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COWASJEE EARTHQUAKE STUDY CENTRE NED NEWSLETTER

Inside this issue:

EDITORIAL

The first issue of Volume 3 of the Newsletter in hand is a reflection of the consistent policy of disseminating related knowledge.

Aspects of mitigation are becoming more and more relevant, as the seismic activity in northern areas of Pakistan is constantly on increase with much more severity. Most of the construction in these areas is non-engineered and the write up of article Aspects of Mitigation is worthwhile for improving upon such construction.

It has always been emphasized that any contribution in terms of articles shall be appreciated by CESNED, however, CESNED have yet to benefit from contributions from outside

Northern Areas of Pakistan Faces Series of Quakes

The Northern Areas of Pakistan are constantly experiencing earthquakes for the last three months. The north of Pakistan is situated at the meeting point of four great mountain ranges the Himalayas, Karakurum, Hindukush and Pamirs and includes some of the world's highest peaks such as K2, Nanga Parbat and Rakaposhi.

It is one of the most seismically active areas of the world, at the plate boundary between the Indian Sub-continent and the Eurasian landmass. The seismic activity of this region is comparable to other highly seismic areas such as Western United States and the Philippines.

The present wave of quakes started with an earthquake on November 02, 2002 near Gilgit. The magnitude of this earthquake was measured 4.5 on Richter scale. The quake hit near Gilgit, about 125 miles north of Islamabad and about 400 km (240 miles) north of Peshawar. Major aftershocks followed the main earthquake. It caused heavy landslide which blocked the Karakoram Highway (KKH) at Tato Pani, 150 km south of Gilgit. At least 10 people died and around 1500 others affected because of landslides. Another 30 people have been injured in the Karakoram mountain range where four villages have been badly damaged. The casualties had been reported from Tato Pani, Muthat, Railkot and Jall villages, located around 50 km (30 miles) from the Nanga Parbat mountain near the northern town of Gilgit.

The next earthquake hit the Gilgit region on November 21, 2002. Aftershocks rumbled for several hours and about 53 aftershocks were recorded since the first major earthquake. The quake killed at least 25 people. The earthquake was measured 5.5 on Richter scale. Six villages in Astore Valley in Diamer District, some 80 km west of Gilgit, were the most severely affected. Damage to roads, infrastructure and electricity had been massive with the quake cutting off roadways leading into the Astore

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Children outside a collapsed Building
Source: Islamic Relief Worldwide

CESNED Participates in International Conference on Protection of Structures Against Hazards

A two days International Conference was organized by CI-Premier Conference Organization on "Protection of Structures Against Hazards" on November 14-15, 2002 in Singapore. Themes of the Conference included Terrorists Attacks, Impact and Shock Loads, Chemical and Biological Hazards, Structural Collapse, Corrosion and Natural Degradation, Natural Hazards, Vibrations, Ground Subsidence, and related issues such as Mitigation, Rescue, Safety and Evacuation techniques etc. Cowasjee Earthquake Study Centre NED (CESNED) participated in the Seminar by submitting a paper titled "Post Disaster Mitigation- Relief to human Sufferings" by Mr. Adnan Qadir, Associate Professor, Mr. Muhammad Masood Rafi, Assistant Professor,

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China Hit by an Earthquake

An earthquake of magnitude 6.4 hit Southern Xinjiang, China on February 24, 2003 at 02:03:44 (UTC). The epicenter of the earthquake was located at 100 km (65 miles) East of Kashi or 3330 km (2070 miles) West North West of Beijing. At least 257 people killed, more than 1,000 injured and many homes destroyed or damaged in Bachu County.

This earthquake occurred near the boundary between the Tarim Basin and the Tian Shan mountain range in the north-west Tarim Basin. The region is very close to the Northern areas of Pakistan, which is constantly experiencing shocks from earthquakes for the last few months. In a broad sense, earthquakes in this region result from stresses induced by the collision of the Indian and Eurasian continental plates, even though the boundary between these plates lies about 1000 km to the south.

The Indian Plate continuously moves northward at a rate of 4.5 cm per year relative to the Eurasian Plate generating massive mountain ranges including the Himalaya and causing the uplift of the Tibetan Plateau. These stresses are transmitted to the north, through the rigid and undeforming Tarim Basin, where they generate the Tian Shan mountains and numerous earthquakes like this recent event. Several nearby mapped faults have orientations similar to the thrust fault that the earthquake occurred on, although seismologists have not yet associated the quake with a specific fault.

