Department Evaluation by Visiting Committee

Recently, the Department received the Visiting Committee which was commissioned by the University to evaluate the performance of a department in teaching and research, assess the quality of the undergraduate and graduate programmes, and identify the strengths and weaknesses of the department, review its overall development, and make recommendations on future direction as well as follow-up actions.

The Committee comprises three external and two internal (NUS) members: Prof C Michael Walton of University of Texas at Austin, Prof Ko Hon-Yim of University of Colorado at Boulder, Prof Robert H Dodds, Jr of University of Illinois at Urbana-Champaign, Prof Chew Yong Tian of Department of Mechanical Engineering, NUS and Prof Goh Thong Ngee of Department of Industrial & Systems Engineering, NUS. During the 5-day visit from 4-8 August 2003, members of the Visiting Committee inspected our teaching and research facilities, met staff, students and alumni of the Department, and also held discussion meetings with the Dean, and the Provost and Vice Provosts.

The Visiting Committee was impressed by the quality of our teaching and research facilities. The newly introduced two-track (Structures & Geotechnical Engineering and Environmental Engineering & Infrastructure Systems) BEng programme, was considered a “very positive, progressive change”. The Visiting Committee commended the Department’s research thrusts in Geotechnical, Water Resources, Structures (e.g. Offshore), Infrastructure Systems as well aligned with Singapore’s needs and priority.
The Sixth International Symposium on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures (FRPRCS-6) was recently held in Singapore. The event was organized by the Department of Civil Engineering at the National University of Singapore and the Fiber-Reinforced Polymer Society (Singapore). It was supported by the American Concrete Institute (ACI), USA, Institution of Engineers, Singapore, Japan Concrete Institute (JCI), Japan, and The Concrete Society, UK. A total of 180 academics, researchers, manufacturers and engineers from close to 30 countries participated actively in this very successfully staged Symposium. Five exhibitors showcased their products, expertise and R&D works at the Symposium.

The FRPRCS Symposia Series is the world’s premier conference on the development, design and application of FRP reinforcement in concrete structures. It was initiated in 1993, and subsequently held every two years in the continents of America, Europe and Asia, on a rotational basis. The previous symposia were held in Vancouver, Canada in 1993, Ghent, Belgium in 1995, Sapporo, Japan in 1997, Baltimore, USA in 1999, and Cambridge, UK in 2001.

The FRPRCS-6 International Symposium in Singapore marked the 10th anniversary of the FRPRCS Symposia Series, and signified the beginning of an era, in which one could witness global interests in FRP reinforcement, as well as the use of FRP reinforcements as structural shapes, and in masonry and steel structures. Three keynote lectures were given by distinguished experts in the field. Professor A. E. Naaman of the University of Michigan, USA, gave an assessment on the progress and prospects of the application of FRP reinforcing bars in structural concrete, with input from a survey of expert opinion. Professor T. Uomoto from the University of Tokyo, Japan, provided a much desired approach for the durability design of GFRP rods and Professor T. Ueda from the Hokkaido University, Japan, gave valuable insights into the development of flexible continuous fiber reinforcement to provide structural ductility.

Besides the keynote lectures, a total of 136 papers from 27 countries were scheduled for presentation at this Symposium. Each technical paper had been reviewed and approved for presentation by at least two members of the International Scientific Committee. An International Steering Committee, comprising past symposia chairmen, was also formed to chart the future directions of this prestigious event. It appointed a three-man
taskforce to decide on the Best Paper Awards which were initiated for the Symposium. These taskforce consisted of Professor C. W. Dolan from USA, Professor F. S. Rostásy from Germany, and Professor H. Okamura from Japan. All of them are well known in the areas of FRP reinforcement and structural concrete.

