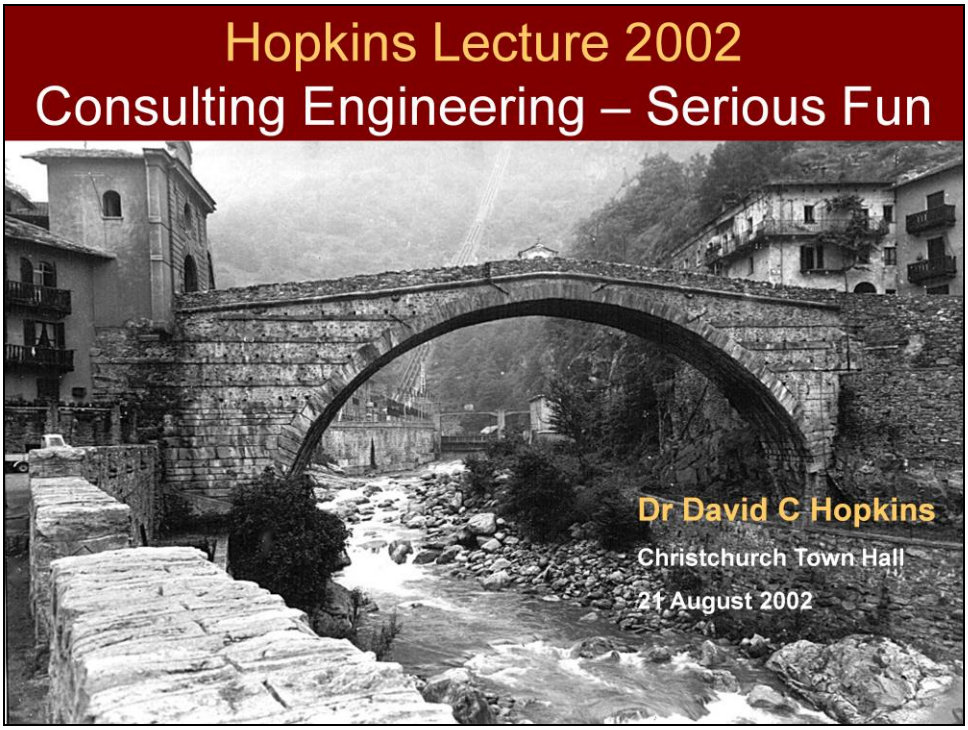


Chancellor Dame Phyllis Guthardt, Vice Chancellor Dary Le Greuw, IPENZ Chairman Ross Major, members of the Hopkins family, distinguished guests, ladies and gentlemen.

Thank you and welcome.

It is a very special honour for me to present the 2002 Hopkins Lecture, not just because of my connection to the late Professor Hopkins! Since the first lecture, given by my father in 1978, there has been a consistent array of distinguished speakers. It is an honour to be in such company.

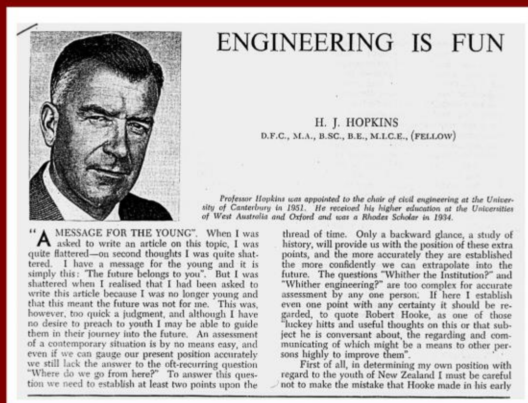
The fact that the Hopkins Lecture is now established as an annual event is testimony to those such as Toby Richards, David Elms, Bob Park and Brian Wood who helped inaugurate it, and to many others for their support.

Their efforts in making the vision of a commemorative lecture a reality are much appreciated by all the family of Harry and Dorothy Hopkins.

The support of the University and of the Canterbury Branch of IPENZ has been a key to the continuation of the Hopkins Lecture over the last 24 years.

Thank you all.

Serious Fun?



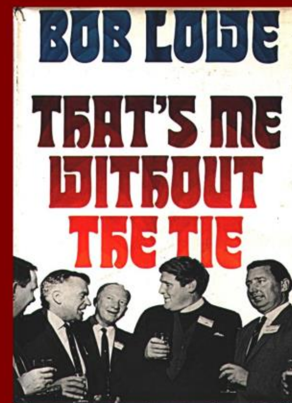
ENGINEERING IS FUN

H. J. HOPKINS
D.F.C., M.A., B.SC., B.E., M.I.C.E., (FELLOW)

Professor Hopkins was appointed to the chair of civil engineering at the University of Canterbury in 1951. He received his higher education at the Universities of West Australia and Oxford and was a Rhodes Scholar in 1934.

"A MESSAGE FOR THE YOUNG". When I was asked to write an article on this topic, I was quite flattered—on second thoughts I was quite shattered. I have a message for the young and it is simply this: 'The future belongs to you". But I was shattered when I realised that I had been asked to write this article because I was no longer young and that this meant the future was not for me. This was, however, too quick a judgment, and although I have no desire to preach to youth I may be able to guide them in their journey into the future. An assessment of a contemporary situation is by no means easy, and even if we can gauge our present position accurately we still lack the answer to the oft-recurring question "Where do we go from here?" To answer this question we need to establish at least two points upon the thread of time. Only a backward glance, a study of history, will provide us with the position of these extra points, and the more accurately they are established the more confidently we can extrapolate into the future. The questions "Whither the Institution?" and "Whither engineering?" are too complex for accurate assessment by any one person. If here I establish even one point with any certainty it should be regarded, to quote Robert Hooke, as one of those "luckey hitts and useful thoughts on this or that subject he is conversant about, the regarding and communicating of which might be a means to other persons highly to improve them".

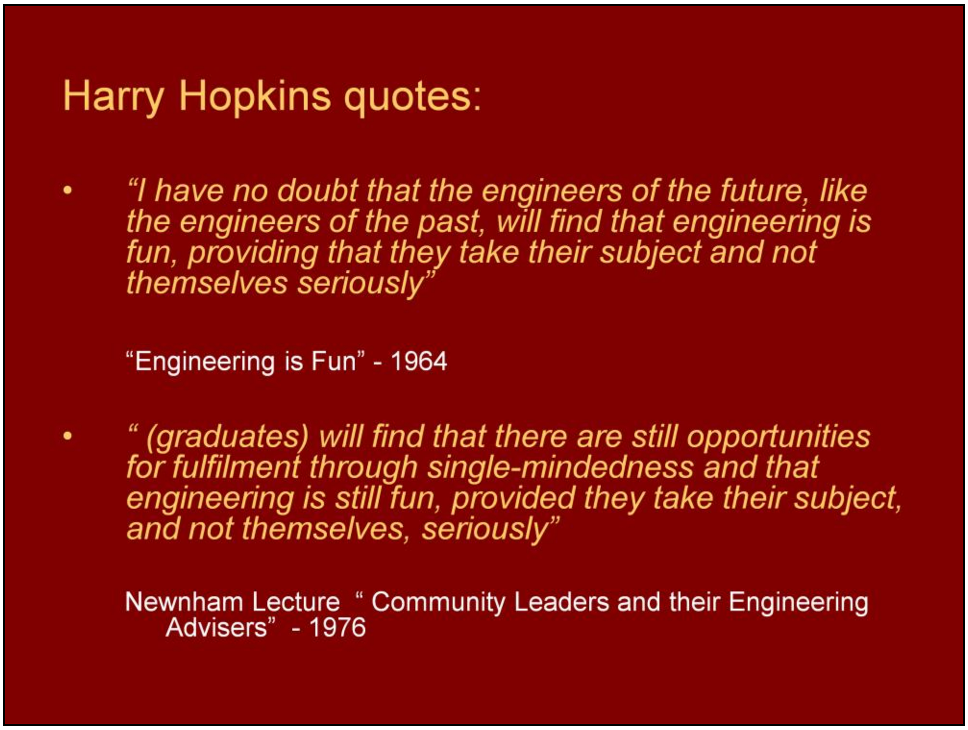
First of all, in determining my own position with regard to the youth of New Zealand I must be careful not to make the mistake that Hooke made in his early



The title is derived from my own experience of more than thirty years in consulting engineering work.

Work that has been **widely varied**, has taken me to many **different countries**, has involved **serious responsibilities**, always been **challenging** and has provided lots of **fun.**

- Fun in the satisfaction of helping others with one's advice,
- Fun in the professional relationships with colleagues and with clients,
- Fun in the contact with people from other cultures,
- Fun times.



But the title also comes as a result of looking back at some of my father's published papers.

One, titled "Engineering is Fun" published in 1964 concluded with *"I have no doubt that the engineers of the future, like the engineers of the past, will find that engineering is fun, providing that they take their subject and not themselves seriously"*

Another paper, the Newnham Lecture given in February 1976, entitled " Community Leaders and their Engineering Advisers", concluded with almost identical words – *" (graduates) will find that there are still opportunities for fulfilment through single-mindedness and that engineering is still fun, provided they take their subject, and not themselves, seriously"*

Speaking of fun, let's start, as all good programmes do, with an ad break…

(Video shows man returning from run and leaning against his car to recover. A passing truck driver eating a chocolate bar sees him, thinks the man wants to push the car over the cliff. Truck driver helps, proving energy from chocolate bar, and leaves very pleased. Owner looks forlornly down slope at his disappearing, somersaulting car!)

Why did I show that?!

To remind me to communicate to you all what my objectives are this evening –

in the hope that the result will be much better for such communication.

My objectives

- Insights into issues faced
- Opportunities, lessons and challenges
- Convey some of the seriousness and some of the fun of consulting engineering
- Provide some thought-provoking material

•To provide you with some *insights into the issues* faced by consulting engineers

•To give some idea of the *opportunities and challenges* available to future civil engineers

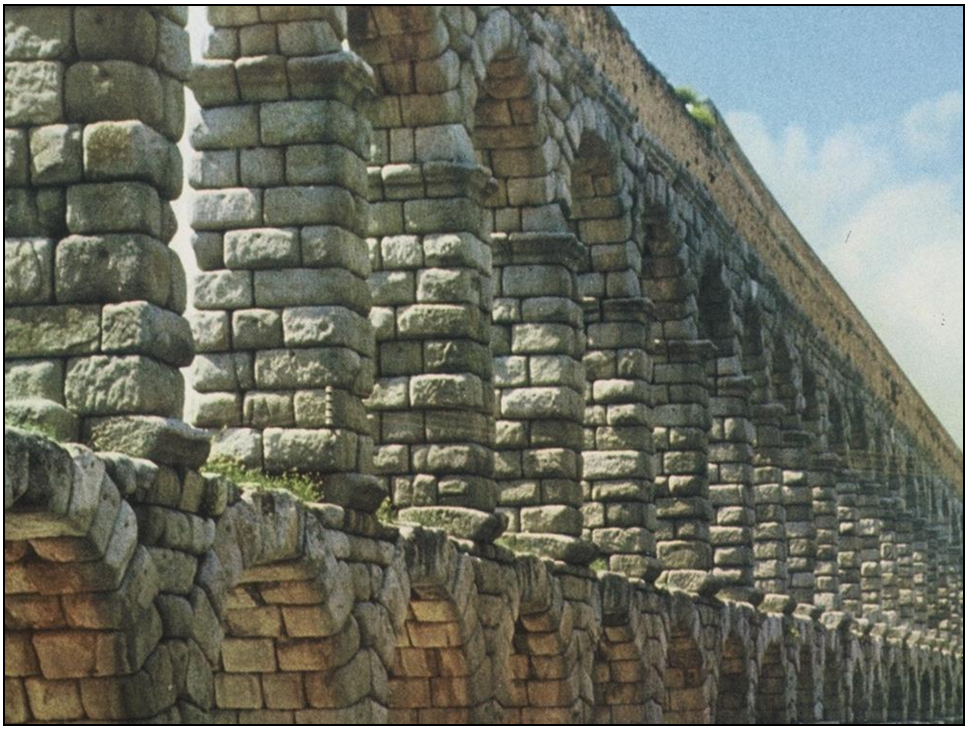
•To show *some of the seriousness and some of the fun* of being a consulting engineer

•To *encourage you to think* about and relate what I have to say to your own experience and the future of New Zealand, particularly the future of New Zealand-based professional engineers.

- What I plan to do is to cover a range of topics, offering some observations, indicating lessons and/or challenges that emerge.

Topics:

- The value of **understanding fundamentals** – Pont du Gard
- The value of **basic research** – Seismic Isolation
- The value of **training** – Consulting trends
- **Failures** in engineering development
- **Earthquake risk mitigation** – defensible position/lifelines/erb's
- **Earthquake Risk Buildings** in New Zealand
- **Globalisation and Consulting Engineering**



Note: Slides used to separate the topics are copies of slides taken by Harry Hopkins.

1. Understanding fundamentals

Observations

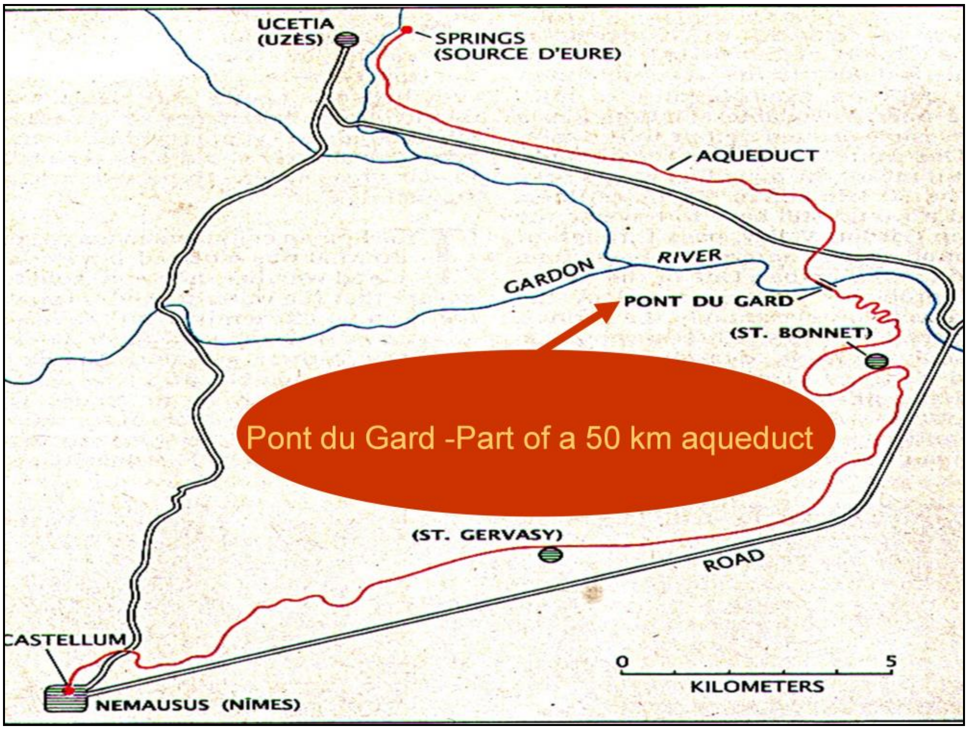
- Strongly advocated by Harry Hopkins
- Exemplified by Pont du Gard
  - Roman aqueduct bridge
  - Agrippa 19 B.C.

- Harry Hopkins was known for his advocacy of understanding fundamentals, and taking lessons from the past.

- He was also known for his love of bridges and particularly the Pont du Gard, built by the Roman Marcus Agrippa in 19 B.C.

