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NEWSLETTER

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The Quindío, Colombia Earthquake of 25 January 1999

John Macdonald talks about his experience of the effects of the Colombian Earthquake which he visited as leader of an EEFIT team

The earthquake that hit the city of Armenia and the surrounding coffee-growing area of Colombia in January was one of the most devastating in the country's history. 1,171 people lost their lives, almost 5,000 were seriously injured and an estimated 205,000 were made homeless. This was despite its relatively modest magnitude of 5.9Mb (USGS), compared with other historical earthquakes in the area of magnitude >7.0, which have been much less damaging.

Two weeks after the earthquake four members of the Earthquake Engineering Field Investigation Team (EEFIT) visited the area to assess the damage. The team spent five days touring the affected area and meeting local engineers, and some additional time in Bogotá to gather further information.

The problems were caused by a combination of the superficial nature of the earthquake, local ground conditions and poor construction. Normally the earthquakes in the region of the Quindío Department of Colombia are directly associated with the subduction of the Nazca Plate under the South American Plate at a depth of 100-200km. However this earthquake was very shallow, occurring on a superficial strike-slip fault in the Romeral fault system which crosses the country in a NNE-SSW direction. Estimates vary but the USGS and the local geotechnical institute Ingeominas put the depth at less than 20km. This gave rise to high peak ground accelerations, including large vertical components.

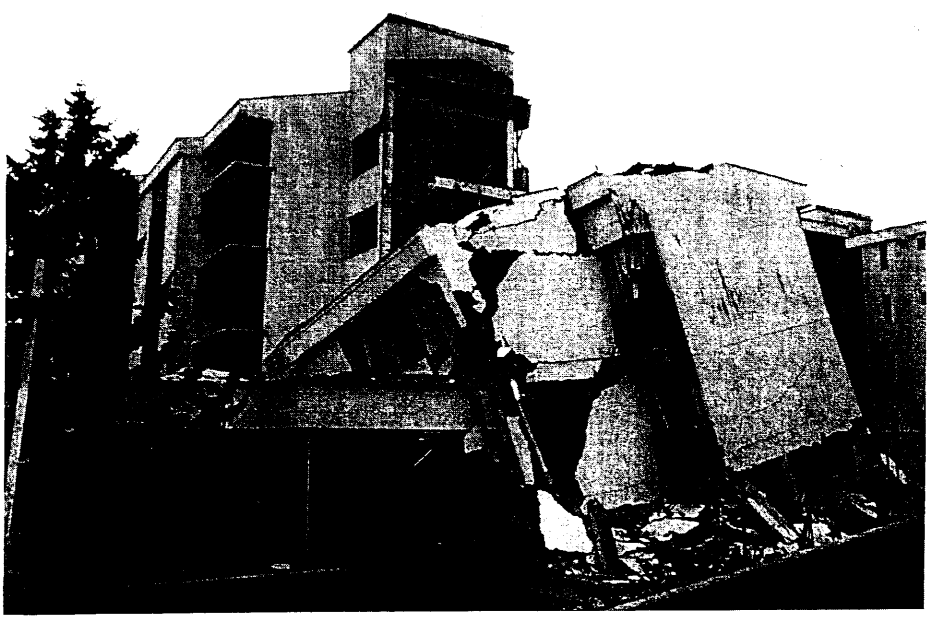

Figure 1. Typical collapse of a concrete framed building in Armenia due to poor detailing

These accelerations were exacerbated by local ground conditions. The general area, being in the foothills of the volcanic Cordillera Central mountain ridge, is covered by approximately 100m depth of pyroclastic rocks and lava flows, overlain with 8-12m of volcanic ash. These materials are poorly consolidated which led to significant amplification of the underlying rock motion. Furthermore in Armenia and Pereira there were areas of made ground, filling some of the small valleys which ran through the cities. This fill was often very poorly consolidated, giving rise to large amplifications. Near Pereira a peak ground acceleration of 0.08g was measured on rock, whereas on fill it was as high as 0.3g. In Armenia accelerations of 0.5g were measured in all three orthogonal components on soil.

The local topography also may have affected the distribution of damage. In Armenia much of the damage appeared to be concentrated on the tops of ridges. However with much less construction within the steep-sided valleys it is difficult to draw any definite conclusions from this.

The northern half of Armenia was much less damaged than the southern half, possibly partly due to the local ground conditions and less hilly topography but also largely due to the better and newer construction in the

Figure 2. A house at the "Experimental Centre for Bamboo Construction". Other new bamboo structures also performed well during this earthquake

area. In Pereira the significant damage was limited to relatively localised areas, often associated with filled ground.

What was clear from the distribution of damage was the importance of microzonation studies to identify areas of greater risk.

A seismic design code was only introduced in Colombia in 1984. Encouragingly the majority of engineered buildings constructed since that date did not suffer any major structural damage. There was however severe damage and collapse of many earlier structures and more recent non-engineered buildings. The majority of the failures were due to well known problems, particularly of detailing. Most engineered buildings had reinforced concrete frames. Problems due to inadequate shear links, short or coincident reinforcement laps, weak columns with respect to the beams, poor quality concrete and lack of bond between the concrete and the reinforcement were all too common (Fig. 1).

