THE IMPORTANCE OF COMMUNITY INVOLVEMENT ON THE ROAD TO SCHOOL SEISMIC SAFETY IN BRITISH COLUMBIA: THE OBSTACLES AND CIRCUMVENTING THEM

Tracy Monk

Family MD, founder Families for School Seismic Safety (www.fsssbc.org)
e-mail: tlmonk@telus.net

SUMMARY

This paper outlines the road to a 1.5 billion, 15 year commitment by the government of British Columbia to school seismic safety. Over the course of a concerted one and a half year public education, media and lobbying campaign, school seismic safety has come to grip the collective social conscience and is becoming a focal point for promoting broader mitigation measures. The recognition of schools as an infrastructure priority has built a sense of community across the political spectrum

Key components to the approach were an alliance with the scientific community in educating government and the population about the risks and the solutions, and the incorporation of a public health approach to the problem. From a public health perspective, if there is any population in whom an expensive preventive intervention is worthwhile – it is children.

The paper reviews general obstacles to mitigation, including fatalism of the population and perceived lack of short-term political gain for governments. The specific obstacles to mitigation of schools in BC will also be examined. These obstacles have included: 1) Failure to designate the buildings as a priority for retrofit. 2) Locus of responsibility placed within the already cash-strapped education sector. 3) Discomfort at the price tag.

A return to basic social principles assisted government in setting priorities and funding this work These basic principles include the recognition of the 2 following facts: 1) Children are number one on the public safety agenda 2) The 2 basic human rights of children, to physical safety and an education must not compete for the same funds. We don't need equations or calculations of cost-effectiveness to tell us what our guts already know and millennia of evolution have wired us to feel, there is no greater treasure to a society than its children

In engineering, as in public health, there is much work left to be done in educating the population about risks and prevention. Hopefully, the case study of BC can be an example of the broader benefits which flow from taking a multidisciplinary approach to the issue and creating an alliance between engineers and the community.

On Nov 6, 2004, the Premier of British Columbia, Canada, made a 1.5 billion dollar commitment to ensuring that the schools of British Columbia will meet acceptable seismic life safety standards within 15 years. This commitment was made largely in response to a concerted one and a half year public education, media and advocacy campaign by the parents of BC school children, under the banner of Families for School Seismic Safety.

This paper will examine the components of the success of this advocacy campaign and review the obstacles often encountered in efforts to promote mitigation of seismic hazard both generally, and with specific reference to schools. An essential component in the success of this campaign was an alliance with the scientific community. The concern and commitment of a few scientists, played an essential role in educating parents and the broader population both to seismic risk and the importance of prevention.

I will also provide a brief overview of the issue of school seismic safety both globally and in North America. Schools have frequently been disproportionately damaged in earthquakes; sometimes they have been occupied, with catastrophic consequences, and sometimes they have collapsed unoccupied, still with serious and long lasting social and economic repercussions.

In British Columbia, school seismic safety has now come to grip the collective social conscience and has become a catalyst for broader mitigation measures.

<u>Obstacles to mitigation</u>

It has been traditionally difficult to convince populations and governments to embrace the idea of preventive interventions, particularly for rare events. In the wake of the tsunami of December 2004, the importance of preventive interventions has, at least briefly, risen to the top of the political agenda. It is widely recognized that a window of opportunity for preventive interventions opens up in the aftermath of a disaster (Olshansky et al, 2004).

General obstacles to risk mitigation include the following:

- Fatalism of the population
- Perceived lack of short-term political gain for politicians
- Discomfort at the price tag

Fatalism is often simply a result of lack of understanding. Spence and Coburn (2002) have explained that in many ways the state of hazard mitigation is at the same point now, that public health was at in the mid-nineteenth century. The population was very fatalistic and believed that epidemics were just part of life. Large numbers of people were dying of water -borne illnesses. The population had to be educated to understand first, that the epidemics were preventable, and then to see that it was worth it to spend a portion of our public funds on prevention. The simple message for the public is that although we cannot prevent nature from unleashing her forces, the ensuing disaster can often be prevented.