The Best Paper Awards are as follows:

**Best Paper (Application):**

Strengthening of Concrete Structures with Prestressed and Gradually Anchored CFRP Strips
*by I Stoecklin and U Meier*
EMPA, Switzerland

**Best Paper (Research):**

Local Bond Stress-Slip Relations for FRP Sheets-Concrete Interfaces
*by J G Dai and T Ueda*
Hokkaido University, Japan

Accelerated Techniques to Predict the Stress-Rupture Behaviour of Aramid Fibres
*by K G N C Alwis and C J Burgoyne*
University of Cambridge, UK

**Honorable Mention:**

Blast Resistance of Prototype In-Built Masonry Walls Strengthened with FRP Systems
*by M K H Patoary and K H Tan*
National University of Singapore

The proceedings of the FRPRCS-6 International Symposium, which consist of a set of two volumes, are available at a special rate of S$250 or about US$150 (inclusive of delivery) from the FRPRCS-6 Secretariat (E-mail: frprcs6@nus.edu.sg ; Fax: +65-67791635) while stocks last. (For further information, please visit the Symposium website at [http://courses.nus.edu.sg/course/cvetankh/internet/frprcs6](http://courses.nus.edu.sg/course/cvetankh/internet/frprcs6).

The next FRPRCS Symposium would be held in New Orleans in November 2005.

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**Twelfth Asian Regional Conference on Soil Mechanics and Geotechnical Engineering (12ARC), 4-8 August 2003, Singapore**

The Asian Regional Conference (ARC) on Soil Mechanics and Geotechnical Engineering is the most important and largest event held under the auspices of the International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE) in the Asian Region, taking place every four years. The 12th ARC was jointly organised by the Southeast Asian Geotechnical Society (SEAGS), National University of Singapore (NUS) and the Nanyang Technological University (NTU), with NUS taking the lead in the organisation.

The initial response to the call for papers has been overwhelming. After a rigorous review process, a total of 238 papers from 34 countries were published in Volume 1 of the conference proceedings. This voluminous proceedings is a record for ARCs.

Despite prevailing health concerns arising from SARS, the 12th ARC was held successfully in Meritus Mandarin, Singapore, from 4 to 8 August 2003. Over 400 delegates from 33 countries attended this conference.
The technical programme consisted of 7 keynote lectures delivered by prominent researchers and engineers and 24 parallel sessions. Among the parallel sessions, 11 of them are special sessions sponsored by ISSMGE Technical Committees (TC2, TC9, and TC23) and Asian Technical Committees (ATC3, ATC7, ATC9, ATC10, ATC11, and ATC12). This is the first ARC in which the TCs and ATCs played such a major role in the technical programme. The goal of integrating TCs and ATCs into the technical programme is to provide a forum for various committees to share their latest activities with the geotechnical engineering community at large and broaden the scope of participation. Robust exchanges in a number of these special sessions attest to the success of this goal. The keynote and technical committee papers will be published in the post-conference Proceedings Volume 2.

The remaining 15 general sessions focused on a multitude of facets associated with the role of geotechnics in large-scale infrastructural development in Asia such as excavations and tunnels, deep and shallow foundations, marine geotechnics, earthquake and soil dynamics, numerical modelling, geoenvironmental engineering, soil properties, slopes and embankments, ground improvement, and consolidation. In conjunction with the conference, a technical exhibition with 16 exhibitors showcasing the latest geotechnical technology and software was also held. Visits by the conference delegates to major geotechnical project sites, NUS and NTU were also arranged.

The conference has its light moments as well. Besides the welcome reception, a gala dinner banquet was also held in the Imperium Restaurant in Ngee Ann City to provide a relaxed setting for delegates to interact socially. The delegates were treated to a chamber dance performance that boldly juxtaposes contemporary dance with traditional Javanese dance in a high energy and dynamic presentation. In addition, various delegates also took turns on stage to sing their favourite songs in their native languages, showcasing the rich diversity of cultures in Asia. It was certainly a memorable evening that many delegates would remember us by for years to come.

After the conference, the Conference Organising Committee and Secretariat received congratulating and compliment messages from many happy delegates from all corners of the world.
The Department organized its third Work Improvement Team (WIT) Convention on 24 July 2003 and, in support of University’s introduction of the Safety Innovation Team Programme (SITP) to bring about improvements in workplace safety and health, had included SITP projects in this year’s convention.

All six WITs of the Department, CHAIN, CONSTRUCT, EIGHT, HEW, KEYS and PILLAR, participated in the competition with each team presenting both a WIT and a SITP projects. Through this convention, the WITs were able to showcase their achievements and share their creative and innovative ways of solving problems in their workplace. The convention provides an excellent platform for the WITs to prepare for the competition at national level, such as the National Innovation and Quality Circle Carnival and PS 21 ExCEL Convention.

