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NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF EARTHQUAKE ENGINEERING

Cowasjee Earthquake Study Centre NED NEWSLETTER

Karachi experiences unexplained 'JOLT'

According to the Pakistan Meteorological Department (PMD), an earthquake measuring 3.6 magnitude on the Richter scale hit Karachi on 17 January 2017 which lasted for 10 seconds. PMD reported the depth of earthquake as 12 km with its epicentre within the city. Some localized tremors were felt in Gulshan-e-Iqbal, Gulistan-e-Jauhar and other adjacent areas. Local residents, students and faculty members at NED University (**Figure 1**) and Karachi University came out of their classes and offices. No damage to the property was, however, reported.

Figure 1: People standing in ground at NED University after the tremor on 17 January 2017 (Source: Geo News)

Strangely, no other seismological centres in the region and the accelerometers installed at NED University recorded these tremors. Later, some experts on national news channels shed their doubts on the accuracy of news provided by PMD. They suspected that the tremors were not related to any seismic activity. Those who felt the tremor heard a sound and it felt as if the walls were shaking. These unexplained tremors have led much public speculation of their nature and origin. One of the public opinions is that these tremors may have been caused by offshore drilling off the coast of Karachi in the Arabian Sea by oil companies. However, this seems unfounded to date despite the fact that no other reason for the tremors is confirmed to date.

The city of Karachi (with a population of approximately 20 million people) sits near the convergence of the Eurasian, Arabian and Indian tectonic plates. This makes the city an area which is prone to seismic disturbances. According to some of the seismologists, Karachi has all the elements which make it a perfect candidate for a mega disaster in case of an earthquake - dense population, violation of building laws and a history of earthquakes being on the fault line. Sufficient evidences exist to indicate that a massive earthquake measuring 7.5 on Richter scale hit Debal (east of present day Karachi) in the Indus Delta in 893 or 894 AD. Up to 150,000 people were believed to have died due to this earthquake and the Indus River changed its course westward. Historical records also indicate that to the north of Debal, (near Hyderabad) the towns of Bahmanadad and Mansura were badly affected by the earthquakes in the past. These were important cities in the region at that time but suddenly disappeared from the historical record. It is evident from the available technical literature on the seismology of the region that earthquakes of magnitude of 7 and above have been reported in around along the coastline of Pakistan. Of these, four were accompanied by tsunamis in 1914, 1945, 1947 and 1972. In January 2012, a 7.2 earthquake hit close to the town of Dalbandin in Balochistan. Strong tremors were felt in Karachi despite the fact that Dalbandin is 400 kilometres from Karachi and that the epicentre was 80 kilometres deep.

Irrespective of the controversy over the reason of present shaking and in view of the seismic activities in the past around Karachi, the following questions require a careful consideration of the government and the researchers

(1) Does the 2005 earthquake in any way, affected the tectonic plate movement for the rest of the country, especially Karachi, since it lies close to fault-lines?

(Continued on page 2)

6.4 magnitude earthquake shakes Pasni and Gawadar

Pakistan's National Seismic Monitoring Center recorded a strong 6.4 magnitude earthquake in early morning (3.03 am) on 8 February 2017. The epicentre of this earthquake was 23 kilometres (14 miles) southwest of the Pasni town of Baluchistan. Residents in the provincial capital Quetta, and other cities and towns near the epicentre (including the port of Gwadar, Turbat) woke in panic and rushed out of their homes.

Figure 2: Damaged house in Pasni.(Source: Associate Press)

Any earthquake greater than 6 magnitude is considered potentially dangerous and there were initial concerns that this event might lead to a large number of casualties. Fortunately, only minor damages were reported due to this earthquake. Some building damage was not surprising as many structures comprised of stone masonry and block construction (**Figure 2**).

(Continued on page 2)

EDITORIAL

The volume 17 of CESNED Newsletter in hand is based on the events that happened over the last 6 months. These events include the news related to some of the recent seismic events in Pakistan and the activities that the Department of Earthquake Engineering has carried out to make the society safe against natural hazards.

I sincerely hope that our readers find the information contained in this newsletter informative and interesting to them — Editor

Inside this Issue:

Karachi experiences unexplained 'JOLT' *(Continued)*

(2) Does the recent seismic activity in the southern and coastal areas of Sindh is an indication of increased tectonic activity? Should not this be a valid reason of concern for the local government in Karachi in view of the way high-rise buildings are constructed in the city, often without any regard for construction rules?
(3) Is there a disaster risk reduction model for Karachi? Are there any steps taken by the Karachi administration towards disaster risk reduction? Are the institutions prepared to operate during a disaster?

