UJNR Panel on Wind and Seismic Effects

Panel Update

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This issue of *Panel Update* Volume 3 Number 1 marks the beginning of our fifth year of circulating our bimonthly eNewsletter to share Panel activities with its members. Our June issues highlight the Panel's recently conducted technical site visits. These site visits followed the Panel's three day Technical Meetings of 14-16 May 2007 in Tsukuba. Proceedings of the Panel on Wind and Seismic Effects will be published in the fall and circulated to all Panel members and manuscript authors.

HIGHLIGHTS - TECHNICAL SITE VISITS 39TH MEETING OF THE US-JAPAN PANEL ON WIND AND SEISMIC EFFECTS 17-19 MAY 2007

1. Tokyo Metropolitan Expressway Route

The Metropolitan Expressway Company Limited, a privatized organization in 2005, is responsible for design, construction and management of Tokyo's Metropolitan Expressway. The delegation was briefed on investigation and techniques used to repair fatigue cracks in expressway steel bridge piers and orthotropic steel decks. Fatigue cracks are detected by magnetic particle testing procedure. Of 2011 piers tested, 566 had fatigue cracks. As temporary measure, holes are drilled at each end of the crack to prevent propagation of cracks that allowed traffic flow until permanent repairs. Monitoring is performed following a five year inspection plan. When visual inspection identifies serious cracks, annual inspections are performed for those selected fatigue cracks.

Modern Tokyo transportation relies on multiple highways that overlay the extinct canals and waterway systems of near the end of the Edo period (1603 – 1868). The delegation visited the Ohashi Junction of the Central Circular Shinjuku Route under construction designed to allow vehicles to pass through the central part of Tokyo by avoiding surface traffic congestion. A double loop reinforced concrete spiral ramp system is being constructed to connect the underground expressways with elevated highways. Completion of this Central Route is expected to reduce about half of the congestion on the expressways and expected to significantly reduce carbon dioxide emissions. The construction cost of the junction is $200 million.

Figure 1: Group photo of members of the Panel Delegation at construction site of the Ohashi Junction of the Central Circular Shinjuku Route, Tokyo Metropolitan Expressway

2. Seismic Retrofit Project of Lower Murayama-Shimo Reservoir Dam (Tokyo Metropolitan Government Bureau of Waterworks).

This reservoir along with the nearby Yamaguchi and Murayama-Kami Reservoirs were built between 1916 and 1934. The dam for the Murayama-Shimo Reservoir is 587 m long and is an earthfilled dam (33 m high) made by compacting materials such as clay and sand. After the Great Hanshin-Awaji Earthquake in 1995, the dam was checked for seismic stability. Since heavily populated residential areas are downstream and the reservoir is able to gravity feed several purification plants, it was determined to be critical to the Tokyo area. Therefore a detailed seismic study was done and strengthening was determined to be necessary.

The dam consists of a shell, core, bomb shield and a counter weight fill. The strengthening consisted of adding drainage, reinforcing the counter weight fill with geogrid and covering the crest of the dam with a cement-stabilized soil layer. The geogrid prevents sliding of the counter weight. The cover on the crest of the dam is to prevent failure of the top of dam during overtopping.

As part of the project, the reservoir was drained a minimum level so that strengthening could be done. A minimum level was maintained in order to sustain local wildlife. The project is to be completed by March 2009 at an estimated cost of $90 million.

