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NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING

Cowasjee Earthquake Study Centre
NED
NEWSLETTER

CESNED ACTIVITIES

"Building Pakistan's Capacity for Instruction, Research, and Practice in Earthquake Engineering and Seismic Retrofit" 1st Year Progress

"Building Pakistan's Capacity for Instruction, Research and Practice in Earthquake Engineering and Seismic Retrofit" is Pakistan–US Joint earthquake related research project under cooperative program. **Dr. S. F.A. Rafeeqi ,Professor and Dean, Faculty Civil Engineering and Architecture,NED University of Engineering and Technology, Karachi** is the Principal Investigator from **Pakistan side** and **Dr. Brian E. Tucker President ,GeoHazards International** is the Principal Investigator from **US side.**The other partner Institutions from **US side are Earthquake Engineering Research Center, University of California, Berkeley,John Blume Earthquake Engrg. Center, Stanford University,Pacific Earthquake Engineering Research Center Computers & Structures, Inc**. The first year progress of the project is as below**.**

Project Progress in First Year

Fig:Prof.S.H.Lodi delivering his speech.

Project progress has been good in year one, first visit to Pakistan by US team was made in July prior to that project participants began meeting via videoconference in March. Almost five videoconferences have been successful. Participants are investigating how the use of videoconferencing can be expanded to enhance the project and promote academic exchange.Team members from the United States visited Pakistan in July to meet with project partners, learn about the local built environment and construction practices first-hand, visit potential case study buildings, build relationships with the Pakistani team members, and revise the project work plan. The project team has begun curriculum development, case study development, and training activities. Major project accomplishments are discussed as below.

Orientation for Pakistan Side Partners:

An orientation for Pakistan side partners was held at NED University Karachi on July 10, 2007, prior to the visit of US partners. The purpose of the meeting was to present an overview of the project to partners in academia, private engineering consulting, management, private architecture consulting and the construction industry.

Exchange Visits:

A portion of the project team from the United States visited Pakistan July 20-28, 2007. The following team members made the trip: Gregory Deierlein, Professor, Stanford University, David Mar, Principal, Tipping Mar & Associates Khalid Mosalam, Professor, University of California, Berkeley. Janise Rodgers, Project Manager, GeoHazards International Thomas Tobin, Chief Operating Officer, GeoHazards International While in Pakistan, the project team (both Pakistani and US) met with partners from both academia and industry. The first session of the meeting held on July 21 at NED University was with faculty members of engineering universities in Sindh including Karachi, Khuzdar, and Jamshoro. In the second session of the meeting the project team had a discussion with 4 participants from the construction industry. Another meeting was held on July 23 at NED University with industry partners. The project team visited sites in Karachi to get the general idea of the local construction practices and forming systems. The five American team members traveled with Dean S. F. A. Rafeeqi, Professor Sarosh Lodi, and Mr. A. A. Farooqi to Islamabad and the area affected by the 2005 earthquake. In Islamabad, the project team met with project partners and the Higher Education Commission (HEC) on July 24, 2007. In the first session, the team met with potential partners from academia and industry from Islamabad, Taxila, Lahore, and Peshawar.

In the second session, the team visited a sample building site in Islamabad. The team also visited Earthquake Reconstruction and Rehabilitation Authority (ERRA). *(continued on page 4)*

Inside this issue:

EDITORIAL

The second issue of volume 7 of CESNED NEWS LETTER marks the completion of seven years. we have kept our promise to keep you well informed about earthquake happenings all around the globe along with latest development in earthquake engineering .For almost all these years we have been requesting readers to contribute through writing so that we may think of bringing some changes from routine. CESNED NEWSLETTER can always take a new look if professionals working in earthquake prone areas start sharing their experiences in seismic retrofitting and pre and post earthquake mitigation efforts through planning, designing and detailing .Once again it is emphasized that this modest.

