EAB Accredits CE Programme

The Bachelor of Engineering (Civil) Programme at NUS was recently accredited by the Engineering Accreditation Board (EAB) of the Institution of Engineers, Singapore (IES) at all classifications of degree, for a term of five years, for graduates matriculating in 2002 to 2006. This is the first programme to be accredited by EAB. The BEng (Civil) programme of the Department has also been accredited earlier by the Joint Board of Moderators of ICE and IStructE for student intakes of 2001 to 2005 inclusive at UK M.Eng. level for degrees awarded at Pass, Pass plus Merit level and above.

To review the programme, the EAB evaluation panel comprising Mr Chua Koon Hoe (Leader), Dato’ Ir. Lee Yee Cheong and Professor Cheong Hee Kiat, visited the Department on 18 and 19 February 2003. The panel was accompanied by the Secretary, Er Ong See Ho and three observers, Mr Basil Wakelin (representing the Institution of Professional Engineers New Zealand), Mr Donald Wroe (representing the Engineering Council, New Challenges in CE Profession: An Alumnus’ Perspective

Mr Koh Wai Keat is Senior Manager, Veolia Water Systems (formerly known as Vivendi Water Systems). He received his BEng (Civil) and MEng, specializing in wastewater treatment, from the Department in 1986 and 1989, respectively. Mr Koh started his career as a process engineer with a regional water treatment company, designing and commissioning water and wastewater treatment plants/systems primarily for the industrial sector. He then moved on to regional sales and business development work. Prior to his present position he also worked for another International Water Company specializing in seawater desalination projects. Following his recent visit to the Department for an “Alumni Get-Together”, Mr Koh shared his thoughts with the Department as an Environmental Engineer on some critical issues facing the profession of Civil Engineering through an e-mail interview.

What is the possible impact of a broad-based education against specialized training in the practice of Civil Engineering? How will it influence the marketability of CE graduates?

In my opinion, broad-based education is desirable as long as it does not compromise on rigor of training in core engineering principles and fundamentals. I suppose broad-based training...
New Challenges in CE Profession: An Alumnus’s Perspective

EAB Accredits CE Programme

The paper entitled "Numerical Simulation of the Effects of Spacer on Concentration Polarization in Spiral Wound Reverse Osmosis Modules" co-authored by SW Ma, LF Song, SL Ong and WJ Ng of the Centre for Water Research (CWR) was given a Best Student Paper Award from the North American Membrane Society (NAMS) at its 2003 Annual Meeting held on 19-21 May 2003 in Jackson Hole, WY, USA. This is the second year in a row that CWR has received the Best Paper Award from NAMS. As NAMS is a key professional association on membrane technology, these awards are a reflection of the quality of membrane technology research efforts spearheaded by the CWR.

CWR Researchers Receive Best Student Paper Award

The role of EAB is to ensure that the programme serves to equip graduates with sound knowledge of fundamentals of the discipline, and to develop in them an acceptable level of professional competence that would meet the needs of the profession locally and be adequate for the responsible fulfillment of engineering assignments globally. The evaluation team inspected the teaching material and students’ work, and had discussions with the Dean of Engineering, Head of the Department of Civil Engineering, teaching staff, students and industry representatives. The team members also visited the various laboratories and other teaching and student learning facilities of the Department. Some of the key observations reported by the evaluation panel are:

(a) The broad-based curriculum has been well developed and managed by a team of highly qualified and dynamic staff.
(b) The Department has continually introduced new and innovative teaching methodologies to keep the programme relevant to the industry.
(c) The entry standards for students are very high.
(d) Excellent opportunities are provided for students to obtain overseas exposure.
(e) Commendable effort by the students’ Civil Engineering Club in its projects to benefit the community through application of engineering skills.
(f) Outstanding teaching facilities are available in the Department.
(g) Very good support from professional engineers in the execution of design projects.
(h) The faculty members are engaged in a rich array of R&D projects which are funded mostly by external sources.

