Geotechnique and Natural Hazards

Interdisciplinary Panel Discussion

May 9, 1992

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FIRST CANADIAN SYMPOSIUM ON GEOTECHNIQUE AND NATURAL HAZARDS

TRANSCRIBED TAPES
OF

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SUMMARY OF CONTRIBUTORS TO PANEL DISCUSSION

PREFACE

GeoHazards '92, held in Vancouver between May 6 and 9, 1992, was conceived as a contribution from the Canadian geotechnical community to the United Nations' International Decade for Natural Disaster Reduction. Keynote presentations on social as well as scientific and engineering aspects of geohazards attracted approximately 300 delegates. The proceedings volume (Geotechnique and Natural Hazards, 1992a) catalogues the spectrum of geohazards in Canada and is a compendium of slowly evolving Canadian hazard reduction and risk management guidelines and policies. The technical program included a mandatory one-day field trip for which delegates chose from amongst three alternatives. Collectively, the tours illustrate the diversity of geohazard exposure to the burgeoning population of Greater Vancouver and the challenges facing those involved with geohazards locally. The technical tours guidebook (Geotechnique and Natural Hazards, 1992b), which includes all tours, is an important record of this diversity.

The final component of the technical program was a panel discussion followed by an open exchange between delegates and the panel held on Saturday, May 9, 1992. The session was chaired by Dr. Norbert Morgenstern, University Professor (Civil Engineering) at the University of Alberta, a widely known and respected consultant in geohazards, and the current President of the International Society for Soil Mechanics and Foundation Engineering. The panel included distinguished representatives of the consulting, government, insurance, legal and planning sectors, all with extensive experience in geohazards. The purpose of the session was to establish a focus for continued involvement by the Canadian geotechnical community in the International Decade through reflection on the preceding three days. The session was taped and members of the Organizing Committee acted on Dr. Morgenstern's request to prepare some form of permanent record.

This volume is compiled from the taped transcript. Each contributor was supplied with a complete hard copy and asked to edit their contribution. The guideline I provided as editor was that the substance of the remarks and the tone in which they were delivered should not be altered. All contributors, with one exception, responded.

The document provides an unusually frank record upon which the Canadian geotechnical community can establish its priorities for hazard mitigation - in the spirit of the United Nations' International Decade initiative - into the next century. Many of the recommendations here must be addressed by the scientists and engineers at the cutting edge of geohazard inquiry; but also embodied in the transcript are cogent warnings regarding the concomitant need to circumvent divergence in the technical and societal approaches to hazard mitigation by improving professional standards of practice and encouraging greater interdisciplinary communication and cooperation.

K.Wayne Savigny, Editor
Vancouver, B.C.
June 1993

Dr. Norbert Morgenstern, Chairman - Opening Remarks

Ladies and Gentlemen: I am Norbert Morgenstern from the University of Alberta and I am the Chairman of the panel discussion this morning. To join us in this panel discussion we are very pleased to have five distinguished representatives of different professions with different perspectives on the issue of Hazard Mitigation, Risk Sharing and related matters. By way of brief introduction, on my immediate left is Glen Urquhart, Senior Partner in the firm of Singleton Urquhart McDonald, well known to some of us in the construction industry. Glen is an old friend and sometimes adversary to many of us, with many years of experience in construction-related litigation and contract issues. He has expert credibility in the engineering community by being originally a graduate in mechanical engineering from the University of Manitoba.

On his immediate left is Dr. Anselm Smolka from Munich, Germany. He is a Senior Geophysicist with the Geoscience Research Group of the Munich Reinsurance Company, one of the largest international insurance organizations dealing with hazard-related insurance.

On his left, Mr. Graham Morgan, a consultant, with many years of experience particularly in western Canada. Graham, I am sure, will not be upset if I advise you that in 1956 he and I were a survey party for Geocon in the outskirts of Toronto. Graham was the rod man and I was the instrument man. He and I often reminisce about those days and remember that we did a very bad job on that occasion.

On his left, is Mr. Erik Karlsen who is currently Director, Development Services Branch, Ministry of Municipal Affairs, Recreation and Culture. We are going to be very pleased to have his perspective on the planning and related issues of land development.

At the end of the table is Dr. Peter Cave who has spoken to us so eloquently earlier in the meeting and who will have the opportunity to add further impressions and views toward the end of the panel discussion.

I have given each of the panelists a general theme to guide their discussions. A capsule of what each person is going to talk about has been printed in the program for you, though they may well deviate from that. The panel presentation is not intended to be structured particularly but intended to provide background to encourage further discussion. This formal part of the panel discussion will continue until the coffee break. We have distributed a sheet of paper to each of you and I believe there are still some at the door. What I would like, if you wish to take part in the discussion after the coffee break, is for you to just indicate so on the sheet of paper. Please provide your name and affiliation and a general idea of your presentation whether it is a question to one of the panelists or a contribution on some sub-theme so that during the coffee break I can, with the assistance of some the panelists, group these. No need to write anything very extensive, just a sense of whether you want to talk about insurance or liability or the planning processes or risk assessment or some of the technical issues - we have quite a wide spectrum. It is better to group them rather to have

them all over the place. We will try and have as many of you as practicable take part in the discussion. I have then been asked to summarize the technical content of our meetings before closing the session. That will occur at 12:30.

That ends the introductory comments and it now gives me great pleasure to call on our first speaker, Glen Urquhart.

Mr. Glen Urquhart

Thank you Dr. Morgenstern and ladies and gentlemen. What I am going to be talking to you about is really the risk that you as professionals encounter with respect to natural hazards. I think you will find the trend in our society today is the attempt to reduce risk or have an aversion to risk to natural hazards over which we as a society may be able to exert some control. The control that we as members of society require of you as professionals is absolute physical safety. You cannot hurt us. We won't let you do it and if you do it there will be sanctions imposed upon you. So if safety is possible you have to exercise your professional techniques and if you fail to do so this may result in civil or criminal (I emphasize the word criminal) liability to you, if you injure or hurt anybody as a consequence of your failure to use your professional expertise and knowledge. Let me give you an example of the statistics today. I have acted over a number of years, in about 5,000 to 6,000 construction cases involving architects, engineers, chartered accountants. The statistics I have from the insurance industry relating to design professionals and architects and engineers, in particular geotechnical people, is that one out of every three of you will be sued during your lifetime career, one out of three. So as you sit there today take a look to the people on each side of you and you know that one of you is going to be in my office or somebody like me. So you are going to be involved with us lawyers whether you like it or not. That's a fact of life.

But my purpose here this morning is to alert you to some of the risks that you as professionals are now facing today, that you are facing in the area of natural hazards. One of the factors which has definitely increased your risk of being sued is the fact that you have attended the symposium. You are now knowledgeable. You now know that you can do things about natural hazards. You can't say anymore - I don't know, that's not the state-of-the-art. You do know! The first symposium that you've had has now elevated that knowledge up to a much higher level than it was before. I will give you another example. Two years ago, we gave a symposium of a similar nature to architects and mechanical engineers involving closed building environments - that you cannot build buildings anymore and re-circulate the air. The example is the Legionnaires Disease. An architect or a mechanical engineer who designs a building and fails to take that into account may now be liable. The government went to every province and gave the seminar. Building environments have now gone from the state-of-the-art into a scientific stage and that is where you are today. Having had this symposium, you professionals are now alerted to the risks and you know that the risks can harm and cause economic loss to the public. Therefore, you have to be extremely careful in performing your professional services not to cause physical

Fourthly, I want to refer to warning systems and preparedness. Design professionals will be required to consider advanced warnings to persons who may be affected physically or economically by natural hazards. Now the example I gave you is the highway to Whistler from Vancouver. Some of you know it. There are numerous notifications of potential hazard of a slide if you have been up there, warning you as you drive along that there is a risk. This is a type of notice you are going to be required to give to the public. You are going to be required to alert the user of problems which may occur.

Another situation which occurred near Whistler was a case where a developer went into an area and decided to develop a site. He did quite a bit of the work in developing a site when the Department of Highways came along and applied to the court for an injunction restraining him for doing any more work because there was an indication up the valley that there could be a potential slide which, if it occurred, would end up down at the new subdivision. The court heard some of the most eminent people in your professions say it was not a serious problem. The court approximately 10 years ago concluded that there was a potential for a failure. The court didn't accept the experts opinion and said there was a potential for failure, issued the injunction and shut down the development. The developer lost a lot of money. The developer didn't turn around and sue the engineers that he had involved in the site but I can tell you today he would. The developer would allege - "I know you couldn't tell me that I'd win or lose my court case but you could have warned me that there is this potential hazard there. That warning would have given me an opportunity to do something very simple: make choices."

That is my message to you people namely that when you are considering projects and sites, you must tell your clients what the risks are so that they can make choices and don't do it orally, do it in writing. Tell them what are the risks of the projects. The owner cannot complain if you have given them all the information related to the project with respect to risks that you are aware of and advise them that it's their choice. If they decide to go ahead, that's their business. But one of the things that is very difficult to defend is the argument that you failed to tell me; because if you told me, I wouldn't have done it. So be very careful and if you see a problem, warn your clients about it. It is very cheap loss prevention. It takes maybe 10 to 15 minutes to write a letter. You may spend three or four thousand hours with me if you fail to do it and you don't get paid for it, not one cent! So give the owner a chance to make choices and don't forget it is his or her piece of property. Shift the risk to the parties best able to bear it and that is the person who owns the property. Why do professionals always want to accept that risk? Somehow, design professionals always grab the project, take all the risks themselves and in many cases try to slide it off to the contractor who in turn tries to give it back to the owner. Just say to the owner: "It's your problem. I am not going to accept that risk. I think I can recognize and tell you about that risk, but you must accept that risk".

Let me give you another example which is the one I referred to earlier and that is the case on the Whistler Highway and it is called Just vs. the Province of British Columbia, which was really the Ministry of Transportation and Highways (MOTH). In Just, the court was faced with the question of liability of MOTH with respect to the services they performed to

stabilize the slopes along the Squamish Highway. The route, Highway 99 to Whistler, is known by most people to be a very dangerous highway. MOTH has established a rock section responsible for rock stabilization inspection. A rock scaling crew was created whose function it was to remove potentially dangerous rocks and other hazardous conditions. In the winter Mr. Just was driving along the highway and stopped because of a snow storm. His car was struck by a large boulder causing serious injuries to him and killing his daughter. Mr. Just brought an action against the Government alleging that MOTH had negligently failed to maintain that highway and protect him. Both the trial judge in the court appeal dismissed Mr. Just's claim, on the basis that the action or inaction with MOTH was not a matter of public policy and therefore they were not negligent. But Mr. Just was undeterred. He appealed to the Supreme Court of Canada. The Supreme Court of Canada in 1991 reversed the trial judge and the Court of Appeal's decision and found that it was reasonably foreseeable, the keyword 'foreseeable', that a car might be struck by a rock on the highway if the slopes along the highway were not reasonably maintained. Thus the Supreme Court found MOTH had a responsibility to prevent rocks from falling down highway slopes onto the highway. So the law is becoming more defined. The law is saying that the public is entitled to look to you as design professionals to protect them from physical injury, harm, and economic loss. So there is a strict obligation on all of you with respect to the performance of your duties.

A recent decision that just came down two weeks ago in the Supreme Court of Canada is called the Norsk case. It involved a tug boat that knocked out a bridge whereby the CNR couldn't get its trains across. CNR didn't own the bridge so how could the tug boat owe any duties to the CNR? The Supreme Court of Canada found that the tug boat company owed a duty to the CNR because it was foreseeable that if they knocked out the bridge which the CNR used, the CNR might suffer a loss.

Now you can translate the above principles into your work. If you see a cliff or a slope that may not be stable, could that affect a person driving a car? Could that affect the community near the slope? Could it result in flooding? You have to be very careful. The issue is 'foreseeability'. Can you foresee down the road that a risk is apparent? If you can, you've got to do something about it. You've got to alert people to foreseeable risks and hazards. The way you can save yourself from claims is to always enter into a contract with the owner and write a limitation clause which excludes liability or limits your liability to the amount of insurance available but that does not exempt you from liability with respect to the third parties.