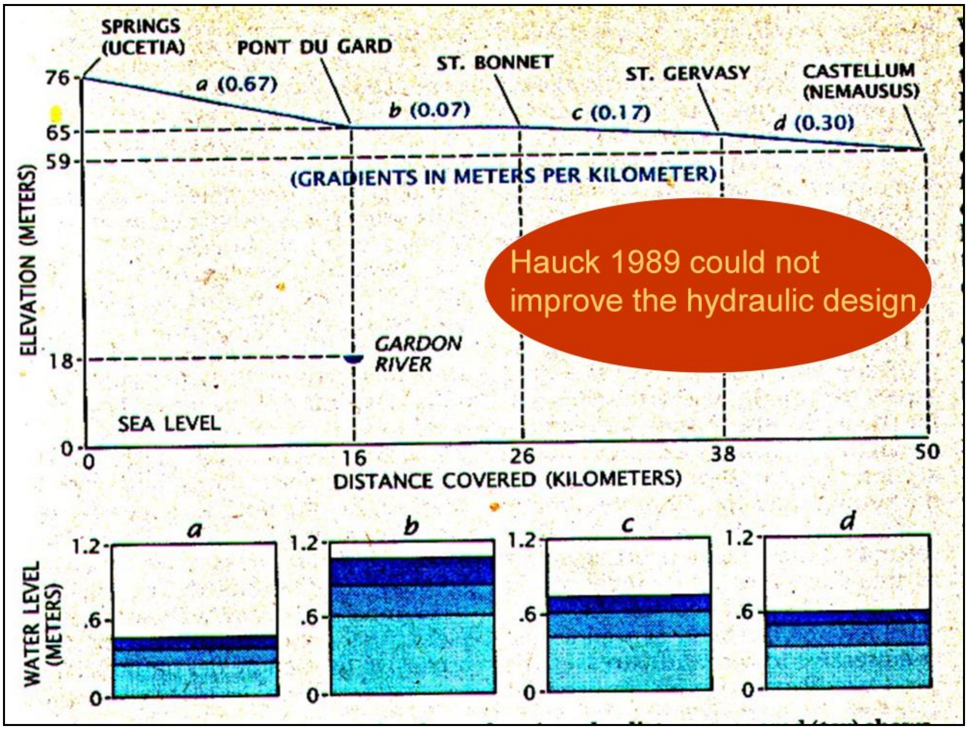
Pont du Gard

- This magnificent and awe-inspiring structure…..

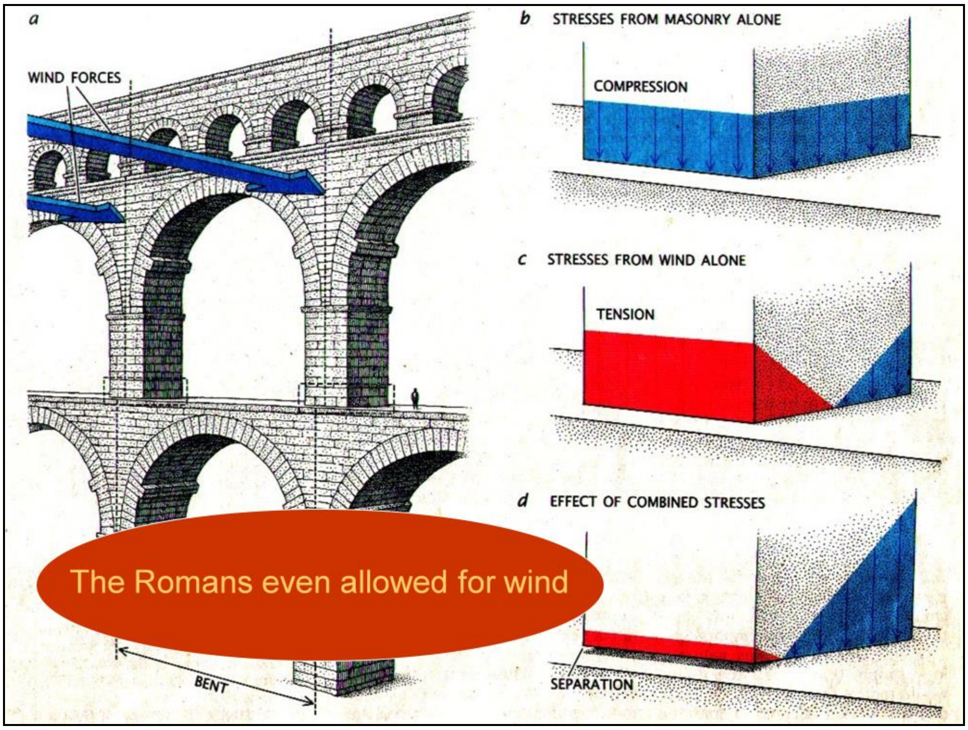


• was part of a 50 kilometre long aqueduct bringing water from Uzes to Nimes, falling only 17 metres in this distance, or 340mm per kilometre.

• At the time of construction it provided 600 litres per day per head of the 50,000 population (About 350 litres per second).



- In 1989, an American professor, George Hauck, with the aid of modern computer technology looked at the hydraulic efficiency of the aqueduct.
- He found it difficult to make improvements and concluded that the Roman engineers were more sophisticated than generally thought.
- Note how the first section is steeper – to reduce the required height of the Pont du Gard
- Note how the bridge section is flatter – to reduce scouring on the structure



- Hauck also looked at the structure in relation to wind loading on the 16-storey high bridge, and found the proportions well matched to likely wind pressures, including a factor of safety of about 2.

- There are many conclusions that could be drawn from the Pont du Gard, both from its design and its durability.

- For the present purposes, let us simply recognise that the Romans' ability to produce an optimum design relied on their understanding of the fundamental principles as based on their observation of natural behaviours, and their recording of such details.

Lesson/challenge:

- Continue to teach fundamentals not applications

Harry Hopkins said:

> *"… the curriculum of an Engineering School should be determined more by the progress of science than the requirements of present-day practice."*
>
> *"Ideas, if well taught and firmly held, will not only demand techniques to implement them, but provide the knowledge to build them"*
>
> Inaugural address as Professor of Civil Engineering at University of Canterbury 1951

- There are immense pressures these days to introduce instruction on techniques of practical application into university courses.

- For instance in the field of maintenance management there are sophisticated computer programmes to help organise this activity. Lots of spreadsheets for ticking off every known maintenance activity.

- It is helpful to know these techniques.

- But it is even more helpful to understand the processes which cause assets to leak, rust, erode or wear out.

- Thus applications should not be taught at the expense of instruction in the fundamental principles.

- Harry Hopkins put it like this in his inaugural address as Professor of Civil Engineering in 1951, entitled " The Academic Engineer":

  "A review of civil engineering practice indicates the necessity for the curriculum of an Engineering School to be determined more by the progress of science than the requirements of present-day practice."

  "Ideas, if well taught and firmly held, will not only demand techniques to implement them, but provide the knowledge to build them"

  It is just as true today.

Photo: Harry Hopkins

2. Value of basic research

Observations:

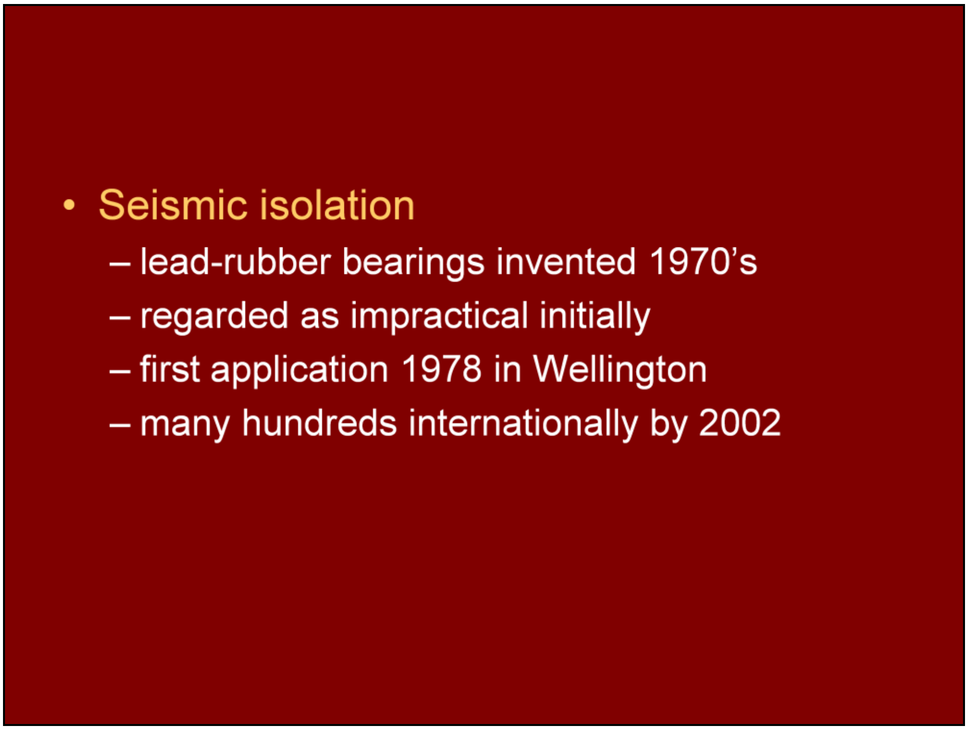
- Undue emphasis on short term results
- End product not always apparent at time
- Zero tolerance for Government to pick winners
- Venture capital situation improving

- It is becoming increasingly common for those with the money and influence to require that research be shown to have some forseeable practical benefit, preferably one for which a cost/benefit ratio can be computed.

- There can be no doubt that this is a worthwile approach in cases where incremental development is sought to produce a more refined version of an existing product. And incredible achievements have come from this as evidenced by, say, the development of the motor car over the last 100 years, or in software over the last 20 years.

- It is interesting to observe in this context that the community has virtually zero tolerance for governments picking winners from research ideas. This is in contrast to the attitude of venture capitalists in USA who regard one or two failures as a possible advantage in an applicant for funds for a new venture.

- But what of those “off the wall”, ‘outside the square”, “left field” – you name the cliché – ideas that take time to have their day.



An example:

- In the 1970's, a group of scientists at the DSIR, including Dr Bill Robinson, was working on energy dissipation devices to protect engineering structures from the effects of earthquake ground motions. Many and various devices emerged and were applied by practising engineers, usually involving the yielding of steel.
- Bill Robinson discovered some remarkable properties of lead, that metal best known for taking fish bait to the sea bottom. Dr Robinson noted that if you compress lead in a confined space, it changes its crystalline structure and that it takes considerable energy to effect this change. More remarkably, it turned out that when the pressure was released, the crystalline transformation was reversed almost immediately, so that the same energy absorption capacity was available for a reverse cycle of deformation.
- These discoveries, coupled with the existence and use of rubber bridge bearings, led (if you will pardon the expression) to the idea of a seismic isolation bearing made of alternate layers of rubber and steel with a lead core.
- It is fair to say that at the time it was first mooted, the idea of sitting large buildings on these devices was seen to be fascinating but impractical. But time moved on and knowledge of earthquake ground motions and the ability to analyse them improved.
- In 1978 the Ministry of Works designed a building (William Clayton Building near Wellington Fault) with seismic isolation bearings – the first application of the technology. The incorporation of the bearings reduced the expected forces in the building to about

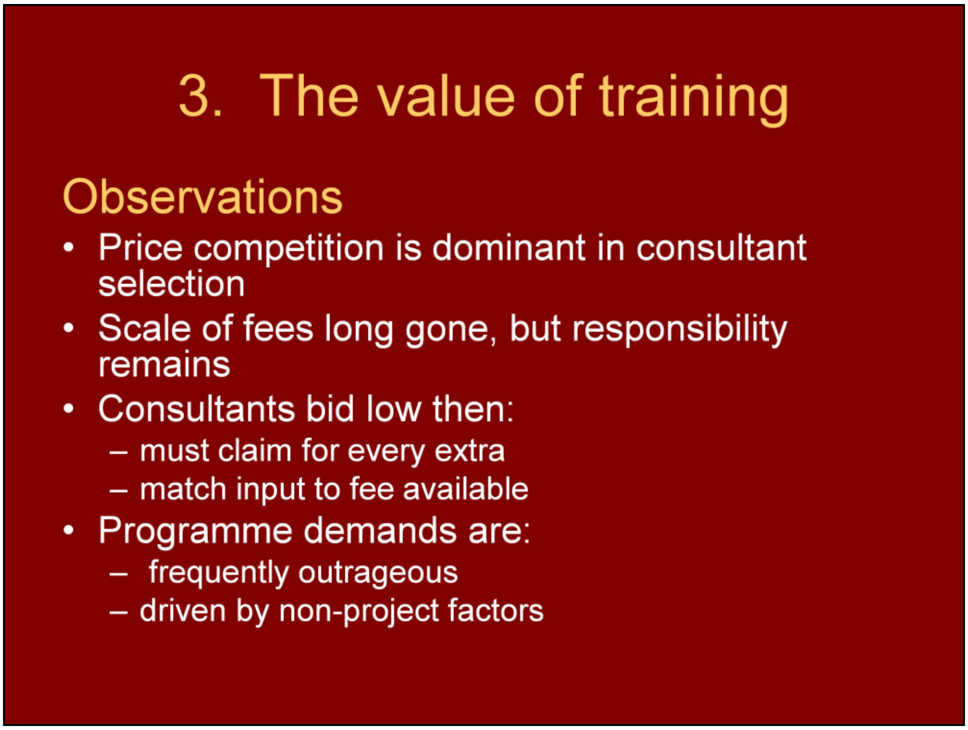
40% of normal values, which was good news for both the structure and its contents.

- In New Zealand the technology has been applied in several buildings, some retrofitted and others new. These include Parliament Buildings and Te Papa.
- But the success of this technology in reducing earthquake risk is best measured by its application internationally. Japan has around one hundred seismically isolated buildings, USA more than 50, China also more than 50, many more in other countries. Over $1 billion worth of these NZ invented bearings have been installed in buildings valued at over $10 billion.
- Robiinson Seismic and New Zealand consulting engineers are presently looking for opportunities to apply this technology internationally, including in developing countries.
- Looking back, one could lament the fact that commercial applications were not more strongly developed from New Zealand.
- With Government initiatives such as the Venture Industry Fund, and the Growth and Innovation Fund, opportunities to develop such ideas are far greater now than in the 1970’s.

Lessons / challenges:

- We should continue to support fundamental research in all fields and…
- be patient regarding the benefits.
- We must develop the ability and attitude to capitalise on new inventions so that more benefits accrue to New Zealand.

Photo: Harry Hopkins



Price competition amongst consulting engineers is the order of the day and has been for over 20 years.

It is hard to believe that less than 30 years ago, engineering consultants had what was known as a minimum scale of fees. In addition, they were prohibited from advertising or promoting their services.

The scale of fees for larger jobs worked on a percentage basis, with a defined minimum % depending on the value of the work. The scale was based on the amount of input usually necessary to address all the issues in design and construction, as well as take care of client changes to a reasonable extent.

The situation is now with competitive pricing that firms feel compelled to bid low to secure a project in order to obtain ongoing work for their company and experience for their employees.

Few client managers appreciate that in most cases the consultant is required to assess a physical situation, devise an original solution to fit what are unique circumstances and take responsibility for the adequacy of their design to meet a range of possible scenarios.

Often the pressure on consultants is compounded by a request to make up for delays in client decision making by speeding up the design and documentation process. Or it may be to meet a bonus deadline for a client manager.

There is thus:

- undue pressure to perform
- uncertainty in workload
- lack of time and inclination to train young professionals, especially in technical matters.
- 10% spent on business development
- 2% or less spent on training.