Although these events are rare, the economic and social consequences of earthquakes are enormous. Multinovic has reviewed natural hazard outcomes for EUROPA- MHA member nations. He states the following:

> EUR-OPA Major hazards agreement (MHA) member states are all exposed to adverse effects of natural hazards such as earthquakes, floods, wildfires, landslides and avalanches. . . empirical data from past disasters indicate that, although rare, the effects of earthquakes – expressed in terms of physical and functional damage and human casualty – in many cases substantially exceed the

> adverse effects of all other hazards individually, and in some cases even the aggregate effects. (Multinovic, 2004)

Because these events have long time horizons, politicians may have the impression that they will only be incurring costs, without scoring political points, by undertaking preventive measures whose cost-effectiveness may not be realized for decades or more.

At the outset of our BC campaign, political insiders told me that no one would see fixing up a "bunch of tired old school buildings" as "politically sexy". My response was that this effort would appeal to all mothers and anyone who values education. This intervention is not politically sexy, like a sports car is supposedly sexy, but rather "sexy" the way a picture of a man holding a baby is "sexy." Ultimately, an informed population can understand that this is something that it wants, both for itself, and for other nations less privileged. A popular demand creates the short-term political gain that politicians desire.

It is the opportunity to ride in like "white knights" that makes it so appealing for governments to <u>respond</u> to disasters. Creating a "white knight" opportunity for government in disaster <u>prevention</u> simply requires an educated population with an imagination. Recent disasters which enhance the ability of the population to consider the possibility that "that could have been me" – intensify the public's imagination; but a recent disaster is not a pre-requisite for the creation of a positive political climate for prevention. BC's Premier made a commitment to school seismic safety 1 month before the tsunami in South East Asia and 2 years after the collapse of a school in Molise Italy.

Specific obstacles to seismic mitigation of schools in British Columbia have included the following:

- Failure to designate school buildings as a priority for retrofit
- Locus of responsibility within the already cash-strapped education sector

Although often designated as post disaster receiving centers, these buildings were designated a priority 1.3 in our building code (while hospitals and police stations are a 1.5). Although many other nations designate these buildings as critical infrastructure, our Federal Department of Emergency Preparedness did not consider schools to be critical infrastructure while banks and national monuments made this list. (see Appenidx A for list of national critical infrastructure) This left parents to wonder if the contents of school buildings were somehow not a national treasure, and if these buildings were not essential to the functioning of our communities.

It is interesting to note that GeoHazards International (an NGO retrofitting schools in developing nations – led by seismologist Brian Tucker) conducted a survey in Nepal prior to undertaking efforts to retrofit schools in the Khatmandu valley. The aim was to ensure that this was actually what the population wanted. When asked if they would spend their own funds to prevent earthquake collapse of their houses of government or temples, the answer was "no". When asked if they would spend their own funds to prevent collapse of the neighbourhood school, the answer was an overwhelming "yes".

In North America, deep layers of bureaucracy and division of responsibilities between multiple levels of government have distanced us from our ability to see and act on basic priorities. This is how school seismic safety so often falls between the cracks. There have been some wonderful exceptions such as California, Utah, Seattle and New Zealand where schools have been extensively retrofitted and replaced.

Public Education in BC, as elsewhere in the world, has faced increasing cutbacks. Although funding for the buildings is separated out as a capital budget, the educational budget is seen as a single pile in the minds of the public and educators alike. It was difficult for anyone within education to even consider asking for funding to make school buildings safe if it seemed that it would in any way compete with day to day classroom needs of children. Essentially, parents and educators had been left feeling that they had to choose between educating their children or keeping them safe. Two basic human rights of children were left to duel it out within the same budget.

A central tenet of Families for School Seismic Safety was the notion that school building safety was not an educational issue, but rather a safety and infrastructure issue, and must not compete for the same funds. It was on these grounds that we have pursued federal funding, in addition to provincial funding, for school upgrades. (Education is traditionally a provincial jurisdictional issue, but there have been precedents for joint federal provincial hazard mitigation initiatives as part of our national disaster mitigation strategy with projects such as Manitoba's Red River floodway – a 600 million project)

Other types of government infrastructure have not had to face inherent competition of two such basic human rights; hence, prisons, bridges, tunnels, water supply, community centers and even the liquor branch have all been upgraded. Education was saddled with a particularly hazardous building inventory in which to house children for the day. The management of these buildings has also been separated out from the management of most other government facilities – within the Ministry of education. In the wake of Taiwan's '99 earthquake, which disproportionately damaged schools, it was noted that these buildings had also been managed differently than other government infrastructure with less oversight. Taiwan has taken steps to remedy this.

