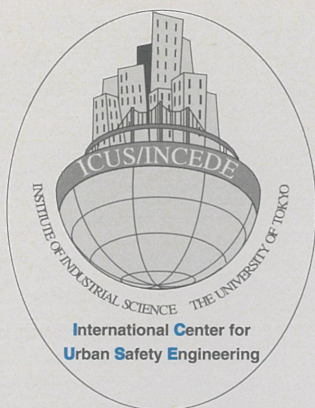


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# ICUS/INCEDE NEWSLETTER

*International Center for Urban Safety Engineering*



Institute of Industrial Science  
The University of Tokyo

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## SEPTEMBER 11 2001 EVENT AND LESSONS FOR DISASTER REDUCTION

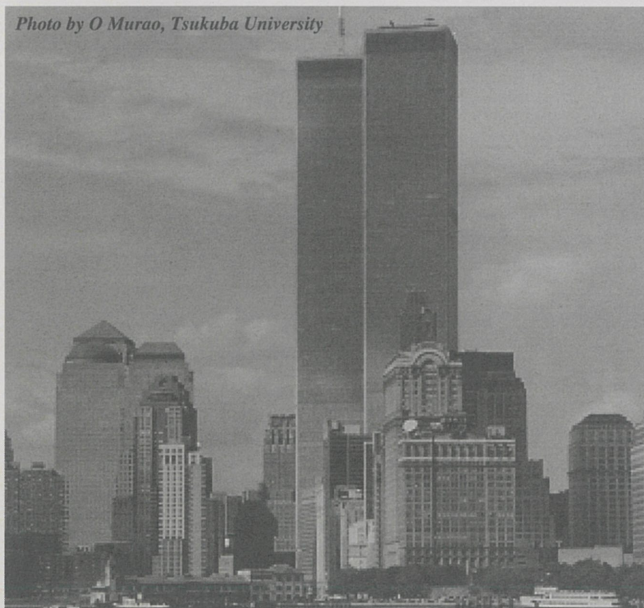
By  
*Kimiro MEGURO*

On the morning on September 11, 2001, terrorists destroyed the World Trade Center Buildings 1 and 2 using two hijacked airplanes as missiles. Over 2800 people were killed and 135-million m<sup>2</sup> of office space destroyed. Rescue operations were carried out for several days and demolishing activities at Ground Zero lasted eight months. Though this event was not caused naturally, the response activities after the event, including rescue and relief operations, information collection,

actions for prevention of secondary damage, etc. were very similar to those usually carried out after a large-scale urban natural disaster. The economic damage inflicted by this event was the worst in US history. Besides structural damage, the effects due to the disruption of operations and businesses at the organizations and companies that had offices in the collapsed structures were considerably large. Indices such as the NASDAQ and Dow Jones were affected. Considering

the situation explained above, we identified this event as a new type of urban disaster, which was brought by the concentrated vulnerability of complicated urban functions. We visited New York to go over the lessons learnt and study the methods of using them for better future preparedness. Over 40 members having various specialties from many organizations joined the survey team. This article gives a brief outline of the findings of the group A, which I had the opportunity to lead and also

*Photo by O Murao, Tsukuba University*



*WTC Complex, Lower Manhattan, New York, Before (Left) and After (Right) September 11 2001 Attack*



presents the results from our study on the failure mechanism of high-rise buildings. The report of the group (in Japanese) is available at <http://infoshako.sk.tsukuba.ac.jp/~toshiw3/Labo/murao/wtc/>.

**STUDY GROUP VISITS NY**

From February 25th to March 2nd, 2002, I had the chance to visit New York on a survey after the World Trade Center attack. I was part of a team assembled for the purpose of evaluating the damage inflicted by the collapse of the Twin Towers and the subsequent response/recovery actions. Disaster mitigation cannot advance through theoretical approaches only but also through investigation into actual damage. The main objectives of our survey were to assess the preparedness, response, recovery and reconstruction processes surrounding the World Trade Center attack, and, to understand the influence of the elements of the urban environment in the magnitude of the disaster.