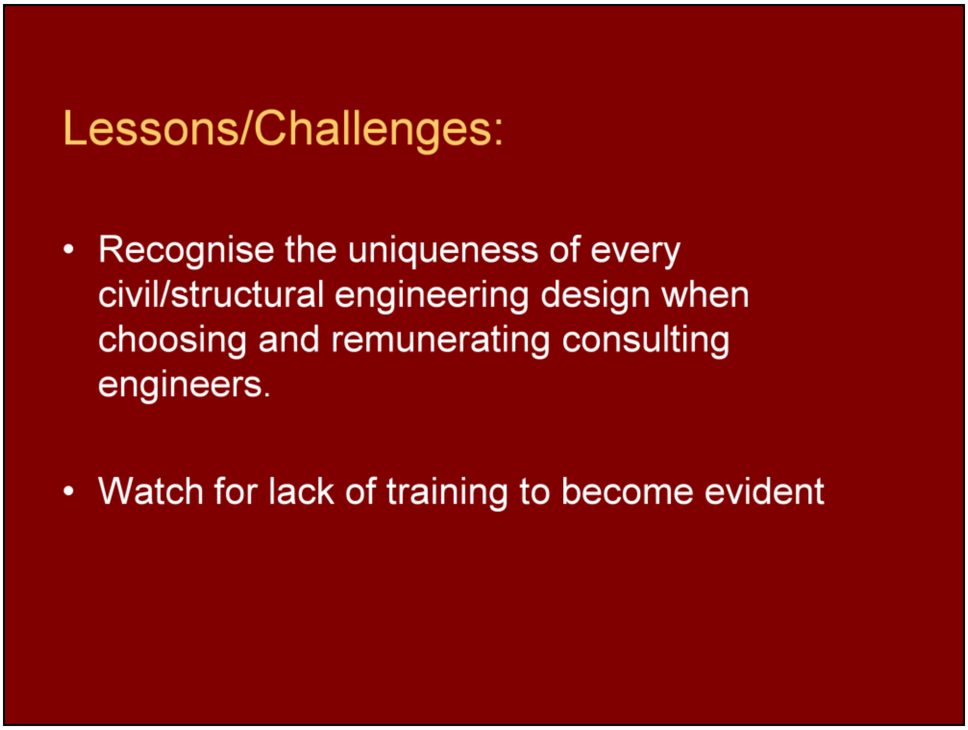
The end result of this pressure to work with unrealistic financial and time constraints is pressure on profit margins, with a resulting emphasis within the consulting firm on performance to their fee budget. This means less emphasis on innovation, technical development and training.

It is not unknown for consulting firms to budget less than 2% of salary on training, while struggling to keep promotional costs below 10% of salary. I believe that many in the profession feel trapped by this situation, and are all too aware of the possibly serious consequences in the longer term.

Firms prefer to buy in experienced staff rather than take on the responsibility of training them. Requests then go to the universities to turn out graduates who are more immediately useful – i.e. are trained in applications rather than fundamentals - something to be resisted strongly.

Interestingly, there are a few firms, usually small ones with niche skills, that spend very little on promoting themselves, other than through the quality of their work.

The giants of civil engineering's past, including Marcus Agrippa, Thomas Telford and John Roebling had a strong ethic of providing training and passing on skills and experiences to the following generation of professionals.



Recognise that consulting engineers face serious responsibilities. Give them adequate time and resources to safeguard your interests. Allow them time to understand your real problems and so come up with innovative cost-saving solutions. And time to train the next generation in the art – for that is what it is.

It is important that consultants and their clients find a way to redress the imbalance that currently exists. There is already evidence that lack of proper training is resulting in inferior products – leaking buildings being one example. Precast concrete floors could be another.

Photo: Harry Hopkins

4. Engineering failures

Observations

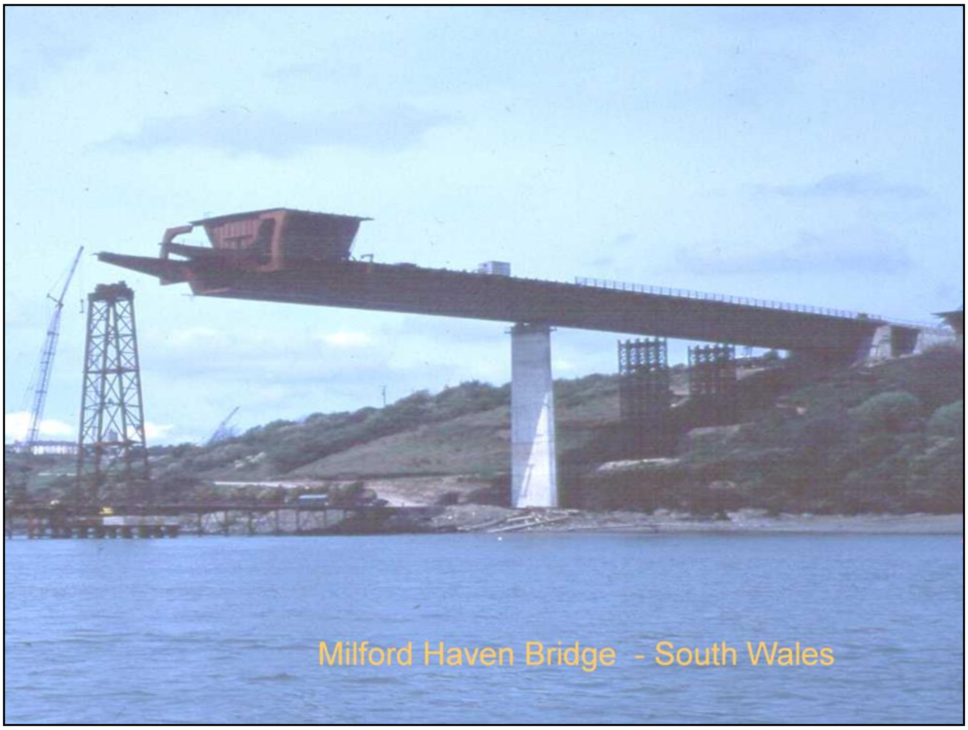
- Valuable source of lessons
- Each project a prototype
  - fun to address challenges
  - serious consequences of error

Engineering failures make great headlines. Such publicity for engineers is not good. But failures do provide a valuable source of lessons.

They remind us that civil engineering structures, at least, are usually prototypes, drawing and building on experience with similar but not identical projects.

The process of design and construction is done once only.

While it is fun to address the challenges, the consequences of failure are almost always serious.



1. One of my first jobs was to assist in the reconstruction of a major steel box girder bridge that collapsed during construction. Milford Haven Bridge.

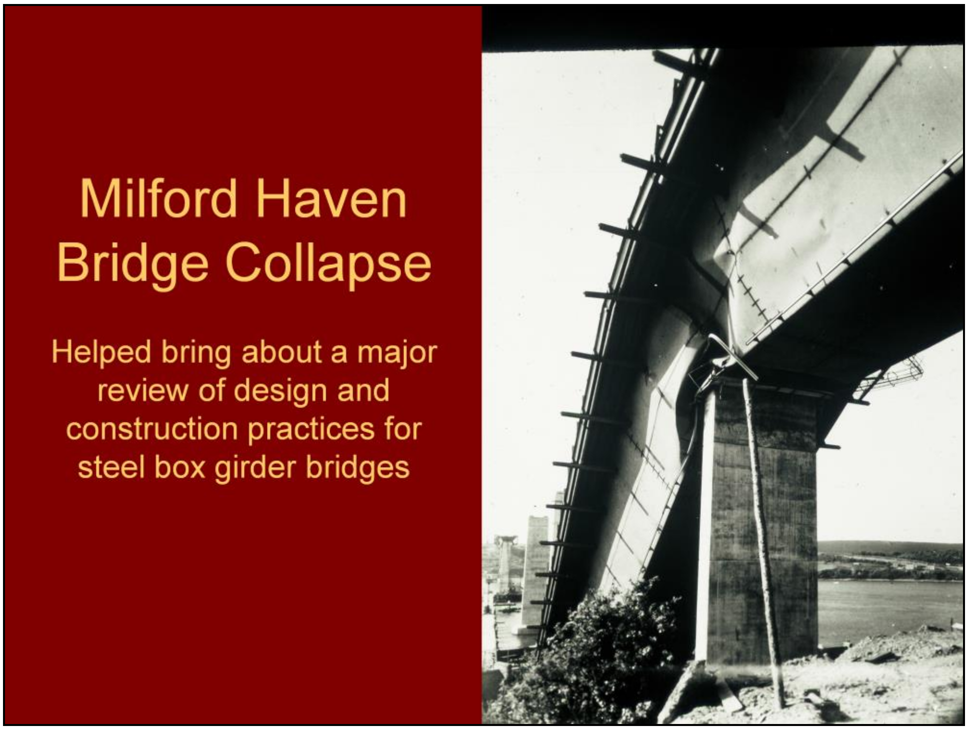
2. The climate of scrutiny of technical and managerial detail provided invaluable insights into the workings of major projects. It also produced in me a strong interest in engineering failures and the lessons that can be derived from them.

3. Safety factors during erection were allowed to be less than for in service.

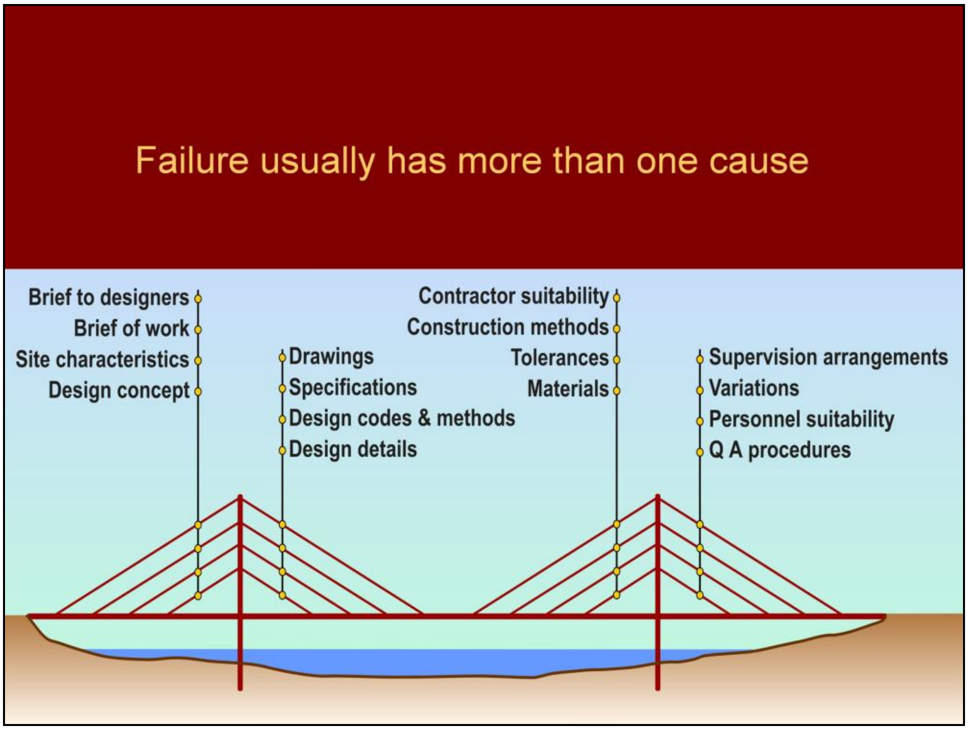
4. On the north side a stage was reached with maximum cantilever moments. The box was trundled out and successfully positioned over the intermediate support.

1. On the south side at the equivalent stage the bridge was ready for the last section to be trundled out the next day.
2. When the box was part of the way out, the section over the first pier buckled and the bridge went down, killing four people.
3. The collapse triggered a major revamp of design rules for steel box girder bridges, and delayed completion of the bridge by over two years.
4. The most significant factor in the collapse was that the south side was not built as accurately as the north and the misalignment of the pier support and the internal diaphragm precipitated the failure.

Photo courtesy John Evans, Contractor’s Engineer



A sorry sight for anyone, but especially a consulting engineer or contractor.



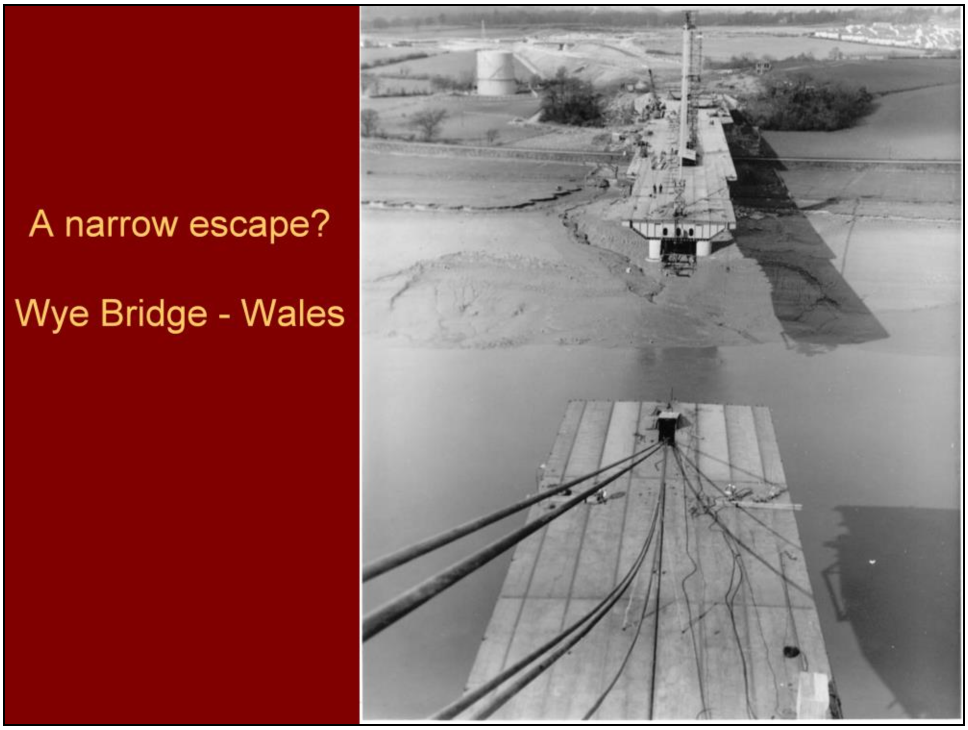
A consistent lesson from engineering failures is that normally no single factor is the cause. Each project has vital supporting strands.

Each project is unique and thus a prototype.

For major engineering works, consequences of failure are significant.

Whatever fun there is in designing structures to serve the community and resist the forces of nature (and for engineers there is lots), there is a corresponding seriousness in the responsibility taken.

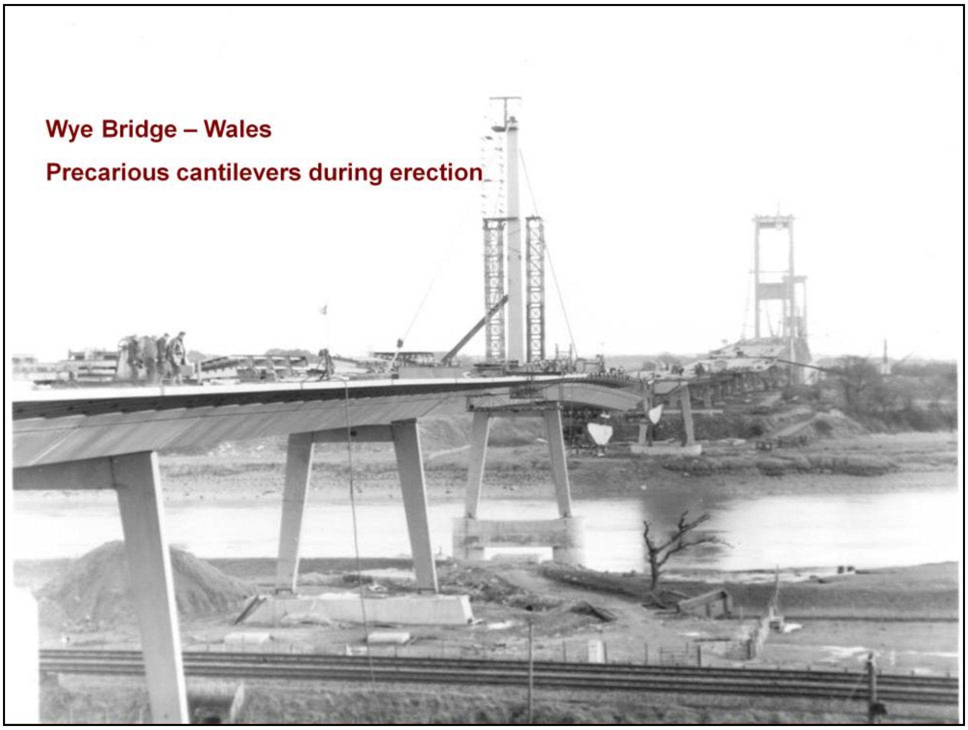
There can be no fudging the issues. It is difficult to draw parallels between the technical work of engineering firms and accounting or business firms such as Arthur Andersen, Enron and Worldcom.



