Chapter 5 Reconstruction of Homes and Cities

Section 10 Ports

1. Overview of damage

(1) Tsunami damage

The earthquake ground motion and tsunami caused major damage to the facilities at all ports on portion of the Pacific coast of Japan spanning from Hachinohe Port in Aomori Prefecture to Kashima Port in Ibaraki Prefecture (14 international hub ports and major ports and 17 regional ports), and temporarily paralyzed all port functions.

The damage to port and harbour facilities caused by the tsunami was extensive and serious along the Pacific coast from the Tohoku region to the northern Kanto region. The first line breakwaters at Hachinohe Port, Kamaishi Port, Ofunato Port, and Soma Port were completely destroyed or partially destroyed by the tsunami. An analysis was made to the effect that the damage in question was a result of the caissons sliding due to the large water level differences generated by the tsunami at the areas bordering the seawalls and due to the downward slippage of caissons resulting from the foundation mounds having been scoured due to the strong water flows associated with the water level differences. As for seawalls, many facilities collapsed due to overflow.

In addition, the tsunami caused a lot of debris, vehicles, containers and other items to sink within shipping routes and anchorages, hindering the navigation of ships. There were also many cases where lumber, containers, moored ships and other items stored in ports flowed into urban areas, causing damage. Furthermore, most cargo handling machinery was rendered inoperable due to damage to electrical systems resulting from flooding caused by the tsunami.

Furthermore, there were many cases in which inland areas were flooded beyond the inundated areas indicated in the hazard map. People who were closing floodgates, locks, etc. or providing guidance for evacuation fell victim to the tsunami. There were also cases in which people working in port areas fell victim to the tsunami because they were unable to evacuate to the evacuation locations before the tsunami arrival time.

(2) Broad-ranging damage due to earthquake ground motion and liquefaction

While most of the damage at ports and harbors in the prefectures of Aomori and Iwate was caused mainly by tsunami, at ports and harbors located south of Sendai Bay, damage to mooring facilities and revetments due to earthquake ground motion was significant in addition to damage caused by the tsunami. Moreover, damage caused by ground liquefaction increased because the duration of the earthquake ground motion was very long, for at least three minutes.

In Soma Port and Onahama Port, the aprons behind the quay walls and the cargo handling areas saw subsidence arise due to liquefaction and tectonic deformation. The amount of subsidence seen at the ports of Iwate, Miyagi, and Fukushima prefectures reached 0.7 meters on average and a maximum of 1.7 meters. As a result, the sites behind the quay walls caved in and ground level differences were created. At the same time, the inundation seen behind the quay walls at the time of high tide, etc. also caused problems for cargo handling work.

At Chiba Port, far from the epicenter of the earthquake, liquefied petroleum gas (LPG) tanks collapsed due to the earthquake ground motion, and land subsidence occurred due to liquefaction taking place in the reclaimed land found in the coastal areas of Tokyo Bay. In addition, in Tokyo Bay, communication became temporarily difficult, and the evacuation of ships was delayed. Combined with the limited space available for harborage, there were occurrences seen such as some of the sea areas becoming congested with ships taking refuge there. Damage caused by the earthquake ground motion and liquefaction spread widely throughout eastern Japan.

Figure 5-10-1 Damage situation at ports and harbors as a result of the tsunami and earthquake ground motion

Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

2. Emergency recovery

(1) Recovering logistics functions following the restoration of ports and harbors in disaster-affected areas (eliminating obstacles to clear sea routes, etc.)

Following the lifting of the tsunami warning and tsunami advisory, port offices and port administrators of the Ministry of Land, Infrastructure, Transport and Tourism began conducting on-site inspections of damage to port and harbour facilities starting on March 14. In addition, the regional development bureaus found across Japan, the National Institute of Land and Infrastructure Policy, and the Port and Airport Research Institute dispatched an emergency disaster response team (TEC-FORCE) to confirm the damage situation, perform inspections, provide technical support, and carry out other such tasks.

The Tohoku Regional Development Bureau and the Kanto Regional Development Bureau of the Ministry of Land, Infrastructure, Transport and Tourism, with the cooperation of industry groups based on an agreement on emergency disaster countermeasures, began clearing of obstacles from sea routes starting on the day following the lifting of tsunami warnings and advisories in order to bring emergency cargo ships into the heavily damaged ports on the Pacific coast as soon as possible. It is necessary to ascertain the situation in terms of runoff when carrying out work to clear of obstacles from sea routes. As such, items such as containers and culture rafts floating in the harbor were visually checked. Meanwhile, since it was difficult to visually confirm any obstacles that were submerged in the sea, narrow multibeam sonar[1] capable of specifying the exact position, type, shape and depth of an obstacle was used at Sendai-Shiogama Port and other locations to identify obstacles found submerged in the sea, including containers, automobiles, fishing boats and pleasure craft and simultaneously perform removal work.

As a result of these efforts, the first ships entered Miyako Port and Kamaishi Port on March 16. After that, by

[1] Narrow multibeam sonar: A device that shoots sound waves (acoustic beams) from the bottom of a ship and measures the depth of the water by measuring the time it takes for the sound waves to bounce back. The device makes it possible to ascertain the overall topography of the seabed, and to confirm elements such as port depths and the distribution of fishing reefs in a highly efficiently and high-density manner.

March 24, some of the quay walls became available at all 14 major ports located between Hachinohe Port and Kashima Port.

In addition, the earthquake-proof berths built at each port played a major role in the reconstruction of livelihoods and industry in the disaster-affected areas as a whole, as they were used not only for the transport of emergency supplies after the earthquake but also for alternative transport for feed, coal, and other such cargo that was difficult to handle at other affected berths.

In addition, support personnel and emergency supplies were transported by medium- to long-distance ferries and RORO ships from places outside the disaster-affected areas as well, such as Hokkaido. The existence of quay walls for ships carrying out mass bulk transport played a major role in the recovery and reconstruction of the disaster-affected areas.

In addition, at Sendai-Shiogama Port (Shiogama Port District) and Hachinohe Port, the damage to the oil depots located in the ports was relatively minor, so the Ministry of Land, Infrastructure, Transport and Tourism focused on clearing of obstacles from the routes leading to the oil tanker mooring facilities, resulting in the early resumption of the delivery of oil to the disaster-affected areas.

As a result of these recovery activities which took place immediately after the earthquake, about 70% of the 373 public quay walls found between Hachinohe Port and Kashima Port (including regional ports) were provisionally usable by the end of March 2012, about one year after the earthquake. In April 2011, immediately after the earthquake, the volume of cargo handled at ports in the disaster-affected areas decreased to about 22% of that handled during the same month of the previous year. However, by October of that year, the volume of cargo handled increased to be 101% of the volume of the previous year due to the resumption of business activities following the restoration of port and harbour facilities and due to a significant increase in the handling of energy-related cargo such as coal and petroleum products needed for reconstruction.

Tohoku Regional Development Bureau established a liaison and coordination meeting with the participation of private companies such as construction companies and diving business operators to carry out work such as the clearing of obstacles from sea routes and emergency restoration work for port and harbour facilities. Then, after receiving support from all over the country, the aforementioned work was carried out after having secured a system for carrying out the work. As for the work entailing the clearing of obstacles from sea routes, it was the case that sailors and ships of local companies suffered serious damage. As such, in cooperation with the Japan Dredging and Reclamation Engineering Association, work ships such as those equipped with cranes were procured from all over the country and work such as the removal of the runoff was carried out. When it came to receiving vessels loaded with emergency relief supplies and fuel oil, etc., port stevedores and cargo handling equipment were secured with the cooperation of entities such as the Japan Harbor Transportation Association and local governments in accordance with the progress of the obstacle removal work taking place in the affected ports.

The Ports and Harbors Bureau of the Ministry of Land, Infrastructure, Transport and Tourism, brought three of its large dredging and oil recovery ships (Hakusan, Seiryumaru, Kaishomaru) into major ports during the period spanning from March 12 to March 26, and conducted tasks such as the provision of relief goods, fuel, and drinking water to the disaster-affected areas. The Hokkaido Development Bureau loaded relief supplies and fuel onto its regional disaster prevention floats and transported them from Muroran Port to Ofunato Port and Soma Port. At Soma Port, which initially had few quay walls available, the regional disaster prevention floats were stationed so that they could be used as temporary mooring facilities.

Figure 5-10-2 View of work entailing the clearing of obstacles from route at Sendai-Shiogama Port

Source) Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, “Earthquake Memorial Museum”

Figure 5-10-3 The arrival of emergency relief ship (Hakusan of the Hokuriku Regional Development Bureau) at Miyako Port

Source) Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "Earthquake Memorial Museum"

Figure 5-10-4 Japan Coast Guard patrol vessel "Miura" arrives at Sendai-Shiogama Port loaded with emergency relief supplies (March 19, 2011)

Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

Figure 5-10-5 The Kyushu Regional Development Bureau's Kaishomaru arrives at Sendai-Shiogama Port carrying emergency relief supplies (March 17, 2011)

Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

The situation in terms of the restoration of each port immediately after the earthquake was as follows.

< Hachinohe Port >

After the tsunami warning and tsunami advisory were lifted, sea route obstacle clearing work such as removing sunken obstacles found in the sea routes, anchorages, and so on was carried out starting on March 15. On March 19, the port was partially restored, and the cargo handling work system was secured.

< Kuji Port >

After the tsunami warning and tsunami advisory were lifted, depth surveys were conducted starting on March 14. On March 20, the port was partially restored, and the cargo handling work system was secured.

< Miyako Port >

After the tsunami warning and tsunami advisory were lifted, sea route obstacle clearing work such as removing sunken obstacles found in the sea routes, anchorages, and so on was carried out starting on March 14. On March 17, the port was partially restored, and the cargo handling system was secured.

< Kamaishi Port >

After the tsunami warning and tsunami advisory were lifted, sea route obstacle clearing work such as removing sunken obstacles found in the sea routes, anchorages, and so on was carried out starting on March 15, the day in which the work fleet was secured. On the same day, the port was partially restored, and the cargo handling work system was secured.

< Ofunato Port >

After the tsunami warning and tsunami advisory were lifted, sea route obstacle clearing work such as removing sunken obstacles found in the sea routes, anchorages, and so on was carried out starting on March 19, the day in which the work fleet was secured. On March 22, the port was partially restored, and the cargo handling work system was secured.

< Sendai-Shiogama Port >

After the tsunami warning and tsunami advisory were lifted, sea route obstacle clearing work such as removing sunken obstacles found in the sea routes, anchorages, and so on was carried out starting on March 14. On March 18, the port was partially restored, and the cargo handling work system was secured.

< Soma Port >

Measurement surveys were conducted starting on March 27. On March 29, disaster prevention floats arrived in port and relief supplies were brought in.

