## Seismic Upgrade Of Kitsilano High School: A case of incorrect risk assessment?

## Context

The three story 83 year old main building of Kitsilano High School has been assessed in terms of its structural integrity to withstand a sizeable earthquake and has been found wanting. It has been deemed too expensive to seismically upgrade the existing building so that the current solution is to tear down the old structure and build a completely new one that is compatible with modern seismic standards. The document below while not disputing the engineering assessment of Kitsilano's structural integrity, asks if in the light of the time horizon of a structural damaging earthquake does it make sense to upgrade or replace the building? In the time period we are looking at, it is quite probable that the old building will meet its end due to reasons other than an earthquake.

## Part I: Intial Assessment of the Problem

The decision to proceed with seismic upgrades to existing buildings in Vancouver is a result of incorrect risk assessment. There is a continual comparison to earthquake events in California. Every time we hear of a Californian earthquake there is the newspaper headline "Californian Earthquake; Wakeup Call for BC". However the seismic situation in BC is completely different from that in California. It would make just as much sense for the headline to read "Haitian Earthquake; Wakeup Call for BC", but we never see this because the headline is ridiculous. The same can be said for the Californian headline. The province for the Californian earthquake zone lies about 200 miles off the western shore of Vancouver Island. The earthquake hazard for Vancouver is at least an order of magnitude lower than it is for California.

In the popular press the main fear for earthquakes in Vancouver is a megathrust event much like the Alaskan earthquake of 1964, the Sumatran earthquake of 2004, and the Chilean earthquake of 2010. Technically the greatest hazard is from the smaller closer inland earthquakes. However the hazard, because these quakes are smaller is more local, and the probability for one of these quakes to cause damage to a particular building is quite small. Thus you must assess what are the chances that significant damage will occur in the particular area in which a building is erected over the life span of that building. This is hard to do. We know a megathrust event is likely to cause damage. Thus the time interval between megathrust events can be used as a rough guide for the time interval expected for damage to any one building in Vancouver. In the Pacific Northwest megathrust events come about once every 600 years, and the last occurred January 26, 1700. We know the date because the tsunami from the event was recorded in the written annals of Japan.

The year 1700 was a long time ago, 310 to be exact. The governor of New France was Louis-Hector de Callière who had succeeded Frontenac 2 years previously. The fall of New France to the British was 59 years away. The founding of Vancouver would have to wait another 127 years after that. How many buildings standing anywhere in the world in

1700 still stand today? This is only a 300 year interval. We are looking for a 600 year interval. How many buildings standing in 1400 are still standing today? How many sovereign states in 1400 are still intact today? How much of the local infrastructure that existed in 1400 still exists today? Only the Catholic Church comes to mind. So when you are constructing a building in Vancouver to withstand an earthquake you are actually building for the ages.

So what are the chances that Kitsilano gets hit by a significant earthquake before another event occurs? For example the eligible school population drops below a critical level and the VSB decides to consolidate the high school population in the west end into one super school based at Prince of Wales. Kitsilano is torn down for real estate development. PW is torn down in order to enlarge it. Neither tear downs has anything to do with earthquakes. I consider this scenario much more likely than an earthquake.

Here is another. There is global warming. The ice caps are melting. This is a known fact despite what George Bush, Stephen Harper, or Donald Trump may say. In the time span we are looking at, 300 to 600 years, Vancouver could face significant flooding and be abandoned. The probability of this event is likely higher than Kitsilano being hit with a significant earthquake. We seem to be fixated on earthquake danger. Nobody seems worried about global warming, climate change, and population crisis which probably will play a more significant role in Kitsilano's future than an earthquake.

In 300 years a lot can happen which has nothing to do with earthquakes. It takes awhile for this to sink in.

Thus I do not think demolishing any building in Vancouver for the sole purpose of seismic upgrading makes any sense. It is a nice financial plumb for the construction industry and they get kudos for doing it. If a building is brand new or has to be replaced for other reasons, by all means, build it to modern seismic standards. If the only reason why a building is coming down is to replace it with one that meets current seismic standards, the upgrade is a waste of money. Vancouver is not a California.

Attached in figure 1 is a <u>map</u> of earthquakes 1627 to 2007. The megathrust event of 1700 is plotted. Note in and around Vancouver the dot concentration is somewhat abated. There are more dots in Quebec city and Montreal.

## Part II: Is the Kitsilano Seismic Upgrade really a guise for a school modernization program?

I visited the open house on the Kits renovation yesterday<sup>1</sup>. As expected my points regarding the time horizon of a destructive earthquake event were brushed aside as not being relevant. The decision to upgrade public schools to withstand seismic shocks had been made some years ago, and the mandate to the committee in charge of the renovation is to carry it out. I rather suspect that the earthquake hazard is a stand-in argument used to get the government and taxpayer to buy into a school modernization program. The actual

<sup>&</sup>lt;sup>1</sup> March 3, 2010

earthquake hazard is probably not a prime motivation factor to the proponents of this program.

