

The Role of Construction Consultants in Disaster Recovery

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5 **Abstract.** Disaster recovery requires speed above all, and the public and private sectors need to work together. In the event of a disaster, the activities of the construction industry play a crucial role. Construction consultants, surveying companies, and geological survey companies play an important role. Construction consultants oversee the entire process of disaster recovery, from assessing the damage immediately after the disaster to managing the restoration work. In some cases, local governments order construction management (CM) services to supervise
10 the entire disaster recovery work, and in such cases, construction consultants are even responsible for part of placing construction procurements. In this way, construction consultants have become an indispensable part of the disaster recovery process. This report is an introduction to the activities of construction consultants in times of disaster, using the heavy rains situations as examples, and presents of challenges and recommendations.

1. Introduction

15 Japan has high precipitation, mountainous terrain with looming plains, and rushing rivers. As a result, the country has always been prone to flood disasters. Recent climate change has caused extreme precipitation events, increasing the frequency and intensity of disasters. Population and
20 assets are concentrated in the plains, which account for only a small proportion of the country's total land area, and flood control measures are extremely important for the stability of the population.

Although the civil engineering departments of central and
25 local governments have been primarily responsible for all aspects of flood control, including research, framing, planning, construction, and management, their organizations have been downsized and weakened, especially in municipalities, and public agencies are
30 seemed to shift their work from being proactive in specific tasks to focusing on public relations and procurement.

Therefore, it is more important than ever for the public and private sectors to work together to ensure the steady and robust practical operations.

35 At the same time, science, technology, and project operation and management methods are evolving, and it is important to create paths for further development and utilization of these through cooperation between the public and private sectors. The construction industry has been
40 receiving procurements from public organizations and supporting social improvements for many years, and has accumulated a wealth of experience in this field. Construction consultants have accumulated and honed their knowledge through many years of research, framing,
45 and planning, and there are many talented individuals who can play an active role in the industry.

This paper describes how construction consultants are playing an active role in disaster recovery and reconstruction, and presents challenges and prospects.

2. Case Study of Torrential Rain Disaster

2.1 Response to the July 2018 Torrential Rain Disaster, on the Oda River System (Kurashiki City, Okayama Prefecture)

2.1.1 Outline of the disaster

From the end of June to early July 2018, a rainy season front stagnating near Japan and Typhoon No. 7 over the South Sea caused record-breaking torrential rains over area nationwide, mainly in western Japan. As a result, rivers overflowed and mudslides occurred simultaneously over a wide area, resulting in more than 200 deaths and missing persons and damage to more than 50,000 residences. In addition, the damage to lifelines such as electricity, water and sewage systems, and transportation infrastructure in the urban centers caused extensive socioeconomic damage.

2.1.2 Survey of Damage Situation

The Oda River in the Takahashi River system and its tributaries were damaged by torrential rains on July 5 and 6, 2018, and a committee was established to investigate the cause of the damage and to study restoration methods, etc. The committee conducted a survey of the damage on July 10. The construction consultants conducted a joint on-site survey and, under the direction of the procurer, conducted a trace water level survey, soil investigation, and simple sketches at the breach points to collect information for the investigation of the cause of the damage and the study of countermeasures.

2.1.3 Investigation of the cause of the damage and basic policy for countermeasures by the Oda River Levee Investigation Committee

Based on the results of the field survey, the Oda River Levee Investigation Committee held five meetings, including a field survey, to analyse the causes of the damage and to formulate a basic policy for countermeasures at the section where the levee broke. In the committee meetings, the construction consultant handled the field survey and geological survey, levee stability study related to seepage, composition, and

verification of the general situation of flood (water level, flow volume, and plane flow), and verification of the inundation through flood analysis (setting the inner and outer water levels of the levee) under a tight schedule. Prepared materials and assisted in committee operations based on the results of the studies.

2.1.4 Examination of special projects

On September 7, MLIT (Ministry of Land, Infrastructure, Transport and Tourism), CRDB (Chugoku Regional Development Bureau) announced that the Oda River confluence will be replaced to downstream and that the Oda River will be excavated and its banks strengthened, and branch rivers banks will be raised and strengthened through intensive river improvement projects that will be implemented over approximately five years in order to safely carry the river flow volume caused by the future same heavy rainfall as this time. The construction consultants will work with the MLIT CRDB and Okayama Prefecture on the project. The construction consultant assisted in preparation of the project plan by studying the target flow volume, improvement menu, drawing, and project cost calculation under this tight schedule.

