Chapter 5 Reconstruction of Homes and Cities

Section 5 Roads

1. Overview of damage

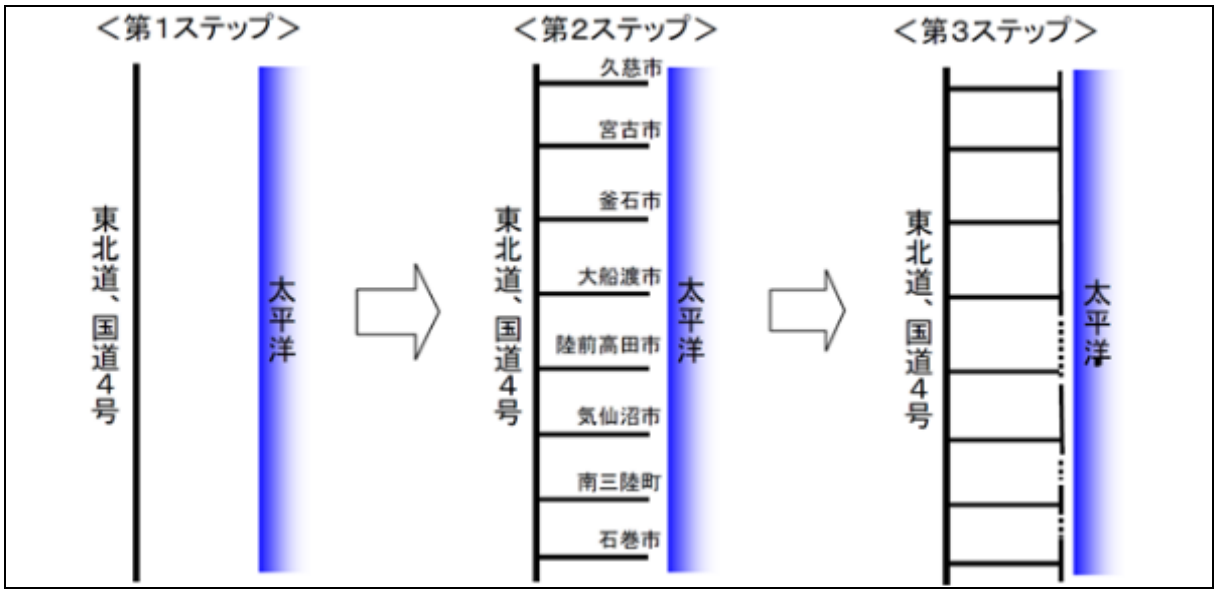
The Great East Japan Earthquake damaged 4,198 roads, and approximately 16,000 people were isolated as a result of severed roads. In terms of national highways managed directly by the national government, 22 sections of National Route 45 were closed to traffic. The superstructures of five bridges, including the Kesen Ohashi Bridge (181.5 meters long) in Rikuzentakata City, were washed away, and two other bridges sustained severe damage equivalent to a total collapse.

2. Emergency restoration

In accordance with agreements with organizations such as the Japan Civil Engineering Contractors' Association, Inc., the Tohoku Regional Development Bureau of the Ministry of Land, Infrastructure, Transport and Tourism began road clearance operations on March 12, 2011, the day after the earthquake, in cooperation with local construction companies, the Ground Self-Defense Force, the police, and other organizations. The aim was to remove debris from the roads and perform simple repairs of uneven surfaces to make roads passable, even if only for emergency vehicles, thereby opening relief routes.

Immediately after the earthquake, the clearance routes from the Tohoku Expressway and National Route 4 to major cities along the Pacific coast were consolidated into 16 routes. During the first phase, efforts concentrated on clearing roads to secure relief routes (Operation “Teeth of a Comb”). Emergency restoration work to enable the passage of general vehicles was carried out in the second stage. On the day after the earthquake, 11 routes were cleared, and 15 routes were cleared by the 15th of the same month. The government also advanced the clearance of longitudinal roads along the Pacific coast, such as National Route 45, and 97% of the roads became passable by the 18th, one week after the earthquake.

Figure 5-5-1 Conceptual Diagram of Road Clearance



Source: ~~Website~~ of the Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, “Why Roads Were Cleared at an Early Stage”

There were three factors that allowed road clearance to be completed in a short period of time.

① The relatively minor damage due to the seismic reinforcement of bridges

In light of the damage to roads caused by the Great Hanshin-Awaji Earthquake, 490 bridges under the jurisdiction of the Tohoku Regional Development Bureau were strengthened through seismic reinforcement measures. As a result, catastrophic damage such as bridge collapse was prevented.

Example: National Route 13 & Fukushima-Nishi Road (Fukushima City): Azuma Overpass and Izumi Overpass

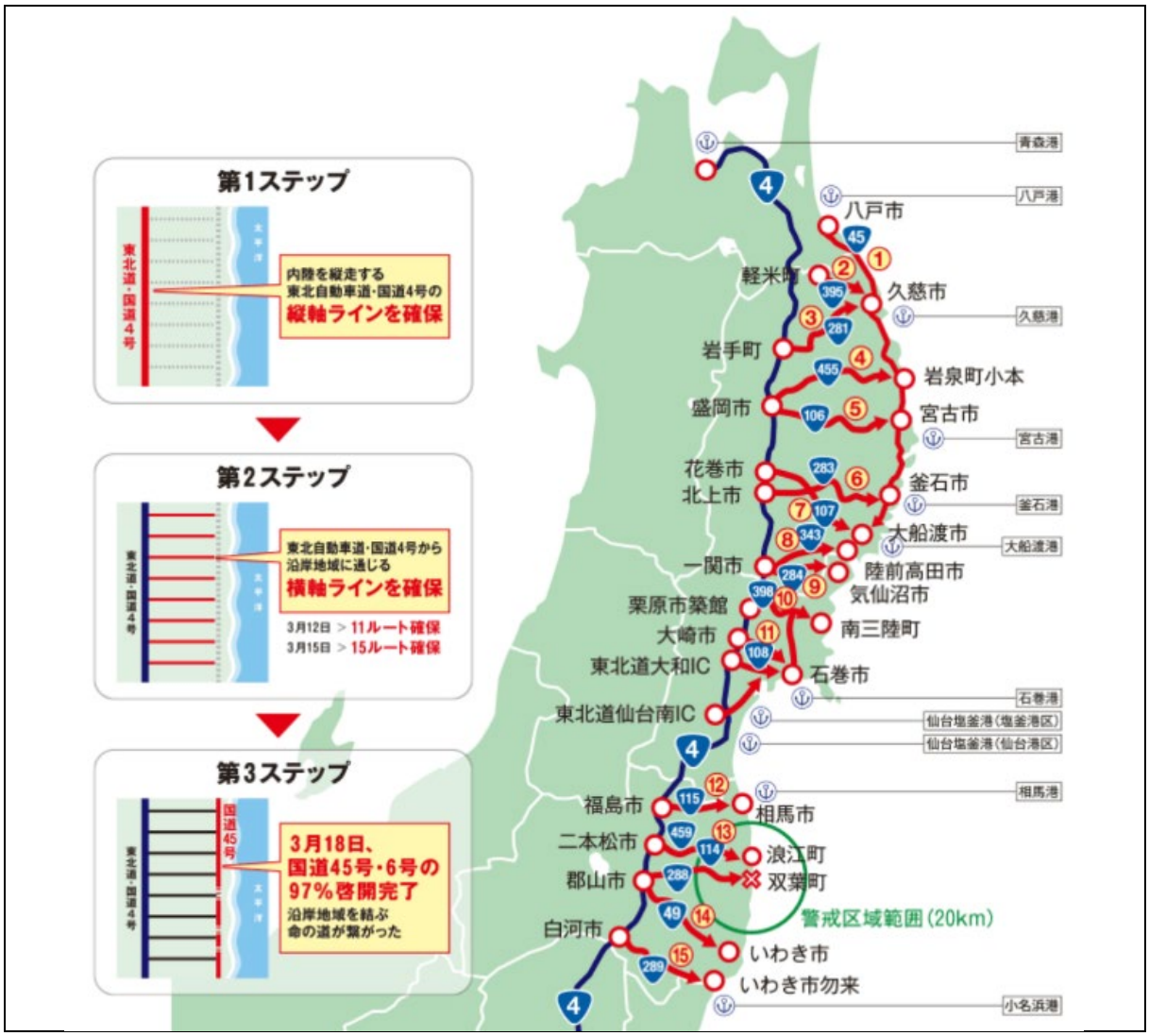
② Prioritization of clearing 16 routes through Operation "Teeth of a Comb"

