Structures Group Report

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Structures Presentations (10)

Structural performance - buildings and bridges
(3 presentations)

Geotechnical engineering (3 presentations)

Tsunami modeling and impacts (4 presentations)

INVESTIGATION OF THE PERFORMANCE OF BUILDINGS WITH STRUCTURAL WALLS IN THE TOHOKU EARTHQUAKE OF 2011

Japan PI: Toshikatsu Ichinose, Nagoya Institute of Technology
US PI: Santiago Pujol, Purdue University
Presenter: Susumu Takahashi, Nagoya Institute of Technology

Purpose: Only a few retrofitted RC buildings were seriously damaged by the 2011 Great East Japan Earthquake. The causes of this damage were investigated to provide useful facts for preventing such damage in future.

Major Outcomes:

1) Deformation demand on coupling beams were much larger than other members.
2) Bar cutoffs created during retrofit caused damage.

STUDY ON SEISMIC DAMAGE OF BUILDINGS AND THEIR MECHANISM

Japan PI: Hitoshi Shiohara, The University of Tokyo
US PI: John W. Wallace, UCLA

Objective: To collect and record data on structural damage of engineered buildings as well as to investigate factors which caused structural damage. Carried out as a joint effort of Japan (AIJ) and US (EERI).

Major Outcomes:

1) Joint reconnaissance efforts of building damage by Japan and US researchers
2) Jointly participated and presented at International Symposium of JAEE in March 2012, Tokyo
3) Presentation at special session of 11(?) WCEE
4) Contribution to the publication of reconnaissance report by AIJ in 2013

EVALUATION OF THE SEISMIC PERFORMANCE OF BRIDGES DURING THE GREAT EAST JAPAN EARTHQUAKE

Japan PIs:	Kazuhiko Kawashima, Tokyo Inst. Technology
	Kenji Kosa, Kyushu Inst. Technology
	Mitsumasa Akiyama, Waseda University
	Yoshikazu Takahashi, Kyoto University
US PI:	Ian Buckle, University of Nevada Reno

Objective: Clarify failure mechanism s and induced damage to bridges due to ground-motion and tsunami

Major Outcomes:

1) Identified brittle shear failure mode in Shin-kansen viaducts
2) Identified failure mode of elastomeric bearings under combined tension and shear during a significant ground motion (long duration effect?)
3) Identified two failure modes during tsunami inundation: simple lateral drag and lateral flow after spans uplifted
4) Developed a practical measure to identify vulnerability of bridges based on lateral tsunami force and lateral bridge capacity

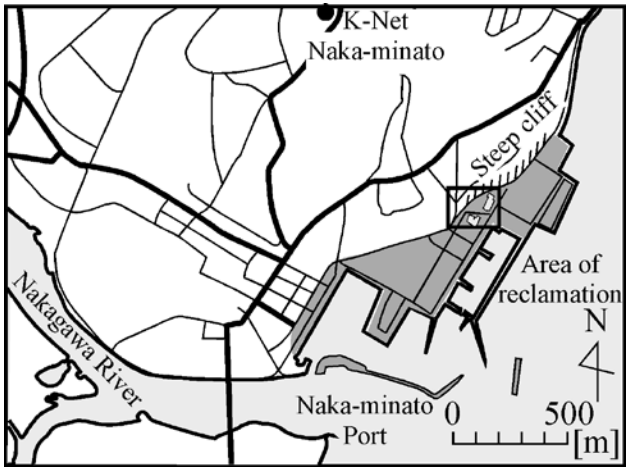
SITE CHARACTERIZATION OF SOIL LIQUEFACTION IN KANTO REGION BASED ON FIELD INVESTIGATIONS

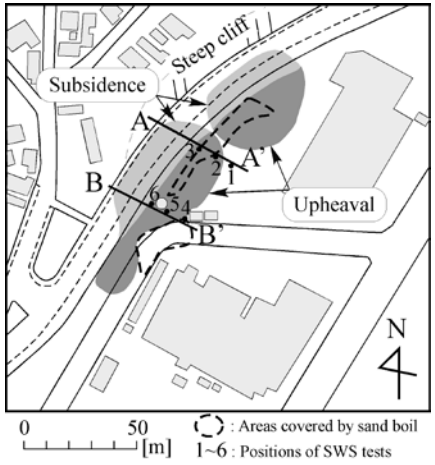
Japan PI: Y. Tsukamoto, Tokyo University of Science

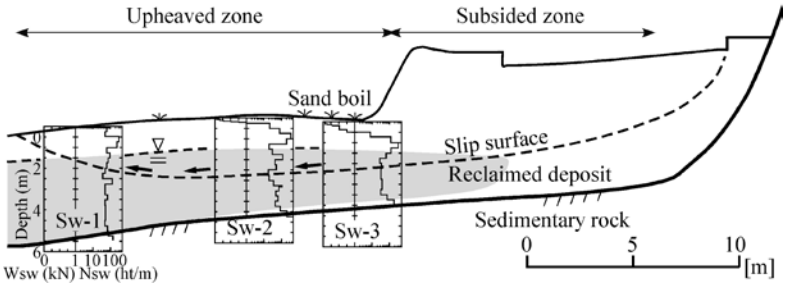
US PI: R.W. Boulanger, University of California, Davis

Objective: To conduct field investigations and collect soil profile data in Kanto region using the Swedish Weight Sounding test method at sites of liquefaction to determine failure modes which led to malfunctioning of infrastructure. Modes identified included ground settlement, lateral spreading and slip failure.