Low-rise non-engineered buildings also fared badly. Although simplified guidelines for such buildings are given in the seismic design code there is little enforcement of the regulations and local construction methods are often lacking. Easily-avoided shortcomings were identified in partially constructed houses.

There were several types of construction for low-rise buildings. The traditional bahareque buildings had bamboo or timber frames with walls similar to wattle and mortar, often with some cross-bracing. Roofs consisted of clay tiles, metal sheeting or occasionally palm on a bamboo or timber frame. Failure of these buildings was often due to deterioration of the frame, generally being worse for those buildings with the heavier clay tile roofs.

Newer non-engineered buildings often incorporated laminar board walls, masonry walls, reinforced concrete ring beams, concrete floor slabs or full concrete frames. Many different combinations of these components were present. The unreinforced masonry suffered much damage but reinforced concrete ring beams at first floor or roof level were often found to be effective in improving the integrity of the buildings. Concrete frames were often poorly designed and constructed with irregularities in the frames and with poor details. These buildings, particularly those with heavy roofs, often performed badly and were the cause of the majority of the casualties.

Another problem associated with non-engineered buildings in many cases was their location on areas of filled ground or on steep slopes.

One significant success in non-engineered buildings was the performance of modern bamboo structures. An experimental centre for bamboo construction was located very close to the epicentre but only very minor damage was observed (Fig. 2). Also a newly built area of bamboo houses in Armenia survived extremely well, despite being on steeply sloping ground in an otherwise badly affected area. These new bamboo houses differed from the more traditional ones in that they had better connections and foundations and, for those in Armenia, lighter roofs. Being new, the materials had not deteriorated, but the bamboo was not in direct contact with the ground to reduce the likelihood of rotting in the longer term. It seems that bamboo could be a very effective material for earthquake-resistant simple low-rise buildings if these improved details are adhered to or further developed, and they are well maintained.

Dissemination of information on good building practice for low-rise housing, coupled with stricter enforcement of regulations, would greatly improve the situation in countries such as Colombia.

As stated above, the engineered buildings constructed since the introduction of the seismic design code generally performed well structurally. However, very frequently there was severe damage to masonry infill panels. As well as the danger of falling masonry, this has led to very high costs of repair and, with many buildings being made uninhabitable, there have been major social problems with the large number of homeless. This highlighted the need for further research in the area of masonry infill panels and their interaction with building frames.

Several buildings in Pereira, retrofitted after an earthquake in 1995, were inspected. Structurally they all performed well but again there was significant damage to masonry infill panels. Shear walls had commonly been used, but in one case they had been added asymmetrically and often they were not adequately tied together, particularly at the tops of the buildings. Although no damage was observed to the shear walls, due to their relative movement there was major cracking of non-structural walls.

One building inspected had been retrofitted with reinforced concrete jackets around selected columns and beams. Again there was negligible structural damage but the deflection of the frame had still been sufficient to cause moderate damage to masonry infill.

Although none of the retrofitted buildings that were inspected suffered any significant structural damage, compared with the major damage caused by the previous earthquake, the importance of details in the retrofitting schemes, in order to limit non-structural damage, was highlighted.

A notable feature of the earthquake outside the towns was the large number of landslides which blocked many roads in the area. The small town of Pijao south of the epicentre was cut off for over a week, with more than 40 landslides blocking the only surfaced road to it. Heavy rain for the two weeks after the earthquake caused further land slides of unstabilised ground. Many of the more major roads in the area were also blocked, including the main east-west route across country from the west coast port of Buenaventura to Bogotá, over a pass in the Cordillera Central mountains.

There was disruption to the electricity supply in Armenia due to the failure of the transformers at one of the two sub-stations. Water supplies in the south of Armenia were severely affected for several days due to the lack of power at the water treatment plant and many ruptures of pipes. There was also some disruption of telecommunications caused by damage to the telecom building in Armenia. Fortunately there was no piped gas in the area so there were no resulting fires following the earthquake.

The emergency services did not respond well to the disaster initially. This was partly due to the collapse of the fire station (Fig. 3) and the partial collapse of the police station in Armenia, coupled with the difficulty of access due to the landslides on the roads. This highlights the needs to bring older safety-critical structures up to present standards and to have disaster management plans in place.