Immediately after the earthquake, 16 routes leading from inland areas to the disaster-affected areas were consolidated under Operation Teeth of a Comb. This allowed for focused inspections and investigations, prioritizing road clearance.

③ Gaining the cooperation of the local construction industry through disaster agreements

To clear roads on coastal routes such as National Route 45, disaster agreements with the construction industry had been arranged in advance, enabling cooperation from local construction companies and others immediately after the earthquake (a total of 52 teams, including local and inland construction companies).

Figure 5-5-2 Map of Operation Teeth of a Comb



Source: ~~Website~~ of the Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism "Earthquake Memorial Museum"

3. Restoration and reconstruction

(1) Road projects by the national government

1) Restoration work

As described above, the Tohoku Regional Development Bureau started clearing roads on the day after the earthquake. Emergency restoration projects were started in succession beginning with areas where clearance had progressed, and around 70% of the damaged areas were restored within a week. By April 10, 2011, one month after the earthquake, the emergency restoration of National Route 6 between Yotsukura Town and Hisanohama Town in Iwaki City (approximately 4 km in length) had been completed, and the road was opened to traffic. This enabled passage through a total of 42 sections, including detour sections (and excluding sections subject to nuclear power plant regulations). As a result, a total of 607 km of road under the jurisdiction of the Tohoku Regional Development Bureau were made passable—481 km on National Route 45 between Sendai City and the border of Aomori Prefecture (including Sanriku Road), and 126 km on National Route 6 between the border of Ibaraki Prefecture and Sendai City (excluding sections subject to nuclear power plant regulations).

There were three factors that allowed the emergency restoration of roads to be completed in a short period of time.

① Prompt conclusion of construction agreements through the use of emergency discretionary contracts

By utilizing what are known as emergency discretionary contracts (Article 29-3, Paragraph 4 of the Public Accounting Act), which are special provisions that apply in the event of a disaster, restoration work was assigned to construction companies under pre-arranged disaster agreements, enabling construction to begin once written consent was received. In addition, notices of suspension orders were generally issued for construction projects that were underway within the jurisdiction at the time of the earthquake. This allowed resources and personnel to be redirected to disaster-affected areas, ensuring full-scale efforts for emergency restoration.

② Prompt collection of information by TEC-FORCE

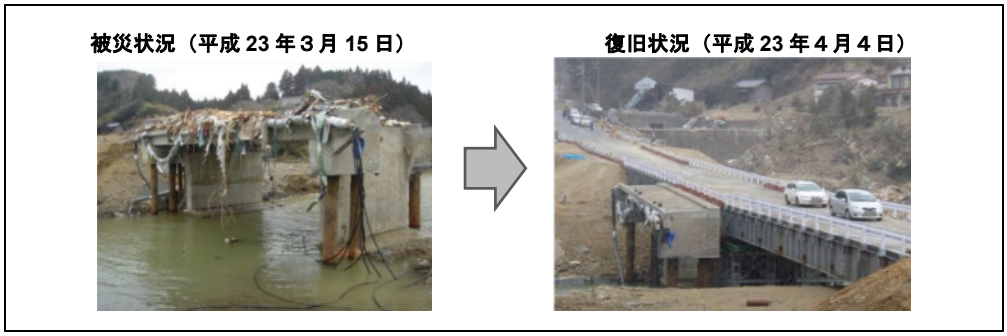
The support organization of the Tohoku Regional Development Bureau and national development bureaus (TEC-FORCE) began dispatching personnel to the site on the day after the earthquake (255 workers in 63 groups were dispatched at the peak of support efforts on March 16). These workers promptly assessed the status of damage by utilizing micro-communication lines (exclusive lines of the Ministry of Land, Infrastructure, Transport and Tourism), satellite communication vehicles, Ku-SAT, and lighting vehicles. This enabled restoration measures to be planned as quickly as possible.

③ Innovative construction methods, etc.

With regard to bridges damaged by the tsunami, three emergency prefabricated bridges (two owned by the Ministry of Land, Infrastructure, Transport and Tourism, and one owned by the SDF) were promptly installed to enable passage as quickly as possible.

In addition, at grade-separated crossings with JR, which were affected by the tsunami, consent was obtained from JR to use temporary embankments on the railway tracks, enabling the quick construction of temporary roads. In some cases, leftover construction soil from the vicinity was utilized in order to secure embankment materials quickly at embankment outflow points.

Figure 5-5-3 Photos Before and After Restoration (Nijuichihama Bridge on National Route 45 (Kesennuma City, Miyagi Prefecture))



Source: Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

2) Reconstruction Roads and Reconstruction Support Roads

a. Project overview

Due to severe financial constraints, only some sections of high-standard highways along the Sanriku coast had been opened for traffic at the time of the earthquake. These sections included the Kamaishi Yamada Road (Sanriku Expressway) and Sennin-Toge Road (Trans-Tohoku Expressway). Because of this, it took more than seven hours to travel from Sendai to Miyako immediately after the disaster due to traffic congestion and detours on National Route 45.

On the other hand, in light of past tsunamis, the Sanriku Expressway was planned on elevated land, allowing it to avoid damage from the earthquake or tsunami and greatly aid in emergency transport. In the wake of the earthquake, roads functioned as emergency transportation roads for human assistance and the transport of goods. They also served as tsunami evacuation sites and helped prevent flooding, demonstrating secondary roles in disaster prevention. Examples of such roads include Kamaishi-Yamada Road in Kamaishi City, Iwate Prefecture, where around 570 elementary and junior high school students took refuge without a single casualty, and Sendai Tobu Road, which had an embankment structure that allowed around 230 people to escape danger.