< Onahama Port >

Measurement surveys were conducted starting on March 18 and Osumi (Japan Maritime Self-Defense Force) arrived in port with relief supplies also being brought in.

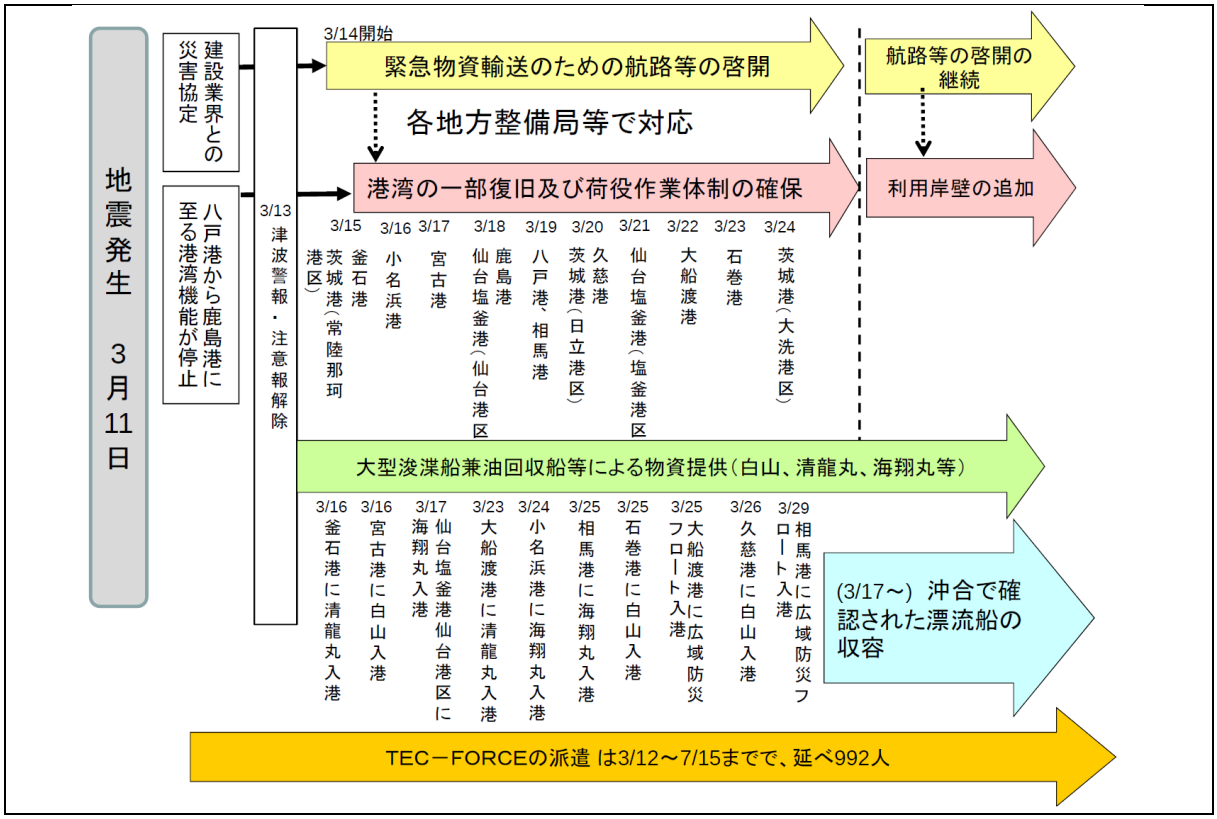
< Ibaraki Port >

Immediately after the earthquake, work to clear sea routes was carried out, such as the removal of obstacles sunk within areas such as sea routes and anchorages. On March 15, service began for a portion of the Hitachinaka Port District after draft restrictions had been set up. On May 18, the draft restrictions were lifted, and full-scale service began.

< Kashima Port >

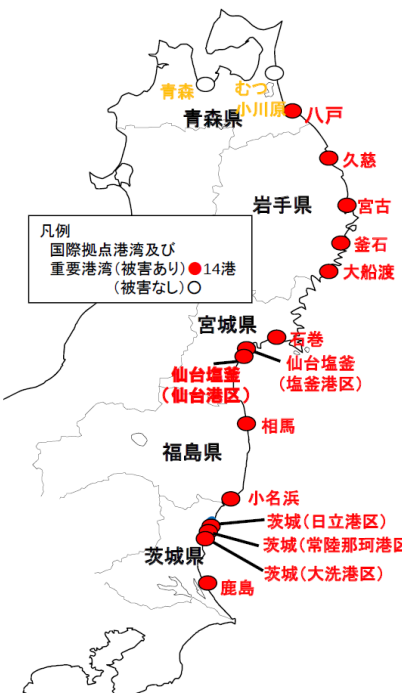
Immediately after the earthquake, work to clear sea routes was carried out, such as the removal of obstacles sunk within areas such as sea routes and anchorages. On March 18, service began for a portion of Kashima Port after draft restrictions had been set up. By July 29, all draft restrictions were lifted, and full-scale service began.

Figure 5-10-6 Initial response undertaken at ports immediately after the earthquake



Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

Figure 5-10-7 Start of port use after the earthquake



都道府県	港名	岸壁の利用可能時期※		緊急物資、燃料等を積載した第一船の入港時期
		災害対策利用	一般利用	
青森県	八戸港	3月14日（吃水制限9m）	3月19日（吃水制限9m）	3月23日
岩手県	久慈港	3月15日（吃水制限8m）	3月20日（吃水制限8m）	3月26日
	宮古港	3月15日	3月17日	3月16日
	釜石港	3月15日	3月15日	3月16日
	大船渡港	3月22日（吃水制限9.5m）	3月22日（吃水制限9.5m）	3月23日
宮城県	石巻港	3月23日（吃水制限10.2m）	3月23日（吃水制限10.2m）	3月23日
	仙台塩釜港（塩釜港区）	3月21日	3月21日	3月21日
	仙台塩釜港（仙台港区）	3月16日	3月18日	3月17日
福島県	相馬港	3月19日（原則は日中航行のみ）	3月19日（原則は日中航行のみ）	3月25日
	小名浜港	3月15日（原則は日中航行のみ）	3月16日（原則は日中航行のみ）	3月18日
茨城県	茨城港（日立港区）	3月20日（吃水制限9m）	3月20日（吃水制限9m）	3月27日
	茨城港（常陸那珂港区）	啓開作業は不必要	3月15日	－（4月6日：RORO船）
	茨城港（大洗港区）	3月24日（吃水制限5m）	3月24日（吃水制限5m）	－（6月6日：定期フェリー）
	鹿島港	3月18日（吃水制限8m）	3月18日（吃水制限8m）	3月25日

※災害対策利用とは港湾の一部の岸壁に係る啓開作業が終了し緊急物資輸送船舶等が利用可能になること。

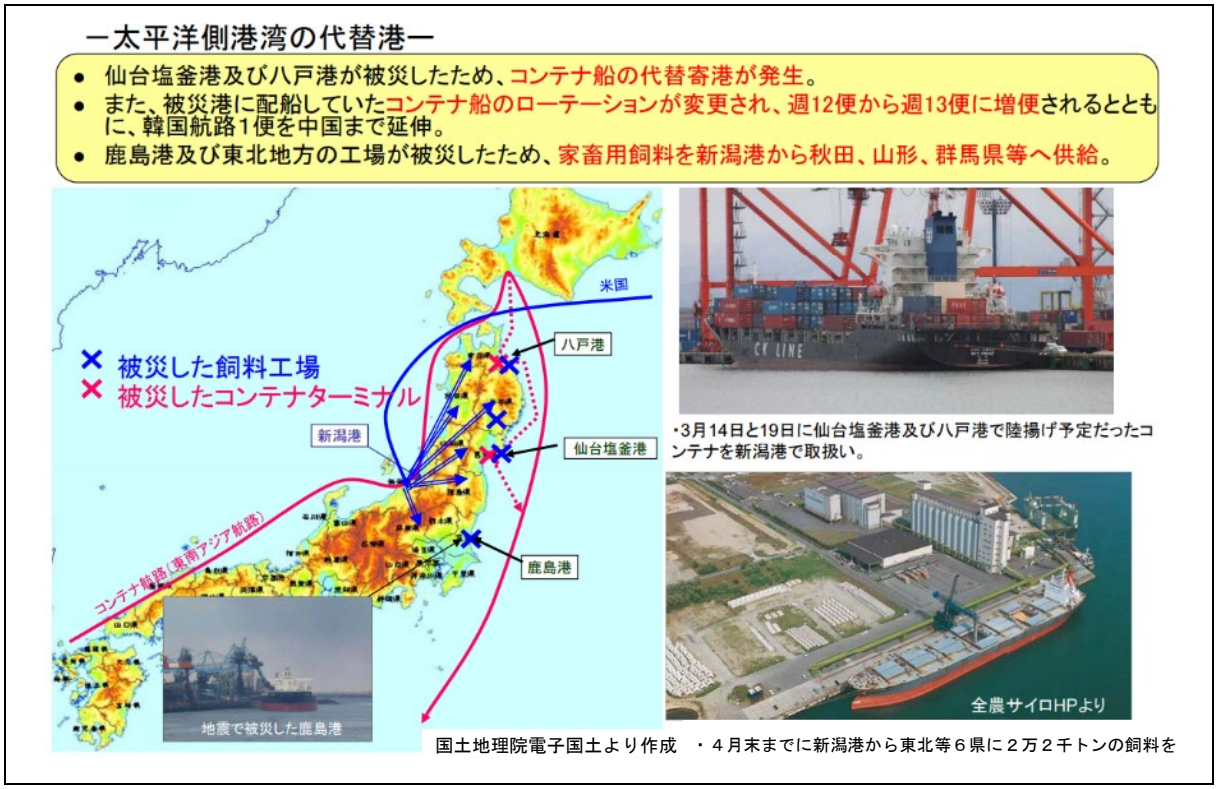
※一般利用には港長（海上保安部）による安全の確認が必要。

Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

(2) Demonstrating port backup functions

During the time when logistics were brought to a standstill owing to the damage sustained by ports on the Pacific coast of the Tohoku region, ports on the Sea of Japan side acted as back-ups. Specifically, emergency relief supplies from Hokkaido, western Japan, and other countries were unloaded at ports on the Sea of Japan side, such as Akita Port and Niigata Port, and transported overland to the disaster-affected areas. In addition, since Sendai-Shiogama Port and Hachinohe Port sustained damage, containers that were scheduled to be unloaded there were instead unloaded at Niigata Port and Akita Port. Furthermore, feed mixture factories located around ports such as Hachinohe Port, Ishinomaki Port (Ishinomaki Port District, Sendai-Shiogama Port), and Kashima Port were also damaged, so feed for livestock was unloaded at Sakata Port and Niigata Port and then supplied after overland transport took place.