An example of a near miss?

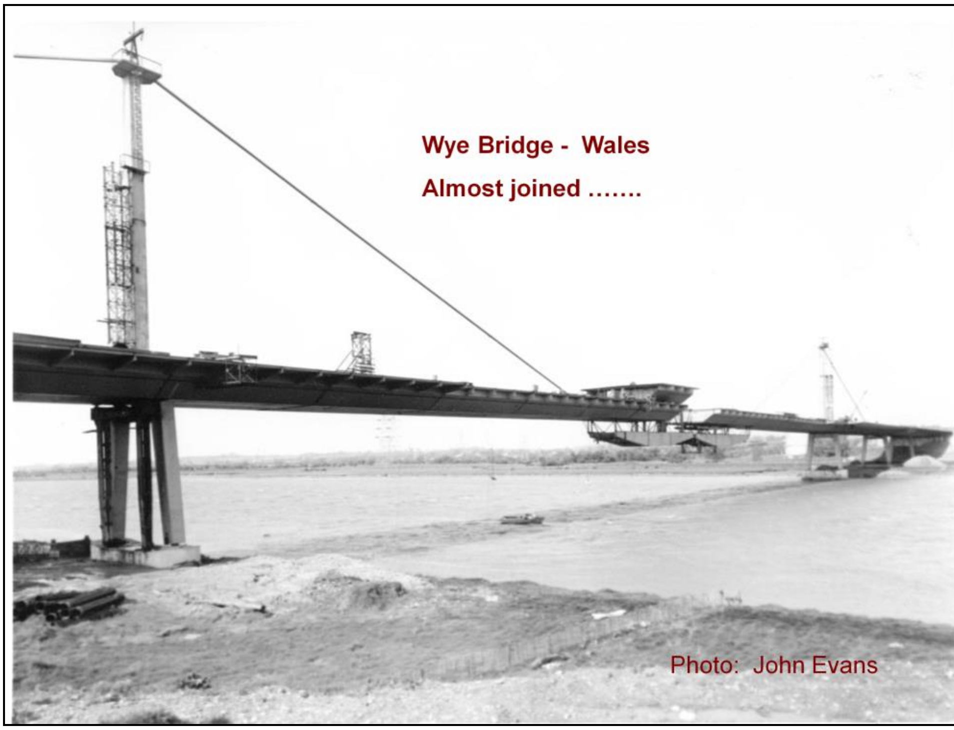
- Construction of the Wye Bridge involved cantilever erection from each side. Reduced factors of safety again applied for the erection process
- The contractor’s engineer was aware of the demands this placed on the bridge and temporary works
- The scale of his responsibility is apparent from the picture

Photo: Courtesy John Evans, Contractor’s Engineer



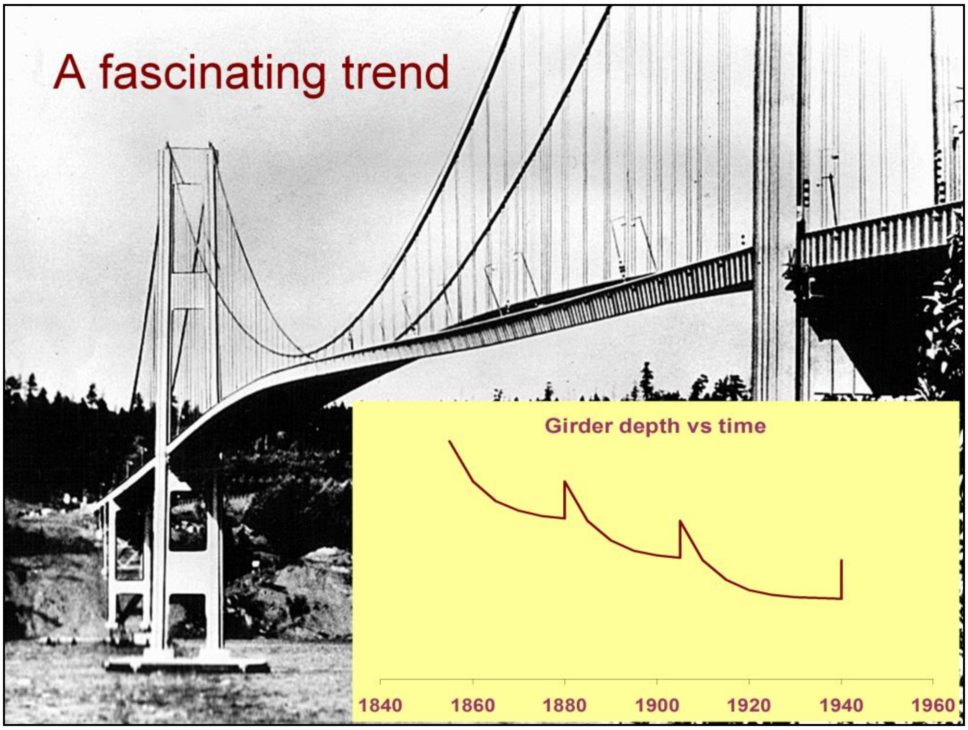
1. The precarious nature of things during construction can be seen from this picture.
2. Note the large deflections of the cantilever, and the heavy weights on it.

Photo: Courtesy John Evans, Contractor's Engineer



1. Imagine now that the last box section has been placed, but not connected to the cantilever on the other side. From a distance the bridge would look connected.
2. The Contractor's Engineer, John Evans, went out to measure the small gap between the two sides in order to determine the detailed procedure to make the connection.
3. As he was taking measurements, he felt and heard a rumbling sound behind him
4. He noticed that his cantilever was moving down in relation to the other side
5. He had thoughts of impending disaster
6. He turned around to see a fully laden asphalt truck driving out on to the cantilever
7. He ran very fast waving his arms for the truck to stop.
8. It did. And backed off.
9. "I thought I could drive across to the other side, now you've got all the boxes in position" the driver said.
10. "Expletive deleted" said the engineer as his pulse began to return to normal

Murphy's Law in action – but thwarted this once!



A fascinating trend:

Most people are familiar with the failure of Tacoma Narrows suspension bridge – galloping Gertie. This resulted amongst other things through not having a stiff enough deck structure. But how stiff is stiff enough?

Some years ago a researcher produced a diagram to show how the depth of of stiffening girders for suspension bridges had varied over time. The saw-tooth shape is remarkable. It shows an overall downward trend punctuated by sudden jumps. Well, guess what, the sudden jumps follow notable failures. And more fascinating still – the gap between the failures is around 30 years – about the living memory of a consulting engineer!

This graph points to the propensity for engineers and human beings to progressively refine things. In this case there was a set back each time there was a failure. But the long term trend was down.

This propensity to refine was a contributory factor to the collapses of steel box girder bridges in the 1970's. With each successful construction, came the thought that the factor of safety allowed in construction (or some other aspect) could be trimmed. This was fine until an adverse combination of circumstances brought about failure.

Lessons/Challenges

- Avoidance of failures requires:
  - Holistic imagination
  - Understanding of fundamentals
  - Attention to detail
  - First class technical skills and insights
  - Careful and proper organisation
  - Exemplary communication
  - Use of available experience

Failures result from a variety of factors.

Avoidance of failures requires:

Holistic imagination

Understanding of fundamentals

Attention to detail

First class technical skills and insights

Careful and proper organisation

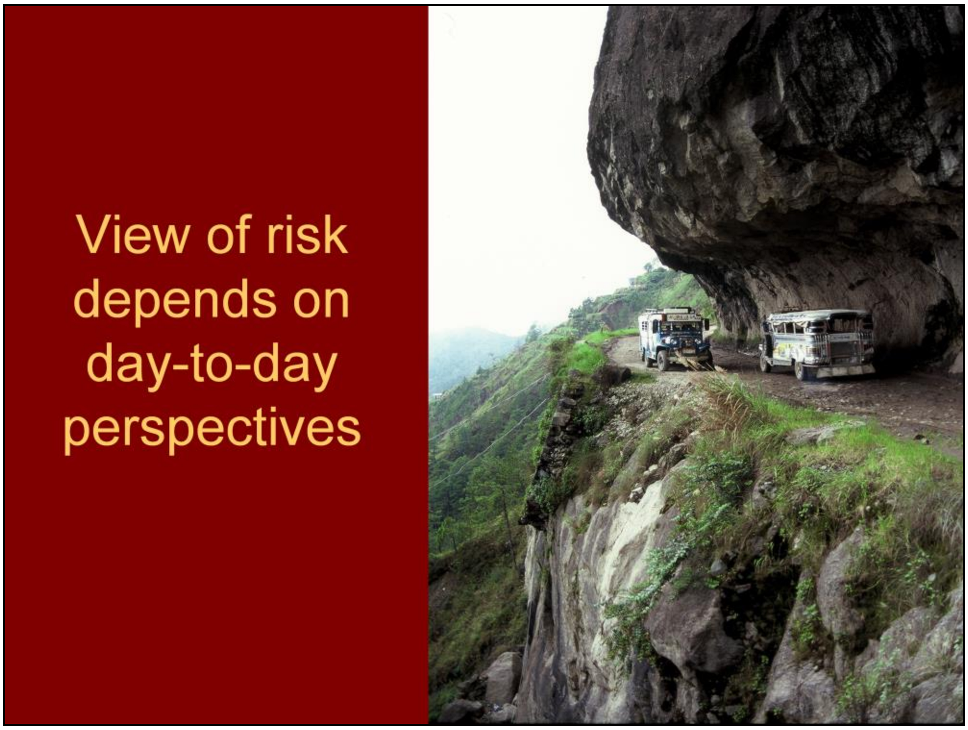
Exemplary communication

Use of available experience

Photo: Harry Hopkins

Earthquake risk mitigation is a pet topic for me. I want to share some thoughts on that with you:

- Combined earthquake hazard maps for Wellington
- Engineering Lifelines project for Wellington
- City Aware project – also in Wellington



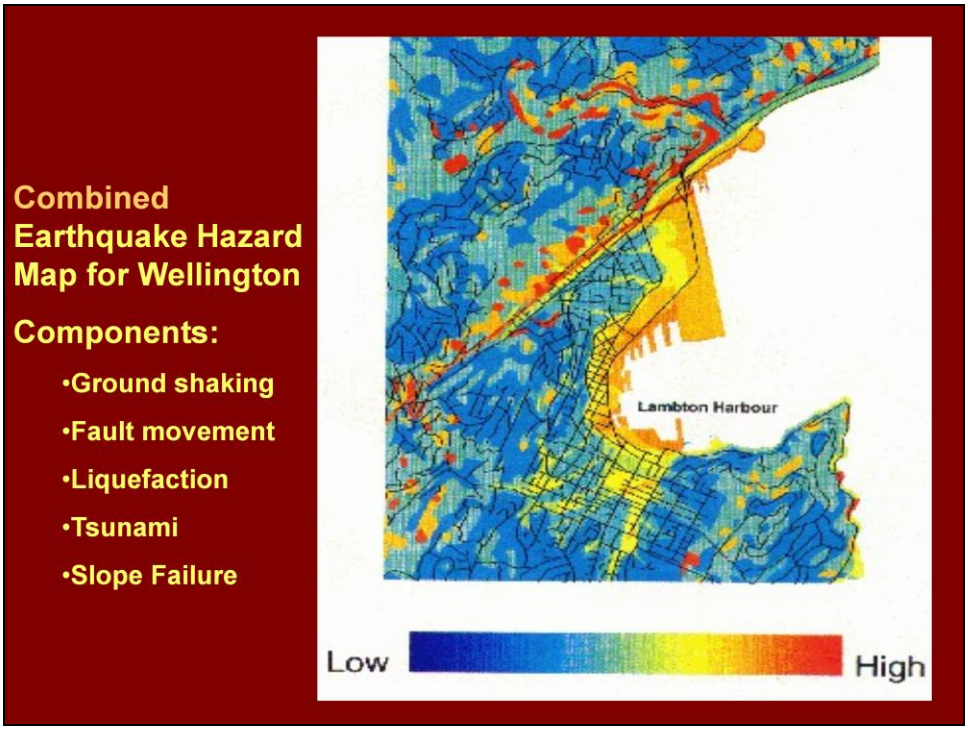
A person’s view of risk depends on risks faced every day.

- Someone who carries vegetables to market on this road will have a different perspective to most of us.
- Someone who celebrates the end of each day because they found enough to eat is unlikely to respond to even the most sound reasoning on the need for earthquake risk mitigation, even if it for the local hospital or school.

1. New Zealand has an enviable reputation in the field of earthquake engineering. In the structural field this is due in no small measure to the influence of Professors Tom Paulay and Bob Park of Canterbury University, who gave their students remarkable insights into structural behaviour and the importance of both concept and detail. Many others in teaching, research and in practice have reinforced this through the years.
2. There is something in the pioneering heritage of New Zealanders that causes them to want to understand the fundamentals and to address them as economically and effectively as possible. This has resulted in development of earthquake codes and legislation which, although drawing on international and especially US experience, have their own unique NZ flavour. Concepts such as capacity design, in which columns of multi-storey buildings are designed to be stronger than the beams, were developed here and have found ready acceptance in other parts of the world.
3. For four or five decades after the Napier earthquake much of the focus of earthquake engineering was on structures. But the last twenty years have seen an enormous broadening of what is recognised as earthquake risk. Failing structures still account for most of the deaths in a major earthquake and much of the mayhem,

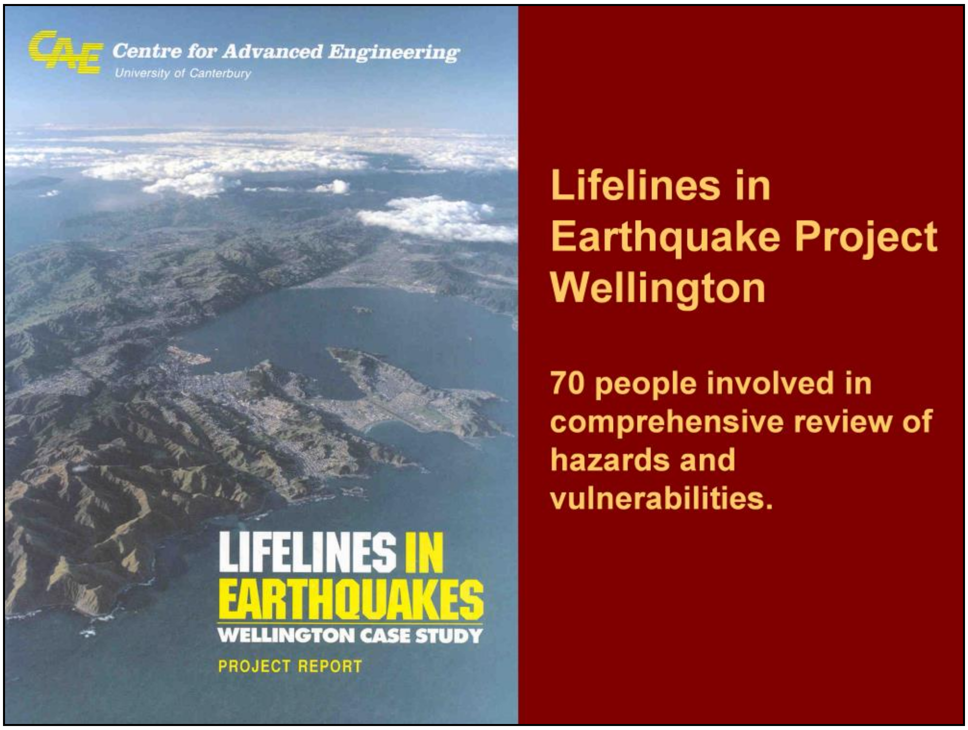
but the viewpoint has now shifted towards that of building **resilient communities**.

