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PANEL ON SEISMIC SAFETY OF SCHOOLS

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ABSTRACT

Panelists in the panel session on Seismic School Safety will address or comment on the following questions:

1. What is the expected earthquake damage to public (elementary through high school) schools in the U.S. and British Columbia?

2. What is the worst case earthquake scenario in terms of student fatalities (in the U.S. and British Columbia)?

3. What level of seismic safety of schools is acceptable?

4. What actions are needed to achieve that level of safety?

5. What new state, provincial or national programs (or policies) are needed?

1. What is the expected earthquake damage to public (elementary through high school) schools in the U.S. and British Columbia?

In 2002, the State of California's General Services Commission, GSA, published a report on the "Seismic Safety Inventory of California Public Schools". Required by California Assembly Bill, AB300, the seismic safety inventory placed California's public school buildings into one of two categories. Category 1 included buildings expected to perform well and achieve a life-safety performance in future earthquakes. Category 2 buildings were those buildings that were not expected to perform well in future earthquakes and that required detailed seismic evaluations to determine if they would achieve the life-safety performance level. The report stated that approximately 14% of the current square footage of California Public Schools fell within Category 2.

The Province of British Columbia, Ministry of Education, published the "School Seismic Assessment" in November 2004 prioritizing the need for detailed seismic evaluation of the 1500 schools in the province. The assessment reported that schools with a High or Moderate/High priority would be the focus of seismic upgrading. In one district there were 96 schools in the High and Moderate/High priority category.

Seismic evaluation and mitigation have been undertaken by numerous school districts throughout the State of California. However, there are no requirements that California school districts perform detailed seismic evaluations.

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Families for School Seismic Safety, FSSS, in British Columbia have criticized the Ministry of Finance's Seismic Mitigation Program for the slow pace of evaluation and retrofit. In a letter to the Premier, Tracy Monk of FSSS, estimated that the seismic retrofit work necessary to address the needs of the Province would take 60 years to complete at the current rate of funding.

2. What is the worst-case earthquake scenario in terms of student fatalities (in the U.S. and British Columbia)?

All public school buildings in California are required to conform to the Field Act, a result of the 1933 Long Beach Earthquake. The Field Act was intended to protect public school children during earthquakes and, to a great extent, the Field Act has been successful. In a single California earthquake, student fatalities should be minimal. There have been no California public school building collapses in an earthquake since the 1933 Long Beach Earthquake. However, there have been instances of significant damage, particularly to buildings constructed between 1933 and 1978. Heavy concrete and masonry school structures constructed during that period have the potential for collapse or partial collapse. Fortunately, most California school buildings consist of wood-framed structures.

The definition for Life Safety includes the statement that a "margin remains against collapse." There are many variables involved that will affect the performance of a particular structure in an earthquake. Theses variables include how the building was designed, constructed and maintained. Additionally, there are variables in the soil beneath each structure and numerous variables inherent with each individual earthquake. In California, building codes have been modified for public school buildings that are more stringent than those for regular occupancy buildings. It has been a conscious effort to stack the odds in favor of good performance considering all the variables that could affect earthquake performance.

Detailed evaluations will typically show that wood framed structures from that time period do not technically meet the strict guidelines of a life-safety performance level. However, well constructed, single-story, wood framed construction typically does not collapse. This was evidenced by school performance during the Loma Prieta and Northridge earthquakes.

Nonstructural damage, especially toppling of heavy furniture, poses a risk to life-safety during earthquakes. There may be nonstructural hazards in older and newer schools that require mitigation. The 1971 San Fernando, 1989 Loma Prieta and 1994 Northridge earthquakes all occurred outside of regular school hours.

A much larger threat to life-safety in US schools exists in the North-West states and the New Madrid fault zone in the center of the country. Without legislation similar to the California Field Act, schools in those regions have been constructed to much less stringent seismic codes. Many schools in those regions continue to operate in un-reinforced and under-reinforced masonry structures which are known to be dangerous in earthquakes.

Schools in British Columbia were not constructed to Field Act standards and may have the same deficiencies that threaten the North-West and New Madrid zone schools in the US.

3. What level of seismic safety of schools is acceptable?

First and foremost, new public and private schools should be constructed to a seismic performance level conservatively above the life-safety performance level. Second, existing schools should be retrofit to a life-safety seismic performance level, including many older wood framed structures.

Why would a structural engineer recommend retrofit despite the lack of clear evidence that the buildings would collapse? It places school buildings well above the "life safety" level and away from the performance objective of collapse prevention. This is in keeping with the goals of new public school construction in the State of California since 1933. Retrofitting existing school buildings affords the school population a similar margin of safety that would be expected in new construction.

My 30 years of structural engineering experience includes earthquake reconnaissance work. My observation is that earthquake recovery hinges on returning to as normal a life as possible soon after the event. Many schools, in their original condition, will likely not be repairable after an earthquake. Or, they will require a long period of reconstruction. Also, many schools, particularly those in urban environments, lack adequate flat sites for temporary school housing. Not only would districts be looking for temporary school sites but communities eliminate the possibility of using schools for emergency and relief staging areas.

4. What actions are needed to achieve that level of safety?

The State of California and Province of British Columbia should take the following actions:

1. Complete the process of rating the seismic safety of existing public and private school buildings constructed prior to 1978 and 1986, respectively.
2. Implement a mandatory non-structural bracing program in public and private schools.
3. Require detailed seismic evaluation of non-conforming buildings.
4. Implement mandatory seismic retrofit of all public and private schools that do not meet the minimum life-safety performance objective.

5. What new state, provincial or national programs (or policies) are needed?

Implementation of mandatory school seismic safety programs will require bold leadership in state and provincial governments. In the State of California it will also be necessary to modify the Private Schools Building Safety Act and Charter School Act. In the current economy it will be difficult to find the bold leadership required. The earthquake engineering profession should continue to lobby and educate. We should also be ready to increase our efforts as the economy improves to keep school seismic safety the highest priority.