At the Great East Japan Earthquake Reconstruction Design Council meeting held on June 25, 2011, a proposal was made for emergency improvements on the Sanriku Expressway and other expressways in order to strengthen the infrastructure required to support regional activities. Based on this proposal, they began defining the specific route in July of that year, and after consulting with local municipalities and nearby residents, the route was finalized by late August. Project evaluation procedures were conducted from September to October, and following the approval of the third supplementary budget on November 21, the projects began, with the Sanriku Coast Expressway (Sanriku Expressway, Sanriku-Kita Jukan Road, and Hachinohe-Kuji Expressway) designated as a “reconstruction road,” and the Miyako–Morioka Connector (Miyako–Morioka), Trans-Tohoku Expressway Kamaishi-Akita Route (Kamaishi–Hanamaki), and Tohoku-Chuo Expressway (Soma–Fukushima) designated as “reconstruction support roads.” Furthermore, the Miyagi-Kenpoku Road, managed by Miyagi Prefecture, also had its second phase initiated in FY 2011, and its third and fourth phases initiated in FY 2013. These phases were sequentially implemented as reconstruction support road projects.

Figure 5-5-4 Location Map of Reconstruction Roads and Reconstruction Support Roads

Source: Reconstruction Agency, “Current Status of Reconstruction and Future Efforts (October 2022)”

Later, thanks in part to efforts to accelerate the construction work described below, reconstruction roads (Sanriku Coast Expressway) were fully opened to traffic in Miyagi Prefecture with the completion of the Kesennuma Road (Kesennuma-Port IC–Karakuwahanto IC) in March 2021, and with the completion of the Noda-Kuji Road (Fudai IC–Kuji IC) in December of the same year, the entire 359 km section from Sendai to Hachinohe was opened to traffic.

As for reconstruction support roads, the entire Miyako–Morioka Connector opened with the completion of the Hiratsuto Matsukusa Highway (Hiratsuto/Iwai–Matsukusa), and the Kawai–Hakoishi and Hikime–Haratai sections of Miyako Hakoishi Road in March 2021; the entire Trans-Tohoku Expressway Kamaishi-Akita Route (Kamaishi–Hanamaki) opened with the completion of the section between Kamaishi JCT and Kamaishi Sennintoge IC in March 2019; and the entire Tohoku-Chuo Expressway (Soma–Fukushima) opened with the completion of the Soma-Fukushima Road (Ryozen IC–Date-Koori IC) in April 2021. In addition, the entire Miyagi-Kenpoku Road, managed by Miyagi Prefecture, was fully opened in December 2021.

As mentioned above, the reconstruction roads and reconstruction support roads reached a total length of 570 km when the Sanriku Coast Expressway was fully opened in December 2021.

b. Efforts for acceleration

ア） Establishing Reconstruction Road Councils

To achieve the early completion of reconstruction roads and other key projects for reconstruction following the Great East Japan Earthquake, it was essential to address various challenges by building consensus on project progress among all stakeholders, as well as through seamless cooperation with relevant organizations. To this end, Iwate, Miyagi, and Fukushima Prefectures each established their own Reconstruction Road Councils consisting of the prefectural governors, mayors of relevant municipalities, and representatives from the local business community. Each prefecture held seven meetings, with the Tohoku Regional Development Bureau of the Ministry of Land, Infrastructure, Transport and Tourism and each prefecture serving as the secretariats.

Meetings Held

Iwate Prefecture: November 15, 2011 to June 19, 2017 (seven meetings total)

Miyagi Prefecture: November 25, 2011 to June 20, 2017 (seven meetings total)

Fukushima Prefecture: November 26, 2011 to June 27, 2017 (seven meetings total)

イ） Formulation of design concepts

The Sanriku Coast Expressway functioned as a “path to life” after the earthquake, even though only a portion of the road was in service. Roads are required to support daily life (through medical services, industry, and tourism) during times of non-emergency, as well as to protect lives (through evacuation, emergency rescue, and recovery) during disasters. Meanwhile, severe financial constraints demanded even greater efficiency in the development of roads. To address this issue, the following six design concepts were defined and promoted as part of key projects for the reconstruction of disaster-affected areas.

① Ensuring resilience

By establishing routes that avoid areas prone to flooding due to tsunamis, roads will be made resilient, maintaining their transport functionality without disruptions even in the event of a tsunami of the magnitude seen during the Great East Japan Earthquake.

② Keeping costs low

Taking into account local traffic conditions and land use conditions, the use of compact two-lane interchanges will be promoted instead of conventional four-lane trumpet interchanges.

③ Supporting reconstructive urban development

The locations of routes and interchanges will be determined to ensure accessibility and convenience for reconstructive urban development sites planned on elevated ground.

④ Strategic placement of interchanges and other infrastructure that connect to hubs

Interchanges will be placed strategically in order to ensure access to fisheries, commercial and industrial facilities, and disaster prevention hubs, as well as the establishment of emergency vehicle entrances to hospitals.