In Oct 2004, the government of BC completed an assessment of the 800 schools within our zone of seismic risk. 311 were found to be at high risk of sustaining severe damage to structural elements in the event of a moderate to strong earthquake. (The results of the assessment may be viewed at www.bced.gov.bc.ca/news/edufacts.) The initial estimate, to address all structural and non-structural safety issues in BC's 800 schools within the zone of risk is 1.5 billion dollars. There are indications that it may be possible to achieve life safety performance for less. Two days before the assessment results were made public, the Premier made a 1.5 billion commitment to seeing this work done within 15 years.

The price tag in BC comes in around 2% of GDP spending on education. This is in line with the theoretical estimate given by Spence for European nations (Spence, 2004)

<u>Components to a successful approach: surmounting the obstacles</u>

The following elements played a part in the success of this advocacy campaign:

1) Alliance with the scientific community – an educated population is not fatalistic
2) A public health approach – if there is any population in whom an expensive preventive intervention is worthwhile, it is children.
3) A return to basic social principals
    a) Children are number one on the public safety agenda
    b) The two basic human rights of children to education and physical safety must not compete for the same funds
4) Extensive use of web site and internet to create an alliance of concerned parents and experts
5) Concerted lobbying of all 3 levels of government
6) Frequent media events and press releases and letters to the editor. Media serves as an even more direct pipeline to the ear of government, than lobbying – and media coverage must accompany lobbying to reinforce the message.

<u>Alliance with the scientific community</u>

The support and assistance of the scientific community in ensuring that all information presented to the public was scientific, factual and calmly delivered, was central in creating political and public credibility for the group. Prof Carlos Ventura, Director of UBC's earthquake engineering research facility, was a local leader in helping to educate the public in order to create a "culture of prevention." Andy Mill, Head of the Seismic Task Force of APEG-BC (Association of Professional Engineers and Geoscientists) also took a lead role as an expert who could explain engineering concepts in simple terms for the media. Local seismologists such as Garry Rogers, John Clague and Michael Bostock have also done an excellent job of informing the public of the nature of the seismic risk faced by the province of BC which sits on Canada's west coast, along the Ring of Fire.

The nature of the risk has undoubtedly been better understood by the population, than the nature of prevention. Preparedness, such as having water ready, bookcases screwed in, and an emergency plan, were well understood; but the message which had not been well understood by the public was the fact that earthquakes don't kill people, bad buildings do – and bad buildings can be "fixed" – or at least strengthened to improve outcomes.

What was a particular surprise in BC was the fact that our schools happen to have been built of some of the most vulnerable materials and designs, and in many neighbourhoods, the school would be the most dangerous building to be in, during an earthquake. Most of our residential construction is nailed together wood-frame construction which performs relatively well.

Architectural history has seen many of our schools constructed first in the early 1900's as "little red brick schoolhouses" from unreinforced masonry, and then with non-ductile concrete between the mid- fifties and mid-seventies. In addition, schools have other features which tend to make them higher risk structures: large windows on main floors, large open gyms and a history of numerous additions over the years – often without due consideration for principles of seismic resistant design – especially when these additions were made before these principles were understood.

The issue of the poor seismic resistance of BC schools had surfaced a few times in the political history of the province. Various parent groups from individual schools at risk, and even a brilliant student-led seismic advocacy effort (The Van Tech Lizards) had helped to bring the issue into the public consciousness

Parents of BC had noticed the collapse of a school in Molise Italy, in Oct 2002 – which killed 27 children in a relatively small quake. The parents of the village stated afterwards that the school should have been the safest building in town – instead it was the only one to collapse. It was even more surprising when similar events unfolded in Bingol Turkey in May 2003. These events - and the creation of an internet community of concerned parents under the FSSS banner – allowed the advocacy around the issue to coalesce. As the parents of BC began to investigate the disproportionate risk to school buildings elsewhere in the world, they were astonished to discover how often schools had been disproportionately affected in earthquakes both in North America and around the world.

