ICUS NEWSLETTER

International Center for Urban Safety Engineering

Institute of Industrial Science
The University of Tokyo

VOLUME 9 NUMBER 1
APRIL – JUNE 2009

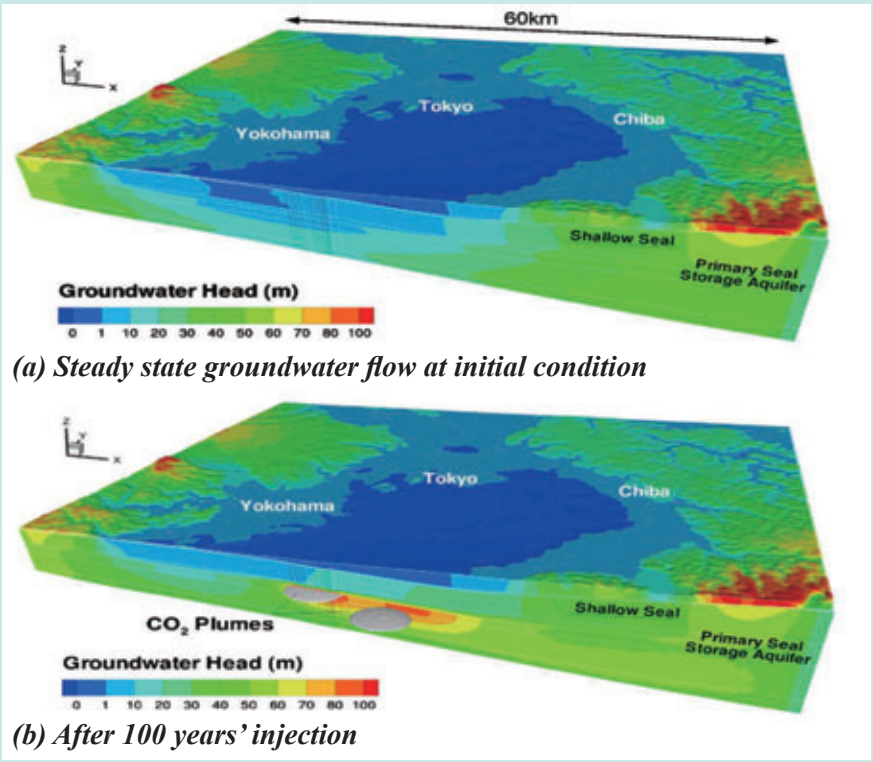
MASSIVELY PARALLEL SIMULATION OF CO_2 GEOLOGIC STORAGE

By

Satoshi Imamura[1] and Hajime Yamamoto[1]

CO_2 capture and storage (CCS) has the potential to significantly reduce the amount of CO_2 released into the atmosphere to mitigate climate change. Technologies are needed to store CO_2 in deep geologic formations safely and permanently. We have developed a high-performance computing system that simulates the long-term fate of injected CO_2, as well as potential impacts and associated risks of CO_2 injection on surrounding regional environment. By combining this system with a world-class super-computer, the Earth Simulator (ES, total 5,120 CPUs) at JAMSTEC, we can now perform high-resolution simulations 100 times finer than previous systems. As a case study, a hypothetical industrial-scale CO_2 injection in Tokyo Bay, which is surrounded by the most heavily industrialized area in Japan, was considered, and the impact of CO_2 injection on near-surface aquifers was investigated, assuming relatively high seal-layer permeability (higher than 10 micro darcy).

However, when a volume of CO_2 is injected into a virgin/native aquifer, it eventually pushes the equivalent volume of water out of the aquifer. In industrial-scale projects of CO_2 geologic storage, it is expected that the amount of CO_2 fluid injected into an aquifer can be several million tons/year for a typical storage site. Continuous long-term injections for more than several decades will buildup groundwater pressures in extensive regions. The Tokyo Bay area is the most populated and industrialized area in Japan, with annual CO_2 emission from large emission sources around Tokyo Bay is about 100 $MtCO_2$/year, comprising roughly 8% of Japan's CO_2 emissions (1.3 $GtCO_2$/ year). Recently, significant efforts have been made to identify the potential for CO_2 geologic storage in the sedimentary basin underlying the Tokyo Bay. It is obvious that a geo-



(a) Steady state groundwater flow at initial condition

(b) After 100 years' injection

Simulated regional groundwater head distribution before and after CO_2 injection

logical CO_2 storage site near large emission sources has an advantage in reducing the transportation costs of captured CO_2 especially in Japan, where the cost of building pipelines is quite expensive.

We conducted a large-scale numerical simulation of CO_2 geologic storage that evaluates CO_2 trapping capacity and its impact on regional groundwater pressure, using parallel computing techniques. The simulation is designed for a preliminary investigation of hypothetical industrial-scale CO_2 injection at Tokyo Bay. To solve the high resolution model efficiently, we used the Earth Simulator. The model will be used to simulate the hypothetical injection activities in the study area.

