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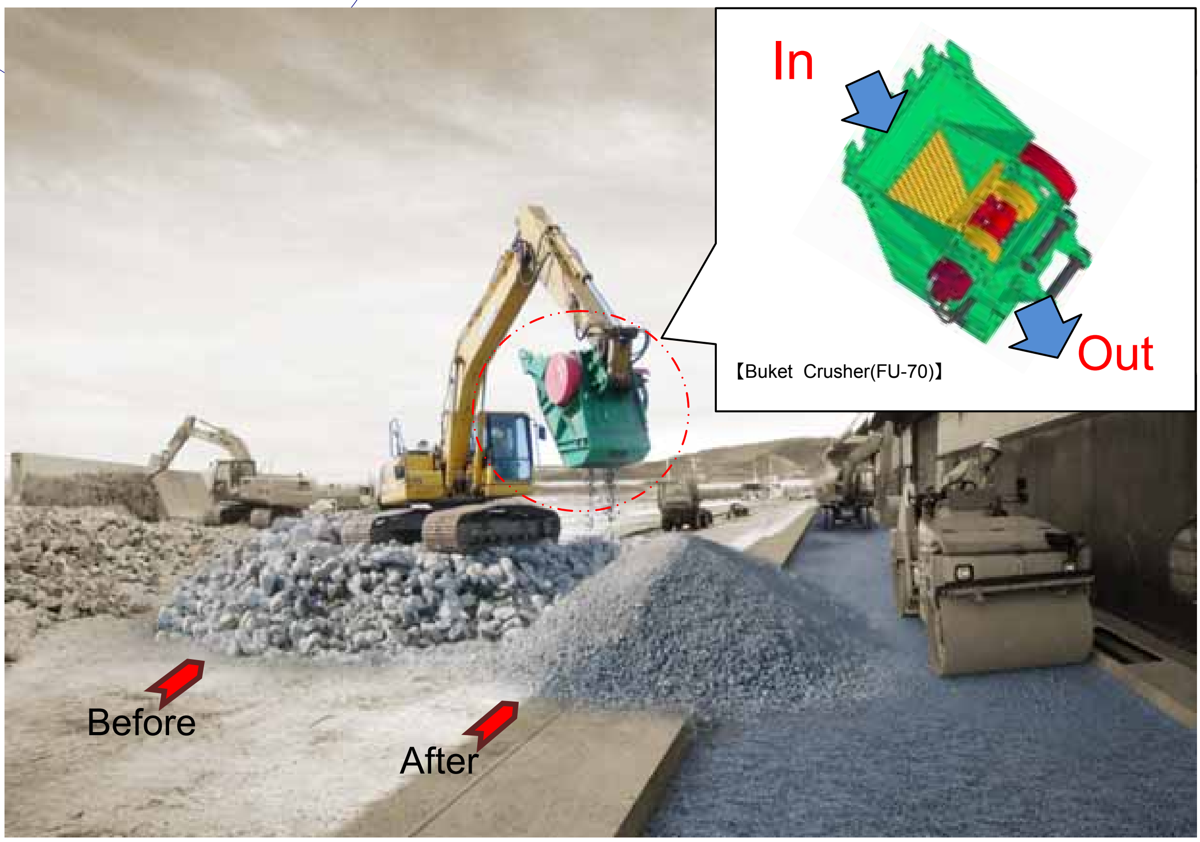
Japanese Infrastructure Newsletter

IDI QUARTERLY

Infrastructure Development Institute—JAPAN



Bucket Crusher (FU-70)
(Recycling Crusher Runner (Detachable))

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The 13th Infrastructure Technology Development Award 2011

The Japan Institute of Construction Engineering (JICE) was established as a public interest corporation to promote construction engineering in Japan by conducting cutting-edge research and development activities.

As more incentives should be provided for construction technology researchers and research institutes to enhance the level of construction engineering more effectively, JICE commenced Infrastructure Technology Development Award with Coastal Development Institute of Technology (CDIT) under the auspices of the Ministry of Land, Infrastructure, Transport and Tourism(MLIT).

