The 3rd UNIST International Symposium on

Sustainable and Resilient Urban Infrastructure

Technical Program and Abstracts

Organized by

School of Urban and Environmental Engineering
Ulsan National Institute of Science and Technology (UNIST)

UNIST, Ulsan, Korea on January 17-18, 2014

Welcome

I am very honored to invite you to the 3rd UNIST International Symposium on Sustainable and Resilient Urban Infrastructure which will be held in Ulsan, Korea during January 17-18, 2014. The symposium is organized by Ulsan National Institute of Science and Technology (UNIST) and local and international experts are invited from academic institutions of Japan, Hong Kong, U.K., U.S.A., and Korea.

The objectives of the symposium are (1) to exchange ideas on improving sustainability and resiliency of our urban infrastructure, (2) to discuss research experiences and activities how best to manage infrastructure to mitigate disasters and to prolong the life cycle, and (3) to cultivate opportunities for cooperation in research and education on the subjects among the participants in the near future.

Please come and enjoy this informative program. We look forward to your active participation.

January 17, 2014

Chung-Bang Yun, Chair Professor
Head of Urban and Environmental Engineering
UNIST

Organizing Committee

Prof. Myoungsu Shin
Prof. Dong Keun Yoon
Prof. Sung-Han Sim
Prof. Marco Torbol

Program of the 3rd UNIST International Symposium on Sustainable and Resilient Urban Infrastructure

	Friday, January 17, 2014[1] (Room E204)
8:30 - 18:00	Registration
9:00 - 9:20	**Opening Ceremony** Opening Remark: *Prof. Chung-Bang Yun*, Head, School of Urban and Environmental Engineering, UNIST Introduction to UNIST: *Prof. Chung-Bang Yun*
9:20 - 10:40	**Session I: Reliability and Risk Analysis** Session Chair: *Marco Torbol* Presenters: *Carmine Galasso, Marco Torbol, Do-Soo Moon, Young-Joo Lee*
10:40 - 10:50	Coffee Break
10:50 - 12:10	**Session II: Disaster Resilience and Management** Session Chair: *Dong Keun Yoon* Presenters: *Juchul Jung, Gi-Hyoug Cho, Kanako Iuchi, Dong Keun Yoon*
12:10 - 13:30	Lunch
13:30 - 15:30	**Session III: Sustainable Concrete Structures and Materials** Session Chair: *Myoungsu Shin* Presenters: *Thomas Kang, Myoungsu Shin, Yuma Kawasaki, Jae-Eun Oh, Kyoungsoo Park, Jae Hong Kim*
15:30 - 15:50	Coffee Break
15:50 - 17:35	**Session IV: Structural Health Monitoring** Session Chair: *Sung-Han Sim* Presenters: *Yong Xia, Soojin Cho, Taekeun Oh, Sung-Han Sim, Won Hee Kang*
17:35 - 18:00	**Closing Remarks and Photo**
18:00 – 18:30	**Move to Dinner**
18:30 – 20:30	**Dinner**

	Saturday, January 18, 2014[1]
9:30 – 11:00	Group Discussion
11:00 –	Lunch and Cultural Tour at Gyeongju

1) Cars will be arranged to pick up participants at Olympia Hotel at 8:00am on Friday, January 17 and at 8:50am on Saturday, January 18.

Session I: Reliability and Risk Analysis

(9:20am-10:40am) Chairperson: Marco Torbol

9:20am-9:45am	Carmine Galasso (Newcastle University, U.K.)
	Are simulated ground motions an option for assessing seismic risk to civil infrastructure networks?
9:45am-10:00am	Marco Torbol (UNIST, Korea)
	Parallel fault tree analysis for civil engineering
10:00am-10:25am	Do-Soo Moon (University of Illinois, U.S.A.)
	A new method for deriving analytical seismic fragility curves
10:25am-10:40am	Young-Joo Lee (UNIST, Korea)
	Post-hazard performance prediction of transportation network
10:40am-10:50am	**Coffee break**

