# Comprehensive Efforts after the Great East Japan Earthquake

## to Reduce Damage by a Comprehensive Interdisciplinary Approach

KISHIDA Hiroyuki (Dr. Eng.)
Executive Director for Research Affairs

*(Keywords) Large earthquake, reconstruction/recovery, interdisciplinary*

### 1. Introduction

On the same day as the Great East Japan Earthquake of March 11, 2011, the NILIM began to send staff to the disaster region to provide technological support by surveying the state of damage and cleanup work on site. Later, the head office and regional development bureaus of the Ministry of Land, Infrastructure, Transport and Tourism (hereafter "MLIT") provided technical support as needed at each stage, either on site or at study meetings, to draw up reconstruction and recovery plans or to prepare various countermeasures such as revising necessary technical standards. By January 27, 2012, the number of personnel, all experts in their respective disciplines, sent to the disaster region under TEC-FORCE had reached 142 (372 man-days), as shown in the table.

### 2. Past efforts

This section introduces the major activities for each phase which the NILIM has carried out.

(1) Immediately after the disaster

The NILIM provided technological guidance to help evaluate the serviceability and quickly restore various social infrastructures which are indispensable for saving lives and rebuilding them. Regarding roads, it provided technical guidance concerning serviceability evaluations and emergency inspections to support the clearing, inspection, and restoration of trunk roads. Concerning rivers and coasts, it provided technical guidance by surveying the state of damage and emergency restoration necessary before a flood discharge. Regarding ports and airports, experts on tsunami and various kinds of facilities surveyed the damage to key ports and to Sendai Airport. For sewage treatment systems, they surveyed the state of damage and provided technical guidance to ensure public hygiene in the event of sewage overflows, and guidance on how to respond urgently to the suspension of sewage treatment plants. In particular, to summarize emergency proposals until sewage treatment plants have recovered, the NILIM has provided technical support with emergency restoration methods and simple treatment methods. Regarding building construction, it has carried out a number of damage surveys, and regarding erosion control, it has given technical guidance on inspecting and evaluating the safety of steep slopes at risk of collapse and sediment disasters.

Table 1. Personnel sent to the region under TEC-FORCE

| Specialization | Total number of personnel dispatched |
|---|---|
| Sewers | 23 (64 man-days) |
| Rivers | 5 (15 man-days) |
| Shoreline | 8 (21 man-days) |
| Bridges | 14 (41 man-days) |
| Dams | 3 (8 man-days) |
| Road disaster prevention | 2 (6 man-days) |
| Building structures | 38 (99 man-days) |
| Building fire prevention | 6 (17 man-days) |
| Airports | 3 (16 man-days) |
| Ports and harbors | 15 (44 man-days) |
| Erosion control | 17 (25 man-days) |
| Earthquake disaster prevention | 8 (16 man-days) |
| Total | 142 (372 man-days) |

* Total of 84 (252 man-days) sent during the month immediately after the disaster

(2) Major past efforts

After emergency activities of this kind, the NILIM and the bureaus of the MLIT jointly examined the damage and its causes, then based on the results, verified the suitability of present technical standards etc. and considered measures to restore facilities.

Typical activities include verifying serious damage caused by the tsunami along the coast, and identifying the scale of the tsunami at coastal locations, then based on the results, conducting joint studies with researchers in various related fields to prepare a handbook on simulating tsunami inundation. To encourage use of this handbook to help prepare restoration countermeasures, the NILIM set up a contact section for consultation by cities, towns, and villages. The results have also helped to set design tsunami levels for coastal dikes, which are essential for restoration and recovery (in cooperation with the Ministry of Agriculture, Fisheries and Forestry, July 11). Studies on methods of designing structures in other fields are also being conducted in line with the concept of setting design tsunami levels. Regarding building construction for example, the Building Structure Standards Committee formed by the NILIM

has studied “Countermeasures to Ensure Safety based on Damage to Buildings, etc.” and has clarified the external forces required to study the structure of tsunami evacuation buildings by, for example, finding out how a tsunami forms a swell-head upon encountering a building. Standards for improving non-structural members and measures to handle long-cycle earthquake motion are also being studied.

In addition to tsunami damage, this earthquake caused liquefaction resulting in widespread damage. On reclaimed land in the Kanto region, along Tokyo Bay and in the interior, all far from the hypocenter, the earthquake caused severe damage to ordinary homes and other buildings. Meanwhile, public infrastructure such as water mains, sewer pipes, and other lifelines was severely damaged as well as structures, and river levees settled and were breached. The NILIM studied common technical matters for combating liquefaction at meetings with various experts, and helped them distribute the findings of their surveys. The results showed that the FL method, which has long been used for judging liquefaction, can generally judge the occurrence of liquefaction caused by an ocean trench earthquake. Earthquake records obtained during this recent earthquake will be used to study and verify dynamic analysis methods for ground, improve the precision of estimating ground deformation, and help rationalize liquefaction countermeasures. All these issues must be considered when conducting reviews in each field in future.

To study tsunami and liquefaction countermeasures and design concepts, the NILIM will use its strengths as a comprehensive research institute to collect documents and exchange information on countermeasures in related fields, methods of setting the external force of tsunami, etc.

Technical standards for structures which are revised or scheduled to be revised reflecting the results of research by the NILIM include, in addition to the above standards, the Specifications for Highway Bridges and the Guideline to Earthquake Resistance Countermeasures for Sewage System Facilities.

New efforts are also needed. Radioactive substances dispersed by the accident at the Fukushima Daiichi Nuclear Power plant have severely affected many sewage treatment systems, particularly in the Tohoku and Kanto regions. The NILIM is surveying the behavior of radioactive substances in sewage treatment processes, and studying the safe handling of sewage sludge containing radioactive substances.

For information about research in each field and their incorporation in major standards, please refer to reports on research trends and achievements in each field related to the Great East Japan Earthquake in later sections.

**3. Conclusion**

One challenge revealed by the earthquake is, as pointed out by the Central Disaster Prevention Council, the need to conduct nationwide studies of the largest earthquakes and tsunami which occur once every 1,000 years, and to revise preparations for nationwide disasters including West Japan, by for example, forming a Cabinet-level committee to study models of massive earthquakes of the Nankai Trough. The NILIM, to improve crisis management research to prepare for huge external forces and multiple natural disasters, must work on: 1) analyzing historical cases, 2) revising methods of building disaster scenarios, 3) examine robust “hard” (structural) countermeasures, and 4) study the combination of both “hard” and “soft” countermeasures to mitigate disasters, by holding seminars and forming working groups, etc. within the NILIM. As a comprehensive research body that supports the technological policies of the MLIT, the NILIM will not only provide technical support for restoration of the affected regions, but will also support integrated crisis management countermeasures including both “hard” and “soft” measures throughout Japan.