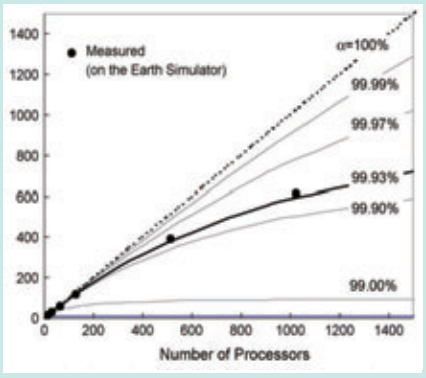
MASSIVELY PARALLEL COMPUTATION

The simulations conducted in this study are computationally demanding, because of the large number of grids and the complex nonlinear processes involved. We adopted the ECO2N module of TOUGH2-MP for the simulations. TOUGH2-MP/ECO2N is an efficient parallel simulator for large scale, long-term CO_2 geologic storage in saline aquifers. It was developed at the Lawrence Berkeley National Laboratory.

ES consists of 640 nodes with eight vector processors and 16 GB of computer memory at each node, for a total of 5,120 processors and 10 TB of main memory. The total peak performance is currently 40 Tflop/s and is increased to 131 Tflop/s by March 2009. In this study, TOUGH2-MP was ported to the Earth Simulator and successfully run on it. The code was specially tuned up to increase its vector operation rati for the efficient use of the ES vector processors.

Amdahl's law states that if a parallelization ratio is the proportion of execution time for a parallelizable part to the total execution time when executed serially, then the speedup that can be achieved by using n processors is: $S_n=1/(1-\alpha+(\alpha/n))$.

Figure above shows the speedup obtained for TOUGH2-MP on the

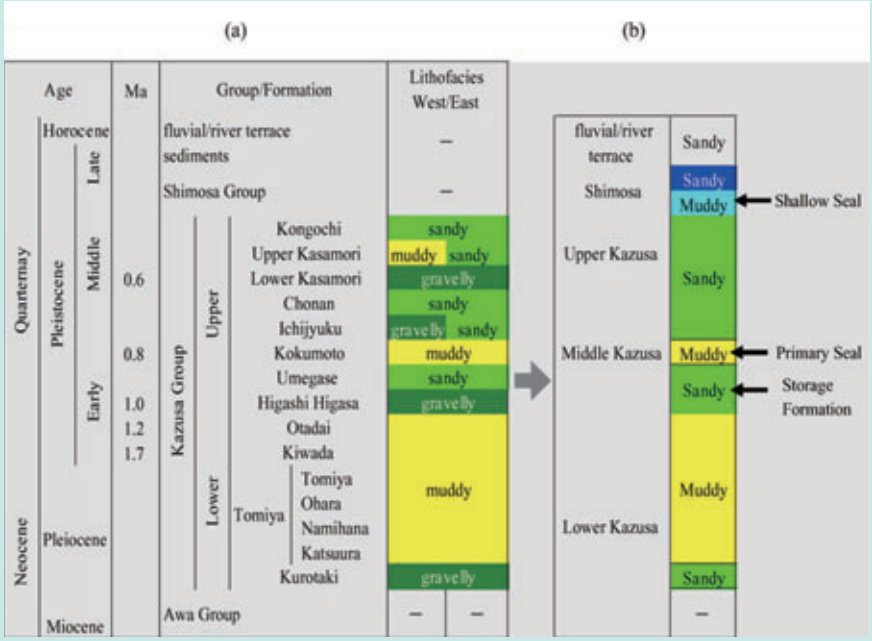


Relation between computational speed and number of processors (α: parallelization ratio)

Earth Simulator. As seen in this figure, the parallelization ratio α is currently 99.93%, with the code benefiting from parallelization on ES with more than 1,000 processors. In this study, the calculation time (CPU time) for the two-phase flow simulations with about 10 million gridblock models was generally 1–2 days for 1,000 years' simulation on 1,024 processors.

MODEL SETUP

The Kanto Plain is the largest coastal plain in Japan, surrounded by Tokyo Bay, the mountains of Kanto area, the Miura Peninsula, and the Boso Peninsula. Since the 1950s, extensive explorative investigations and production of natural gas (mostly methane gas, dissolved in deep groundwater) have been carried out in the Boso Peninsula. The geologic structure in the plain is well understood through dozens of deep borehole investigations and geophysical explorations for land subsidences and earthquakes. In recent years, a number of hot spring wells (for spa resorts) have been drilled to depths over 1 km. A three-dimensional geological structure model was constructed for the 60 km by 70 km modeling area centered in Tokyo Bay. The surface topography is represented by 50 m grid digital elevation model (DEM) data published by the Geographical Survey Institute, Japan, and the formation boundaries are defined by 200 m grid DEM data. Discretization results in approximately 121,100 grid-blocks on each horizontal layer and 84 layers in the vertical direction, for a total of about 10 million grid-blocks and 40 million connections among them. Figure below lists the geological units/layers for the Kazusa Group and the associated model hydrogeologic layers. These geologic formations have been organized into layered hydrogeologic units, based primarily on the sandy or muddy properties. For this study, it is assumed that CO_2 is injected through 10 wells in the bay, at an annual rate of 1 $MtCO_2$/year for each well



Lithofacies of the Kazusa Group: (a) lithofacies and (b) conceptual hydrogeological model. Arrows indicates storage formation and seal layers.

over 100 years, resulting in a total annual rate of 10 $MtCO_2$/year. The simulation runs cover a time period of 1,000 years, including a post-injection period of 900 years. Given the variations in elevation and thickness of the model layers, the behavior of injected CO_2 will be in turn affected by the variations in ambient temperature, salinity, and pressure, all of which influence the solubility of CO_2 in brine, as well as the density and viscosity of CO_2 and brine.