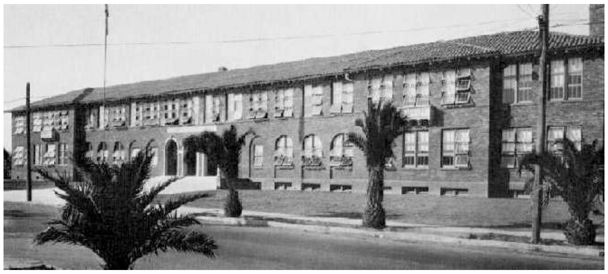
North American History of School Collapses

In North America, death tolls have been relatively low in earthquakes. It is also important to note that no North American earthquake has ever occurred during school hours. A review of history shows the alarming facts outlined in table 1. Schools have been disproportionately damaged, often to levels of life-threatening severity, again and again in North American history. The disturbing time line begins in Long Beach in 1933 where the earthquake of magnitude R 6.3 occurred in the evening. Seventy schools collapsed, 120 were seriously damaged. There were 5 children in a gymnasium that evening who were all killed – had school been in session – the death toll among children could have been greater than a thousand. (See photos) It is widely known that the events of Long Beach led to the creation of California's Field Act which legislated special protection for schools. It also led to the abandonment of this style of construction.

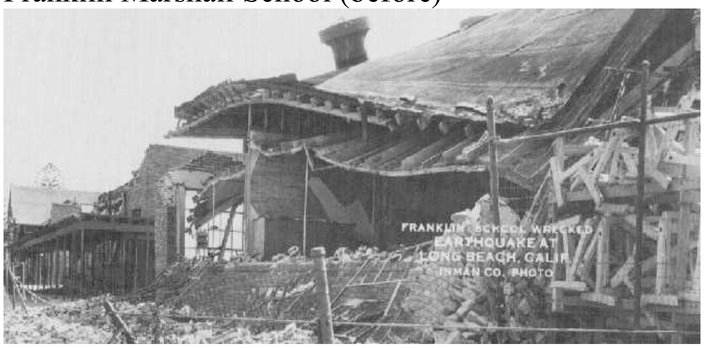
Table 1 – North American Schools in earthquakes – none during school hours

Year	Location	M	Outcome	Source
1933	Long Beach, California	6.3	70 schools collapsed, 120 damaged (Field Act enacted)	California Seismic Safety Commission
1935	Helena, Montana	6.25	Collapse of Helena high school. The greatest amount of damage to a single structure was incurred by this building	National Geophysical Data Center (NGDC)
1946	Courtney BC, Canada	7.3	Serious damage to interior of classroom	BC Archives
1949 & 1965	Seattle & Puget Sound	7.1 6.5	Washington schools sustained a disproportionately high level of damage - schools built prior to 1950 suffered extensive structural and non-structural damage. Thirty were damaged in 1949. Ten of these schools were condemned and permanently closed . Three Seattle schools were torn down, and one was rebuilt. In 1949, a large brick gable over the entry of Lafayette Elementary School in West Seattle collapsed directly onto an area normally used for assembly of pupils at the time of day the earthquake occurred.	Source – (1)
1952	Kern County California	7.3	About 20 schools were damaged or destroyed by this earthquake. Many of the schools that collapsed were built prior to 1933.The Cummings Valley School completely collapsed	NGDC
1964	Alaska	9.2 approx 120 km from epicenter	Government Hill Elementary School split in two and was virtually destroyed when the ground beneath it slumped down. Fortunately, the earthquake occurred on Good Friday, a school holiday. The entire second floor of West High School classroom wing was a total loss.	NGDC
1993	Scotts Mills, Oregon	5.7 crustal	Mount Angel High School – large quantity of bricks fell into school yard	

(1) http://www.geophys.washington.edu/SEIS/PNSN/INFO_GENERAL/NQT/where_damage.html



Franklin Marshall School (before)



Franklin Marshall School (after)

It is easy to forget the role that both luck of timing, and extensive mitigation in California, have played in the relatively low death tolls in North American earthquake history to date. While it is true that North American construction is superior to adobe and other third world styles – it is not immune to earthquake collapse and we are lucky that death tolls have not been higher, especially among children.