Session II: Disaster Resilience and Management

(10:50am-12:10pm) Chairperson: Dong Keun Yoon

10:50am –11:15am	Juchul Jung (Pusan National University, Korea)
	Assessing the indicators of community disaster resilience
11:15am-11:30am	Gi-Hyoug Cho (UNIST, Korea)
	A dynamic estimation of casualties from an earthquake based on a behavioral survey of Korea
11:30am-11:55am	Kanako Iuchi (Tohoku University, Japan)
	Resilience in the face of uncertainty – is science-based land use sustainable?
11:55am-12:10am	Dong Keun Yoon (UNIST, Korea)
	Disaster resilience as community volunteer capacity
12:10am-1:30pm	**Lunch**

Session III: Sustainable Concrete Structures and Materials

(1:30pm-3:30pm) Chairperson: Myoungsu Shin

1:30pm-1:55pm	Thomas Kang (Seoul National University, Korea)
	Performance of corner post-tensioned slab-column connections subjected to bi-directional clover-leaf loading pattern
1:55pm-2:10pm	Myoungsu Shin (UNIST, Korea)
	Ductile fiber-reinforced cement composites: sustainable seismic design solutions
2:10pm-2:35pm	Yuma Kawasaki (Ritsumeikan University, Japan)
	Fracture mechanisms of corrosion-induced cracks in reinforced concrete by BEM and AE-SiGMA
2:35pm-2:50pm	Jae-Eun Oh (UNIST, Korea)
	Determining factors for geopolymeric reactivity using NaOH of Korean Class F fly ashes
2:50pm-3:15pm	Kyoungsoo Park (Yonsei University, Korea)
	Nonlinear dynamic fracture, micro-branching and fragmentation under impact and blast
3:15pm-3:30pm	Jae Hong Kim (UNIST, Korea)
	The laser backscattering-rheometer for simultaneous measurement of cement flocculation and rheology
3:30pm-3:50pm	**Coffee break**

Session IV: Structural Health Monitoring

(3:50pm-5:10pm) Chairperson: Sung-Han Sim

3:50pm-4:15pm	Yong Xia (The Hong Kong Polytechnic Univ., Hong Kong)
	A substructuring method for model updating and other applications of large-scale structures
4:15pm-4:30pm	Soojin Cho (UNIST, Korea)
	System identification of a swing truss bridge using a wireless sensor network employing orientation correction
4:30pm-4:55pm	Taekeun Oh (Incheon National University, Korea)
	Defect characterization in concrete elements using vibration analysis of contactless impact-echo test data

4:55pm-5:10pm	Sung-Han Sim (UNIST, Korea) **Stability assessment of a railway bridge for high-speed trains**
5:10pm-5:35pm	Won Hee Kang (University of Western Sydney, Australia) **Statistical capacity reduction factor calibration of steel beams and composite columns**

Session I

Reliability and Risk Analysis

Are simulated ground motions an option for assessing seismic risk to civil infrastructures?

Carmine Galasso

Newcastle University, U.K.

ABSTRACT

This study focuses on the engineering validation of hybrid broadband ground motion simulations in terms of seismic response of reinforced concrete bridges with skew-angled seat-type abutments (or simply 'skewed bridges'). Synthetic records, simulated at fine grid spacing, represent an attractive option for loss estimation purposes, e.g., if transportation networks are of interest. Moderate and strong earthquake events may cause system interruption over a long period of time, resulting in unacceptable socioeconomic losses and societal disruption. In order to assure that the damage estimates of a bridge (or a portfolio of bridges) computed using simulated and real recordings exhibit similar statistics, the equality, in statistical sense, between seismic responses to these two kinds of accelerograms needs to be tested. To this aim, three short bridges located in California are selected as seed bridges here, from which different models are developed by varying key bridge structural parameters such as column-bent height, symmetry of span arrangement, and abutment skew angle. Through extensive nonlinear dynamic analysis conducted using simulations and actual recordings for two historical earthquakes; i.e., 1989 Mw 6.8 Loma Prieta earthquake and 1994 Mw 6.7 Northridge earthquake, it is demonstrated that median deck rotations and column drift ratios produced by simulations agree reasonably well with those produced by recorded ground motions. However, the intra-event dispersion in the structural response due to the simulations is generally lower than that for recorded ground motions, consistently with the findings of previous studies on the same topic. Hypothesis tests on selected samples are carried out to quantitatively assess the results' statistical significance for both demand parameters. Finally, the sensitivity of the two demand parameters to some ground motion intensity measures is investigated for both simulations and recorded waveforms.