4. No longer is it seen as acceptable to consider only what happens to physical assets. The impact of the physical loss on the community is the key issue to be addressed. This has brought in many other professionals under the banner of "earthquake engineering". This includes lifeline managers, social scientists, risk analysts, insurers, emergency management professionals, and business continuance planners.

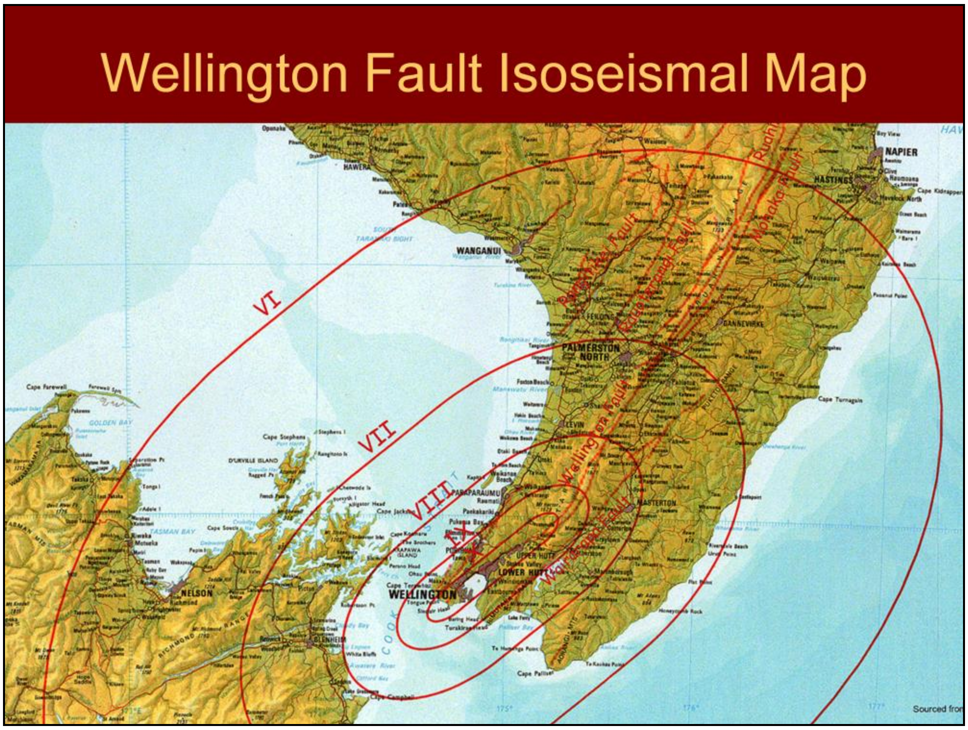


1. Research in geology and seismology has provided increasing knowledge and understanding of the earthquake phenomenon. Geographical Information Systems (GIS) have exploded in their range of application over the last two decades and particularly in the last decade.

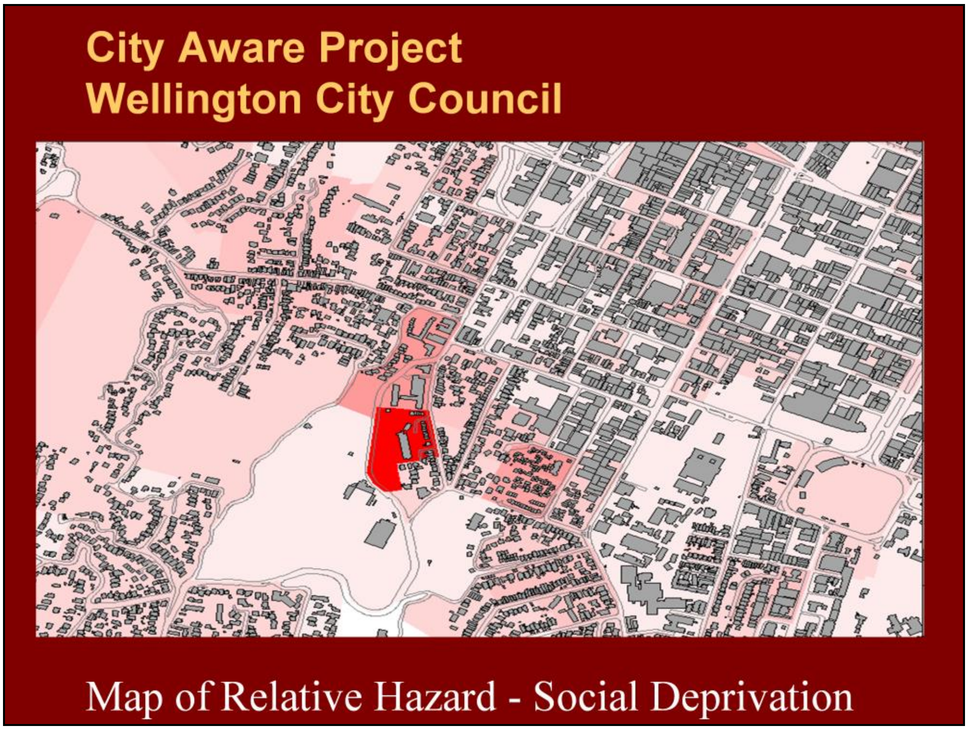
2. The ability to assemble and display data in pictorial and map form has aided the dessemination of this new knowledge. More importantly GIS technology has allowed information to be presented in ways that bring the message home to those needing the knowledge for planning, design or other purposes.
3. An example of this is the combined earthquake hazard maps for Wellington produced by the Wellington Regional Council.



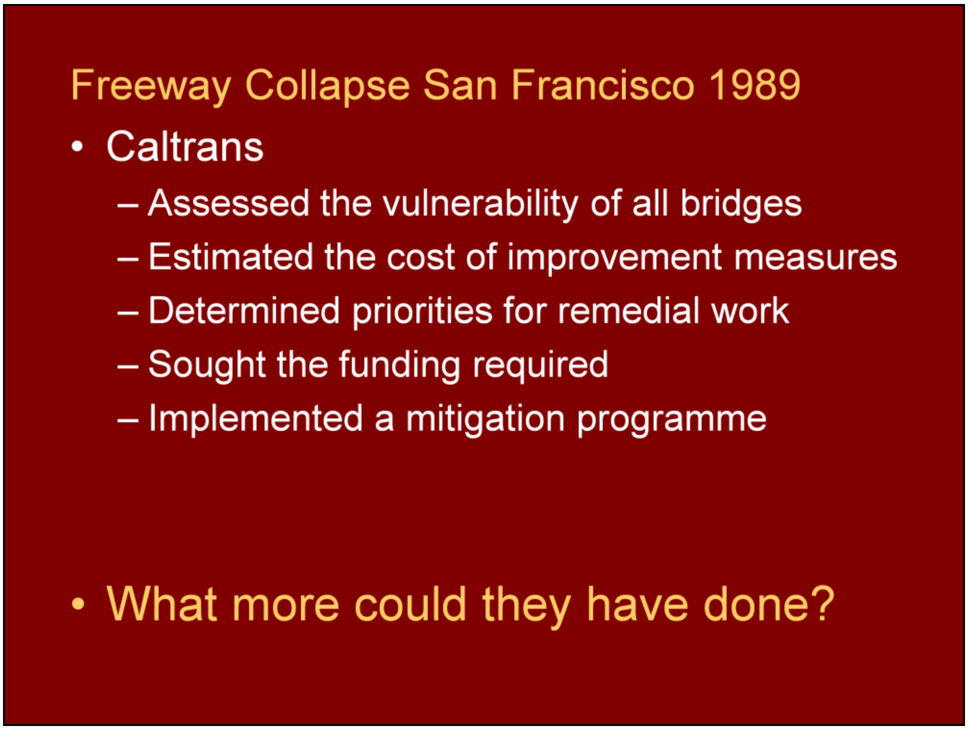
1. But the power of GIS is not limited to the ability simply to present information. The assembly and visual representation of information provides researchers and practitioners with fresh insights into the issues involved.
2. This was graphically illustrated during the Wellington Lifelines in Earthquake project in 1990. For the first time graphical information on the hazards could be laid over the assets at risk. Lifeline managers gained a much better appreciation of the risks their assets faced, and a ready means to communicate that to their councils and boards of directors.
3. The last decade has seen a significant number of developments in making Wellington's lifelines more resilient in earthquake. It has also seen 17 other lifelines projects initiated around the country with a remarkable building of awareness of the risk to the community.
4. An unexpected by-product of the Wellington Lifelines Project and others is that the examination by managers of earthquake vulnerability resulted in improvements in handling more common risks encountered in the day-to-day operation. Not least of these spin-offs was a better knowledge of their assets and their general condition. Perhaps more significant was the bringing together of lifeline managers to meet each other and share their ideas, approaches and concerns.
5. Recognition of these benefits has led to the formation of lifelines groups in Wellington, Auckland, Christchurch, Wairarapa, Hawke Bay, Dunedin and elsewhere. There can be no doubt that these communities will benefit from the efforts of those involved when the hazard event occurs. **But, as I have explained, they are already benefiting.**



1. Application of GIS has provided the means to graphically display the earthquake risk to communities.
2. The City Aware project in Wellington provides some insight into this field and the intricacies involved.
3. It starts with modelling an earthquake event in terms of ground acceleration or movement. The picture shows how the intensity of earthquake shaking due to movement of the Wellington Fault reduces with distance from the rupturing fault segment.
4. On to this map building stock is added, in this case building by building. Numerous characteristics of each building can be stored including the type, age and materials. Such things as the area, number of floors and occupancy (daytime or night-time) are included in the data base.
5. Characteristics defining the earthquake performance of each building are added defining how much damage is likely for each intensity level. The same is done for likely injuries, deaths and other factors including social deprivation.



1. When this mix is integrated over the whole city, it is possible to draw maps of the intensities of damage, injury, deaths or even social deprivation.
2. This analysis provides a possible scenario following a major earthquake. It is not a prediction, but even in advance of the event, the information can be used in many ways. These include planning of hospitals, securing of emergency services premises, recognising the need to improve the performance of key assets and so on.
3. The City Aware project gives an indication of the sophistication involved in the analysis.
4. Much greater sophistication is possible – if it can be justified.



Damaging earthquakes are low probability high consequence events that occur very infrequently in any one community.

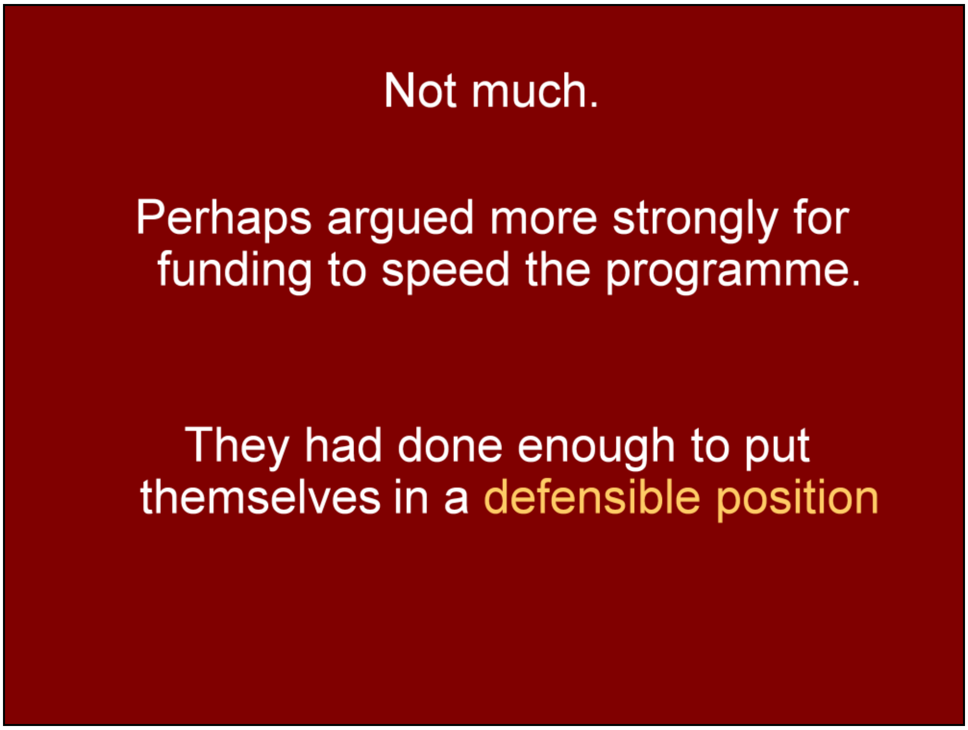
But earthquake risk is something that each of us has a responsibility to address.

The question is what to do now for an event that may not occur in our lifetime.

The question that organisations and individuals must ask themselves and then respond to is:

"*Given the state of knowledge of earthquake risk and the likely expectations of the community, are we in a* ***defensible position*** *should a major earthquake occur?"*

1. Consider the case of the freeway collapse in San Francisco in the Loma Prieta earthquake in 1989. Caltrans engineers were responsible for the earthquake performance of all of California's bridges. The dramatic collapse of a major section of elevated freeway, with attendant injuries, loss of life and disruption to transport networks, could, on the face of it, be seen as a failure on their part to address known risks adequately.
2. However, it emerged that Caltrans had done a survey of all bridges, identified the vulnerabilities, determined the nature and cost of repairs, and on the basis of this and the importance of the bridges overall, had prioritised the repairs in a comprehensive programme of strengthening. Each year they had sought funds to implement the programme, and each year they carried out the work according to the assigned priorities. Unfortunately the earthquake came before they reached the I880 freeway.
3. What more could they have done?



1. Maybe they got their priorities wrong, and may be they should have pressed for more funds to speed the programme up.
2. But the key point in their ***defensible position*** is that they had recognised the risk, had taken steps to assess the consequences, had established a prioritised programme of repair, and were implementing it according to funds available.
3. In establishing the programme they communicated the risk to community decision makers responsible for allocating funds.
4. That request for funds no doubt needed to be balanced with other community needs on the basis of the perceived relative importance of earthquake risk to the community.

1. Take earthquakes seriously.
2. Do what the community expects of you to prepare. This may not be much. But it will probably not be nothing.
3. All organisations to take a serious look at the earthquake risks they face.
4. They should take action sufficient to put themselves in a ***defensible position*** should a major earthquake occur soon.

Photo: Harry Hopkins

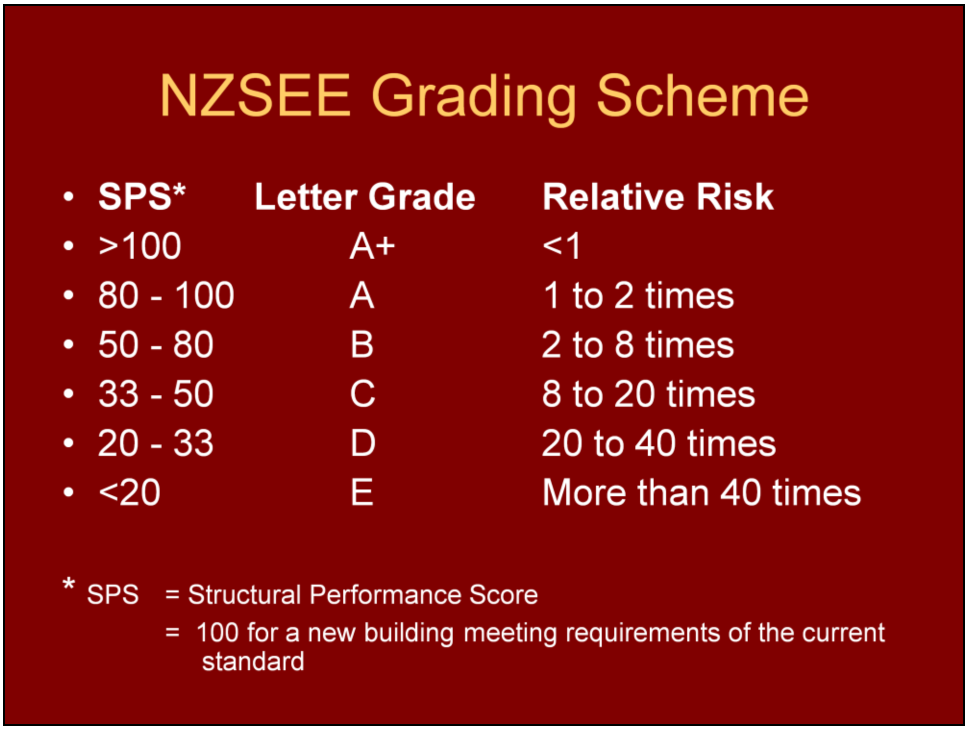
1. Every time there is a major earthquake in a city overseas, we see spectacular and sickening building collapses. More often than not, the prime cause is a critical structural weakness such as a soft storey or plan irregularity. Regular, well detailed buildings, particularly those with shear walls consistently perform well.
2. These overseas failures are a reminder that the same could happen in New Zealand. Yes, we have good codes and a design and construction industry with a strong record of compliance. But we still have buildings that will not perform well in earthquake because of critical structural weaknesses.
3. Building codes in NZ have developed over the years and it only since 1976 that codes made what is now regarded as proper provision for structural detailing and hierarchy of failure of beams and columns. Thus there are numerous buildings that do not comply with current code. Even those built after 1976 cannot be automatically exempted. Pressures to create open spaces, to provide garages, to allow panoramic views, to meet budget constraints and/or simply to maximise profit from the construction can result in buildings with the same critical structural weaknesses that exist in buildings overseas.