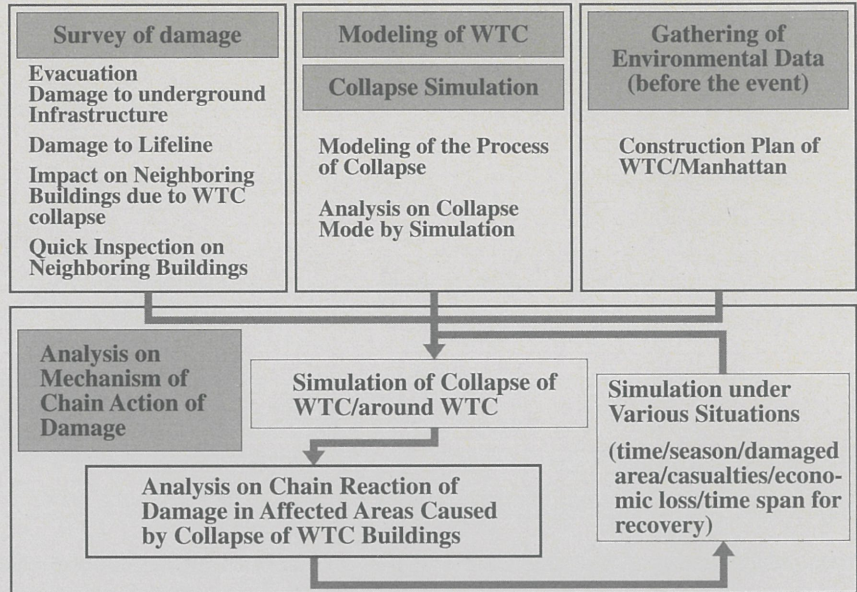
The team consisted of members coming from different Japanese Governmental Agencies, universities, research institutes, and private companies. The members were experts in a variety of fields such as structural collapse analysis, economic loss evaluation, insurance, evacuation, social sciences, etc. The team, led by Professor Yoshiaki Kawata from Kyoto University, was composed of four groups, whose responsibilities are briefly described below.

Group A) Structural damage and its effects on City functions, and recovery process

Group B) Fire-fighting and rescue operation activities at the site, and disaster management system of City, State and federal levels of organizations

Group C) Overall impact of the event, including that on world finance, etc. over time

Group D) Crisis management and response activities of



*General Objectives of the Team Survey (Group A)*

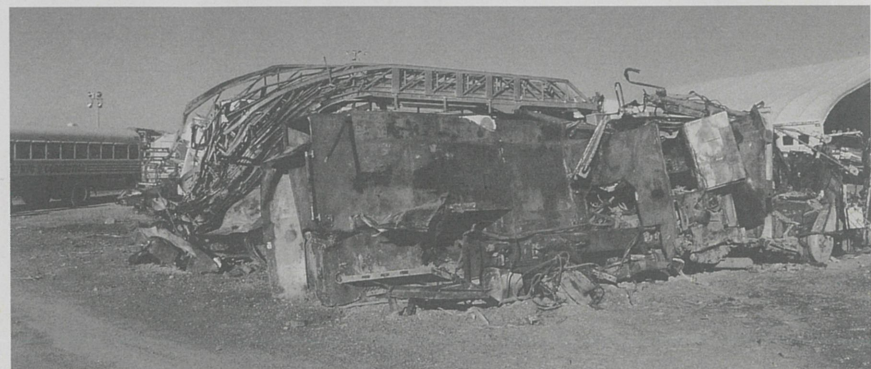
Japanese companies and Japanese tourists

I had the privilege to be appointed as head of Group A. We gathered information related to the World Trade Center Towers facilities and surroundings (structures and utilities), damage to underground structures and lifelines, impact on neighboring buildings, quick

inspection results, evacuation, disaster response activities among others. For this purpose, we visited many offices and sites as listed below: Con Edison, Inc., United States Environmental Protection Agency, Fire Department, MTA New York City Transit, FEMA Regional Office, NYC Long-Term Recovery Office, Disaster Assistance Service Center,