In summary, what are the principles that you can derive? They are probably these: is the loss, damage or injury caused by the natural hazard, a foreseeable result of the conduct or lack of conduct of you as design professionals. Secondly, can the claimant, the person who is injured, say that the design professionals should have contemplated that the claimant would suffer injury. Can the claimant say that I am a person who this person should have known would suffer losses by their failure to do their job. Thirdly, with respect to government agencies, the question is whether the agency, as one of their duties, was obligated to protect the public. I think it is going to be very difficult for the government not to have that

obligation. For example, if at one of Hydro's dams there is a slide and the people at Hydro knew about it, I would think that the government would be responsible through BC Hydro for that loss, including the engineers. Of course the president of the organization would probably be very cranky with his engineers for being involved in this slide. So government agencies can be responsible.

Now there are factors which ought to mitigate the responsibility or risk of the design professionals. For example, I doubt if anybody can predict whether there is going to be a magnitude 9.0 earthquake here. In fact, if you believe one of the presentations to this symposium, we are never gone to have one. So it all depends on how you look at it. It all depends on how you observe the facts but if it is unpredictable and no reasonable person could have expected that problem to have occurred, you are probably safe. My view to you is this: why take the chance? Alert the people you work for, with, or anybody else who may be injured by a natural hazard. Take that risk and give it back to somebody else. You don't need to accept it yourself. Allow other people to make some choices. You don't have to accept all of the responsibility. Those are my comments. Thank you very much.

Chairman

Thank you Glen for those extremely interesting and challenging introductory comments to our panel discussion. It certainly provides a valuable perspective for the rest of the presentations and discussions to follow. One important element of risk management is insurance. We are very pleased to have Dr. Smolka with us to share his experience and views on how insurance contributes to that issue.

Dr. Anselm Smolka

My talk is the possible role of insurance in risk management. I would like to make two basic remarks at the outset. First is why I will concentrate exclusively on earthquakes. The reason is that in order to play a role in risk management, insurance against a certain hazard must be common, or should be a common practice. This is the case for earthquake in a differing degree from country to country but certainly it is in Canada. It is not the case for landslides which are usually excluded from insurance coverage. You may ask me why during the discussion. The second point is that first and foremost insurance has to manage its own risk in order to be able to play a significant role in risk management. So a good part of my remarks will address exactly that problem, how insurers have to manage their risks, although the solutions found can be easily transferred to other businesses. I am going to address the role of insurance in risk management using the four basic steps of which the risk management process actually consists. They are:

- risk identification
- risk evaluation
- risk control, and finally,
- financing the risk

Here are some examples of risk identification. My company usually produces after large events like the 1985 earthquake in Mexico or the 1980 Mount St. Helen's eruption, publications to draw out the lessons of these catastrophes. There are other publications on the windstorms which affected Europe in spring of 1990, and a severe hail storm which affected Munich in the year 1984 with total losses in the range of about US$2 billion. The Munich Reinsurance Company has prepared a world map of natural hazards suitable for preliminary hazard-exposure assessment. That would be just risk identification.

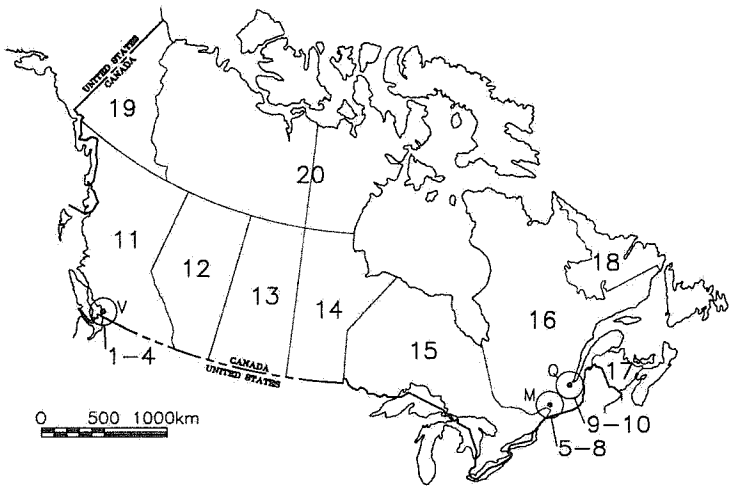
You can go further and try to evaluate the risk. Some years ago, the insurance industry became aware that fire may constitute a significant hazard following an earthquake in Los Angeles or San Francisco. So the insurance industry commissioned a study to look quantitatively into that problem. Ironically the figures which came out of that study were so high that some insurance representatives had difficulty believing them. Then a recent example from Canada. There is, as you are well aware, an earthquake hazard in British Columbia and in the eastern part of the country and to get an idea on the quantitative impact of the earthquakes affecting the Vancouver area, Munich Reinsurance of Canada commissioned a study on the economic impact of an earthquake. The scenario used was a magnitude of 6.5 in the Strait of Georgia quite close to Vancouver. The sample copy of this study, which was just published last week will be on display on the registration desk during coffee break. You may be interested in the results; the total economic losses are in the range of somewhat between Cdn$15-30 billion. That is direct structure, building and contents losses and indirect losses to infrastructure.

TYPE OF ZONE	OBJECT	PURPOSE	APPROACH
exposure zone	hazard (long term)	rating (zone-specific)	probabilistic
accumulation assessment zone	values-at-risk	PML assessment (portfolio)	deterministic ("scenario")
loss accumulation zone	hazard (event-specific)		

FIGURE 1:Re-zoning scheme for earthquake insurance, the Munich Reinsurance Company.

I would like to try to explain some of the specific problems the earthquake insurance industry has in managing its own risk. First, we have to try to calculate a premium which is adequate to the risk and, of course, we have to try to charge that premium - which is not common

place. Second, we have to prepare for catastrophic extreme events like a Cdn$15 billion earthquake affecting Vancouver. In order to do so, Munich Reinsurance introduced the zoning scheme Figure 1. The scheme was first introduced 15 years ago and it is used now in most countries, or almost all countries in the world, if there is any significant earthquake hazard. We have three types of zones. The exposure zone or hazard zone serves mainly the purpose of calculating an adequate rate which reflects the risk. Then the other two zones, the so-called accumulation assessment and the loss accumulation zone address the problem of the probable maximum loss to be expected. In Canada, the insurance market only recently started to use an accumulation assessment scheme. It now controls its earthquake insured liabilities for 20 zones covering all Canada; four in southern British Columbia and the Vancouver area, four in the Montreal area, and two in Quebec (Fig. 2). Companies report their earthquake liabilities to the Insurance Advisory Organization and to the re-insurers on a uniform basis. In the past years, new tools have become available to study the risk involved in earthquakes, not only in earthquake insurance, but the earthquake risk in general. Portfolio analysis program packages are available from some consulting companies, and for specific reinsurance purposes, our company developed its own program (Fig 3). The input data are the hazard and an earthquake catalogue; you calculate the earthquakes, frequency of different earthquake magnitudes, and include any site effects. The second input is the values at risk. These may be insured values or any values at risk in the accumulation assessment zones (Fig. 2). You could also go into more detail and use the three digit postal codes for Canada. Finally, you will need some functions giving you the expected loss percentage per intensity degree and the final result is then a curve which gives you the expected probable loss for each occurrence probability or recurrence period. You get, of course, increasing loss percentages with increasing recurrence periods. The mentioned event in this economic impact study, about a $15 billion event, would have a recurrence period in the order of somewhere between 500 to 1000 years.



ZONE 1	Richmond, Fraser Delta	ZONE 11	British Columbia
ZONE 2	Rest of Greater Vancouver	ZONE 12	Alberta
ZONE 3	Victoria	ZONE 13	Saskatchewan
ZONE 4	Rest of Vancouver Earthquake Zone	ZONE 14	Manitoba
ZONE 5	Montreal	ZONE 15	Ontario
ZONE 6	Greater Montreal	ZONE 16	Quebec
ZONE 7	Surroundings of Montreal	ZONE 17	Maritime Provinces
ZONE 8	Rest of Montreal Earthquake Zone	ZONE 18	Newfoundland
ZONE 9	Quebec City and Epicentral Region	ZONE 19	Yukon Territory
ZONE 10	Rest of Quebec Earthquake zone	ZONE 20	Northwest Territories

FIGURE 2 EARTHQUAKE ACCUMULATION ASSESSEMENT ZONES

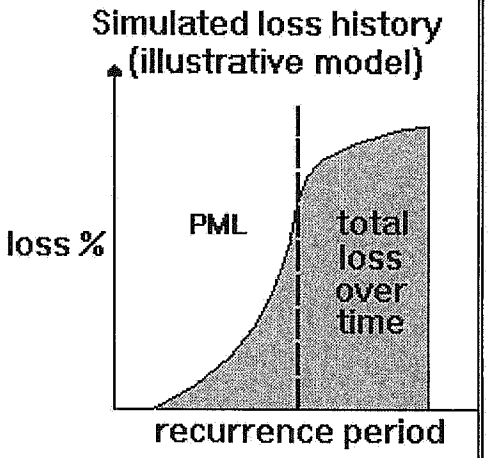
RISK ELEMENT	DESCRIPTION TOOL	RESULT
hazard	hazard curves, microzoning (site effects)	
values at risk	accumulation assessment zones	
vulnerability	loss functions	

FIGURE 3:Portfolio analysis - the new comprehensive approach to earthquake insurance problems, the Munich Reinsurance Company.

Now what role can insurance play in controlling the risk? As I said, the first pre-condition is that insurance is widespread. It has to be common practice, otherwise it cannot, of course, play any role. Possible incentives can be the premium level, deductible level, or co-insurance. A premium level incentive means you will give a reward for the reduction of earthquake risk by charging lower premiums. You can introduce deductibles which means in the case of an earthquake you may a have deductible of 2% of the sum insured, the common practice here in Canada. In the case of a loss, you have to carry this 2% figure yourself and only the amount exceeding is insured. That raises interest in controlling the loss. Co-insurance goes even farther. Co-insurance means that you carry a certain share, 20% or 25% in each and every loss. That raises the interest with the insured to control the loss, to reduce the loss, and to use loss mitigation and loss prevention measures. But this is, I would say, an ideal world I am talking about. You won't find many countries which systematically use such insurance incentives. If you look into existing earthquake tariffs, they hardly implement such useful loss prevention, loss mitigation measures. One effort right now is in the United States in connection with the so-called "Earthquake Project", a project for Federal earthquake insurance legislation. The focus is to make earthquake insurance available on a much broader basis than it is the case as yet, and this insurance legislation actually addresses explicit loss mitigation measures. Thus, loss mitigation measures are an integral part of this project.

I should mention briefly, that in using such measures, you have always to find the right balance, for example the deductible. In California, the usual deductible for the homeowner is 10% of the sum insured. This is a very high amount. If an earthquake affects your house, you have to carry 10% of the sum insured yourself and only the amount exceeding is covered by insurance. As a consequence, not that many people in California take out earthquake insurance . There are even geologists who don't carry earthquake insurance!. The rationale is simple; the probability that an earthquake will cause a loss which is higher than 10% of the value of a wood frame house is relatively low. Of course with the wood frame house there is the fire following problem but fire following is covered in California as in Canada anyway with a normal fire policy as opposed to other countries. So you have to be careful to choose the right level of the deductible. Ironically, just last year or at the beginning of this year, an earthquake insurance program was introduced in California which covers this deductible. This works exactly against the focus of the aforementioned earthquake project.

The fourth and last element is risk financing. If you plan and prepare for financing the extreme loss, there is an interplay between the primary insurance which is kept within the country and the reinsurance which is a worldwide business.

In California, in the case of a repetition of the 1906 San Francisco Earthquake, about 30% or 35% of the loss would be kept within the U.S. insurance market. The remaining 65-70% would go to the international reinsurance market. In third world countries, this percentage is even much higher. In Mexico, 1985, 98% of the insured loss was paid by the international reinsurance community. Only 2% was kept in the country. With Hurricane Gilbert affecting Jamaica in 1988, a similar figure exists.