Laws to regulate building standards exit in Pakistan; implementation mechanism is far from being effective

The laws to regulate building design and construction exist in the country. After the 2005 earthquake, seismic provisions were added to the Pakistan Building Code 1986 which made it compatible with the 1997 US Uniform Building Code. The commissioner of Karachi recently initiated a programme entitled ***Commissioner Programme on Earthquake Safety for Karachi***. One of the objectives of the programme includes to evaluate existing buildings in Karachi and to suggest measures to strengthen the vulnerable buildings. Standardisation of the building bylaws and regulations to comply with the earthquake safety requirements is also the goal of this programme. Despite of these and other similar efforts, there still remains a huge gap between legislation and its implementation.

Pakistan lacks institutional capacities in enforcing the approved quality standards

Currently, two types of steel are available in market: hot-rolled deformed and cold-twisted ribbed bar. These bars are manufacturing using ingots instead of iron ore. Pakistan Standards and Quality Control Authority, allows only the rebars which conform ASTM 615, 706 and BS4449 for safer infrastructure. Therefore, use of non-standard material in steel rebar production, and the use of these bars in the construction may result in devastating consequences in terms of loss of life and property, as was witnessed during the 2005 Kashmir earthquake.

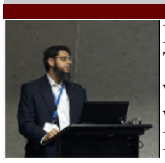
Pakistan lacks research and development in earthquake engineering capacity building

The Cowasjee Earthquake Study Center (CESNED) under the auspices of the Department of Earthquake Engineering has been working specifically to increase capacity in earthquake risk reduction (DRR) in Pakistan since 2001. It has now become a focal point in conducting the studies related to seismic vulnerability assessment, and risk reductions and mitigation in Pakistan. CESNED has strong linkages with the global and national partners such as UNDP, Aga Khan Development Network, World Bank, USAID, Aga Khan Planning and Building Services, Pakistan, National Disaster Management Authority, etc. Following studies conducted by CESNED is a testament to its commitment towards DRR

⇒ Seismic Risk Assessment for Pakistan
⇒ Karachi City Scenario
⇒ Disaster Risk Management Plan and Planning Map of Gadap town
⇒ Tsunami Risk Assessment Model for Gwadar and Pasni
⇒ Applied Research on Safer Construction and Technology Transfer

Since the present Chief Minister of Sindh, Mr. Murad Ali Shah is an alumnus of NED University, it is prayed and hoped that he will focus on integrating crisis management into policy making and planning at the grass root level for the betterment of people of this province.

NED UNIVERSITY PARTICIPATES IN 16WCEE IN CHILE



Dr. Haider Hasan, Associate Professor in the Department of Civil Engineering at NED University of Engineering and Technology presented his paper entitled Assessing tsunami risk to Karachi Port through simulation of currents that were reportedly produced there by the 1945 Makran tsunami at the 16th World Conference on Earthquake Engineering which was held in Santiago on 9-13 January 2017. Higher Education Commission of Pakistan provided the funds to Dr. Hasan to attend the conference.

Earthquake Shakes Pasni and Gawadar *(Continued)*

Pasni has a population of around 400,000 people. Mr. Bashir Bangulzai, Commissioner of Makran Division, stated to the Dawn News that complete survey of the Makran division was conducted which did not reveal life or property damages. Tufail Baloch, Deputy Commissioner Gwadar, also confirmed that no damage occurred in Gwadar.

The geology of Baluchistan is dominated by the Makran Fault System, or Makran Accretionary Wedge. Compression is the main tectonic force in this system. Although subduction is slow here, the area has experienced large earthquakes in the past.

This region has the highest rates of seismicity and largest earthquakes in the Himalaya region (**Table 1**) caused mainly by movement on the thrust faults. A M = 8.0 earthquake shook the region on 27 November 1945, which generated a tsunami within both the Gulf of Oman and the Arabian Sea. The shaking and ensuing tsunami from this mega-thrust event killed an estimated 4,000 people. This deadly event occurred approximately 85 km southwest of today's M = 6.4 earthquake, which also appears to have occurred along or near the subduction zone.

