School Seismic Safety in British Columbia:
A Grassroots Success

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Abstract:

This paper outlines the road to a US$1.3 billion, 15-year commitment by the government of British Columbia, a province of Canada, to school seismic safety. 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. Lobbying and media campaigns were also critical.

The paper examines the history of disproportionate damage to school buildings in earthquakes around the world with particular focus on Canada and the USA. Then, general obstacles to seismic safety are reviewed, including fatalism of the population and perceived lack of short-term political gain for governments, along with specific obstacles encountered in British Columbia. The paper contains recommendations for scientists and experts on how to engage in successful advocacy.

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Introduction

On 6 November 2004, the Premier of British Columbia, a province of Canada, made a US$1.3 billion commitment to ensuring that the schools of British Columbia will meet acceptable seismic life safety standards by 2019. 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 British Columbian school children, under the banner of Families for School Seismic Safety (FSSS), working in collaboration with British Columbia's engineers and scientists.

This paper examines the components of the successes and long-term challenges of the FSSS advocacy campaign and reviews the obstacles often encountered in efforts to promote seismic safety both generally, and with specific reference to schools. Four essential components in the success of this campaign were:

- an alliance with local scientists and engineers in developing and disseminating factual and compelling information outlining the problem;
- a public health approach to the problem;
- a lobbying campaign consisting of meetings with politicians and public officials at all levels of government; and
- a publicity and media campaign which created public support and focussed the politicians' attention, creating a "white knight"

opportunity for government (further discussion is below on a "white knight" opportunity).

These lessons are discussed in order to focus on the development of a broader "culture of prevention" (UNISDR, 2005).

Overview of school earthquake damage

To place school seismic safety in context, this section presents an overview of school seismic safety both globally and in North America, demonstrating that schools frequently sustain disproportionate levels of damage in earthquakes. Sometimes they have been occupied, resulting on some occasions in greater loss of life among children than adults, and sometimes they have collapsed unoccupied, still with significant social and economic impacts.

Outside of Canada and the USA

When an earthquake strikes during school hours, the consequences are often devastating for children and teachers caught in structural collapses. In October 2005, approximately 19,000 children in Pakistan died in an earthquake, most of them while attending school (Hussain et al., 2006). In 1988 in Spitak, Armenia, then part of the USSR, schools were disproportionately damaged and the death toll among school children was over 1,000 (NGDC, 2004). In one school, 285 of 302 children died (Noji et al., 1990). In Cariaco, Venezuela in 2001, two of the five reinforced concrete buildings which collapsed were schools (López, 2004). School was in session when the earthquake hit. In Spitak and Cariaco, more children died in the disaster than adults.

In the aftermath of the collapse of a primary school in Molise, Italy in 2002 killing 26 children and one teacher (Augenti et al., 2004), the citizens remarked that the school should have been the safest building in town. Instead it was the only one to collapse. Ben Wisner, one of the drivers behind global school safety campaigns, remarked on Radix, a disaster risk reduction and sustainability network at http://www.radixonline.org:

> 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.

Other school collapses of occupied buildings during earthquakes, some representing a disproportionate death rate among pupils, include:

- Bingol, Turkey in 2003 killing 84 people (Gülkan et al., 2003).
- Ardakul, Iran in 1997 killing 110 people (CNN, 1997).
- Tangshin, China in 1976 when over 2,000 students died (FSSS, 2004).
- Ahmedabad, India in 2003 when at least 25 school children died (FSSS, 2004).

Wisner et al. (2007) details even more examples.

Taiwan's experience in the Chi Chi earthquake of 1999 highlighted again the importance of ensuring the seismic safety of schools. Again, schools took a disproportionate hit, but on this occasion they were empty because the earthquake hit in the middle of the night. As Ellsworth (2004) 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.

The economic impact of the failure of their children's school buildings was enormous for the Taiwanese. At a social level, families were disrupted "from the bottom up" impairing the productivity of parents (Wei Lee, personal communication). The broad economic impacts of the loss of school buildings extended well beyond the educational sector into all aspects of the economy.

Similarly enormous economic and social impacts occurred with the failure of unoccupied school buildings in an earthquake in 1963 in Skopje, Macedonia, then part of Yugoslavia. Forty four schools were destroyed representing "57% of the total urban school building stock [in Skopje], providing education for about 50,000 children" (Milutinovic and Massué, 2004). Milutinovic and Massué (2004) further explain that for the European countries who are members of the EUR-OPA Major Hazards Agreement:

> Earthquake data indicate that only a small proportion of existing buildings suffered severe earthquake damage. Unfortunately, these were mostly government buildings, especially schools, and in some cases health care facilities.