Now, different countries have found different solutions to the share of the government and the private sector in financing the risk. One example already mentioned is the Earthquake Project in the U.S. That is still in the future and nobody knows if it will become legislation, and, when it does, then it is still three years ahead or so. It is a strongly political issue of course. Japan has a solution in that the government feels responsible for the residential sector. Residential earthquake insurance is actually reinsured with a government-owned Japanese reinsurance corporation whereas the commercial and industrial sectors are insured with private insurance companies. New Zealand has a scheme, the so-called Earthquake and War Damage Insurance scheme, in which insurance is given by the government-owned earthquake commission up to the actual cash value of the building, the so-called indemnity value. The amount exceeding is then handled by the private insurance market. Now there is a change going on in this scheme because the New Zealand government has become aware that the risk it carries is simply too high and, like the solution found in Japan, the Earthquake Commission will bow out of commercial insurance. They plan within a three year period to shift exclusively to the residential sector, leaving the total commercial sector to the private insurance market.

I can mention one example that may be of interest to Canada. It is France. France has a scheme of insurance that is mandatory. It is also set by the government and it insures all sorts of natural hazards including landslides.

Now I have come to the end of my talk. I was asked to give some recommendations for Canadian practice. I suggest the following five points.

The first point is to promote awareness of the catastrophic nature of earthquakes and other natural hazards even also in low risk, rather, call it low hazard areas. What I refer to is the east of Canada. My feeling is that the on-going discussion on a possible megathrust earthquake affecting British Columbia has somewhat detracted attention from the fact that there is a significant earthquake hazard in the eastern part of the country and the values at risk are much higher by a factor of 4 or 5 than in the Vancouver area, so this is a real significant problem.

The second point would be the outcome of this economic impact study. We don't know very much about the loss potential due to fire following an earthquake. So I think a study similar to that one done for Los Angeles and San Francisco would be quite appropriate for large Canadian cities, just considering the construction style and density of construction in these cities.

The third point is that the insurance community should introduce an efficient accumulation control. This process started two years ago but the progress is quite slow. What it means in practice is that before that process was started, the insurance companies here did not know what their liability in the case of a large earthquake, including maybe a fire following, would be. Now by means of such an accumulation control they are in a position to say that. That is a precondition, of course, for taking any risk management decisions and buying the necessary catastrophe protection with the reinsurance market.

The fourth step is to introduce insurance conditions which reflect the actual risk level and foster the application of loss control measures. One point is the premium which reflects the actual risk level. I have already mentioned that this is not a commonplace. The practice here in Canada is, you have to pay to my knowledge, 6¢ per $100 to insure your house, your private house, against earthquake damage. In the commercial sector, if you are a business owner, you get earthquake insurance basically free of charge and you may ask me about the reasons during the discussion.

The fifth and last point is to prepare for financing the extreme event. I think in view of the loss potential arising from a large earthquake affecting British Columbia or eastern Canada, you have to think about solutions like the Earthquake Project and insurance legislation which is going on now in the United States. Thank you.

Chairman

Thank you very much Dr. Smolka. It is extremely important that we get an overview at this meeting of the role of insurance in these matters and we are very grateful to you for providing it and I am sure that it will generate in its wake much interesting discussion and questions.

The government land planning process in many aspects is an essential part of hazard mitigation and we are grateful to Mr. Erik Karlsen, that he is able to join us this morning and share his views and experience on these matters.

Mr. Erik Karlsen

Managing the use and development of land in relation to geotechnical hazards is a complex problem for which we do not yet have a fully developed set of approaches. This presentation will deal with some aspects of public policy in this field that might be overlooked by those who deal with this primarily from scientific or technical perspectives.

Yesterday Dr. Peter Cave spoke about the Municipal Act legislation which is used as a basis for regulating the use and development of land in British Columbia. Work on this began in the early eighties, leading to legislation in the mid-eighties.

We have benefited from the work of persons like Dr. Cave, Mr. Graham Morgan and Mr. Bob Gerath who have developed a systematic response to the application of scientific and technical expertise to land-use planning and development control. Yet, if we are to meet all of the challenges leading to the avoidance of developments where geological hazards pose a risk, there will need to be better and broader public understanding of these risks and a more comprehensive approach.

I will illustrate my point with a couple of examples and then use some children's building blocks to show that what might be considered common sense to experts in this field and to young children is not generally understood or acted upon by most of the public, and this has implications for public policy.

In the early 1970's I was working in the East Kootenays and involved in discussions with the Municipality of Sparwood about expanding the town site south, across the highway onto the lower, gentle slopes of Balmer Ridge. Sparwood's planning and engineering consultants had planned the land uses and the roads and parcels were all nicely laid out on the map. The project was approved. After the meeting someone asked whether or not the subsidence faults on top of the ridge should be looked at. Several of us went up the ridge and indeed table-high subsidence had occurred on fault lines. The bedding planes indicated that if this resulted in a landslide the proposed town site expansion would be at risk. A geotechnical study confirmed this and the plans were scrapped. Sparwood expanded to the north.

One might have thought that common sense would have suggested that in a slide prone region, with collapsing mining tunnels underneath the ridge, that putting a town site at the bottom of the ridge did not make much sense.

Another example, also in the Kootenays, occurred in the Columbia-Windermere Lakes area which is comprised of glaciolacustrine silt deposits. Everyone in this room knows what happens when water is added to these silts. Everyone also knows that when you develop land, water is added by waste disposal to ground and landscape watering. Drainage is focused through road construction and hard surfacing. High density development near cliff edges certainly does not make a lot of sense under these conditions, yet this was proposed. Even today proposals still come forward in this and other regions to develop near the edge of glaciolacustrine cliffs.

Yet another example is streamside development on alluvial fans. These areas are attractive to development. They occur in mountainous regions and are usually the only gently sloping well drained areas "suitable" for settlement. They are also the most geologically active, with potentially devastating results.

As young children we learned that in order to build a small pyramid out of building blocks we had to lay down a foundation on a stable surface and then build up from there. I recently saw a television program on artificial intelligence. The computer programmers failed in their first attempts to build a pyramid from children's play blocks by forgetting that you have to start at the bottom. Picture this: a robotic arm picks up blocks one at a time, moves them over to where the structure is to be built and drops each block from a height of two feet. The result is a nice jumbled pile of blocks. Any two or three year old will see the folly of this and yet somehow this sense of structural stability is lost to many of us over time.

So when we look at the settlement patterns throughout British Columbia we find that housing is located at the edge of cliffs, next to streams on alluvial fans, or among car sized boulders at the bottom of mountain slopes all because these sites seemed to the owners and builders and to those who had approval responsibilities in the past, to be nice places to live.

When planners and engineers start raising concerns about these situations we have heard the following types of responses:

"You put my land in the flood plain. You had better get it out!"

"When I bought this land there was no need for a building permit. You just enacted a bylaw which says I can't have one unless I do a geotechnical study. I can't afford this and besides, the Ministry of Highways moved these buildings here a few years ago when the road was rebuilt so it must be safe and if it isn't, they are responsible."

"There is no where else to build in this region except on alluvial fans. Are you going to make everybody move?"

"Gee, you must be kidding. There are more of those big car size rocks sitting up there? Wow!" Then you tell the guy that they might fall on his house. "No way, I have lived here for 20 years, nothing has fallen yet. It is not going to."

"So if I can't sell my house are you going to mortgage to fix it? What are you going to do to help me?"

"Stop sending us information on natural hazards. Our building inspector will have to take this into consideration and we won't be able to allow people to develop anymore." "You guys have all the information and the expertise to tell us what to do. So why don't you - why should we go to all the expense - liability."

Where do we go from here? Public awareness is essential. We need to inform people about the facts but we also have to be capable of responding to value-laden concerns embodied in the preceding comments. Natural hazards are fearsome topics in terms of their realities and yet they are so intangible in terms of temporal and spatial incidence that it is difficult to take advantage of the genuine concern that people have about their safety. We need to be clearer about the various components of the problems of natural hazards and to take a broader systematic look at these.

There are technical, legal, administrative, policy, and financial interests to the individual and to society. We have to be sensitive to the needs of each of the stakeholders. We have to understand what their needs are, what their issues are and we have to involve them in a consultative process to develop responses.

Stakeholders include land owners and purchasers; real estate and development industry; politicians at all levels of government; consultants, university-based technical specialists and advisors; senior administrators, legal specialists; the emergency response community; the financial community; and all the approval authorities. The issues are: public awareness, mutual understanding and appropriate standards. Who sets these, who's responsible for them, who backs them up, who pays for what; who advises, who decides and who regulates? What about the insurance and liability? The whole concept of apprehended hazards is another issue. Rather than spend money after the fact, some feel that we should take some of that money and spend it before the fact.

There was a relatively few number of people 15 years ago in government dealing with these issues. In fact, we probably could have put them on the podium. There are so many more people dealing with these now and talking to each other. This is really healthy and I foresee that as we move forward, we will be moving forward together. We've made some enormous strides and there is much more to do. Thank you.

Chairman

Thank you very much Mr. Karlsen. It was certainly a great treat to get the perspective from inside government and the difficulties of dealing with the issues that are of mutual interest. I particularly enjoyed your description of the trials and tribulation of the application of common sense in contrast with Mr. Urquhart's requirement of foreseeability. I hope he will bear that in mind the next time he retains expert witnesses.

I should also alert the panel now and in a way I am glad I didn't tell them earlier on, but in fact this panel discussion is being recorded. It is not clear to us what is going to happen to the record but I am sure that you will be consulted if anything public comes out. I think we are sorry we don't have it on video tape for the cartoons and the demonstrations.

We have asked Dr. Peter Cave to monitor the discussions that have been going on and to summarize for us his views on what has been emerging on matters of risk assessment, particularly with regard to the administrative and planning issues that Erik Karlsen has so vividly talked about. Dr. Cave.

Dr. Peter Cave

Thank you. I have been asked to sum up my impressions of the conference and, this morning. After listening to matters of law and matters of insurance, I must admit I am not quite as happy as I was yesterday. Yesterday we were talking about the technical and mathematical details of modeling dam safety: a rather nice secluded world to live in. But now we have come to the nub of the matter. Today we are all involved in a sort of elaborate, macabre "risk transference" dance. Think about that. If we were First Nations gathered for a conference we might be doing a different kind of dance. Our dance asks the question. Who is going to be stuck with this problem? I guess that's what we have really been talking about this morning. How do we transfer risk? It's an interesting question and it's one that is central to our society. In fact there are many people who would analyze the whole capitalist market system exactly in those terms, describing it as a technique for transferring and assigning risk. As a planner there is a parallel too in terms of my own activities because the main role of the planner in my view is to try to make sure that the costs and the risks of today's development are not paid for and transferred to the next generation. So we are in constant battles with developers as to how much they should pay, while they in turn believe that lower standards should be acceptable and that the taxpayer should pay the tab when retrofitting is required. So there is a lot of "cultural core" to the issues that we are talking about. One of the purposes of the program of hazard land management in Fraser-Cheam which I described yesterday is in fact to address these legal issues. As far as we are able, we set a framework within which engineers can operate with some degree of legal certainty. We have announced, for example, that we will as a local government accept a certain degree of risk in issuing permits. That enables an engineer I think to approve development in our region which he might find very difficult to approve in other regions where the local government was more intransigent and that intransigence could go either way. It could be in

terms of demanding absolute and total safety which would be a very literal interpretation of the Act, or alternatively by trying to ignore the onus on local government to ensure safety according to the Act. Neither one is a favour to the engineer.