Parallel fault tree analysis for civil engineering

Marco Torbol[1]

[1]*School of Urban and Environmental Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan 689-798, Korea*

ABSTRACT

Nowadays, in civil engineering fault tree analysis technique is used for the probabilistic risk assessment of complex systems, such as nuclear power plants. But, the existing algorithms that solve the tree are serial. This study develops a new method that handles and solves large fault trees through GPGPU parallel architecture. The focus of this study is on nuclear power plants but the method can perform probabilistic risk assessment of other complex systems. Two parallel algorithms are included in the new method. One is the handler of the fault tree, i.e. the preprocessor, and one is the solver. The probability of the top event, the probability of each cut set, and the weight of each single basic event within the cut set are all computed. Both algorithms were developed and optimized for GPGPU computing. These processors can handle extremely large fault trees, which could not fit in the available memory of previous architecture, with reduced computational time, more than an order of magnitude. The algorithms presented are the foundation of the next generation parallel solvers of the tree-based analysis for the probabilistic risk assessment of complex systems. The size of the fault trees that can be handled increases the resolution of the model and the computational speed increases the accuracy of the results.

Keyword: Fault tree analysis, Reliability, System Safety, GPGPU computing, CUDA

[1] Assistant Professor

A new method for deriving analytical seismic fragility curves

Do-Soo Moon[2]

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ABSTRACT

The existing method for deriving analytical seismic fragility curves can be broken into two categories, depending on whether an analytical function or simulation method is used. Although both methods have shown decent performances in many seismic fragility problems, they often oversimplify the given problems in reliability or structural analyses owing to their inherent assumptions. This paper introduces a new method for the development of analytical seismic fragility curves, which overcomes the shortcomings of the existing methods. The new method proposes the integration of sophisticated software packages for reliability analysis (FERUM) and structural analysis (ZEUS-NL) to generate more accurate seismic fragility curves with less computational cost than the simulation-based methods. Because the proposed method performs a reliability analysis using the first-order reliability method, it provides component probabilities, allowing the development of the fragility curves of a structure at the system level. The new method was applied to numerical examples of 2D frame structures. The results were compared with those from Monte Carlo simulations, and the proposed method was found to derive the seismic fragility curves more accurately and efficiently. The effect of the system reliability analysis was also investigated to evaluate its necessity.

[2] Postdoctoral Research Associate

Post-hazard Performance Prediction of Transportation Network

Young-Joo Lee[1]

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ABSTRACT

The performance of a transportation network can be reduced significantly by structural damage of its constituent bridges induced by natural hazards such as earthquake and flood. It is thus essential to predict the post-hazard performance of the network in an efficient and accurate manner for rapid risk-informed decision making on hazard mitigation and response. However, it is challenging to estimate the post-hazard performance of a transportation network due to the uncertainty in hazards and structural damage and the complex nature of the network flow analysis. Moreover, the bridge structures deteriorate over time, which requires time-varying network reliability analysis. In this presentation, a non-sampling-based approach to estimate the time-varying post-hazard performance of a bridge transportation network in terms of flow capacity is proposed. The proposed approach evaluates the probabilities of structural damage scenarios efficiently using the matrix-based system reliability method and rapidly computes the corresponding flow capacities using a maximum flow capacity analysis algorithm. The matrix-based framework integrates these results to obtain the probabilistic distributions and statistical moments of the network flow capacity. It also enables computing the conditional mean and standard deviation of flow capacity given structural damages, and component importance measures conveniently facilitating risk-informed decision making. In the proposed approach, probability calculation and network flow analysis are performed separately, which renders time-varying post-hazard flow capacity analysis efficient. A numerical example based on Sioux Fall network demonstrates the proposed approach. After presenting the corresponding analysis results, a future research plan to solve more realistic problems of lifeline network is discussed.

[3] Assistant Professor

Session II

Disaster Resilience and Management

Assessing the indicators of community disaster resilience

Juchul Jung[1], Dalbyul Lee[1], and Hyungjun Park[1]

[1]*Pusan National University, Korea*

ABSTRACT

The objective of this research is to assess indicators of community resilience. We focused on mitigation strategies of natural hazard. Exploring the indicators of community resilience can be used to assess whether communities have capacity to build the more resilient communities. Losses of communities have been increased and some communities have experienced repetitive physical losses. Nevertheless, most of communities have neglected risk reduction strategies in recovery step.