Editor

COASTAL AREA OF SIND SUSCEPTIBLE TO SOIL LIQUEFACTION AND ITS MITIGATION

Cowasjee Earthquake Study Centre at NED University was established after the devastating 26th January 2001 Bhuj Earthquake. This centre continuously disseminating the knowledge related to earthquake and providing guidelines for pre-earthquake mitigation. This article is also one of the part of such activity.Immediately after the Bhuj Earthquake a reconnaissance team of the centre lead by the Chairman, Department of Civil Engineering visited earthquake effected areas of Badin, Thatta, Hyderabad and Therparker districts to collect the damaged pattern in that areas. Working from the collected data by the team and published geological studies the author is able to locate the areas which may in future liable to liquefy during strong earthquake. The article is also aimed at creating awareness among the professionals with regard to design of engineering systems against any such future calamity.

Fig 1:Badin-Kadhan road (5 km away from Kadhan) craters in the earth are clearly visible.

The 2001 earthquake produced widespread liquefaction in the southern and western belt of Taluka Deplo, Taluka Mithi and Nagarparkar. Tharparkar areas which were severly affected were Islamkote, Chilyan, Demo Dahdal, Diplo, Chachre, Sanghi and other places. In many parts of the coastal district of Badin, several feet wide craters appeared (Figure 1) on ground. At number of places, subsoil water sprang from the earth (sand boil) which submerged Baden-Kadhan road (Figure 2). The coastal and adjoining areas of Sind susceptible to liquefaction is shown in Figure 3 which is inferred from local field data and satellite image observation and extrapolation to area of similar susceptibility.

Fig 2:Badin-Kadhan road (5 km away from Kadhan) Sugar cane lands were devastated by large earth fissures.

Liquefaction

The application of cyclic loads as produced by earthquake to relatively loose deposits of sands and silty sands below the water table may result in partial or complete loss of supporting capacity of the deposit. If soil strength (τ_{soil}) is completely lost as given by shearing strength equation,

$\tau_{soil} = (\sigma_n - u_d) \tan \varphi$,where, σ_n = normal vertical stress on failure plane,u_d = excess dynamic pore water pressure due to earthquake stresses φ = angle of internal friction of soil .

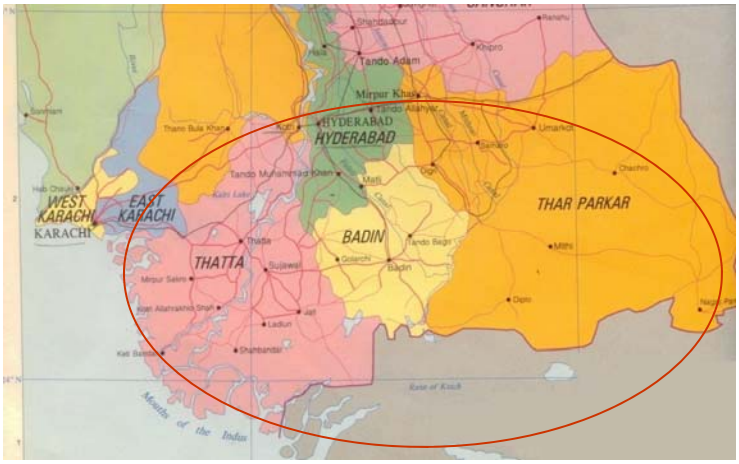

Fig 3:Circled area susceptible to liquefaction

At least temporarily, water flows upwards to surface creating sand boils, buried pipelines and tanks become buoyant and may float to the surface. Structures supported above or with in the deposit undergo significant settlements and tilting. This phenomenon is referred to as "liquefaction" and is obviously a condition to be avoided in any type of major future constructions in such areas.

Factors Pertinent to the Soil Liquefaction Problems

Void Ratio or Relative Density:

Lower the relative density (or the higher the void ratio of soil) the more easily a soil will liquefy. The most common methods used in the field to determine relative density are either to estimate it - based on penetration tests or else to actually measured it from undisturbed soil samples.

COASTAL AREA OF SIND SUSCEPTIBLE TO SOIL LIQUEFACTION AND ITS MITIGATION

Ratio of Shear Stress to Initial Effective Stress:

The ratio of cycle shear stress to the initial effective confining stress has proven to be convenient expression for presenting data for liquefaction. This characterization must be carefully evaluated from established laboratory or field tests.

Number of Stress Cycles:

This factor may also effect the above two factors and therefore important factor to be evaluated. Under field conditions the number of significant cycles is dependent upon the frequency and duration of loading of the earthquake and may be determined from cyclic triaxial test data.