*Debris processing at Fresh Kills. All debris was checked for objects that could help in identification of victims*



*A fire fighter truck smashed by falling debris of the collapsed tower*



Metropolitan Transportation Authority New York City Transit, Port Authority of NY/NJ, Emergency Mapping Center of NY, Fresh Kills at Staten Island, etc. On the final day of survey trip, we had a half-day joint workshop with US researchers.

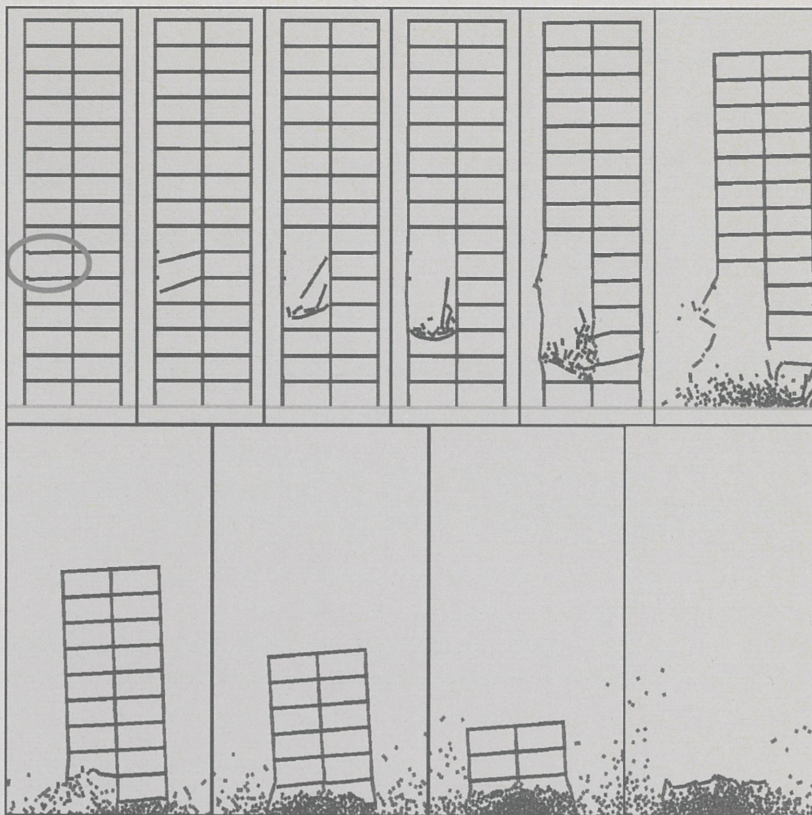
### FAILURE OF HIGH-RISE BUILDINGS

Currently, we are working on the modeling of the collapse behavior of the Twin Towers. In this study, the key issue is to identify the process of collapse and the most critical elements in the structure that led to the complete collapse. Once these objectives are accomplished, the mechanism of chain action, the effect of different environmental conditions, and the effect around the WTC can be discussed.