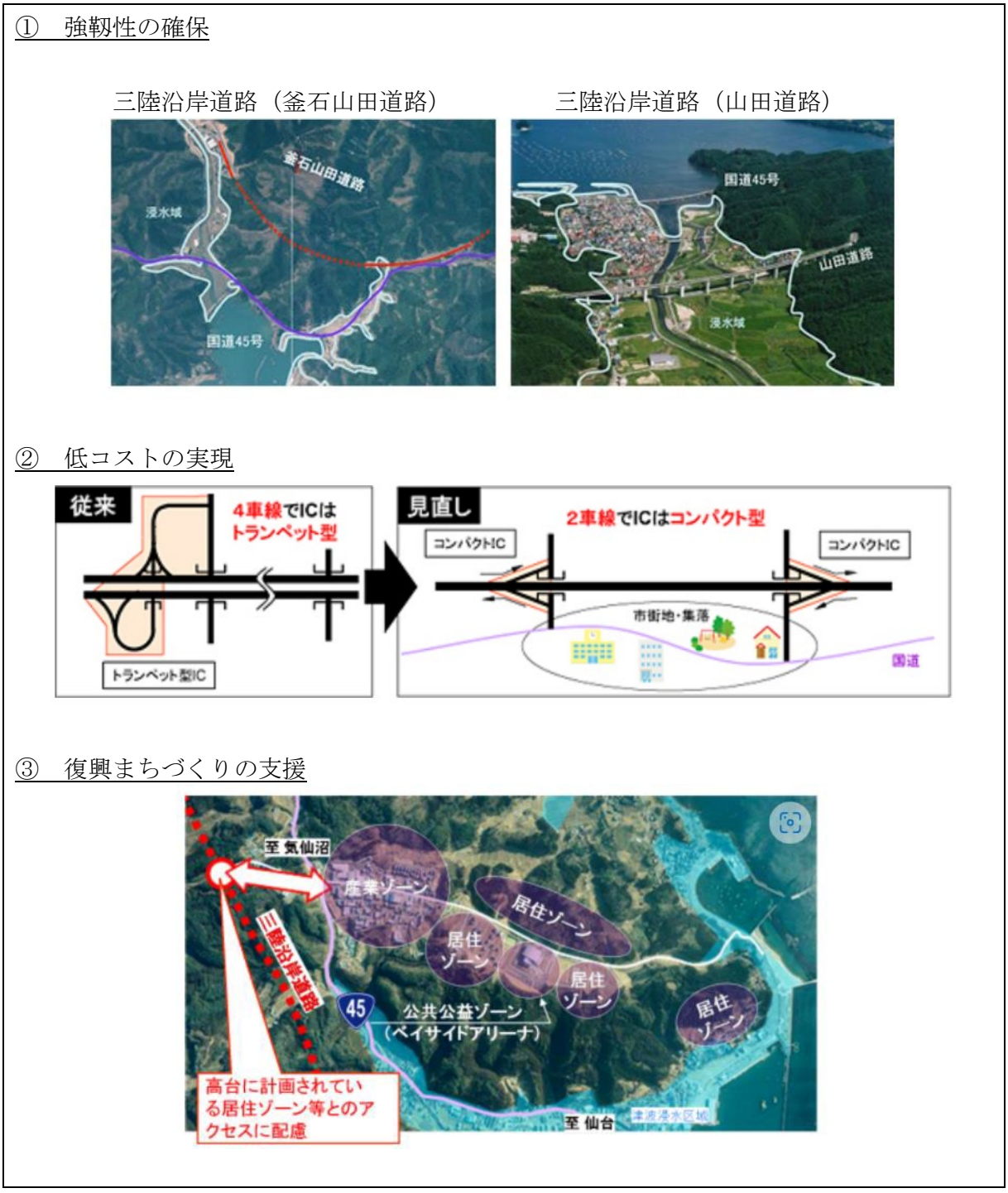
⑤ Enhancing evacuation functions

Taking into account how the Sanriku Coast Expressway served as an evacuation site following the Great East Japan Earthquake, as well as the fact that many local communities have requested direct connections to emergency evacuation routes, roads will be equipped with enhanced evacuation functions (e.g., by installing evacuation stairs) in preparation for times of disaster.

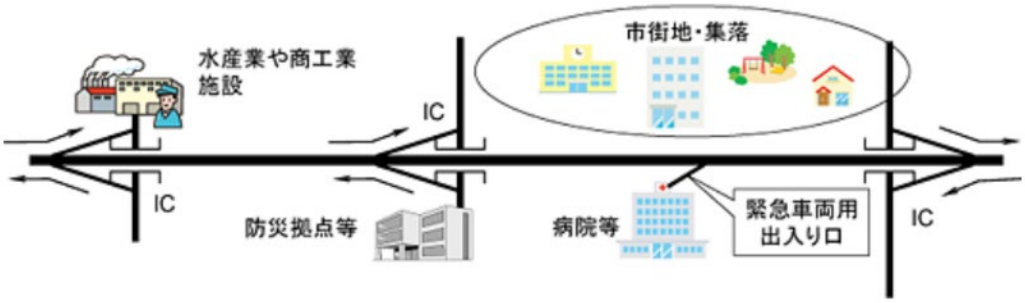
⑥ Assessing passability using information and communication technology (ICT)

Probe data from the public and private sectors will be utilized to provide drivers with information on routes that are passable during disasters.

Figure 5-5-5 Design Concept for Sanriku Coast Expressway

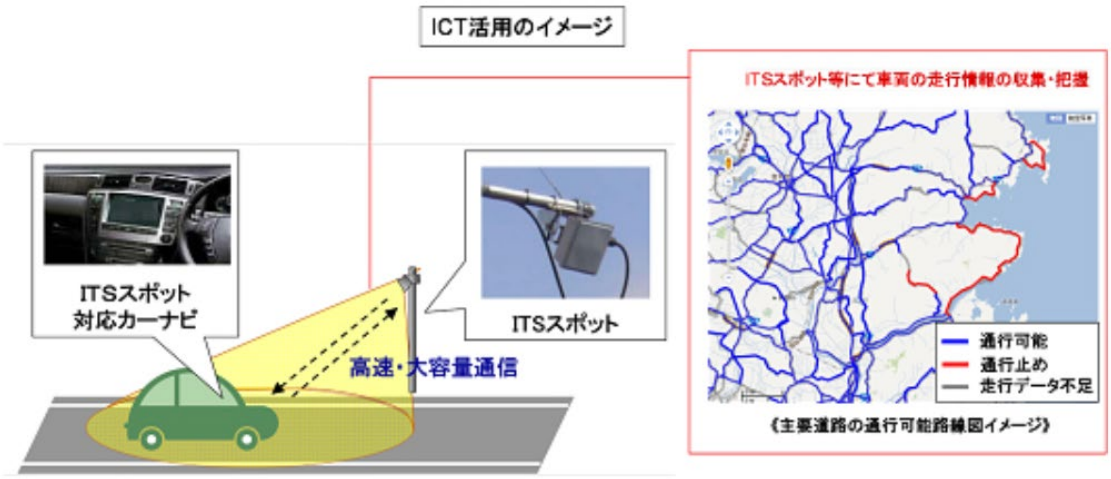


④ 拠点と連絡する IC 等の弾力的配置



⑤ 避難機能の強化

⑥ ICT（情報通信技術）による通行可能性把握



Source: Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, “March 11 Reconstruction Road and Reconstruction Support Road Information Website”

ウ） Implementing business promotion public-private partnerships

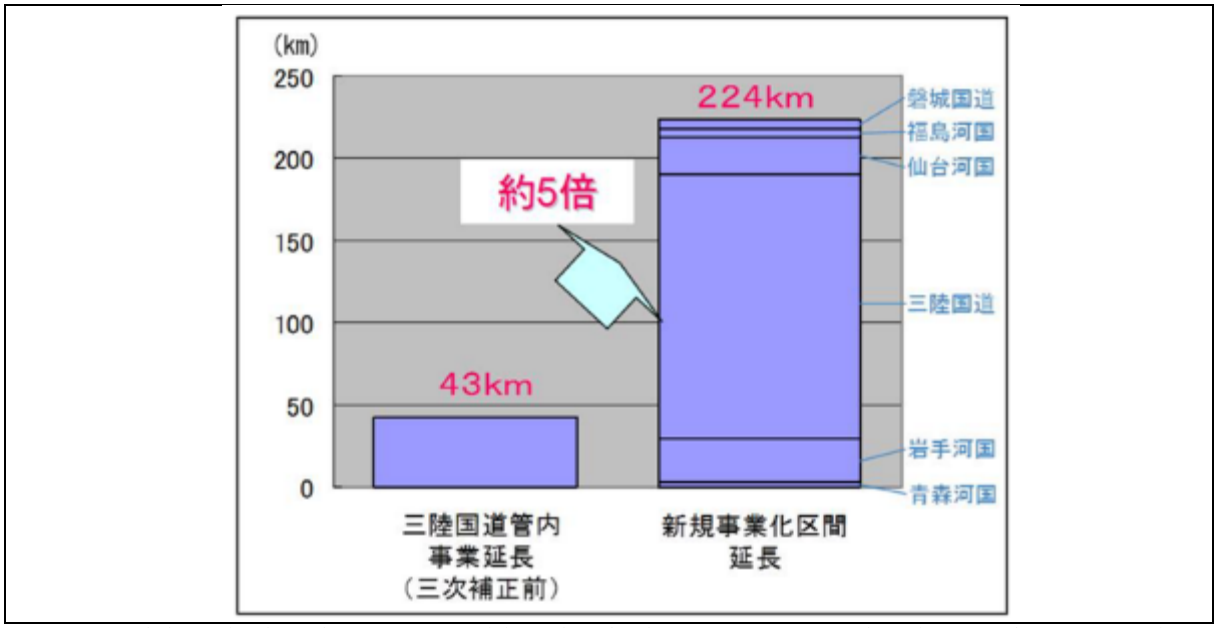
There were requests from the disaster-affected areas for reconstruction roads and reconstruction support roads to be developed quickly, and in order to meet their expectations, project durations needed to be shortened drastically.