Community disaster resilience is helpful whether community has capacity to withstand the impact of natural hazard and adapt next disturbance (Milleti, 1999; Peacock et al., 2010). Moreover, resilient community has less impact from natural hazard (US IOTWSP, 2007). The difference of community resilience results in differential capacity to absorb the impact of potential natural hazards. That is why many governments should try to enhance and assess resilience of their communities. The community resilience related natural hazard is constituted with society, exposure, and hazard response. Of the coverage, we chose some substantial indicators of mitigation of the hazard response from the literature of the evaluation of community resilience. Hazard mitigation is the most significant step as a long-term and proactive step (Beatley, 2009)

This study employed case study method and considered the Korea community. We chose case communities located in coast and watershed. These communities are the most vulnerable communities in Korea, where we collected the official documents, conducted interviews and had the field trips. From the case study, we identified the indicators of resilience in case communities. Bases on the result, we found that planning and education are elements of the most significant indicators of community resilience.

Keywords: Community Resilience, Sustainability, Indicator, Hazard Mitigation

A dynamic estimation of casualties from an earthquake based on a behavioral survey of Korea

Gi-Hyoug Cho[4]

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ABSTRACT

One of the essential information to estimate causality caused by an earthquake is spatio-temporal distribution of population. HAZUS is a geographic information system developed and freely distributed by the Federal Emergency Management Agency (FEMA) to estimate natural hazard loss and damages. As inventories of behavioral patterns, however, are based on US data, it may not provide reliable and meaningful information of hazard exposures for Korean cities.

To estimate accurate hourly exposures for an earthquake, the study used daily time-behavioral survey conducted by Statistics Korea. The survey contains approximately 21,000 respondents' behavioral data for 24 hours. Combining structural damage estimates calculated by HAZUS and spatio-temporal behavior patterns estimated by daily time-behavioral survey in Korea, the study shows simulation results of causalities with a given scenario of an earthquake in Ulsan area.

[4] Assistant Professor

Resilience in the face of uncertainty – is science-based land use sustainable?

Kanako Iuchi[1]

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ABSTRACT

Increasing urban resilience through science- and technology- based structural measures has been a major approach in managing natural disasters in modern world, especially in industrialized countries. Not unique to this, Japan, with land prone to natural disasters, has relatively successfully mainstreamed disaster management; institutional and legislative frameworks have been thoughtfully developed and modified over decades to prevent and recover from natural disasters, while structurally, urban infrastructure has been reinforced and upgraded in accordance with advancing technologies and engineering.

In the wake of the Great East Japan Earthquake (GEJE) on March 11, 2011 more than 15,800 people deceased and inundated 561 km^2 of land from tsunami generated, making Japanese society re-realize effective damage and loss reduction from large natural disaster events by structural measures are incomplete. With this experience of what is called "beyond expected" event, recovery has been including non-structural measures together with structural ones. In particular, land use that avoid residences in tsunami risk areas has been considered for adoption together with construction of high-height levees that theoretically prevent tsunami of occurrence with once every few hundred years. Procedures to adopt such use of land has been quite scientific and centralized, making the initial land use plan in the recovery in localities proceed urgently yet similar to one another. Three years after the GEJE, this science-based, one-size-fits-all planning procedure is complicating local planning processes. It throws a question whether such scientific and rational approach of land use to uncertain risks like tsunami that may occur once every one thousand years be a sustainable solution to the local communities.