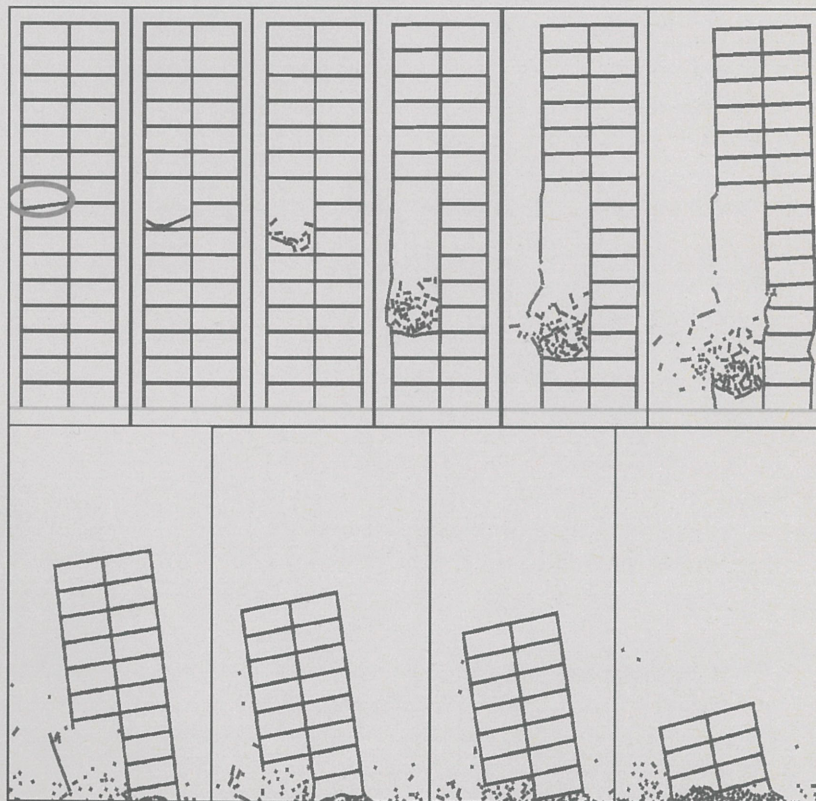
At present our research efforts are directed to better understand the real behavior of the phenomena, which will help in developing a new type of disaster related database. With this tool, we can discuss the problem from different points of view: time, location, leader organization, etc. Using this database combined with a new generation of interactive disaster manual, which is being developed in our research group, an efficient course of action to follow in a disaster situation, with a great potential for disaster reduction, can be designed. The second task of our research group is the simulation of the WTC structure collapse. If we can understand the failure mechanism, we can discuss measures to protect the structures from any attack or ways to prevent the complete structural collapse and to prolong the time upto total collapse for evacuation. For this type of analysis, the Applied Element Method, which has been developed within our research group, has been adopted. Although the complete model is not ready yet, the adjoining figures show some preliminary results, which correspond to the collapse mechanism of a 15 storey steel

building when exposed to fire in the 9th floor, and in the 6th and 7th floors. It can be clearly observed that the failure mechanism is quite

different. It may be mentioned that the collapse through the stages shown in the figures was complete within about 7 seconds of the time



*Dynamic analysis of failure mode in case of fire in the 6th and 7th floors by AE Simulation*



*Dynamic analysis of failure mode in case of fire in the 9th floor by AE Simulation*

*AE Simulation: The AE simulation is a new method develop at our research group that allows the analysis of structures from the initial stages of load application until complete collapse. In the simulation shown above, the thermal effect on the steel structure is considered in the collapse process analysis.*



that the first members 'collapsed' as a result of changes in stiffness from the simulated heating. This type of analysis is helpful to identify the most critical structural elements whose failure should be avoided to prevent the total collapse of the structure. The adjoining figure shows an example of using the latest tools in remote sensing, GIS, and available information, records and experience to have a higher degree of disaster preparedness.

**NATURAL AND MAN-MADE DISASTERS**

The study discussed above is mainly oriented towards structural countermeasures against a possible terrorist attack. Though it can be argued that there are several important points of difference in the two situations, I would like to emphasize that although man-made disasters and natural disasters have quite different triggers, the scenario is basically the same, once a disaster situation arises.

For instance, an earthquake strikes all the population, including those who should take disaster response actions whereas in a terrorist attack the affected target group is more limited, and the affected geographical area may also

*By combining 3D-GIS and past disaster survey reports, lessons and/or Newspaper articles, a new style disaster information database that can really contribute increase disaster reduction capability is being prepared*

be smaller. However, a situation similar to the tragedy arising from the gas-leak in the town of Bhopal in India, or a major terrorist attack as September 11, 2001, though surely not a natural disaster had severe implications and called for massive relief and rehabilitation operations.