I believe that insufficient knowledge of historical “near misses” (i.e. the failure of empty buildings – often schools) contributed to complacency among school board facility managers, governments, emergency preparedness experts and even some engineers.

World History of School Collapses

The experience of Taiwan in the Chi Chi earthquake of 1999 highlighted again the importance of ensuring the seismic safety of schools. As William Ellsworth has stated:

> The Chi-Chi earthquake exposed the vulnerability of technologically advanced society to damage and loss. Some of the lessons, such as the importance of building earthquake-resistant schools continue to be relearned despite the best advice of scientists and engineers. (Ellsworth, 2004)

Again schools took a disproportionate hit, and on this occasion were empty. The economic impacts were enormous nonetheless as families were disrupted “from the bottom up” impairing the productivity of parents (Wei Lee, 2004) and enormous efforts had to be undertaken both to create temporary schools and then replacement permanent schools.

Other world examples of schools collapsing unoccupied, where the economic and social impacts were enormous nonetheless, include Skopje, Yugoslavia 1963 where 44 schools were destroyed representing 57% of the building stock (Multinovic, 2004). Multinovic goes on to explain that among EUROPA-MHA (multi-hazard agreement) member states, earthquakes have only caused severe damage to a small portion of existing buildings – unfortunately, most were schools, some were hospitals (Multinovic, 2004)

Some other near misses include the following:

- Sapporo, Japan 1952 – 400 schools collapsed (as per USGS)
- El Asnam, Algeria 1989 – 70-85 schools collapsed or were severely damaged (Bendimerad ,2004; NGDC 2004)
- Pereira, Colombia 1999 – 74% schools damaged (Garcia & Cardona, 2000)
- Xinjiang, China 2003 – dozens of schools collapsed (Harmsen, 2003)
- Boumerdes, Algeria 2003 – 130 schools suffered extensive to complete damage (Bendimerad 2004) (Full table in - Wisner et al, 2005)

When earthquakes strike during school hours, the consequences have often been devastating. In Spitak Armenia, 1988, schools were disproportionately damaged and the death toll among school children was over 1,000. (NGDC, 2004) For example, there was a school with 302 children, of whom 285 (94%) died (Noji et al., 1990). In Cariaco Venezuela, 2001, 2 of 5 reinforced concrete buildings which collapsed, were schools (Lopez, 2004) School was in session when the earthquake hit. As a result, more children died than adults.

Other school collapses (some representing disproportionate deaths among children) have included the following:

- Molise, Italy 2002 (27 children died) (Aguenti et al, 2004)
- Bingol Turkey 2003 (84) (Gulkan et al, 2003)
- Ardakul, Iran1997 (110) (CNN, 1997)
- Tangshin, China 1976 (>2,000) (FSSS, 2004)
- Ahmedabad, India 2003 (>25) (FSSS, 2004, Wisner et al 2005)
- Bachu, China 2003. (>20) (Wisner et al, 2005)

In summary, children around the world are often facing disproportionate risk from seismic hazard. As Ben Wisner (Benfield Grieg Hazard Research Institute) has stated:

> “The question is why, again and again, even in industrialized nations with a wealth of engineering expertise – schools 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.”

Activating populations to mitigate risk is really all about activating the most primitive and protectionist parts of our brain – the cave people in us all. There is no more potent activator of that part of our brains than children at risk. It is no coincidence that many successful seismic advocacy efforts have had, as a starting point, risk to children and schools. (Olshansky, 2004) Once the public has grasped the issue of prevention, with children as a focal point, they become ready to embrace broader mitigation measures.

It is also important to realize that a message purely about the risk does nothing to activate a population if it is unaccompanied by simple and hopeful explanations of preventive interventions which can be undertaken. Simply informing the public that there is going to be an earthquake is not enough. The public needs to understand that it can do more than just screw in bookcases and make an emergency kit – it can do more than just be prepared for a disaster. The public can press government to prevent the disaster by mitigating public buildings (especially schools and hospitals, when life safety is at issue, in addition to police and fire stations). Government should also be encouraged to create incentives for the mitigation of private buildings.