[5] Associate Professor

Disaster resilience as community volunteer capacity

Dong Keun (D.K.) Yoon[1]

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ABSTRACT

Spontaneous volunteers play a significant role in times of disaster. Before governmental and organized voluntary disaster agencies arrive in sufficient strength, civilian volunteers often spontaneously mobilize to protect their lives and belongings in the early period of disaster. This study examines the characteristics of spontaneous volunteers at three different levels of flood stage risk during Fargo, North Dakota's response to the 2009 Red River flood threat. The Red River crested at a record level on March 28, 2009. More than 20,000 civilian volunteers spontaneously mobilized and gave of their time to respond to the threat of Red River flooding. Unaffiliated volunteers signed-up at coordination sites throughout the city and filled more than 3 million sandbags and piled these sandbags along the riverfront. Sign-up data from 11,553 volunteers were geocoded to connect volunteers to the local area's 96 census block groups. Data on these census block groups were then complied from the American Community Survey (ACS) 5 year data (2006-2010). Factors in terms of socio-economic and geographical characteristics of spontaneous volunteers are examined before, during, and after the flood stage at the 2009 Red River Flood. Findings show that education, race, age, occupation, and geographic factors are significantly associated with volunteerism along with different levels of risk in the case of the 2009 Red River Flood.

[6] Assistant Professor

Session III

Sustainable Concrete Structures and Materials

Performance of corner post-tensioned slab-column connections subjected to bi-directional clover-leaf loading pattern

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ABSTRACT

Performance of corner post-tensioned (PT) slab-column connections has been rarely studied, despite that such an element is commonly used in low-to-high seismic regions. This study performs in-research for better understanding of complicated moment and shear transfer mechanism at corner PT slab-column connections. Literature was thoroughly reviewed and finite element simulations were performed on two previously tested isolated corner connections, which were subjected to bi-directional clover-leaf loading pattern. The documented seismic test results, along with the finite element simulations, provide an innovative way to review the scarce test data in detail. Using such a unique approach, the shear-moment transfer mechanism at corner PT connections and the eccentric shear stress model were assessed in depth. Particularly, the bi-directional lateral behavior was closely observed with increasing drift during the clover-leaf loading.

[7] Associate Professor

Ductile fiber-reinforced cement composites: sustainable seismic design solutions

Myoungsu Shin, Ph.D., P.E.[1]

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ABSTRACT

Presented are two experimental studies aimed at improving the seismic performance of reinforced concrete structures through the use of different fiber-reinforced cement composites (FRCCs). In the first study, six 1/2-scale shallow coupling beams having the length-to-depth ratio of 3.5 were tested under cyclic lateral loading up to 10% drift. The key test variables were material type, main reinforcement layout, and transverse reinforcement ratio. For the material type, normal concrete and high performance FRCC using PVA fibers of 2% volumetric ratio were compared. Two types of main reinforcement layout were tested: conventional and diagonal reinforcement. The ratio of transverse steel varied to be about 0, 50, and 100% of the minimum specified in KCI 2012 and ACI 318-11.

In the second study, five 1/4-scale rectangular hollow bridge columns were tested under cyclic lateral loading. FRCCs with an economical type of hooked steel fibers were used. The main test variables were fiber volumetric ratio (0, 1, or 2%), presence of coarse aggregate, and column length-to-depth ratio (2 or 3). In all specimens, no transverse reinforcement was provided to identify the sole contribution of concrete or FRCCs on the confinement as well as the shear strength.

[8]Assistant Professor

Fracture mechanisms of corrosion-induced cracks in reinforced concrete by BEM and AE-SiGMA

Yuma Kawasaki, Kazuyuki Izuno and Masayasu Ohtsu

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ABSTRACT

Following the onset of corrosion in reinforcement, expansion of corrosion products generated corrosion-induced cracks in concrete. Nucleation of micro-cracks can be detected by acoustic emission (AE) and analyzed by SiGMA (Simplified Green's functions for Moment tensor Analysis) analysis, by which crack kinematics of locations, types and orientations are quantitatively estimated. AE-SiGMA was applied to clarify mechanisms of corrosion-induced cracks. Based on fracture mechanisms, numerical analysis was conducted by the boundary element method (BEM).

The generation of corrosion-induced cracks was performed by cyclic wet and dry test. By applying the BEM analysis, extension of the corrosion-induced cracks in an arbitrary direction was analyzed. In order to respect to the orientations of crack extension, results of the BEM analysis were compared with those of the SiGMA analysis. Then, the corrosion-induced cracks are observed by stereo-microscope. From all results and comparisons, a great promise for AE techniques to clarify mechanisms of corrosion-induced cracks in reinforced concrete (RC) structures is demonstrated.