Nineteen technologies competed for the 13th Infrastructure Development Award. In principle, the applicants' technologies should have been developed within the past five years and applied to the real sites within the past three years.

As a result of examination, institutes and researchers with the following technologies were awarded 13th prizes.

They are the five excellence prizes, "Building of Ridged-frame Viaduct with Half Precast Method (The method elevating the track directly above the operating railway)", "New Technique to Detect Layers De-bonding with Infrared Imaging for Airport Asphalt Pavement", "Bucket Crusher (FU-70) (Recycling Crusher Runner (Detachable))", "SWE-SSRT（Seismic While Excavating using SSRT）(The shallow seismic reflection survey ahead of tunnel face using tunnel excavating blasts as the seismic source)" and "Sub Marine Cleaner (SMC) Method (Sealed Absorption Type Bottom Sediment Removal Equipment)".

Two of the excellence prizes were introduced in the previous issue of IDI Quarterly (No.57) and other three prize technologies are introduced below.

For any inquiries/ comments please contact JICE :
Homepage: http://www.jice.or.jp/
(Japanese version only)
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Bucket Crusher (FU-70)

Recycling Crusher Runner (Detachable)

1. Develop & Research background and opportunity

The construction industry has done its duty to the recycling-based society. More than the contribution it brought to the society, the reduction to environmental load and construction costs are also required nowadays. Especially lots of concrete buildings built during the period of high economic growth need to be rebuilt, which would cause more and more industrial trash. Under such a situation, we began to research and develop this attachment to any type of excavators which is used to crush the stone to make them

Picture 1, Bucket Crusher (FU-70)

recyclable in 2006. With this attachment, it is possible for anyone to make the disposed concrete become recycling material and reuse them immediately on site. This new technical achieve the expectation to reduce the costs and also to protect the environment.

2. Contents of technology

Upon the development of mechanical power sources for the Backhoe's removable-type reclaimed aggregate manufacturing machine and focus on usability and convenience ,we adopt without using the V-belts, the drive shaft is directly connected to the hydraulic motor so as to do power transmission directly to keep quality of aggregate produced and stable machine capacity with limited output.

The concrete husks pulled down conventionally on the spot are taken out of the spot by dumping track. Although the aggregate (macadam) used on the site was purchased from the outside of the site and was constructed, everyone can produce the recycled aggregate simply in the construction site without choosing the backhoe which becomes the source of power, by using the method of construction that this technology is used. It makes it possible to use as the sub-base material of a road, the basic material of a structure, back-filling material, and back-fill material.

Work Flow (Use as Sub-base Course Material)

Before Demolition

Demolishing

Application

On-site Production

1. Before Demolition	Concrete Construction
2. Demolishing	Under 350mm Demolishing
3. On-site Production	Crusher Run between 20mm – 90mm
4. Application	backfilling material, Ground sill, Sub-base course material

Diagram 1, Work Flow, Work Process

3. The effects of this technique

According to the technique, the machine usage can be promoted at a construction site thanks to many possibilities.

These possibilities are as below:

・reduction of construction cost because of declining of concrete waste's transportation to outside and of purchasing aggregate (crushed stone)

・decreasing of traffic jam and accident

・improvement of residential area in vibration and noise

・cost reduction of road maintenance

・reduction of automobile exhaust

4. Application Field of the Technique

・ Place where backhoe can be used. (heaped 0.8 m^3)

・ Place where Special Construction Work has not been prohibited.

・ Intensity of crushing material should not harder than 40N/mm^2.