As with most government programs, the prime movers are special interests who have something to gain by a school moderization program. The building trades and construction industry are for it, School boards and teachers are for it, and even the students and parents of students are for it. I must admit that even I am for it. However there is the question of how to sell it to the government and the general taxpayer. Earthquakes! This is a perceived hazard in BC. California is close enough to scare us, there are frequent big offshore earthquakes and some little ones close by, we can find engineers who will testify that buildings like Kits will indeed fall down if hit by an earthquake, and all geologists, if asked, will say that earthquakes do happen in Vancouver. This is a nice package that most if not all legislators will buy. Inconvenient facts like the time horizon for destructive events get ignored because it does not support the program.

I am not saying that the promoters of a school modernization program are deliberately deceiving our legislative and decision making bodies. The promoters probably believe in the perceived earthquake threat just as much as do the decision makers. Earthquakes are just a convenient fact on which to hang a school modernization program. The time horizon for destructive events is too hard a concept to fathom, difficult to assess quantitatively, and besides does not promote the cause. So it is forgotten or perhaps never even thought about.

The same school modernization program could even have been promoted in Saskatoon. Their buildings will fall down too, if hit by an earthquake. However there is a difference. There is no perceived earthquake threat there because the time horizon for a destructive event is in excess of a million years. A seismic upgrade program would be laughed off as being ridiculous. In Saskatoon a school modernization program will have to be sold as a school modernization program. In Vancouver the time horizon is just small enough to see earthquakes as a perceived threat, but large enough that the threat is small. The threat is small enough that in the time horizon being considered, 300 years, it is most probable that schools like Kits will suffer the slings and arrows of outrageous fortune that have nothing to do with earthquakes.

I think people have a hard time to perceive of a time horizon of longer than 10 to 20 years. In 1960, I thought 1972 was far enough away that I did not have to worry about it. Indeed in terms of what I was like in 1960, it made little sense to worry about what would happen by 1972. What did happen by 1972, and there was lots of it, could never have been predicted in 1960. Thus an earthquake threat that could be 300 years in the future is perceived as being apparently an order of magnitude closer like 30 years. That is indeed a threat.

However in order to appreciate 300 years, I have to regard history and what the world was like 300 years ago, and what has happened since. By doing this you realize that a lot can happen in 300 years that have nothing to do with earthquakes and cannot be

predicted. For example, the time horizon for world climate change and population crises, come home to roost in about 100 years. Does it make sense then to seismically upgrade a building to prepare for a 300 year event?

My canonical 300 years is just a guess. It is based on the crudely measured frequency of megathrust earthquake events in the Pacific Northwest. However my scientific intuition tells me that it is a reasonable guess. Since Vancouver visited Burrard Inlet in 1792, 92 years after the previous megathrust event, I do not believe there has been an earthquake in Vancouver that would have knocked down Kitsilano High School if it had existed from that time. Indeed I have doubts whether the megathrust event of 1700 would have knocked it down. The epi-centre of that event was too far away. In view of this and in the absence of any other time horizon prediction, I would say that the raison d'etre of the whole school seismic upgrade program is based on an incorrect risk analysis.

At the open house, we met a Kitsilano teacher who was instrumental in teaching our sons. She was excited about the Kits renovation. She was going to have a new school, with new infrastructure like modernized electrical wiring with lots of plugs for computers. I asked her about the earthquake hazard, and she acknowledged that it was convenient to have that in order to justify the renovation. I asked if it would not be better to spend the renovation money directly on current education seeing that the current budget cuts were going to lay off a slew of teachers, the consequences of which had not yet sunk in. She replied that that was not a reasonable question. The money was there for the seismic upgrade. If it could be refused ("Committee Turns Down Kitsilano Seismic Upgrade Funds" does not a good headline make), the money would not be plowed back into education and particularly not into Kitsilano High School. I think that about sums up the situation.

I did leave my written composition regarding the incorrect risk analysis with the committee. I doubt that anything will come of it. They are not in a position to act upon it, nor will they have the motivational incentive to pass it up to those who could act and who might be interested.

In conclusion, I will add a disclaimer, like all good scientists, that my analysis here does not rule out the very very small probability that Kitsilano could be hit by an earthquake tomorrow and fall down.

Patrick L. Walden B.Sc. (UBC, 1966), Ph.D. (Caltech, 1972) Nuclear Physicist March 5, 2010



Figure 1 Earthquake map of Canada. Note the dot density near Vancouver. It is on the edge of a high density dot environment, not in it. The cities of Quebec and Montreal are more highly covered with dots.