Figure 5-10-8 Roles played by Niigata Port after the Great East Japan Earthquake (transportation of containers, feed, etc.)

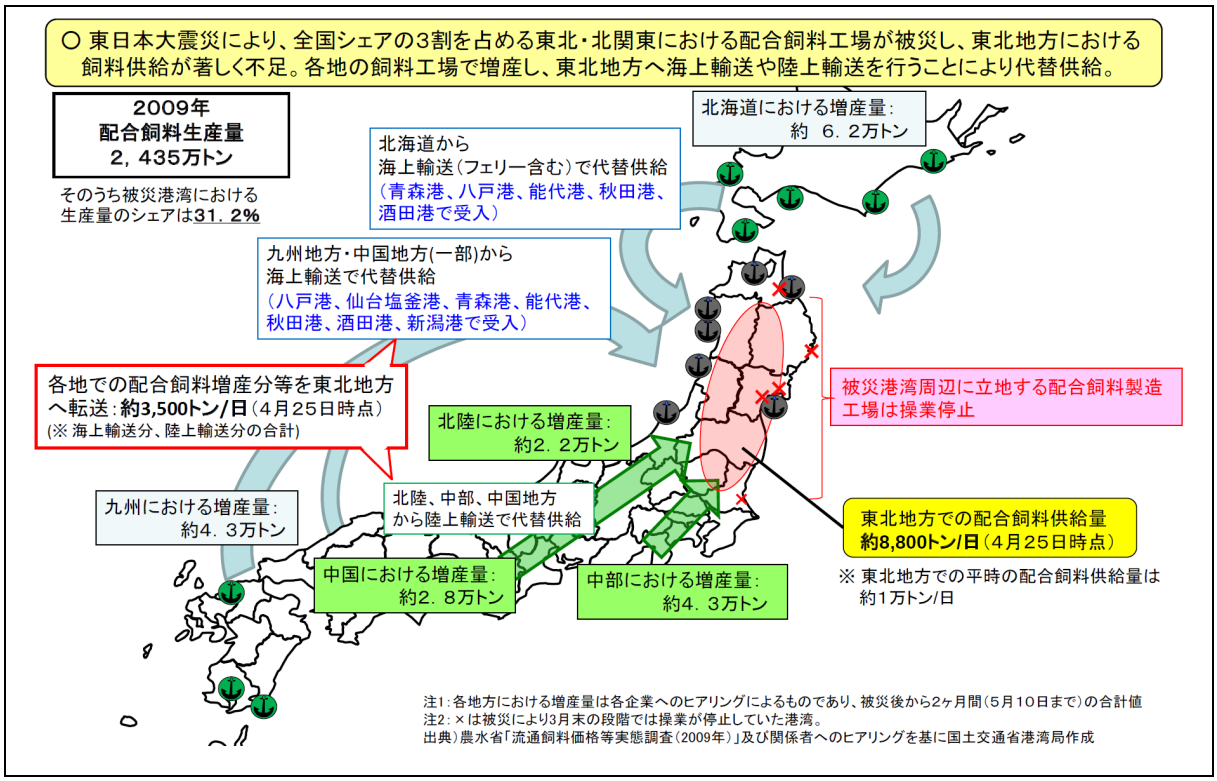


Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

Figure 5-10-9 Roles played by Niigata Port after the Great East Japan Earthquake (transportation of fuel and relief supplies)

Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

Figure 5-10-10 Impact on industrial activities outside the disaster-affected areas (example of alternative transportation for feed mixtures)



Source) Ministry of Land, Infrastructure, Transport and Tourism, “The Second Meeting of the Disaster Prevention Section of the Ports and Harbors Subcommittee of the Council of Transportation Policy (Material 3)” (June 3, 2011)

3. Restoring and reconstructing

(1) Development policy based on the Great East Japan Earthquake

1) Formulating industry and logistics reconstruction plans

In working on the restoration and reconstruction of ports and harbors, a council consisting of entities such as port administrators, local governments, and companies located in ports and harbors, examined measures for the restoration of port functions in accordance with the restoration and reconstruction plans of companies, as well as the ideal state of logistics functions which serve to support the reconstruction of industry and the ideal state of tsunami disaster prevention undertaken in cooperation with industrial activities and urban planning efforts. Based on this, by the middle of August 2011, each port affected by the disaster formulated and announced their "reconstruction plans for industry and logistics," which contained forward-looking recovery and reconstruction policies and work schedules.

The overviews of the reconstruction plans for industry and logistics at each port are as follows.

< Hachinohe Port >

- Recovery process of port and harbour facilities

  Based on the fact that the group of companies in the hinterland were resuming industrial activities in earnest as demonstrated by elements such as the Hachinohe Mill of Mitsubishi Paper Mills resuming production in May 2011 with an expectation that it would make a recovery to 90% of pre-earthquake levels by the end of September, the aim is to have port functions fully restored within about two years. In particular, the cargo handling capacity of container terminals is to be restored during FY2011.
- Comprehensive tsunami countermeasures

  In order to secure the safety and security of citizens' lives in the hinterland of Hachinohe Port and to secure elements such as bases for industrial and logistics activities, protection lines will be formed to secure safety in relation to tsunamis that frequently occur. In addition, since it takes a certain period of time to complete the protection lines, in preparation for the event of a tsunami of the largest class, the government and the private sector will work together to establish a disaster prevention system using the "Hachinohe City Disaster Prevention Council," secure evacuation facilities, formulate BCPs for ports and harbors, and take other non-structural measures.

< Kuji Port >

- Recovery process of port and harbour facilities

  With the fish market reopening at the end of March 2011 and other industrial activities resuming in earnest, including fisheries, the aim is to have the port be fully restored within about two years.

< Miyako Port >

- Recovery process of port and harbour facilities

  With the fish market reopening in April 2011 and other industrial activities resuming in earnest, including fisheries, the aim is to have the port be fully restored within about two years. In particular, the top priority will be given to the restoration of breakwaters, which are essential for maintaining the functions of the prefecture's largest fishery yield.

< Kamaishi Port >

- Recovery process of port and harbour facilities

  Based on the fact that the group of companies in the hinterland were resuming production activities in earnest as demonstrated by elements such as Kamaishi Steelworks (the name for the facility at the time) of Nippon Steel Corporation restarting operations in April 2011 with an expectation of recovery to 80-90% output by August, the aim is to have full-scale restoration of port and harbour facilities such as quay walls within approximately two years.
- Bay mouth breakwater

The reconstruction of the local economy in the hinterland of Kamaishi Port is included within the basic plan for reconstruction-based urban development of Kamaishi City. In order to protect these areas from frequent tsunamis, the combined protection of the bay entrance breakwater and the seawall can reduce the total cost when compared with the protection of the seawall alone. Furthermore, this would be both reasonable and effective because it would lead to securing a degree of serenity in the harbor and would allow for the reduction of the impact on the landscape and living environment through a reduction of the height of the seawall. The ministry aims to restore the breakwater at the mouth of the bay within five years.

< Ofunato Port >

- Recovery process of port and harbour facilities

  Based on the prospect of the resumption of production activities by the group of companies located in the hinterland as demonstrated by elements such as the prospect of Taiheiyo Cement Corporation resuming cement production in November 2011, the aim is to have the full-scale restoration of port and harbour facilities such as quay walls take place within approximately two years. In particular, the only quay walls in the prefecture to serve foreign trade container ships will be fully restored within FY2011.
- Bay mouth breakwater

  In the outline of the reconstruction plan of Ofunato City, an industrial zone is planned in the coastal area and a commercial and residential area is planned to be built behind it. In order to protect these areas from tsunamis which occur frequently, it would be both reasonable and effective to protect them by combining the bay entrance breakwater and the seawall, as is the case with the Kamaishi Harbor entrance breakwater. The ministry aims to restore the breakwater at the mouth of the bay within five years.

< Ishinomaki Port (Ishinomaki Port District, Sendai-Shiogama Port) >

- Recovery process of port and harbour facilities and measures against land subsidence

  The aim is to have the mooring facilities fully restored within two years. At this time, in order to ensure the safety of cargo handling and ship mooring, the height of the crest of the quay walls should be raised to the height it was before the earthquake, and the continuity with the site found behind the quay walls should be ensured.
- Improving tsunami disaster prevention functions

  In order to protect the industries in the coastal areas and the towns behind them from tsunamis that occur with high frequency, tidal walls will be installed after conducting tsunami inundation simulations. In addition, to prepare for an event involving a tsunami of the largest class, the government will reconstruct information transmission methods and implement non-structural measures such as installation plans for places such as evacuation buildings.
- Recovering private-sector port and harbour facilities

  When it comes to the recovery of private port and harbour facilities (quay walls and revetments), the establishment of systems through the use of public assistance will be sought after.

< Sendai-Shiogama Port >

- Recovery process of port and harbour facilities

  The quay walls at Takasago Container Terminal No. 2, which is mainly used by international marine container ships, will become operational by October 2011 for large container ships of North American routes. After that, restoration will move gradually while using the quay walls provisionally, aiming for full-scale restoration within two years, including related facilities.
- Improving tsunami disaster prevention functions

  As a result of examining inundation damage caused by tsunamis with a high frequency of occurrence, it was found that the areas where industry and logistics were found to be concentrated, along with residential areas, would also be damaged. In these areas, new protection lines will be established. In other areas, the already-established plans will be reviewed, and the necessary facilities will be put in place. In addition, to prepare for an event involving a tsunami of the largest class, the government will reconstruct information transmission methods and implement non-structural measures such as installation plans for places such as evacuation buildings.

< Soma Port >

- Recovery process of port and harbour facilities

  For the offshore breakwater, which is essential for the importing of coal and for cargo handling undertaken for the Shinchi Thermal Power Station, a gradual construction method will be considered to realize the effects as early as possible with the aim of restoration taking place within about five years. The aim is to restore quay walls and other port and harbour facilities within three years.
- Strengthening disaster prevention functions in relation to occurrences such as earthquakes and tsunamis

  Based on the results of studies on tsunamis with a high frequency of occurrence, immediately after a tsunami is identified, a tsunami inundation simulation will be conducted. Based on the results of that simulation, the elements such as the establishment of protection lines and the development of evacuation facilities will be considered. In addition, since it takes a certain period of time to put protection lines in place, non-structural measures will also be taken, such as the utilization of existing facilities as evacuation locations and the formulation of BCPs to prepare for the event of a tsunami of the largest class.