Soil Grain Characteristics:

The grain characteristics including particle size, shape and gradation influence the susceptibility of soil liquefaction. The envelope shown in Figure 4 is based on a number of grain size tests on sands that did liquefy in actual earthquakes and the soils most likely to liquefy in the laboratory tests.

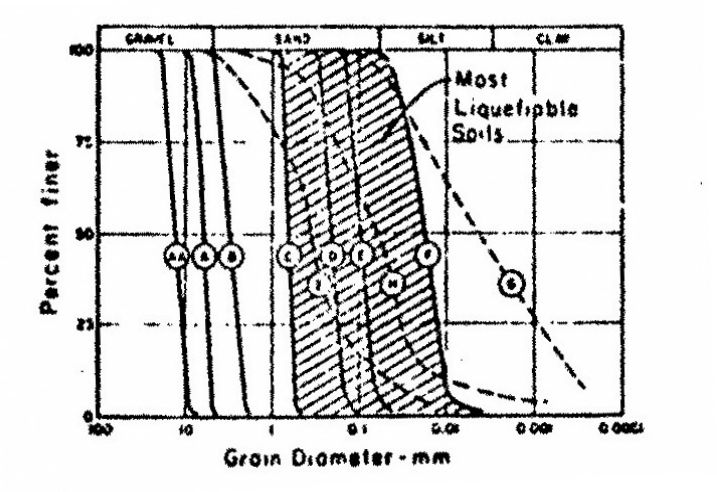

Fig 4 :Soil Susceptible to liquefaction

Method for Evaluating Soil Liquefaction Potential:

Since there are many factors that strongly influence the liquefaction potential of any soil deposit, any method for evaluating such potential must takes the following procedures into consideration:

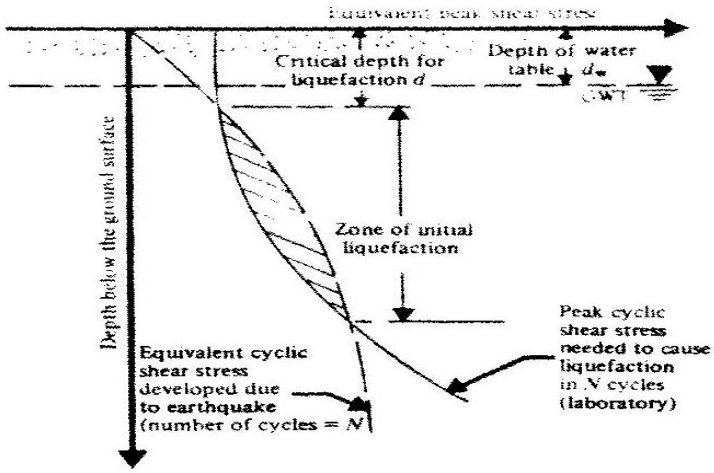

Fig 5 : Procedure by which zone of liquefaction is identified.

1).Established the soil conditions, the design earthquake and determine the time history of shear stresses induced by the earthquake ground motions at different depth with in the deposit. The variation of equivalent cyclic shear stress (characterized by the number of equivalent cycles corresponding to amplitude of loading) by earthquake with depth is plotted as shown in Figure 5.

2).The variation of the cyclic shear stress required to cause liquefaction (laboratory liquefaction resistance must correspond to the same earthquake magnitude and number of cycles) with depth is then plotted on the same graph. Liquefaction can be expected at depths where the cyclic loading exceeds the liquefaction resistance as shown in Figure 5. The evaluation of liquefaction potential is basically comparison of loading and resistance throughout the soil deposit of interest.

Mitigation TechniquesA wide variety of soil improvement techniques are available for mitigation of liquefaction. The most common techniques are:

1 Densification 2. Reinforcement 3.Grouting/ Mixing 4. Drainage

Verification of the effectiveness of soil improvement is an important part of liquefaction mitigation. Direct or indirect measurement of stiffness, strength, or density characteristics both before and after improvement can allow reliable evaluation of soil improvement effectiveness.

Source: CESNED by Dr A Samad Khan Senior Research Fellow Civil Engg Dept NEDUET.