Some other examples of the failure of unoccupied school buildings around the world include:

- Sapporo, Japan in 1952 when 400 schools collapsed (USGS, 2003).
- El Asnam, Algeria in 1989 when 70-85 schools collapsed or were severely damaged (Bendimerad ,2004; NGDC 2004).
- Pereira, Colombia in 1999 when 74% of schools were damaged (García and Cardona, 2000),
- Xinjiang, China in 2003 when dozens of schools collapsed (Harmsen, 2003).
- Boumerdes, Algeria in 2003 when 130 schools suffered extensive to complete damage (Bendimerad 2004)

Wisner et al. (2007) provides even more examples.

The extensive case studies of both student deaths and unoccupied school collapses, around the world show that school children often face disproportionate risk from seismic hazard. Neither the wealth of countries nor their level of technological expertise seems to make a difference in leaving children and schools at increased risk of death and injury during earthquakes.

Canada and the USA

Many engineers in Canada and the USA seem to be unaware of the disproportionate levels of damage to school buildings in their countries' earthquake experiences. In fact, as of mid-2007, few large earthquakes had happened during school hours in Canada or the USA. Even going back 100 years and including the several thousand fatalities in the 1906 San Francisco earthquake (much higher than the official casualty list), death tolls in earthquakes in these countries have been relatively low compared to earthquakes around the world. A review of the historical record of school damage in earthquakes highlights how much *luck* has gone into these low death tolls, and how children in schools have been particularly lucky, despite being at significantly increased risk.

In Canada and the USA, schools have been disproportionately damaged, often to levels of life-threatening severity (Table 1). The disturbing history of poor performance of school buildings in American earthquakes can be traced back to at least Long Beach, California in 1933.

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

Year	Location	Magnitude	School damage	Source
1933	Long Beach, CA	6.3 (*Richter*)	70 schools collapsed, 120 damaged	CSSC (2002)
1935	Helena, MT	6.25	Collapse of Helena high school. The greatest amount of damage to a single structure was incurred by this building.	NGDC (2004)
1944	Cornwall, ON	5.6	Collegiate and Vocational School - falling masonry broke through the roof of the adjacent gymnasium obliterating a large area of the unoccupied gym.	NRC (2007)
1946	Courtney, BC	7.3	Serious damage to interior of classroom	NRC (2007)
1949 & 1965	Seattle & Puget Sound, WA	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.	Noson et al. (1988)
1952	Kern County, CA	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 (2004)
1964	Alaska	9.2	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 (2004)
1993	Scotts Mills, OR	5.7	At Molalla Union High School, a large quantity of bricks fell into the school yard.	EERI (1993)

The earthquake of Richter magnitude 6.3 occurred in the evening. Seventy schools collapsed and 120 were seriously damaged. There were five children in a gymnasium that evening and all of them were killed. Had school been in session, the death toll among children could have been over a thousand. This event led to the creation of California's Field Act which has "enabled a higher design and construction requirement for California's public schools since 1933" (Mujumdar and McGavin, 1999).

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 Canadian and American earthquake history to date. While it is true that construction in Canada and the USA is often superior to that in other countries, it is not immune to earthquake collapse.

The overall record of poor performance of school buildings also highlights the serious shortcomings of currently available tools to create casualty models for Canadian and American schools. The available tools create casualty projections based on casualty experience to date in Canadian and American building typologies. These projections omit the repeatedly catastrophic performance of school buildings in the estimates they create because these buildings were unoccupied when they failed. Models which omit the data will underestimate the total casualties for earthquakes which happen during school hours, and they do not provide the full story that a large proportion of casualties could be schoolchildren.

Japanese engineers acknowledge that prior to the 1995 Kobe earthquake, a sense of complacency was common. In Canada and the USA, insufficient knowledge of the historical "near misses" can contribute to complacency among school boards, governments, emergency managers, parents and even some engineers.

General Obstacles to Mitigation

It has been traditionally difficult to convince populations and governments to embrace the idea of preventive interventions, particularly for rare events. General obstacles to disaster risk mitigation include the following:

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

Fatalism often results from lack of understanding. Coburn and Spence (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.

At that time, the population was generally fatalistic, believing that epidemics were just part of life. The consequence was that large numbers of people died from water-borne illnesses with a prominent example being cholera. The population had to understand first that the epidemics were preventable and then to be convinced that it was worthwhile spending adequate public funds on prevention.