< Onahama Port >

- Recovery process of port and harbour facilities

  The mooring facilities necessary for coal imports and the handling of cargo for the Hirono Thermal Power Station, the Nakoso Thermal Power Station, etc. will be given top priority with restoration to take place as soon as possible. In addition, other facilities will be subject to emergency repair so as not to interfere with the restoration schedule of the companies located in the area behind the port and harbour facilities as much as possible, with the aim being that the restoration of major mooring facilities be completed within approximately two years and that the restoration of all facilities be completed within approximately three years.
- Strengthening disaster prevention functions in relation to occurrences such as earthquakes and tsunamis

  Based on the results of the study on tsunamis with a high frequency of occurrence, elements such as the establishment of protection lines and the development of evacuation facilities will be considered in the same manner as is the case at Soma Port. In addition, until the construction of protective lines is completed, the government and the private sector will work together to establish a disaster prevention system, and non-structural measures will be taken such as the formulation of BCPs to prepare for the event of a tsunami of the largest class.

< Hitachi Port District, Ibaraki Port >

- Recovery process of port and harbour facilities

  The aim is for restoration of mooring facilities for the efficient transportation of completed vehicles and the regular Kushiro RORO route to be completed during FY2012. At this time, since the ground has sunk by about 70 centimeters, measures will be taken to raise the height of quay walls where cargo will be exposed to sea spray during high tide and when waves are present, as well as for quay walls where cargo handling will be hindered, to the heights which they were before the disaster. Scraping will be carried out so as not to hinder the use of the land behind the quay walls.
- Strengthening disaster prevention functions and disaster mitigation functions

  In the Hitachi Port District, the tsunami inundation simulation results showed that the possibility of inundation of the hinterland of the port by a tsunami with high occurrence frequency is low. However, due to the large amounts of flood damage caused by the Great East Japan Earthquake, a study area for tsunami countermeasures will be located and measures will be taken which combine structural and non-structural elements.

< Hitachinaka Port District, Ibaraki Port >

- Recovery process of port and harbour facilities

  Based on elements such as the resumption of economic activities of the group of companies located behind the port, including the resumption of production by Komatsu Ltd. on March 22, 2011, and the resumption of exports of construction machinery on April 25, the aim will be for restoration of mooring facilities, etc. to take place in FY2012. In order to fulfill its function as an international RORO transport hub port supporting international distribution hub ports and companies located in northern Kanto, the aim will be

to have the restoration of the quay walls of North Wharf A, which handles international regular containers and international RORO cargo, take place in FY2011. As for the quay walls of North Wharfs D, E, and F, which handle Tomakomai regular service RORO sea routes (before the earthquake: 12 instances/week) and Kitakyushu regular service RORO seas routes (before the earthquake: 3 instances/week), the quay walls at Wharf D will be restored by the end of FY2011, with the quay walls at Wharf E and Wharf F to be restored sequentially.

- Strengthening disaster prevention functions and disaster mitigation functions

  In the Hitachinaka Port District, the tsunami inundation simulation results showed that the possibility of inundation of the hinterland of the port by a tsunami with high occurrence frequency is low. However, due to the large amounts of flood damage caused by the Great East Japan Earthquake, a study area for tsunami countermeasures will be located and measures will be taken which combine structural and non-structural elements, as is the case with the Hitachi Port District.

< Oarai Port District, Ibaraki Port >

- Recovery process of port and harbour facilities

  With the Tomakomai regular service ferry route (before the earthquake: 12 instances/week), a trunk cargo and passenger transport route connecting Kanto and Hokkaido, resuming operation with a provisional water depth on June 6, 2011, and other logistics activities having resumed in earnest, the restoration of Wharf No. 3 is planned to take place by the end of FY2011. In addition, Wharf No. 4 and the public marina are to be restored by the first half of 2012, and Wharf 1 and 2, which handle marine products, will be restored during 2012.

- Strengthening disaster prevention functions and disaster mitigation functions

  In the Oarai Port District, the tsunami inundation simulation results showed that the possibility of inundation of the hinterland of the port by a tsunami occurring in high frequency is low. However, due to the large amounts of flood damage caused by the Great East Japan Earthquake, a study area for tsunami countermeasures will be located and measures will be taken which combine structural and non-structural elements, as is the case with the Hitachi Port District and the Hitachinaka Port District.

< Kashima Port >

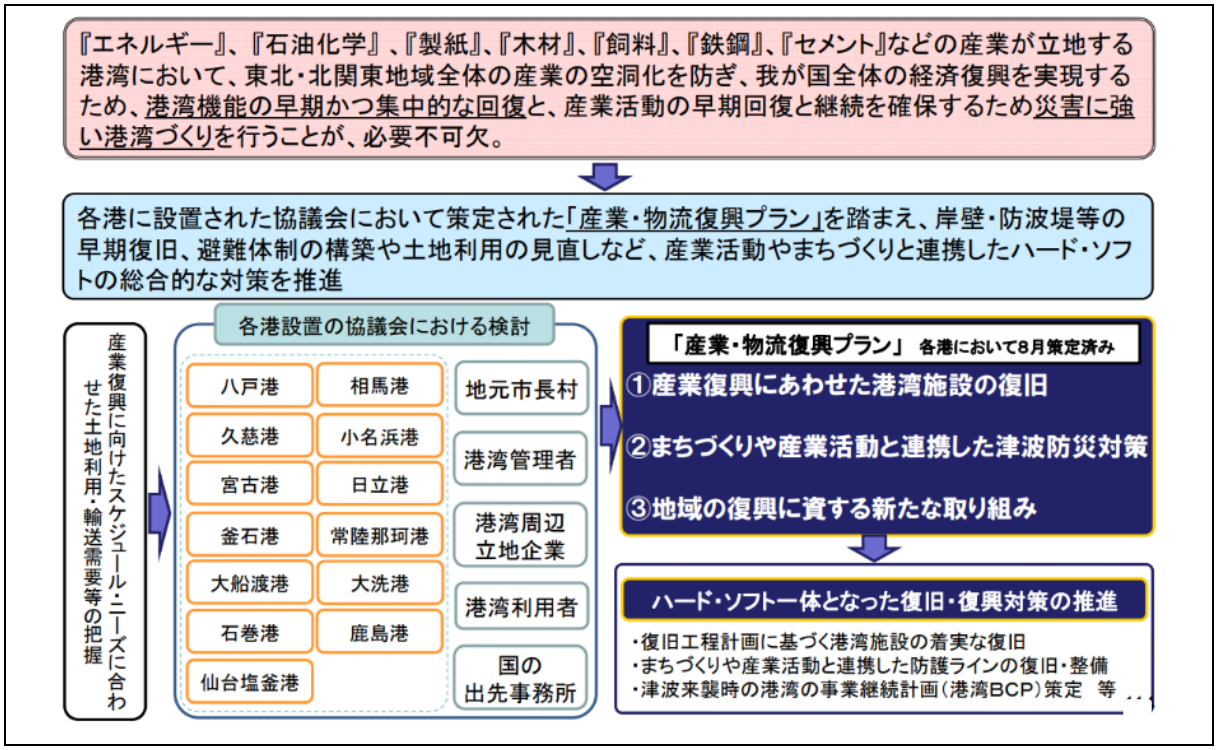
- Recovery process of port and harbour facilities

  Based on the fact that the businesses located behind the wharf have fully resumed their economic activities, such as is the case with Zennoh Silo Corporation, which partially resumed operation on March 15, 2011, Sumitomo Metal Industries, Ltd. (which existed as such at the time), which resumed operation on March 19 and resumed normal operation on May 31, and Mitsubishi Chemical Corporation (which existed as such at the time), which resumed operation on May 20, the aim is to have the quay walls restored during FY2011. In addition, in order to secure the depth of water for large vessels carrying raw materials to the Kashima Coastal Industrial Region, one of the largest industrial complexes in Japan, the dredging of sediment caused by the tsunami in the outer port route, the central route and the southern route, will be carried out with the highest priority.

- Strengthening disaster prevention functions and disaster mitigation functions

  At Kashima Port, the tsunami inundation simulation results showed that the possibility of inundation of the hinterland of the port by a tsunami with high occurrence frequency is low. However, due to the large amounts of flood damage caused by the Great East Japan Earthquake, a study area for tsunami countermeasures will be located and measures will be taken which combine structural and non-structural elements, as is the case with Ibaraki Port. In particular, measures to prevent the outward flow of elements such as tsunami evacuation buildings and containers will be examined for non-structural measures.

Figure 5-10-11 Promotion of the plans for the reconstruction of industry and logistics



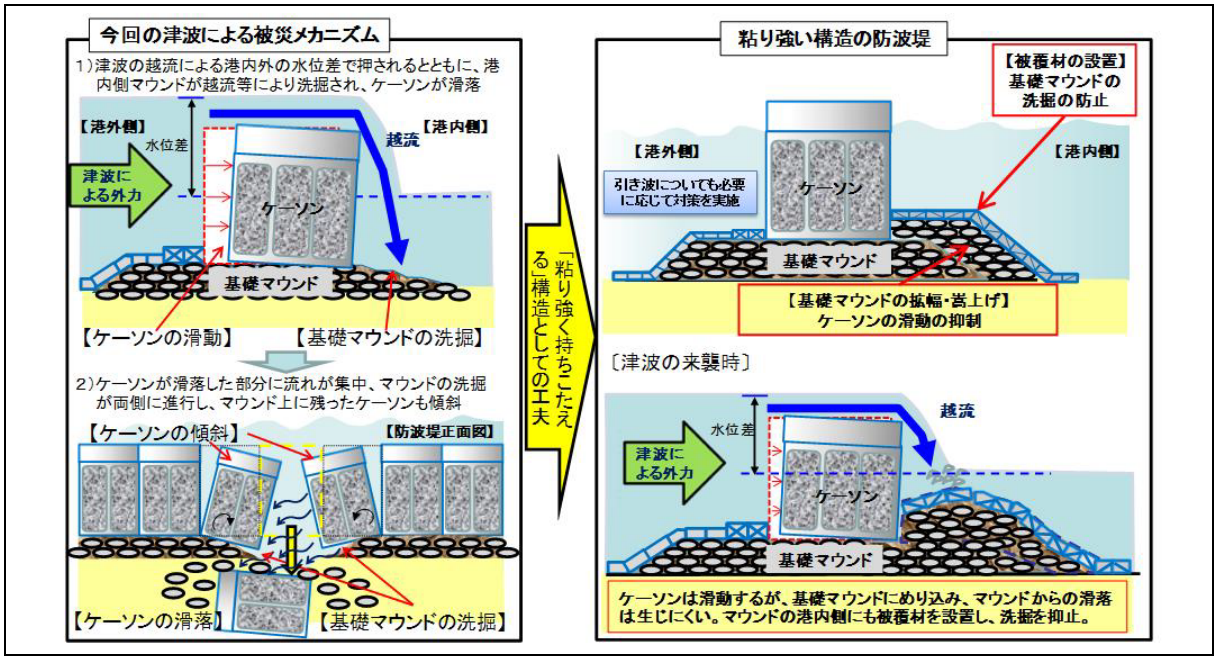
Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

2) Introducing “tough structure” to tsunami breakwaters

During the Great East Japan Earthquake, breakwaters collapsed at many ports due to the tsunami. The causes of damage to elements such as the tsunami breakwaters at Kamaishi Port and Ofunato Port were thought to be the striking of tsunami far above the breakwater which scoured the foundation mounds inside the ports. The tsunami also generated extremely large water level differences between inside and outside the port bordered by the breakwater and the subsequently pushed the caisson to the inside of the port, causing the caisson to slip down.