For monitoring and controls of plant processes and they are being made available on various types of networks (e.g., the Ethernet). Dial-in control and monitoring through the Internet is now fairly common.

What are the major challenges currently faced by the Civil Engineering profession and how could these challenges be met in the training of CE graduates?

There is no doubt that environmental engineering is evolving very fast with successful implementation of new technologies as well as new concepts. Even practicing engineers are struggling to keep abreast with the rapid changes in technologies. Unlike before, governments and private owners and developers are now more willing to invest multi-million dollars in environmental projects using yet-to-be-proven processes in order to solve their problems whether it’s a water shortage issue or waste disposal problems. So, I guess the main challenge here is to train or at least introduce these new technologies to students in the University. Undertaking some final year R&D projects focusing in these technologies will help but inviting practicing industrial specialists to conduct some classroom courses will probably be useful too. Well-planned, industrial attachments for students in forward looking and technology driven companies are also invaluable.

How is information technology changing the practice of Civil Engineering and what level of IT skills a fresh CE graduate should possess?

Environmental engineering is fast gaining importance due to the rapid development and testing of new technologies and the increased emphasis on sustainable development. In practice, many of these new technologies are further enhanced and successfully implemented with sophisticated instrument, controls and automation know-how. Therefore, fresh graduates need to be trained not only in advanced programming techniques but also be introduced to the latest software packages available in the industry. This can include understanding the capabilities of latest hardware available such as PLCs and smart field instruments. For example, PLCs are now becoming more powerful for monitoring and controls of plant processes and they are being made available on various types of networks (e.g., the Ethernet). Dial-in control and monitoring through the Internet is now fairly common.

Provides greater marketability for fresh graduates, broadening their choices in other areas like banking, sales and marketing. But broad-based education at the expense of technical competence is not necessarily desirable for employers looking for fresh graduates to fill hardcore engineering or technical positions. It is fairly difficult to find local world class engineers or technical specialists with the passion for engineering. To some extent, I feel that specialized training can help develop this passion.

The major challenges currently faced by the Civil Engineering profession are:

- For monitoring and controls of plant processes and they are being made available on various types of networks (e.g., the Ethernet). Dial-in control and monitoring through the Internet is now fairly common.
- There is no doubt that environmental engineering is evolving very fast with successful implementation of new technologies as well as new concepts. Even practicing engineers are struggling to keep abreast with the rapid changes in technologies.
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- This can include understanding the capabilities of latest hardware available such as PLCs and smart field instruments. For example, PLCs are now becoming more powerful for monitoring and controls of plant processes and they are being made available on various types of networks (e.g., the Ethernet). Dial-in control and monitoring through the Internet is now fairly common.
Geo-X Team Wins First Runner-Up Prize

The Geo-X team, comprising five members from CE’s graduating Class of 2003: Lin Jenq Ping; Siew Chen Keat; Goh Hock Jin; Ooi Shein Din and Ng Ken Tong, and six from the Technopreneurship Minor programme offered by NUS Entrepreneurship Centre, has won the First Runner-up prize at the Fourth Start-up@Singapore National Business Plan Competition and Forum. The competition was jointly-organised by the Economic Development Board (EDB), NUS Centre for Entrepreneurship (CET) and Business School Alumni Association (NUSBSA), and was held on 31 May 2003 at Suntec City Convention Centre.

The prize was given for the development of technology business plans to commercialise findings from a Final Year Research Project carried out in the Department of Civil Engineering. It dealt with sophisticated foundation testing and ground improvement technologies for the civil engineering industry. Besides winning $10,000 at the competition, Geo-X was also one of the finalists in the Megabucks 2003 entrepreneurship competition held in the Indian Institute of Technology, Kanpur, India.

Offshore Engineering Career Talks & Job Fair

On March 21, representatives of six companies from the offshore engineering industry, namely, Cooper Cameron, FMC Energy Systems, Kellogg Brown and Root, Keppel FELS, Sembcorp Marine and Sembawang Marine Offshore Engineering made informative pitches to raise awareness of offshore engineering as a career and to provide employment opportunities for our graduates in this industry. The event was organized by the Department of Civil Engineering and the Office of External Relations, Faculty of Engineering, with co-operation from Economic Development Board (EDB).