RESULTS AND DISCUSSION

Results show that the largest lateral plume appears in the injection layer, with the buoyant CO_2 accumulating and spreading under a less-permeable muddy layer. Each plume extends over a range of 4–5 km, which is about half the distance away from the neighboring injection sites. The results indicate that the individual plumes from each injection sites have not merged during 100 years' injection. The circular shapes of the plumes during the injection indicate a pressure-driven feature of the CO_2 migration. Numerically, it is well known that the ''diamond'' shape of saturation fronts appears when five point finite difference methods with rectangular shaped grids are employed.

In this simulation, by using the Voronoi gridding, the circular shapes of these plumes suggest that the grid orientation effect is comparatively mild. If the injection rate is different for each injection site, the shape of these CO_2 plumes may be distorted, owing to pressure interference between the sites. After the termination of the 100 years' injection, the plumes continue to move mainly due to the buoyancy forces, and eventually a couple of merged plumes are found in the southwest side at 1,000 years. It is found that the directions of the buoyant movement after 100 years are roughly consistent with the maximum gradient directions on the bottom surface of the Kazusa Group, since the primary seal is modeled almost parallel to the bottom elevations of the Kazusa Group. After injection is stopped at 100 years, the plume enters slightly into the seal layer and moves to a shallower region as a result of buoyancy forces, but does not fully penetrate through the seal; it basically continues to be contained under the sealing layer. However, this may also indicate that CO_2 may not be safely trapped over much longer time periods. In reality, the entry pressure of sealing layers should contribute significantly in keeping the CO_2 out. The seal layer in the current model has one-order-of-magnitude higher entry pressure than the sand tentatively, but it is not based on experimental data from the seal layer. In order to discuss the containment of the CO_2, especially over much longer time periods, the effect of the entry pressure must also be investigated in detail. The seal contains alternating beds of sandstone and mudstone that can allow for local leakage of CO_2 through sandy portions. To address this issue, the development of a precise lithofacies model for the seal would be required, which is outside the scope of this article. Initially injected CO_2 is mostly stored as supercritical fluid. However, after the termination of the injection, the contribution of groundwater dissolution gradually increases and finally becomes dominant. The reason for this large contribution of dissolution is attributed to the large surface area of the plumes, which enhance dissolution of CO_2 into surrounding groundwater. However, actual groundwater in this area dissolves methane and has the salinity of 0.2–0.5 mol/L. These two factors should both act to reduce the amount of CO_2 dissolution in groundwater within the storage aquifer, but they are also not accounted for in this current model.

Front page figure shows the simulated spatial distribution of calculated hydraulic heads at pre-injection and 100 years. Our simulations of the hypothetical CO_2 geologic storage suggest the following:

(1) CO_2 plumes from injection can spread over a range of several kilometers within 100 years, using the investigated injection schemes. (2) Buildup of groundwater pressure in shallow confined aquifers on the order of few bars can occur over extensive regions, including urban inlands. (3) Groundwater discharge to the shallow aquifer can increase on the order of tens of millimeters per year as a result of injection activities.

Sensitivity studies indicate, however, that the predictions obtained in this study could be heavily affected by uncertain parameters such as porosity, pore compressibility, and seal permeability. Findings (2) and (3) mostly concern the case in which the permeability of the seal layer is high, so that vertical pressure propagation occurs effectively, as assumed in this study. If the seals were not as permeable, the lateral pressure buildup would reach farther and be higher; then the concern would be that the actual storage aquifer might be updipping to become a shallow groundwater resource at some distance away from the injection site. In this study, it is demonstrated that, for the case in which the permeability of seals overlying a reservoir is insufficiently low (higher than 10 microdarcy), the distribution of low-permeability layers can significantly affect the prediction of near-surface pressure buildup, suggesting the importance of hydrogeological characterizations even in shallow depths. In such a case, modeling studies should fully account for the multilayer characteristics of the storage site when investigating pressure perturbation due to CO_2 geologic storage. The large-scale simulation technique employed in this study could be a very powerful tool in performing site-specific modeling of CO_2 storage candidate sites, with its ability to comprehensively represent hydrogeological features. We plan to refine our preliminary hydro-geological model of Tokyo Bay using a more accurate geological model, when such a model becomes available in the future.

[1]Taisei Corporation Ltd.

RC58 Held Public Forum on BCM

Prof. Meguro released the ICUS report on BCM at the forum.

Dr. Nishikawa from MLIT gave a special lecture at the forum.

The Research Committee 58 (RC-58) held a forum to report its results to the general public, at IIS Convention Hall on April 21, 2009. The topic of RC-58 was "Business Continuity Management (BCM) Systems Suitable for Japanese Society". Businesses are faced with many threats to the continuance of their trade and planning. To avert those threats or to reduce their effects has been getting increasing attention. Japan is confronted with particular situations such as the high likelihood of natural disasters, high population density, and also its own cultural background. BCMs need to be designed considering these conditions.

Starting in year 2007, 13 companies from various sectors of Japanese society have joined the research committee and studied the topic for two years. There were over 100 participants in this forum, which showed that substantial number of businesses and their departments have a great interest in BCM in Japanese society. In this forum, following the opening address, results from the first year's activity was reported by Prof. K. Meguro, Director of ICUS.