2.2 Response to the Torrential Rain Disaster Caused by Typhoon No. 19 in 2019, on the Chikuma River (upstream name of the Shinano River system)

2.2.1 Outline of the disaster

On October 12, 2019, a typhoon hit the Izu Peninsula, resulting in "Typhoon No. 19 Torrential Rainfall in 2019," which caused record-breaking rainfall in a wide area of Shizuoka and Niigata prefectures, the Kanto Koshin and the Tohoku region, resulting in over 100 casualties and over 30,000 houses damaged, mainly in the Kanto and Tohoku regions. The Nagano Shinkansen Train Centre was also flooded due to overtopping of the Chikuma River, which paralyzed the Hokuriku Shinkansen Line.

2.2.2 Immediate response to the disaster

Construction consultant companies voluntarily collected and organized meteorological and hydrological data on a

real-time basis from publicly available information for basins where they might receive procurements, and provided support for the prompt publication of an outline of the outflow of water and the effects of river improvement projects. In the Chikuma River, they also collected and organized data in the same way, and monitored real-time images such as CCTV from offices and municipalities' websites to estimate the risk areas. These results were used to estimate flow volumes in the disaster. Based on these results, iso-rainfall maps, actual water levels, and flow volumes were prepared and used as materials for basin committees, etc., and for outlining outflows.

2.2.3 Various studies for disaster application materials

MLIT has launched the "Emergency Flood Control Project," in which the national government, prefectures, and municipalities concerned work together to implement hard and soft measures to prevent another disaster in the entire basin for rivers that have been severely damaged by floods in recent years. On January 31, 2020, the government announced that the Chikuma River, together with the downstream Shinano River, would be included in the Shinano River System Emergency Flood Control Project, in which the national, prefectural, and municipal governments work together to implement riverine measures, basin measures, and community development and soft measures at a cost of approximately 180 billion yen over 10 years. Under a tight schedule, construction consultant companies assisted in the study of the target flow volume, improvement menus, preparation of drawings, calculation of project costs, and preparation of application materials. In the study of the improvement menus, the damage situation was assessed through on-site inspections, and runoff analysis, water level calculations, inundation analysis, etc. were conducted and the proposed improvement menus were presented to procurers.

3. Engagements in Large-Scale Disasters

Disaster recovery requires speed and a concerted effort by the public and private sectors. In times of disaster, the activities of the construction industry play a role from the occurrence of a disaster to the completion of restoration work. Construction consultants, surveying firms, and geological surveying firms, known as construction-related industries, play a particularly important role in disaster recovery. Construction consultants oversee the entire disaster recovery process, from the initial assessment of the damage immediately after a disaster occurs to the construction management of the recovery work. In some cases, local governments place orders for construction management (CM) services to supervise the entire disaster recovery work, and in such cases, construction consultants may even be responsible for part of the procurement of the work. In this way, construction consultants have become an indispensable part of the disaster recovery process. Figure 1 shows the flow of disaster recovery and the work of construction consultants at the time of a disaster. The specific activities from ① to ⑥ in Figure 1 are written in the following, with the construction consultant, surveying company, geological survey company, general construction company, and specialized construction company clearly identified.

① **Confirmation of damage**, "*construction consultants/surveying companies (including aerial surveying)*" will conduct surveys and measurements to record the scale and situation of the damage when the topography is altered after the disaster due to emergency measures. Provide advice on evacuation of residents and road closures. Conduct monitoring of the damaged area. Planning of emergency countermeasures, which must be done urgently and quickly so as not to delay the emergency countermeasure work. In recent years, survey use new technologies such as UAVs. In case of a large-scale disaster, aerial surveying is conducted to confirm safety during lifesaving operations.