Keywords: Acoustic Emission, BEM, Corrosion-induced cracks, Reinforced Concrete, SiGMA Analysis

Determining factors for geopolymeric reactivity using NaOH of Korean Class F fly ashes

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ABSTRACT

Material characteristics determining strength development in geopolymerization of Class F fly ashes are studied using six different Korean Class F fly ashes, which possess typical properties of Class F fly ash in chemical and mineral compositions, glass content and profile of X-ray diffraction pattern. The study results indicate that the strength development is related to the higher content of network modifying elements rather than with the higher glass content of fly ash.

Nonlinear dynamic fracture, micro-branching and fragmentation under impact and blast

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ABSTRACT

For the investigation of nonlinear dynamic failure phenomena including microbranching instability and fragmentation, a theoretical and computational framework is presented. In order to represent such failure phenomena, a traction-separation relationship across fracture surface is defined on the basis of a potential, which leads to a consistent constitutive relationship for nonlinear cohesive failure. For a computational method, adaptive operators, which include surface element insertion, edge-swap, and mesh refinement and coarsening, are employed to improve computational cost and accuracy. Computational results demonstrate that the potential-based constitutive model with such adaptive operators leads to an effective and efficient framework to simulate physical phenomena associated with dynamic failure.

[9] Assistant Professor

The laser backscattering-rheometer for simultaneous measurement of cement flocculation and rheology

Jae Hong Kim[10]

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ABSTRACT

In a fresh mixed concrete, cement particles flocks with time and the degree of cement flocculation reportedly depends on the rate of shear strain. The change of particle size is often monitored via a laser reflectance measurement, where the increase of cement particles was observed. That is the result of cement flocculation. Devising the laser reflectance measurement coupled with a rheometer allowed us to monitor the flocculation at a given shear rate. Their concurrent measurement revealed the shear-dependent flocculation or deflocculation, and their effect on the thixotropy was also discussed with the rheological change measured.

[10] Assistant Professor

Session IV

Structural Health Monitoring

A substructuring method for model updating and other applications of large-scale structures

Yong Xia[1] and Shun Weng[2]

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[2]*School of Civil Engineering & Mechanics, Huazhong University of Science and Technology, China*

ABSTRACT

In vibration-based model updating, the parameters of a structural model are iteratively modified so that its vibration properties reproduce the measured counterparts in an optimal way. The finite element model of a large-scale structure usually consists of a large number of nodes and elements. Its eigensolutions, eigensensitivities, and model updating are very expensive in terms of computation time and memory. This study develops a new substructuring-based model updating method in two approaches, forward and inverse.

In the forward approach, the entire model is divided into manageable substructures. The first a few eigenmodes in each substructure are retained as master modes. The master modes of all substructures are assembled into a reduced eigenequation of the global structure, by imposing constraints on the interfaces of the adjacent substructures. Eigensolutions of the global structure are then calculated from the reduced eigenequation. The contributions of the discarded higher modes (slave modes) in each substructure are compensated with the residual flexibility. Similarly, the eigensensitivities with respect to an elemental parameter of the global structure are calculated. Next, the substructuring method is applied to the model updating process. The effect of the division formation of substructures and retained master modes on the computational accuracy and efficiency is investigated.

The inverse approach is developed by extracting the substructural flexibility matrices from the experimental modal data. Consequently the substructures will be directly updated so that their flexibility matrices match the measured counterparts. The model condensation technique is employed as the measurement is usually conducted at incomplete points of the entire structure.

The proposed substructuring methods have been applied to numerical, laboratory, and real structures. Results demonstrate that the substructuring methods are computationally efficient and accurate in finite element model updating and associated applications including eigensolutions, eigensensitivties, and damage identification.

System identification of a swing truss bridge using a wireless sensor network employing orientation correction

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ABSTRACT

System identification was performed on the swing span of a steel truss bridge dating from 1896 using acceleration data collected from a wireless sensor network (WSN). The swing span can rotate 360° to allow river traffic to pass through the locks located under the bridge. The WSN installed on the swing span consists of twenty-three nodes that measure synchronized tri-axial acceleration. Five days of measured data was segmented according to three functional positions of the span (locked facing downstream, locked facing upstream, swung for river traffic) and load conditions.