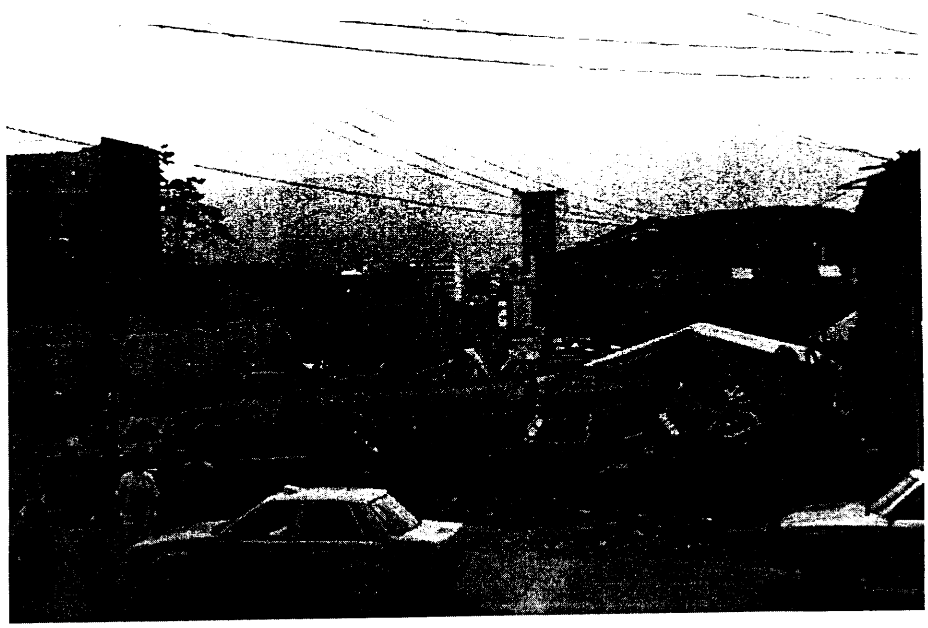

Figure 3. The remains of the fire station in Armenia that collapsed onto the fire engines, destroyed them and killing nine firemen

Fortunately there was only minor damage to the hospitals. The one in the north of Armenia had been identified as at risk and retrofitting had commenced recently. The work had only reached an early stage so it was not yet very effective, but the building survived nevertheless, probably because the ground excitation was not so great in that area.

Finally the response of the Colombian people must be noted. Despite the magnitude of the disaster the attitude of the population was remarkably positive. The team was very well received and was greatly helped by local engineers and also by many ordinary people who let us inspect their buildings. The consequences of the earthquake for the country and the individuals will remain for years to come but people were already looking positively towards the future.

A full EEFIT report is in preparation, which should be published towards the end of the year.

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The Kathmandu Valley Earthquake Risk Management Project

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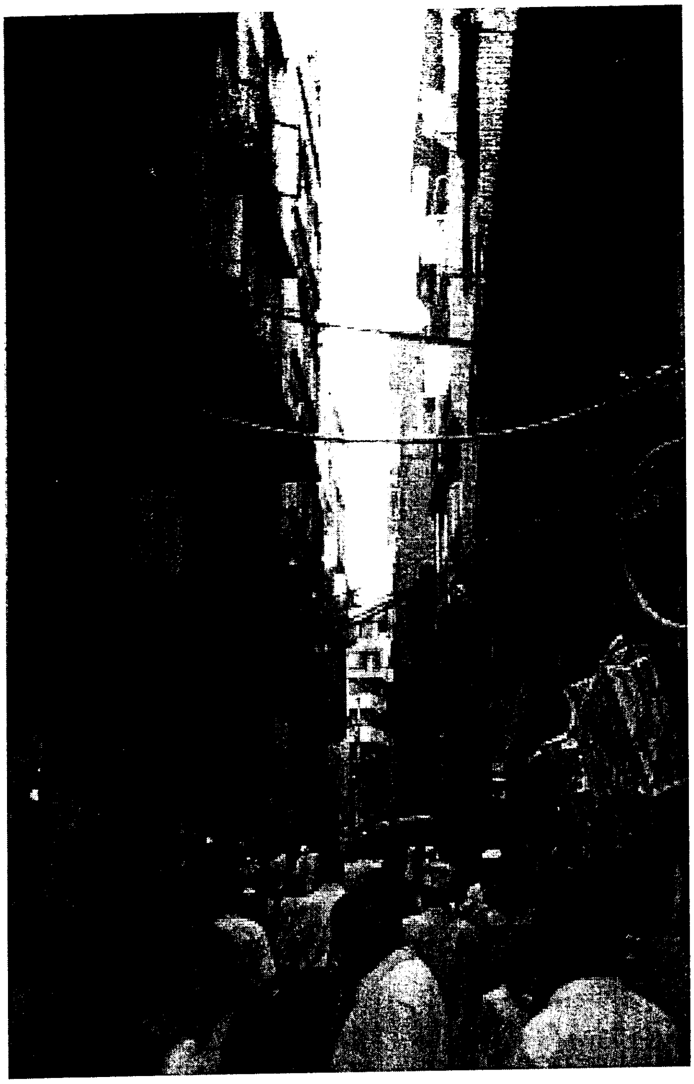
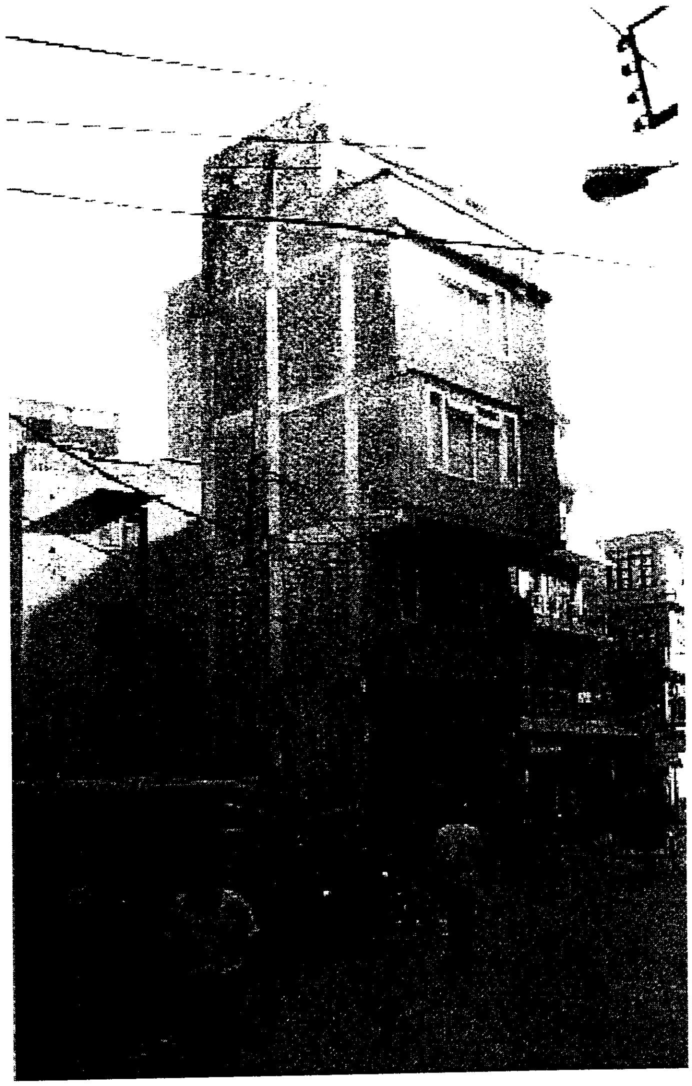
Kathmandu Valley, like many urban areas in developing countries, has an earthquake risk that has increased significantly since its last major earthquake. The valley has a burgeoning population of almost 1.5 million people, uncontrolled development, and a construction practice that has actually degraded over this century. Nepal is among the poorest and least developed countries in the world. It has a per capita GDP of US$ 145 and approximately 14% of the national GDP is derived from foreign development aid. Kathmandu Valley has an urban growth rate of 6.5% and one of the highest urban densities in the world. These factors combine to affect earthquake risk management in many ways:

- a lack of government funds to support earthquake risk mitigation programs,
- inexpensive and poorly constructed dwellings that often fail even in the absence of earthquakes,
- a tendency in the general population to ignore the earthquake hazard due to more immediate needs, and
- a lack of awareness about the earthquake hazard.



Like many streets in the downtown area of Kathmandu, this busy road is less than 4 meters wide with 5 to 7 storey masonry buildings on both sides



This typical building in downtown Kathmandu shows how home-owners frequently cantilever upper stories of their buildings to maximize floor space

Nepal currently has no seismic building code (although one is in the process of being passed into law), and practically all buildings are constructed without the input of an engineer and without considering seismic forces.

Despite its earthquake risk, Kathmandu Valley previously had no co-ordinated effort to reduce this risk. The technical information about earthquake risk in Kathmandu Valley was incomplete and scattered among several governmental agencies. However, a more important contributor to the region's lack of earthquake preparedness was that the technical information that was available had not been synthesized, applied to the infrastructure of modern day Kathmandu Valley, or presented in a form that the public and government officials could digest.

The Kathmandu Valley Earthquake Risk Management Project (KVERMP) was to designed to address these issues by developing a sustainable earthquake risk management program for the valley and establishing a local organization to oversee this program. KVERMP began in September of 1997 and will end in May of 1999. The project is being implemented by the National Society for Earthquake Technology – Nepal (NSET-Nepal) and GeoHazards International (GHI). Funding comes from GHI and the US Agency for International Development through the Asian Disaster Preparedness Centre. KVERMP includes the following activities:

Simple Loss Estimates

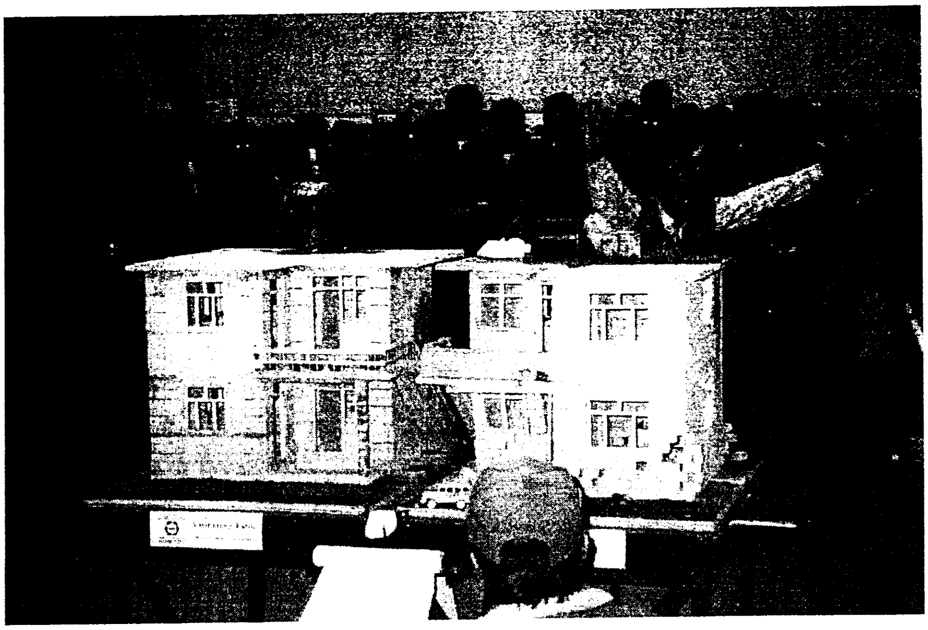
Simple earthquake loss estimates were made for a repeat of the shaking of the most recent major earthquake to affect Kathmandu Valley, occurring in 1934, on its modern day infrastructure. Although the next major earthquake to affect the valley will be different from the 1934 event, Kathmandu Valley's soft-surface geology makes it reasonable to assume for planning purposes that the relative pattern of shaking will be approximately the same for all distant earthquakes. Information about Kathmandu Valley's infrastructure was gathered during interviews with officials from more than thirty critical facilities. Loss estimates were made using a variety of methods designed for use in developed countries such as the US and Japan. The accuracy of these methods is reduced when applied to Nepal due to differences in design, construction and maintenance of infrastructure. However, these methods provide useful order-of-magnitude estimates for losses at a level of effort that makes sense for Nepal. These estimates were presented in an easy-to-understand form to valley leaders.