Generally, the length of a new road project ranges from several kilometers to several tens of kilometers at most. However, in this case, the length of new projects reached 161 kilometers within the jurisdiction of the Sanriku National Highway Office alone, requiring the implementation of an enormous amount of work equivalent to ten ordinary new projects.

In response, a system was devised to enable enormous tasks to be carried out efficiently and project durations to be shortened. To shorten project durations, it was crucial to shorten the duration of so-called “upstream” processes

that precede the start of construction, which usually takes over six years, or about four years at the earliest.

Figure 5-5-6 Lengths of New Road Project Sections



Source: Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "March 11 Reconstruction Road and Reconstruction Support Road Information Website"

These "upstream" processes include a wide range of tasks, including survey access explanations, surveying, design work, design discussions, coordination with relevant organizations, land investigations, land acquisition, and archaeological assessments.

Of these tasks, those carried out exclusively by employees are expected to involve a huge amount of labor in a wide range of fields. This includes external consultations and coordination, as well as the execution and management of design work entrusted to the private sector. As such, significant shortages of labor are expected, even if employees from regional development bureaus across the country arrive to provide support.

Therefore, as a result of examining ways to utilize superior technology from the private sector in upstream processes, the decision was made to implement public-private partnerships. Private-sector engineering teams, comprising experts in project management, surveying, design, land use, and construction, worked collaboratively to plan the most efficient approaches and implement the projects.

The specific tasks carried out through public-private partnerships for project implementation are as follows.

① Consultation and coordination

Design consultation with local communities, consultation with relevant organizations, etc.

② Management of the execution of contracted tasks

Management of the execution of contracted tasks related to design, investigation, etc.

③ Project progress management and proposals

Studies and proposals for shortening project durations and improving project efficiency

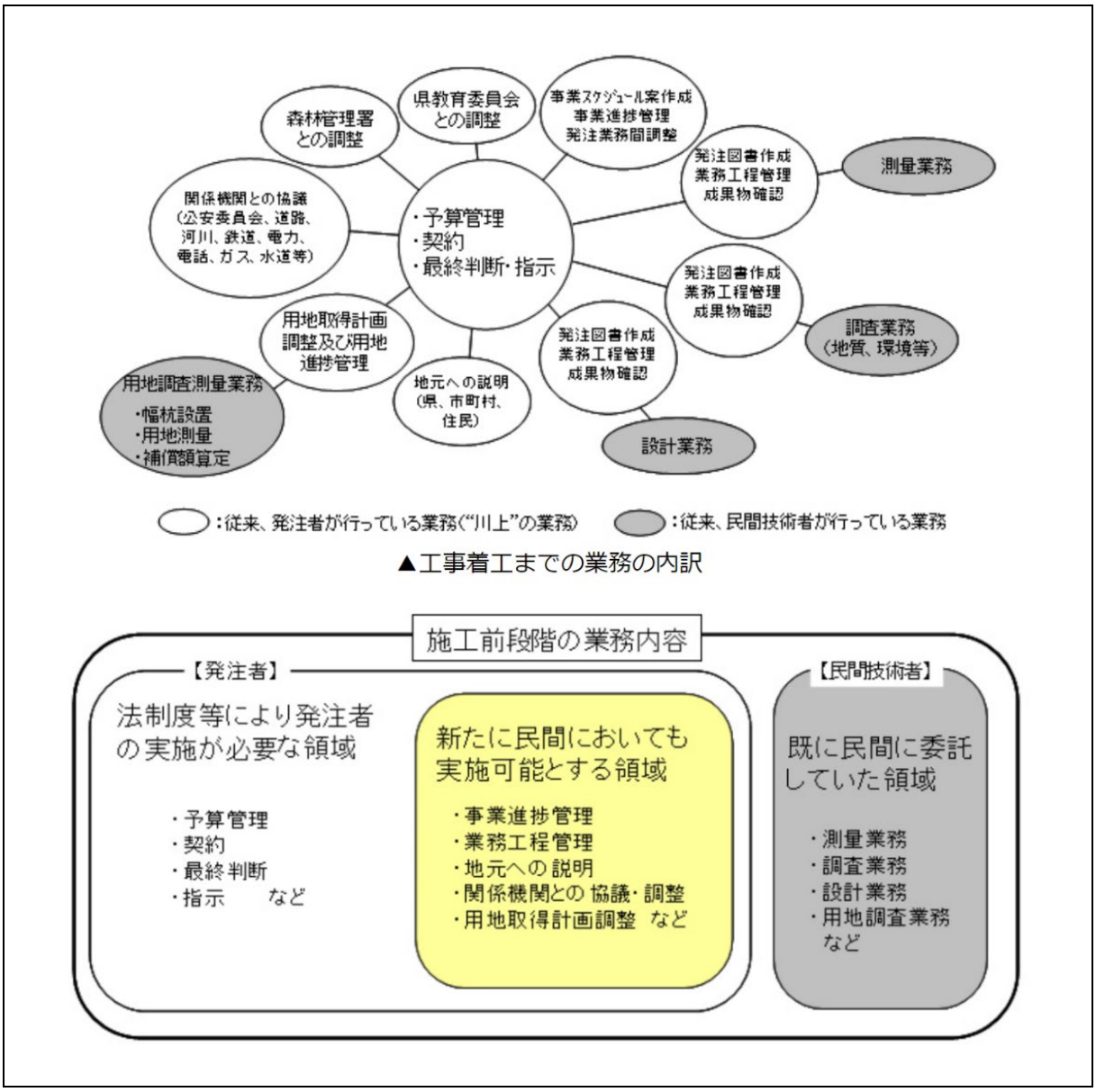
The following are three key points regarding these public-private partnerships for project implementation.

First, this was the first time that private companies were hired to manage tasks such as surveying, investigations, design, and land acquisition prior to construction, which had previously been handled exclusively by the client.

Second, the client and the private-sector engineers, such as those involved in design and construction, cooperated in the execution of the work. By bringing together a diverse range of knowledge and experience, projects were able to be advanced in a manner that was efficient from various standpoints, from design to construction.

Third, the new project sections were divided into roughly 10 to 20 km segments, and teams consisting of personnel from both the public and private sectors were stationed on site at each segment and put in charge of project management.