This year’s programme saw the teams presenting their Safety Innovation Projects in the morning followed by a buffet lunch which provided ample opportunity for the academic and non-academic staff to interact. This was followed by the WITs’ Projects presentation in the afternoon. As in the past years, the teams continued to display a very high standard of presentation skills and were very innovative in their solutions to the problems they were working on.

CONSTRUCT of the Structural Engineering Laboratory came out on top in both the WIT and SITP project categories with their projects on Frequent Damage to Displacement Transducers in Pressure Loading Test and Dust Hazards in Carrying out Grinding Operation on Concrete Specimens, respectively. In eliminating or minimizing the damage of displacement transducers during load testing, the team has achieved an annual cost saving of about $14,000 for the Department. CONSTRUCT also came up with an innovative way of carrying out grinding operation on concrete specimens where dust hazard is completely eliminated. The first runner-up for WIT projects was KEYS of the Department Office, which introduced the online CE e-Calendar to the Department to improve the accessibility of information on department events. CHAIN comprising of members from various laboratories and the Department Office was the second runner-up with their presentation on an integrated online registration system to provide postgraduate students profile for the various laboratories and Department Office. The runner-up for SITP projects was PILLAR of the Geotechnical Engineering Laboratory who had been working hard to create a healthy and hazard-free work environment with their project on Enhanced Safety Operation for Geotechnical Centrifuge Model Tests.

The panel of judges consisted of Prof T F Fwa, Prof Shanmugam and Assoc Prof K H Tan.
Alumni from Classes 1987-1989 revisited the Department

Ten alumni from Classes of 1987-1989 joined the members of the Department Management Committee over a breakfast meeting on 5 July 2003. This was the 6th Alumni Get-Together organised by the Department to keep in touch with alumni and to obtain useful feedback from industry. Assoc Prof Cheu Ruey Long, himself an alumnus from the Class of 1987, also attended the meeting. A special highlight for this get-together was the presentation by Geo-X Corporation, a start-up company which promotes technology transfer from NUS to industry. Geo-X Corporation, comprising mainly of our new crop of CE graduates together with a few graduates from other Departments (Electrical & Computer Engineering and Building & Estate Management), was specially invited to make a presentation at the breakfast meeting. Useful feedback was given by the older alumni to the new alumni on their business plan. As in the previous sessions of get-together, there were interesting reminiscences of old times and candid exchange of views on current issues and concerns facing the industry. The Department is grateful to the alumni who have taken time off their busy schedules to touch base with the Department.

Completed Research Projects

Multii-Objective and Real Time Reservoir Operation (R-264-000-061-112)

The uneven spatial and temporal distribution of available water resources necessitates optimal operation of existing reservoirs. Construction of new reservoirs is most probably prohibitive due to both economical and land-scarce factors. For Singapore, the second factor is definitely true. Thus, to face future’s huge water demand, water resources planning efforts are increasingly focusing on efficient and integrated operation of the existing multiple reservoir systems.

This study looks into the applications of multi-objective evolutionary algorithms in defining optimal policies for the operation of multi-objective reservoir network system. An approach is proposed to circumvent some important issues faced by the traditional approaches (such as Linear Programming (LP), Dynamic Programming, etc.) for optimal operation. The proposed approach suggests a novel selection process of the most preferred solution. First in the process is to generate optimal solutions on the Pareto front with NSGA-II, a family of Genetic Algorithm which truly considers multi-objective functions. This is followed by clustering the entire Pareto front into different regions; clustering technique of Kohonen unsupervised neural network is applied here. Should information be not sufficient in a particular cluster, NSGA-II is applied once again focusing only on that particular cluster.
Note that NSGA-II has the advantage to produce a set of feasible solutions in one simulation while LP, for example, is limited to generate only one optimal solution per simulation.

The proposed scheme is first demonstrated on a classical (hypothetical) non-linear four-reservoir test problem and then on the Chaliyar river basin system in Kerala State, India.