Before I make a few remarks about other themes which have struck me as the conference has gone along, I would like to take a couple of minutes to clarify some issues which I raised in my talk yesterday which seem to have provoked a number of different responses. I drew a distinction, if you recall, between our ability to regulate in the face of the probability statements concerning events which we know will happen at some time in the future, and our inability to regulate in the face of probability statements about events which may never happen. I think some of you may have taken that distinction as one which I was drawing from an intellectual or perhaps even an academic point of view. That is not the case. What I was describing to you is that the political reality within which we live. The fact of the matter is that society will only regulate against the one kind of hazard and not against the other. That may not be legitimate in that, at the infinite extreme of intellectual argument, these two contrasting probabilities will merge together. But it is a social reality that for the one kind of event we can regulate and for the other we cannot.

The second thing I have been trying to emphasize and I think it came through in Mr. Karlsen's talk is that whether we like it or not as professionals, the fact is that the government is ahead of the people in this province and it is also, to a degree, ahead of the profession. Early on in some of the talks on Wednesday, the notion was presented that it is the politicians that you cannot educate. It's the politicians who drag their feet. It's the politicians who will not act. That's a nice comfortable criticism to make. It makes us feel good to blame the politicians. I would like to be able to join that chorus of complaint but in fact in British Columbia it is unjustified at least in the context of geotechnical hazards. The provincial government for better or worse, prodded by Mr. Karlsen, and his colleagues, has acted. It has given us a mandate to deal with these issues. The people do not particularly like it and I have made the contention here at the conference that the profession itself hasn't recognized fully and responded fully to what it has been handed by the government in terms of statutory power and that the professional association needs to take seriously its new mandate.

Some of these themes have been emphasized earlier in the conference. Mr. Stephen Vick, for example, emphasized the need to acknowledge uncertainty and to bring it forward to clients. Dr. John Costa gave what I though was a first rate presentation on the issue of the failure of naturally formed dams, in the course of which he said, "People do not want to know the bad news". He said that the United States Geological Survey has no legislative responsibility and that geologists are lucky. Geologists are not well prepared to deal with public officials or public opinion. The theme of all this is that the public is not anxious to face up to the problem of risk.

Another theme that struck me as the conference has gone along, and this is a particular interest of mine, is the comparison between the need to retrofit and the need to protect new development by making sure it is built up to standard. I have been impressed by one talk after another both from a policy perspective and from an engineering perspective

emphasizing the difficulty of retrofitting. I mean technically, intellectually, the mathematical problems of retrofitting and also the cost of retrofitting have been stressed. It is not easy. It is very expensive. The need to retrofit structures which were not adequately engineered is very difficult from a decision-making point of view and altogether a thoroughly undesirable situation to be in. I think this places even more emphasis on the need to make sure that we build new structures, new projects, and new developments up to standard and that we don't compound that problem for future generations.

The solution to the problem of risk transference and the problem of community acceptance is to develop a consensus and thereby to de-politicize the process. This needs a number of things to happen including a really serious professional commitment. For that professional commitment to occur I think we need at least three events to happen. There needs to be first of all a convergence of professional opinion or scientific opinion. I don't want to labour the point too much but I do think it is worth repeating that the kind of serious scientific difference of opinion which we heard on Wednesday between Dr. Gary Rogers and Dr. Doug Campbell needs to be resolved. It needs to be resolved because the issue is one of statutory mandated action. We are not talking here about an academic difference of opinion which may or may not require social action. We are talking about issues of law and building safety standards and therefore it seems to me that the professional association should take steps to try to ensure a convergence of professional opinion by whatever conferences or symposia or review processes are appropriate. The second thing that I think needs to happen from a professional point of view is to try to ensure standards of professional performance and I referred to that issue specifically yesterday. Thirdly, I think the question of education and public relations is important. Yesterday evening at the banquet I was delighted to learn that Dr. Cathy Hickson is talking even down to the level of kindergarten and junior school classes about issues of volcanoes. I think that kind of openness and public education and public relations is very important if we are ever going to build the kind of consensus that will depolarize these kinds of issues.

Finally, just let me repeat a few comments and recommendations which I have made before and which I believe would go along towards resolving the problems of development approval in the context of existing legislation in British Columbia First, I think it important to encourage the development of an accessible regional research inventory to provide a ready conceptual framework for site-specific geotechnical research. My own experience suggests that regional research is, for fairly obvious academic reasons, less popular than systematic or case-study work which is process-oriented. However, a spatially-oriented, historical interpretation of geomorphic evidence, particularly of deglaciation, is generally essential as a background to any estimate of existing geotechnical hazards in an area. This is primarily a challenge to the academic institutions. But it is also a challenge to all.

All people who are practicing in the field should think about the issue of regional research and try to assist in whatever ways they can to personally develop an accessible inventory. In practice that probably means being open to cooperate in a voluntary way through your companies with the British Columbia government which has a mandate, and I think adequate funding, to undertake both.

Secondly, I personally would like to see a lobby to treat slope hazards research and slope hazard warning in a similar way to the way in which we treat seismic, meteorological and flood hazards. That means trying to persuade the senior levels of the government that they do indeed have some public responsibility for information.

Thirdly, I think we should all try to move ahead together to try to define acceptable levels of risk. I do not necessarily advocate widespread acceptance and reuse of the kind of risk threshold matrices that we use in Fraser-Cheam without serious debate and discussion. The point is that if our province as a whole does not develop these kinds of risk acceptability thresholds politically, then the courts will do it for us. And if the courts do it for us it is going to be expensive, it's going to be slow and it's going to be exceedingly painful. We can cut that off at the pass by means of an open discussion leading to provincially set standards of acceptable risk.

Fourthly, I would like to see, looking further ahead, progress on two fronts. One would be to look at ways in which the kind of work that Mr. Graham Morgan has been doing, which deals with risks to individuals rather than the aggregated risk to the community (which is the basis of our planning legislation) - ways in which risk to the individual can be built into the approval system. I would also like to explore ways in which the legal system could accommodate and be prepared to deal with the dynamic issues relating to hazards and particularly to our ability to monitor hazards and provide for protection or response or evacuation. A hazard protection program could be one that is triggered in the event that the monitoring system indicates action. At present our legal system does not accommodate that so we ultimately have only a choice of building or not building, proceeding or not proceeding. Perhaps that is where the legal system should be for some number of years and I am not advocating that we move immediately to try to incorporate the more sophisticated thinking which Mr. Morgan brings to these issues nor am I advocating that we try to incorporate monitoring into our hazard protection program immediately. Rather I suggest that we begin to work on those issues now with a view to bringing them into the system 5-10 years in the future.

To conclude, let me say that I want to give a personal expression of thanks to the organizers of this conference who I think have shown a particularly flexible and broad-minded approach to the problem by inviting the kinds of speakers you have heard this morning to give their opinions on risk management. It's unusual to do that and I think it shows a future which will indeed bring about that consensus and de-politicize what should really be a simple technical issue. Thank you.

Chairman

Thank you Peter for your very constructive guidance. In parallel with Dr. Cave's monitoring of the symposium, we have asked Mr. Graham Morgan to reflect on what he has heard related to matters of risk management and associated technical issues. I'd call on Graham.

Mr. Graham Morgan

At the risk of taking Mr. Urquhart's comments out of context, his use of the phrase "absolute physical safety" conveys to me the concept of a risk-free society. This is a condition which we surely cannot afford. There must always be an acceptable element of risk. During this conference we have discussed risk-based evaluations of natural hazards but, with the exception of Dr. Cave's paper, there has been little discussion of risk acceptability. We vitally need greater joint participation in this important area. Yesterday, Dr. Morgenstern raised the question "Are we designing or are we building structures that are too safe?" I thought I would make an attempt at addressing this question, albeit briefly, during the next few minutes.

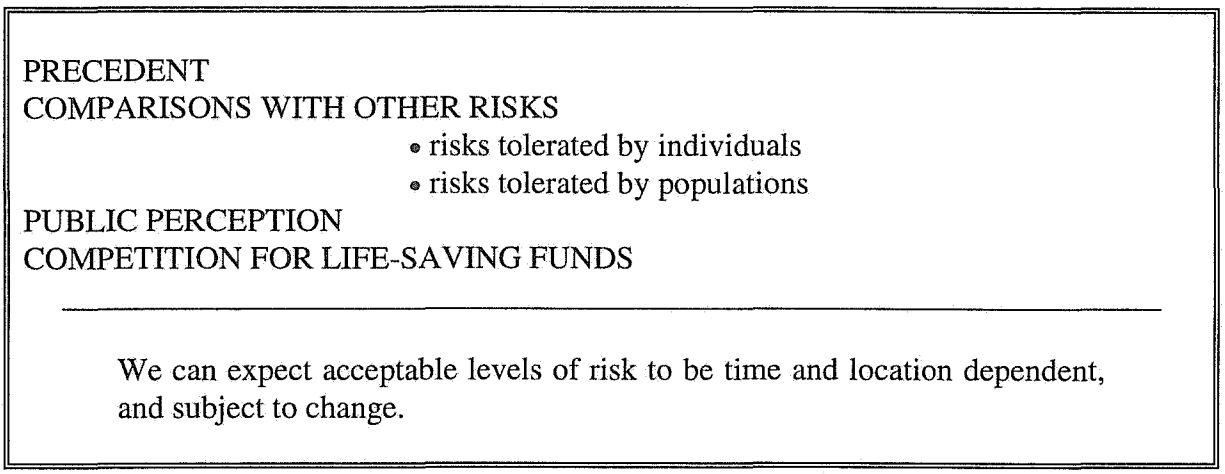


FIGURE 4: A multifaceted approach to decisions on acceptable levels of Risk.

Figure 4 summarizes a multifaceted approach to decisions on acceptable levels of risk. We should first consider available precedent. As part of my work I recently came across a thesis by Oosthuizen (Oosthuizen, 1986; Oosthuizen and Elges, 1988) from South Africa. Figure 5 is very slightly modified from Oosthuizen (1986). I suggest, for example, that where a 100 people are at risk, the acceptable annual probability of a dam failure is somewhere in the range of 10^{-2} to 10^{-3} or 1:100 to 1:1000. Assuming the horizontal axis of Figure 5 signifies number of lives lost rather than "endangered" (and the details of the thesis suggest this to be so), I have superimposed on this figure the reported failure rate of dams in the United States which it may be argued is a level of risk the Americans tolerate, if only barely. It is evident that the level of acceptable risk depicted by Oosthuizen seems high by comparison with the U.S. experience. A few days ago I received another reference with a similar plot, this time from Holland (Dutch Directorate General for Environmental Protection, 1989). A plot from this reference is reproduced as Figure 6. For 100 people at risk, this reference recommends protection in the order of 10^{-1} to 10^{-8}. Even allowing for differences in individual

interpretation of these figures, it is clear that there are major differences in suggested levels of acceptable risk.