Date	Epicentre, region	Magnitude	Max intensity
1852	Kahan, Baluchistan	8	IX
1889	Jhalawan, Baluchistan	8	VIII
1892	Qilla Abdullah, Baluchistan	8.8	VIII to IX
1909	Sibi, Baluchistan	7	VIII to IX
1929	Sibi, Baluchistan	7	VIII to IX
1931	Sharigh Valley, Baluchistan	7	VIII to IX
1931	Mushh, Baluchistan	7.4	VII
1935	Quetta, Baluchistan	7.5	VIII
1945	Pasni, Makran	8.3	VII to VIII
2008	Ziarat, Baluchistan	6.4, 6.4	VII
2011	Dalbandin, Baluchistan	7.2	IV to V
2013	Mashkel, Baluchistan	7.8	IX to X
2013	Awaran, Baluchistan	7.7	IX

Table 1: Past Seismicity in Baluchistan

PROJECT ON TRAINING RELIGIOUS LEADERS IN DISASTER MANAGEMENT

The religious perspective of an earthquake is that this is an act of God. While this fatalist view of divine role in creating natural hazards is a truth, it is possible to highlight the critical role of human activities in turning a hazard into disaster (for example, through building collapse or poor community preparedness). In this context, there is an urgent need to promote a culture of seismic safety in Pakistani society by providing people with natural disaster awareness, education and training on the steps and measures that are known to save lives. Pakistan's religious leaders can play a unique and critical role in promoting disaster preparedness and prevention by teaching the Islamic obligation of community leaders to protect and save lives. For instance, religious institutions and leaders can lead earthquake safety drills. They can include life safety lessons in their sermons, record videos, or broadcast radio or TV messages carrying basic ideas of how to save lives. Mosques could also be used to disseminate information and to distribute literature related to life safety in case of earthquakes. Religious scholars and elders are among the most highly respected people in the Pakistani society. People not only listen to them but they also take guidance from them on all matter including personal matters. Therefore, engaging religious leaders to advocate safety to reduce seismic risk by providing knowledge and training to a large number of people could be beneficial for disaster risk reduction. This approach to create safe communities is based on the simple teaching of Islam that life is sacred and saving one's life is a religious duty.

In both the 2005 earthquake and the 2010 floods, the religious leaders, their volunteers and their organizations were the first responders. Despite of their eagerness to help communities in difficult times, religious groups are generally not well trained and have very little technical expertise to be able to effectively support the effort before, during and after disasters.

Presently, no platform exists where scientific and religious leaders could interact and join hands in the cause of saving lives of Pakistan's most vulnerable population. To overcome this critical shortcoming, a training programmme for religious leaders has been designed by Peace and Education Foundation (PEF), Pakistan in collaboration with academic and government science experts in the U.S. and Pakistan. The organisations and agencies which participated in the programme include GeoHazards International, USA, Indiana University, USA, NED University of Engineering anf Technology, Pakistan, University of Baluchistan, Pakistan and National Disaster Management Authority, Pakistan). The long-term goals of the project include

1) to improve the understanding of earthquake risk in Pakistan's religious institutions,
2) to build capacity for managing earthquake risk among religious leaders, and
3) to contribute a new element of community engagement to a comprehensive natural disaster education program for Pakistan.

It is anticipated that the project will help to bridge the gap between religious and scientific communities in Pakistan. This will also provide a different model in the area of disaster management in which religious communities could actively participate for the development of disaster-resilient communities. Moreover, the developed educational materials (produced using the teachings of Islam) will be broadly accepted by the households due to the involvement of religious team members.

To commence the activities of the project, a three-day regionally-focused pilot interactive workshop on disaster risk reduction entitled **Pakistan Earthquake Hazard Mitigation Workshop for Religious Leaders** was held in Islamabad from 20-22 February 2017. Prof. Sarosh H. Lodi (**Figure 3**), Prof. Muhammad Masood Rafi, from NED University of Engineering and Technology, Karachi, Mr. Din Muhammad Kakar, from University of Baluchistan and Mulvi Muhammad Rasheed, religious scholar, were the invited speakers. Over 20 religious leaders from all Muslim sects (Deobandi, Brelvi, Shia and Salafi) participated in the workshop.

Figure 3: Trainers and participants in a mosque during vulnerability assessment exercise.

Day one of the workshop started with the welcoming session and the introduction of the project and its participants. Next session focused on the perception of natural disasters in Islam and Islamic teachings on preventions and safeguarding humanity. The following sessions discussed science of earthquakes, their history in the region and the devastation and socio-economic impacts on the region. The day closed with the discussion on how the effectiveness of the knowledge shared during the workshop can be increased for the victims of future earthquakes.

Day two of the workshop focused on training exercises in earthquake vulnerability, community resilience, disaster management and preparedness, and risk reduction. Different sessions were conducted by Prof. Sarosh Lodi, Prof. Muhammad Masood Rafi on Day 2 of the workshop.

The third and last day of the workshop explored the role of religious communities in disaster response, exercises for madrassas in the disaster preparedness and the development of earthquake safety literature for community development programmes. In the end, souvenirs were presented to the speakers and certificates were distributed among the participants. It was also decided to plan a future workshop for women and female madrassa instructors.