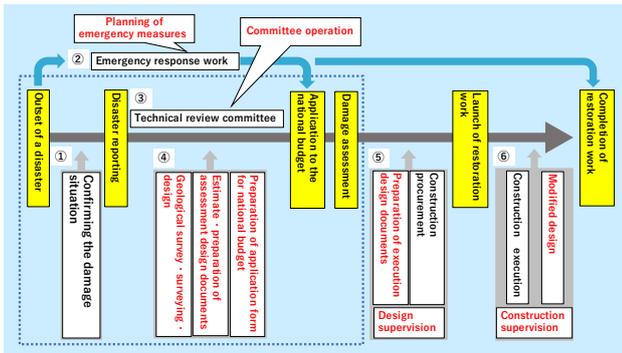


Figure 1 : Role of construction sector in disaster recovery

② Emergency response work, *"general construction*

5 *companies, specialized construction companies"* perform work that requires emergency response for safety after a disaster. This includes temporary restoration of levees and road reopening. The work is usually started immediately after the disaster, and usually takes place day and night. 10 Safety checks are conducted during emergency work and after temporary restoration.

③ Technical Review Committee, *"construction*

15 *consultants and geological survey companies"* will confirm the magnitude and damage mechanisms of floods and earthquakes prior to the main restoration, such as levee breaches and facility collapse due to flood, earthquakes, tsunami, and liquefaction. If necessary, a committee of academics will be formed to provide technical decision and support. Construction consultants and geological survey 20 companies will conduct surveys and analyses in response to the committee, which will be reflected in the restoration design.

④ Preparation for the application of Gov. budget,

25 *"construction consultants, geological survey companies, and surveying companies"* will conduct survey and design in a short time for disaster assessment, and calculate construction costs. In the design process, they also plan the level of improvement and conduct necessary geological surveys. In the case of a large-scale disaster, support 30 engineers are assembled from nationwide in order to deal with many issues in a short time.

⑤ Design implementation and supervision,

"construction consultants, geological survey companies, and surveying companies" conduct the design 35 implementation for the main restoration. In the case of a large-scale disaster, a large amount of design work needs to be done in a short time, as deadlines are set for special emergency projects for severe disasters.

Construction consultants and general construction

40 *companies"* provide Project Management (PM) and Construction Management (CM) when there is a shortage of engineers from local governments or others.

⑥ Restoration work and construction supervision,

"General construction company/specialized construction 45 *company"* will conduct the main restoration work. The deadline is set for special emergency projects for severe disasters. The work must be carried out in a short time.

"General construction, consultant company", if any problems arise during the construction work, will consult

50 with the parties concerned and make changes to the design as appropriate. If there is a shortage of engineers from the local government or others, they will provide Project Management (PM) and design and Construction Management (CM) as ⑤

4. Challenges and recommendations

4.1 Decrease the number of staff in the authority and to recommend CM method

In recent years, procurers have been required to ensure 60 quality, reduce costs, and provide highly transparent contracts for public works projects, and their responsibilities have been increasing. In response to this, it has become necessary to make use of those who can appropriately perform procurement-related work, under 65 the situation of significant decrease of the number of procurer employees in local public entities (see Figure2). Depending on the scope of support for procurement-related work, the "CM method" is the one in which part or all of the procurement-related work related to construction 70 supervision is outsourced to the private sector, the "project

promotion PPP (Public Private Partnership) method" is the another in which part of the procurement-related work is outsourced to the private sector from the investigation and design stages.

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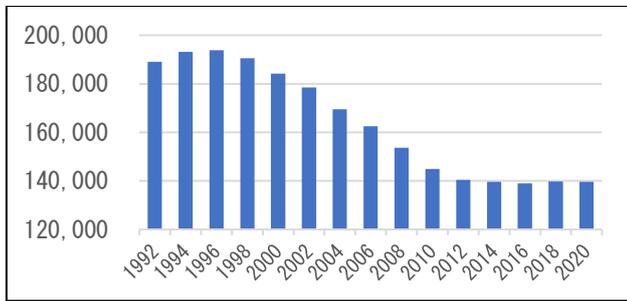


Figure 2: No. of staff at the civil engineering department of local government (Source: Compiled from the Ministry of Internal Affairs and Communications' Survey of Capacity Management of Local Governments)

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The major challenge for the affected municipalities, which had no experience in procuring large-scale public works projects, was to establish a project implementation system necessary to start the project early and implement it in a short time. The affected municipalities placed the highest priority on the early start and completion of the projects. At the same time, it must be ensured transparency and fairness in the use of government funds and be fulfilled accountability to the public. Number of staff in the civil engineering department, which is responsible for public works projects in local governments, has decreased by approximately 55,000 (-28.4%) since its peak in FY1996.