Risk Management Planning

The loss estimates have effectively raised the awareness of Kathmandu Valley's leaders about the need to manage the valley's earthquake risk. In October 1998 KVERMP brought together the valley's decision makers, critical facility managers, and technical specialists to discuss the most urgent actions needed to reduce earthquake risk and the feasibility of those actions. A consensus based plan was developed which includes a list of high-priority short-term actions, important long-term actions, and, most importantly, a realistic strategy for implementing those actions. NSET-Nepal was given the role of advocating, aiding and monitoring this plan. According to this plan, these actions will begin to be implemented in summer of 1999.

School Vulnerability Assessment

An inventory of the structural characteristics and vulnerability of the majority of Kathmandu Valley's approximately 650 public schools is in the final stages of development. Structural characteristics of school buildings are being determined through a survey form filled out by school headmasters. Although Nepali headmasters have no training in engineering or earthquake risk, they have frequently been involved in the construction of their school buildings and have first hand knowledge about the techniques and materials that were used to build them. A local engineer will categorize the schools by level of vulnerability using the survey responses and information gathered by visiting 10% of all schools in the valley. Techniques that can be used to strengthen typical Nepali construction will be identified and detailed retrofit designs and cost



This demonstration at Earthquake Safety Day convinced onlookers that earthquake resistant building techniques really work. The building model on the left incorporates simple and affordable seismic safety measures, whereas the collapsing building model on the right uses typical Nepali construction techniques

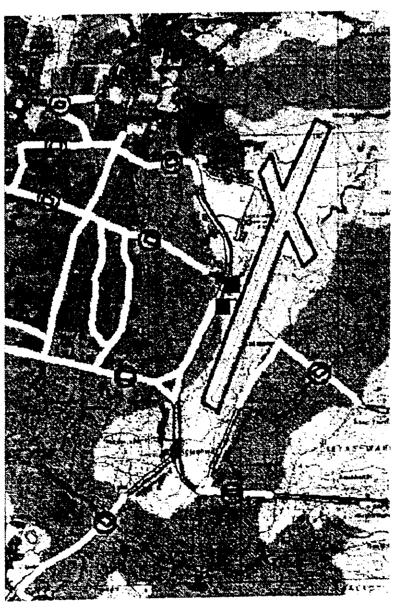
estimates will be made for three typical schools. A project will begin this spring, using the results of this inventory, to motivate communities to increase the safety of their schools.

Public Awareness

In January of 1999, KVERMP organized the first annual Earthquake Safety Day for Nepal. This event was held on the anniversary of the devastating 1934 quake. The Prime Minister of Nepal inaugurated the event and officially released "The Kathmandu Valley Earthquake Risk Management Action Plan". The event, despite its name, spanned three days and involved a series of awareness raising displays and demonstrations, including a shake table demonstration of scale models of typical Nepali homes, skits about earthquake preparedness, first aid demonstrations by the local Red Cross Society, full-scale models of earthquake resistant building techniques, and booths displaying the work of local private and government organizations. Approximately 12,000 people attended.

KVERMP has been successful in raising the level of awareness and concern about earthquake risk in Nepal. Several earthquake risk mitigation and preparedness projects are now in the proposal stage, due at least in part to the focus drawn to earthquakes by this project. The challenge now is to transfer the momentum of KVERMP into a locally driven and sustainable earthquake risk management program for the valley. NSET-Nepal has been established as the key local group concerned with earthquake issues through their work in this project. Securing NSET-Nepal's future is the first step in meeting this challenge.

For more information on the activities described in this article or information about GHI (including how to become a member), please visit http://www.geohaz.org .



Kathmandu Valley Airport Vicinity

Bridge with 60% to 100% likelihood of being impassable

Paved road with 10% of area likely to be impassable

Oil tanks

Area with high liquefaction susceptibility

This map, an example of the simple loss estimates produced by KVERMP, indicates that Kathmandu Valley's only airport could be inaccessible after a major earthquake due to liquefaction damage to nearby bridges

Dealing With Earthquakes In Cities Of Developing Countries

A meeting to be led by Dr Brian Tucker on 12 August 1999 will outline how the risk of earthquake to cities in developing countries can be reduced. The meeting will be jointly hosted by SECED and the Hazards Forum as a contribution to the IDNDR.

