Countermeasures against Kumamoto Earthquake 2016

Yasuo Morita, Ministry of Land, Infrastructure, Transport and Tourism
(Former Director General, Kumamoto Office of Rivers and National Highways)
An earthquake of magnitude 6.5 occurred on April 14, 2016 at 9:26 p.m. (foreshock) with the hypocenter in Kumamoto Region. Twenty-eight hours later, at 1:25 a.m. on April 16, another earthquake (main shock) occurred with a magnitude of 7.3, of which intensity was 7 on the Japanese intensity scale. The “Kumamoto Earthquake” caused tremendous damage in Kumamoto, Aso and the surrounding areas, including those from aftershocks that occurred more than 4000 times in total.

Source: Japan Meteorological Agency
(The map shows the seismic intensity distribution of the earthquake on April 16)
Tremendous Damage Occurred

Tremendous damage occurred also on transportation infrastructures such as an airport, roads and railways, in addition to human damage caused by collapse of many houses and landslides and damage on essential utilities such as electricity, gas and water supply. Thus, the earthquake caused immense problems to prefectural residents and to the economy such as small and medium-sized companies, agriculture, forestry and fishery, and tourism.

- Earthquake fatalities
  - Directly related 50
  - Indirectly related 212
  - As of April 13, 2018, Fire and Disaster Management Agency

- Damaged houses
  - Not less than 200,000

- Evacuated residents
  - Peak number
    - Not less than 180,000

- Damage to traffic infrastructure
  - Kyushu Shinkansen
  - Kyushu Expressway
  - Kumamoto Airport and others

Mashiki Town (April 23, 2016)
Damage to Kyushu Expressway

Kyushu Expressway, which runs longitudinally through Kumamoto Prefecture, was severely damaged in and around Kumamoto City and was totally closed for about two weeks.

State of road closures (after earthquake on April 16)

- Ueki IC: Reopened on April 29 (Friday) at 9:00 a.m.
- Kashima JCT: Reopened on April 26 (Tuesday) at 3:00 p.m.
- Yatsushiro IC: Reopened on April 17 (Sunday) at 3:00 p.m.

Kyushu Expressway

Wide area map

(1) Inclined bridge columns

(2) Collapse of road embankment

(3) Disconnected bridge beams

(4) Collapse of overpass

Two-way traffic restriction (for approximately 1 year)
The main shock on April 16 caused a large-scale slope failure 700 m long and 200 m wide in Minami-Aso Village (the entrance part on the west side of Aso Caldera) and severed Route 57, a major road connecting Kumamoto, Aso and Oita, and the JR Houhi Line. “Aso Oohashi Bridge” of Route 325 that connects the road to Route 57 also collapsed.

**Route 57**
- L=206 m

**Route 325 “Aso Oohashi Bridge”**
- L=206 m

**The JR Houhi Line**

**Large-scale slope failure**
- Volume of landslide: Approximately 500,000 m³

**Minami-Aso Village (the entrance part on the west side of Aso Caldera)**
Furthermore, prefectural road Kumamoto-Takamori Line (Tawarayama Tunnel and a group of long bridges) and Aso-Chouyo Oohashi Bridge (village road) were severely damaged, paralyzing traffic of more than 20,000 to 30,000 vehicles per day.
A team of disaster countermeasure specialists consisting of staff members of the Regional Development Bureau, etc., of the Ministry of Land, Infrastructure, Transport and Tourism was dispatched to affected sites such as collapsed roads, slopes and damaged bridges. This emergency disaster countermeasures team with approximately 440 members, named TEC-FORCE (Technical Emergency Control Force), started the damage survey on April 22. After the occurrence of the disaster, the total man-days of the dispatched members reached approximately 8,200 by May 31 and such a quick implementation of the survey contributed to the early completion of emergency restoration.
Because Kyushu Expressway was totally closed for about two weeks after the earthquake, securing of traffic on national highways, which run parallel with the expressway and are under direct control of the National Highway Office, became a top priority issue. The main shock of April 16 also caused severe damage, such as sinkholes on road surfaces and bumps near bridges, on the direct-controlled national highways. However, all emergency restoration was completed to allow normal traffic within 24 hours after the main shock, except one site damaged by the large-scale slope failure (Route 57 in Minami-Aso Village).
As a detour route for Route 57, which was closed by a landslide, restoration of damaged parts of the prefectural road was expedited and ordinary vehicles (except large-sized or heavy-duty vehicles) could use the road **two days after the earthquake**. In addition, we helped (partly took over) the emergency restoration work of national and prefectural roads managed by Kumamoto Prefecture to support emergency medical services/rescue activities, transportation of critical materials and restoration of the residents’ daily lives.
Complete restoration operation within 5 years after earthquake

Key
- Major devastation site

May 9, 2016 (Project implementation by the Government on behalf of municipalities)
- Materialization of project of Aso Oohashi Bridge of Route 325

May 13, 2016 (Project implementation by the Government on behalf of municipalities)
- Materialization of project of prefectural road Kumamoto-Takamori Line (Tawarayama Tunnel Route)
- Materialization of project of village road Tochinoki-Tateno Line (Chouyo Oohashi Bridge Route)

June 14, 2016
- Start of feasibility study of North-side recovery route of Route 57

Road Restoration by National Highway Office (3)