Over recent years this issue has been addressed by a Study Group of NZSEE that has developed:

- A method for quick and easy assessment of structural performance in earthquake.
- Detailed guidelines and recommendations on improving the structural performance in earthquake.
- Studies of the cost benefit of improving the structural performance of buildings in various parts of the country.

  This work has been in response to NZSEE initiatives to examine the issue, and the development of proposed new legislation extending coverage to all buildings (other than small residential ones). The proposed legislation would require all buildings with less that 33% of the strength (performance capacity) of a new building to be improved or demolished within a specified time.

- A proposed grading scheme to be applied to all buildings. The aim is to increase awareness of earthquake risk generally and to underpin legislation with a market-forces approach……



The Grading Scheme would result in a Grade A, B, C, D, or E – sound familiar?

The idea is to have this grading on the title of a building, or readily available through a LIM or PIM so that awareness of earthquake risk is developed in the community. Market forces could then, to some extent, drive earthquake risk mitigation. If an owner of a building of Grade D found that tenants were shying away, there could be a case for upgrading the building. This would only happen if the owner saw a worthwhile return on the investment required.

It is important to realise that the 33% figure represents only the worst of non-complying buildings in New Zealand. For buildings of 33% strength of new ones, the risk is approximately 20 times that for a building complying with the new building standard.

This means that even with the new legislation, there will be many buildings that do not comply with new building standard, but which will not be legally required to have their structural performance improved.

Lessons/Challenges

- Keep earthquake risk in balance with other risks and day-to-day priorities
- Professionals must communicate risk in a way that allows sensible decisions that will stand up to the wisdom of hindsight

1. Keeping earthquake risk in balance is difficult

2. Professionals have an obligation to the community to communicate the risks consistently in a way that allows sensible decisions to be made on day-to-day approaches.

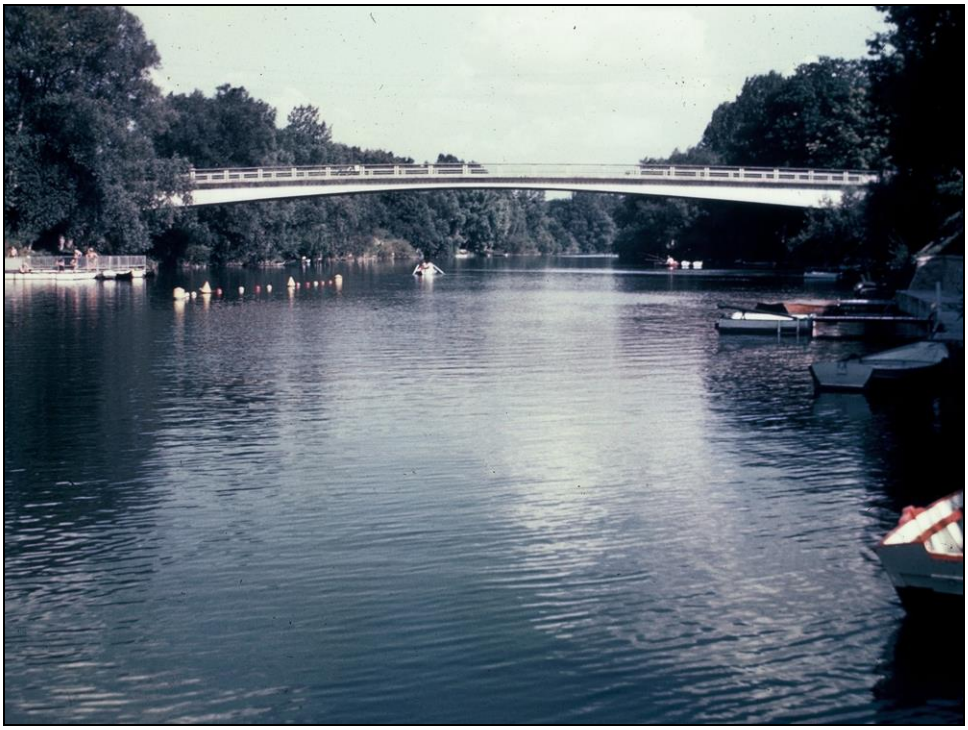
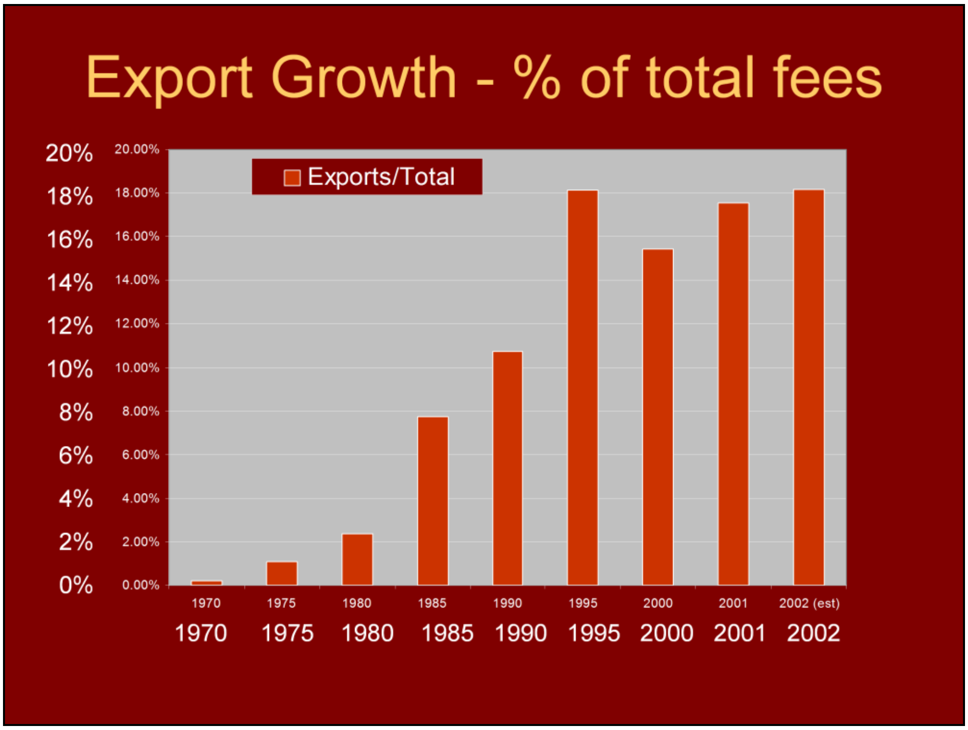


Photo: Harry Hopkins

1. NZ engineering consultants are highly respected for their attitude and all round practical knowledge.
2. Most consultants here are exposed to a wide range of activities related to their special interests. The small market does not permit narrow specialisations that exist in larger economies.
3. Such practical breadth is invaluable when technical challenges of a remote village in a developing country have to be met. For example, the engineer who is regarded as a structural design specialist in NZ, is able to cope with a range of issues from water supply to geotechnical investigations, at least to deal with day-to-day challenges.
4. There is also something in the NZ psyche that gives New Zealanders empathy with those in developing countries.



1. NZ consulting engineers have been involved on the international scene for over 3 decades. The progress of this involvement is shown.

2. It can be seen to be about 20% of all business, and still on the rise. Some firms will have a much higher percentage.

3. What will this figure rise to? No one knows. But there is plenty of room for it to increase before it becomes unsustainable through a lack of an adequate home base market. Make no mistake, involvement in overseas projects, even with the modern communication technology, takes tremendous effort, funds, human resources (usually of the most senior and experienced personnel), time and patience.

4. The increasing involvement of NZ engineers in overseas work is a reflection of the energy and enterprise of engineering consultants, and particularly of the leading firms and their leaders.

1. Much, but by no means all, of the work done by NZ consulting engineers has been in developing countries, notably Asia and the Pacific. The challenges faced by these nations to improve their standards of living are enormous. There are two key areas:
   - Development of industry and supporting infrastructure
   - Development (and in some cases establishment) of viable governance – institutional strengthening in the words of the development banks.
2. It is easy to see that there is a role for consulting engineers in the first. The requirements for energy, roads, ports, airports, water supply, water treatment, housing, hospitals and schools offer huge challenges and opportunities, added to which is the need for engineering in the development of industries. New Zealand consulting engineers are well represented in this development. It takes only a small proportion of the overall market to satisfy even our wildest ambitions.
3. The second major area requires not just engineers but a full range of advisers – financial, legal, legislative, tax, health, education, insurance, local government, building codes and so on. In these areas, NZ has more to offer than is commonly realised. The government reforms in NZ since 1984 have given many people here experience of putting new structures of ownership and management into place.
4. In many government agencies and elsewhere there are people who have the potential to provide advice – that is to become consultants. Maybe not full time

consultants, but we need to recognise that their skills and experience are saleable and develop a mindset within government circles that allows these key skills to be made available readily.

International design and documentation

- Drawings done by computer and easily transmitted or available on websites
- Analysis data and results easily sent internationally
- Cheaper but very capable resources available overseas
- Implications for NZ firms and individuals

1. Engineers produce drawings, specifications and contract documents – amongst other things. All documents and almost all drawings are now done on computer. It is possible for a drafter to produce a drawing in Bombay and send it to Wellington immediately for review by the designer.
2. For some years now, large US architectural and engineering practices have been using drafting firms based in India, Philippines, Indonesia and elsewhere to produce the bulk of the drawings for major projects.
3. The skills available from these overseas specialist firms are comparable in most respects to what is available locally. But the cost per hour is 25 to 50% of the local rates. For large jobs this cost differential provides ample margin to pay for the additional management, oversight, communication and travel involved in delivering the requisite quality.
4. It is not just drawings and specifications. Imagine the complexity of the structure of a modern Olympic stadium, say in an earthquake prone country. It is possible to send all the geometrical and loading data electronically from UK to NZ in order for the earthquake engineering specialists to analyse the structure for earthquake effects and develop design concepts and details for earthquake resistance.
5. So, we have, at least, a two-way street. NZ firms getting drafting done in Malaysia or India where the requisite skills are available at lower cost, and UK firms sending material to NZ to take advantage of our specialist knowledge - and our cheaper rates.

An example:

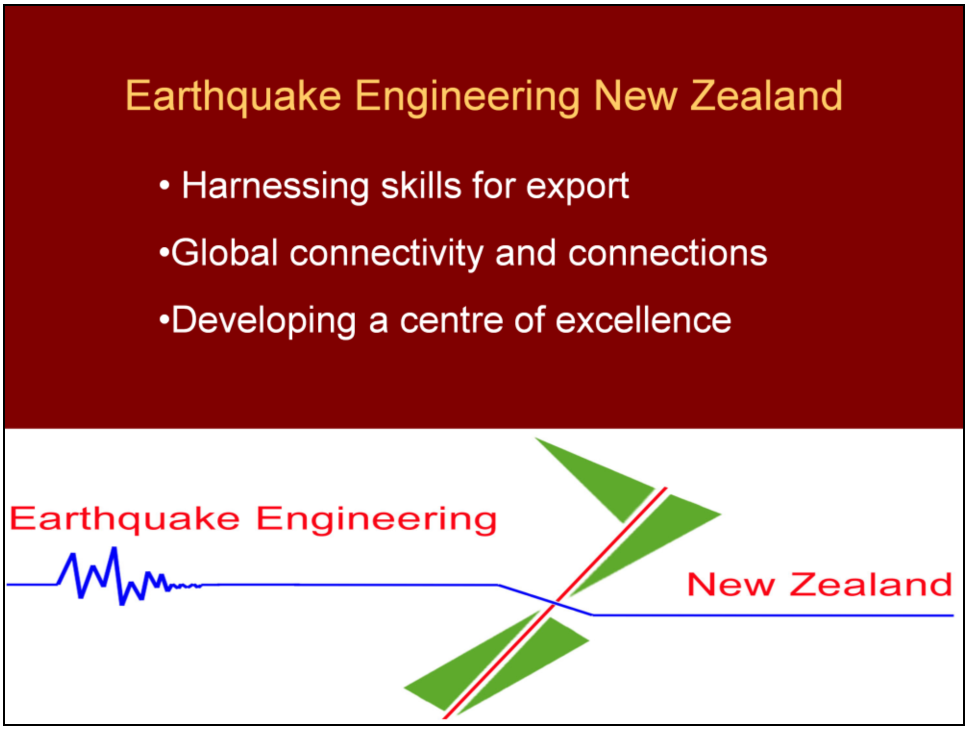
Project Manager in UK …….

….engineer in NZ………

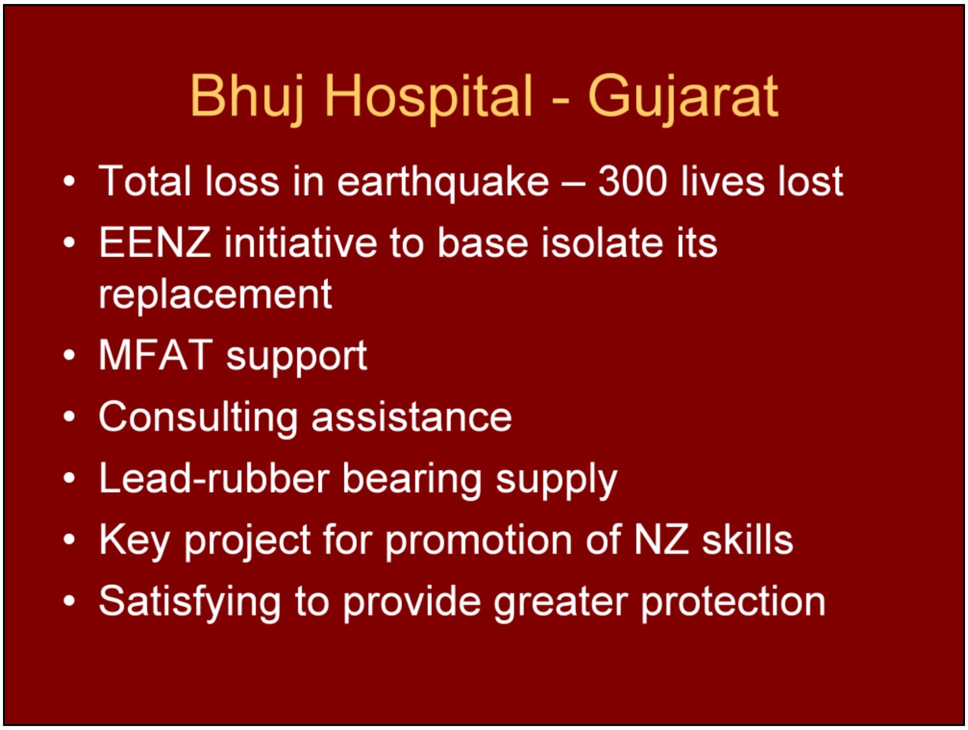
…..drafter in Malaysia ….