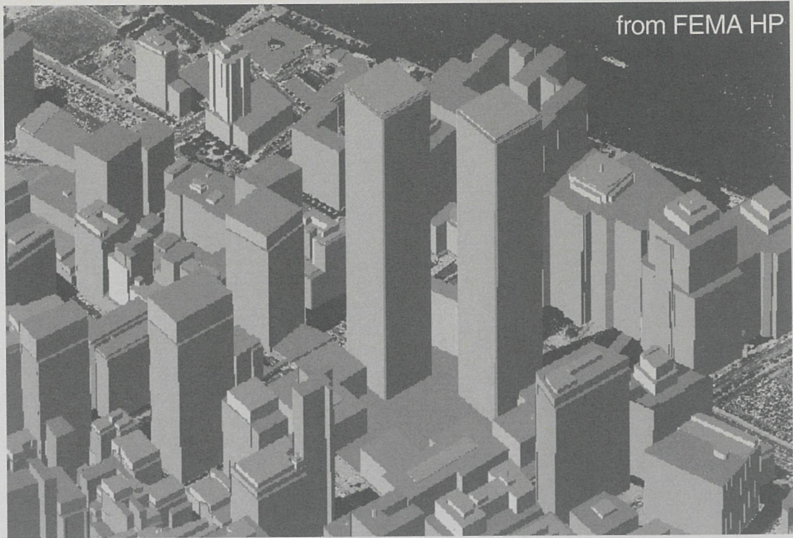
Thus, it may be appropriate to consider that the countermeasures and response actions are similar in both cases. This is the reason why we should take this opportunity to learn valuable lessons, understand the process and evolution of a

disaster situation, and improve our preparedness and response capacity under these situations.

**ACKNOWLEDGEMENT**

I would like to take this opportunity to express my deepest sympathies to the people of New York as well as my gratefulness to all the institutions and officials, especially Dr. Kozo Aoyama, Institute of Public Administration, NY University who kindly shared their experiences and information with us during our interviews.

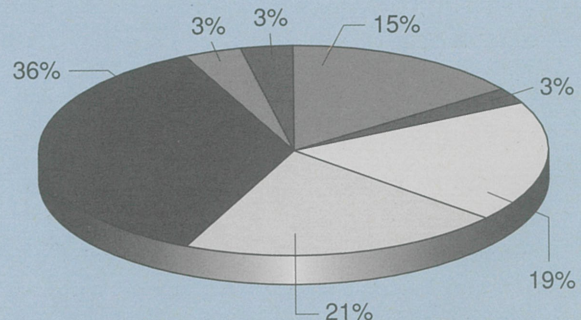
*(Kimiyo MEGURO)*



**ICUS/INCEDE Annual Report —2001—**

In the first year of activities ICUS/INCEDE faculty published about 270 papers and reports, and an approximate break-up is given in the adjoining figure. Besides, four open lectures from experts in different fields and workshops were held to provide a forum for experts to exchange views and information on latest research and development efforts, and, bring professionals in different sectors closer.

A workshop held in Bangkok, Thailand has set the pace for closer international cooperation between researchers in the region. Closer links are also being established with the Asian Institute of Technology, Bangkok for collaborative research. More information can be obtained from our website <http://icus-incede.iis.u-tokyo.ac.jp>.