5. Application of the technique

The Bucket Crusher has been use to reform construction in Bikuni Gyoko-kita, Hokaido during Dec 2010 to Mar 2011 and there are 81 other application cases in Japan

Picture 2, Producing Crusher Run On Site

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SWE-SSRT (Seismic While Excavating using SSRT)

The shallow seismic reflection survey ahead of tunnel face using tunnel excavating blasts as the seismic source

1.Background

There are several existing seismic survey methods to predict the geological conditions ahead of tunnel face. We have previously developed a survey method - Shallow Seismic Reflection survey for Tunnels (SSRT). In general, a seismic survey of a tunnel excavating requires careful arrangement of the seismic sources and measurement equipments which causes interruptions to tunnel excavating work. However, when the blasting is used for excavating the tunnel, the excavating blasts themselves can be used as the seismic survey source, and it becomes possible to continuously evaluate the geological features ahead of tunnel face. We called this method - Seismic While Excavating using SSRT (SWE-SSRT). Figure-1 shows the image and concept of SWE-SSRT.

2.Outline

The data acquisition of SWE-SSRT requires only sensors and a recording system. Blasts used in tunnel

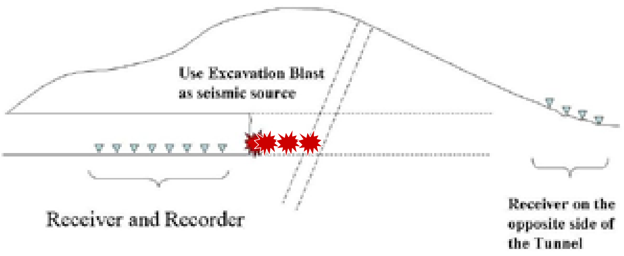

Figure-1: Image and concept of SWE-SSRT

excavation usually detonate in multiple-steps (more than ten) successively over a short time interval (delay blasting). The delay time between the first blast and the second one is set to about 250 ms (milliseconds) and the seismic waves generated by the first blast are used for analysis. Figure-2 shows the observed waveform of the excavating blasts at the long offset site outside of tunnel.

The most important technology of SWE-SSRT is how to detect the time of the blast accurately and to synchronize the recording with it. In order to solve this problem, the Rubidium atomic clock and custom-designed recorder were developed. Figure-3 shows the time recording device that used the Rubidium atomic clock and the operation method of this device in tunnel construction site.

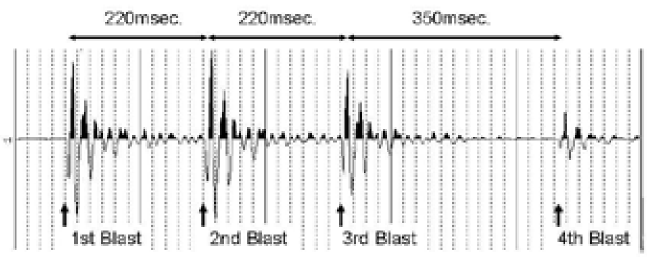

Figure-2: Observed waveform of the excavating blasts in multiple-steps at the long offset site