Fig: Location of Kashi Earthquake in China, very close to Northern Areas of Pakistan
(Source: Britannica Atlas)

Deaths from Earthquakes in 2003

Date	Region	Magnitude	Number
2002/11/02	Gilgit, Pakistan	4.5	10
2002/11/21	Gilgit, Pakistan	5.5	25
2003/01/21	Near the Coast of Guatemala	6.5	1
2003/01/22	Colima, Mexico	7.8	29
2003/01/27	Turkey	6.1	1
2003/02/24	China	6.4	257
Total			323

Source: *www.usgs.org and Associated Press*

Recorded Earthquakes of Magnitude 7.0 and Greater in 2003

	Year	Month	Day	Time	Latitude	Longitude	Depth	Magnitude	Region
1	2003	1	20	08:43:06.6	-10.40	160.75	33	7.3	Solomon Islands
2	2003	1	22	02:06:33	18.76	-103.84	24	7.8	Colima, Mexico

Source: *www.usgs.org*

Northern Areas...

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Valley. Power and telephone lines as well as water channels had been damaged in most areas. The earthquake destroyed 100 houses while 1,256 were damaged. The quake killed 17 people, injuring 65. 15,000 persons have been rendered homeless. Most of the injured belonged to Astor. The dead included 10 residents of Turbiling.

Another mild earthquake rattled a remote mountainous region of northern Pakistan on February 13, 2003. The magnitude of the tremor was 4.1 and it was felt in the Gilgit region. However, there was no immediate news of damage or casualties.

(*Source: Associated Press)*

CESNED Participates...

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and Miss Farnaz Batool, Lecturer. The paper focused on the evaluation of existing state of affairs of awareness and effectiveness of ambulance networks and hospitals in Karachi in emergency preparedness. Proceedings of the conference is available, in CESNED for reference.

Aspects of Mitigation

In the last issue general description and behaviour of free-standing walls, walls enclosure without roof and with roof was discussed. As has been emphasized that adequate resistance of a four wall enclosure will only be provided when either there is a horizontal load transferring mechanism through diaphragm i.e, slab or proper joint detail at the corners. It has also been mentioned that the lateral load resisting system in case of four walls enclosure shall be provided by the walls in the direction of lateral load, i.e inplane stiffness of the wall is of major consequence. Such walls are known as shear walls and they primarily behave as a cantilever. To ensure that they act as cantilever, adequate resistance to sliding and overturning should be present.

The weight of the wall in case of masonry and concrete construction most of the time provide adequate resistance. The foundations of such walls when designed for the same provide the pre-requisite for such walls to behave as cantilever. The consequence of the lateral loads on such shear walls is elaborated through Figures 1 and Figures 2.

While resisting the in-plane horizontal forces a mechanism as shown in Figure 1 is formed, which eventually lead to development of diagonal tension and compression as a result of shearing stresses caused by horizontal sliding action and bending stresses caused by cantilever action as shown in Figure 2. This sort of behaviour may be witnessed in solid walls i.e without opening and eventualities due to cantilever action and shearing actions can be taken care-of by proper detailing of the end zones and disrupting horizontal planes of weaknesses in case of masonry construction.

Shear walls with openings, however, always remain an integral part of a normal dwelling, and, therefore, needs additional care in planning and detailing of such openings, as such walls in many cases behave more like a frame then a shear wall.

In order to understand the behaviour of such walls reference is made to the Figure 3 & 4, bellow taken from "A Manual of Earthquake Resistant Non-Engineered Construction" published by National Information Center for Earthquake Engineering (NICEE). The numbers on the

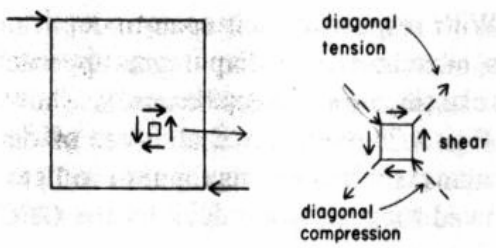

Fig 1. Direct shear resistance

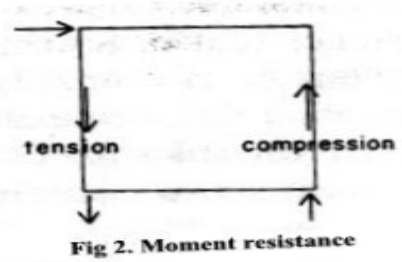

Fig 2. Moment resistance

figures are explained on the side for ready reference, and to make the explanatory paragraph more apprehensive. The dotted lines in Figure 3 represent the approximate deflected shape, primarily due to the more flexible nature of the piers created between the openings.