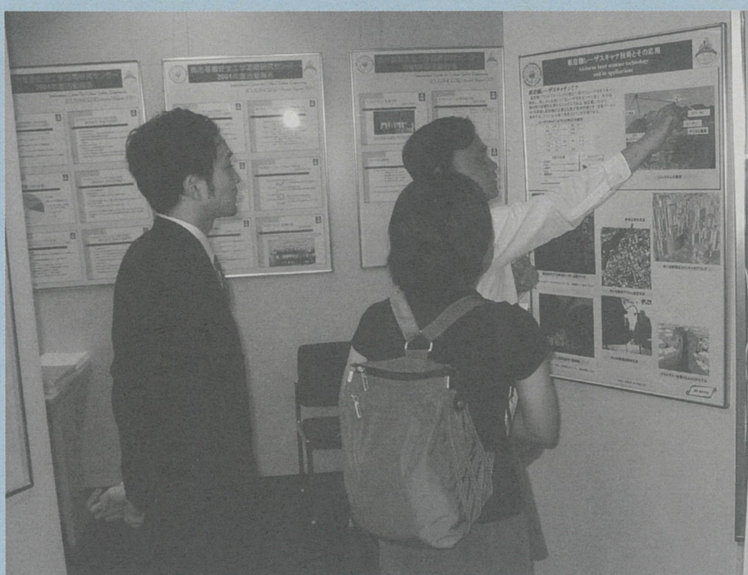
- Seisan Kenkyu \*
  - Professional magazines
  - Japanese Journals/Conf
  - Others
  - Books/translation
  - International Journals/Conf
  - Reports
- \* Journal of the IIS, the University of Tokyo

*ICUS/INCEDE research papers*



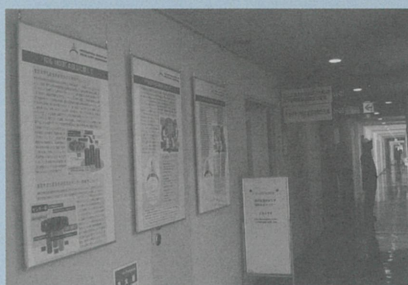
## ICUS/INCEDE participates at the IIS Open House

The SEIKEN KOKAI (Open House) is an annual event during which all the research facilities at the Institute of Industrial Science (IIS), University of Tokyo are thrown open for the people. Panels showing ongoing and completed projects are displayed, and faculty and staff are available for direct interaction. Typically, professionals from different companies and organization use the Open House as an opportunity to obtain information about the latest directions in research at IIS. Groups of school children also visit the campus during the Open House.



*Visiting Professor Setojima explains to visitors*

This year the event was held at the Komaba Research Campus on 6<sup>th</sup> and 7<sup>th</sup> June. About 4,600 persons from private enterprises, academic and research organizations, visited the campus during the two days. Groups of junior and senior high school children also came on a tour to the Campus.



*Entrance of ICUS/INCEDE*

The theme of the results exhibited by the ICUS/INCEDE this year was **"Role of a research organization of university for urban safety design"**. The three groups of the center exhibited their results under the following banners:

### Sustainable Engineering

**"Non-Destructive Inspection and Evaluation of Existing Concrete Structures"** - this concentrated on the development of software to evaluate the degree of deterioration in existing concrete structures. This software is being developed using principles of database generation and management and expert-system design to help professionals obtain and interpret data using nondestructive tests without direct participation of experts.

### Urban Safety and Disaster Mitigation

**"Against Coming Tokai Earthquake, Hazard and Software Based Measures for Damage Reduction"** - several groups drawn from government departments, and public and private sector, are engaged in planning for disaster mitigation in the event of the Tokai earthquake, which is likely to hit the eastern parts of Japan any time. The group at ICUS presented a manual based on user-needs for response at the time of the disaster. The manual also describes optimum management of resources including personnel in event of disaster.

### Infrastructure Information Dynamics

**"Remote Sensing for Environmental Monitoring and Measurement & Sustainable**

**Urban Space Design"** - proposes a new methodology for collection and analysis of information about urban structure, development of urban 3-D model using Three Line Scanner (TLS), and a system for supporting decision making for urban environmental management using GIS technology.

About 150 persons visited the Center's panel display during the open house, with about 80% of the visitors being drawn from private companies. This only goes to show that the private sector has high expectations from the Center and will look forward to the impact on the efforts towards creation of a safer urban environment. We will do our best to attract a wider audience in the coming years!!