Activities in the first year concentrated on reviewing the existing BCM related literature produced in Japan and abroad. In recent years, BCM systems and Business Continuity Plans (BCP) have become increasingly popular in Japan as well as in US and Europe. Many guidelines to prepare BCPs have been published in Japan. To compare these existing reports, three working groups (WGs) were created. WG1 discussed the differences among the guidelines in Europe and US and those in Japan. WG2 compared the Japanese Cabinet Office Guidelines with those of other Japanese government agencies. WG3 carried its work on a similar line with WG2, but the comparison was done with private sector companies. In these comparisons, "Business Continuity Guidelines 1st edition" (published by Central Disaster Management Council, Cabinet Office, Government of Japan, 2005) was assumed as a standard. Outcomes from each of the three WGs were introduced by Prof. Meguro. Next, activities carried out by the committee in the second year were reported. In the second year, three WGs carried out extensive interactive discussion.

Mr. Y. Kato, Sompo Japan Risk Management and coordinator of WG1a first presented the research outcomes of his group. WG1a discussed suitable BCM systems for private companies. Secondly, Mr. K. Noda, Asia Air Survey Co. Ltd. and coordinator of WG1b, explained the research outcomes of WG1b. WG1b discussed suitable BCM systems for local governments. Finally, Dr. M. Soejima, Obayashi Corporation Technical Research Institute and coordinator of WG2, introduced the research outcome of her group. WG2, discussed suitable methods for evaluating BCP. The final report of these research outcomes written in Japanese was published in April, 2009.

After the coffee break, a special lecture was given by Dr. S. Nishikawa, Ministry of Land, Infrastructure, Transport and Tourism (MLIT). Dr. Nishikawa talked on "BCP-To maintain the employment and economy in Japan through the international competition". The audience listened very attentively to his lecture. The lecture was followed by a panel discussion. Under chairmanship of Prof. Meguro, Dr. Nishikawa, Mr. Kato, Mr. Noda and Dr. Soejima discussed about BCM Systems Suitable for Japanese Society as panelists. A lively discussion was done with some opinions and questions from the floor.

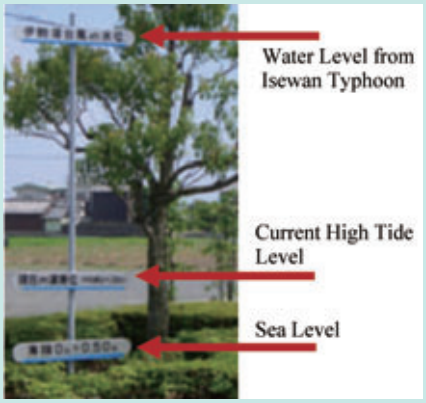
Prof. H. Sawada delivered the closing speech and introduced the newly proposed Research Committee 67 (RC-67) which focuses on environmental CSR in private corporations. RC-67 has been launched in May.

Working group heads, Prof. Meguro and Dr. Nishikawa joined a panel discussion.

(By M. Soejima, Obayashi Corporation)

50 years since the 1959 ISEWAN Typhoon

Flooding during Isewan landing



Water level from the typhoon

A Panel discussion moment

The Isewan typhoon landed on Wakayama Prefecture at approximately 6 PM on September 26, 1959. It was a super-huge typhoon with a diameter of 1,500 km and an atmospheric pressure of 929.9 hPa at landing. It was the third biggest typhoon among the recorded typhoons in Japan. About 5,000 lives were lost, which makes it the worst natural disaster in Japan during 20th century before the 1995 Kobe earthquake. The experience of the Isewan typhoon led to the establishment of "Disaster Countermeasure Basic Act" in 1961 that was the first general act for constructing disaster prevention/ mitigation system in Japan.

Institute of Social Safety Science held a symposium on June 5-6, 2009 commemorating 50 years of the Isewan typhoon. Professor K. Meguro, Director of ICUS, organized this symposium and participated in the panel discussion as a coordinator. Roles of Disaster Countermeasure Basic Act in past 50 years, its future directions and current issues were discussed.

After the symposium, the participants visited the damaged area. Although almost all the area was restored during 50 years, we could observe several marks left behind by the typhoon even now. Photo above shows a pole illustrating water level from the Isewan typhoon, average high tide level and sea level. Even now, this region has a high flood risk as the altitude of ground level is lower than the sea level. In order to reduce flood damage, this region has a traditional style of residence called "Mizuya" as shown in the photo below. A Mizuya is built 3m higher than the main residence and is used as an emergency shelter in case of flood occurrence. We could see several Mizuyas in this region.

This site visit was a valuable experience for knowing the typhoon disaster that changed the disaster prevention system of our country.

(By M. Fujiu, Ph.D. Candidate)

A Mizuya house

Special Talk by Prof. John Burland at IIS

A special talk on "Rescuing the Leaning Tower of Pisa - the inside story" was given by Prof. John Burland of Imperial College, London, on the evening of June 17, at the convention hall in IIS. The event was hosted jointly by Japan Chapter of Imperial College Alumni and IIS, the University of Tokyo, Japan.

The Leaning Tower of Pisa has started to tilt even at the very beginning of its construction in the 11th century. Since then, the tower has kept leaning for 800 years. Professor Burland has notably been involved in the rescuing of the Leaning Tower of Pisa for which he was a member of the Italian Prime Minister's Commission for stabilizing the tower. Thanks to their considerable effort, the tower has regained its stability and now it is open to general public. Prof Burland talked about the 10-year struggle of engineers and researchers to rescue the tower.

More than 100 audiences intently listened to the exciting story. Further discussion was continued in the dinner party following the lecture.