Urban earthquake risk in developing countries is large and rapidly increasing. During this century, four-fifths of the deaths caused by earthquakes occurred in developing countries. While in 1950 just over half of the world's urban earthquake-threatened population was in developing countries, by the year 2000, 85% is expected to be. This talk will describe recent efforts by an international, multidisciplinary team to reduce urban earthquake risk in developing countries.

GeoHazards International (GHI) has undertaken a series of projects to help developing countries manage earthquake risk. GHI's approach is to assess the earthquake risk of a city in a developing country affordably, raise awareness of that risk, and design self-sustaining risk management programs. All work is done in partnership with local earthquake risk specialists.

GHI's efforts began with the *Quito, Ecuador Earthquake Risk Management Project*. This project had many good outcomes, such as the establishment of a Disaster Prevention and Awareness Unit in the mayor's office, but it lacked tangibility and immediacy in its benefit to the city. The *Quito School Seismic Safety Project* followed the initial project in Quito. The result was that local funds were committed to retrofit several schools and to upgrade the standard national school design to include seismic resistant features in all future school buildings. This project has appealingly concrete results, but it addressed only a small part of Quito's risk.

The *Kathmandu Valley Earthquake Risk Management Project*, currently underway, combines aspects of both previous projects in Quito, modified to emphasize sustainability. The project is being implemented with a newly created local NGO, The National Society for Earthquake Technology – Nepal, which is establishing itself as a neutral, non-political seismic safety advocate for Nepal.

GHI is now preparing an *Earthquake Safety Ranking* of earthquake-threatened cities world-wide to emphasize the necessity of additional risk management in many cities. The ranking identifies the cities facing the greatest earthquake disaster risk and the cities in the greatest need of improved disaster risk management.

***Brian E. Tucker** (GeoHazards International)*

Organisation of 12ECEE Begins

Following the celebration of the successful outcome of the bid by SECED to host the Twelfth European Conference on Earthquake Engineering in London in the year 2002, the Society is now facing up to the massive task of organising the event. The first milestone along this road is to produce the First Announcement for the Conference by the end of this year so that it can be distributed at the World Conference in Auckland, New Zealand, at the end of January 2000.

Over the summer months, the Steering Committee of SECED will lead the work of sending out invitations for people to join the Scientific Committee, which will design the technical programme for the Conference and co-ordinate the review process for abstracts and papers. At the same time, invitations will be sent to colleagues overseas to join the International Advisory Committee, which will be called upon to advise on the organisational aspects of the Conference, and the International Scientific Committee, which will provide advice to Scientific Committee. SECED Members are invited to send in suggestions for potential members of these three Committees to the SECED Secretariat.

In October of this year, a Conference Committee will be formed to co-ordinate all the various aspects of the conference organisation, including the work of the Scientific Committee, and to liaise with the SECED Committee, through the Steering Committee, and with the International Advisory and Scientific Committees. There will be no shortage of work for the Conference Committee and volunteers are asked to make themselves known to the SECED Secretariat over the coming the months so that a strong and effective Committee can be established in October. The 12 ECEE will be the greatest undertaking in the history of our Society and its success will depend on the effort and commitment of our members.

Could you design a Logo for the 12 ECEE ?

All artistically minded members of SECED are invited to design an inspiring logo for the next European Conference, which will be hosted by SECED. Any suggestions should be send to Secretary for consideration by the main committee (address on back page).

5th US Conference on Lifeline Earthquake Engineering

Seattle, August 12 - 14, 1999

Buffalo, NY - Lifeline earthquake engineers from around the world will converge in Seattle, Washington this summer at the 5th U.S. Conference on Lifeline Earthquake Engineering (5USCLEE). Sponsored by the American Society of Civil Engineers' (ASCE) Technical Council on Lifeline Earthquake Engineering (TCLEE), the conference will take place August 12 - 14, 1999 at the Sheraton Seattle Hotel & Towers. The theme is "Optimizing Post-Earthquake Lifeline System Reliability." It is being organized for ASCE by the Multidisciplinary Center for Earthquake Engineering Research (MCEER), headquartered at the University at Buffalo.

The 5th U.S. Conference on Lifeline Earthquake Engineering will serve as a forum for discussion on the latest research, practice, investigation, and public policy in lifeline earthquake engineering that contribute to improved post-earthquake lifeline reliability worldwide. It will focus on progress made since the 4th U.S. Conference, held in San Francisco in 1995.

The 21/2-day program will consist of invited keynote presentations, 20 technical sessions and additional poster sessions. More than 120 technical papers will be presented. Seven sessions on transportation issues will focus attention on bridge hazards, analysis and retrofit. Five sessions will examine pipeline performance and reliability. Earthquake seismic risk and socio-economic issues and multi-hazard risk assessment will also be explored. Session topics include:

- Case Studies
- Socio-Economic Considerations
- Electric Power
- Seismic Hazards

- Implementation Issues
- Seismic Risk
- Post-Earthquake Investigations
- Transportation
- Multi-Hazard Risk Assessment
- Water and Wastewater
- Pipelines

A featured keynote presentation will be given by the recipient of ASCE's 1999 C. Martin Duke Award. The award annually recognizes an individual who has made substantial contributions to the art, science and technology of lifeline earthquake engineering.