…… project in Greece

But this SKM example is sobering reminder of what globalisation really means: Our Malaysian partners, and their local competitors were getting drafting done in India !



1. There is definitely a role for NZ in this global economy with its internationally branded firms. But we New Zealanders must work out what that role is. And then work at making it happen. No one else is going to do it for us.
2. A promising development in this regard is the intitiation by Wellington City Council and TradeNZ of an earthquake engineering technology business cluster. This is a group of professionals throughout NZ who look to apply their niche skills to overseas work. The focus is to obtain work that would not otherwise be available to the member firms individually. It is a pooling of knowledge and expertise of New Zealanders – both those based here and those offshore. Earthquake Engineering New Zealand we call it. EENZ Logo.
3. EENZ is essentially a marketing network. It does not undertake contracts in its own right. When an opportunity is identified or created, those member firms that can see worthwhile potential business in it, in spite of the efforts necessary to win from a distance, will elect a lead firm and invest their own money and time in pursuit of the prospect.
4. EENZ acts as a catalyst, clearing house and an incubator/disseminator of ideas. It is not just for engineers. Insurers, emergency management professionals, researchers, scientists, management consultants and any group that can see potential in applying their skills are members.
5. The potential benefits of this group extend beyond earthquake engineering. NZ earthquake eingineering skills and expertise are highly regarded internationally and provide ready access to key decision makers in many countries. The goodwill generated and the network of high level contacts can be used to identify and pursue opportunities for other engineering disciplines, and for other NZ organisations in general.



It is in this area that the support of Government through TradeNZ, Industry NZ and MFAT can and do play a significant part.

Bhuj Hospital in Gujarat is a worthwhile example to illustrate this point:

Bhuj Gujarat India - 26 Jan 01

On Independence Day, 26 January 2001, Gujarat suffered a strong earthquake, causing over 18,000 deaths and injuring over 160,000 people. The earthquake destroyed over 300,000 houses and damaged a further 800,000. 100’s of thousands were left homeless.

Amongst this mayhem, a key 300-bed hospital at Bhuj was destroyed with almost total loss of life of those within the building. By a strange quirk of fate, most of the nurses doctors were largely outside the building at the time of the earthquake. They were outside the building at a flag raising ceremony.

Bhuj Gujarat India - 26 Jan 01

It does not take much to imagine the sickening sense of helplessness following such an event.

NZ MFAT was moved to donate some aid money to Gujarat for victims of the earthquake.

With the help of EENZ, and funds were made available by MFAT to bring the designers of the replacement Bhuj hospital to NZ to help them incorporate seismic isolation. *(Dr Richard Sharpe played a key role in making this happen.)*

MFAT paid for an Indian architect and a structural engineer to come to NZ, paid for the NZ engineers to provide design advice and for them to visit the site periodically to monitor the design and construction process.

Quite separately, a NZ manufacturer of lead-rubber bearings, Robinson Seismic, used their knowledge of the project and their competitive international position to bid for the supply of the bearings for Bhuj Hospital. They obtained the $1M plus contract.

This key hospital is due to be opened on Independence Day 2003 and will be a showcase for New Zealand Earthquake Engineering technology in India and elsewhere.

MFAT's funding has also allowed for some follow-up training of local professionals.

Thus, much has been done to promote NZ expertise, and Bhuj Hospital may well provide an example for many other similar projects in earthquake prone areas of India. New Zealanders may participate directly in some, but there will no doubt be many others done by locals, building on their experience on the design and construction of Bhuj Hospital.

Regardless of the degree of future NZ involvement, there is a real possibility that this relatively modest MFAT initiative and contribution will in time be seen as the catalyst for a significant contribution to the reduction of earthquake risk in India.

Should that prove to be the case it is something from which all New Zealanders can derive satisfaction.

For the engineers involved in situations like this, there is the satisfaction of having used their skills to help others not just to build something, but to learn a new skill that will have ongoing benefit.

This achievement, like many other projects carried out by New Zealand consulting engineers, required enterprise, courage, and commitment.

Such projects also require successful business skills to stay in business and thus to continue to make their skills available.

They require the serious application of engineering principles and practice.

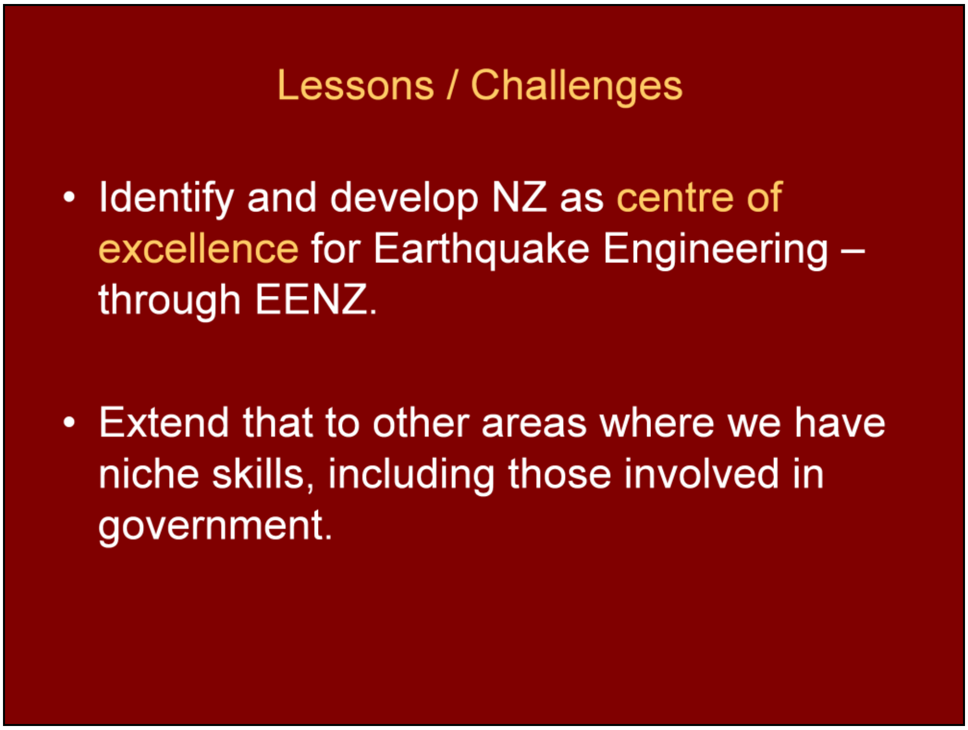
They involve the challenge, and fun, of travel and cultural exchange, even in the tragic circumstances existing at Bhuj.

Must make use of our NZ based skills and sell internationally

Must make better use of expat network – actively

Must become more visible internationally

Think globally. Organise locally. Act internationally.



Identify and develop NZ as centre of excellence for Earthquake Engineering – through EENZ.

Extend that to other areas where we have niche skills, including those involved in government.

Photo: Harry Hopkins

Former President Clinton of USA visited NZ earlier this year and emphasised the importance of trade and aid in fighting world poverty.

It is hard to argue with that.

As the various communities of the world become closer through ‘globalisation’ we each become more aware of the conditions faced by the other 6 billion people on earth.

If New Zealanders were to plot themselves on the graph of international quality of life they would surely be amongst the most fortunate.

Certainly, in consulting engineering terms we have the skills and resources to contribute to this global effort.

Through trade and aid.

If this isthe way of the future, as Bill Clinton says, then it points to immense opportunities for NZ engineers.

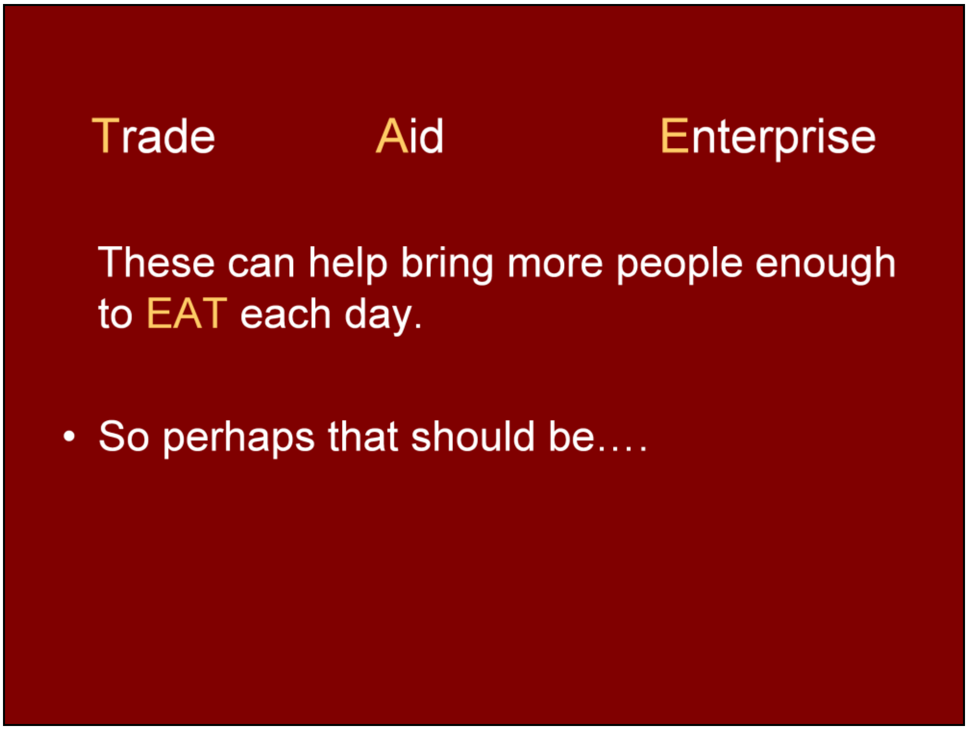
Trade requires industry and development which in turn requires engineering skills and advice to be successful and efficient.

Aid will undoubtedly continue to involve the development of infrastructure and industry in developing countries.

But there is one other ingredient that perhaps binds them or makes both possible, and that is **enterprise**. This requires risk-taking initiatives to create goods and services and thus wealth.

It will take enterprising individuals and organisations to make the most of the global market place.

- To set up the industries.
- To develop natural resources.
- To trade.
- To deliver effective aid.

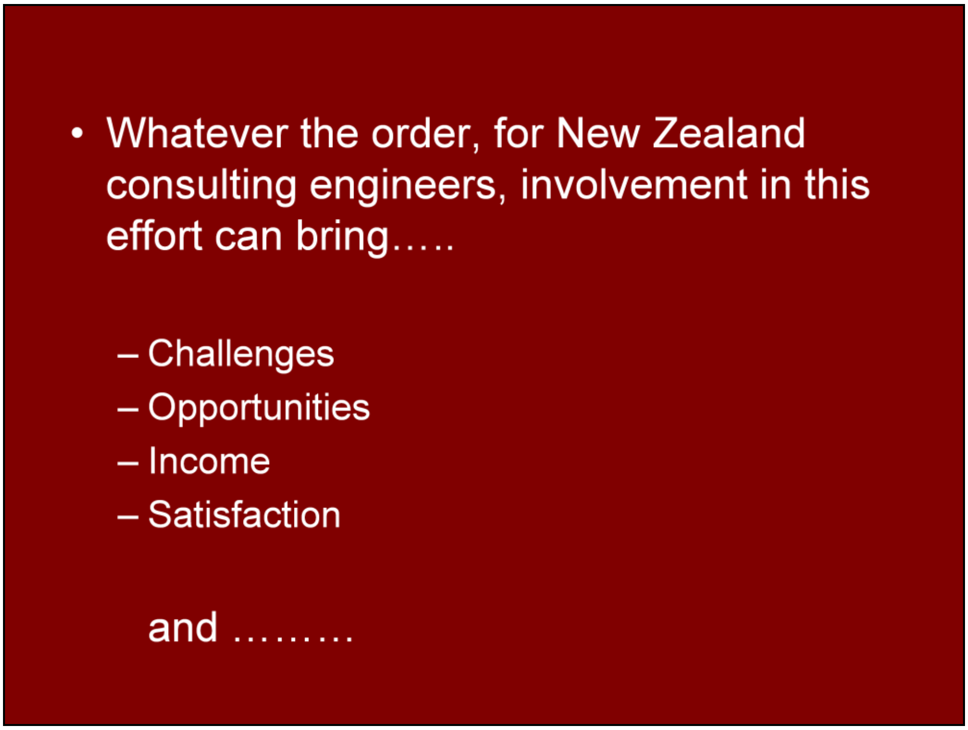


Trade, Aid and Enterprise offer much through which the NZ consulting engineer can contribute to the global community. Organisations like Enterprise NZ Trust with their Young Enterprise Scheme are helping strengthen NZ’s enterprise culture. So you can expect New Zealanders and consulting engineers, in particular to continue to play their part in all three.

These efforts will contribute to bringing more of the 6 billion a better life and enough to eat each day.

So perhaps that should be Enterprise Aid and Trade – in that order.

Enterprise Aid Trade



Whatever the order, for the consulting engineer, this brings…..