The simple message for the public is that nature cannot be prevented from unleashing its forces, but the ensuing disaster can often be prevented. An often cited phrase, also used as the slogan of the Nepalese organisation NSET (National Society for Earthquake Technology) proclaims "Earthquakes don't kill people, bad buildings do." This idea, that nature lets loose extreme events which create disasters only because humans do nothing about it, is frequently documented and says that long-term decisions, policies, and actions are needed to prevent disasters (for example, see Lewis, 1999; Mileti et al., 1999; and Wisner et al., 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 benefits may not be realized for decades or more. Although it is an investment which will reap rewards later and which will look cheap after collapses occur in an earthquake, if there cannot be an obvious payback before the next election, politicians can be sceptical and unsupportive.

Circumventing the obstacles in British Columbia

The founding of Families for School Seismic Safety (FSSS)

FSSS (http://www.fsssbc.org) was founded in June 2003 in Vancouver to tackle the problem of school seismic safety in British Columbia. Previously, the issue of the poor seismic safety of British Columbia's schools had surfaced a few times. Various parent groups from individual schools at risk, and even a brilliant student-led seismic advocacy effort called The Van Tech Lizards had helped to bring the issue into the public consciousness. FSSS was able to build on these efforts.

FSSS began by gathering parents and students concerned about the issue and creating a website and e-mail list to inform the public and gather support for advocacy efforts. We formed an alliance with the scientific, engineering and seismologist communities and wrote a lobbying document which laid out the risks and the solutions. With the facts laid out and the scientific community at our side, we set about meeting with politicians and public officials at all levels to ask for a standardized assessment of the problem and a fixed timeline of 10-15 years to seeing it addressed. We had public letter writing campaigns organized through our e-mail list and school parent advisory groups and we organized media events in order to bring pressure to see the issue addressed.

In November 2004, British Columbia's Premier Gordon Campbell made a US$1.3 billion commitment to seeing all schools brought up to acceptable life safety standards by 2019. It continues to require public vigilance and pressure to ensure that this commitment is met. Parents continue to be astonished that we have to keep asking the government for this work to be done while other hazard mitigation efforts such as upgrading the legislature and prisons and other public infrastructure carry on quietly without the need for public pressure to ensure they are carried out.

Political discouragement

Most countries include schools on their critical infrastructure list. Canada is one of the few countries which does not. While national historical monuments make Canada's critical infrastructure list, schools do not. Other countries have understood the critical infrastructure role of school buildings for a multiplicity of reasons, including their post disaster function, the importance of maintaining educational capacity, and most importantly the value of the staff and students in the buildings. The omission of schools on Canada's critical infrastructure list suggests that the "contents" of school buildings are somehow not important and that the role of schools is not essential to the functioning of Canada's communities.

With the locus of responsibility placed within an already cash-strapped education sector, the funding for this infrastructure work was perceived. to compete with the basic educational needs for children. FSSS repeatedly made the point that the basic human rights of children to education and physical safety should not compete for the same funds.

With regards to earthquake risk, British Columbia has a generally high awareness. The City of Vancouver has seismically upgraded water supply systems and bridges while the provincial electric utility, B.C. Hydro, is systematically upgrading its buildings and infrastructure. The provincial prisons were seismically upgraded and even a provincially run liquor outlet was upgraded. Schools were not seen as a high priority.

In contrast, 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 Kathmandu Valley in order 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 government buildings or temples, the answer tended to be “no”. When asked if they would spend their own funds to prevent collapse of the community school, the answer was an overwhelming “yes”.

At the outset of FSSS’ efforts to improve school earthquake safety in British Columbia, political insiders suggested that no one would see fixing up a “bunch of tired old school buildings” as being “politically sexy”. In a global political policy environment that is perhaps over-driven by political sex appeal, sound bites, and instant gratification, it is key to engage the community in a manner that educates the population to understand the problem and then to demand solutions. A popular demand creates the short-term political gain that politicians desire in countries such as Canada.

Governments sometimes score big political points in responding to disasters once they occur (see “disaster diplomacy” work at http://www.disasterdiplomacy.org) especially when it is used as an opportunity to ride in like a “white knight”. Huge amounts of money are often spent deploying rescue teams and providing emergency aid when much less cash could have been spent far more productively and effectively in preventing the disaster and saving the lives in the first place.