(By R. Kuwano)

Prof. Yashiro, Director General of IIS, presented letter of appreciation to Prof. Burland (left), Excavation drills were carried out to take out soil beneath the tower for adjustment of its tilt (right) which prevented a possible disaster pictured here (middle).

Ground Cave-in in Golf Course

Opening at the ground (left, courtesy: Hokkaido Shinbun) and location of the collapse (right, courtesy: Asahi Shinbun)

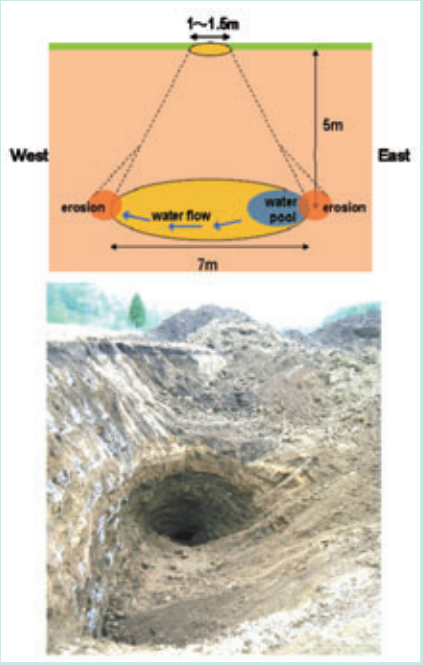
A sudden collapse of the ground occurred in the 8th fairway at the Le Petaw Golf Club in Hokkaido on April 2, 2009, when a woman golfer unfortunately stepped on it. She fell into a hidden hole formed underneath the ground and by the time a rescue team arrived she had passed away.

The hole had a flask shape with a 1 m wide opening at the ground surface, and was 5m deep and 7m wide at the bottom. There was an about 0.6m deep shallow water pool in the east side of the hole. Although the golf course was daily checked by maintenance staff, they could not get any sign of the hidden hole even in the morning of the accident. The ground collapse seemed to have happened all of sudden, as the victim's son who walked just a couple of meters behind her saw her suddenly disappearing into the ground.

The course was originally built more than 15 years ago, by filling a valley with local soil. There used to be a stream along the east-west direction at the location of the collapse. Drain pipes were installed underground to carry away the subterranean water while preventing soil from seeping out.

A detailed investigation took place on May 21 and 22, by Hokkaido prefectural police, assisted by two experts of geotechnical engineering, Prof. Y. Kohata of Muroran Institute of Technology and Dr. R. Kuwano of ICUS, IIS, the University of Tokyo. A large scale excavation was carried out around the hole to understand how and why such a huge underground cavity was created. At the depth of 8m from the ground surface, there was the boundary between original ground and filled soil, where a lateral ground cavity of about 2m wide was discovered in the west side. It seemed to be a path through which soil with water was transported out of the hole. In the excavation on the east side, they found the exact location of the ground where the water flew into the hole. Explanation for the mechanism of ground collapse was tentatively made; soil appeared to be internally eroded by the natural water path at the old stream. The hidden cavity grew silently and eventually caused ground collapse. Further investigation is still underway.

(By R. Kuwano)



Schematic of the opening (top); natural soil pipe from internal erosion at the location of old stream (bottom)

Research Committee 62 Activities

RC-62 Annual Activity Report

Research Committee 62 (RC-62) on "Technologies for Evaluation of Aging Infrastructure Performance Degradation," held its 6th meeting on June 8, 2009. To realize the performance-based maintenance for civil infrastructure, it is necessary to evaluate structural performance using various measuring techniques. However, at present, unfortunately no established techniques are available that can accurately collect quantitative information. In particular, a comprehensive evaluation of an entire structure from the ground to the superstructure is rather difficult. ICUS organized RC-62 in April 2008 to address the challenge of performance evaluation of an entire structure. The first year of our activity focused on the review of current available measuring techniques for concrete or earth structures. Also, we started to seek the future advancement of each technique as well as the merger of several techniques to make it possible to apply to a subsurface concrete structure. The research output of the first year was published as the ICUS committee report 2009-01 in May 2009.

(By Y. Kato)

ICUS Joined the IIS Open House 2009 and Commemoration of 60th Anniversary of IIS

Moments at ICUS display corner as part of the two-day IIS Open House 2009 event; About 300 people from all walks of life visited ICUS during the event.

Every year IIS organizes an Open House for two-day period around May-June to disseminate research activities by all laboratories and research centers. This year IIS Open House was held on May 29 and 30. People from all walks of life including professionals from research organizations, international organizations, industry, non-profit organizations and academic organizations from high-schools to university level take advantage of the unique event to know about latest research and outreach activities of IIS. ICUS has been participating in this event since its inception in 2001.