The reservoir system (Fig. 1) in the Chaliyar river basin consists of five reservoirs, namely Chalipuzha (R1), Maruthpuzha (R2), Kanhirapuzha (R3), Areco barrage scheme (R4), and Iruvanjipuzha (R5). The main objectives of this system are to obtain maximum irrigation releases and hydropower production. The constraints are physical limitations, environmental restrictions (reducing saltwater intrusion, for example) and storage continuity. NSGA-II for this system consists of two objective functions together with 264 constraints and is run with real-value coded representation, tournament selection, modified crossover and mutation. The total number of variables considered is 120 (10 variables representing the various monthly water releases for the whole year) while the number of populations is 100.

From the Pareto front generated it is observed that the solution of two objective functions is quite well distributed along the Pareto front. The wide spread of 100 Pareto-optimal solutions offers the reservoir operator wide alternatives in effective and efficient decision making. The study also shows that NSGA-II yields, in some cases, significantly more water releases than LP. Table 1 highlights water releases, resulting from NSGA-II and LP, only for the month of March when irrigation demand is the highest from all five reservoirs. The same goes also with water releases for hydropower production; NSGA-II releases more than LP.

Kohonen unsupervised neural network is also applied to group the large amount of solutions into 4 clusters. With fully covered Pareto-optimal fronts at different clusters the difficulty in identifying the optimal solution is significantly reduced. The clustering offers information of each cluster as to its anticipated maximum, minimum and mean values. This information allows the reservoir operator to take optimal operational decisions in a very short time period.
Porous Pavement for Drainage Control
(R-264-000-108-112/290)

Porous pavement allows surface runoff to infiltrate into the porous structure of road pavement instead of surface drainage systems. The water collected in the porous pavement structure may infiltrate into the natural ground, or it can be temporarily stored in the pavement and discharged into the storm-water drainage system subsequently. This helps to lower the peak runoff volume to be carried by the storm-water drainage system, hence reduce the capacity demand for the latter and associated level of infrastructure investment.

While the structural design of porous pavement has been well studied and there exist standard procedure in their construction, the drainage requirements have not been adequately addressed in the literature. This study developed a procedure of determining the thickness requirement based on drainage consideration. This thickness design procedure involves the use of a three-dimensional finite element program.

The porous pavement materials must have sufficiently high permeability and water storage capacity to accommodate the surface runoff. The governing criteria are their porosity and permeability. To provide the needed storage, a reservoir course is designed as part of the pavement structure. The locally used LTA plant-mixed graded granite aggregate base was found to give poor performance in terms of permeability and clogging resistance. It is not suitable to use as a permeable base course. Revised gradations with much higher vertical permeability values are recommended in this research.

Clogging resistance is another important requirement for all layers of the porous asphalt pavement. The NUS Falling Head permeameter, a patented product by the research team, was employed for this purpose by monitoring the rate of deterioration in permeability in laboratory clogging tests. The clogging study indicates that a geotextile layer is required between the interface of the reservoir base course and the subgrade soil. An analytical model is proposed to predict the deterioration in permeability due to clogging.

Table 1: Comparison of Results between Linear Programming (Mohan and Raipur, 1992) and NSGA-II for the reservoir operation

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Mean Inflow</th>
<th>Irrigation Demand</th>
<th>Irrigation Releases (10^6 m³)</th>
<th>Hydropower Demand (10^6 kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(10^6 m³)</td>
<td>(10^6 m³)</td>
<td>LP</td>
<td>NSGA-II</td>
</tr>
<tr>
<td>R1</td>
<td>16.4</td>
<td>82.2</td>
<td>82.2</td>
<td>108.7</td>
</tr>
<tr>
<td>R2</td>
<td>19.0</td>
<td>3.7</td>
<td>3.7</td>
<td>4.5</td>
</tr>
<tr>
<td>R3</td>
<td>1.8</td>
<td>5.0</td>
<td>7.0</td>
<td>5.8</td>
</tr>
<tr>
<td>R4</td>
<td>16.5</td>
<td>6.7</td>
<td>6.7</td>
<td>6.9</td>
</tr>
<tr>
<td>R5</td>
<td>5.6</td>
<td>26.5</td>
<td>26.5</td>
<td>26.6</td>
</tr>
</tbody>
</table>

Contact Person: Assoc Prof Liong Shie-Yui
Email: cvelsy@nus.edu.sg Tel: 6874 2155
The thickness design scheme proposed is one in which the pavement thickness was first determined for the most critical rainfall based on the so-called short-term runoff control criteria. This design would be able to reduce the peak runoff volume for the urban drainage facilities. For longer term runoff control, a pumping scheme is proposed so that the same pavement thickness design could be retained. A porous pavement structure of a total thickness of the order of 1.2 m to 1.6 m is found adequate for the Singapore conditions.