For such a case the sections at the level of the top and bottom of the openings shall be worst effected by tension as well as compression stresses thereby giving rise to

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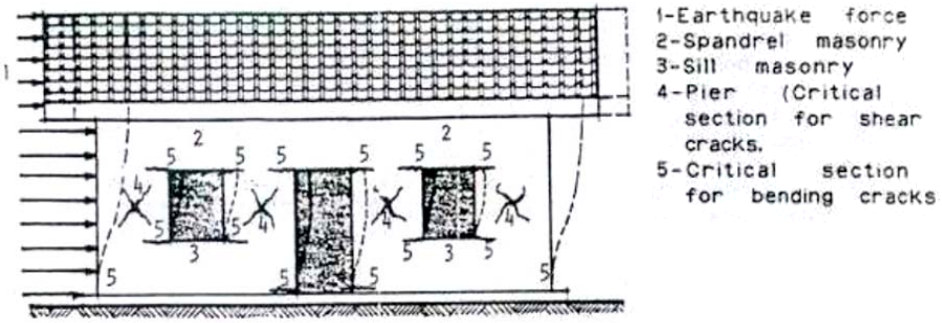

Fig 3. Deflections and cracks

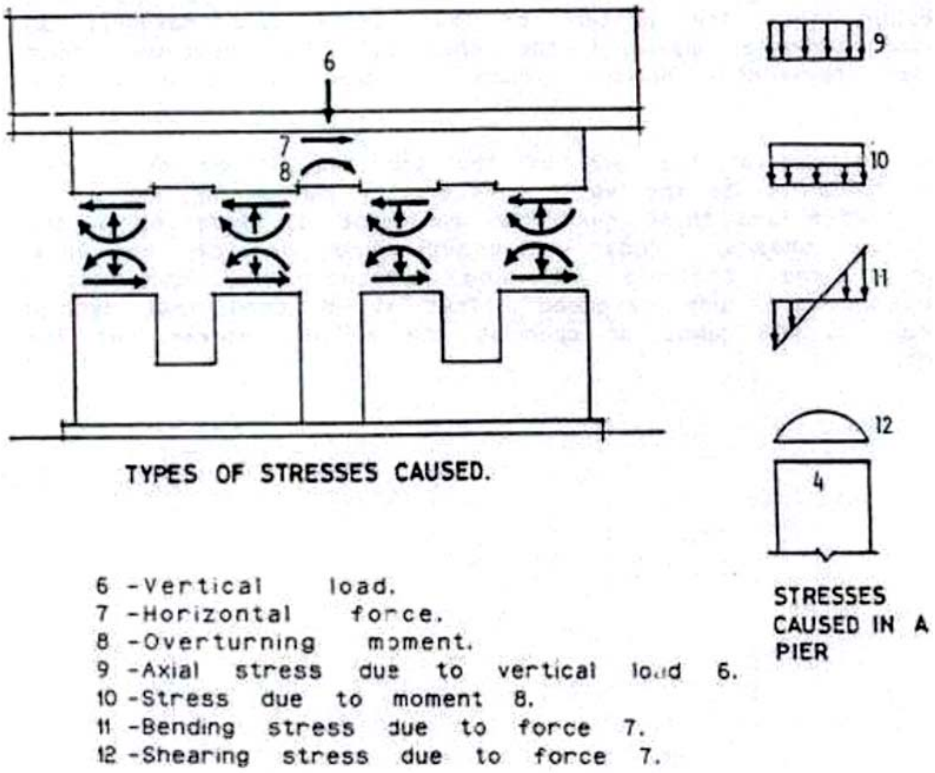

Fig 4. TYPES OF STRESSEES CAUSED

CESNED Continues Work on Mitigation

CESNED engaged three groups of undergraduate final year students to work on projects related to mitigation and disaster management one year ago. The reports of these projects have now been presented and accepted. A brief summary of these reports is as under:

1) Development of Software for Response Spectrum Analysis of Single Degree of Freedom System – Supervisor : Dr. Sarosh H Lodi, Professor

The project was aimed to develop software named **SeismoSoft** to perform response spectrum analysis and produce spectrum graphs. The Software can present results (response) both in tabular form and graphics. The software is based on central difference method, which is an approximation of finite difference of the time derivatives of displacements (i.e velocity and acceleration). The Software has been developed in Visual Basic 6.0. However, it does the analysis only for earthquake response to linear Single Degree of Freedom systems. The input required for the analysis is earthquake motion data and few strong motion data are provided in the Software with the provision for user defined earthquake data as well. The extent of accuracy of this Software is found to be more than 91%.