The project is on-going and the success of this project will be measured by increased awareness about earthquake safety among various segments of society, and the existence and use of emergency response plans in mosques and schools. A possibility of extending this work to other parts of the country, and to other areas of science-religion collaboration (e.g., public health, climate change) also exists for future.

Building Codes of Pakistan - Fire Safety Provisions Launched

President Mamnoon Hussain formally launched Building Codes of Pakistan-Fire Safety Provisions 2016 during an impressive ceremony held at Aiwan-e-Sadr, Islamabad on 27th February 2017 (**Figure 4**).

Figure 4: Prof Lodi receiving his certificate from President of Pakistan

The Building Codes of Pakistan were formulated in 1986 and later modified in 2007. The earlier versions of the codes did not include the provision for fire prevention in buildings and other structures. With the increase in recent building fire incidents, where precious human lives were lost besides huge financial loss, there was a dire need to have a comprehensive legal framework which could be used to preventing and curtailing fire incidents.

National Disaster Management Authority (NDMA) was given this task of inclusion of Fire and Life Safety Provisions in Building Codes of Pakistan by the Government of Pakistan. NDMA signed a Memorandum of Understanding (MOU) with Pakistan Engineering Council (PEC) in October 2015 for the preparation of fire provisions for the Building Code. Funding for the development of these provisions was arranged by NDMA. A High Level Task Force was formed by PEC to prepare these provisions. Prof. Sarosh Lodi and Prof. Muhammad Masood Rafi were also the member of the Task Force. The committee finished their work in June 2016. The prepared document was formally approved by the PEC Governing Board and was later vetted by the Ministry of Law and Justice.

The provisions are based on international standards and have been customised to the local environment in Pakistan. It is expected that these Fire and Life Safety Provisions would bring a material difference in defining building safety standards and directions for fire safety.

CEREMONY TO INAUGURATE EXTENSION OF ADVANCED MATERIAL TESTING LABORATORY (ATML)

The need of a more laboratory space has been felt for some time for various research activities of students and faculty. The Cowasjee Foundation has come to help the Department of Earthquake Engineering in this matter with a generous donation for the construction of the building. A Ground breaking ceremony for the extension of Advanced Material Testing Laboratory (AMTL) took place on 26 January 2017. Ms. Ava Cowasjee, a trustee of the Cowasjee Foundation unveiled the plaque on this occasion (**Figure 5**). The extension work is expected to complete in 2017 which will allow the installation of new testing facilities. The lab will be named as Cowasjee Earthquake Study Centre after Late Ardeshir Cowasjee.

Figure 5: Group photo with Ms. Ava Cowasjee after unveiling of plaque

TESTING OF LOW-STRENGTH CONCRETE SPECIMENS EXPOSED TO ELEVATED TEMPERATURES

Building fire incidents have increased in Pakistan, particularly in Karachi. Most of these engineered and non-engineered RC buildings are constructed using low strength concrete. The absence of data related to elevated temperature properties of building materials is a major hindrance to the assessment of fire exposed buildings. As a result, reliance is made on the elevated temperature property data of concrete available in other parts of the world.

Figure 6: View of furnace and cylindrical specimens inside the furnace

A study is in progress under the supervision of Prof Muhammad Masood Rafi that aims to provide information for the design engineers regarding the assessment of fire resistance of RC structural members. This study is unique in its nature in that there is no research work done to date in Pakistan, on assessing the temperature dependent mechanical properties of concrete. The knowledge of temperature dependent material properties is critical in the assessment of residual capacity of fire damaged structures. Nevertheless, fire damaged RC buildings in many cases can be repaired and retrofitted.

The strength and stiffness of concrete are the most important properties for its structural applications. The worldwide research has indicated that both these properties degrade which may affect load carrying capacity of structural members. Concrete exhibits low thermal conductivity and high heat capacity as compared to other building materials. These properties enable concrete to sustain high temperatures during fire. Nevertheless, chemical, physical and mechanical changes take place in concrete at high temperatures.

This experimental study is conducted using an unstressed residual property test method on cylindrical specimens of 100×200 mm that are heated at temperature variation from 100°C to 900°C in increments of 100°C in an electrical heat treatment furnace (**Figure 6**) for residual compressive and tensile strength, modulus of elasticity and Poisson's ratio of low strength concrete. The heating elements are able to raise the temperature inside the furnace up to a maximum of 1200°C.

Similar specimens were tested at ambient temperature as control specimens. The results are being published by the Journal of Structural Fire Engineering very soon. Tensile strength of concrete was also determined by carrying out splitting tests on concrete cylinders in accordance with ASTM C496/C496M-11.

This study is continuation of a comprehensive research programme on investigating the behaviour of locally available construction materials at the Department of Earthquake Engineering at NED University of Engineering and Technology.

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