Figures 7 and 8 provide further precedent, but from a different slant; acceptable risks to strategic buildings excluding risk to life. Figure 7 is complied from a study of the Puget Sound area (Puget Sound Council of Governments, 1975). It recommended a limiting level of unacceptable risk to hospitals, fire stations etc. in the order of an annual probability of 1:10,000. Presumably the level of acceptable risk would have a lower probability. It is of interest to note that the study selected 1:300 as the limit of unacceptable risks for residences. Again, one must stress that this does not apply to risks to life: it is assumed that there would

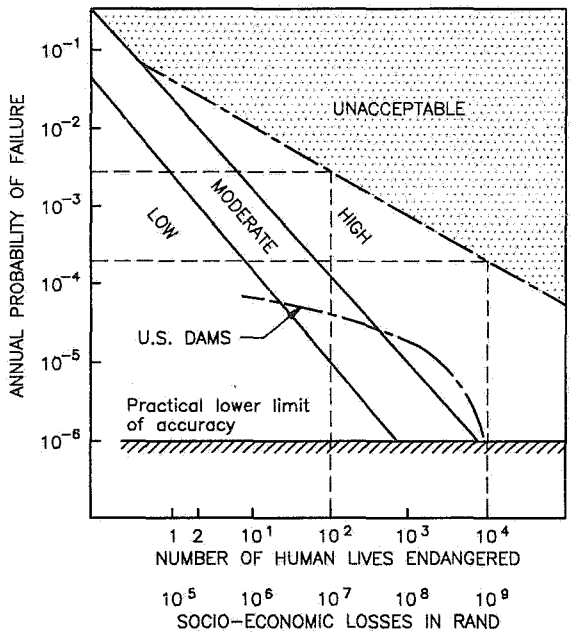


Figure 5. Classification of the Hazard Potential of a Dam in terms of Social and Economic Aspects in relation to Probability of Failure (Oosthuizen, 1986; Oosthuizen and Elges, 1988)

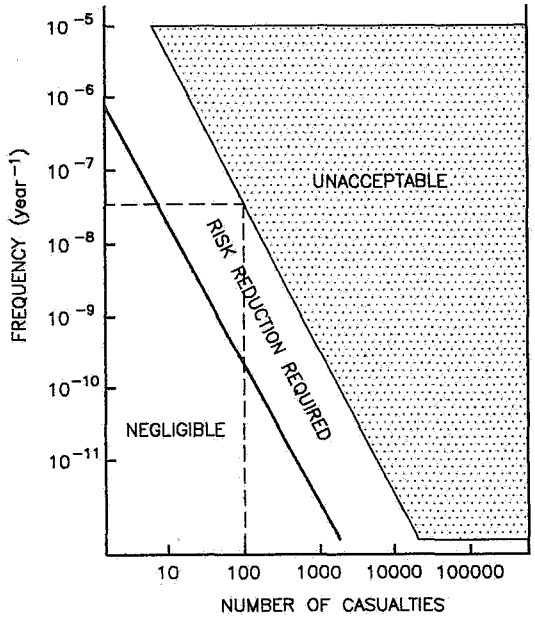


Figure 6. Group Risk Limits for Major Accidents (Dutch National Environmental Policy Plan (Dutch Directorate General for Environmental Protection, 1989)

be adequate warning of the destructive event to permit the buildings to be vacated. Figure 8, a more recent precedent, provides levels of desirable performance goals for buildings of various degrees of importance as selected by the United States Department of Energy (Kennedy et al.,1990). Hospitals and fire stations fall into the "Important and Low Hazard" usage category. The limiting level of acceptable risk of these facilities not being able to perform their function has an annual probability of 1:2000. We appear to be lowering our standards with regard to some of these important structures, perhaps resulting from increased emphasis upon cost-effectiveness. In any case, we are being asked more and more to justify some of the levels of security we are building into our structures.

LAND USE	LEVEL OF UNACCEPTABLE ANNUAL RISK TO PROPERTY (EXCLUDING LIFE RISKS)
hospitals, police and fire stations	1 : 10,000
residential	1 : 300

FIGURE 7:Proposed level of unacceptable property risk for the Puget Sound Area (Puget Sound Council of Governments, 1975).

USAGE CATEGORY	PERFORMANCE GOAL ANNUAL PROBABILITY OF EXCEEDANCE
general use	10^{-3} for the onset of major structural damage to the extent that occupants are endangered
important or low hazard	$5x10^{-4}$ for damage to the extent that the facility cannot perform
moderate hazard	10^{-4} for damage to the extent that the facility cannot perform
high hazard	10^{-5} for damage to the extent that the facility cannot perform

FIGURE 8:Levels of desirable performance for buildings of various degrees of importance (Kennedy et al., 1990).

VOLUNTARY INDIVIDUAL RISKS:	
national leader (U.S. President)	1 : 50
rock climbing	1 : 250(1)
commercial diving	1 : 350
deep sea fishing	1 : 350
offshore oil and gas	1 : 600
air travel (crew)	1 : 1,000
car travel (British Columbia 1984)	1 : 3,500(2)
motorcycle racing	1 : 5,000
construction	1 : 1,500 to 1 : 6,000
air travel (passenger)	1 : 9,000
agriculture	1 : 9,000
skiing	1 : 10,000(3)
child bearing (United Kingdom)	1 : 10,000
INVOLUNTARY INDIVIDUAL RISKS (INCLUDING LOW RISK OCCUPATIONS)	1 : $15x10^3$
manufacturing (building materials)	1 : $50x10^3$
fire (United Kingdom average)	1 : $65x10^3$
household electrocution (Canada)	1 : $100x10^3$
drowning (United Kingdom average)	1 : $200x10^3$
manufacturing (clothing/footwear)	1 : $350x10^3$
natural hazards (Norway average)	1 : $5,000x10^3$
lightning	1 : $10,000x10^3$
structural failure	

Notes:
1) Relative to the population employed in, or exposed to, the activity.
2) For an individual travelling 10,000 kilometres/year.
3) Participation 100 hours/year.

FIGURE 9: Probability of death of an individual involved in voluntary and involuntary activities (after Morgan, 1991).

The next step in our approach to assessing acceptable levels of risk is to make meaningful comparisons with other risks that we as individuals or as groups accept or tolerate. Figures 9 and 10 are taken from Morgan (1991). Figure 9 tabulates a number of life threatening risks that we as (select) individuals tolerate. They are divided into two groups: voluntary risks over which we have a level of personal control and assume responsibility, and involuntary

risks which are imposed on us or we cannot avoid and over which we have little control. Some of the voluntary risks are extremely high, but generally they are about three orders greater than those in the involuntary group. It is important to recognize this distinction. As engineers and planners we should not impose on an individual a risk at the higher voluntary level when in fact it is an involuntary risk.

Although we as individuals are concerned about personal risks, governments and society at large are more concerned over threats to groups of people (any groups, not a select group). The larger the group, the greater the concern. Figure 10 covers life threatening risks to groups of people. The curves at the top of the figure are countrywide failure rates plotted using the number of fatalities occurring in single events on the horizontal axis and the frequency or probability with which these events occur on the vertical axis. This type of plot is useful in judging what may be acceptable or unacceptable by permitting a comparison with past failure rates. Of course one needs to have some ideal of the number of opportunities for relevant events within a country before applying it. There are, for example, abundant opportunities across Canada for large landslides to occur. The suggested threshold levels of acceptability for individual landslides (Figure 10) were selected so that the cumulative effect of those opportunities would be compatible with the countrywide background (the lengthy Alpine experience was taken as a model).

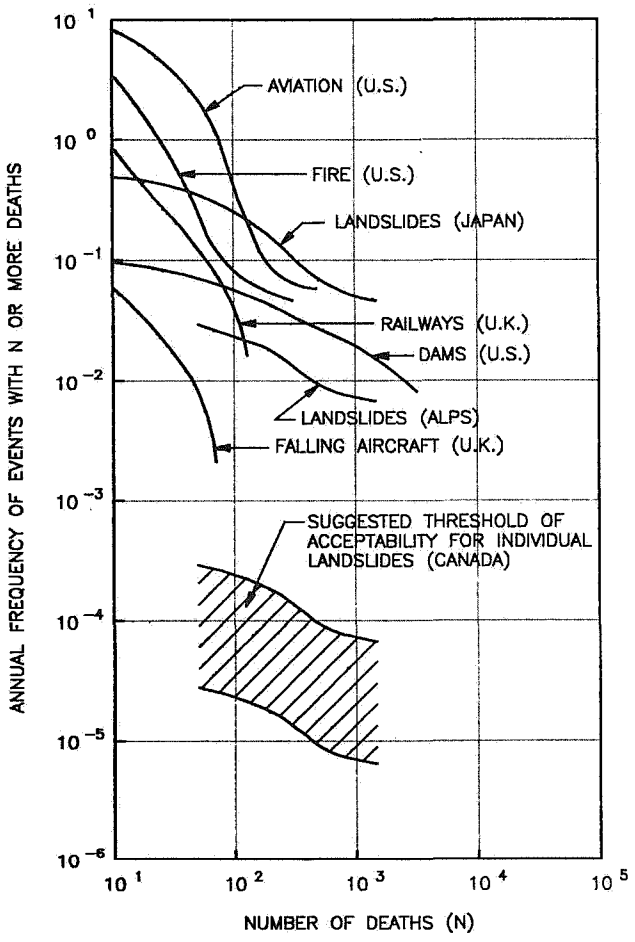


FIGURE 10

The third step involves qualitative considerations, of which public perceptions is of prime importance. Following on early work by Starr (1969), Slovic (1987) and others have made significant advances in this area. With much simplification, Figure 11 lists four important considerations arising out of their work. The first we have already discussed. The second (withdrawable v. permanent) concerns our ability to remove or mitigate the risk; when a natural hazard threatens a community there is usually limited opportunity for this. The third (immediate v. delayed) concerns the so called dreaded risk of delayed consequence such as those resulting from radiation leaks from nuclear power plant accidents. The fourth we have partially discussed but it also concerns familiarity with the risk. For example, an airplane may crash tomorrow killing 300 people and within perhaps a week most of us have ceased to think about it. On the other hand, if a landslide occurred on the Squamish Highway killing a busload of 50 people the shock would be profound and many would still be referring to it 10 years later.

FACTORS AFFECTING PUBLIC PERCEPTIONS OF RISK

voluntary	vs	involuntary		
withdrawable	vs	permanent		
immediate	vs	delayed (dreaded)		
dividual	vs	multiple	vs	familiarity

FIGURE 11:Select factors affecting public acceptance of risk (after Slovic, 1987; Starr, 1969).

The final step on Figure 4 involves the life-saving dollar and of alternatives for spending it. In Canada, Lind (1991) has been a strong advocate of this consideration. It is argued that society has a limited amount of money (or energy) to spend on life saving activities, and governments have the responsibility to spend those dollars efficiently. If we spend money to improve the safety of a facility, that expenditure reduces the probability of a failure and thus the probability of fatalities. The expenditure can thus be equated to a number of lives saved. Thus the upgrading of a facility can be analyzed in increments to determine the optimum, most cost efficient level for saving lives. In addition, deficient facilities in a system can be prioritized to provide opportunities for the most efficient use of limited funds within the system.

In summary, we can expect the outcome of all these considerations to be both time and location dependent. A decision on an acceptable risk level made today will likely not prevail a decade or two away; whatever applies in South Africa may not apply in Canada. A structured approach does however help us to provide and document the justification for a decision at any time and place, and to highlight the need for a revision when circumstances change. It also helps us to address those perennial questions that arise concerning existing

versus proposed situations. Is there some logical argument that will leave people in an existing situation exposed to a higher risk than what we would expose them to if we were building something new? I think there is, and there needs to be.

Chairman

Thank you Graham. I thought that was an excellent introduction to what I am sure will be a stimulating and wide ranging discussion period after the coffee break. I remind you that if you wish to participate please give me an indication by leaving the sheet that we provided on this green table and I will try to organize the discussion in some systematic way during the coffee break. We are running a little behind and therefore I suggest that we reconvene here in 20 minutes. Thank you.

COFFEE BREAK

Chairman

I ask all of you who are going to be speaking to be as brief and explicit as you can in your remarks in order to provide an opportunity for others to participate. In providing some order to the wide range of issues before us, I have decided to first select those presentations that deal with general technical matters and then have some that are specifically legal with questions and comments directed to Mr. Urquhart and then Dr. Smolka and Mr. Karlsen and Dr. Peter Cave and others. So that will be the sequence. I would like to call first on Mr. Graham Rawlings for his comments and he will be followed by Dr. Peter Byrne.

Mr. Graham Rawlings

As a professional consultant working in the field of natural hazards, I find that I am very perplexed. During the last two days, and particularly this morning, consultants have been assailed by so many conflicting demands. Initially we are required to serve the public, and that is a very fundamental point. However to achieve that, we are required to work to higher engineering standards as requested by Dr. Cave: to obtain state-of-the-art education, to protect against liability (as explained by Mr. Urquhart); to accept transference of risk (at the present everybody wants to transfer the risk to the consultant in the absence of any other formalized process of risk acceptability); and finally, we are assailed by the problem of business viability. So many of the projects that consultants are required to do in natural hazard evaluation are multi-disciplinary in nature and have inadequate budgets, low profit margins, and often result in a proportion of bad debts. Can the Panel give us some help to try

to reconcile these various demands? How do we as consultants operating in this field give the public what they need, have a viable business, and at the same time become educated to progressively higher standards?