A field trial section has been constructed in a public car-park along Holland Road. Fig. 1 shows the contrast seen on a rainy day between the porous pavement and the conventional dense-mix pavement with water-tight surface course. For the latter, rain water will flow on the pavement surface and collected in the storm sewer. On the porous pavement, all runoff will flow vertically downward and there is no sign of flowing water on the surface.

Contact Person: Prof Fwa Tien Fang Email: cvefwatf@nus.edu.sg Tel: 6874 2276

Novel Reinforcement Scheme for Tubular Connections (R-264-000-060-112)

There are thousands of offshore platforms operating in oil and gas fields around the world, with some of the aged platforms requiring retrofitting for life extension. These offshore platforms, as well as large span roofs, extensively use Circular Hollow Sections (CHS) due to their excellent structural characteristics. Many components in offshore structures are welded to the structure by the provision of a doubler reinforcement plate. However, current design approach in the industry for plate reinforced connections is very rudimentary and ExxonMobil Upstream Research Company (Houston, U.S.A.) thus sponsored research in Department of Civil Engineering, NUS on doubler-reinforced connections. Selected details of the tests, consisting of fifteen large-scale T-joints, contributed by SMEOL Pte Ltd (Singapore), were reported in the Engineering Research News article (August 2000 issue).

The research team followed on with extensive research into alternative reinforcement schemes and investigated the complex structural behaviour of reinforced joints with the objective to derive practical design recommendations. Arising from the study, a novel reinforcement scheme, termed the collar plate reinforcement, has been conceived. This structural scheme may be applied to an existing joint which is found to be under-strength, or be upgraded to sustain higher loads.
Extensive parametric studies using nonlinear finite element method (FEM) on reinforced joints have been conducted after verifications with test results. Figure 1 shows the excellent correlation of the deformation pattern between the test and numerical results for specimens EX-07 (with doubler reinforcement) and EX-03 (with collar reinforcement).

The calibrated FEM is used to carry out extensive parametric analyses on doubler and collar plate reinforced T-joints subjected to different loadings. The ultimate strength of the reinforced joint is divided by that of the corresponding un-reinforced joints to evaluate the strength enhancement provided by the doubler or collar plate. The strength ratios are then plotted against the plate length and thickness parameter for each un-reinforced case (see Figure 2). The effectiveness of the plate can be readily seen from the plots.

The study is further extended to numerical investigation on CHS X-joints subjected to brace compression, tension, in-plane bending and out-of-plane bending. Figure 3 presents the deformed shapes of doubler and collar plate reinforced CHS X-joints subjected to in-plane bending.

Based on the experimental and numerical results, simplified relations have been established between the main geometric parameters and the strength ratios for different loading types. Comparison between the predicted strength ratio and the numerical results is shown in Figure 4 for collar plate reinforced X-joints under in-plane bending.

Selected results have been submitted to international journals, and presented at international conferences. The principal investigator was invited to present at the International Workshop on Tubular Connections: The Way Forward in Kumamoto, Japan in June 2002. International experts in the workshop complimented the team for the "original and very important" work. The research results will provide an appropriate basis for the formulation of design recommendations to the industry.
Staff activities (July – September 2003)