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For the Great East Japan Earthquake, Urban Renaissance Agency (UR) introduced CM method in the "Reconstruction and Urban Area Development Project" in 19 areas in 12 cities and towns, utilizing private-sector know-how to promote the project smoothly.

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For the river improvement project on the Ouse and Natsui Rivers in Fukushima Prefecture, CM method was applied in a two-year lump-sum contract from April 2019 to March 2021 in order to expand the river area and reduce flood damage to houses along the rivers. CMR (construction manager) was involved in the entire process from basic

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35 planning, basic design, implementation design, site acquisition, construction procurement, and construction. As a result, the procurer system was secured, the technical skills of young Prefecture staff were developed, the flood control safety level was improved promptly, and coordination with multiple related organizations, including the relocation of obstructions and bridge attachments, was smoothly carried out.

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4.2 Contribution to advance disaster prevention.

45 It is important not only urgent response of a disaster, but also doing what can be done in advance to prevent disasters. In this respect, there are many areas where construction consultants can play an active role. Chinese proverb says, "People tend to give preferential value to those who behave flamboyantly when a situation happens, rather than those who prevent it from occurring." The improvement of rivers and other facilities alone is not enough to prevent floods. That has been considered since the start of comprehensive flood control in the Tsurumi River basin near Tokyo, where forests and farmland have been converted into residential areas due to population growth. Although Basin Flood Control for excess flood was advocated there, it was limited to runoff control through floodplains and rainwater harvesting, as well as measures of piloti houses to prevent flood. In Shiga Prefecture, efforts to find places outside of rivers where flood water can be released, have been initiated and are continuing as part of Basin Flood Management. In recent years, climate change has resulted in more intense rainfall, and the MLIT promotes basin flood management, including land use optimization, in cooperation with various stakeholders, in addition to further accelerating the development of facilities throughout the entire watershed, from catchment areas to flooded areas. The publication of hazard maps was initially met with opposition from interested parties, but has now achieved a certain degree of success as a soft measure that clearly shows hazardous areas to the public, encourage evacuation and other actions. Historically, large drainage

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basins such as the Arakawa River (Tokyo), the Yodo River (Osaka), and the Ota River (Hiroshima) have dynamically changed the shape of cities and supported Japanese industry and economy. Basin Flood Management is expected to change the people's living style differently. In the fight against Covid-19 pandemic, medical experts made various proposals to the government, then the government adopted. Construction consultants, together with academic experts, need to create such a trend and make use of their expertise.

What needs to be done can be summarized as follows. Develop and strengthen comprehensive safety measures, including land use, through hard/soft measures from a wide-area perspective. Develop and strengthen comprehensive safety measures through cooperation and collaboration among the national government, prefectures, basic local governments, businesses, residents, and other related parties. Develop local safety measures that integrate urban development and disaster prevention measures. From a medium- to long-term perspective, enhance risk assessment, and study and quantify the effects of hard/soft measure development through proactive disaster prevention. The values that are difficult to quantify in the study of maintenance effectiveness will be examined, and long-term goals will be set based on risk assessment and maintenance effectiveness.

Construction consultants can propose a project to a local community by utilizing their technical expertise, and the project will be commercialized and spread throughout the country as a good example. Examples: geothermal power generation could be introduced to hot spring areas that are frequently hit by flood or debris flow. Small-scale hydroelectric power generation in mountain streams. Improvement of bicycle paths at the tops of levees and on abandoned railway line sites. Combine evacuation from dangerous areas with measures against vacant houses. Propose candidate areas for collective relocation from dangerous areas together with urban redevelopment, etc.

4.3 Ensuring quality of works

Disaster response operations are expected to work within tight schedule. Furthermore, many matters are involved and a vast amount of data is being handled. This makes mistakes more likely to occur. Therefore, some measures need to be taken. In addition to ensure quality by proper verification, proper schedule management and clarifying conditions, some method for improving accuracy as the work progresses should be elaborated.

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