Chairman

Probably not. Mr. Morgan would you like to comment, based on your experience in these matters? There may be some recommendations towards the end of the meeting that might provide a mechanism to address some of these issues.

Mr. Graham Morgan

"Probably not" is an appropriate comment. We are in a transition period. It does concern me that we gave this divergence in attitudes. For example, it would appear that some junior levels of government are attempting to load their share of liability exposure, and the easiest person they can unload upon is the engineer or other professional who happens to be advising them. Engineers, quite rightly, are resisting these attempts. Thirty years ago, perhaps it was considered the responsibility of the senior engineer or geologist to rule on exposure to natural hazards. For the most part, we did not question their advice. Today, society is more informed and should recognize that the resolution of such issues is a shared responsibility. I feel we can no longer expect an engineer to certify land as safe or not safe as required by Section 734 of the Municipal Act. The most that should be expected of the engineer is for him to quantify the hazard and the associated risk. An agreement on this point would be a big step in the right direction.

Mr. Glen Urquhart

One of the things I truly believe should be done by the engineering profession is really to get their act together and charge more money for their services. You can't really go wrong with suggesting that but nobody ever gets together and does it. The engineering profession 90% of the time takes all the risk. The lawyers and the accountants come in as they say, and they pick over the dead and steal all their belongings but you take all the responsibility and you are actually the people who get paid the least for it. One of the reasons is there are too many of you and the second reason is that you are not organized. If you ever notice when you go to a law firm or an accounting firm they don't negotiate with you on fees. You people are always ready to attack one another and be overly competitive. You should probably get together with your associations. I am not saying to do anything in contravention of the Combines Act. We lawyers don't cut fees nor do the accountants. You people do and as a consequence this causes you to accept more risk because you don't spend the time on the necessary investigations. If you got more money for the services you render I think that takes away some of the risk. So I'd say you ought to set up committees, work on it, and get your fees up.

Chairman

That might an appropriate basis to end this symposium! The next comment from Dr. Oldrich Hungr and then Dr. Frank Patton.

Dr. Oldrich Hungr

From the proceedings of this conference, one would judge that we live in a very dangerous landscape here but it's not really quite true. If you look at the statistics over the relatively short history of western Canada, we have had about 15 people killed by small scale rock falls, approximately 150 people by several large slides, less than 50 people by debris flows, and as far as I know no people at all by earthquake or by volcanic activity. So these hazards really are very, rare and perhaps one should say that makes our life easier; but it doesn't because we still have to be concerned about these hazards. We don't want accidents to occur but in guarding against them we must be careful about not going too far. We can do quite a bit of damage, as Dr. Morgenstern pointed out yesterday, by alienating land unnecessarily, by spending too much money for protective structures that are perhaps over designed and so on. What I would like to suggest is that acceptability of natural hazards be given a very high priority in our work. We can only do that if we know the phenomena that we are working with. We have to have a very thorough understanding. We cannot accept things just like that and say I as a professional engineer think this is safe. If I say that I have to be sure that I am not making a mistake in one direction or the other. In other words acceptance demands greater reliability of prediction. I think that rather than stressing the legal issues and the policy issues we should stress a mechanism that would allow us to get more factual information about hazards, distribute it properly and use it in a rational manner. A large part of this is applied research. I think we should do more research and we should provide better ways of checking our work, of getting second opinions and so on. In assessing liability we should take into consideration that many of the phenomena we are dealing with are very difficult to study.

Chairman

Thank you very much. I think Dr. Frank Patton has some comments on a related theme.

Dr. Frank Patton

I had three comments which I was hoping the panel might respond to. The first is one that hasn't been discussed here. It seems to me that a fundamental factor which is necessary to the understanding of geological hazards is the need to collect, protect and make available to others the basic data. In our profession basic data include what is exposed on the surface and what can be determined from drill holes beneath the surface. I think that British Columbia is behind the state-of-the-art in data collection and there should be a central registry for water

well data and for mineral exploration and geotechnical data from drill holes. Some data would have to be kept confidential for an appropriate period of time, then they should be made available to everyone and protected for future generations.

There is also a related area that particularly applies to British Columbia, mapping of forested areas. The obvious time to map the geology of these areas is during and/or immediately following a forestry operation. That is when the geologic units are exposed in road cuts and below the exposed tree roots. My suggestion is that the mapping be paid for by the company earning revenue from that area or from the governments' stumpage fees. The cost should be minimal in comparison to the revenue from the trees and it would result in the collection of fundamental data that would otherwise be lost. The units mapped should include the bedrock, the Quaternary or surficial deposits and the geologic structural features. I think that even if there is nothing else that we could agree on, we should recommend such mapping and the establishment of a geologic data registry to the appropriate agency.

My second and third comments concern professional ethics. In the work that I have been involved with, working with natural hazards, the questions involving ethics are perhaps the most difficult that one runs into. Frequently, the larger and more serious the hazard the more difficult the ethical problems become. People tend to become overwhelmed by the magnitude of some natural hazards (for example, earthquakes or large landslides) and various problems can result. One is in the identification of a hazard. You find the whole spectrum of responses - some professionals run to the newspapers crying "wolf" while others say that the problem does not exist. The truth may be anywhere from one extreme to the other, but it is a difficult thing to handle. Sometimes there is money to be made for the person at one end of the spectrum who says there is no problem, while for the person who cries "wolf", there usually isn't much money but they will gain considerable attention, at least initially. It is often very expensive to find out what the truth is and the process can take considerable time. It's a difficult problem. Each of us might have a different opinion on a particular hazard. I would like to hear if any of the panel would care to comment on this problem.

Another ethical problem that we run into frequently involves the terms of reference for studies of natural hazards. If we as professionals accept terms of reference that aren't appropriate to the study or are incomplete in any significant way, then we have no business being involved in that study. The problem is that inappropriate terms of reference occur more frequently than we care to admit.

Then there is the problem of the bias individuals involved in technical matters bring to the preparation of regulations and the composition of commissions and panels. Are there people in our society who are completely unbiased? I don't think that anyone can be truly unbiased although many may profess to be. If you are in government, the natural tendency for the group that regulates some part of a public activity is to gradually become an advocate and protector of the group that the government agency is trying to protect the public from. If you are in a university, you can become involved in the selling of your own consulting and lecturing services and with the raising of funds for your particular research interests. If you are in a consulting firm, you would naturally like to have more business. This can result in

biases in that direction. Sometimes the strength of the bias may vary with the size of the consulting activity.

There is one bias that I am particularly sensitive to. That is a bias attributed to technical persons involved with manufacturing. Other professionals (scientists and engineers) frequently dismiss the manufacturer's views on instrumentation requirements for the warning of or monitoring of natural hazards by saying that the manufacturer just wants to sell instruments. The problems of ethics and bias in many of the areas noted are different in Europe and Asia than in North America. Yet there are some factors which we have in common. For example, as techniques and methods of instrumentation for monitoring hazards become more complex, the individuals who are likely to be most familiar with those techniques may be those in the instrument manufacturing industry. The required expertise may no longer reside within the areas of the traditional professions. I think that the traditional tendency for professional engineers or geologists to say the manufacturers' views need not be considered is losing its validity in several significant areas of the study of natural and man-made geologic hazards. I would like to hear whether Mr. Urquhart or any other panel members have comments on these questions about ethics of professionals when dealing with natural hazards.

Chairman

Thank you Dr. Patton. I think Dr. Cave and Mr. Erik Karlsen touched on these matters and perhaps have a perspective in dealing with consultants and a variety of people. Would either of you like to respond to Dr. Patton's point, or both?

Dr. Peter Cave

One of the areas that Dr. Patton referred to which I think is particularly important is the question of the terms of reference for studies. Of course I am not privileged to be on this inside of the fee structure issue for professional engineers but I get the feeling that the issue of terms of reference is even more important than the charge-out rate. To follow up more specifically on the recommendation I made, that the profession should try to insist on high standards, it should prepare a checklist similar to the ones we did for Fraser-Cheam. It should be a standard checklist of things that should be included in any site-specific study and I would very, very much like to see the Association produce one. My feeling is that the focus of all of that work should be on the terms of reference and that indeed is where things go wrong right from the beginning. In fact we find for the most part, that clients who get the worst service from the engineers, who frankly believe they have been ripped off, usually don't end up in that situation because they have hired somebody who is particularly cheap per hour or who is incompetent. They usually end up in that situation because they have entered into a contract which doesn't have the right terms of reference and that is because, in my view, the professional himself is not responding to some guidelines from the Association. So I think that would go a long way to dealing with the issues that Graham raised also.

Mr. Erik Karlsen

I will draw on some experience that some other engineering people have approached in a similar problem. In the Professional Engineers and Geoscientists Association there is a group of people who deal with municipalities, the infrastructure roads, sewers and what have you. A couple of years ago they got themselves organized in an Ad Hoc group basically to discuss establishing common terms of reference for bidding for work of that nature and our Ministry assisted, through a grant, that group of people and they did eventually produce a tendering document which enable the engineering fraternity of municipal employees and the ones who were providing the consulting services. Everybody knew the rules Everybody was following the basic approach. That type of experience you know might address some of the points that have been raised here regarding appropriate terms of reference, appropriate fee schedules and so on. In other words, get organized. Let's talk amongst ourselves. Let's see what we in government can do to assist with this because having legislation out there I'm well aware that there are a lot of questions about how to interpret it but I am a very busy person as are my colleagues and unless somebody comes to us and gives us some guidance or gets organized themselves, we don't have the time to lead that initiative. So over to you folks.

Chairman

Glen, do you have something to add?

Mr. Glen Urquhart

Well as far as professional ethics go I have been involved in about 40 cases, prosecuting engineers for unprofessional conduct and also defending them. I have also done a large number of professional liability lawsuits. Dr. Morgenstern has been involved in some of them where we have had two diametrically opposed opinions particularly on soil conditions. I see nothing wrong with that. I think it is a matter of judgment by a professional. One professional may believe one thing because of his background, his environment, his upbringing and another has a totally different view. Both may be right. There are all kinds of situations where you may not agree with the next person and I think that's good because that fosters ingenuity, creativity and innovation. In my business for example we go to court and I believe one side of the case, the other lawyer believes the other side. One wins, one loses. That doesn't mean either one of us is wrong. The person who loses says the judge was wrong. That's how our system works.

Mr. Graham Morgan

Dr. Patton raised two points. The last concerned "bias". I understand the biases of the consultant very well, and I think I am beginning to understand the biases of government

groups. The levels of bureaucracy that I am in contact with are biased towards the public interest, but they are not as one might think biased towards being over-conservative. If an engineer submitted to the Water Comptroller of this province an excessively high design value for a maximum credible earthquake, he would be asked to account for it and probably a second opinion would be sought. Unjustified acceptance of such a value may result in other dams being ranked as deficient and lead to unnecessary expenditures by others and an ultimate cost to the public. The first point was with regard to a central agency for collecting and distributing basic data, which others have also raised. As Dr. Hungr commented previously, the perception within Canada of natural hazard problems, with the exception of floods and earthquakes, is not high. The Provincial Emergency Program has a very small budget; about a $2.8 million per year. Occasionally we have flood problems as we did in 1989-90 when close to $70 million was spent, but this is very exceptional. Usually it costs less than $5 million to address these problems. Thus based on past expenditures there is little prospect of convincing the Province to embark upon a large effort with regard to accumulation of data, irrespective of the source of funding. One has to look ahead. If the concept is to be justified at all, it will be on the basis of what could happen locally, not on a Province-wide basis, and no one to my knowledge has yet attempted to do this. Furthermore, it is not good enough to refer to practices in France, Austria, or elsewhere; one needs to relate to conditions, projected growth patterns, and expected future demands within this Province.

Chairman

There are matters of substantial technical debate that have very serious financial implications. One that we might characterize is the Campbell-Rogers debate and Mr. Adrian Wightman has a comment on that.