A promising sector with excellent growth prospects, Singapore’s offshore engineering industry has grown 7.5% yearly over the last seven years to register an output of $2 billion in 2002. Today, Singapore is a major centre in the Asia-Pacific region for engineering and manufacture of oil and gas production platforms, as well as specialised equipment. In fact, Engineering talents from all disciplines can look forward to excellent career prospects in this industry, including opportunities for training and postings overseas.

Both Male and female graduates were welcome to pit for some very interesting jobs from offshore rigs, ship conversion to floating production systems, petroleum exploration and production, to data crunching and ‘man handling’ leading people and teams.
Completed Research Projects

Engineered Cementitious Composites and Functionally-Graded Concrete
( R-264-000-105-112)

Aging infrastructure facilities, particularly those made of reinforced concrete (RC), deteriorate at a rapid rate—faster than they are being repaired, rehabilitated, or replaced. A major cause of concrete deterioration is corrosion of the reinforcing steel in the structure resulting from chloride penetration or carbonation. This project has focused on the development of high performance cement-based composites and their application in RC structures for enhanced durability against reinforcement corrosion and deterioration by aggressive substances.

To address the common durability problems experienced by RC structures due to reinforcement corrosion, a new strategy for the design of RC flexural member has been proposed in this project. The design consisted of replacing part of the concrete which surrounds the main flexural reinforcement with an Engineered Cementitious Composite (ECC) which exhibits strain-hardening and multiple-cracking behavior under uniaxial tensile loading. This concept of design with layered ECC is referred to as Functionally-Graded Concrete (FGC). A series of RC beams incorporating FGC were subjected to an accelerated corrosion regime and later loaded to failure to determine their flexural response. The objective of the experiment was to evaluate the effectiveness of the concept of FGC in retarding the corrosion of steel reinforcement and reducing the tendency of the concrete cover to delaminate as measured by a concrete embeddable fibre optic strain sensor (FOSS). The effects of steel loss and corrosion damage on the flexural response of the RC beams were also evaluated. The proposed FGC concept was found to be very effective in preventing corrosion-induced damage in RC beams and minimizing the loss in the beam’s load and deflection capacities.

The proposed fibre optic sensing technique was also found to be useful for measuring and monitoring tensile strains in the concrete resulting from the corrosion-induced expansion of the reinforcing steel. It can also be used to detect any crack forming in concrete due to corrosion where visual inspection is not possible. The research team comprises Dr M Maalej (PI), Prof P Paramasivam and Mr SFU Ahmed.

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Fibre Optics Strain Sensor (FOSS) used to detect and measure corrosion-induced damage in RC structures.
Vibration Analysis of Piezoelectric Laminate Smart Structures
(R-264-000-057-112)

This project is aimed to provide a basic mechanics model for vibration analysis and wave propagation in the flexural analysis of beam and plate structures coupled with piezoelectric layers.

In the free vibration analysis of beams, the Euler model for long and thin beam structures is employed together with the electric potential satisfying the surface free charge condition. The distribution of the piezoelectric potential is obtained by including Maxwell equation in the formulation. Results of the numerical analysis showed that the natural frequencies of the beam are functions of the stiffness and thickness of the piezoelectric layer as well as its position from the mid-plane of the beam. A more significant conclusion is that the longitudinal distribution of the electric potential in the piezoelectric layer is not constant as commonly assumed; otherwise Maxwell equation will be violated. It is related to the shape of the transverse displacement, or more accurately the curvature, of the sandwich beam and is dependent on boundary conditions. It is hope that these formulations and findings will contribute to the future research on the application of smart materials and structures.

