How can concrete technology contribute?
~ Review of certain issues arising in the recovery from the Great East Japan Earthquake ~

Chairman:

Makoto HISADA (Tohoku University)

Panelists:

Toshihiro HAYASAKA (Miyagi Prefecture)
Masashi KOBAYASHI (East Japan Railway Company)
Kyuichi MARUYAMA (Nagaoka University of Technology)
Mitsuyasu IWANAMI (Port and Airport Research Institute)
Minoru KANO (Kajima Corporation)
Kazuo YAMADA (National Institute for Environmental Studies)

This panel discussion was held by the Concrete Committee during the Japan Society of Civil Engineers 2012 Annual Meeting at Nagoya University on September 7th, 2012. It was organized by Dr. Makoto HISADA, Tohoku University professor and chairman of "Subcommittee on Processing and Efficient Use of Disaster Debris" under the JSCE Concrete Committee. The themes covered by the panelists consisted of three main topics related to the reconstruction recovery effort following the Great East Japan Earthquake: work on damaged structures, evaluation of tsunami force in design, and processing and efficient use of disaster debris.

Chair and panelists

Floor

Topic 1: Work on damaged structures

T. HAYASAKA "Damage to bridges and future work"

・The status of bridge damage in Miyagi Prefecture was explained. In an emergency survey, it was found that of 1307 bridges in Miyagi Prefecture, 45.3% were damaged. The damage was characterized as tsunami-induced collapse, failure of shoes and expansion devices and ground

subsidence behind abutments. This damage points to the importance of designing structures in consideration of maintenance and disaster restoration.

・There are three types of bridge work project currently in progress in Miyagi Prefecture: disaster restoration projects, bridge life-span extension projects and seismic retrofit projects. The purpose, target and budget of each of these project types are different and it is important to relate them and implement them efficiently through due consideration of the features of each.

M. KOBAYASHI "Restoration of railway structures and ongoing seismic measures"

・In the restoration of damaged structures, the first priority was to centralize information coming from the disaster area and unify decisions about restoration methods. Based on a basic policy for emergency restoration methods and permanent measures, which is based on accumulated past experience, instructions for restoration were issued within 24 hours of the earthquake. This quick response led to rapid implementation and the entire route of the Tohoku Shinkansen reopened 49 days after the earthquake.

・In the years leading up to the Great East Japan Earthquake, a program of retrofitting of RC columns and piers where earthquake-induced shear failure was anticipated had been completed and planning was under way to retrofit those susceptible to damage in future earthquakes. Since seismic retrofitting has in the past shown great effectiveness, it will be continued further in preparation for possible major earthquakes, such as one directly hitting the Tokyo metropolitan area and the expected Tokai, Tonankai and Nankai earthquakes.

Dr. Hayasaka

Dr. Kobayashi

Topic 2: Evaluation of tsunami force in design

K. MARUYAMA "How to take tsunami force into account"

・JSCE established the "Subcommittee on Evaluation of Wave Force Acting on Bridge Structures by Tsunami" within the Concrete Committee. This subcommittee has investigated the mechanism of bridge collapse in the tsunami and the tsunami force acting on bridges.

・Over 200 bridges, of the approximately 1700 bridges in the inundated area, collapsed as a result of tsunami action. All river-crossing bridges collapsed, while a few other bridges within the

inundation area fell as well. The subcommittee's investigations include not only the collapsed bridges but also those that survived a statistical approach relative to bridge characteristics; analysis based on a mechanism.

・Three approaches have been tried in figuring out the failure mechanisms: statistical analysis, mechanical model and hydrodynamics simulations. Using the statistical analysis, it was difficult to find any trends in the damage caused by the tsunami disaster. With the mechanical model, a parameter incorporating the weight of the bridge and the fluid force is used to judge whether a particular bridge would collapse or not. This method is found capable of making a reasonable judgment if the fluid velocity is known. Hydrodynamics simulations and model experiments have also been conducted by several researchers in order to clarify the tsunami force and the mechanisms of collapse in more detail.