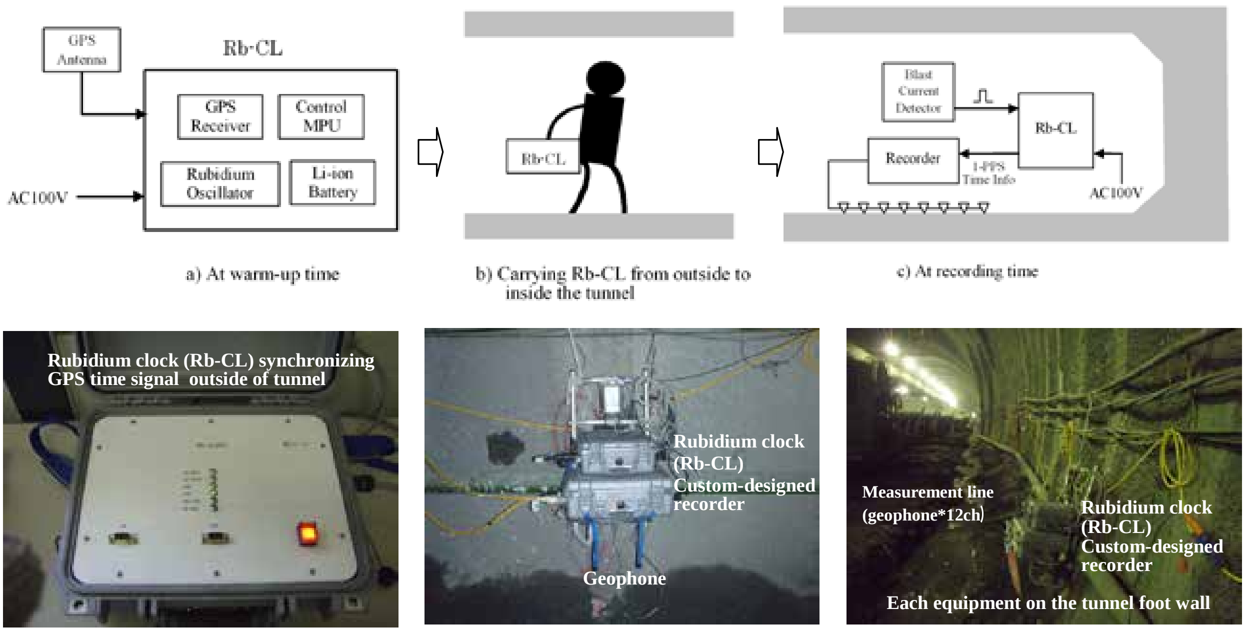

Figure-3: Time recording device that used the Rubidium clock and operation method in tunnel

3.Characteristics and effects

The characteristics and effects of SWE-SSRT are collectively shown as follows.

① SWE-SSRT is a tunnel survey method that uses the excavating blasts as the seismic source.

② SWE-SSRT does not interrupt the tunnel excavating work and operation.

③ Continuous survey and prediction is possible.

④ The cost is about half that of past survey methods. The main reason is that the seismic source need not be specially prepared before or at the survey.

⑤ To synchronize the internal clock of recorder equipments of SWE-SSRT inside tunnel, the Rubidium atomic clock and custom-designed recorder can be used.

4.Applicable range

・SWE-SSRT is applicable at tunnel construction site that always use the blasts for tunnel excavating.

・In application of SWE-SSRT, it is desirable for a tunnel to be a straight line.

5.The application track records

SWE-SSRT had been applied at three road tunnels in Japan. Figure-4 shows the SWE-SSRT application at the Furue-minami tunnel located on Kyushu Island in the southwest of Japan.

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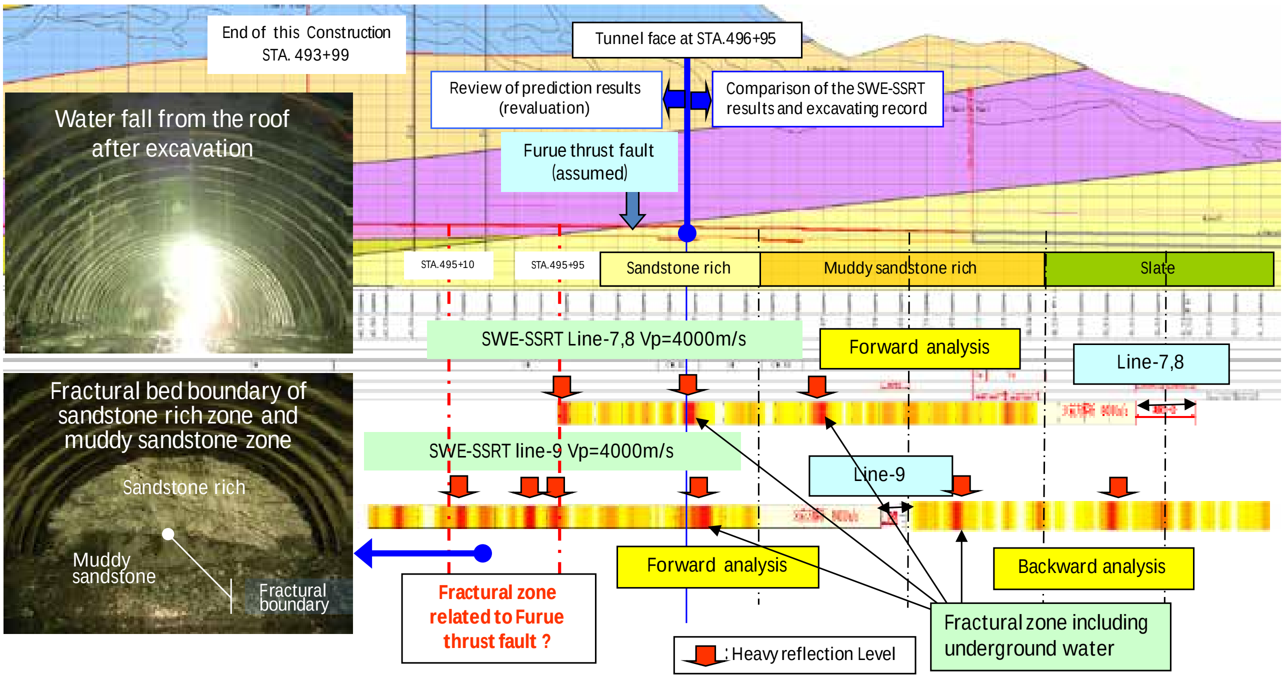