2) Seismic Evaluation and Risk Rating System for Existing RCC Buildings – Supervisors : Mr. Zaffar Razzaq, Associate Professor and Dr Sahibzada Farooq Ahmad Rafeeqi, Professor and Chairman

The Work has been made exclusively for the purpose of addressing the need of seismic evaluation and categorization system for existing RCC buildings in Karachi. The Document discusses the conceptual and technical aspects of seismic evaluation as well as societal challenges faced by the engineering community of Pakistan. The report is based on literature review of existing evaluation procedures developed by different countries. Then in the light of existing situation of Karachi, the document endeavours to make a proposal for both pre-earthquake evaluation and post-earthquake evaluation of existing RCC frame type buildings. The report presents a stepwise procedure for the earthquake risk assessment of buildings from preparation of inspection to submission of final report. It provides a seismic risk rating system for buildings developed along with software.

3) Development of a Disaster Management System for Traffic – Supervisor : Dr. Mir Shabbar Ali, Associate Professor

This Report presents the observational and analytical aspects of traffic disaster management and the development strategies that may prove to be fruitful in solving the typical urban arterial congestion problems. Such problems result in extremely chaotic situation when a natural disaster occurs or an imposed congestion is made to occur at any particular arterial segment by any traffic blockage or maintenance work being carried out at that anchor point. Various parameters like volume counts, LOS, signal timings, peak hour factors, delay times, running time per mile, capacity of the arterial segment as per existing number of lanes, mode wise traffic and diversion routes are analysed in order to develop a traffic disaster management system. The exercise was carried out to upload the actual data in the GIS running softwares.

Keeping in view the usage of GIS to the introductory level, other softwares used were QRSII (Quick Response System II) Version 6, and HCS & DNPS 86 (Highway Capacity Analysis Software). The findings of the Work are, however, is that there are many more variables or factors that need to be evolved according to our traffic flow conditions. Besides that, ITS (intelligent Transport System) has been studied and the procedure for the development of a self organizing Traffic Control System using Network Models has been followed.

It is demonstrated that apart from existing governmental infrastructure, the techniques that are developed for managing a traffic disaster may compete well with the prevailing techniques, if all possible parameters affecting the behaviour are completely and exhaus-

RESOURCE PERSONS:

- Prof. Dr. A. S. Khan
- Prof. Dr. S. F. A. Rafeeqi
- Prof. S. H. Lodi

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Information, news items, short notes on research findings are invited from across the globe.

Aspect of Mitigation

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horizontal bending cracks marked as "5" in Figure 3. These sections can, therefore, be termed as critical sections for bending tension and compression. It may also be noted that earthquake forces would bring the same effect in the reversed direction, thereby reversing the stresses. These sections and the corner of the walls, therefore, need special attention to safeguard against these reversing stresses.

The piers in between the openings on the other hand shall carry maximum shear near the mid height, thus becoming the critical section fro shear (Diagonal Tension), as shown by "4" in Figure 3.

It should be remembered that the magnitude of the tensile stresses in the shear wall is strongly dependent on the value of seismic force and it increases more rapidly due to effect of overturning moments (which depends on the force as well as the total height of the building).

The stresses due to all the effects i.e, vertical load "9", local bending stresses caused due to bending of piers between openings "11" and bending stresses due to overturning moment "10" are all shown in Figure 4. It shall be noted that the stresses shall remain compressive for small seismic forces i.e, the effect "9" shall remain dominant, while for larger seismic forces effect "10" and "11" shall dominate giving rise to tensile stresses and consequently cracks occurring at corners of opening in walls and diagonal cracks at centres of wider piers. These cracks may join together further complicating the crack pattern and subsequently damaging the wall. Different degrees of damage can occur depending upon the magnitude of inertia forces and the resistance available at the critical sections of the resisting elements. The categories of damage along with factor affecting damage shall be the topic for the next issue of the Newsletter.