Figure 5-5-7 Outline of Specific Tasks Carried Out by Public-Private Partnerships



Source: Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "March 11 Reconstruction Road and Reconstruction Support Road Information Website"

c. Benefits of development

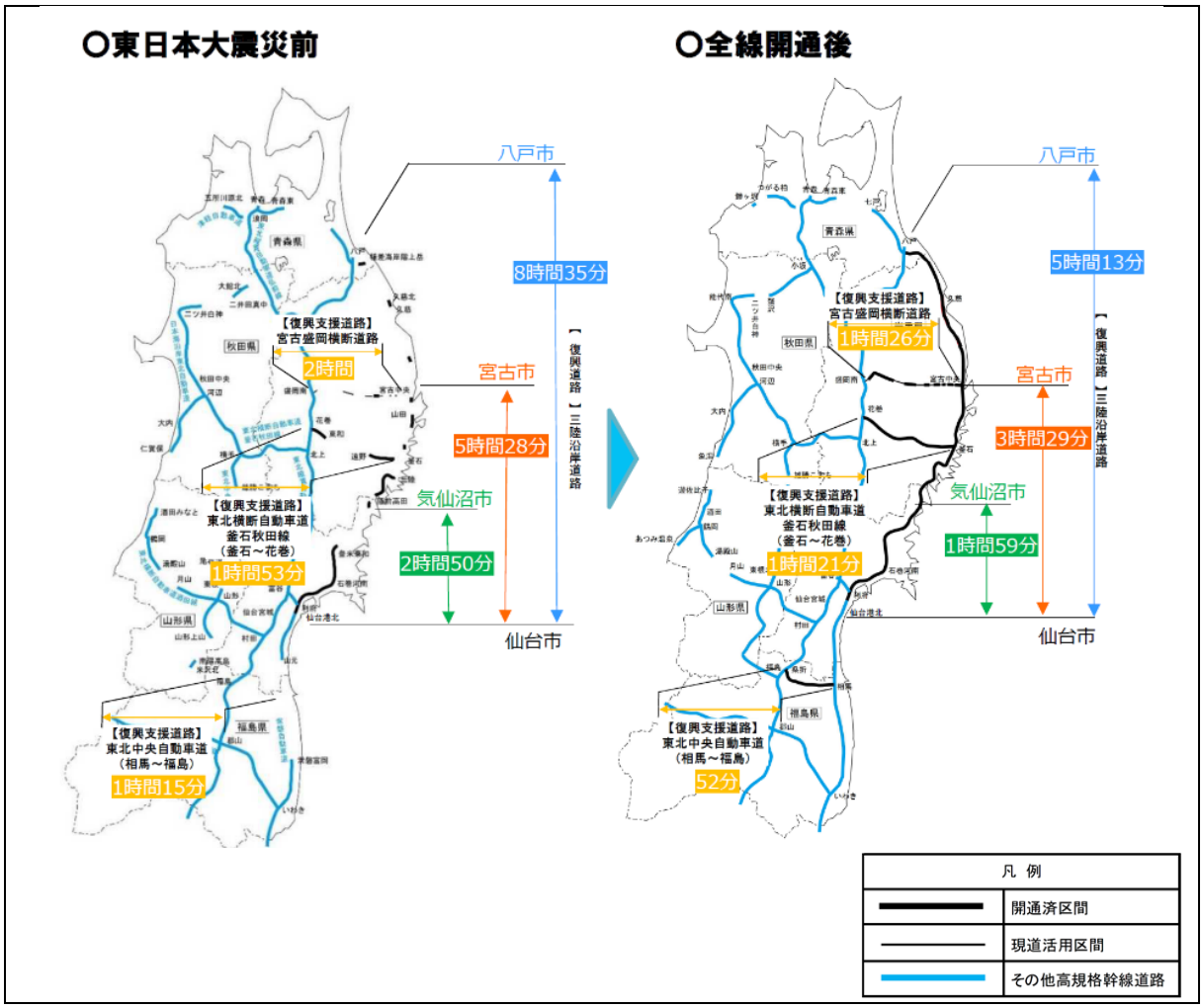
ア） Benefits of development on each route

Travel time between cities along the Sanriku coast was greatly reduced as a result of the development of reconstruction roads and reconstruction support roads.

With the opening of the Sanriku Coast Expressway, the travel time between Sendai and Hachinohe was reduced from 8 hours and 35 minutes to 5 hours and 13 minutes, between Sendai and Miyako from 5 hours and 28 minutes to 3 hours and 29 minutes, and between Sendai and Kesennuma from 2 hours and 50 minutes to 1 hour and 59 minutes.

With the opening of the reconstruction support roads, the travel time between Morioka and Miyako was reduced from 2 hours to 1 hour and 26 minutes, between Hanamaki and Kamaishi from 1 hour and 53 minutes to 1 hour and 21 minutes, and between Fukushima and Soma from 1 hour and 15 minutes to 52 minutes.

Figure 5-5-8 Changes in Travel Time Resulting from the Development of Reconstruction Roads and Reconstruction Support Roads



Source: Ministry of Land, Infrastructure, Transport and Tourism Press Release, “Resilient Reconstruction Roads and Reconstruction Support Roads for New Communities: All Roads in Service at a Critical Juncture 10 Years After the Great East Japan Earthquake” (March 7, 2022)

As a result of coordination with reconstructive urban development projects from the planning stages, around 60% of the interchanges in Miyagi Prefecture and over 90% in Iwate Prefecture were built within 10 minutes of reconstructive urban development project districts. As such, the average distance between interchanges on the Sanriku Coast Expressway is now 4.6 km, resulting in various benefits due to improved convenience. In Shizugawa District, Minamisanriku Town, the placement of the Sanriku Coast Expressway interchange was selected to ensure accessibility to residential zones planned on elevated land. As a result, town halls, hospitals, and houses were built

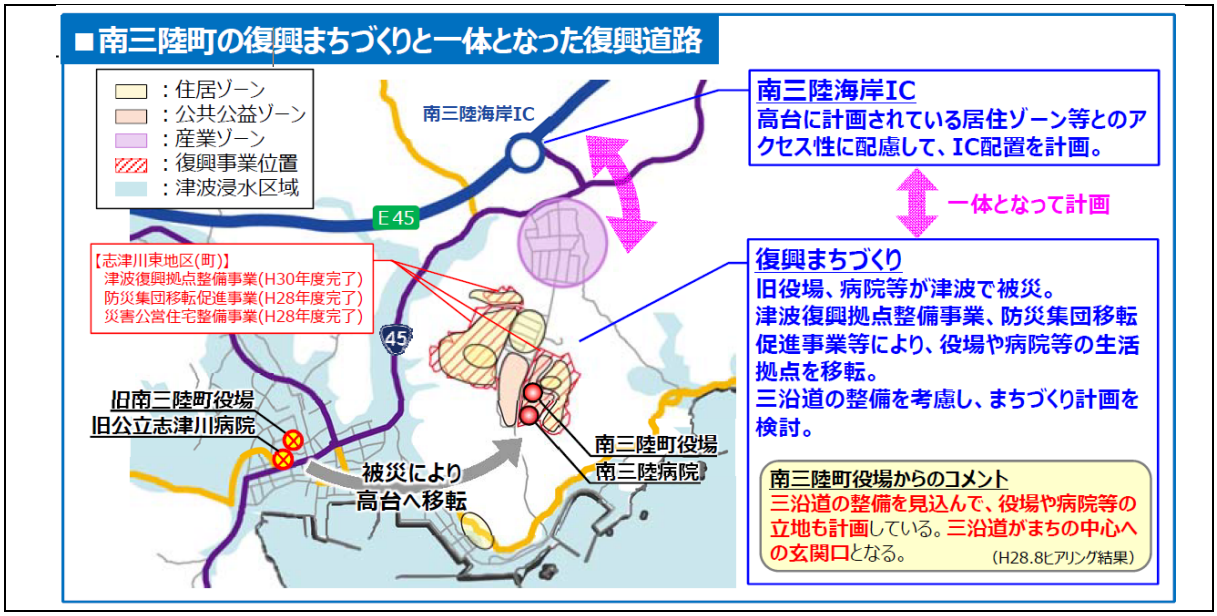
around the interchange, turning the area into a new gateway for the town.