*ICUS/INCEDE secretaries  
Ms Shiuchi(L) and Ms Murakami(R)*



## Industry - ICUS/INCEDE Interaction (RC-39)

### — Research Committee (RC-39) —

A new Research Committee (RC-39) titled "*Research Committee on Sustainable Engineering for Urban Safety*" has been established by the ICUS/INCEDE. Besides the members of the faculty of the Center, the committee comprises of 16 private companies and research organizations. (The complete list of participating companies and the members is available at our website <http://icus-incede.u-tokyo.ac.jp/>).

The broad spectrum of the primary activities of the member organizations is proof of the keen interest the Center has evoked within the short period of its existence. The committee will work for a two-year period and address issues related to:

1. Difference in the response of different structural systems

2. Optimum method(s) for carrying out monitoring and evaluation of structure
3. Appropriate methods for repair and retrofit of deteriorated structures
4. Application of new technologies for Urban Safety Engineering

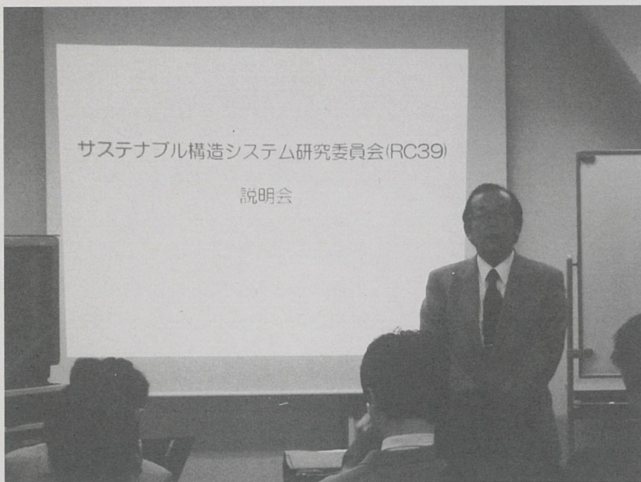
The first introductory meeting of RC-39 was held on June 26 at ICUS, where the faculty of the ICUS made brief presentations about the activities currently underway in their groups, and their perspective of the needs of further research and development activities in order to realize the goal of sustainable urban development.

In order to make optimum use of the available expertise and time, it was decided to constitute smaller

'working groups' to examine the following issues in greater detail.

1. Methods to handle an aging infrastructure, including nondestructive testing and monitoring, retrofitting, etc.
2. Global environment including levels of carbon dioxide, etc.
3. Study of the phenomenon of formation of heat islands in urban environments
4. Disaster prevention and response, including development and dissemination of suitable literature
5. Developments in sensing technology and its applications in studies related to urban safety

Through exchange of information and interactions, efforts will be made to identify common areas of interest and initiate joint studies.



*Professor T Uomoto, ICUS/INCEDE Director, at the introductory meeting of RC-39*



*The introductory meeting of RC-39 in progress*

### Visitor to ICUS/INCEDE

Ms Chada Narongrit, Department of Geography, Faculty of Social Science, Kasetsart University, Thailand, arrived at the Center for a

six month stint (April 1-September 30, 2002) to carry out research work on "*Estimation of daily evapo-transpiration from rice*

*paddy field by using TERRA/MODIS data*". She belongs to Yasuoka Laboratory.



## Dr. K. Meguro Awarded from ISSS

Dr. K. Meguro, ICUS/INCEDE won the prize for the Best Paper of the Year from the Institute of Social Safety Science, Japan, on the 1st of June 2002. In this paper, he proposes a new system for promotion of retrofitting of low earthquake resistant houses. With this new system, both house owners and government at national and local levels would greatly benefit and the total damage that would occur in case an earthquake strikes could be drastically reduced. Although retrofitting weak structures is the most important issue for earthquake disaster reduction, in reality, its importance and usefulness is not popularly understood. Moreover, the national government cannot compel owners to strengthen their houses because they are private property. As a consequence, only very few people have retrofitted their houses. In Japan, there is the principle that people affected by natural hazards should recover by themselves

and governmental money cannot be spent in private property. Paradoxically, when the earthquake strikes and houses collapse, the government invests a lot of resources to take care of the affected people. Most of this money, however, would not be spent if the



