

Questions and answers about APEG's proposal to the federal and provincial governments for a performance-based seismic risk assessment of BC schools

As per Andy Mill (Head of the Seismic Task Force of APEG – Association of professional engineers and geoscientists)

Q. Why do we need a new risk assessment?

The existing school list is really several lists in different districts prepared by different people in different ways. The existing body of information is not a Risk Assessment; it is a disjointed set of individual priorities. If you asked the nay sayers the following questions about the current "lists", the answers would be no:

- Do we know the priority of all schools in BC?
- Do we know what the estimated statistical death toll is in the province in the next 50 years?
- Do we know what the estimated statistical injury count is in the next 50 years?
- Do we have a handle on the cost to upgrade?
- Do we agree on what is high risk and what is not?
- Do we understand the role of URM in this equation?
- Do we agree on unified concepts for upgrading (or not) URM?
- Does the existing risk data reflect BC construction?
- Does the risk data reflect BC seismology?
- Does the risk data reflect current research at UBC and elsewhere?

The reason we want a risk assessment is because we don't have one now. All we have is disjointed pockets of data. We need to communicate the extent of the problem and we do not have the tools to do it.

As per Dr. Carlos Ventura – Professor of Civil Engineering and director of the UBC Earthquake Engineering Research Facility

Q: Why “reinvent the wheel” by devising a new assessment plan?

A :APEG's purpose is not to "reinvent the wheel," but to "improve the wheel" and use it more effectively. The data from existing assessments can be used and fed into a new risk assessment tool. Work carried out previously will not be wasted, but rather standardized and placed into a broader provincial context.

Q: Are better tools for assessing building risk more valuable than clearer arguments and incentives for funding seismic retrofits?

A: One can't be separated from the other. **If we use the "wrong" tools for assessment, the price for the seismic retrofit program can be very high. Worse, we could be spending a lot of money in "solving the wrong problem." When money is tight, it**

makes sense to spend a little to save a lot. In this case, the use of better seismic risk assessment tools has a significant impact on the amount of money needed for the actual retrofits. It does not make sense to use 20-plus year-old-assessment techniques to decide what to retrofit, when we can use state-of-the-art techniques that will help us more reliably determine how much money is needed to retrofit our schools.

Q: We seem to be about 10 years behind such places as California, so couldn't we benefit from their experience in terms of convincing school boards, trustees and politicians to take appropriate action?

A: We are about 10 or more years behind California in implementing technology, but in terms of developing technology and knowledge, we are up to par with California. In some aspects of technological developments, we are ahead of California. It is well recognized around the world that Canadian engineers are among the best. It is just very unfortunate that our own communities fail to recognize - **and use** - all the advances that we have made.

Q: Risk-assessment tools to assess school and other buildings already exist and include relatively simple methods for evaluating building earthquake risk. Vancouver applied this method to all public buildings some years ago to set priorities for seismic upgrading. Why do it again?

A: Structural seismic risk assessment methods have been in around since the late 1960s. The philosophy of these methods is the same, but the technical approach has changed. Recent earthquakes have taught us to improve the reliability of these methods. Tremendous advances in earthquake engineering in the last decade are also helping us improve our efficiency. One of the most significant recent advances is the "performance-based" approach now used in seismic risk assessment.

For example, the NRC method, which follows closely the methodology developed by the Applied Technology Council (ATC) in California in the 1980s, is based mainly on the experience of engineers and observations from earthquakes in the 60s and 70s. The ATC-13 document in the mid 80s was the "starting point" for many documents developed in other countries to assess the seismic risk of building inventories. An important consideration is that all this information was generated based on the experience of engineers in California, and for the types of earthquakes that occur in California. The NRC document was developed based on the California methodology and adapted somewhat to the Canadian "seismic problem."

Since we don't have the "active" seismicity that California has, the developers of the NRC document had to make some adjustments to the methodology and adapt it to the Canadian setting. In the absence of any other document, the method presented by NRC was used by the City of Vancouver to assess public buildings using a "rapid screening" methodology.

Q: But the ATC has also published a lot of useful risk assessment methods, including "ATC-21, Rapid Visual Screening of Buildings for Potential Seismic Hazards." A new ATC guide sounds promising, too: "ATC-57 - Improving Seismic Design and Construction Practices, 2003." (See their website at www.atcouncil.org).

A: The mandate of ATC is to develop methods and techniques to reduce the seismic risk in California. Even US engineers from other states are very careful when implementing ATC techniques in their own states, because they recognize that the seismicity in the US is very different from state to state. It would be foolish for Canadian engineers to adopt ATC techniques without due consideration of our own seismic setting.

The ATC-21 made a significant impact in the profession when it was introduced in the late 80s. Some of the information presented in this report is now somewhat dated and it does not reflect what we have learned from the most significant earthquakes that have occurred in recent years (like the 1989 Loma Prieta and 1994 Northridge in California, the 1995 Kobe in Japan, the 1998 Koaceli in Turkey and 1999 Chi Chi in Taiwan, just to name a few). Also, many experienced structural engineers have criticized the document's scoring technique. While the ATC-21 document is a very useful reference, it does not reflect what we now know about seismic performance of structures during earthquakes.

The ATC-57 report was developed mainly to expedite the implementation of basic research knowledge into practice in order to improve seismic design and construction practice. That document is not directly applicable to the BC problem.

Q: Why doesn't the APEG proposal address these and other methods and explain why a new, more sophisticated approach is worth the investment?

A: The determination of seismic hazard for application in specifying seismic design forces has changed significantly in the last 40 years and the sophistication of building code seismic provisions has increased tremendously.

As indicated by Prof. Arthur C. Heidebrecht, one of the members of the of Canadian National Committee on Earthquake Engineering (CANCEE), which operates under the direction of the Associate Committee on the National Building Code, the seismic hazard in Canada has been fully recalculated by the Geological Survey of Canada, and this should be taken into account in the evaluation of existing buildings.

The ongoing improvement in the knowledge of seismic hazard and its geographical distribution throughout the country has allowed us to move from a general qualitative sense of seismicity based on historical earthquake activity to the expression of hazard using two ground-motion parameters (peak ground velocity and acceleration) determined probabilistically. In addition to changes in the way in which seismic hazard is described, earthquake activity in Canada during the recent historical period has been used to produce more reliable estimates of seismic hazard.

Studying and learning from the damage due major earthquakes around the world enables

engineers to improve seismic design provisions. Each major earthquake provides one or more significant lessons that lead to further code improvements. The proposed APEG methodology takes full advantage of this recently acquired knowledge.

Another major reason for implementing improved assessment techniques arises directly from the results of broadly based earthquake engineering research being conducted in Canada and around the world. Such research, as reported in the literature and presented at conferences, often demonstrates the need for making changes to improve the way in which we design and evaluate the seismic resistance of structures. The proposed project takes full advantage of research results obtained recently by Canadian engineers and researchers. And most importantly, since this research was conducted locally, the research results are directly applicable to the BC seismic setting.

Q: Should we look at what worked -- and did not work -- in California? For example, see the School Facilities Seismic Improvement Program of the Earthquake Engineering Research Institute, at: http://quake06.org/quake06/best_practices/SFSIP.html.

A: Yes. We should learn from the experience gained by others.

Q: Isn't the biggest challenge how we make the right choices? Don't we— parents, politicians, bureaucrats, voters — need to collectively make the safety of BC's schoolchildren our top priority?

A. Absolutely. The biggest challenges are not the technical ones. Engineers have been telling "society" for years that we have a problem, but "society" does not appear to be listening, or at least not taking action. That's where FSSS comes in.