For the restoration of tsunami breakwaters, etc., it was decided to have the design be geared towards tsunamis with a high frequency of occurrence (such as the Meiji Sanriku Earthquake Tsunami) based on the recommendations of the Expert Committee of the Central Disaster Prevention Council, and to create a “tough structure” that would achieve disaster mitigation effects even against tsunamis taller than the design tsunamis. As for the “tough structure,” the basic construction method to be deployed was one involving the raising of the foundation mound inside the port to increase sliding resistance. It was decided that the method would be adopted after having conducted a verification of the effects through hydraulic experiments, etc.

Figure 5-10-12 Conceptualization of a breakwater with a tough structure



Source) Ministry of Land, Infrastructure, Transport and Tourism, “Introduction of Tough Breakwaters and Seawalls”

(2) Port projects

At each affected port, reconstruction projects were implemented based on the aforementioned “plans for the reconstruction of industry and logistics” formulated at each port. The following consists of the overviews of the main projects, the names and scales of the projects, and the durations of the projects at each affected port.

< Hachinohe Port >

- Project overview

  The development of breakwaters and other structures in the Hachitaro and Outer Harbor Districts of Hachinohe Port will improve the logistics efficiency of port users, and result in the securing safe harbor areas and the reduction of marine accidents involving offshore vessels in stormy weather.
- Project name and project scale
  - Hachinohe Port Hachitaro and Outer Harbor Districts Breakwater Development Project: 116.4 billion yen (of which, the port development project costs are 114.1 billion yen) *Budget allocation amount during the reconstruction period: Project costs of 11.6 billion yen
  - Hachinohe Port Hachitaro and Kawaragi Districts Sea Route Anchorage Development Project: 56.6 billion yen (of which, the port development project costs are 56.6 billion yen) *Budget allocation amount during the reconstruction period: 30.6 billion yen
  - Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 3.1 billion yen in national funds
- Project implementation period

  FY2011 to FY2020 *Development period during the reconstruction period

< Kuji Port >

- Project overview

  Protect lives and property from tsunami damage and ensure the safe and secure lives of residents of the region. In addition, improving calmness of ports will increase the efficiency of transportation by improving the cargo handling rate at quay walls. In conjunction with this, the number of marine accidents involving

offshore vessels will be reduced by ensuring evacuation anchorages for vessels.

- Project name and project scale
  - ■ Kuji Port Bay District Breakwater Development Project: 155 billion yen (of which, the port development project costs are 146.8 billion yen)
    *Budget allocation amount during the reconstruction period: Project costs of 54.8 billion yen
  - ■ Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 159.8 billion yen in national funds
- Project implementation period
  FY2011 to FY2020 *Development period during the reconstruction period

< Miyako Port >

- Project overview
  Improve the level of calmness at the port, improve the efficiency of cargo handling of ships, and ensure safety. In addition, contribute to regional revitalization by expanding opportunities for social interaction in association with improved convenience in terms of tourism and social interaction facilities.
- Project name and project scale
  - ■ Miyako Port Ryujinzaki District Breakwater Development Project: 25.4 billion yen (of which, the port development project costs are 24.9 billion yen)
    *Budget allocation amount during the reconstruction period: Project costs of 8.8 billion yen
  - ■ Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 159.8 billion yen in national funds
- Project implementation period
  FY2011 to FY2020 *Development period during the reconstruction period

Figure 5-10-13 Overview of breakwater development in Miyako Port's Ryujinzaki District

Source) Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "Restoration and Reconstruction of Ports in Tohoku: The Forefront of Reconstruction" (Date updated: March 18, 2021)

< Kamaishi Port >

- Project overview
  In order to support the reconstruction of industry, improvements to facilities will be implemented to ensure the safe mooring of ships and to improve cargo handling efficiency.
- Project name and project scale
  - ■ Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 159.8 billion yen in national funds
- Project implementation period
  FY2015-FY2016 *Development period during the reconstruction period

< Ofunato Port >

- Project overview

  By relocating the logistics base functions of aging existing facilities, efficient facilities will be developed to cope with the increase in the size of vessels. This will reduce maritime transportation costs and contribute to the promotion of regional economies and regional revitalization.

- Project name and project scale
  - Ofunato Port Nagahama and Yamaguchi Districts Domestic Distribution Terminal Development Project: 4.6 billion yen (of this, port development project costs are 4.6 billion yen) *Budget allocation amount during the reconstruction period: Project costs of 1.6 billion yen
  - Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 159.8 billion yen in national funds
- Project implementation period

  FY2012 to FY2020 *Development period during the reconstruction period

< Sendai-Shiogama Port >

- Project overview

  The development of the integrated transport terminal for Nakano District of Sendai Port District will result in the improvement of the efficiency of logistics for companies using the port and function as a logistics base for elements such as emergency cargo transport in the event of a large-scale earthquake.

- Project name and project scale
  - Sendai-Shiogama Port (Sendai Port District) Nakano Area Integrated Transport Terminal Improvement Project: 6.8 billion yen (of which port development costs are 6.2 billion yen) *Budget allocation amount during the reconstruction period: Project costs of 300 million yen
  - Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 42.5 billion yen in national funds
- Project implementation period

  FY2011 to FY2020 *Development period during the reconstruction period

< Soma Port >

- Project overview

  The development of an international logistics terminal at the district of Wharf No. 3 will result in the improvement of the efficiency of logistics for companies using the port and the securing of a function as a logistics base for elements such as emergency cargo transport in the event of a large-scale earthquake. In addition, it will be possible to transport LNG in bulk using large vessels, meaning that the stable and inexpensive import of LNG to the Tohoku region with the Soma Port serving as the base for that, will become a reality. In addition, a harborage will be secured within the port to reduce maritime accidents involving offshore vessels in stormy weather.

- Project name and project scale
  - Soma Port Sea Route and Anchorage Development Project: 6.8 billion yen (of which, the port development project costs are 2.3 billion yen) *Budget allocation amount during the reconstruction period: Project costs of 2.5 billion yen
  - Soma Port Wharf No. 3 District International Distribution Terminal (Earthquake Proof) Development Project: 31 billion yen (of this, port development project costs are 26.2 billion yen) *Budget allocation amount during the reconstruction period: Project costs of 6.4 billion yen
  - Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 30 billion yen in national funds
- Project implementation period

  FY2011 to FY2020 *Development period during the reconstruction period

< Onahama Port >

- Project overview

  By developing an international logistics terminal, build a wide-area and efficient maritime transport network for resources, energy, etc., and improve the efficiency of transport using large transport ships.

Moreover, a harborage will be secured within the port to reduce maritime accidents involving offshore vessels in stormy weather.

- Project name and project scale
  - Onahama Port International Distribution Terminal Development Project: 176.9 billion yen (of that, 168.3 billion yen is for the port development project)
    *Budget allocation amount during the reconstruction period: Project costs of 55.1 billion yen
  - Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 30 billion yen in national funds
- Project implementation period
  FY2011 to FY2020 *Development period during the reconstruction period

Figure 5-10-14 Overview of the Onahama Port International Distribution Terminal Project

Source) Ports and Airports Department, Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, “Nine Years After the Great East Japan Earthquake: The Present and Future of Tohoku Ports” (March 11, 2020)

< Ibaraki Port >

- Project overview
  Improve the efficiency of logistics in the outer harbor district by responding to the increasing size of ships and the increasing demand in terms of foreign cargo. Moreover, together with the securing of calmness inside the port, a harborage will be secured within the port to reduce maritime accidents involving offshore vessels in stormy weather. In addition, in the Central Wharf District, a response will be undertaken with respect to large ships and the efficiency of logistics will be improved by eliminating congestion at mooring facilities and wharf sites. In addition, earthquake-proof berths will be developed to enable the transport of emergency supplies to the hinterland in the event of a large-scale earthquake.
- Project name and project scale
  - Ibaraki Port, Outer Harbor District of Hitachinaka Port District, Project for the Development of an International Marine Container Terminal: 117.3 billion yen (of which, the port development project costs are 95.2 billion yen) *Budget allocation amount during the reconstruction period: Project costs of 13.1 billion yen
  - Ibaraki Port, Central Wharf District of Hitachinaka Port District, International Distribution Terminal Development Project: 6.3 billion yen (of this, port development project costs are 5.9 billion yen) *Budget allocation amount during the reconstruction period: Project costs of 5.4 billion yen
  - Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 5.4 billion yen in national funds
- Project implementation period
  FY2011 to FY2020 *Development period during the reconstruction period

< Kashima Port >

- Project overview
  In addition, a response will be undertaken with respect to the increasing size of ships and the efficiency of

logistics will be improved by eliminating congestion at mooring facilities and wharf sites. In addition, efforts will be made to ensure calmness in the port, secure harborage areas, and curb the burying of waterways by drifting sand. Furthermore, earthquake-proof berths will be developed to enable the transport of emergency supplies to the hinterland in the event of a large-scale earthquake.

- Project name and project scale
  - Kashima Port, Outer Harbor District International Distribution Terminal Development Project: 112.5 billion yen (of this, port development project costs are 103.1 billion yen) *Budget allocation amount during the reconstruction period: Project costs of 41.7 billion yen
  - Projects (reconstruction) to which the general subsidy for social infrastructure development applies: Amount included within 5.4 billion yen in national funds
- Project implementation period
  FY2011 to FY2020 *Development period during the reconstruction period

Since it was necessary to dispose of disaster waste over a wide area in order to carry out recovery and reconstruction projects, the Ministry of Land, Infrastructure, Transport and Tourism provided local governments and other entities with information such as that concerning the types of waste that can be recycled and the candidate sites for sea-surface disposal sites, and accepted the waste at designated recycling ports and other ports. In addition, in order to promote landfill disposal of disaster waste and accumulated sediment, subsidies were provided for the putting in place of revetments for landfill waste in the Ishinomaki Port District of Sendai-Shiogama Port and the Hitachinaka Port District of Ibaraki Port. At Sendai-Shiogama Port, a mixture of tsunami sediment and by-products generated in the steelmaking process was used as gravel for a part of work such as the quay walls-raising work.

(3) Improvement effects

The following are overviews of the effects yielded after the implementation of projects at each affected port.