The analysis of circular plate with a piezoelectric layer is based on the Kirchhoff and Mindlin plate model. Two thin layers of electrode cover the two surfaces of the piezoelectric layer, which is used to actuate the plate structure through external voltage applied across the thickness of the electrode. Free vibration analysis, together with static and dynamic response due to external voltage applied to the piezoelectric layer are presented. The mode shape of the electric potential distribution can be obtained from the free vibration analysis, which is generally shown to be non-uniform in the radial direction in contrast to what is commonly assumed. The results show that for free vibration analysis, the distribution of electric potential in the longitudinal direction of the plate can be solved, provided an appropriate form of the electric potential field that ensure the satisfaction of the Maxwell equation is adopted. For the case of static actuation, the analytical solution of the deflection indicates that the external electric potential brings uniform normal moment. For time-varying applied potential, the dynamic response of the deflection of the plate and the electric potential in the piezoelectric layer can be solved using the modal superposition method.

The findings of this research may form a framework in the design of piezoelectric materials in mechanical systems for practical applications, such as the ultrasonic motor. The research team comprises Assoc Prof Wang Quan (PI) and Assoc Prof Quek Ser Tong.

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Characterisation of Singapore’s Old Alluvium
(R-264-000-135-112)

Singapore’s Old Alluvium was deposited by a braided river system and is a natural heterogeneous soil mix exhibiting wide range of properties. Its strength and stiffness at a given depth differ by an order of magnitude, and this can not be explained by differences in density and water content. Composition analysis reveals that the majority is clayey sand and the concept of granular void ratio is generally used to determine reasons for such high degree of variability in engineering properties. The importance of identifying fine content is highlighted in this project and it should be based not only on size but also on mineralogy. It is further postulated that the way of calculating granular void ratio need to be modified to accommodate such a natural soil with wide range of grading, different mineralogy and over-consolidation history.

An experimental programme was carried out on undisturbed soil samples obtained by using the Mazier samplers and block sampling from two test sites. Results from a series of isotropic consolidated undrained triaxial tests and particle size distribution tests reveal that strength and stiffness of material is governed by granular void ratio rather than the global void ratio. The strength of Old Alluvium increases with a decrease in granular void ratio. Steady state line in void ratio vs. mean effective pressure plane can be better defined using granular void ratio. Results highlighted the
importance of understanding the mineralogical composition and stress history in the characterization of natural soils. The research team comprises Dr G R Dasari (PI) and Assoc Prof Tan Thiam Soon.

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Organic Matter Characterization and Its Treatability in Water Reclamation (R-264-00-056-112)

Characterization of dissolved organic matters in raw water and product water are important for treatment process selection and operation. The characteristics of organic matters in terms of molecular weight distribution, hydrophobicity and functional groups are essential for assessing the performance of Reverse Osmosis (RO) system. This is especially important for dealing with the removal of organics that are potential precursor of disinfection by-products (DBPs). Appropriate detection protocols for characterization of organic matters were developed in this study. The protocols developed were used to assess the performance of RO process in terms of dissolved organics rejections. It is noted that RO process could readily remove most hydrophobic acid organic fractions from treated secondary effluent. It was also observed in this study that hydrophobicity of dissolved organic matters is significant in assessing treatability of organic species using RO process.

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e-mail: cveongsl@nus.edu.sg Tel: 6874 2890

Staff Activities (April - June 2003)

I. Advisory/Editorial Board & Professional/Technical/Conference Committees

<table>
<thead>
<tr>
<th>Name of Staff</th>
<th>Details of Membership</th>
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</thead>
<tbody>
<tr>
<td>Lee Der-Horng</td>
<td>Associate Editor, IEEE Transactions on Intelligent Transportation Systems, Institute of Electrical and Electronics Engineers Inc., Piscataway, New Jersey, USA.</td>
</tr>
<tr>
<td>Leung Chun Fai</td>
<td>Chairman, Investigation Committee for Singapore PE Board</td>
</tr>
<tr>
<td>Tan Kiang Hwee</td>
<td>Council Member, Institution of Engineers Singapore from May 2003 to May 2005</td>
</tr>
<tr>
<td></td>
<td>Council Member, Institution of Engineers, Singapore (Elected for a second 2-year term from May 2003 to May 2005; serving as Assistant Honorary Treasurer, and Chairman of Transportation Engineering Technical Committee)</td>
</tr>
<tr>
<td></td>
<td>Member, Technical Advisory Committee, Second International Symposium on New Technologies for Urban Safety of Mega Cities in Asia, 30-31 October 2003, Tokyo, Japan</td>
</tr>
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II. Others