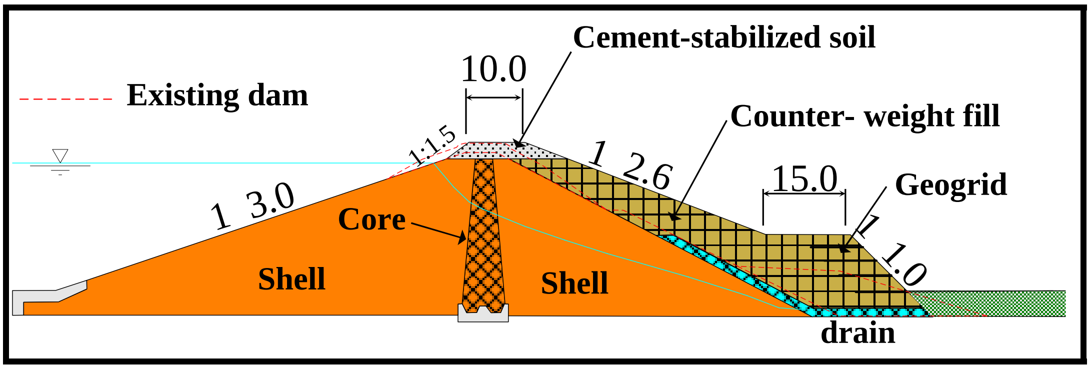

Figure 2: Dam strengthening (Courtesy, Tokyo Metropolitan Government Bureau of Waterworks)

3. Building Vibration Control System (Obayashi Corporation).

The delegation visited the thirty two story Shinagawa Intercity Tower A. The building is equipped with two unique Hybrid Mass Damper systems designed by the Technical Research Institute of Obayashi Corporation. The structure is 144.15 m tall with three basements, thirty stories and one penthouse.

The Hybrid Mass Damper (HMD) system is composed of three major components; 1) the Active Mass Damper (AMD), 2) the Tuned Mass Damper (TMD) and 3) the Multi-Layer Laminated Rubber Bearings. In this application the HMD is secured above the AMD which is set on the passive mass of the TMD, supported with the Multi-Layer Laminated Rubber Bearing. The Multi-Layer Laminated Rubber Bearing has no frictional drag, and thus the TMD can move smoothly from a small external force level. The design also makes possible shifting smoothly from TMD to HMD according to the response level of the building.

The applied active control systems also make it possible to control multi-vibration modes including torsional modes of the building. The 200 ton TMD was tuned to the 1st natural frequency of the building. Methods were developed that allowed for a smooth transition between dampers based on the response of the building.

Figure 3: Members of the Panel Delegation are inspecting the Hybrid Mass Damper System in the Shinagawa Intercity Tower A Building

4. Karematsuzawa Bridge (Tohoku Regional Development Bureau).

The delegation visited the Karematsuzawa Bridge on the Sanriku National Highway under management of the Tohoku Regional Development Bureau near Kamaishi City, Iwate Prefecture. This 310 m long steel arch bridge, one of the longest arch bridges in Japan, was constructed over the gorge to straighten the 15 km section of a winding highway on steep topographic conditions. The bridge eliminated 46 sharp curves, and reduced a stretch of highway having a 9.6% grade to a 4% grade. The realigned highway and bridge significantly reduced vehicle accidents and driving time. The cost of this 15 km highway construction was $700 million.

The bridge's steel members were fabricated using weathering steel to reduce bridge maintenance. An issue that may exist is possible environmentally detrimental releases from steel's surface treatment or its interaction with adjoining materials. The delegation was briefed on the method (the cable erection method) used to construct the bridge over an 80 m deep gorge.

Figure 4: Overview of the Karematsuzawa Bridge (left) and group photo of members of the Panel Delegation at the site (right)

5. Kamaishi Port Tsunami Breakwater

The Pacific Ocean coast of Iwate Prefecture in northeast Honshu has a long history of tsunami attacks that have killed thousands of citizens and destroyed various coastal villages. The delegation visited Kamaishi Port to discuss the recently completed deep breakwater structure at the mouth of Kamaishi Bay with the representatives of the Kamaishi Port Office of the Port and Airport Department of Tohoku Regional Development Bureau. The planning of the breakwater started in 1978 and was completed in spring 2007. The breakwater consists of two dikes with a central opening for large ships. The dikes are comprised of trapezoidal and rectangular caissons. The total length of the breakwater system is 2260 m long. A second smaller breakwater (seawall) closer to the port harbor deflects remaining waves. The breakwater is the largest in Japan constructed in 63 m of water (the deepest water site in the world) with a 30 m high caisson designed with parallel slits to reduce wave force. Its 700 million ton base rock rubble foundation with armor stone layer on the outside face acts as a seismic countermeasure.