Since effectively disseminating its research and information collected to society has been one of its core goals, ICUS considers IIS Open House as a valuable opportunity to interact with all members of society to get valuable comments and feedbacks on their activities to realize its vision of a safer urban environment. All 9 laboratories affiliated to ICUS prepared panels on their research and outreach activities as well as planned activities. Themes were "Development of earthquake resilient urban environment" (Meguro Lab.), "Monitoring of environment and disaster risk over Asia" (Sawada & Takeuchi Lab.), "Life-cycle management of civil infrastructure" (Yokota Lab.), "Long term behaviour of earth and undrground structures" (Kuwano Lab.), "Durable and sustainable concrete materials and technology" (Kato Lab.), "Regeneration of modern timber architecture" (Koshihara Lab.), "Improvements of disaster response capacity of hospitals" (Ohara Lab.), "Development of safe, healthy and comfortable urban society"(Huang Lab.) and "Urban traffic management" (Tanaka Lab.). Also international activities by the center and activities by its regional network offices, BNUS in Dhaka and RNUS in Bangkok, were at display. During the event, ICUS Newsletters, Reports and other publications were displayed and presented to interested parties. ICUS staff and students from affiliated laboratories presented live demonstrations of various systems developed by the center and participated in interactive explanations about the research activities to the visitors. ICUS Quiz, which asked visitors to test their general understanding of key ICUS research displayed at the event, was popular among visitors especially among high-school students and families since successful answers were rewarded with symbolic prizes with the ICUS logo on it. About 300 people visited ICUS during the event out of which about 40 were from industry.

This year's event was significant in view of the 60th anniversary of the foundation of IIS. Special events including forums were organized on May 31 at IIS to celebrate the occasion where all laboratories and research institutes displayed their summarized research at a specially designated place. All ICUS laboratories also participated in this special display. On May 28, Prof. J. Hamada, President, the University of Tokyo welcomed all to lectures and celebrations to commemorate the anniversary where several university vice presidents, alumni of the IIS attended. Professor Emeritus Hiroshi Hara, Professor Emeritus Hiroyuki Sakaki, and Executive Vice President Masafumi Maeda made a series of very interesting lectures on the campus, research and organization of the IIS. The anniversary celebrations coincided with the groundbreaking ceremony for the start of the renovation of Building 60 on the Komaba Research Campus, the publication of a book detailing the last ten years of activities at the IIS and a "60 year commemorative special issue" publication.

(By P. J. Baruah)

16th ICUS Open Lecture was held at IIS

Prof. Ikuo Towhata
(the University of Tokyo)

Dr. Hiroshi Dobashi
(Metropolitan Expressway Co. Ltd.)

Dr. Satoshi Imamura
(Taisei Co. Ltd.)

The 16th ICUS Open Lecture was held at IIS on April 3, with approximately 90 participants. Three presentations were given on the broad theme of the lecture, "Contribution of geotechnical engineering to the urban infrastructure environment".

Following the welcome speech by Dr. Kuwano, Prof. Tohata of the University of Tokyo discussed on the factors of prosperity and decay of urban cities. Then he presented how the land constructed by the reclamation of waste materials can be utilized effectively in Tokyo. Dr. Dobashi of Metropolitan Expressway Co. Ltd. Talked on the project of Central Ring Road of Metropolitan Expressway currently constructed between Shinjuku and Shibuya. Various techniques adopted for the safety and environmental consideration were introduced. Dr. Imamura of Taisei Co. Ltd. presented on the technology of Carbon Dioxide Capture and Storage (CCS). The closing remarks were given by Prof. K. Meguro, followed by a small party where further interactive discussions were continued.

(By R. Kuwano)

46th Annual RSSJ Conference Hosts ICUS Special Sessions on "Disaster Prevention and Environment"

The special session was appreciated by participants (left) due its interdisciplinary nature; Dr. Miyazaki (middle) and Prof. Sawada (right) chaired the two sessions.

The annual conference of Remote Sensing Society of Japan (RSSJ) was held on May 21-22, 2009 at Institute of Industrial Science, The University of Tokyo. RSSJ is one of two largest remote sensing societies in Japan and its research fields cover wide range of topics ranging from sensor technologies to terrestrial, oceanic and atmospheric issues. This year's hot topic in RSSJ was early damage detection of disasters by remote sensing technologies such as satellite borne SAR (Synthetic Aperature Radar) and visible sensors and air-borne Laser measurement, because of the recent Iwate-Miyagi Nairiku earthquake that occurred at the northern part of Honshu Island in 2008.

Two ICUS special sessions were successfully organized at the conference: one focused on "Disaster prevention", the other focused on "Environment", respectively. Dr. S. Miyazaki chaired the session on Disaster prevention and four speakers presented on utilization of remote sensing technology for large-scale disasters. The session on Environment was chaired by Prof. H. Sawada and four speakers presented on utilization of remote sensing in forest monitoring and land cover change detection. Prof. K. Meguro, Director of ICUS, gave an invited lecture on disaster information management for improvement of overall disaster prevention.

This was the first time when a ICUS special session was held in a conference of an academic society. After the session, many participants said ICUS activities interested them, and also remarked that information exchange from other research area was useful for them. ICUS expects to hold special sessions like this with relevant academic societies in future.

(By T. Endo)

Visit to Maintenance Demonstration of Metropolitan Expressway Co. Ltd.

Fracture of the weld caused by stress concentration

Portable hammer to detect the sound level with microphone

Magnetic Particle Testing for detection of surface defects

A total of 7 members from ICUS, namely Prof. Sawada, Dr. Endo, Dr. Baruah, Dr. Numada and three students, visited the maintenance demonstration of Metropolitan Expressway Co. Ltd. on Tuesday, June 9, 2009.

They joined several other groups from severeal other universities and organizations in the visit. After an introductory session at the headquarter of Metropolitan Expressway Co. Ltd. all participants were taken to a maintenance site near Kasai junction of the Tokyo Metropolitan Expressway Coastal Line. This junction connects the coastal line of Tokyo Metropolitan Expressway in Edogawa Ward, Tokyo.