The conference will also host an exposition of exhibitors of lifeline earthquake engineering products and services. The program will conclude with an optional boat tour of Seattle's Elliott Bay, taking in key sites and structures of interest to lifelines professionals.

Full conference registration includes admission to all technical sessions, exhibitors' exposition, all meal functions, and a copy of the conference proceedings. Fees before July 2, 1999 are $320 for ASCE members and $365 for non-members. Registrations received before July 30, 1999 are $365 for members and $410 for non-members. Fees for those registering after July 30, 1999 and at the conference are $380 for members and $425 for non-members.

Daily registration includes admission to all technical sessions and the exposition. Fees are $165 for ASCE members and $200 for non-members if received before July 2, 1999. Registrations received by July 30, 1999 are $185 for members and $220 for non-members. Registrations received after July 30, 1999 and on site are $195 for members and $230 for non-members.

A limited number of student registrations are available on a first-come, first-served basis. Student registration includes admission to all sessions and the exposition. Fees are $50 before July 30, 1999 and $60 thereafter.

For conference registration or exhibitor information contact: Andrea Dargush, Multidisciplinary Center for Earthquake Engineering Research (MCEER), University at Buffalo, Red Jacket Quadrangle, Buffalo, NY 14261-0025; tel.: 716-645-3391, ext. 106; fax: 716-645-3399; e-mail: dargush@acsu.buffalo.edu, visit the MCEER Web site at http://mceer.buffalo.edu.

Seismic design of RC buildings

Indian Institute of Technology, Kanpur, June 7 - 11, 1999

This 5 day course is intended for practising civil and structural engineers, and has been run successfully on a number of occasions since 1992. Further details can be obtained from Professor Sudhir Jain at IIT Kanpur (skjain@iitk.ac.in). ***Please note that the date of this course has changed since the last issue of this newsletter.***

Review of SECED Communication Systems

The society utilises three main methods of disseminating information to the members and to other interested parties, these are; the newsletter, fliers and the web pages.

The committee has initiated a review of the communication systems to determine if they satisfy the purposes of the society, which are in essence to satisfy the needs of the members of the society. The review has started with a quick appraisal of the types of information which can and should be disseminated. This quick review has been reported back to the SECED committee, which will then discuss them further. Some of the initial review output is presented below and the object of this is to seek feedback from all members of the society to determine if the initial thoughts do, in general, satisfy the objectives of the full membership.

Some topics, which could be expanded on within the newsletter, or added as regular new columns, are suggested below:

- New (or perhaps old favourite) book reviews
- New contracts in the field of earthquakes and civil engineering dynamics to show how vibrant and diverse the sector is within the UK and overseas
- Summaries or listings of new books in related fields which have arrived at the libraries of the ICE, IStructE, and the IMechE
- Previews of forthcoming evening meetings of the society
- Reviews of past evening meetings, perhaps extending these to become Proceedings when appropriate
- News and emergent issues being considered by the committee members and by, the technical raporteurs to the committee.

It appears that not all members and companies affiliated with the members are aware of the breadth of information that can be published within the newsletter or by flier. From the summary list of information above, if any members or their companies wish to forward information to the editor of the newsletter for inclusion in future issues, or wish clarification as to the suitability of potential information, they are invited to contact the editor, the author of this article or other members of the SECED committee.

John Donald (Email: john.donald@aeat.co.uk)

SECED Register of Members

All SECED members are reminded that the current Register of Members is still available in the form of either 1.44Mb disk or paper copy. One copy of either disc or document will be available free to members for a limited time and then for a cost of £10 thereafter. It should be noted that the Register contains information of all those members recorded as fully paid-up at the 1 January 1998. The computer disc has been prepared using both Microsoft Access and Aldus Pagemaker software. **Requests for a copy of the Register should be made to Liz Marwood, Technical Affairs Division at the ICE.**

Tel. 0171 665 2238, Fax 0171 799 1325 or E-mail: marwood_l@ice.org.uk.

SECED Members receive IStructE Award

SECED members Edmund Booth and Andreas Kappos, together with Prof. Bob Park from New Zealand, have been the co-recipients of the Murray Buxton award of the Institution of Structural Engineers. The award is made each year for papers published in the Structural Engineer. The title of the paper by Booth-Kappos-Park was 'A critical review of international practice on seismic design of reinforced concrete buildings' and appeared in the 2 June 1998 issue.

SECED-Imperial College Short Course: Update

Registrations have been pouring in for SECED-Imperial College Short Course on Practical Seismic Design for New and Existing Structures on 22-24 September. The course fee is £550 (which includes a full set of course notes) but SECED members can register for the special price of only £400 provided they book their place by 20 August. Due to the size of the lecture theatre where the course will be presented, there will be only about 60 places on the course and nearly half of these have already been taken. Registration enquiries should be addressed to Sally Verkaik at the Centre for Continuing Education at Imperial College (tel: 0171-594 6882, fax: 0171-594 6883, Email: cpd@ic.ac.uk).