Figure-4: SWE-SSRT application at the Furue-minami tunnel (example of the fault zone prediction)

Sub Marine Cleaner (SMC) Method

Sealed Absorption Type Bottom Sediment Removal Equipment)

1.Background and Motivation for the Development

Organotin that should have been prohibited to use as endocrine-distrupting chemicalshad contained in the ship bottom paint that have had adverse effect on shellfish due to its persistent and remaining at bottom of the sea. Existing abatement method of hazardous bottom sediment might have caused the secondary contamination and also would dredge large volume of sediment without abating adequate thickness of hazardous sediment that will require large scale of sediment treatment plant. These have been difficult issues to solve.

This method made it possible to abate hazardous bottom sediment, such as endocrine-distrupting chemicals, accumulated on the sea bottom at the thickness of ten (10) centimeters by jetting water in the sealed equipment and pumping up stirred up sediment without roiling seawater. This submarine cleaner is the sealed type and does not roil sea at the dredging work nor cause secondary pollution. This method also abates sediment shallowly that reduces the volume of disposal and cost of construction without requiring large scale landfill. This can contribute greatly to improve the sea environment of enclosed coastal seas.

Photo-1 Set SMC to the crane barge

Photo-2 Submarine Cleaner

2.Technological Details

Technique to abate hazardous substance (such as TBT, dioxin and PCB) accumulated on the sea bottom without roiling seawater (causing secondary contamination) at the thickness of ten (10) centimeters .