During the demonstration, maintenance problems in expressways were introduced. There are two maintenance problems in steel structures of expressways. There are invasion such as rust and the fatigue fracture by cyclic loading from passing vehicles. Check of the fatigue fracture is especially found to be important in case of Tokyo Metropolitan expressway because of the high frequency of the large-size vehicle traffic. The fracture is often seen at the point of the weld caused by stress concentration.

The maintenance check method is divided into three steps: the car rounding check, the walking check, and the approach check. The visit was focused on the technologies used in the approach check.

Several kinds of checking technologies were demonstrated, e.g. radar technology for searching steel placing inside concrete, thermographing method for detecting air hole inside concrete, magnetic particle testing for detection of defects on the surface of structures and ultrasonic testing for detection of defects inside structures.

Also other methods to detect defects where a human hand cannot reach were shown. These included a portable camera with light pole which can be extended like a fishing rod and portable hummer to detect the sound level with microphones.

The expressway network in Tokyo is important for the efficient functioning of the urban activities. The usual maintenance by Metropolitan Expressway Co. Ltd. can provide us with a continuously functioning expressway that is safe and comfortable.

The visit provided an excellent opportunity to study the real maintenance processes and methodologies.

(By M. Numada)

Research Committee 67 Activities

The first official meeting of the "Research Committee on Evaluation of CSR activities in Environment Conscious Society (RC-67)" was held on 2 July, 2009 following the introductory meeting on May 29. Recently, the Cooperate Social Responsibility (CSR) is considered important and many activities are propagated as CSR activity. However, we found that the effects of the activities were seldom examined by organizations themselves. Therefore, ICUS established this study group (headed by Prof. H. Sawada) to develop an appropriate methodology to evaluate the CSR activities from the point of environmental soundness. At first, the group focuses on the activities related to forestry which more than half of Japanese companies introduced as an CSR activity. The RC-67 is planned to continue for two years.

2nd meeting of RC-67 at IIS on 2 July

(By H. Sawada)

BNUS Activities

BNUS compiled a survey report on cyclone Aila

On the May 25th, 2009, cyclone Aila passed through 14 districts in the coastal area of Bangladesh. According to official sources, about 190 lives were lost and more than 50,000 people became homeless. Other total or partial destructions included about 6.12 million thatched houses, 3.20 million hector harvestable paddies, large number of shrimp ghers and 1.47 million livestocks as well as poultries. At least 7,000 people were injured by the storm and about 48 million people were affected. In Nizum dwip, 20,000 people are homeless, 58,950 animals are killed and 50,000 deer have been missed.

Constructed in 1960s, coastal polders breached by tidal surge during the Cyclone increased the damage. Relief works were hampered due to breached embankments. Storm surge of about 3m height impacted western region of Bangladesh, submerging numerous villages, severely affecting agricultural lands due to intrusion of saline water and isolating more than 400,000 people by severe flooding in coastal regions. In Patuakhali district, a dam broke and submerged five villages.

In Satkhira district the cyclone damaged about 130 km of embankments with an estimated reconstruction and maintenance cost of about $3.80 million. In Khulna district, such costs for 211.24 km of damaged embankment would be about $7.75 million. Other relevant costs, such as repairing and reconstruction of sluice gate/ regulator, other hydraulic structures etc. would require about $6.96 million.

Cyclone Aila damaged embankments at Kapatakha river in Satkhira district.

BNUS conducted a socio-economic survey of households in old Dhaka

To make an effective plan in disaster risk reduction, one of the major goals is to raise awareness level of the local community. In order to assess social vulnerability of individuals due to earthquake within households, BNUS has conducted a socio-economic survey of 200 households in Ward No. 68 in the older part of Dhaka City. The social vulnerability indicators have been selected from the literature and the relevant data needed for the analysis is collected through house to house socio-economic questionnaire survey. Information regarding the level of public awareness about earthquake risk of the community was found through this survey. The sample size is chosen at random basis at 95% confidence level which is 2% of total projected household of 10,942 in the study area in 2009 (according to Bangladesh Bureau of Statistics). Finally the vulnerability of the community has been studied considering the existing socio-economic condition of the locality.

BNUS carried out seismic microzonation study of Cox's Bazar Municipality

Cox's Bazar lies in the south-eastern coastal region of Bangladesh. Being a prime tourist spot, the area has been experiencing rapid urbanization in the last few decades. However, construction of significant number of buildings and other structures has occurred in an unregulated manner and without seismic design considerations. Landslide and related casualties have also become very common in the hilly areas of the locality. In order to assess seismic vulnerability based on ground susceptibility and adopt mitigation strategies for urban areas, seismic microzonation is considered to be the first step. BNUS is carrying out a study on microzonation of the Cox's Bazar Municipality area using geographic information system where reflection of ground shaking and the site attributes of soil amplification, liquefaction and landslide are the salient features. Probable earthquake hazard and expected ground motion calculation, sub-soil investigation, liquefaction potential determination and slope stability analyses were carried out to develop microzonation maps. The study shows that 87% of the study area is highly susceptible to liquefaction. Approximately 8% of the municipality consists of hilly region, 97% of which is found to be very unsafe in view of natural slope stability.

(By M. A. Ansary, BNUS)

RNUS Activities

RNUS is actively participating in a project with colleagues in School of Civil Engineering at AIT and Panya Consultants Co. Ltd., Thailand to develop a Seismic Hazard Map of Thailand and developing Seismic Microzonation Map as well as GIS database of buildings and lifeline systems in 3 major cities in Thailand. Also, a project on Seismic vulnerability and risk assessment of Dhaka, Chitagong and Sylhet city of Bangladesh is ongoing. This project is part of the Comprehensive Disaster Management Program of Bangladesh. RNUS along with AIT is supervising field survey of more than 20,000 buildings in the region.