< Hachinohe Port >

The improvement of breakwaters, waterways, anchorages, etc. has resulting in the improvement of the calmness of the port and ensured the safety of cargo handling at the berth, and has served to support the improvement of efficiency in terms of distribution undertaken via transport by large ships. As a result, contributions have been made in the form of private-sector investment of approximately 96 billion yen and the creation of employment for approximately 150 people with efforts such as having LNG terminals and shipbuilding factories located in the coastal area.

< Kuji Port >

By improving the breakwater, the level of calmness in the port has been improved and safety in cargo handling work at the quay walls has been ensured As a result, contributions have been made in the form of private-sector investment of approximately 6.5 billion yen and the creation of employment for approximately 30 people by having a biomass power plant located in the coastal area.

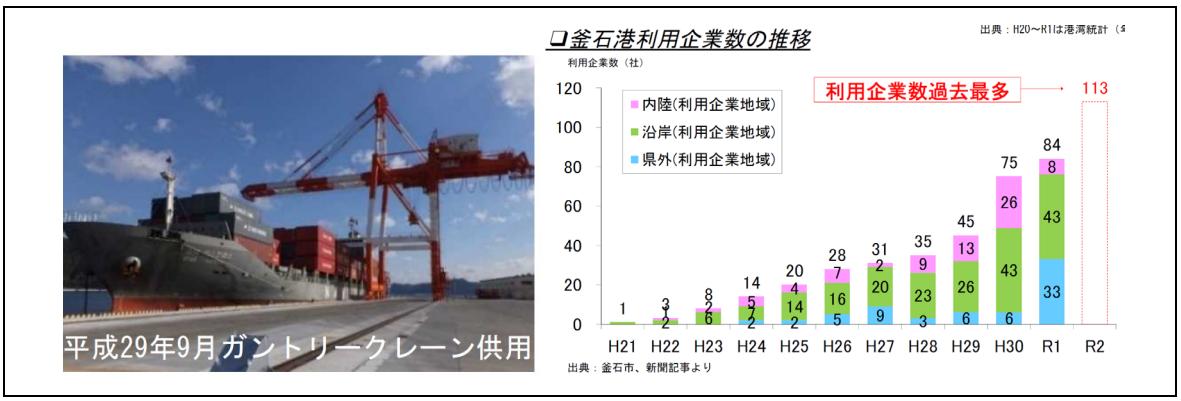
< Miyako Port >

By improving elements such as the breakwater and quay walls, the level of calmness in the port has been improved and safety in cargo handling work at the quay walls has been ensured. In addition, the improved convenience of tourism and social interaction facilities has resulted in expanded opportunities for tourism and interaction in the region, and the number of tourists entering Miyako City has increased to a figure that is approximately is 2.7 times higher than that before port development took place, contributing to the promotion of the regional economy.

< Kamaishi Port >

Logistics efficiency has been improved by strengthening the cargo handling function of the quay walls and new factories have been located in the inland areas. This has contributed to private-sector investment of approximately 3 billion yen and the creation of approximately 70 jobs. The number of companies using the port has also increased significantly.

Figure 5-10-15 Strengthening port functions at Kamaishi Port and changes in the number of companies using the port



Source) Ports and Airports Department, Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "10 Years After the Great East Japan Earthquake: The Present and Future of Tohoku Ports" (March 1, 2021)

< Ofunato Port >

The improvement of Quay Wall and Roads of port transportation facilities has improved the efficiency of logistics by increasing the size of ships. As a result, biomass power plants have been constructed in the waterfront area, contributing to private-sector investment of approximately 24 billion yen and the creation of employment for approximately 10 people.

< Sendai-Shiogama Port >

The improvement of berths, waterways, anchorages, etc. has improved the efficiency of logistics via transport by large ships. The number of automobiles produced in the Tohoku region by automobile manufacturers using Sendai-Shiogama Port having increased by approximately 1.5 times when compared to before the development of the port took place, contributing to promotion of the local economy.

< Soma Port >

The improvement of breakwaters, waterways, anchorages, etc. has resulting in the improvement of the calmness of the port and ensured the safety of cargo handling at the berth, and has served to support the improvement of efficiency in terms of distribution undertaken via transport by large ships. As a result, things such an LNG base, natural gas power plant, and biomass thermal power plant were constructed in the coastal area, contributing to approximately 214 billion yen in private investment and the creation of more than 170 jobs.

Figure 5-10-16 Overview of Soma Port development

Source) Ports and Airports Department, Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "10 Years After the Great East Japan Earthquake: The Present and Future of Tohoku Ports" (March 1, 2021)

< Onahama Port >

The improvement of breakwaters, waterways, anchorages, etc. has resulting in the improvement of the calmness of the port and ensured the safety of cargo handling at the berth, and has served to support the improvement of efficiency in terms of distribution undertaken via transport by large ships. In association will this, contributions have been made in the form of private-sector investment of approximately 310 billion yen and the creation of employment for approximately 440 people by having things such as a biomass power plant and an IGCC (integrated gasification combined cycle) power plant located in the coastal area.

< Ibaraki Port >

The improvement of breakwaters, waterways, anchorages, etc. has resulting in the improvement of the calmness of the port and ensured the safety of cargo handling at the berth, and has served to support the improvement of efficiency in terms of distribution undertaken via transport by large ships. In July 2020, the second phase of the parking lot was completed at the Central Wharf District, contributing to the promotion of the local economy as an export base for finished automobiles.

< Kashima Port >

The improvement of breakwaters, waterways, anchorages, etc. has resulting in the improvement of the calmness of the port and ensured the safety of cargo handling at the berth, and has served to support the improvement of efficiency in terms of distribution undertaken via transport by large ships. As a result, grain-related enterprises are located in the coastal areas, contributing to the realization of a stable supply of grains, etc.

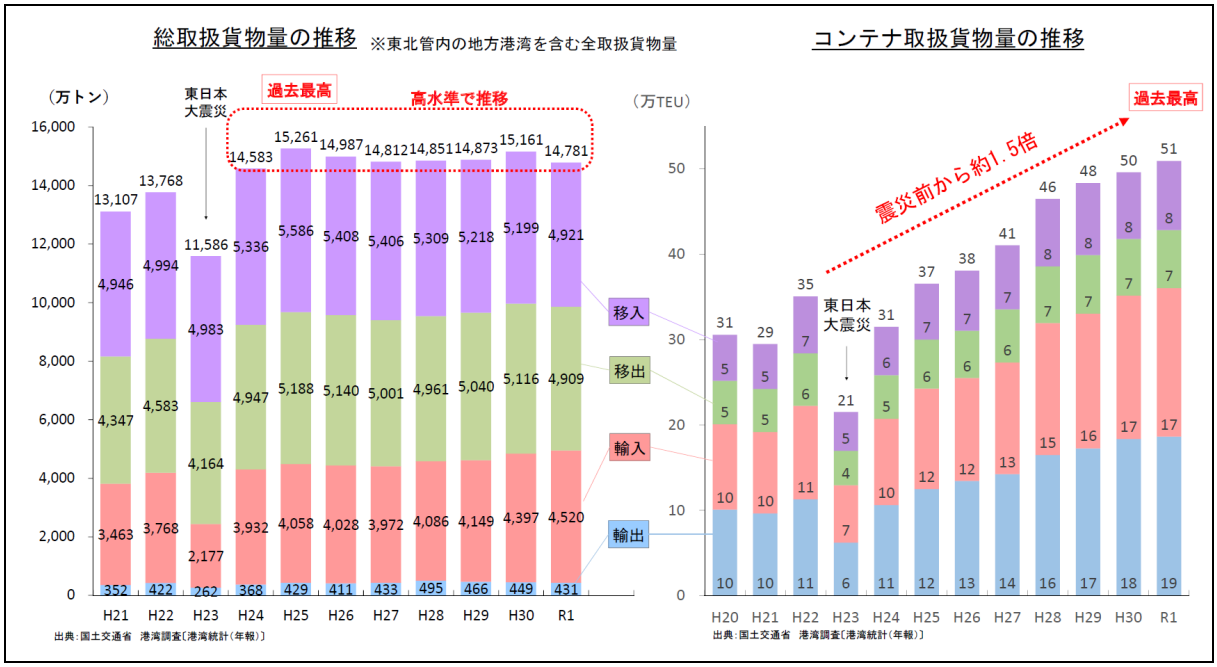
Efforts were made at each port based on the plan for the reconstruction of industry and logistics, etc., which in terms of disaster prevention, meant that breakwaters and other things were restored and newly built. Port BCPs were also formulated at major ports and disaster prevention drills and other such events based on those BCPs were implemented.

On the economic front, the volume of cargo handled at ports such as Hachinohe Port, Kamaishi Port, Sendai-Shiogama Port and Onahama Port after the disaster exceeded that handled before the disaster, with record high volumes being handled. In addition, the number of port calls made by domestic and foreign cruise ships in the Tohoku jurisdiction has steadily increased, reaching a record high in 2019. This is thought to be largely due to the fact that the development of things such as high-standard roads in the regions behind ports resulted in elements such as the promotion of new business establishments in the surrounding areas and in the expansion of port tourism areas in addition to the strengthening of port functions (maintenance of sea routes, quay walls, wharf sites, cargo handling equipment, etc.).

Figure 5-10-17 Disaster drill based on the port BCP (Hachinohe Port in FY2017)

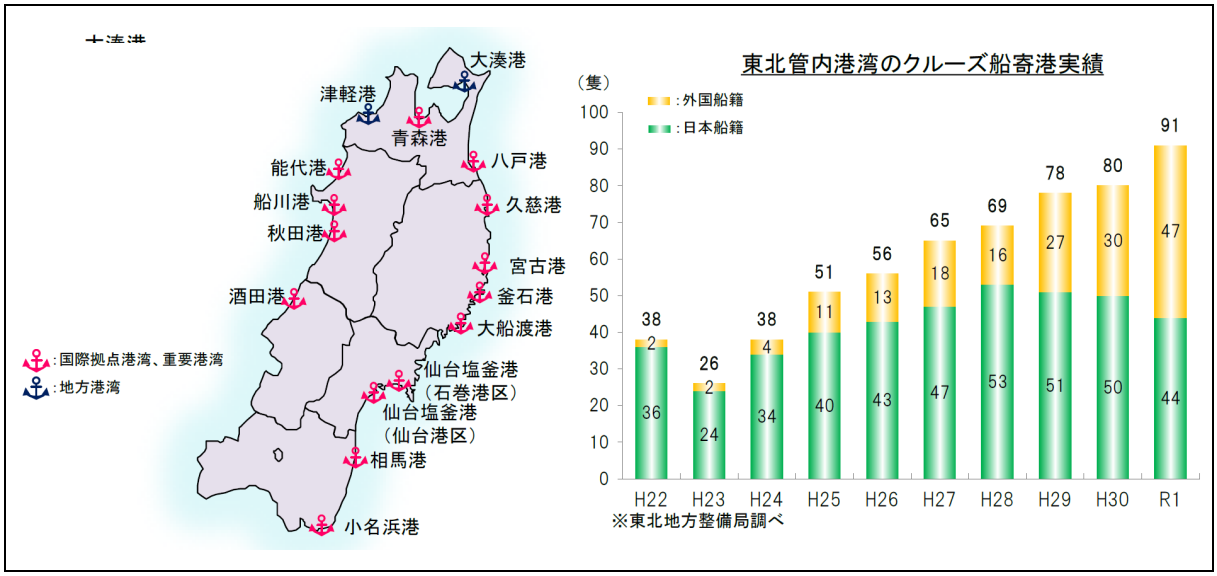
Source) Ports and Airports Department, Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "10 Years After the Great East Japan Earthquake: The Present and Future of Tohoku Ports" (March 1, 2021)

Figure 5-10-18 Volume of cargo handled at ports in the Tohoku Region



Source) Ports and Airports Department, Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "10 Years After the Great East Japan Earthquake: The Present and Future of Tohoku Ports" (March 1, 2021)

Figure 5-10-19 Cruise ship visits at ports in the Tohoku Region



Source) Provided by the Ministry of Land, Infrastructure, Transport and Tourism

4. Issues that arose in project implementation and responses, etc.

(1) Issues that arose in project implementation and responses

In formulating the plan for the reconstruction of industry and logistics, a council consisting of the national government, port administrators, local governments, and enterprises located in ports was established and coordinated in order to smoothly coordinate restoration and reconstruction schedules and the content of development in port areas where various entities operate.