Assoc Prof Leung Chun Fai was invited to present a paper on “Life-long learning for engineers - current trends and future directions” at the 5th WFEO World Congress on Engineering Education and 2nd ASEE International Colloquium on Engineering Education, Nashville, USA, 20 -22 June 2003.

PUBLICATIONS. January – March 2003


Seminars Held: April – June 2003

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<thead>
<tr>
<th>Date</th>
<th>Title</th>
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<tbody>
<tr>
<td>14 Apr</td>
<td>Biofouling in Drinking Water Systems</td>
<td>Mr R.T. Bachmann, Postgraduate student, Sheffield University, United Kingdom</td>
</tr>
<tr>
<td>13 Jun</td>
<td>Machine Learning Approach for Material Behaviour Modeling</td>
<td>Dr Sudhir Kumar Barai, Assistant Prof, Department of Civil Engineering, Indian Institute of Technology, India</td>
</tr>
<tr>
<td>13 Jun</td>
<td>Innovative Soil Stabilization Method With The Cellular Confinement System</td>
<td>Mr Daniel F Senf, Chief Engineer &amp; Global Sales &amp; Marketing Manager, Presto Products Company, Geosystems, A Business Unit of Alcoa</td>
</tr>
<tr>
<td>16 Jun</td>
<td>An Assessment of Design Methods for Driven Piles in Sands</td>
<td>Dr E U Klotz, Asst Branch Manager, Singapore Branch, Ed Zueblin AG, Stuttgart, Germany</td>
</tr>
<tr>
<td>21 Jun</td>
<td>Special Applications of FRP Systems in Structural Strengthening</td>
<td>Assoc Prof Tan Kiang Hwee, Mr Leong Kok Sang, Mr Zhao Haidong, Mr Liew Yong Seong</td>
</tr>
<tr>
<td>28 Jun</td>
<td>Recent Advances in Fire and Structural Engineering in UK – Research to Practice</td>
<td>Dr Y C Wang, Manchester Centre for Civil &amp; Construction Engineering, UMIST &amp; University of Manchester</td>
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cont’ from page 6
Farewell

Assoc Prof Wang Quan

Assoc Prof Wang Quan left the Department on 19 June 2003 to take up a faculty position at University of Central Florida, USA. He left the following farewell message before his departure: “It has been a wonderful time for me to work and provide my service to Civil Engineering Department at NUS since April 1999. Although it is very painful, I have to say farewell to all my graduate students, my colleague friends, and all the supporting staff. I would like to take this opportunity to sincerely thank all of you for your friendship and help during my service here. I will miss all of you.”

Dr Ganeswara Rao Dasari

After three years with the Department of Civil Engineering, Dr Ganeswara Rao Dasari left NUS in June 2003 to join a multi-national oil company in USA to carry out research and development in offshore engineering. He is best remembered by his obliging character being always willing to help his colleagues and students. During the three years at NUS, he has been actively involved in research on numerical analysis of geotechnical problems, land reclamation, study of wave on seabed mines and soil characterization. He has a good numbers of papers accepted in top tier geotechnical journals for the above research.

<table>
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<tr>
<th>Date</th>
<th>Conference/Workshop/ Short Course</th>
<th>Contact Person</th>
</tr>
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</table>
| 19 - 20 June 2004 | The 13th KAIST-Kyoto-NTU-NUS Symposium on Environmental Engineering | Ms Lee Lai Yoke  
E-mail: cveleely@nus.edu.sg  
Tel: (65) 6874 2182; Fax: (65) 6874 5266 |