ICUS Welcomes Visiting Prof. Y. Ichihashi & Dr. M. Numada

ICUS welcomes Mr. Yasuyoshi Ichihashi who joined ICUS on May 1 as Visiting Professor. Mr. Ichihashi has been working in the Ministry of Foreign Affairs, Govt. of Japan, and still currently is a diplomat. He served in Bulgaria and Mongolia as Ambassador to Japanese Embassy, and spent long time in China (Shanghai as Consul-General, Beijing as Minister/ Counselor, Hong Kong as Consul). His other postings include Genève and Bangladesh, and he also served as Deputy Representative of the Government at the World Expo 2005 in Aichi. It is certainly quite exceptional for ICUS to have such an incumbent diplomat as its member. ICUS expects to benefit from his rich diplomatic background in international arena with contributions in the area of ICUS's international activities/ strategies, as well as their linkages to the Government's external policies related to science and technology. This is a unique challenge for both the Center and the Ambassador himself. Yet his appointment this time shows the ICUS's eagerness to develop broader international strategies and activities.

Visiting Professor Y. Ichihashi (left) and Dr. M. Numada (right)

ICUS would also like to warmly welcome Dr. Muneyoshi Numada to ICUS from April 1, 2009. He received his B.Engg. at Meguro laboratory at Chuo University, Japan in 2000 and carried out his research towards his M.Engg. degree at Konagai Laboratory at the University of Tokyo. He received his Ph.D. from the University of Tokyo for his research on numerical simulation of landslide disaster.

Before joining ICUS, he was a management consultant in a private firm solving various important business problems for clients in industry from 2006 to 2009.

ICUS expects him to contribute to new leadership, use global networks to carry out its activities and to give new insight to ICUS.

(By K. Meguro)

Farewell to Dr. K. Worakanchana

Dr. Kawin Worakanchana retired from ICUS on March 31st, 2009.

Dr. Worakanchana joined ICUS as a Project Researcher in April 2007. During his stay, he continued his research on 3-D Applied Element Method for modeling un-reinforced and retrofitted masonry structures and participated in joint activities between ICUS and RNUS in Thailand. ICUS would like to thank him for all his great contributions during his stay and wish him all the best. Also, ICUS expects to continue professional relationship with him in future.

ICUS Activities

• Prof. K. Meguro visited Incheon, South Korea to attend a meeting on the management of USMCA2009 from April 10 to 12. Prior to that, he visited Chengdu, China from April 7 to 9 to give an invited lecture in a seminar held by Sichuan Provincial Government.

• Dr. M. Koshihara joined other ICUS members to oversee the arrangement of USMCA2009 in Incheon, South Korea from April 10 to 12. From June 24 to 29, he visited Istanbul, Turkey to participate and present at the International Symposium on Timber Structures.

• Dr. K. Worakanchana stayed at RNUS to continue his research and teaching duties till the end of his term at ICUS.

Awards

Dr. P.J. Baruah and Dr. T. Endo received best paper award from Japan Technical Association of Pulp and Paper Industry (TAPPI) for their paper titled "Estimation of Timber Volume in Eucalyptus Plantations using Satellite Images" (in Japanese) published in February 2008 issue of Journal of Japan TAPPI. The research was a result of University-Industry collaboration between IIS and Mitsubishi Paper Mills (MPM) Co. Ltd. Other authors of the paper are Dr. T. Katsura of MPM and Prof. Y. Yasuoka of National Institute of Environmental Studies.

Editor's Note

Last July ten unexpected visitors had come to my laboratory. They were 10 spotbill ducks, called Karugamo in Japanese. This year spring, for the comfort of our laboratory, we made a garden in the veranda of our laboratory using timber from forest-thinning. Eventually, a mother duck flew to our garden and laid eggs from which 9 ducklings were born. The problem was, our laboratory is located on the 4th floor of IIS and there was no food and water for them. We prepared some food and also made a small water pool for them in our veranda. Till now, 3 ducklings have grown up, although 6 had been lost from stealing by crows or other reasons. Recently, the mother duck somehow took these grown-up ducklings and flew away. We yet don't know when exactly this happened.

Our laboratory and ICUS are located in a huge reinforced concrete building. One of my research themes is how to create comfortable office using and incorporating timber within a reinforced concrete building. We think visiting of the ducks is one of the evidences of successful results of our research. We believe that urban safety should take into account comfort of life at the same time.

(By M. Koshihara)

Roof-garden at the veranda (top); Mother duck and the ducklings (bottom)

If you would like to contribute an article to ICUS newsletter or have any comments or suggestions, please contact the editorial committee at icus@iis.u-tokyo.ac.jp.
Any article within the scope of urban safety engineering and management will be considered for publication after internal peer review by the editorial committee. To know the scope of ICUS activities, please visit ICUS homepage at http://icus.iis.u-tokyo.ac.jp/

International Center for Urban Safety Engineering, ICUS
Institute of Industrial Science, The University of Tokyo
4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan
Tel: (+81-3)5452-6472, Fax: (+81-3)5452-6476
http://icus.iis.u-tokyo.ac.jp/

PRINTED MATTER