

## CAESAR'S ANATOMICAL/AUTOPSY SURVEY FOR OLDER/DAMAGED HIGHWAY BRIDGES

CAESAR (Center for Advanced Engineering Structural Assessment and Research), one of PWRI's research institutions located in Tsukuba, Japan, is a national center of excellence in research and technical support for highway administrators in performing design, construction, maintenance, and disaster mitigation for highway bridges. The establishment of CAESAR on 1 April 2008 was reported at the 40<sup>th</sup> UJNR joint Panel meeting held in Gaithersburg, Maryland, U.S., May 2008 and the contribution by CAESAR was welcomed in the Panel Meeting Resolutions.

As Mr. Matsuo, Research Coordinator for earthquake engineering, PWRI and CAESAR, reported during the Panel Meeting, CAESAR's mission addresses highly sophisticated issues for which relevant diagnosis and prognosis technique, assessment method, or corrective method has not been generally understood. CAESAR, working with highway administrators, tackle anatomic/autopsy survey of older bridges that will be decommissioned to improve their diagnosis/prognosis techniques and to measure, test, and simulate structural components and systems. That's what CAESAR calls scientific trials.

Mr. Murakoshi, Chief Researcher for Structural Assessment and Superstructures of CAESAR, leads several projects in autopsy survey for bridges that will be decommissioned. One of the on-going projects is the autopsy study using Asahi Bridge (see photo 1). The bridge is three-span continuous steel I-girder bridge located in Hokkaido. This work is jointly performed with Mr. Ishikawa, serving concurrently as Chief Research of CAESAR from CERl (Civil Engineering Research Institute for Cold Region) and his CERl team. The Asahi Bridge was built in 1953 and decommissioned in December 2008 because of functionally obsolescence. A truck load test, vibration test, and non-destructive evaluations for decks were conducted on-site from October 2008 to December 2008 and a series of fatigue load test, of a part of the deck plate and numerical simulations for the bridge and deck behavior, will be carried out in the near future.

In addition, another key project involved performing an autopsy on a large-span steel truss and girder bridge with total length of 1,200 m (see photo 2). The annual average daytime traffic is 20,000 vehicles; 10% are designated as heavy vehicles. The bridge was open in 1962 and will be decommissioned in 2009 because of its deterioration – corrosion, fatigue, and lack of adequate seismic performance. Many large-parts of the bridge were sampled and transported to CAESAR's large-scale structural test laboratories, followed by load tests and non-destructive evaluations, etc. that were performed on-site. Researchers conducted a visual bridge inspection, reviewed the history of earlier rehabilitation works, and started performing finite element models. They will analyze many issues to improve the inspection technique to identify structural deficiencies and perform prediction technique to estimate remaining strength of deteriorated critical structural components during 2009 and 2010. Mr. Kimura, Chief Researcher for Inspection Technology and Concrete Structures, CAESAR, is preparing other autopsy projects for concrete structures.

In addition to countering Japan's decaying highway bridges, CAESAR is working hard to facilitating a more disaster resilient nation. As the collapse of bridges in the 14 June 2008 Iwate-Miyagi Nairiku Earthquake, Dr. Unjoh, CESAR's Chief Researcher for rehabilitation and earthquake engineering and Dr. Sakai, CESAR's Senior Researcher were part of the technology Scan Team. The collapse of the Maturube Oh-hashii Bridge was reported in the Panel's newsletter, *Panel Update*, Volume 6, Number 2, August 2008 and is in Photo 3 below. Dr. Nakatani, Chief Researcher for management system and substructures, and his team are seeking effective seismic reinforcement measures for the Maturube Oh-hashii Bridge collapse and for other existing bridges. Drs. Unjoh and Nakatani also are working in technical committees involved in investigating the cause of the collapse of the Maturube Oh-hashii Bridge and recommending corrective measures for other bridges with similar damage during the earthquake.

CESAR findings will be shared during future Panel Meetings and during the Panel's TC/G-hosted US-Japan Bridge Engineering Workshops.

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Asahi Bridge



Truck load test for vehicular breaking forces



NDE for deterioration of deck plate

Photo 1. Autopsy survey using Asahi Bridge in Hokkaido.



Photo 2. A large-span steel girder and truss bridge used in the autopsy survey and corrosion of its typical gusset plate.



Photo 3. Collapse of Maturube Oh-hashii Bridge during the 2008 Iwate-Miyagi Nairiku Earthquake and emergency scan team by a special unit including CAESAR researchers.

## 24<sup>TH</sup> US-JAPAN T/C G BRIDGE ENGINEERING WORKSHOP

Task Committee G (T/C G), Transportation Systems, hosted its 24<sup>th</sup> US-Japan Bridge Engineering Workshop during 22-24 September 2008, in Minneapolis, Minnesota. This Workshop is a continuation of a series of technical interchanges between the United States and Japan on topics related to bridge engineering. This 2008 Workshop focused on seismic design/retrofit and maintenance. Forty-five people attended the workshop. The US delegation was led by Dr. W. Phillip Yen (US-side T/C Chair), Federal Highway Administration, Department of Transportation (FHWA/DOT) and the Japanese delegation was led by Mr. Atsushi Yoshioka (Japan-side T/C Chair), CAESAR (Center for Advanced Engineering Structural Assessment and Research), PWRI. The T/C chairs organized their delegations to facilitate an open exchange of ideas and to encourage discussion. The delegations consisted of FHWA researchers, State DOT bridge engineers, CAESAR researchers, NILIM researchers (National Institute for Land and Infrastructure Management of the Ministry of Land, Infrastructure and Transport, Japan) and associated academic researchers and industrial bridge engineers.

The 2 ½ day workshop featured nine technical sessions with 42 presentations and two breakout sessions that

addressed seismic issues and maintenance. Critical issues included the practice of bridge maintenance, seismic retrofit design in the US, code requirements on the post-earthquake serviceability, and manuals on the post-earthquake emergency recovery of damaged bridges after a severe earthquake in Japan. In addition, an interdisciplinary topic on the maintenance and durability of seismic retrofit materials was raised. The workshop closed with the Resolutions that the 25<sup>th</sup> Workshop will be held in Japan in the fall of 2009. The past Workshop agenda and technical papers are available at <http://www.pwri.go.jp/eng/ujnr/tc.htm>. The 24<sup>th</sup> Workshop agenda and technical papers will be soon uploaded to the web site.

Following the Workshop, the delegation members participated in three-day Bridge Technical Site Visits where small technical meetings were held at particular bridge project sites with representative engineers and researchers. Minneapolis experienced the I-35 W bridge collapse on 1 August 2007. The delegation attended the Minnesota DOT and the bridge site to discuss the collapse, design, and construction of the new bridge and methods to improve bridge engineering. The new bridge construction was completed within a year of the collapse and included many monitoring sensors that are arranged inside the bridge. The delegation also visited the Multi-Axial Subassemblage Testing (MAST)-NEES Facility, University of Minnesota to discuss their experimental studies. The delegation then moved to San Francisco, California. On 26 September they reviewed projects on seismic retrofit and replacement of large span bridges around the San Francisco Bay. There was active discussions on the design of RC towers, retrofit of truss bridges, and durability of seismic retrofit devices.

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Photo 4. Group Photo of the Task Committee G Delegation