A Public Health Approach to Seismic Mitigation

Creating better, more hazard resistant buildings is a public health intervention in the same way that building safer highways and legislating seat belts are public health interventions. Safer buildings can be achieved through legislating and enforcing building codes and mitigation of older buildings. The seismic mitigation of schools can be seen as a childhood injury prevention program.

An advantage to building mitigation, compared to say vaccination, or seat belt laws, is that it does not require the compliance of the beneficiary. No one has to show up for the shot, or remember to buckle up, and the intervention protects generations of inhabitants.

In public health, interventions are assessed in terms of cost per year of life saved. (Or sometimes as cost per DALY or QALY, disability or quality adjusted life year.) In school aged populations average age at death or injury would be 12. Each child death represents 63 years of lost life. Each brain or spinal cord injury represents 63 years of expensive medical care – a cost incurred by society as a whole. The public health approach captures what we all feel in our guts, that the loss of a young life is more tragic. It is a basic evolutionary principal that we place extra value young life. Global media coverage of events in which even a small number of children perish together, (worse if their demise was preventable) is further evidence of our deep collective sense that children are number one on the public safety agenda.

Experts in engineering sometimes fear that they appear self-interested if they speak publicly about the need for seismic mitigation. I would argue that no one thinks that doctors and public health officials act out of self-interest when they state publicly that children need vaccinating, the drinking water must be clean, and we must take measures to prevent influenza pandemics. Engineers and seismologists are simply another expert community laying out risks and prevention.

The other central point in a public health approach to structural mitigation is that it focuses on the humans and human impacts. There has been a tradition within engineering to, quite rightly, focus on the buildings and often to make cost-benefit analyses primarily in infrastructure terms. The economic impacts of the human consequences of earthquakes have seldom been quantified. (Exceptions include the work of Shoaf, Seligson, Porter and others) The cost benefit analyses become even more compelling when human impacts are taken into account.

Ultimately, whatever the cost-benefit analyses, there are certain things we do as a society, simply because they are the right thing to do. In medicine the current threshold for cost-benefit of drug therapies is $40,000 per year of life saved. There are many things we routinely do in medicine which cost considerably more, but which we do because it is what is right.

To create the popular desire for public expenditure on disaster mitigation, rather than purely disaster response, requires imagination, it requires a "what if" leap in the minds of tax payers. The human impacts, especially those on children, grab us all, and pull us by our primitive brainstems into the act of imagination that is required to undertake sensible preventive measures.

FSSS Lobbying, and Media Campaign

FSSS (Families for School Seismic Safety – www.fsssbc.org) was founded in June 2003. Our first step was to compile a lobbying document. We laid out the information in a bullet-proof and compelling manner that explained the problem in simple terms that any politician could understand. We made condemning comparisons to other jurisdictions which were far ahead of us in carrying out this work such as California, Seattle (our sister city) and New Zealand. We pointed out that prisons had been upgraded while schools had not. We made nice charts demonstrating how far behind we were (see chart below) and what pace we were on – 60 years to the finish.

Our lobbying document laid out the case for potential cost-effectiveness in building management terms, public health terms and legal terms (e.g. possible legal costs if liability found in case of brain injured child – 5 to 10 million).The assistance of the scientific community was essential in creating accurate and objectively presented scientific information. Our approach was always reasoned and scientific, it was never about fear mongering, it was simply about having our priorities in the right place as a society and being able to say at the end of the day, that we had done our best to protect children from a known risk.

The final section of the lobby document was "the ask". We asked government to carry out an assessment of all schools at risk within 1 year and to ensure that all schools met acceptable life safety standards within 10-15 years.

Initially the information was presented only to politicians at the provincial and federal levels behind closed doors. It was clear in its presentation that there was potential for political embarrassment, but also potential to look good and be praised publicly if they acted on the information. We realized that many decades of governments and bureaucrats had failed to take sufficient action and it was no one administration's fault

When government did not appear to be responding, FSSS launched mass e-mail campaigns through our web site and e-mail list. We held press conferences and media events. A range of parents appeared on the news and on numerous radio shows discussing the issue. Calm, reasoned and concerned parents were sometimes accompanied at news conferences by experts.