As accessibility to areas along the Sanriku coast improved, new businesses were built and facilities were expanded across the region, leading to increases in corporate municipal tax revenues in some districts compared to before the disaster. In Kamaishi City, for example, the development of an expressway network reduced risks involved in product distribution, such as delayed deliveries. This led to the expansion of large-scale commercial facilities into the city center, contributing to local employment.

In addition, enhanced access to ports and expressway networks improved logistics efficiency, contributing to the reconstruction of industry in disaster-affected areas. In the Soso Region of Fukushima Prefecture, the development of the Soma-Fukushima Road strengthened accessibility to inland areas and prompted companies to choose locations in the hinterland of Soma Port. For example, a steel processing manufacturer operating in the hinterland of Soma Port was able to attract customers from the Yamagata Prefecture area and increase business by shortening delivery times. Furthermore, they were now able to make two round trips per day to transport products to the Nakadori region in Fukushima Prefecture and the Yamagata Prefecture area, allowing them to reduce the number of vehicles required for product transportation.

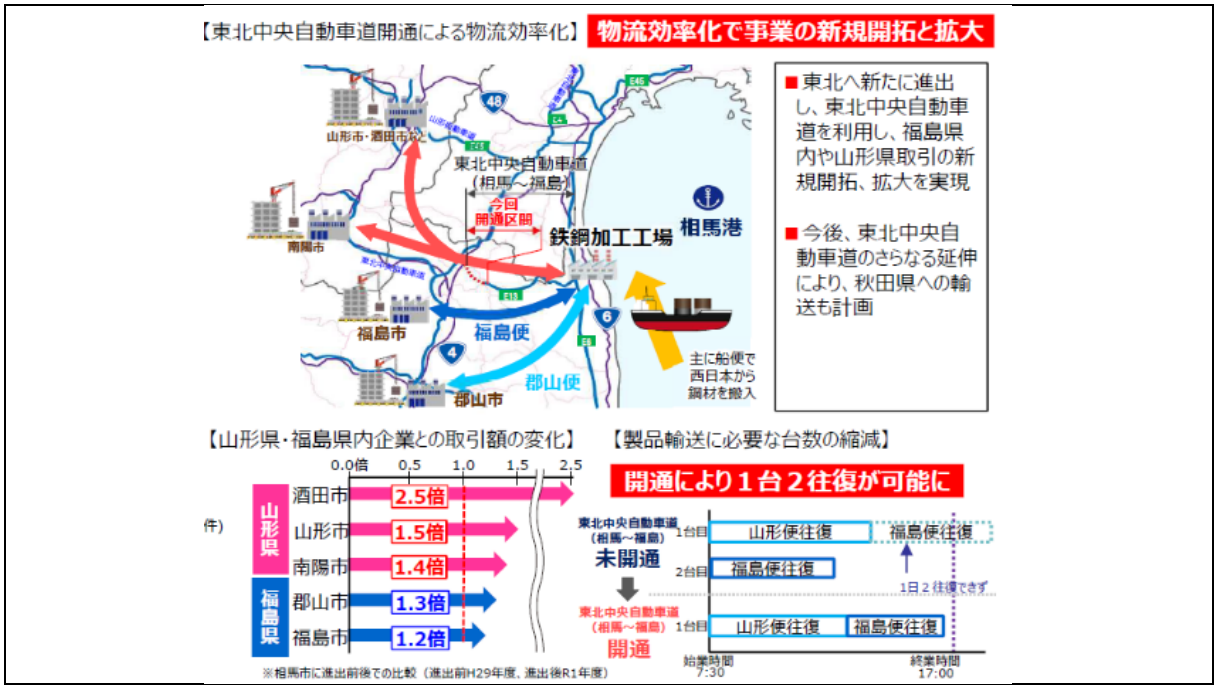
Since the earthquake, a total of 10 roadside stations (*michi no eki*), including five renovated ones, have opened along the reconstruction roads and reconstruction support roads (as of March 2022). By enhancing road guidance and establishing various facilities to attract customers as well as rest services, these roadside stations have helped generate activity and provided support as hubs for reconstructive urban development. Michi no Eki Takata Matsubara, which opened on September 22, 2019, attracted about one million visitors in less than two years since its opening.

Figure 5-5-9 Examples of Coordination with Reconstructive Urban Development (Minamisanriku Town, Miyagi Prefecture)



Source: Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "March 11 Reconstruction Road and Reconstruction Support Road Information Website"

Figure 5-5-10 Examples of Benefits from Improved Distribution Efficiency (Soma City, Fukushima Prefecture)



Source: Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, “March 11 Reconstruction Road and Reconstruction Support Road Information Website”

Figure 5-5-11 Development of Roadside Stations

Source: Ministry of Land, Infrastructure, Transport and Tourism Press Release, “Resilient Reconstruction Roads and Reconstruction Support Roads for New Communities: All Roads in Service at a Critical Juncture 10 Years After the Great East Japan Earthquake” (March 7, 2022)

イ） Examples of urban development utilizing roads (Rikuzentakata City)

In the Sanriku coastal region, the development of the Sanriku Coast Expressway shortened travel times, reducing the time between Sendai and Miyako by approximately 2 hours and between Miyako and Hachinohe by about 1.5 hours, thus shortening travel times between cities. From Rikuzentakata City, the travel time to Sendai City has been reduced by about 1 hour (from about 3.5 hours to about 2.5 hours).

The situation of industry and livelihood in kuzentakata City have been recovering since the earthquake. However, the city continues to face a number of challenges, including the declining population and the utilization of land affected by the disaster.

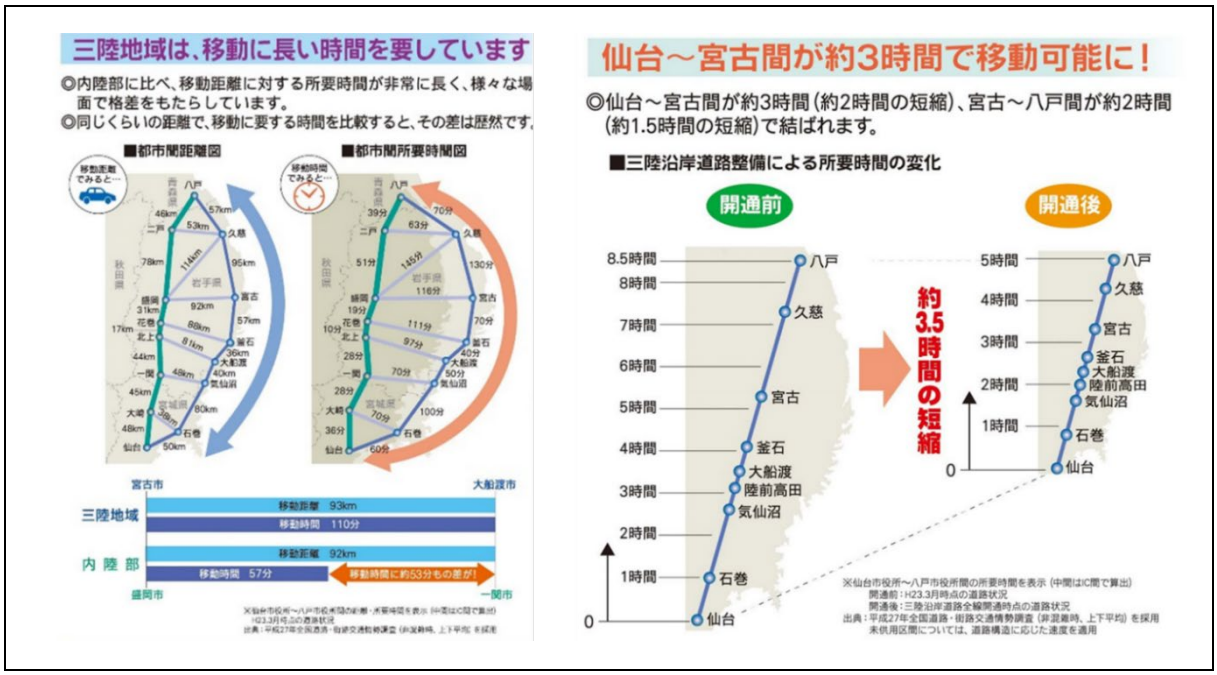
In order to address such regional challenges, efforts were made in Rikuzentakata City to build attractive urban areas in parallel with the development of roads and other infrastructure, thereby promoting the revitalization of the city.