Dr. K. Meguro

houses were not damaged or did not collapse. This post-earthquake investment can be more efficiently used in pre-earthquake preparedness. Currently, Japan is

facing a population decrease accompanied by an increase in the elderly population ratio. In this context, the only way to preserve a high quality housing stock is by building long-lasting houses. These houses should be built at suitable locations and be given proper maintenance and/or retrofit if needed so that they can be used for long time. In this way, the efforts of successive generations will be added and each person's individual contribution will be reduced and focused on keeping the quality of the housing stock. By recognizing this situation, Dr. Meguro proposed a scheme for promoting the retrofitting of houses and he is currently trying to establish a legal system based on it. Dr. Meguro sincerely hopes that in the near future, this system becomes a national law that will help Japan to ensure the high quality of its housing stock as well as to save human lives when future earthquakes strike.

### Forthcoming Conferences of Interest to ICUS/INCEDE

#### The Ninth East Asia-Pacific Conference on Structural Engineering and Construction (EASEC-9)

EASEC-9 to be held in Bali, Indonesia (December 16-18, 2003) is organized by the Dept. of Civil Engineering, Institut Teknologi Bandung, Indonesia. The main theme of the conference is Embracing the Challenges in 21st

Century. It highlights the needs of immediate regional cooperation to meet the demand of free market and globalization. Further details and information can be obtained from <http://si.itb.ac.id/easec9/>.

#### The 4th International Conference on Concrete Under Severe Conditions of Environment and Loading (CONSEC-04)

CONSEC 04 to be held in Seoul, Korea from June 20 - 23, 2004 will have presentations on latest

development in the subject by experts and aims to continue the transfer of advanced technologies

across the world. Further details about the Conference are available at <http://conlab.snu.ac.kr/consec/>.

### ICUS/INCEDE Activity Records

Some of the international conferences in which members of ICUS/INCEDE faculty participated during the period April - June 2002, include the following:

Prof. T. Uomoto, Director, ICUS/INCEDE participated in the 30th Annual Conference-Canadian Society of Civil Engineering held at

Montreal, Canada (June 5 - 8, 2002).

Prof. Y. Yasuoka participated in two international conferences: 1) 29th Intl Symp on Remote Sensing of Environment at Buenos Aires, Argentina (April 8 - 12, 2002), and, 2) 2002 Intl Geoscience and Remote Sensing Symp at Toronto, Canada (June 23 - 27, 2002).

Dr. D. Dutta was in Australia during May 5-22 to participate in Joint Research Studies on Urban Flood Risk Management and Improvement of Topography Data for Hydrological Modeling. Dr. Dutta spent time mainly in University of Western Australia, Australian National University and Macquarie University.



**Editor's Note**

ICUS/INCEDE entered the 2nd year this April. Looking back last year - many activities, such as a joint workshop with Asian Institute of Technology (AIT), workshop on civil engineering and open lecture, have been done.

Dr. M. Setojima (Kokusai Kogyo Co., Ltd.) and the undersigned have joined ICUS as Visiting Professor and Assistant Professor, respectively. It is expected that

activities at ICUS will increase with more persons joining in.

ICUS functions as the aggregate of specialists drawn from diverse research fields. Team action reconfirmed that various problems related to urban safety are solvable. In the current fiscal year, it is planned to set up a liaison office at the AIT to coordinate joint research projects and promote better understanding among researchers in the region.

The world was gripped by the

soccer World Cup during the period April to June. That Japan lost in the first game of the second round was regrettable. However, it was a good tournament for the region, with Japan and South Korea advancing to the Second Round, and the latter making it to the last four. We congratulate South Korea on their splendid performance, and indeed if only there was a little more cohesion, the World Cup story may have been quite different.

(Y. Kato)

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