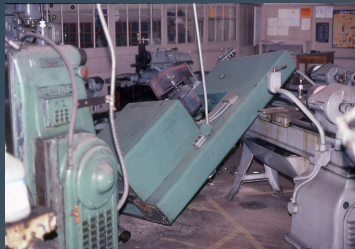


A 1" Sheet Metal Screw into a Wood Floor will NOT stop a 1500 lb Lathe from Relocating

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## Owner Supplied Nonstructural Equipment

- Generally Not Covered By Codes
- Can Cause Difficulty in Evacuation
- Can Cause Fires
- Can Cause Injuries



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## Furniture Blocking Egress



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## Inappropriate Storage Hazards



**Inappropriate Storage**

**Too Much Material to Store**

**Still Too Much to Store**

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## More Storage Failures



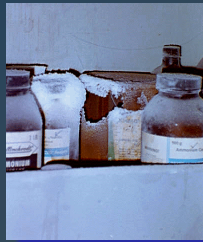
Richard Miller Photo



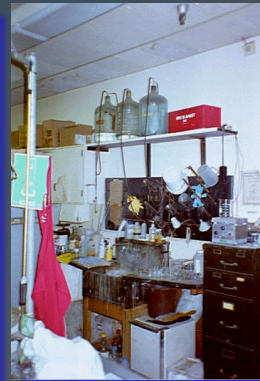
Richard Miller Photo

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## Science Facilities / Hazards



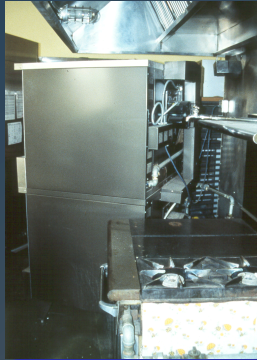
EERI Photo



Old Chemicals, Acids  
w/Organics, and High  
Unrestrained Items

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## Miscellaneous Nonstructural Hazards



Heavy Unrestrained Kitchen Equipment



HS Electronics Lab



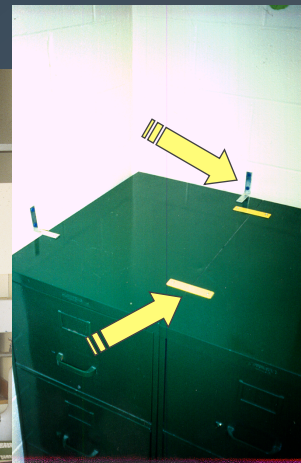
Elementary School Kiln Amongst Toppled Stored Items

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## Inappropriate Remedies



Inappropriate materials, bracing, and fasteners.



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## Inappropriate Remedies

### ☛ Window Film IF NOT INSTALLED PROPERLY

- First cost of installation as well as cost of future repair or replacement.
- Potential for harm to students/staff from hurled objects, wind gusts, temperature fractures, earthquake fractures, and blast fractures.
- Examine the existing edge conditions
- Is putty cracked and dried...does it contain asbestos?
- Is any silicon used for setting the existing glazing?
- Are wood window frames dry rotting...is there any lead paint on the frames?
- Is the glass abutted against the frame behind the stops?
- Is there sufficient edge bite?
- Size of Window Panes?
- Does the District have a significant security/vandalism problem?

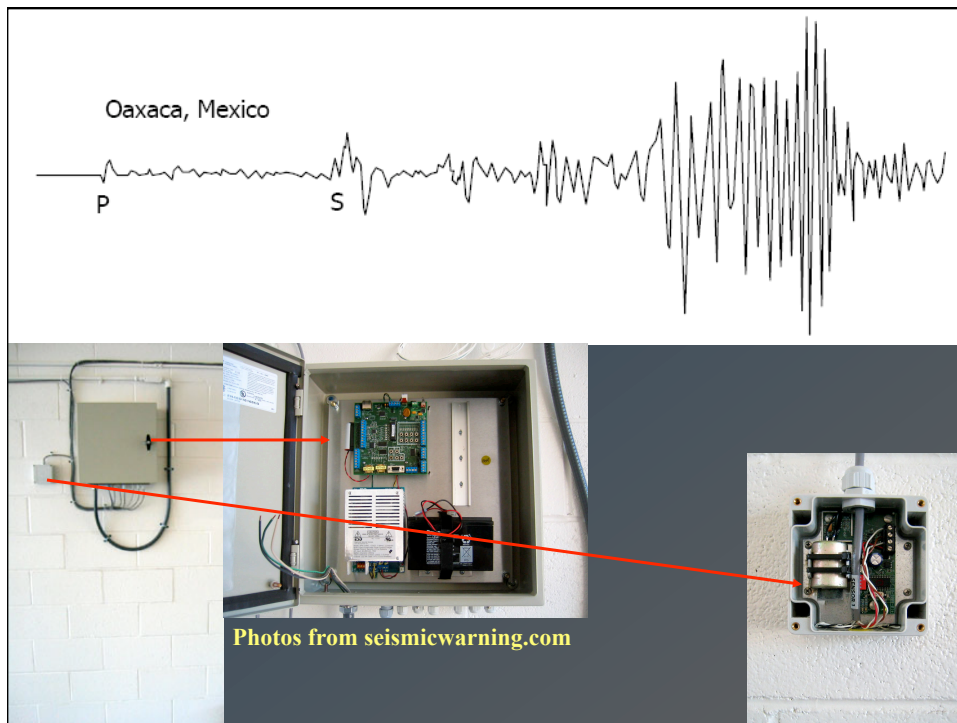
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## Since Common Sense Doesn't Work

### What is the Future of Earthquake Safety for Students in Public K-12 Schools?

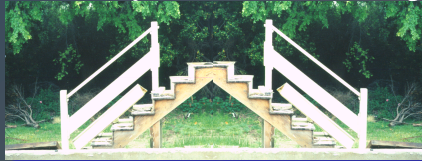
## P-Wave Early Warning

- Earthquakes Produce various waves
  - P-Waves travel fastest
  - S-Waves travel a bit slower
  - L-Waves travel much slower ... yet, do *most* of the damage
- EARLY Recognition of p-waves could give seconds of **EARLY WARNING (NOT PREDICTION)**
  - Similar to Smoke Detectors being an Early Warning Device
- Seconds of Early Warning allow for ...
  - Drop (duck) Cover Hold BEFORE Strong Shaking Starts
  - Startup-shutdown of vital equipment



## Recommendations

- ALL California School Districts should have p-wave Early Warning Technology
- SSC to work with to DSA and OES to Set Standards for Owner Supplied Equipment
- Require District Training in Seismic Retrofit
- Consider Publishing District Training Videos or pod casts ... could be Produced by Students
- Avoid Window Film unless installed and maintained properly
- SAB to Fully Fund AB300 Collapse Hazard Inventory



**It is Time for the Stairs  
to Lead Up or Down ...  
but ... not Nowhere ...**

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## Questions