Creating a “white knight” opportunity for government in disaster prevention requires the public to understand the issue and to demand that the government spend the necessary funds—such as by recognising it as an “investment”, not an “expenditure”. This feeling was captured by a popular radio host and political columnist in British Columbia who, after British Columbia’s government had committed funds to school seismic safety, proclaimed that he “couldn’t think of a better way for the government to spend our money”.

Obstacles met and overcome

The main obstacles to seismic mitigation of schools in British Columbia were:

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

In much of the world, including Canada, 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 (Wisner et al., 2007).

There have been some notable exceptions such as California, Utah, and New Zealand where many schools have been extensively retrofitted and replaced. Just across the Canada-USA border from Vancouver, Seattle will have completed upgrading or replacing its at-risk schools by 2010.

Public education in British Columbia, as in many so-called “affluent democracies”, has faced increasing cutbacks. Although funding for the buildings is a separate capital budget, the education budget is seen as a single pie. In British Columbia, 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, such as teachers salaries, textbooks, and lab or music equipment. Essentially, parents and educators had been left feeling that they had to choose either between educating their children or keeping them safe while they were being educated. Two basic human rights of children were left to duel it out within the same budget.

Other types of Canada’s infrastructure have not had to face inherent competition of two such basic human rights, which is why other buildings, including some liquor stores have been upgraded in British Columbia, as noted above. As well, the management of school. buildings was separated out from the management of most other government facilities and placed within the Ministry of Education. As a similar example, in the wake of Taiwan’s 1999 earthquake, which disproportionately damaged schools, it was noted that these buildings had been managed differently than other government infrastructure which meant, for example, less oversight. Taiwan has taken steps to remedy this due to the earthquake disaster.

In Canada, education is under provincial jurisdictional, however there are precedents for joint federal-provincial disaster reduction initiatives as part of the national disaster mitigation strategy. A prominent example is Manitoba’s Red River floodway which was one factor in averting the flooding of Winnipeg during the 1997 flood disaster.

A central tenet of FSSS was the notion that school building safety was not an educational issue, but rather a safety and infrastructure issue. Therefore, the two must not compete for the same funds. With the precedents in federal-provincial disaster reduction initiatives, FSSS pursued federal funding, in addition to provincial funding, for school seismic safety.

In October 2004, in response to the joint submission to government by FSSS and the Association of Professional Engineers and Geoscientists in British Columbia (APEG BC), British Columbia’s government completed an assessment of the 800 schools within British Columbia’s zone of high 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 initial estimate, to address all structural and non-structural safety issues in British Columbia's 800 schools within the zone of risk, was US$1.3 billion. Two days before the assessment results were made public, the Premier committed that money from provincial funds to ensure that all of British Columbia's schools were brought up to acceptable seismic life safety standards within 15 years.

The price tag in British Columbia comes in around 2% of the province's spending on education. This is in line with the theoretical estimate of cost for European countries, given by Spence (2004) of 2% of GDP spending on education to address school building seismic safety.

British Columbia's school building annual capital budget has ranged historically between US$125 and US$585 million per year. Current spending levels have been around US$180-225 million per year. The seismic commitment adds another US$90 million per year for 15 years. The combined total is well within the traditional range of spending on school infrastructure, meaning that the cost of safety does not exceed previous expenditures on the capital budget for schools and is within normal parameters of basic infrastructure maintenance.

Lessons in surmounting the obstacles

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

1. an alliance between community members and local scientists and engineers in developing and disseminating factual and compelling information outlining the problem;
2. a public health approach to the problem;
3. a lobbying campaign consisting of meetings with politicians and public officials at all levels of government; and
4. A publicity and media campaigns which created public support and focussed the politicians' attention, creating a "white knight" opportunity for politicians.

Alliance with local scientists and engineers

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 FSSS. Carlos Ventura, Director of the University of British Columbia's earthquake engineering research facility in Vancouver, was a local leader in helping to educate the public. Andy Mill, Head of the Seismic Task Force of APEG BC also took a lead role as an expert who explained engineering concepts in simple terms for the media. Local seismologists such as Garry Rogers, John Clague, and Michael Bostock did an excellent job of informing the public of the nature of the seismic risk in British Columbia. While academic publications exist (for example, Clague, 2002 and Rogers, 1996), these experts helped to ensure that the content of these materials was made accessible to most members of the public.

The seismology message of earthquake risk has been better understood by the population than the engineering message of the needed solutions. Preparedness, such as having water ready, large appliances tied down, and an emergency plan for each family, tended to be well understood, but the message which had not been grasped by the public was the fact that earthquakes don't kill people, bad buildings do. A particular surprise to parents was that schools in British Columbia were built using some of the most vulnerable materials and designs. In many neighbourhoods, the school would be the most dangerous building to be in during an earthquake.