Challenges

Opportunities

Income

Satisfaction

and ………

…..Serious Fun

- The overall challenge is **serious.**

- But tackling the engineering issues is **fun.**

Thank you

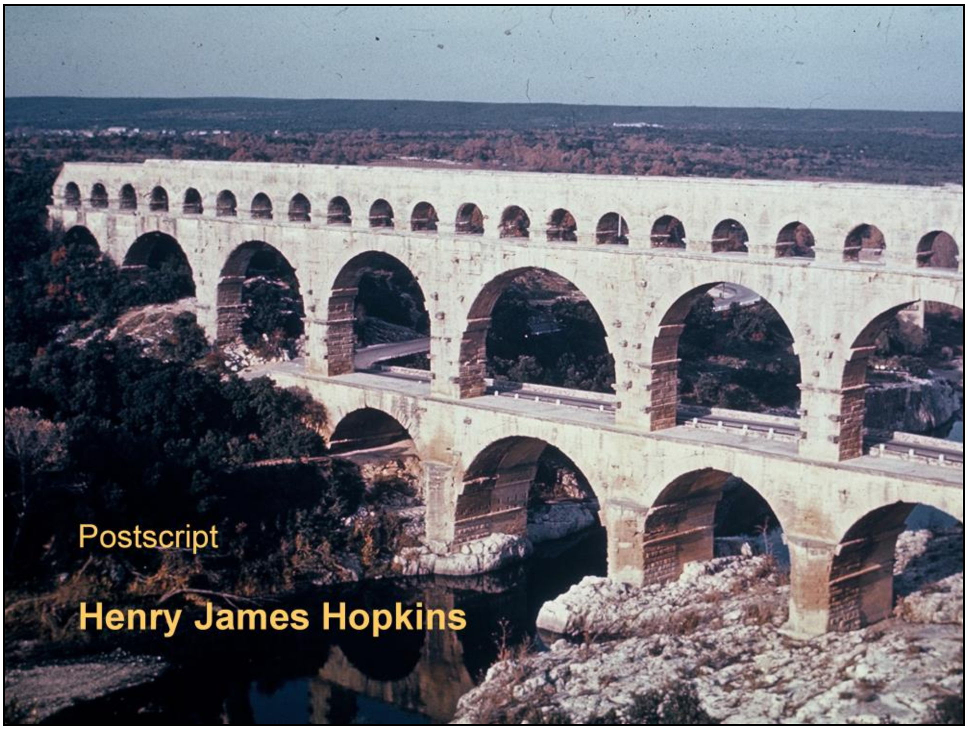


Photo: Harry Hopkins

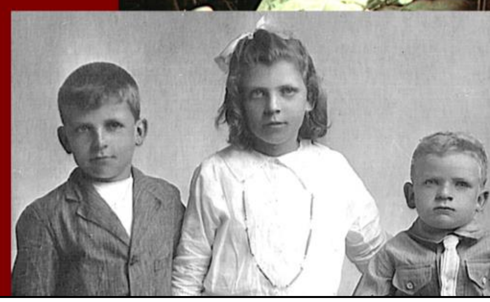
In a young lad from Dwellingup

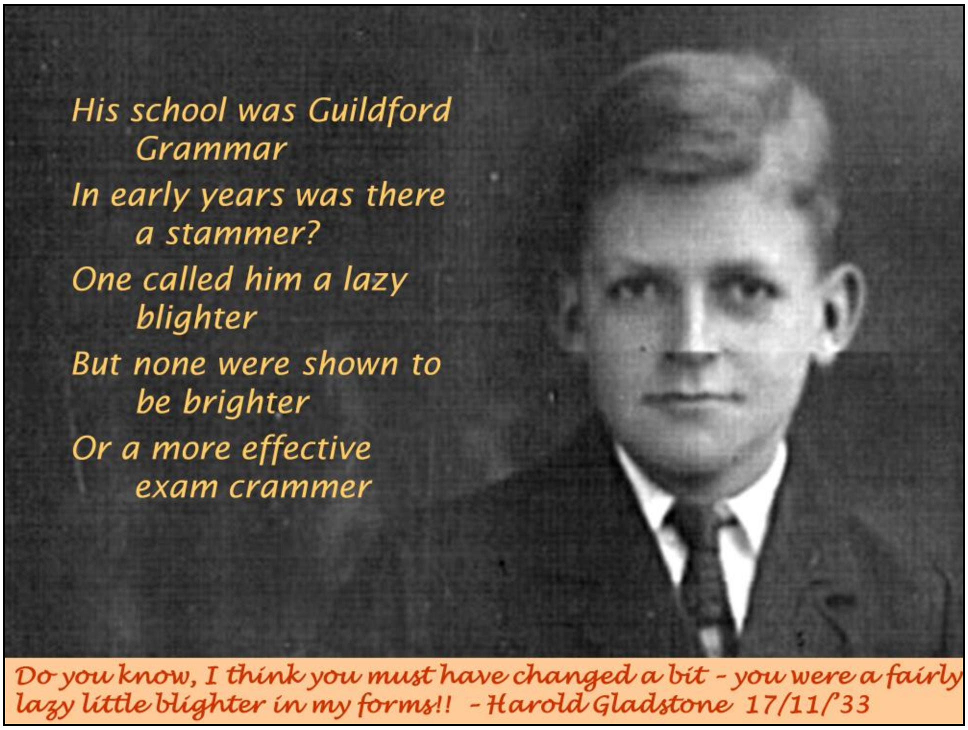
A special mind was swelling up

HJ was from WA –

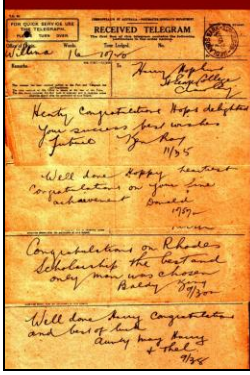
My father I am proud to say

So now some tears are welling up




His school was Guildford Grammar
In early years was there a stammer?
One called him a lazy blighter
But none were shown to be brighter
Or a more effective exam crammer
Do you know, I think you must have changed a bit - you were a fairly lazy little blighter in my forms!! - Harold Gladstone 17/11/'33

It was colossal to win the Rhodes
To travel to UK and Brasenose
At study he did box on
To graduate MA(Oxon)
And develop his skill with prose

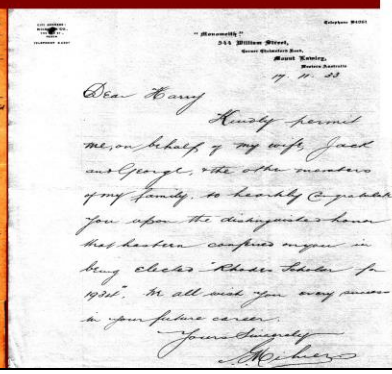

RECEIVED TELEGRAM

Hearty Congratulations Hope delighted your success best wishes future

Well done Happy heartiest Congratulations on your fine achievement Donald

Congratulations on Rhodes Scholarship the best and only man was chosen Baldy

Well done Harry Congratulations and best of luck Aunty May Harry + Thel

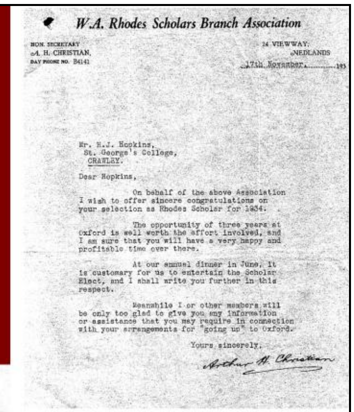

"Monomeith"
344 William Street,
Corner Chelmsford Road,
Mount Lawley,
Western Australia

17. 11. 33

Dear Harry

Kindly permit me, on behalf of my wife, Jack and George, & the other members of my family, to heartily congratulate you upon the distinguished honor that has been conferred on you in being elected "Rhodes Scholar for 1934". We all wish you every success in your future career.

Yours Sincerely


W.A. Rhodes Scholars Branch Association

HON. SECRETARY
A. H. CHRISTIAN,
DAY PHONE NO. B4141

24 VIEWWAY,
NEDLANDS

17th November, 193

Mr. H.J. Hopkins,
St. George's College,
CRAWLEY.

Dear Hopkins,

On behalf of the above Association I wish to offer sincere congratulations on your selection as Rhodes Scholar for 1934.

The opportunity of three years at Oxford is well worth the effort involved, and I am sure that you will have a very happy and profitable time over there.

At our annual dinner in June, it is customary for us to entertain the Scholar Elect, and I shall write you further in this respect.

Meanwhile I or other members will be only too glad to give you any information or assistance that you may require in connection with your arrangements for "going up" to Oxford.

Yours sincerely,

Arthur H. Christian

WA Rhodes Scholar 1934

As a student he made quite some noise

Playing cricket and hockey with poise

One girl he liked a lot

Was Dorothy Louise Trott

Who to him was an amalgam of joys

His head was in quite a whirl
At this quite exceptional pearl
With ardour he pursued her
This brunette BA from Bermuda
They were to have four boys and one girl

Engineering for Courtaulds, bridges for Rail
Cricket at Oxshott, rarely to fail
He flew for the RAF
Narrowly avoiding death
By not ditching in the sea
He won the DFC
And then back to Australia did sail

Via Bermuda to Perth WA
Wife and family well on the way
Research and teaching. Hockey and cricket-
With the boys on the back yard wicket
Four years he was destined to stay

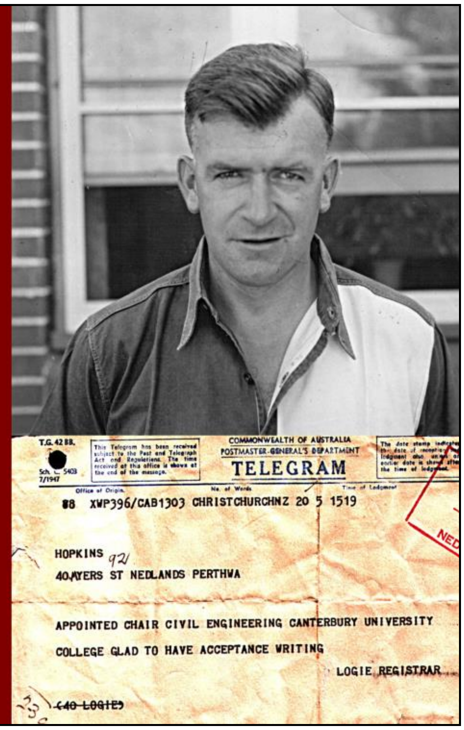
'51 saw him to NZ take a long hike

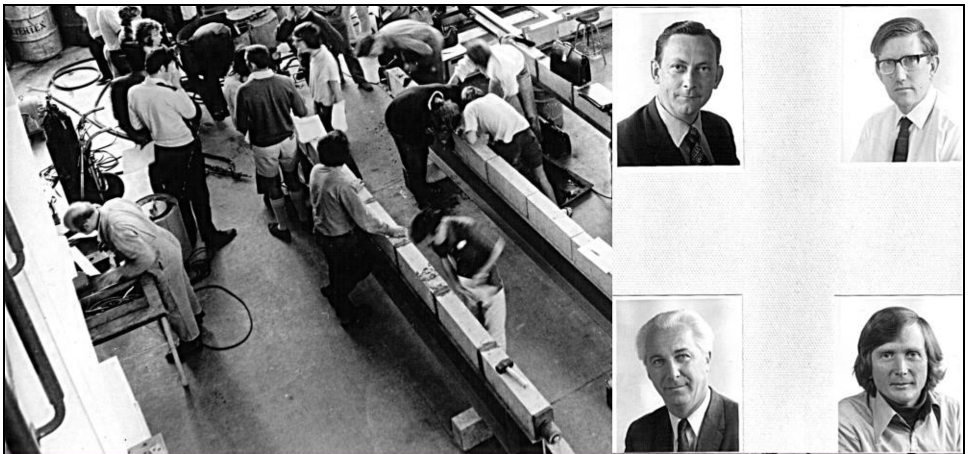
During a very prolonged dock strike

The whole family on Monowai set off

So that he could be a Civil Eng Prof

Of his ilk they had not seen the like





Under Harry the Department thrived
As for staff and resources he strived
Labs for fluids, soils and concrete
Well chosen staff to make it complete -
From government the development dollars derived

Bob Park Peter Wood

Tom Paulay David Elms

Research on sands, bridges and beams

Publications in these subject streams

9am lectures were compulsory

Even when he'd been out till three

Keep up with this man - in your dreams

Sands for concrete

A study of shapes and sizes

H. J. HOPKINS
D.F.C., M.A.(OXON.), B.E., B.SC.(W.AUST.), C.ENG., F.I.C.E., (FELLOW)

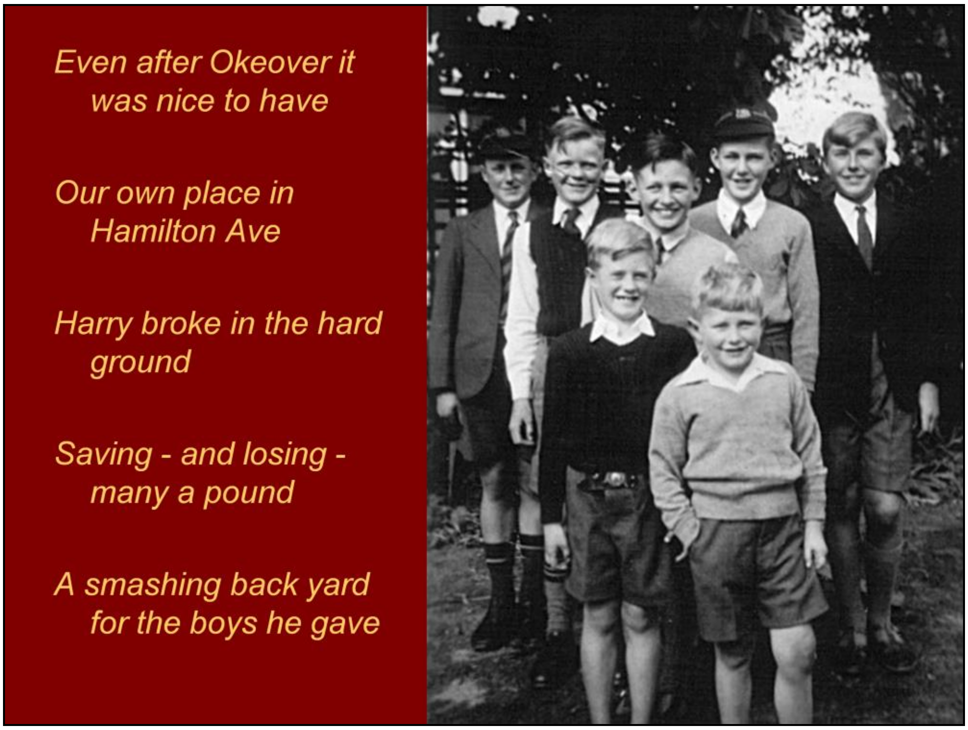
ENGINEERING IS FUN

H. J. HOPKINS
D.F.C., M.A., B.SC., B.E., M.I.C.E., (FELLOW)

Professor Hopkins was appointed to the chair of civil engineering at the Univer sity of Canterbury in 1951. He received his higher education at the Universitie of West Australia and Oxford and was a Rhodes Scholar in 1934.

"A MESSAGE FOR THE YOUNG". When I was asked to write an article on this topic, I was quite flattered—on second thoughts I was quite shattered. I have a message for the young and it is simply this: 'The future belongs to you". But I was shattered when I realised that I had been asked to write this article because I was no longer young and that this meant the future was not for me. This was, however, too quick a judgment, and although I have no desire to preach to youth I may be able to guide them in their journey into the future. An assessment of a contemporary situation is by no means easy, and even if we can gauge our present position accurately we still lack the answer to the oft-recurring question "Where do we go from here?" To answer this question we need to establish at least two points upon the thread of time. Only a backward glance, a study o history, will provide us with the position of these extra points, and the more accurately they are established the more confidently we can extrapolate into the future. The questions "Whither the Institution?" and "Whither engineering?" are too complex for accurate assessment by any one person. If here I establish even one point with any certainty it should be regarded, to quote Robert Hooke, as one of those "luckey hitts and useful thoughts on this or that subject he is conversant about, the regarding and communicating of which might be a means to other persons highly to improve them".

First of all, in determining my own position with regard to the youth of New Zealand I must be careful not to make the mistake that Hooke made in his early



From left:

Brian Hopkins, Alan Wylde, Andrew Hopkins, Bruce Rankin, Tim Hopkins, Mike Stockwell, David Hopkins

David Brian

Tim Harry Dorothy Andrew

Jill

The Hopkins Family Circa 1955

In any field, especially sport
For his team's success he fought
A six hitter at cricket -
Left arm slow round the wicket
Was how many a victim was bought

David Harry Brian
At Oxshott Cricket Ground 1959

Dorothy's support to him was immense

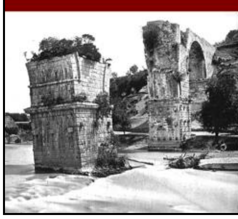
With her charm poise and common sense

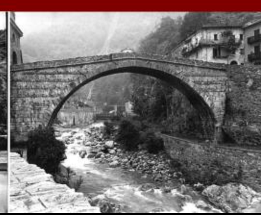
A vital couple so rare

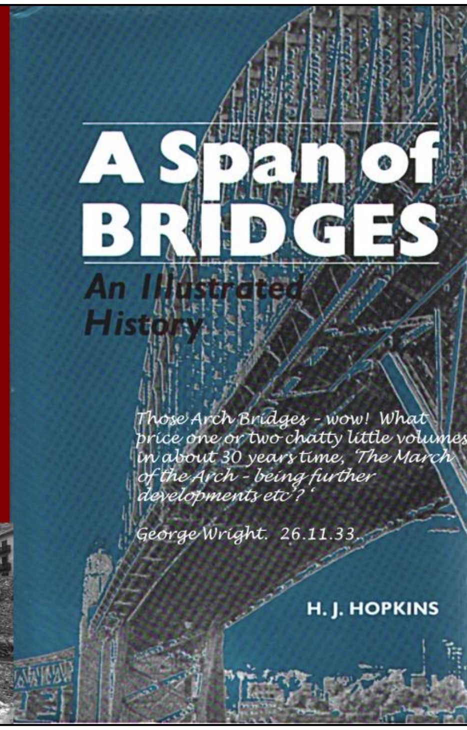
They were a wonderful pair

Though post-mortems after bridge could be tense!

Several global sabbaticals it took
On his subject to learn and to look
With determination impassioned
"A Span of Bridges" he fashioned
An individual authoritative and loving book







For 28 years as Civil
Engineering head

Through labs, lectures,
lateness to bed

This forbidding man of
good cheer

Ensured that success was
right here

As quality engineers
were bred

On the profession he was particularly keen

On countless boards and committees seen

With contributions pithy and apt

His career was deservedly capped

With an OBE from the Mother Queen

In loving memory of:

Henry James Hopkins

11 August 1912 to 9 January 1986

Dorothy Louise (Trott) Hopkins

4 March 1914 to 20 November 1984