Mr. Adrian Wightman

I don't think it's appropriate to get into the specific technical issue here this morning but I'd simply like to suggest, so that perhaps we move towards a consensus on this perceived controversy over the seismic hazard issue that Dr. Campbell and Dr. Rogers be requested to publish their positions in a learned society journal and perhaps in this way we can generate an unhurried and unemotional discussion, a written discussion and hopefully by that means move towards a consensus.

Chairman

Dr. Liam Finn had some comments on a similar theme.

Dr. Liam Finn (comments unedited)

I think that in expressing our opinions about this controversy between, or differences of opinions between Drs. Rogers and Campbell, we should keep in mind first that they are talking about two different things. Dr. Rogers is talking about the probability of a certain level of acceleration or velocity being exceeded in a specific time frame. Every earthquake that could conceivably occur contributes to that number. Not just one earthquake. Not the earthquake that may occur and cause us a design problem. Every earthquake contributes to that. The Earth Physics Branch, when they calculate that number, they include some very small earthquakes which if they happen right underneath feet can, in fact, cause significant accelerations but very little damage. That number is an index number that goes into something that establishes the risk of the structure. I think we can very slide from considering the hazard, that is what will nature present to us and the risk which is what happens when it does. You can make very serious judgments of costs and consequences if you forget that. The probability of a given set of consequences from a given ...

(Tape ended - missing text)

... is very expensive and we are making it unnecessarily expensive both in the geotechnical and structural sense. Let me speak first about the part that I pretend to know something about, the geotechnical sense. We are going to find large scale retrofit, by that I mean on dams and large structures, prohibitively expensive if we treat them as if we were designing them again. Nobody designing a major dam for instance will tolerate a zone in the foundation that might liquefy. But when you are retrofitting you might want to consider how big is that zone and what is its possible influence, if any. But if you insist on removing all vestiges of unpleasant or unacceptable behaviour in the design sense you are going to drive your costs to the roof. The other thing is the criteria that we use for assessing whether we have done enough retrofitting or not. When we are designing it is easy to select an acceptable factory of safety, use conventional design methods and create a structure without too much additional expense that meets those requirements. When we are retrofitting, because now we are dealing with an established structure, it is so expensive to do all these things that we need to look at alternative requirements. What we are really trying to do is to keep our structures in some semblance of shape so at the most when we go back we will have to do some superficial remedial repairs but there is no risk of a major, in the case of a dam for instance, dam break. If you shift the requirement from factor of safety to tolerable deformation and that was advanced first by Newmark in 1965, it's not a new idea, then your costs can be cut considerably because a factor of safety greater than 1 admits no deformations. If you can accept some you can save money. There have been two dams in the United States since 1989 that have in fact been treated in this way. The remedial measures are not complete yet but the estimate is that shifting from factor of safety with tolerable displacement has saved on the average $7 million per dam. There are some tailings dams that are now undergoing remediation, where the same principle is being applied. With the same very significant potential savings. So when we look at this question of retrofit, we should also take the opportunity to establish a different set of criteria. Our technology must

allow us to do that so we have to make a judgment call. We shouldn't just do the same thing that we do for design. In the structural side there are a couple of samples. In England they are now evaluating their bridges to carry European lorries or trucks, applying the conventional code for bridges. A very large number of bridges cannot carry these trucks so they have gone to a system of actually testing the bridge under truck loads. They find the bridges can carry the loads. It is the same for retrofitting here for seismic effects on our bridges. The simplified procedures that we use for design do not use optimally all the structural features of the system. When you are designing it does not pay to explore these too much. When you are retrofitting, a lot of money is involved. It pays to do that. I would make a plea for two things. In discussing all these hazards make a distinction between ground motion and risk, between hazard and risk and when we are retrofitting, look at the opportunity to adopt different criteria and procedures for evaluating the efficiency or the effectiveness of what we are doing.

Chairman

The next question is from Ms. Susan Hollingshead.

Ms. Hollingshead

My question is directed toward Mr. Urquhart. During your opening remarks, you gave the impression that the standard against which professional engineers will be judged in a court of law is that of an expert, "... the very best person ..." you can find. It has always been my understanding that we as professionals are legally and ethically required to meet the standards set by our peers; in other words, that an engineer's actions and level of skill will be measured against that of the 'average' engineer of the same calling. Isn't the role of the expert witness to provide credible testimony as to what an average engineer would have done under the same circumstances, not to identify the state-of-the-art at the time in question?

Mr. Urquhart

The test is, what would another engineer in circumstances of a similar nature have done?

The role of the expert engineer is to provide objective, independent testimony as to what are the standards in the industry and what an engineer would have done to comply with that standard. It may also involve the question of whether the engineer has complied with the state-of-the-art of the industry at the time. This is particularly true in situations where the state-of-the-art has advanced quite considerably in the last few years. Thus the test is a test of what would have occurred at the time the alleged mistake or error occurred.

Chairman

Dr. Bob Pack.

Dr. Bob Pack

The issue I'd like to bring up is that of zoning and I'm addressing my comments more particularly to Dr. Cave. With regard to the hazard zoning process, when a point has arrived at say the second stage of geotechnical investigation when an Engineer draws a line on a map. It involves a significant portion of a subdivision where there are multiple owners. Immediately they are faced with a situation where they've lost property value. In other words, there is now a perceived risk that wasn't there before and future buyers are going to know that. They therefore wouldn't want to buy that property. The landowners, of course, are not too happy with such a geotechnical report. I'm perhaps suggesting a way out of this problem for municipalities or for regional districts, by providing a mechanism by which the residents can recover some of that lost value. The retrofit issue is one for discussion and one of difficulty but it's extremely difficult when you have multiple owners. Because you've got to get residents together and they have to agree on a plan to work on. I use a sewer expansion project as an analogy. It's a common need of multiple residents to improve the value of their property or solve a health problem, whatever the case may be, and in this case, the municipality takes an active role in developing the engineering and cost sharing through the province in developing a sewer project. Could not the same sort of thing be applied to natural hazard mitigation in such cases where the municipality or the regional district, I suppose in most cases it would be the municipality, would promote to the residents a mitigation? And could there not be a fund set up within the province to fund those sorts of programs in the same way that sewers and other infrastructures, are addressed?

Dr. Peter Cave

Yes, it could. That program could occur, in fact it does exist. I like to say that I think that your perspective on the problem is very astute, is very realistic and that it is the one from which we approach natural hazards. It's essentially a question of putting ourselves not so much in the position of being regulatory and restrictive but rather trying to assist people to solve a problem that they face. And that perspective derives at its root from recognition of the reality of what causes a loss of value. There have been three questions in a row which deal with that issue and I'd like to make a comment on that. I have addressed this in some other papers that I've written. The key questions are: What causes the loss of value for the homeowner? Is it in fact the regulatory process or is it in fact the recognition of the hazard? Or to personalize a thing, is it the planner or council that is causing the loss of value, or is it the geotechnical engineer? Now, the bottom line on this is that it is ultimately the recognition of the hazard which causes the loss of value. Let me put it to you this way. Suppose for example that in a given situation an engineer identifies a clearly definable, life-threatening hazard confronting a home owner. Obviously that home owner has lost real value in his property in terms of the marketplace. Is it possible for me as a planner or for our

council or regional board to recreate that value by saying, "well I'll promise you that we won't down zone it, we'll give you a permit anyway?" Is that in fact going to recreate the market value? And obviously the answer is no. Because only a fool is going to buy that place and furthermore nobody's going to insure it and nobody's going to issue a mortgage on it and the mortgage companies more so than the insurance companies are right on top of this issue at the moment. So the process of loss of value is one of scientific advancement and the only way in which you can prevent it is by stopping people engaging in scientific inquiry. That is because what people are trying to peddle is a false value. A value based upon ignorance. That is the value which they are claiming to have "lost". This is not a "taking" in the American sense. There is no conceivable way in which loss of value for geotechnical reasons could or should be conceived as a "taking". What it is in fact is scientific advance and it's exactly the same loss that is suffered by a drug company or by any manufacturer who discovers that the product that he's been making is unacceptable for public health reasons and they have to drop that product and move to another product because science has advanced and determined there's a problem with it. Similarly, or the recognition that the land which you have bought is in fact a contaminated site. That is a real loss of market value with or without regulation. So the regulatory process becomes one of assisting people to get over this problem. In Fraser-Cheam we do have a very elaborate program to try to do that, and interestingly enough we turn out to be, on almost every occasion, on the side of the land owner rather than facing public opposition. Now that is my answer also to the question of what you do in the interior of the province. What are these municipal councils and regional boards doing for themselves and what are they doing for their citizens when they're refusing to face up to these hazards? What are they in fact achieving? What they're achieving is a number of property transactions at unreal and unrealistic property values. I can assure you that when those facts come to light the new owners of those properties are going to be down on those regional boards members and regional districts and municipal aldermen and planners and building inspectors like a ton of bricks. They're going to be saying, "you knew or should have known when I bought this property that I was paying an unrealistic value but you conspired to prevent the science from telling me". They may be personally liable, but they are going to be politically liable and they are gaining nothing by burying their heads in the sand. You never achieve anything by trying to close down scientific advancement and that is what we are dealing with. We are not dealing with a regulatory process essentially. So I agree completely with your perspective and that is the whole thrust of a good hazard management program, to assist people who are confronted with a real problem. And it is a problem very similar to a health problem that they may have, diagnosed by a medical scientist.

Chairman

Thank you for those very wise words. Ms. Rosanna von Sacken.

Ms. Rosanna von Sacken

I have a couple of brief comments for Mr. Erik Karlsen and Dr. Peter Cave. The first one is on some of the statements that Mr. Karlsen had quoted. And one of them was, "...you put my land in a flood plain ... you take it out ...", and we laughed because we thought it was a funny and naive statement, but more importantly because we are aware of what can or cannot be done, what should and should not be done. Unfortunately for the landowner, who probably has little or no knowledge or understanding of why his land is subject to various hazards, it is a real problem, especially if he/she was told mitigation is necessary if he/she intends to stay, and he/she may have to pay for the mitigation and be inconvenienced. Perhaps ignorance is bliss, because as professionals, we have an obligation and the responsibility to not only identify the potential hazards but also to advise those who may be affected, whether it's the government, private individuals or developers. I don't really have the solution. But what it boils down to is that sometimes we don't want to hear the bad news or the truth. It is natural to put off dealing with a problem until we absolutely have to. Who really owns the problem? Who has the money? How much money is involved? Who decides what to do or how to split the costs in a fair way? In these tough economic times, shirking the responsibility or being ignorant is cheaper and easier. We have to come up with some alternatives - perhaps sharing the cost between property owner, government and developer is one option.

My second comment was the public awareness that Dr. Cave mentioned. Out there are currently a number of very good useful pamphlets and brochures that are available to the public in regards to earthquakes. Scientists are saying that there is one chance in ten that a major earthquake could occur in southwestern British Columbia. It may happen tomorrow or in the next fifty years or it may happen in next 200 years. The general public tends to focus on the next 200 years. They tend to do nothing about being prepared for an emergency, and why should they? Especially if they believe that it is not going to happen for 200 years (i.e. well beyond their lifetime) or if there is nothing they can do about it? There should be other mechanisms to increase the public awareness on these issues whether there are free or almost free workshops, lectures or seminars. Currently there is a very good display going on in all the major malls titled "The First 24 Hours". Sponsored by various agencies, it shows what we can do in the event of a large earthquake. To educate the public, agencies need to get their attention by showing them something tangible, something they could do, see, feel, or hear. The target may be the children, the future generations, who tend to be more receptive of ideas and suggestions. Scare tactics no longer work, sharing facts are much more effective. Could either one of you comment on those.