Architectural history has seen many British Columbian 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 additions over the years often made without due consideration for principles of seismic resistant design. For FSSS, local scientific and engineering support in documenting, explaining, and highlighting such issues was critical to ensuring the technical credibility needed to convince many people.

A Public Health Approach to Seismic Mitigation

Creating safer buildings, especially with respect to disasters, 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 along with retrofitting of older buildings. The seismic mitigation of schools can be seen in some ways as a childhood injury prevention program

In public health, interventions are sometimes assessed in terms of cost per year of life saved, or "disability adjusted" or "quality adjusted" life year saved. For school-aged populations in a British Columbia earthquake, the average age at death or injury would be 12, meaning that, based on Canada's life expectancy statistics, each child death would represent 63 years of life lost. Each brain or spinal cord injury would represent 63 years of expensive medical care which is a cost incurred by every Canadian.

Some medical interventions cost tens or even hundreds of thousands of dollars in order to prolong the life of someone who is expected to die soon. Society has deemed that level of expenditure to be acceptable and expected. Such willingness to spend that money from society's coffers reflects the impressive importance which is placed on life and quality of life.

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, understandably, focus on the buildings and often to make cost-benefit analyses purely in infrastructure terms. The economic impacts of the human consequences of earthquakes have seldom been quantified, with examples of exceptions being Noji (1992), Porter et al. (2006), and Wisner et al. (2007). The cost-benefit analyses actually become more compelling when human impacts are taken into account.

Petal (2004) assessed the relative contribution of structural and non-structural failures to death and injury in the Kocaeli earthquake of 1999 in Turkey. She found that 87% of severe injuries were caused by failures of structural elements and 68% of light injuries were caused by non-structural elements. Infill walls were the most common non-structural element to cause death or injury, accounting for 14% of combined deaths and injuries. Ceiling components and standing cabinets each accounted for 10% of non-structural combined deaths and injuries. 100% of the severe injuries occurred in buildings with heavy damage or which had collapsed.

A fully integrated assessment of the impacts on humans of partial or complete structural and non-structural failures of buildings, would take into account the costs of short- and long-term disability and medical costs for injured survivors. Work absence has easily quantifiable costs for both insurers and employers. Serious injury is often far more costly to society in pure economic terms than death.

Reviewing historical data, including triage category at time of injury, is a potential element of attempts to build more accurate casualty models. It would also be important to differentiate between the subsets of serious injury like chest wounds, from which the patient may either die rapidly or else recover with a good chance of leading their life similarly to before the injury, versus brain and spinal cord injuries, which will likely have huge and lasting impacts and expenses on both the individual and society. In any such calculation, younger people have more expected years of life and so their deaths and injuries will be a greater cost.

At some level, the calculations carried out in this manner seem to help engineers and emergency planners realize that they are not being "sentimental" by making the lives of children a priority, but are acting on principals that are somehow "objectively validated" by equations. Adopting a public health approach to the problem that factors in human consequences, not just infrastructure impacts, enables decision makers to return to basic social principles which are frequently forgotten in today's political climate:

- Children are at the top of the public safety agenda.
- The two basic human rights of children to education and to safety must not compete for the same funds.

At the end of the day, we do not need equations or calculations of cost effectiveness to tell us what our guts already know and what evolution has wired us to feel: there is no greater treasure to a society than its children.

Lobbying

One of the first steps taken by FSSS in British Columbia was to compile a lobbying document. We laid out the information in a compelling manner that explained the problem in simple terms that would be clear to politicians and the public. We made condemning comparisons to other locations which were far ahead of British Columbia in carrying out this work such as California, New Zealand and our neighbouring city across the border with the USA, Seattle. We made charts to demonstrate how far behind Seattle we were. We also pointed out that prisons had been upgraded while schools had not.

Our lobbying document laid out the case for potential cost-effectiveness in building management terms, in public health terms, and in legal terms. For the latter, the possible legal costs if liability were found in the case of a brain-injured child would be US$4-9 million.

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. Both tasks were logistically and financially doable.

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.

Publicity and Media campaign

When governments did not appear to be responding to quiet lobbying, 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, concerned parents were sometimes accompanied at news conferences by scientists and engineers.

The assistance of the scientific community was essential in creating accurate, objectively presented, and verifiable scientific information. Our approach was always rational simple, and scientific. Our message was never aimed at fear mongering or hyperbole. The message 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.