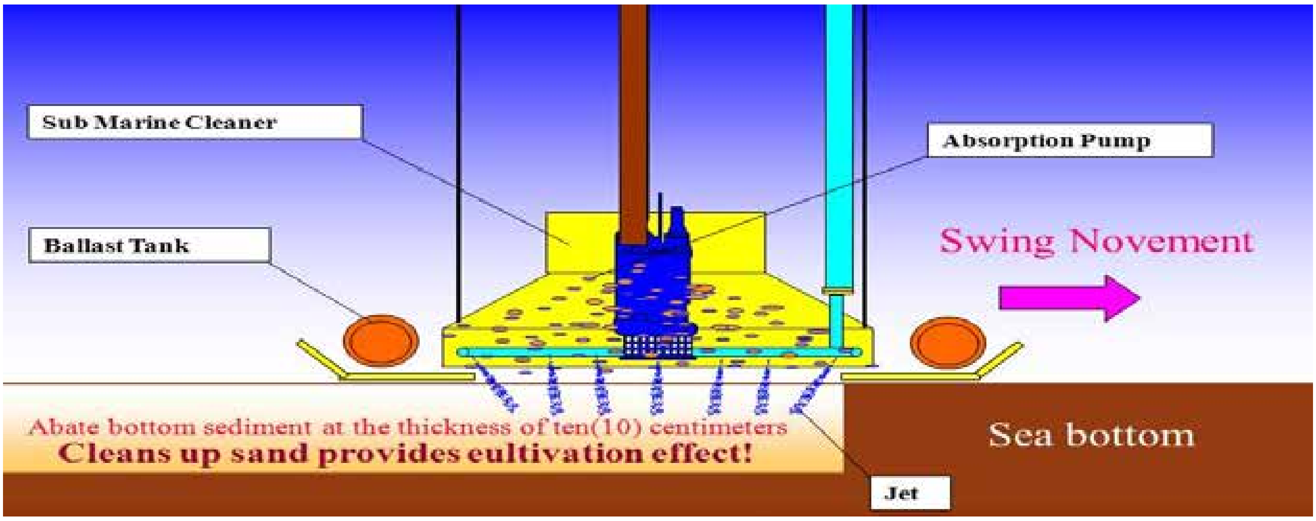

Chart-1 View showing a frame format of Sub Marine Cleaner at sea bed

3.Technological Effects

① Abate bottom sediment accumulated on the sea bottom at the thickness of ten (10) centimeter.

② Equipment is sealed type that can abate hazardous and organic substance accumulated on the sea bottom without causing secondary scattering.

Photo-3: Sea bed prior to the abatement work (A lot of silt remained)

Item	Before	After	Reduction Rate
Sulfide (mg/g･dry)	0.548	0.155	72%
Total Nitrogen (mg/kg･dry)	2850	1760	38%
Total Phosphorus (mg/kg･dry)	730	580	21%

Chart-1 Comparison of before and after the abatement

4.Technological Applications

・Abate floating mud at fishing port and harbor.

・Abate bottom sediment at farms.

・Abate dioxin, TBT and PCB.

・Cultivate sea bed to revive fisheries.

5.Records of Technological Applications

Abate Floating Mud at Hakata Harbor : September,

③ Proceed the work at the high speed of 3,000 ㎡/day.

④ Remove fine silt on the sea bottom and leave clean grained sand. Simultaneously, leading to cultivation effects.

⑤ Abating only necessary sediment enables to reduce amount of dredging sediment and construction cost.

Photo-4 After the abatement work (Shellfish and sand are confirmed)

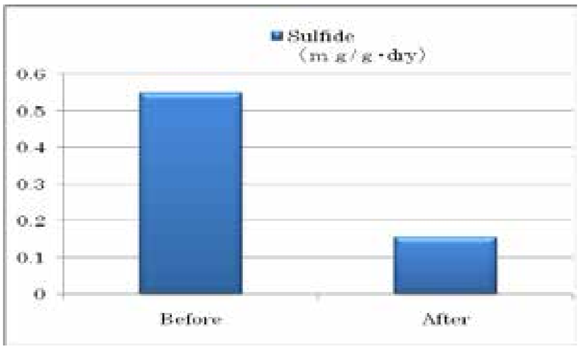

Chart-2 Comparison of the sulfide before and after the abatement

2009～ March, 2010 and other (1)

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Ten months have passed since the huge quake hit East Japan

10 months have already passed since the Great East Japan Earthquake and subsequent tsunami had attacked east Japan Pacific coast on March 11th 2011. Since then up until January 10th 2012, aftershocks greater than M7.0 occurred 6 times, greater than M6.0 hit 96 times and greater than M5.0 hit 580 times according to the Japan Meteorological Agency. Those aftershocks are mainly occurring in the epicenter zones stretching with 200km width and 500km length, and also in the area at the east side of the axis of ocean trench close to the epicenter. Even coastal area with shallow water depth and adjacent to the land, M3.0-M4.0 class aftershocks are still occurring. Right now we see a decreasing trend of the aftershock, but a potential of sizable aftershock attack still remain, so we need to continue close watch seismic activity along the coast line.