M. IWANAMI "Restoration of port structures and treatment of tsunami force in design"

・The damage caused to port structures, such as breakwaters, seawalls and mooring facilities, was explained. To withstand enormous tsunamis, a hybrid caisson combining concrete and steel should be adopted for breakwater construction. Caisson foundations can also be improved to prevent toppling of the caisson and give additional durability against large tsunami forces. For mooring facilities, it is sufficient to implement seismic design to prevent failure. A lot of damage occurred through the complex interaction of disaster-related events, such as the tsunami and liquefaction.

・Concrete engineering can contribute to the improvement of port structures. For example, lightweight concrete and precast concrete can be effectively used to level structures and strengthen breakwater caissons.

・Design guidelines for tsunami-resistant port structures were published in August 2012.

Prof. Maruyama

Dr. Iwanami

Topic 3: Processing and efficient use of disaster debris

M. KANO "Untitled"

・In order for rapid restoration to take place after a disaster, it is important to ensure that appropriate arrangements between contractors and contractees are already set up in peacetime.

Among engineers, there is a need to cultivate the ability to diagnose earthquake-damaged structures.

・A consortium for the processing and efficient use of disaster debris has been established. In managing the uses of disaster debris, it is necessary to ensure that there will be no serious problems in the future; that is, the trade-off between environmental protection and the economic imperative must be correctly set. The establishment of laws might be also necessary to ensure that the correct decisions are made. Further, cooperation among various related societies and associations as well as with industry is important to ensure smooth progress in the processing and efficient use of disaster debris.

K. YAMADA "Contribution of concrete engineering to nuclear plant cleanup"

・The radioactive contamination of disaster debris is explained.

・When planning the processing of disaster debris, the possibility of radioactive contamination must be considered. In particular, since the half-life of cesium 137 is about 30 years, any contaminated debris must be kept under adequate control.

・In the planning of debris processing, it is crucial that storage solutions for radiation-contaminated debris are stable over the long-term and that diffusion, elution and transudation of radioactive contaminants are prevented. Because storage locations for radioactive waste must remain intact for about 300 years, concrete is expected to play a role as a containment material.

Dr. Kano

Dr. Yamada

Discussion:

Related to topic 1:

Q: Since the ideas of disaster restoration and extending the life span of bridges are different, how can both be implemented at the same time? Is it in fact possible?

A: Doing both in parallel would be preferable. However, such projects would be too big to manage easily. Basically, bridge life span extension projects are implemented according to a plan and in sequence.

Q: We have heard that seismic retrofitting was proven effective in the Great East Japan

Earthquake. Are there any cases where seismic retrofitting was not effective?

A: There were no cases of seismic retrofitting not being effective. In some cases, it is possible that the seismic retrofitting might have been over-specified, but it is difficult to confirm this.

Q: What about the following situations? Instances where a structure that would be expected to fail did not or a structure that would be expected not to fail did in fact fail?

A: No, all of the damaged structures were those scheduled for strengthening in the near future.

Related to topic 2:

Q: In the evaluation of tsunami force, are the influences of undertow and the impact of disaster debris considered?

A: No, they are not. The analysis considers only the influence of the leading wave. It is recognized that incorporating tsunami forces into design is difficult. The goal is to distinguish which bridges were destroyed by the tsunami and which were not. This will give us important information for use in deciding suitable paths for restoration in the case of disaster

Q: Is reparability considered when restoring damaged port structures?

A: For port structures such as breakwaters, the mechanism of resistance to tsunami force is self-weight. In this case, once a structure moves, restoration becomes difficult. The concept of reparability should be incorporated into the design specifications for port structures, just as it is in the seismic design of bridges for Level II earthquake ground motion.

Related to topic 3:

Q: Why does not debris processing absolutely progress?

A: Landfill work is difficult as compared with the Great Kanto Earthquake and the Great Hanshin Earthquake, because the areas designated for landfill are located near the epicenter. In the present case, environment conservation has priority over everything else. It is important to consider how debris can support the recovery process. And it is also necessary to reach some consensus among industries and government.

Q: The Ministry of the Environment orders efficient use of disaster debris in some situations. On the other hand, the ministry also takes some risks in the use of disaster debris. What are your thoughts about this situation?

A: Disaster debris should be used in the recovery process, however incorrect use would lead to environmental pollution. Therefore, debris processing must be conducted under proper management.