Major Outcome: A dozen case history studies were collected in the lower reaches of Tonegawa river. Liquefied soil layers responsible for damage to infrastructure and private houses were identified, which will help reconstruction and restoration efforts in future earthquakes.







Road embankment failures (Nakaminato, Hitachinaka city)

CONSIDERATIONS FOR IMPROVING PERFORMANCE AT GEOTECHNICAL-STRUCTURAL INTERFACES

Japan PI: N/A
US PI: David Frost, Georgia Institute of Technology

Objective: Use observations from post-earthquake reconnaissance of bridges and other structures to

(a) understand the role of interfaces in the geotechnical load path and

(b) the performance of geotechnical-structural systems.

Major Outcomes:

1) Clear evidence that systems, where material property contrasts are distributed over a large zone, perform in a superior manner to those where sharp contrasts in properties exist.
2) Opportunity to better integrate “system thinking” into future design strategies which attempt to not only address traditional “expected loads” but also seek to impact the geotechnical “load path” and thus performance.

QUANTITATIVE ASSESSMENT OF NONLINEAR SOIL RESPONSE DURING THE GREAT TOHOKU EARTHQUAKE

Japan PI: Hiroshi Kawase, DPRI, Kyoto University
Shinichi Matsushima, DPRI, Kyoto University
France PI: Florent De Martin, BRGM

Objective: Focus on stations that observed high acceleration where soil nonlinearity was suspected and examine the cause of site amplification and soil nonlinearity.

Major Outcomes:

1) Unexpected nonlinear behavior of bedrock
2) Influence of geometrical effects is not negligible
3) Inversions of vertical array's data, based on 1D medium, should be treated with care
4) High amplitudes are due to structure and topography effect

POST-DISASTER STRUCTURAL DATA COLLECTION FOLLOWING THE TOHOKU TSUNAMI

Japan PI: N/A
US PIs: Ian Robertson, University of Hawaii
Michael Olsen, Oregon State University

Objective: Perform detailed structural and LiDAR surveys of selected buildings and surrounding topography for use in

(a) time-history tsunami modeling of inundation, and

(b) validation of non-linear structural response analysis.

Major Outcomes:

1) Validation of hydrodynamic loading expressions developed in laboratory experiments
2) Validation of NEOWAVE tsunami inundation modeling.
3) Contribution to development of tsunami design guidelines for use in future US design codes.

PROPAGATION AND COASTAL BEHAVIOR OF THE TOHOKU TSUNAMI AND PERFORMANCE OF COASTAL STRUCTURES

Japan PI: Shinji Sato, University of Tokyo
US PI: Hermann Fritz, Georgia Institute of Technology

Objective:

Conduct US-Japan joint tsunami reconnaissance surveys and obtain/record scientific data for future tsunami disaster mitigation

Major Outcomes:

1) Coastal damage due to 2011 Tohoku Tsunami surveyed in Iwate and Fukushima Prefectures
2) Tsunami flow characteristics developed from video clip analyses
3) Performance of structures evaluated on the basis of tsunami heights and velocities, and
4) Two-level hazard criteria introduced.

STUDY ON DESIGN METHOD OF MULTISTORY BUILDING AGAINST TSUNAMI AND TSUNAMI DEBRIS

Japan PI: Norimi Mizutani, Nagoya University
Tomoaki Nakamura, Nagoya University
US PI: Clay Joshua Naito, Lehigh University

Objective:

To determine the requirements for the structural design of tsunami-resistant multistory buildings against tsunami-induced wave forces including the impact of tsunami-borne debris

Major Outcomes:

1) Obtained useful simulation results on tsunami propagation and inundation to make disaster prevention/mitigation plans
2) Clarified the characteristics of tsunami-induced wave forces and debris-induced impact forces acting on various types of buildings
3) Proposed countermeasures for preventing tsunami-borne shipping containers from flowing out to the sea
4) Clarified the mechanism of tsunami-induced scouring on the foundation of buildings

THE ROLE OF URBAN DEVELOPMENT PATTERNS IN MITIGATING THE EFFECTS OF TSUNAMI RUN-UP

Japan PI: Fumio Yamazaki, Chiba University
US PI: Ronald T. Eguchi, ImageCat Inc.

Objective:
Assess the vulnerability of local areas affected by the 2011 Tohoku earthquake and tsunami. To achieve this objective, we carried out
1) field surveys investigating tsunami run-up heights and building damage,
2) image analysis of aerial, optical and SAR satellite data, and
3) extensive mapping of inundation areas, building damage and crustal movements.

Major Outcomes:
1) Tsunami run-up boundary maps were produced
2) Building damage in the target areas was accessed by field surveys and image interpretation, and
3) Crustal movements were estimated based on the shift of buildings in high-resolution SAR intensity images.

Structures Group Summary

1. Great earthquakes need not be great disasters…

2. Great earthquakes are great learning opportunities to improve the resilience of our communities against future disasters…

3. But..

Structures Group Summary

1. Great earthquakes need not be great disasters…

2. Great earthquakes are great learning opportunities to improve the resilience of our communities against future disasters…

3. But a degree of urgency prevails and international collaboration is the best way - the only way - to win this race against time.

Thank You!