With regard to the restoration of the heavily damaged infrastructures by the disaster of this time, we are moving from initial emergency aid stage into full-scale reconstruction stage. Setting the target date at the end of March 2012, we are actively implementing the followings;

- Restoration of the infrastructures most urgently required
- Provision of disaster victims' housings
- Strategy for the future restoration methodology

On and after April 2012, we will start full-scale reconstruction work according to the local needs and perspectives.

As at the end of November 2011, restoration status in each infrastructure field is as follows.

1. Coastal Infrastructures

Among coastal levees and shore protection facilities extending 300km alongside the Pacific coast in Iwate, Miyagi, and Fukushima prefecture, where most severely hit by tsunami, 190 km portions were devastated. At the neighboring prefecture Aomori, Ibaraki, and Chiba, shore protection facilities were heavily damaged at 43 locations. Emergency measures had completed for the 50km coast lines by the end of September 2011 on a priority basis, because hinterland of those coast lines have vital facilities for the restoration of local livelihood, industry, commodity distribution and agriculture.

Full-scale restoration work of each infrastructure has been starting step by step, after scrutinizing local restoration plan, industrial and distribution plan of each port, in coordination with other projects. For the coastal levees where important facilities are located in the hinterland such as airport, sewage treatment facilities, we plan to construct with priority by March 2013, and a remaining portion will be completed within 5 years.

As for the countermeasures against tsunami, each prefectural government will individually decide plans after discussion with local government. The reason is that the degree of disaster damage and geographical conditions are totally different from town to town, and there are villages those cannot be protected by conventional measures against tsunami. Therefore, "Creation of Tsunami Resistant Multi-Defensive Local Town" is required which is different from town to town.

Coastal levee height should be determined for each bay assuming several decades-tsunami or 100-year tsunami, by scrutinizing historical tsunami height traces, and implementing a possible tsunami simulation.

2. River Infrastructures

The number of river bank damaged by huge earthquake and tsunami intrusion of this time reaches 3,183, and1,726 of them have completed full-scale restoration to the same safety level before the quake. By the next rainy season at June 2012, additional 984 banks will be fully restored. For the lock gate of the river, where reverse flow is projected by tsunami, seismic protection, automatization and remote control measures will be applied.

3. Sewage System

For the damaged sewage pipeline 631km, emergency repair is finished and now full-scale restoration activity is in progress and seismic resistant work is also undergoing in parallel.

Among the damaged 120 sewage treatment facilities, those 95 facilities located inland area and free from tsunami have already get back to normal. Among the tsunami afflicted 16 facilities along the Pacific coast, 14 facilities are in operation under emergency repair and 4 of 14 will get back to normal by March 2012, and 9 of 14 by March 2013. With regard to one damaged large scale treatment facilities, high level sewage treatment is not attained in a short time, but medium level treatment such as modified aeration will be possible by the end of March 2012.

4. Traffic Networks

(1) Road

Emergency restoration activities had been completed for the damaged highways and national roads so these roads are now open to general public. Regarding full-scale restoration, completion date is set to March 2012 for the national roads and December 2012 for the expressways.

(2) Passenger Railways and Freight Railways

Passenger rail has restarted operation in 67 among 76 routes. Among tsunami hit and afflicted 9 routes alongside the Pacific coast, train will gradually start running on the existing route for the 3 routes in Iwate prefecture during 2012 to 2014. For the 6 routes of central and southern Iwate prefecture and Miyagi prefecture, relocation of disaster afflicted area is scheduled based on the “Creation of Tsunami Resist Town Plan”, hence new railway route will be established from now on.

For the freight railways, among disaster-affected 7 routes, 4 routes have restarted operation, and restoration of the remaining portion will be completed by March 2013.

(3) Airport

Airport function was fully recovered by October 1st 2011.

(4) Port Facilities

21 ports and 373 berths were damaged by this disaster, among them, 253 berths have recovered its function by November 2011, although there are some restrictions on draft and movable load limit. Taking priority into consideration, important port facilities will be fully restored within 2 years.