Students participated in the media campaign painting banners and even writing and staging a brilliant play about attending school in a building at risk and government's skewed priorities. The play was attended by politicians and media alike.

The culmination of close to one hundred media hits for the issue in print, radio and TV – was a press conference of international experts at the World Conference of Earthquake Engineering in Vancouver in August 2004. The press conference heralded the release of the OECD expert's recommendations on school seismic safety. Six international experts explained the often disproportionate risk faced by school children around the world. These experts were: Carlos Ventura (UBC), Wilfred Iwan (CalTech), Brian Tucker (GeoHazards International), Robin Spence (Cambridge), Mauro Dolce (Univ Basilicata) and Andy Mill (APEG-BC). The press conference resulted in a front page banner headline story and a national TV news story as well as extensive radio coverage.

Each media event served both to create pressure on politicians and to calmly inform the public of the nature of the risk and the solutions. There has been no panic in BC among parents of school children. The recognition of schools as an infrastructure priority has built a sense of community across the political spectrum. Awareness of seismic risk and mitigation that began with an awareness of the issue specific to schools and children, has translated into a broader level of concern among the public.

Conclusion

Community involvement and an alliance with the scientific community played key roles on the road to school seismic safety in BC. Rob Olshansky (2004) has made the following observations about successful seismic advocacy which have been borne out by the BC experience

- If you are a scientist or engineer, don't be afraid to jump into the policy arena. Seismologists and engineers with broader social interests have been able to successfully mix these talents and interests over the years.
- Take the initiative to meet with key decision makers. If you don't talk to them, they won't know of the earthquake problem. If you don't talk to them about seismic safety, who will?
- The press can be very helpful in publicizing your cause, but use them wisely. (I would add that in BC, press were very effective in gaining the attention of

decision makers. Professional organizations and scientists are essential in adding credibility, and it is an informed voting public who will influence government.)

I would also add the 2 following observations for successful seismic advocacy:

- Simplify the message of prevention for the public – "Earthquakes don't kill people – bad buildings do"* – and bad buildings can be fixed
- Educate the population to the risk and the solutions to create a "culture of prevention"

A panel of seismic experts was convened by the OECD and GeoHazards International in February 2004. They made recommendation on the global issue of school seismic safety. The experts concluded:

> "The motivation for school seismic safety is much broader than the universal human instinct to protect and love children. The education of children is essential to maintaining free societies . . . most nations make education compulsory. A state requirement for compulsory education, while allowing the continued use of seismically unsafe buildings, is an unjustifiable practice. School seismic safety initiatives are based on the premise that the very future of society is dependent upon the safety of the children of the world." (OECD, 2004)

We don't need equations or calculations of cost-effectiveness to tell us what our guts already know and millennia of evolution have wired us to feel, there is no greater treasure to a society than its children. In engineering, as in public health, there is much work left to be done in educating the population about risks and prevention. Hopefully, the case study of BC can be an example of the broader benefits which flow from taking a multidisciplinary approach to the issue and creating an alliance between engineers and the community.

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Appendix B: National Critical Infrastructure Sectors PSEPC has identified 10 sectors that form the basis of the NCIAP. The table below lists these sectors and provides sample sub-sectors for each sector.

Sector		Sample Sub-Sectors
1	Energy and Utilities	Electrical power (generation, transmission, nuclear) Natural gas Oil production and transmission systems
2	Communications and Information Technology	Telecommunications (phone, fax, cable, satellites) Broadcasting systems Software Hardware Networks (internet)
3	Finance	Banking Securities Payments System
4	Health Care	Hospitals Health-care facilities Blood-supply facilities Laboratories Pharmaceuticals
5	Food	Food safety Agriculture and food industry Food distribution
6	Water	Drinking water Wastewater management
7	Transportation	Air Rail Marine Surface
8	Safety	Chemical, biological, radiological, and nuclear safety Hazardous materials Search and rescue Emergency services (police, fire, ambulance and others) Dams[4]
9	Government	Government facilities Government services (for example meteorological services) Government information networks Government assets Key national symbols (cultural institutions and national sites and monuments)
10	Manufacturing	Chemical industry

		Defence industrial base