Route 325
Aso Oohashi Bridge
Expected opening in 2020

Route 57
North-side recovery route
(13km)
Expected opening in 2020

Chouyo Oohashi Bridge Route
Opened on Aug. 27, 2017

Tawarayama Oohashi Bridge
(L=140m)

Kuwazuru Oohashi Bridge
(L=2,057m)

Tawarayama Tunnel Route
Opened on Dec. 24, 2016

Futaeno-touge Tunnel
Permanent restoration (after May 2016)
Factors contributing to the early opening of Tawarayama Tunnel Route, which was highly appreciated as “the best Christmas gift”, were understanding and cooperation of landowners and authorities concerned, hard work round-the-clock by contractees and the management ability of in-house engineers.
* “Kumamoto Reconstruction Project Office” was established in April 2017 and is currently responsible for all post-disaster restoration projects, except the one for “Route 57 North-side Recovery Route (handled by the Kumamoto Office of Rivers and National Highways)”.

Opening of Chouyo Oohashi Bridge Route (August 27, 2017)

* * *
(1) Alliance with local construction industry 1

- It is necessary to continue giving instructions for the start of construction/services to partners, who jointly implement post-disaster restoration projects (construction companies, field surveyors, design consultants), without hesitation soon after damage occurs.

- By making “Agreement for emergency restoration upon occurrence of disaster” beforehand, possibilities for smooth and quick implementation of post-disaster restoration project become promising.

* The construction company that will be dispatched upon occurrence of a disaster has been nominated for every section of 10 to 15 km of national highways (approximately 300 km), which is managed by the Kumamoto Office of Rivers and National Highways.
Key Factors for Post-disaster Restoration Project Management

(1) Alliance with local construction industry

To execute contractee’s responsibility more than during normal times

- To place an order suitable for the circumstances, namely, without too strict adherence to bidding and contracting rules that are applicable under normal circumstances but with adequate understanding of the actual situation of the local construction industry.
- After the contract is made, the contractor and contractee cooperatively make efforts to achieve challenging time-schedule-related goals by addressing any issues they face.
- Revisions of the contract are made more carefully than normal by taking actual site conditions into consideration.

(2) Project implementation by Government on behalf of municipalities

- Among post-disaster restoration projects of any municipality, critical ones (which involve massive damage and require high-level technology for restoration, and of which belated implementation may cause severe damage to the area) are taken over by the Government as projects to be implemented on behalf of the municipal government, so that they can be accomplished in a timely manner under the management system of the Ministry of Land, Infrastructure, Transport and Tourism.

- In Kumamoto, three large-scale post-disaster restoration projects were assumed by the Ministry of Land, Infrastructure, Transport and Tourism in response to the request by the Governor of Kumamoto Prefecture and the Chief of Minami-Aso Village. Among them, the opening of Tawarayama Tunnel Route (Dec. 24, 2016) and the opening of Chouyo Oohashi Bridge Route (Aug. 27, 2016) had a strong impact on the area looking to recover from the earthquake.
(3) Enhancement of organization and office staff

- An appropriate size of PM structure staffed with in-house engineers having high-level empirical knowledge shall be established. Especially, staffing of managers such as project managers (PMr) and assistant project managers is a key issue for success of post-disaster restoration projects.
- In the case of Kumamoto, it was fortunate that a series of project management tasks could be handed off to PMr (Director, Promotion Office for Measures against Kumamoto Earthquake Disaster) and Deputy Director, who are both in-house engineers having the ability to make immediate technical determinations/decisions on-site. The fact that the challenging work was entrusted to them with confidence was an important key that led the post-disaster restoration project succeed.

(4) Involvement of companies having high-level construction technology from early stage

- For restoration work of large-scale structures, etc., early deployment of construction companies that have specialized skills and high-level management ability is critically important.
- In the case of Kumamoto, contracts for restoration work of Tawarayama Tunnel and several long bridges were concluded on a negotiation basis with major general contractors and bridge construction companies.

(5) Sensitivity and behavior of Director, National Highway Office
As a Site Manager on the Front Line

(1) Thorough communication with key personnel
To secure a hotline with responsible persons in various fields such as the Governor of Kumamoto Prefecture (General Manager for civil engineering), Chief of municipal government, Diet members, a representative of the construction industry and so on

(2) Agile judgement and action
To establish rules and to take action boldly and quickly in “an emergency mode” with due consideration for instructions by superagencies → Prioritization of road restoration, selection of construction company, etc.

(3) To securely maintain motivation of staff members
To develop an atmosphere in which all staff members of the office diligently work with a sense of mission of “for disaster victims in the area and Kumamoto Prefecture”

Director’s cheerful expression on his/her face and words of “Thank you”

(0) My understanding about “Japanese land and Infrastructure” since before the Kumamoto Earthquake
Japan is vulnerable to natural disasters.
→ Serious disadvantage compared to advanced nations such as the U.S. and European nations

Under such geological conditions, Japanese citizens have frequently experienced serious natural disasters, but have overcome all difficulties therefrom.

Infrastructures such as roads are very important for the lives of the people.

The current life of everybody is supported by infrastructures built and renewed by predecessors. Thus, we, the current generation, have an obligation to enhance such infrastructures so that we can hand them over to the future generation.
END