5. Damaged Residences

In order to cater for the victim’s requirement that lost their residence, 53,000 emergency temporary housing is required. As at December 2011, 52,000 housings have already been constructed. Meanwhile some of the afflicted people left their home town. They moved nationwide and living in the 9,700 public housing and

65,000 private apartments borrowed by the government.

City, town, or other local governments are providing low cost rental public housing for those sufferers who are facing difficulties to buy or reconstruct their own. Elderly household keeps high share in this area's family unit, so national government is subsidizing private firms, Healthcare Corporation, Social Welfare Corporation and NGO, that operates assisted-living senior condominium.

6. Creation of Restoration Town

Regarding restoration of the severely damaged urban area by this tsunami disaster that reaches 11,900 hectares in total, taking into consideration of local needs and restoration plan that matches geological conditions, we will proceed for the "Multiple Disaster Defense System" by combining hardware and software. For example, measures are taken such as;

- Restoration and upgrading of the coastal levee, repair and upgrading of a city street, collective relocation for future disaster prevention
- Securing and maintenance of the evacuation route and evacuation spot. Topographically-matched ground utilization. Construction regulation
- Utilization of facilities located hinterland of the coastal levee having a function to protect flood spread (such as an embankment road)

7. Landslide Damage, Ground Sinking, Liquefaction Countermeasures

(1) Developed Land for Residence

For the developed land for residence that caused ground displacement or collapse by the quake, countermeasure will be taken to prevent displacement/collapse, by judging the degree of danger after investigation.

(2) Measures Taken for the Spot Exposed to Potential Landslide Risk

For the 30,000 spots exposed to potential landslide risk after the temblor, emergency sandbag pileup and installation of ground behavior observation equipment were completed by the end of August 2011. For the spot where exposed to high landslide risk and/or facing to the vital transportation route, countermeasure will be implemented on full scale by March 2012. The other spots' measure will be taken step by step within 5 years depending upon the degree of importance.

At the 241 municipalities where the big shake was felt, the ground is likely to become softened. Landslide risks caused by a rainfall are higher than normal, so the criteria for issuing landslide warning are lowered in order to issue an early alert.

(3) Countermeasures for a Ground Sinking

The big quake sank the ground level alongside the lowland coastline plain in Miyagi prefecture, and then tsunami seawater covered this lowland. As a result, a huge surface ponding (flooding, puddle) was formed in this area. At the deep water locations where natural water discharge were difficult, pumping water discharge vehicles were mobilized from nationwide and used for water discharge operation. This work was completed by the end of June 2011.

The area has a potential of future flooding caused by torrential rain and/or storm surges, so pumping vehicles have been deployed in widespread areas at present. And some additional water discharge pumping stations are scheduled to be installed along an appropriate river side.

(4) Liquefaction Countermeasures

As for the public infrastructures damaged by the liquefaction of grounds such as river banks, countermeasures will be taken in parallel with the forthcoming full-scale construction works.

About IDI and IDI-quarterly

The Infrastructure Development Institute (IDI)-Japan is a not-for-profit organization under the Ministry of Land, Infrastructure, Transport and Tourism Japan
IDI provides consulting services for Japanese official development aids (ODA), facilitates exchange of specialists around the world and exchange information about both developed and developing countries in the field of infrastructure.

IDI has been publishing the free quarterly journal "IDI Quarterly" since1996 for the purpose of introducing information relating to our public works and construction technology to foreign countries. We have distributed the journal to administration officials in more than 90 countries around the world by e-mail.

We also welcome project information from your country. If you have a manuscript, please send to us. We may include it as an article in our journal IDI-Quarterly. Please refer an example article "Water Pipeline Projects" from Mongolia. (Refer IDI Quarterly No.52).
If you have an interest, send manuscripts to us according to the instructions below.

Instructions for contributors:

- Texts must be written in English within 800 words.
- Ms-word.doc or text.txt files are acceptable.
- Figures and photos should be supplied in an electric format.
- All manuscripts will undergo some editorial modification.
- The editor reserves the right not to publish manuscripts that are not appropriate for this journal.
- Manuscript fee will not be paid.
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