Subsequently, the modal parameters corresponding to the bridge's three functional positions were obtained using frequency domain decomposition (FDD) method. The initial system identification of the bridge resulted in significant anomalies, in comparison with the finite element (FE) model.

To improve the accuracy of the overall identification results, the sensor orientation correction technique was proposed for the measured data from the WSN. The improvement of system identification result by applying the sensor orientation correction technique has been verified by comparing the orientation-corrected mode shapes with non-corrected mode shapes and FE mode shapes.

Analysis of the modal parameters inferred that the boundary conditions for the bridge positions are different due to the interaction of the locking mechanism with the abutments in those positions.

[11] Research Assistant Professor

Defect characterization in concrete elements using vibration analysis of contactless impact-echo test data

Taekeun Oh[12]

Department of Safety Engineering, Incheon National University

ABSTRACT

The conventional (contact type) Impact Echo (IE) test is an effective NDE method used to identify and characterize internal defects in concrete structures. However large testing volumes associated with concrete structures demand many tests, which can be labor- and time-consuming; contactless, air-coupled IE tests offer a solution to this limitation. In this presentation, the effective implementation of air-coupled IE to characterize delamination defects in concrete structures is presented; these include the development of the air-coupled sensor system, understanding defect vibration behavior and development of an effective imaging technique. The developed techniques to evaluate the damage size and depth are applied to simulated and actual bridge slabs that contain defects. This research aims to integrate recent developments in air-coupled IE data with current technology.

[12] Assistant Professor

Stability assessment of a railway bridge structure using multimetric data fusion

Sung-Han Sim[13] and Jong-Woong Park[14]

[1]*School of Urban and Environmental Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan 689-798, Korea*
[2]*Korea Institute of Ocean Science and Technology (KIOST), Ansan 426-744, Korea*

ABSTRACT

This study investigates dynamic responses of a railway subjected to passage of a new generation high speed train HEMU-430x developed in Korea. The evaluation criteria which mainly assess traffic safety and passenger comfort during high speed passage are based on maximum responses of acceleration, vertical displacement, and twist. Measuring displacement and twist from the railway bridges is challenging as most currently available approaches need a reference point that is often difficult to find. Furthermore, twist requires measurement of multiple displacements, while the approaches are typically limited to a single point measurement. To address these issues, a multimetric data fusion method is introduced which is able to estimate multiple displacements based on measurement of acceleration and strain. To realize the multimetric data fusion method, wireless sensors are utilized due to ease of installation and time-synchronized acceleration and sensitive strain measurement. The HEMU-430X drive test is was conducted with three cases of speed which are 290km/h, resonance speed with test bed bridge, 370km/h and 400km/h, maximum test speed. The acceleration, vertical displacement and twist are successfully measured and estimated using the multimetric data fusion technique method. Based on the acquired acceleration, displacement and twist, the stability assessment is conducted for the railway bridge structure.

Keywords: railway bridge, displacement estimation, wireless sensor network, data fusion, multimetric

[13] Assistant Professor
[14] Research Assistant Professor

Statistical capacity reduction factor calibration of steel beams and composite columns

Won Hee Kang[15]

Structural Reliability in the Institute for Infrastructure Engineering, the University of Western Sydney in Australia

ABSTRACT

Composite members have been widely used in modern structures in Australia due to their outstanding structural performance and low strength degradation. In structural design using these composite members, it is desirable to achieve the most optimised balance between the cost and safety of the members within the context of the safety of the whole structure. For this purpose, effective structural design codes for these composite members should be developed based on the rules of mechanics and on experimental test results and the safety margins for the ultimate structural member resistance should be determined based on the statistical rationale provided by a reliability analysis. As more experimental data become available and improved statistical techniques are developed, the safety margin needs to be promptly updated to provide better cost-safety balance of the members. In this presentation, the reliability based capacity factor calibration procedures for the current Australian design code provisions will be reviewed along with the examples of single and multiple factor calibrations. These procedures will be applied to the re-calibration of a single capacity factor for I-beams with compact, non-compact, and not-compact sections, and multiple capacity factors for concrete-filled steel tubes. The significance of the calibration results will be discussed providing useful insight and supporting information for AS 5100.

[15] Assistant Professor

Note