(*continued from page 1)*

The Chairman of ERRA Mr. Altaf Muhammad Saleem along with Gen. Nadeem and 20 officials gave a brief description of ERRA's work to the visiting team.ERRA arranged for the team to visit the earthquake-affected area via helicopter, viewing reconstruction projects in Rawalakot, Bagh, Chakothi, and Muzafferabad. Following the visit, however, participants sent several short articles on the visit to associated organizations such as the American Concrete Institute and the Pacific Earthquake Engineering Research Center.

Fig:*Research team together with the Vice chancellor and administrative members of NED University.*

Case Study Development

During the course of the initial project videoconferences and the organizing meeting in Karachi, the project team decided to select case study buildings in a manner more appropriate to on-ground conditions than that originally proposed. The original proposal was to select a campus of buildings, and then choose case study buildings based on a rational screening process. However, the existing campuses of buildings in Karachi did not contain a selection of buildings representative of typical construction in Karachi, and did not include building types common in other parts of the country.

The project team decided to select 20-24 case study buildings based on the following criteria: (a) buildings would be representative of important types of existing construction in the cities where they are located; (b) buildings would have seismic vulnerabilities typical of existing construction; (c) buildings would be representative of important types of occupancy, use, and ownership; and (d) case study teams would have access to the buildings and information about their design and construction.

The composition of the case study pool would be approximately ten reinforced concrete buildings, five buildings brick masonry buildings, and five stone masonry buildings. At least five buildings would be from Karachi, with the remainder from both urban and rural areas in the rest of the country. Including buildings from other regions encourages participation of partners throughout the country, a key project goal. Real buildings will be used for the case studies, but their identities will be kept confidential and particular characteristics may be simplified or idealized to facilitate their use as teaching tools. The project team also decided to have several of the case studies serve as pilots and be completed more quickly so that adjustments and refinements could be made in the remaining case studies. The pilot case study buildings and teams have been selected and work is underway.The project team has developed a list of components that all case studies should contain.David Mar and Janise Rodgers are leading efforts to adapt the American Society of Civil Engineers (ASCE) Tier 1 assessment procedure to Pakistan conditions. Case study teams will be trained in the adapted procedure and will use it to initially screen their buildings for seismic vulnerabilities.

Fig:*Research team during their visit to earthquake damaged sites in Rawalakot, Bagh, Chakothi and Muzaffarabad.*

Curriculum Development :

The curriculum development efforts are led by a curriculum development team consisting of Professors Rafeeqi and Lodi on the Pakistan side and Professors Deierlein and Mosalam on the U.S. side. Efforts began with a review of the existing civil engineering curriculum at NED University and at other universities in Pakistan prior to the July visit. The team met in Karachi to discuss how best to revise the existing curriculum to include important earthquake engineering topics not already covered. Following the visit, the team developed a draft curriculum revision plan for both graduate and undergraduate curriculum that is currently undergoing discussion with a wider group of faculty at NED University. The revision plan includes the addition of earthquake engineering topic modules to existing courses as well as the creation of several new courses.

The draft plan is the first step toward creating a national minimum standard for the inclusion of earthquake engineering topics in the civil engineering curriculum.

Training

During their visit to Karachi in July 2007, Dr. Deierlien, Mr. Mar, Dr. Mosalam, and Mr. Tobin presented recent advances in earthquake engineering at a technical seminar organized by the Pakistan Chapter of the American Concrete Institute. The seminar was titled "Performance- Based Earthquake Engineering and Applications to the Evaluation and Retrofit of Existing Buildings" and was held at NED University of Engineering & Technology, Karachi, on Saturday, 21st July 2007. The technical seminar was attended by almost hundred local professional consulting engineers, contractors, and academics. Also at NED University in Karachi, Mr.Mar, Dr. Rodgers, and Mr. Tobin led a training session on rapid assessment of existing buildings for younger faculty members and practicing engineers. Session participants discussed the vulnerabilities and likely seismic behavior of a typical apartment building in Karachi. Discussions during this training session provided the starting point for an adaptation of the American Society for Civil Engineers (ASCE) seismic vulnerability screening guidelines for Pakistani conditions. Case study teams will be trained on the use of the revised guidelines by Mr. Mar and Dr. Rodgers via videoconference.

RESOURCE PERSONS:

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- Prof. S. H. Lodi

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