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

<table>
<thead>
<tr>
<th>Name of Staff</th>
<th>Details of Membership</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ong Khim Chye, Gary</td>
<td><strong>Deputy Chairman</strong>, Technical Committee for Civil Engineering, Singapore Accreditation Council for 3 years from July 2003.</td>
</tr>
<tr>
<td></td>
<td><strong>Member</strong>, Taskforce to review the Professional Engineers Act and Rules, Professional Engineers Board, Singapore, June 2003.</td>
</tr>
<tr>
<td>Tan Kiang Hwee</td>
<td><strong>Member</strong>, International Scientific Committee, 4th International Conference on Advanced Composite Materials in Bridges and Structures (ACMBS-IV), to be held in Calgary, Alberta, Canada, from July 20-23, 2004.</td>
</tr>
<tr>
<td>Wang Chien Ming</td>
<td><strong>Member</strong>, International Advisory Committee, International Congress on Computational Mechanics and Simulation (ICCMS-04), 9-12 December 2004, Indian Institute of Technology, Kanpur, India.</td>
</tr>
</tbody>
</table>

II. Others

1. **Assoc Prof Koh Chan Ghee** was invited by JSCE to deliver a keynote at the International Workshop on Structural Health Monitoring of Bridges / Colloquium on Bridge Vibration, Kitmai, Japan, Sep 1-2, 2003. Paper title: "Structural parameter identification: A divide-and-conquer approach"

2. **Assoc Prof Leung Chun Fai** was invited to deliver a keynote lecture entitled "Studying Geotechnical Failures Through Physical Modelling" at the Indonesian National Geotechnical Conference held in Jakarta from 11 to 13 Aug 2003.

3. **Assoc Prof Tan Kiang Hwee** was invited to deliver the following keynote lectures:

   (a) “Effect of Cyclic Loading on FRP-Concrete Interfacial Bond Strength”, at JCI International Symposium on Latest Achievement of Technology and Research on Retrofitting Concrete Structures – Interface Mechanics and Structural Performance, Kyoto, Japan, July 14-15, 2003;
(b) “Innovations in Structural Rehabilitation: FRP Systems and External Post-Tensioning”, at Engineering and Technology Conference (EnTech) 2003, Kuching, Sarawak, Malaysia, July 30-31, 2003;


4. Assoc Prof Tan Kiang Hwee and Mr M K H Patoary received a Best Paper (Honourable Mention) Award at the 6th International Symposium on FRP Reinforcement for Concrete Structures (FRPRCS-6), held in Singapore from July 8-10, 2003, for their paper on “Blast Resistance of Prototype In-Built Masonry Walls Strengthened with FRP Systems”.


Tan, S.A., Fwa, T.F. and Han, C.T., “Clogging evaluation of permeable bases”, J. of Transportation Engineering, USA, ASCE 129(3), 309-315


Conference Presentations (April - June 2003)


Ma, S.W., Song, L.F., Ong, S.L. and Ng, W.J., Numerical Modeling with the Effects of Spacers on Concentration Polarization in Spiral-wound Reverse Osmosis Modules. Paper presented at the 14th Annual Meeting of the North American Membrane Society (NAMS), 17-21 May 2003, Snow Kong Resort, Jackson Hole, United States.


Song, L.F, Yuan, L.Y., Ong, S.L. and Ng, W.J., Retarded Transport of Soluble Microbial Products through the Membrane in an MBR. Paper presented at the 14th Annual Meeting of the North American Membrane Society (NAMS), 17-21 May 2003, Snow Kong Resort, Jackson Hole, United States.