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 the government's skewed priorities. The play was attended by politicians and media. High school students also painted banners depicting powerful images around disaster risk. These were displayed at the world conference of earthquake engineering and at the City Central Public Library.

The culmination of an 18 month media and information campaign 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's (Organisation for Economic Co-operation and Development) recommendations on school seismic safety (OECD, 2004). Six international experts explained the often disproportionate risk faced by school children around the world: Carlos Ventura (University of British Columbia, Canada), Wilfred Iwan (California Institute of Technology, USA), Brian Tucker (GeoHazards International), Robin Spence (University of Cambridge, UK), Mauro Dolce (Università degli Studi di Basilicata, Italy) and Andy Mill (APEG BC, Canada). The press conference resulted in extensive and prominent print, web, radio, and television coverage.

The media—including FSSS' frequent media events, press releases, and letters to the editor—can serve as an even more direct pipeline to the ear of government than lobbying. Media coverage must accompany lobbying to reinforce the message and to maintain momentum. Providing material online and using the internet to create an alliance of concerned parents and professionals ensured a focal point for lobbying and media efforts and provided a coherent message.

Each media mention 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 British Columbia as a result. 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.

Successful safety advocacy

Olshansky (2004) has made the following observations about successful seismic safety advocacy which have been borne out by the experience in British Columbia:

- "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."

APEG BC was very supportive in gaining the attention of decision makers. Professional organizations and scientists are essential in adding credibility to the message delivered both to the public and to government. Ultimately, it is an informed voting public who will influence government.

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

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

The engineering credo highlights the protection of public safety. Engineers sometimes fear that they appear self-interested if they speak publicly about the need for seismic mitigation, yet no one thinks that doctors and public health officials act out of self-interest when they state publicly that children need vaccinating, that drinking water must be clean, and that measures must be taken to prevent influenza pandemics. Engineers and scientists are simply another group of experts laying out risks and risk reduction.

The message of risk is ineffective in bringing about change if it is delivered in isolation. Instead, it must be tied to a message of hope, that there is a solution. Simply informing the public that there is going to be an earthquake and that buildings might collapse is not enough. The public needs to understand that it can do more than just fasten bookcases and make an emergency kit; everyone can and should do more than just be prepared for a disaster to happen. The public can press government to prevent the disaster, such as by making schools safe.

At the time of writing, it has been three years since the British Columbian Premier's US$1.3 billion 15-year commitment was made. Despite this impressive action, there is much work left to be done in holding the government accountable to its promise. The advocacy of engineers, scientists, parents, and all other community members will be required to see the work completed. Issuing an annual report card on the state of progress of this work is one example of an advocacy tool that could play a significant and positive role in ensuring that political good intentions become a long-term reality.

Internationally, in 2006, the United Nations launched a campaign to make schools the global primary focus of efforts to reduce disaster impacts. United Nations Secretary General Kofi Annan (2006) noted:

> Children are especially vulnerable to the threats posed by natural hazards. At the same time, they can be powerful agents of change, provided they are well armed with knowledge about how to prepare in advance, how to act on warnings and how to reduce risk at home and in their communities. It is essential, therefore, to make disaster-risk education a component of national school curricula, and to ensure that children understand how natural hazards interact with the environment.

Activating populations to mitigate risk can be greatly assisted by focusing on 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 often become ready to embrace broader mitigation measures.

We all have a choice between fatalism and activism. We all can inform decision-makers about risks and solutions and take an active advocacy role to ensure that the information is heeded. That creates what the United Nations seeks for disasters: A culture of prevention (UNISDR, 2005).

Conclusions

In summary, school children around the world often face disproportionate risk from seismic hazard while at school. Complacency about seismic risk is misplaced, especially in Canada and the USA where references to low death tolls in earthquakes omit the repeated catastrophic performance of school buildings. A review of the historical record provides a sobering lesson in how lucky these two countries have been in that earthquake-induced school collapses have not yet happened during school hours when staff and students were in the building.

A panel was convened by the OECD and GeoHazards International in February 2004 in Paris in order to review the problem of and to identify solutions for school seismic safety. Based on the observation that schools worldwide routinely collapse during earthquakes, they made the following powerful statement (OECD, 2004):

> 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.

In engineering, as in public health, there is much work left to be done in educating the population about risks and risk reduction. Hopefully, the case study of British Columbia and the work of Families for School Seismic Safety can be an example of the broader benefits which flow from taking a multidisciplinary approach to the issue.

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