In addition, the Ministry of Land, Infrastructure, Transport and Tourism established special measures for disaster recovery at the terminal of the ferry wharf public corporation of Sendai-Shiogama Port, and put systems in place which are related to the elements such as the Act Concerning Acting as an Agent by the State, etc. for Construction Work Related to Disaster Recovery Projects, etc. for Public Civil Engineering Facilities Damaged by the Great East Japan Earthquake (Act No. 33 of 2011).

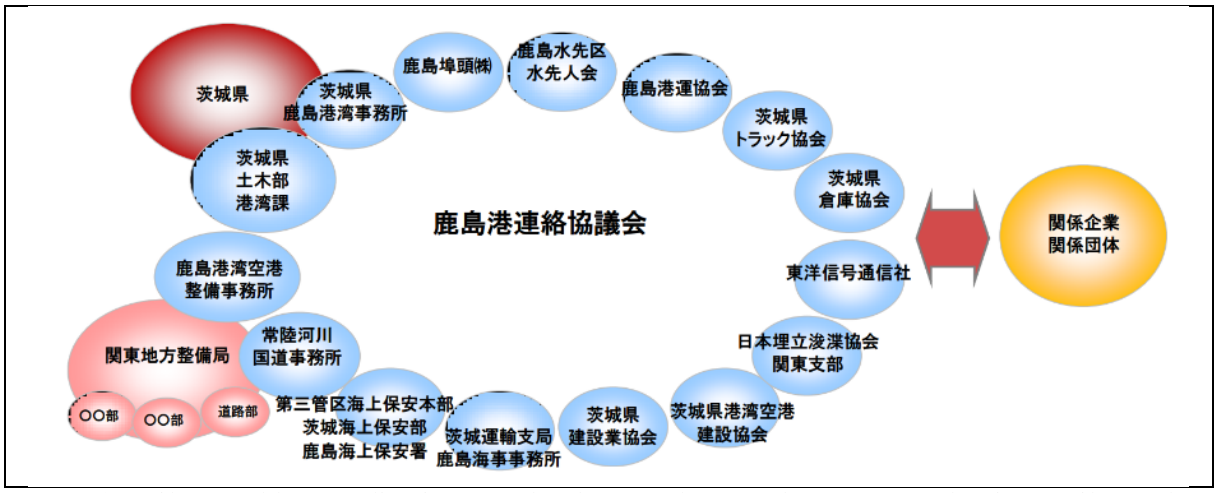
(2) Creative efforts, etc. aimed at preparing for disasters after the Great East Japan Earthquake

Port BCPs were established in conjunction with corporate BCP at each port to enable rapid resumption of business activities in the event of a large-scale disaster. In addition, a council for the continuation of port functions was established in order for the administrative organs and port administrators related to ports and harbors to undertake efforts in various ways to ensure the swift restoration of port functions when port and harbour facilities and other facilities become damaged and logistics functions are suspended.

In addition, in the event of a large-scale disaster similar to the Great East Japan Earthquake, it is assumed that it will be difficult for each port to carry out recovery activities independently, and wide-area cooperation such as cross-regional procurement of materials and equipment necessary for restoration of port functions and mutual cooperation through alternative transportation will be essential. For ports in the Tohoku region, the roles of related organizations and prior measures were organized through the formulation of a “BCP for Tohoku wide-area ports” to ensure that coordination over a wide area would take place.

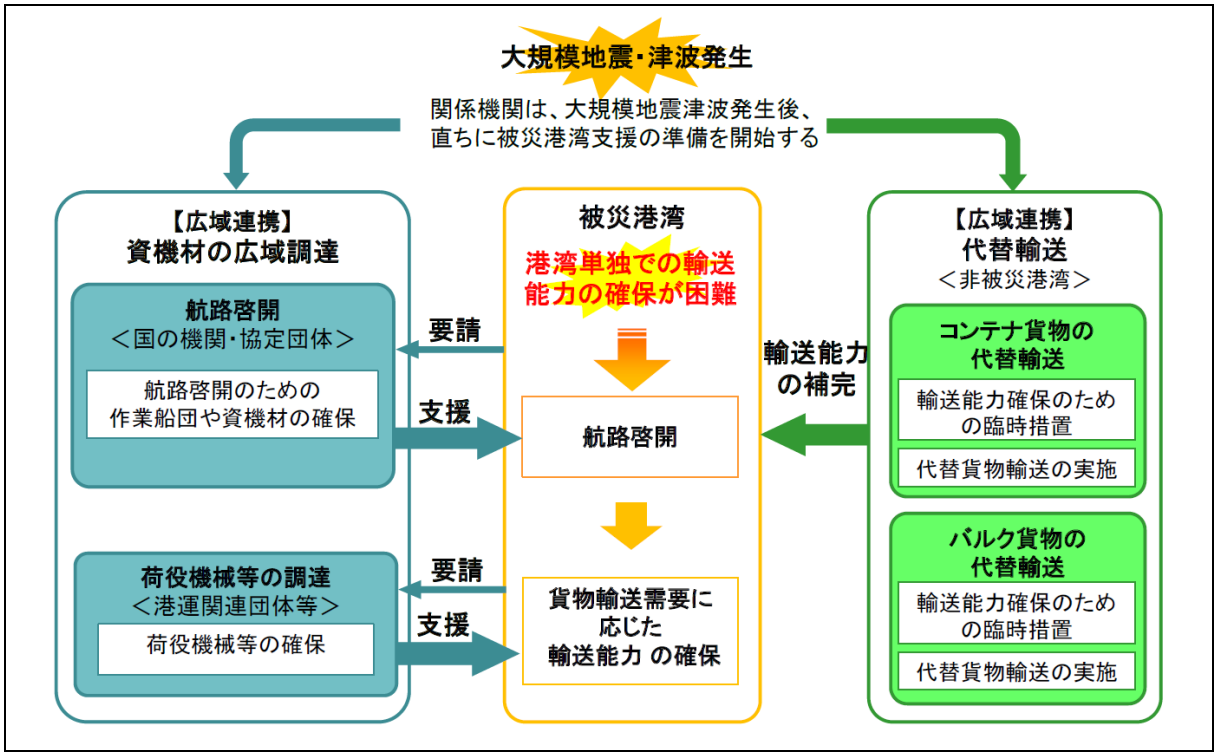
In addition, drills were conducted, and information communication systems were established at each port using elements such as the established port BCPs and the council for continuation of port functions. The training was conducted periodically, and the results of the training were reflected in the action plan through a PDCA cycle while confirming the cooperation system with the relevant parties, and the plan was revised as necessary. In addition, in establishing a liaison system, arrangements were made to consolidate and announce information in the event of a disaster using designated sites on the Internet, and to post information at national and prefectural offices, etc. when access to the Internet is not available.

Figure 5-10-20 Organizational chart for the Kashima Port Liaison Council



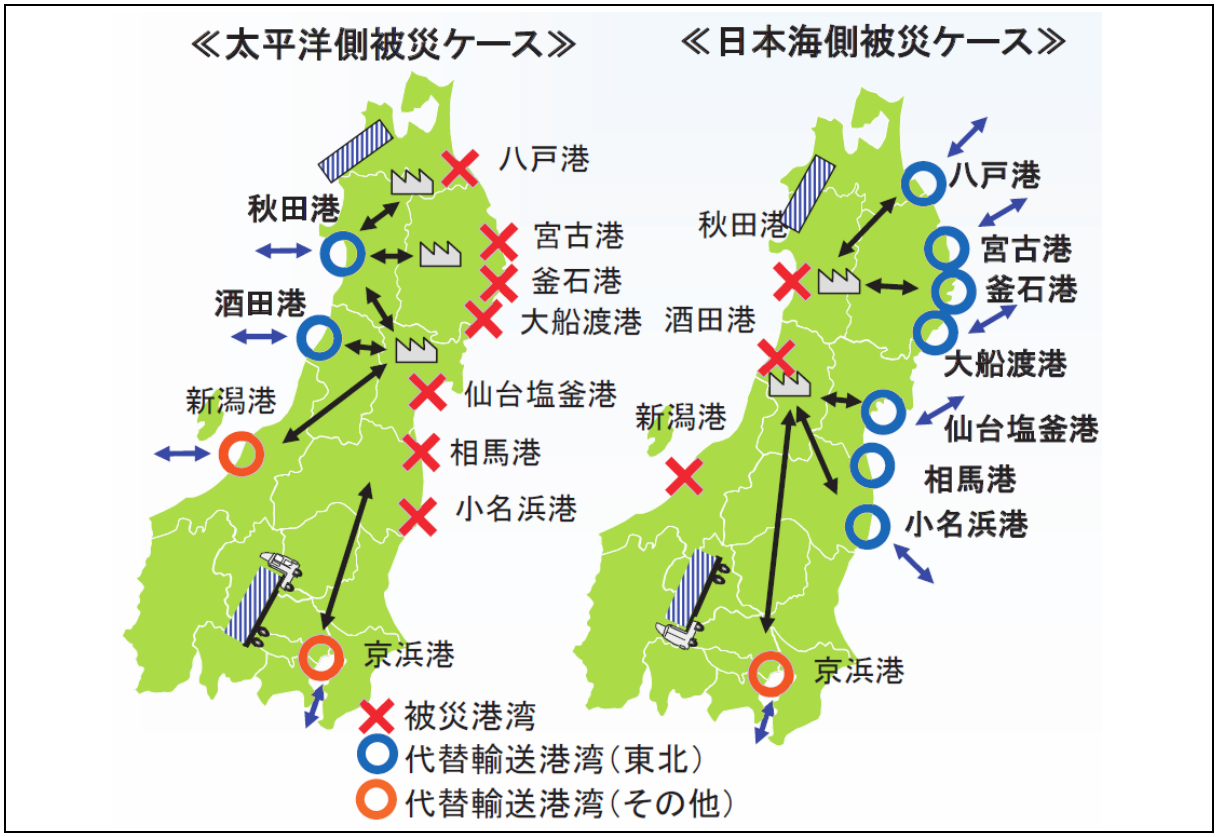
Source) Kashima Port Liaison Council on the Construction of a Cooperative System for Port BCPs, “Action Plan at Kashima Port in the Event of a Large-scale Earthquake”
(March 2017)