<table>
<thead>
<tr>
<th>Date</th>
<th>Title</th>
<th>Speaker</th>
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<tr>
<td>14 Jul</td>
<td>Fullerene interactions with polymers and organic addenda</td>
<td>Dr Yury Brylin Ioffe Physico-Technical Institute of Russian Academy of Science</td>
</tr>
<tr>
<td>14 Jul</td>
<td>New polymer membranes with immobilized fullerene and their possible application</td>
<td>Dr Galina Polotskaya Institute of Macromolecular Compounds St Petersburg Russian Academy of Science</td>
</tr>
<tr>
<td>16 Jul</td>
<td>Unified Method for Pile Analysis and Design – Illustrated with Case Histories</td>
<td>Dr Bengt H Fellenius President of Bengt Fellenius Consultants Inc &amp; President of Unisoft Ltd</td>
</tr>
<tr>
<td>18 Jul</td>
<td>Interpretation of Results from Static loading Tests on Instrumented Piles with Consideration of Residual Load &amp; The Osterberg O-Cell for Static Pile Loading Tests</td>
<td>Dr Bengt H Fellenius President of Bengt Fellenius Consultants Inc &amp; President of Unisoft Ltd</td>
</tr>
<tr>
<td>25 Jul</td>
<td>Transportation Network Optimization Problems with Stochastic User Equilibrium Constraints</td>
<td>Dr Meng Qiang Research Fellow Dept of Civil Eng, NUS</td>
</tr>
<tr>
<td>28 Jul</td>
<td>Removal of Metals from Contaminated Soils</td>
<td>Prof Shankha Banerji Emeritus Professor of Civil &amp; Environmental Eng Univ of Missouri, USA</td>
</tr>
<tr>
<td>5 Aug</td>
<td>Iron(VI) and Iron(V) – Oxidants and Disinfectants in Water and Wastewater Treatment</td>
<td>Virender Sharma, Associate Professor Department of Chemistry, Florida Institute of Technology, Melbourne, Florida</td>
</tr>
<tr>
<td>5 Sep</td>
<td>What Kind of Transport for What Kind of Singapore</td>
<td>Dr K. Raguraman Associate Professor Dept of Geography and Dept of Civil Eng., NUS</td>
</tr>
<tr>
<td>10 Sep</td>
<td>GAO versus PAO. What are these organisms?</td>
<td>Robert Seviour Professor of La Trobe University &amp; Director of the Biotechnology Research Centre Australia</td>
</tr>
<tr>
<td>12 Sep</td>
<td>Trip-Chaining for Taxi Advance Bookings: A Hybrid Modeling of Analytical and Simulation Approaches</td>
<td>Dr Lee Der-Horng Assistant Professor Dept of Civil Eng., NUS</td>
</tr>
<tr>
<td>13 Sep</td>
<td>Nonlinear Explosion and Fire Analysis of Steel Frame Structures</td>
<td>Dr Chen Hong, Research Fellow NUS</td>
</tr>
<tr>
<td>Date</td>
<td>Conference/Workshop/Short Course</td>
<td>Contact Person</td>
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</tbody>
</table>
| 15 Sep | A Novel Method for the Quantitative Detection of Specific DNA or RNA using Fluorescent Quenching-based Probe or Primer | Dr Takahiro Kanagawa  
Professor  
Leader, Microbial Community Research Group  
Institute for Biological Resources and Functions  
National Institute of Advanced Industrial Science and Technology |
| 17 Sep | Human Pharmaceuticals, Hormones and Personal Care Product Ingredients in Runoff from Agricultural Fields Irrigated with Treated Reclaimed Wastewater | I.H. (Mel) Suffet  
Department of Environmental Health Sciences, University of California Los Angeles |
| 19 Sep | SEA: A Robust Evolutionary Algorithm for Rainfall-Runoff Model Calibration                        | Assoc. Prof. Liong Shie-Yui  
Dept of Civil Eng, NUS |
| 25 Sep | Condition Monitoring and Life Assessment of a Steel Bridge                                      | Prof Pradipta Banerji  
Indian Institute of Technology, Bombay |
| 26 Sep | How Hot is Too Hot - Casting of Thick Raft Foundation in Tropical Climate                        | Assoc Prof Tam Chat Tim  
Associate Professorial Fellow, Dept of Civil Eng., NUS |

**Upcoming Conference/Workshop**

<table>
<thead>
<tr>
<th>Date</th>
<th>Conference/Workshop/Short Course</th>
<th>Contact Person</th>
</tr>
</thead>
</table>
| 19 - 20 June 2004 | The 13th KAIST-Kyoto-NTU-NUS Symposium on Environmental Engineering | Ms Lee Lai Yoke  
Tel: (65) 6874 2182;  
Fax: (65) 6874 5266  
E-mail: cveleely@nus.edu.sg |
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National University of Singapore  
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Singapore 117576  
Tel: 6874 2284; Fax: 6779 1635  
E-mail: cvemansu@nus.edu.sg

Advisors:  
Professor T F Fwa, Head of Department  
Assoc Prof K H Tan, Deputy Head of Department (Admin)

Editorial Committee:  
Assoc Prof M A Mansur (Chairman)  
Ms Christine Tan  
Ms Tracey Yeoh