Mr. Erik Karlsen

Thank you I think you've summarized the issue pretty carefully and succinctly. It is just basic human nature, you don't want to know anything you can't do anything about and I think the challenge that a number of speakers have made to all of us is that: let's figure out what we can do about these things, let's take that knowledge which describes real situations

and determine how we can manage our affairs to be able to deal with those whether it involves individual behaviours to avoid risk of injury or what have you after an event to on-site mitigation, retrofitting, whatever to a more collective off-site approach. Our system is not really addressing the collective off-site approach as effectively as I believe it should. There are opportunities to do that, I mentioned the business of alluvial fans and there are parts of the province where the development only occurs on alluvial fans and some of them are pretty risky to say the least. Now does it make sense to build berms and strengthen foundations on every property, or does it make more sense to go into the hill and take a look at what potentially might cause a debris torrent or to channelize and maintain the channel to mitigate against that to what will be an acceptable level? What portion of that should be shared by what levels of government and the individuals? Certainly it is an outstanding policy issue. These are directions that I think that we will see ourselves, I don't think any one individual or agency or profession or what have you has any responsibility here, it really is a societal issue which we have to move forward on together with and I think that what Peter was saying in 5 years may be 10 years and this is the direction we will be going in the next 5 to 10 years.

Chairman

Thank you Mr. Karlsen. I'd like to go on to the final theme and ask Mr. Miles to raise his comments on risk followed by Mr. Peter Jordan.

Mr. Mike Miles

Thank you. I have four comments. The first is that when assessing hydrological hazards or geotechnical hazards there is unavoidable uncertainty in what the magnitude of that hazard might be. There is, therefore, an inherent risk that the person who is making those assessments will be held accountable for unpredictable events. The obvious implication is that the more assessments one makes the more risks that person accumulates over the course of his or her career. At some point the engineer or geoscientist will (hopefully) have accumulated enough assets that the monetary benefits of accepting another assignment aren't justified, given the inherent risk that this entails. At this point the options are to retire early or to become a legal pauper. It is my impression that there are senior engineers or geoscientists in this room who have undertaken both of these options. In comparison, if I can believe the first page on my financial statement, my accountant accepts no responsibility whatsoever for what he has prepared, even though he's getting paid substantially more than I charge any of my clients. This is an unacceptable state of affairs and I suggest that this group discuss the problem of liability and prepare recommendations on how to deal with it.

The second issue refers to indemnity clauses. As a consultant it is increasingly common that I am asked to sign indemnity clauses which essentially say that I accept much or all of the project owners liability. One provincial government ministry in particular is becoming increasingly aggressive in this manner. After taking their indemnity clauses to legal council I have been advised strongly not to sign it. On going to an insurance broker, I have been told

that it is impossible to buy insurance which will cover these indemnity clauses, and, in addition, I have been warned that if I sign it, any existing insurance coverage could be threatened. The implication of this situation is that the most knowledgeable or successful consultants won't accept these kind of assignments. The client may therefore only be able to hire consultants who either naively enter into this kind of contract or are so financially strapped that they must enter into them. Indemnity clauses are therefore another issue which I think the geotechnical community needs to discuss and prepare recommendations on.

The third item is a brief comment on the on-going 'dance' to pass on responsibility or liability to someone else. I had a discussion on this issue over the coffee break with some of my former university professors. I suggest that a reasonable case might be made that if a geotechnical engineer or geoscientist makes an error or omission it is because he or she has been either improperly trained or improperly certified. In this case it is the academic community that should therefore bear the ultimate responsibility for any geotechnical errors or omissions.

My final comment is to Peter Cave. I'd like to compliment him on many of the progressive things he's been discussing with us today. I would however like to mention that I have declined to bid on a number of contracts from regional districts as the terms of reference were either incompetently prepared or didn't allow a competent job to be done. Dr. Cave has chastised the geotechnical community here today possibly with some apparently poorly conducted work. Based on my limited experience, I suggest that one of the reasons for the reported difficulties may have been the terms of reference. A possible way of getting around this problem would be to have the terms of reference for geotechnical or hydrotechnical work routinely prepared or reviewed by competent geotechnical engineers or geoscientists. Thank you.

Chairman

Thank you Mr. Miles. I think the panel and others have dealt with many of these issues in the past and I won't, if you'll allow me, consult with them. I think we've had advice from them on some of these and we appreciate your input. The final discussion I'll invite is from Mr. Peter Jordan who is dealing with natural hazard risk as opposed to business risk.

Mr. Peter Jordan

Well thank you for letting me have the last word. I think Ms. von Sacken's point was really well taken and in a way my comments are on the same line. Mr. Graham Morgan made some very insightful comments on the level of public acceptance of risk from natural hazards and he might want to get in the last word. I feel that there is an unreasonably low public tolerance of risks from natural hazards in Canada as compared perhaps to more experienced countries like Austria or Japan. As Oldrich Hunger pointed out the number deaths and even the amount of damage from natural hazards is extremely low. To use the Squamish Highway example, why do the courts and the public really expect the crown, the public treasury, to

provide a level of protection from natural hazards such as rock fall when they willingly face a level of risk that's probably two orders of magnitude higher of being killed or maimed by another motorist? I think the problem is simply one of ignorance. To use the Squamish Highway example again, the amount of dollars being spent per life saved might not really be in balance when one considers other hazards than natural hazards. I personally think that the public treasury should spend less money on litigation, mitigation, administration and trying to transfer liability around and perhaps more on geological investigation and research and most important: education of the findings of these investigations and research. Educate the public so that the public might be better prepared to accept the risks themselves and not expect others to protect them from natural hazards.

Chairman

Thank you. Mr. Morgan, is there any comment you want to make on that?

Mr. Graham Morgan

I generally agree with Mr. Jordan. The reason why we have a relatively low tolerance to risks from natural hazards is that the larger events occur so infrequently in Canada. There is virtually no familiarity with these hazards and, if you recall, "familiarity" is an important factor governing public perception. I would not however place Austria in the same bag as Japan. Japan has experienced and has learnt to tolerate a much higher level of life threatening hazards than Austria (Fig. 10). The concern over highway rock falls mentioned by Mr. Jordan has been exacerbated by the results of recent law suits. It now appears that the Ministry of Transportation and Highways may be required to show that they are spending their budgeted rockfall maintenance funds efficiently from a life-saving standpoint. On the last topic, the Province can only be expected to fund investigations and research if it can be justified in the context of competition for those funds elsewhere. The need for these and other similar activities in relation to future public safety is yet to be demonstrated. As discussed earlier, the best approach is to identify local needs.

Chairman - Closing Remarks

Thank you.

It is my duty to bring this panel discussion to a close. I wish to apologize to those who still indicated a desire to raise issues and to participate in the discussion. We have run out of time. If somebody wishes to re-convene in a less formal manner I believe that a room has been reserved.

Certainly I'd like to thank you all for coming here this morning, spending this Saturday morning discussing these important points, and I am sure you all want to join me in thanking the panel for their preparations, sharing their experience and their wisdom with us.

The Organizing Committee has charged me with the assembly of some concluding remarks and clearly I am not going to touch on any of the technical details, or perhaps even the philosophical issues, but I will deal with what have we achieved and where might we be going?

One objective of the spring meetings of the Canadian Geotechnical Society is to convene a forum on a subject of current national interest and to leave a record of the deliberations. It is certainly clear that this meeting has met that objective. By attracting some 300 participants, organizing a technical program that has been both stimulating, provocative in many ways, and by providing this fine bound volume of the formal papers, it is evident that the organizers have met their intent, indeed our intent as a Society, in a most admirable manner and for which we are very grateful. I would make one recommendation arising from that, and that has to do with the record of this panel discussion which will not appear in the proceedings. I doubt that it is possible to - or even desirable to - reproduce it in its entirety, but I would recommend to the Organizing Committee that they go through the record and extract the various recommendations that came out of the discussion and the points of guidance that emerged because I think that some terribly important information has been discussed and assembled here, that on its own, circulated to those who attended and placed in other repositories, will be an important resource document.

Now this Symposium was also conceived as a contribution from the Canadian Geotechnical community to the International Decade for Natural Disaster Reduction. Indeed Dr. Dave McClung had a question that I didn't call because I am going to deal with this: What is the status of our participation in that Decade? Making such a contribution is somewhat more problematical than one might have thought. It is now three years that a group of us, acting at the invitation of the Secretary General of the United Nations, presented a report to the United Nations on how the Decade might be organized and what might be achieve. In general terms this report was accepted and the Decade program was approved by almost all Members of the United Nations including Canada.

It became a reality some eighteen months or more ago, although it got off to a slow start because of the Gulf War and other dominant international events. Central to national involvement in the Decade is the establishment of a national committee. We participate - we in Canada - through a national committee. A task force was formed in Canada under the joint sponsorship of the Royal Society of Canada and the Canadian Academy of Engineering, and under the Chair of Professor Alan Davenport, a distinguished Engineer dealing with wind matters. The intent of that task force was to advise how Canada should form such a committee and what it might do. We finished this report some eighteen months ago. Now because the initiative involves interaction with the United Nations, the department that would formalize Canadian participation is the Department of External Affairs. Although the recommendations of our task force appear to have been accepted by the then Minister the Right Honorable Joe Clark and the present Minister the Honorable Barbara McDougal, in fact no action has yet been taken and it's my view that this is becoming unconscionable.

I would urge the Canadian Geotechnical Society, based on a recommendation emerging from this forum, to advise the Government of our activities in hazard-related matters and to invoke the authority of this assembly to express our disappointment with their lack of action in forming a national committee. And I would leave that as a recommendation for the Organizing Committee to deliberate.

Turning to the subject matter that we have dealt with, we can identify many stake-holders. I think Mr. Karlsen in fact had a very comprehensive list which I would certainly enjoy having a copy of sometime. Clearly the public is a major stake-holder. It is also clear that we have an increasingly risk-averse society, for better or for worse! This has economic implications. It also has, certainly in the North American context, impacts on the innovative processes. We have questions on how to pay for this direction of public concern. What is the social contract? One might argue that no community should be required to live with a higher level of risk than they desire. On the other hand, to what degree should taxpayers elsewhere pay for additional safety desired by a particular community? Difficult issues, clearly not all geotechnical but issues in which we have an input. My favorite examples as I discussed the other day are not geotechnical but relate to flood. I have one case history in my files of a dam in Ohio where the return period of the probable maximum flood, depending upon how you calculate it, is something between 2 million and a billion years. One raises the question is this dam too safe? I am involved, perhaps not daily but often, as are many of you in this room, on the evaluation of maximum credible earthquake effects. The science of evaluating maximum credible earthquake is by no means precise. Are some dams being made too safe because of our difficulties in making that assessment? Does not excessive safety squander scarce social resources? An important issue.

We have also had much discussion focused on inadequate safety. Let me not promote the issue too much of excessive safety, clearly there are issues of inadequate safety. We had a very interesting point made by Mr. Lloyd Cluff who illustrated the dramatic change of attitude regarding expenditures for retrofitting at the University of California, Berkeley, on the part of the Board of Regents - the decision makers - when their immunity from liability was removed. The technology hadn't changed but the sense of responsibility was reinforced. On the other hand one's heart, in a sense, goes out to them because it is difficult to agree on the standard of care that they should involve in making their judgment. They have a multiplicity of objectives and clearly there is confusion. There is no clear consensus on standards of care and I think that has been an underlying element in our discussion, with perhaps one bound set by the guidance given us by the law, but there are other bounds about standard of care. What are the criteria for due diligence on the part of decision makers as opposed to just the consulting engineers?

Clearly the technical community is a stake holder. It has a difficult job to do. This has come out in several, almost moving presentations, describing the substantial heavy burden of responsibility, the limitations of available guidelines, and certainly some of the issues we are discussing here, the vexatious issues of liability, and so on. There are very fundamental limitations to our craft and it has sometimes been argued that science and technology are effective for disasters of less than average magnitude but are powerless for extraordinary

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The members of the original Organizing Committee who assisted with the task of publishing the transcript include:

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Mr. Al Imrie (Chairman)	BC Hydro
Mr. Graham Rawlings	Golder Associates Ltd.
Dr. Wayne Savigny (Editor)	Dept. Geological Sciences, University of British Columbia
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