Figure 5-10-21 Image of wide-area cooperation at ports in Tohoku



Source) Tohoku Wide-area Ports Disaster Prevention Council, "Revised Plan for Continuing the Functions of Tohoku Wide-area Ports" (February 2022)

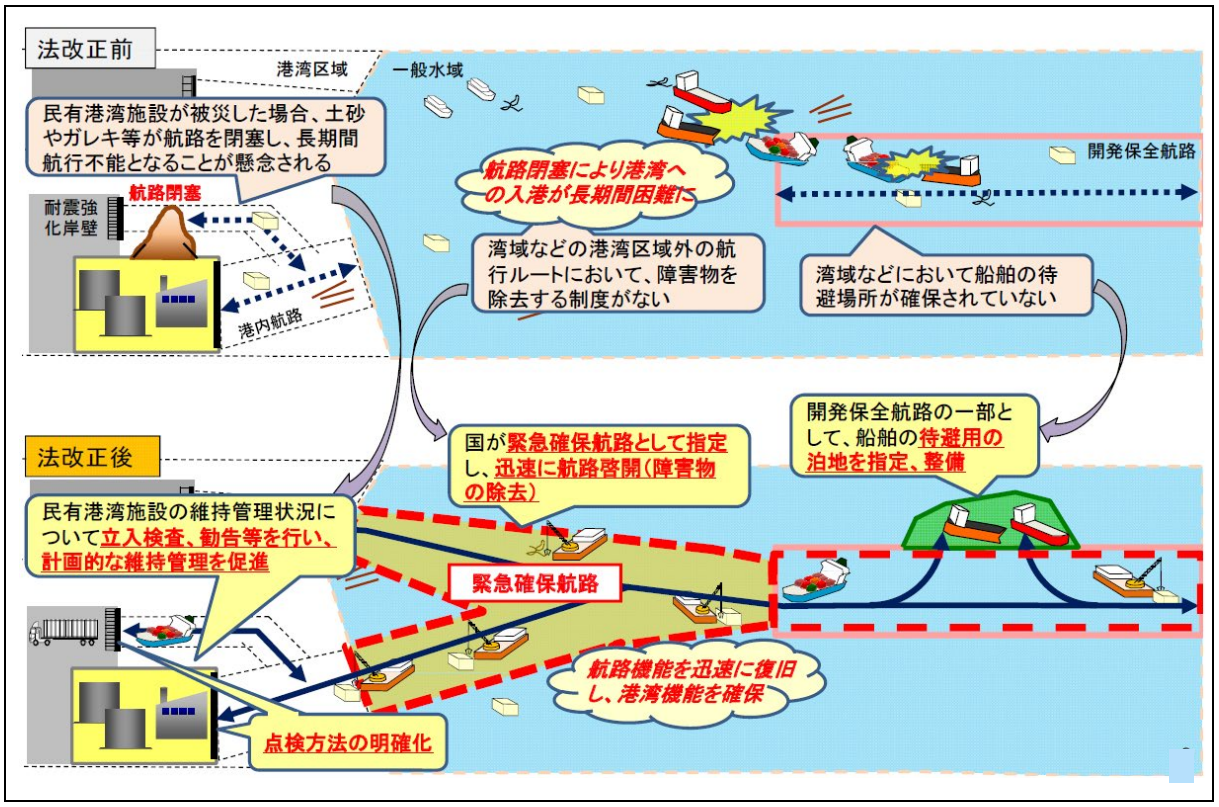
Figure 5-10-22 Image of alternative transport ports in the Tohoku Region



Source: Tohoku Wide-area Ports Disaster Prevention Council, "Brochure for the Plan for the Continuance of Port Functions in the Tohoku Region (BCP): Aiming for Disaster-Resistant Ports"

At the time of the Great East Japan Earthquake, containers, vehicles, fishing boats and other items were washed away and drifted away due to the tsunami, resulting in the closure of waterways. If similar disasters occur in the future, there is a possibility that they will cause a collision of cruising vessels and suspension of emergency supply transportation, which will be a major obstacle to recovery support activities in the disaster-affected areas. In light of this situation, laws and regulations on ports and harbors were revised in 2013 to enable the national government to promptly remove obstacles found along important waterways, etc. As a result, the "waterways to be developed and preserved" which constitute the trunks of navigation routes for ships, were expanded. Also, the "waterways to be secured on an urgent basis" as parts of the branches connecting waterways to be developed and preserved with ports, were newly designated, which enabled the government to carry out the work of clearing each sea route in an integrated manner. Newly designated "Secured Waterways during an Emergency" have been established in Tokyo Bay, Ise Bay, Osaka Bay and the Seto Inland Sea.

Figure 5-10-23 "Waterways to be developed and preserved" and "Secured Waterways during an Emergency"



Source) Ministry of Land, Infrastructure, Transport and Tourism, "53rd Meeting of the Ports and Harbors Subcommittee of the Council of Transportation Policy (Material 1)" (August 7, 2013)

(3) Lessons learned and know-how gained

1) Rapid information collection and emergency restoration

It is necessary to ascertain the situation at an early stage in order to undertake a smooth initial response immediately after an earthquake disaster occurs. However, immediately after a disaster occurs, human resources are limited, and it may be difficult to dispatch personnel to the site due to elements such as damage or traffic congestion on the roads connecting to ports. Therefore, there is a need for a framework involving the live cameras, sensors, drones, etc. that can collect on-site information in real time to quickly collect information, integrate and analyze information using the IoT, and quickly determine the availability of facilities and share it with relevant parties. In addition, assuming the disruption of access routes from land, it is necessary to specify in port BCPs the transport

routes for personnel and equipment using ships to speed up initial responses. In addition, it is necessary to organize in advance the quantity and storage locations of heavy machinery and work vessels necessary for port restoration and to confirm that they can be accessed quickly and safely immediately after a disaster occurs.

For the early recovery of port functions after a disaster, it is important to carry out prompt emergency restoration based on prior cooperation with various entities. For quick and accurate emergency support of transportation and distribution networks and emergency restoration of port activities immediately after a disaster, cooperation with related private companies and local governments and appropriate information dissemination are essential, and a cooperative system for this purpose should be established in ordinary times.

2) Cooperating among related organizations

Ports are required to function as bases for recovery and reconstruction from disasters, and earthquake-proof berths and their surrounding facilities need to be properly utilized as bases for transporting emergency supplies. In the wake of the Great East Japan Earthquake, it took a certain amount of time for the parties concerned to coordinate before ports and harbors were utilized for debris disposal. In preparation for future disasters, it is necessary to establish a system of cooperation with relevant organizations in advance to facilitate smooth disaster waste management, to formulate rules and so on for handling disaster waste, and to organize elements such as the arrangement and capacity of temporary storage sites. In addition, it would be desirable to examine cooperation with recycling ports, which will be the bases for reverse logistics.

Restoration and reconstruction projects for transport infrastructure, including port and harbour facilities, need to be implemented according to regional characteristics while considering their sustainability. Restoration of the original form is not always the only option, and it is also necessary to consider elements such as the strengthening port functions to support the reconstruction of industry.

3) Strengthening the resilience of port and Harbour Facilities

Looking at things from the viewpoint of protection from tsunamis, based on the fact that both the achievement rate in terms of seawalls and the rate of seismic retrofitting in the Nankai Trough Earthquake Disaster Prevention Measures Promotion Area (which has a high risk of tsunamis) are low at present, it is necessary to systematically secure the planned height of seawalls and promote seismic retrofitting in the Nankai Trough Earthquake Disaster Prevention Measures Promotion Area in addition to doing so for the Tokyo Metropolitan Area Earthquake Emergency Countermeasures Area. Furthermore, it will also be necessary to consider multifaceted protective mechanisms depending on the conditions involved.

From the viewpoint of strengthening disaster response capabilities, it is necessary to consider measures for the purpose of systematically increasing the rate at which earthquake-proof berths are put in place in order to reliably maintain logistics networks in the event of a disaster. This is based on the fact that the number of earthquake-proof berths in use is only about half of the number of facilities specified in the port planning (a little less than 40% for trunk freight transportation in particular); the fact that there is an apparent shortage in extensions of earthquake-proof berths used for emergency cargo due to the increase in the size of vessels used for disaster relief operations in recent years; and progress in deterioration of earthquake-proof berths built earlier; and the fact that there are areas with no earthquake-proof berths in peninsulas where ships are the only means of transportation in the event of a disaster. It is also necessary to promote the extension of earthquake-proof berths for emergency cargo transport, to promote measures against their deterioration, and so on.

4) Securing maritime transport networks in times of disaster

From the perspective of promoting measures to build a disaster-resistant maritime transport network, even if port BCPs have already been established at each port, it may be difficult to respond to a large-scale disaster in reality. Therefore, it is necessary to enhance response capability by strengthening cooperation among relevant parties and clarify the division of roles through the implementation of drills that take into consideration the possibility of complex disasters, drills based on wide-area port BCPs that utilize councils for wide-area disaster prevention at ports, and drills that go beyond regional blocs to improve response capabilities. In particular, in the event of an earthquake such as a Nankai Trough Earthquake, which is expected to cause a tsunami over a wide area, it will be necessary to quickly clear sea routes. Therefore, it will be necessary to establish a cooperative system for work

involving the clearing of obstacles from sea routes when it comes to waterways to be developed and preserved and waterways to be secured on an urgent basis.

In the Great East Japan Earthquake, a large number of debris and a large number of vehicles and containers were buried in anchorages and waterways. These obstacles were removed at the time of emergency recovery and during subsequent restoration and reconstruction projects. However, it cannot be said that all obstacles have been completely removed, and there is still a possibility that some obstacles remain in the sea. It is also necessary to examine in advance elements such as the policies on how to handle such obstacles when they are newly discovered in the future and need to be removed.