SECED is also sponsoring up to an additional 20 places on the Short Course to candidates sponsored by national associations for earthquake engineering that are affiliated to the EAEE, with a maximum of two participants from any country. Eight sponsored places have so far been allocated to candidates from Algeria, the Czech Republic, France and Italy.

NOTABLE EARTHQUAKES JANUARY - MARCH 1999

Reported by British Geological Survey

YEAR	DAY	MON	TIME UTC	LAT	LON	DEP KM	MAGNITUDES ML	MB	MS	LOCATION
1999	12	JAN	05:41	53.10N	1.32W	0.3	0.6			MANSFIELD,NOTTS
			Felt throughout Mansfield.							
1999	21	JAN	11:10	53.10N	0.07E	23	2.8			BOSTON,LINCOLNSHIRE
1999	25	JAN	18:19	4.29N	75.68W	33		5.8		COLOMBIA
			Latest reports indicate that at least 1000 people were killed and approximately 3,600 injured. The epicentre of the earthquake is in a mountainous region 115 miles southwest of Bogota on the borders of Tolima and Quindio provinces. The provincial capital of Armenia, situated in the Quindio province high in the Andes mountain, was the worst-hit spot in a disaster zone that covered over 20 cities and towns in 5 provinces. Authorities said half of Armenia's buildings had been destroyed or damaged. The earthquake also caused many landslides along the main routes leading in and out of Quindio and Risaralda provinces.							
1999	01	FEB	13:45	38.11N	1.49W	4	4.1			SPAIN
			At least twenty people injured in the Mula area.							
1999	04	FEB	19:27	4.07N	95.16E	33		6.1		NORTHERN SUMATERA
1999	06	FEB	21:47	12.96S	166.67E	90			7.3	SANTA CRUZ ISLANDS
1999	09	FEB	01:02	55.09N	3.62W	0.7	0.7			DUMFRIES,D&G
			Felt throughout the Newfield area.							
1999	11	FEB	14:08	33.79N	69.03E	33			5.9	AFGHANISTAN
			At least 60 people were killed and approximately 500 people injured in the Maiden Shahr region southwest of Kabul where 7,000 homes were reported to have been destroyed.							
1999	22	FEB	01:00	21.52S	169.66E	33			6.4	LOYALTY ISLANDS REGION
1999	04	MAR	00:16	55.40N	5.24W	19	4.0			ISLAND OF ARRAN,STRATHCLYDE
			Felt throughout the Argyll and Strathclyde areas with maximum intensities of 4-5 EMS							
1999	04	MAR	05:38	28.38N	57.19E	33		6.1	6.6	SOUTHERN IRAN
			One person killed at Kerman and at least 517 houses damaged or destroyed in the Kerman area.							
1999	04	MAR	08:52	5.36N	121.79E	33		6.4	6.5	CELEBES SEA
			Minor damage occurred at Zamboanga.							
1999	08	MAR	12:25	52.13N	159.32E	33			6.7	E COAST OF KAMCHATKA
1999	11	MAR	13:18	41.17N	114.64E	33		5.0	5.1	NE CHINA
			Three people injured, 216 houses destroyed and approximately 3,000 houses damaged in the Zhangbei County.							
1999	20	MAR	10:47	51.57N	177.64W	50		6.3	6.8	ANDREANOF ISLANDS
			Felt strongly on Adak and Amchitka.							
1999	27	MAR	08:03	9.62S	112.76E	33		6.0		JAVA, INDONESIA
1999	28	MAR	19:05	30.49N	79.29E	33			6.6	INDIA BORDER REGION
			At least 100 people were killed, many more injured and many houses were destroyed in the villages of Chamoli and Rudraprayag in the Dehra Dun district.							

Issued by Bennett Simpson, British Geological Survey, April 1999

Forthcoming Events

27 May 1999
Dynamics: An introduction for civil and structural engineers
IStructE. Full day course

27 May 1999
The Road to Total Earthquake Safety.
The 7th Mallet Milne Lecture
ICE 5.30pm.

12 August 1999
Dealing with Earthquakes in Cities of Developing Countries

22-24 September 1999
Practical seismic design for new and existing structures
Imperial College. Three day course

29 September 1999
Strengthening of the Basilica of St. Francis in Assisi

27 October 1999
Machine Foundations - Modelling and Measurements

24 November 1999
Strong Motion Records for Analysis and Design

Contents

SECED Newsletter

The SECED Newsletter is published quarterly. Contributions are welcome and manuscripts should be sent on a PC compatible disk or directly by Email. Copy typed on one side of the paper only is also acceptable.

Diagrams should be sharply defined and prepared in a form suitable for direct reproduction. Photographs should be high quality (black and white prints are preferred). Diagrams and photographs are only returned to the authors on request. Diagrams and pictures may also be sent by Email (GIF format is preferred).

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SECED

SECED, The Society for Earthquake and Civil Engineering Dynamics, is the UK national section of the International and European Associations for Earthquake Engineering and is an affiliated society of the Institution of Civil Engineers.

It is also sponsored by the Institution of Mechanical Engineers, the Institution of Structural Engineers, and the Geophysical Society. The Society is also closely associated with the UK Earthquake Engineering Field Investigation Team. The objective of the Society is to promote co-operation in the advancement of knowledge in the fields of earthquake engineering and civil engineering dynamics including blast, impact and other vibration problems.

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