Takata Matsubara Tsunami Reconstruction Memorial Park was developed through joint efforts between the national government, Iwate Prefecture, and Rikuzentakata City. In September 2019, the Iwate Tsunami Memorial Museum and Michi no Eki Takata Matsubara were opened within the park, and in December 2021, the park became fully operational.

The Iwate Tsunami Memorial Museum displays disaster-related items and preserves monitors and other equipment from the Tohoku Regional Development Bureau Disaster Response Headquarters as they were during the earthquake. These exhibits are designed to help visitors understand the development of Operation Teeth of a Comb. According to a survey of visitors conducted between September and October 2020, approximately 66% of all respondents answered that they lived outside Iwate Prefecture, indicating that many visitors had traveled from far away.

Takata matsubara Sports Park was completed in August 2020, and the Sanriku Fireworks Festival was held there in October of the same year, attracting visitors with around 10,000 bursts of fireworks. The completion of the Sanriku Coast Expressway network was one of the major factors that brought this festival to fruition. As Rikuzentakata City has no railways and its bus rapid transit capacity is limited, it was crucial to have visitors arrive by car for such large-scale events. The opening of the Sanriku Coast Expressway made it possible for visitors to come by tour bus from Sendai City and other parts of Iwate Prefecture, contributing to the local economy through the lodging, food and beverage, and transportation industries.

Figure 5-5-12 Benefits of Road Development in the Sanriku Region



Source: Rikuzentakata City

Figure 5-5-13 Examples of Urban Development Utilizing Roads in Rikuzentakata City

Source: Rikuzentakata City

ウ） Example of urban development utilizing roads (Kesennuma City)

Kesennuma City was one of the cities devastated by the earthquake and tsunami, but steady progress has been seen in restoration and reconstruction projects, including the development of the Sanriku Coast Expressway, a key project in the reconstruction of the disaster-affected areas. As such, activity in the city has been returning to pre-earthquake levels. Utilizing this newly built infrastructure, efforts to revitalize the region are underway with a focus on the future of reconstruction.

The development of the Sanriku Coast Expressway has provided numerous benefits. One of the industrial benefits Kesennuma City has gained through its regional revitalization efforts is the promotion of its core industry—fisheries.

The development of the Sanriku Coast Expressway contributed to the revitalization of the fisheries industry in Kesennuma City in the following ways.

① Expansion of sales channels to distant markets

More than half of the fresh bonito landed at Kesennuma Fishing Port is shipped to the Kanto region. As freshness is crucial for raw seafood, reducing transportation time is essential.

② Increased sales in the seafood processing industry

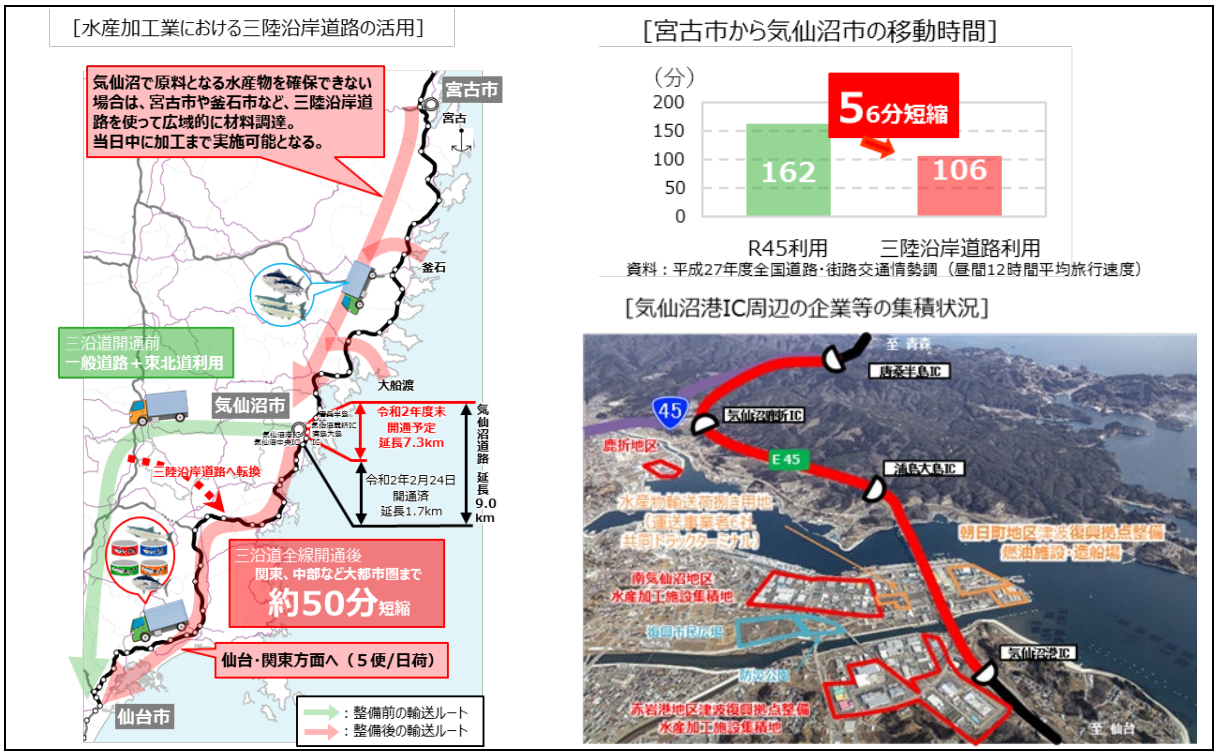
The full-scale opening of the Sanriku Coast Expressway has improved the transport efficiency of wakame seaweed and salmon, which are unloaded at fishing ports on the Sanriku coast and transported to factories in Kesennuma for processing.

③ Expansion of the commuting area

The full-scale opening of the Sanriku Coast Expressway increased the number of working-age people within commuting distance of Kesennuma City. This became an important selling point in attracting factories to the city.

The seafood processing industry in Kesennuma City was severely disrupted by the Great East Japan Earthquake, but the value of shipments has since recovered to around 90% of the pre-earthquake level, thanks in part to these developments.

Figure 5-5-14 Examples of Urban Development Utilizing Roads in Kesennuma City



Source: Tohoku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, “March 11 Reconstruction Road and Reconstruction Support Road Information Website”

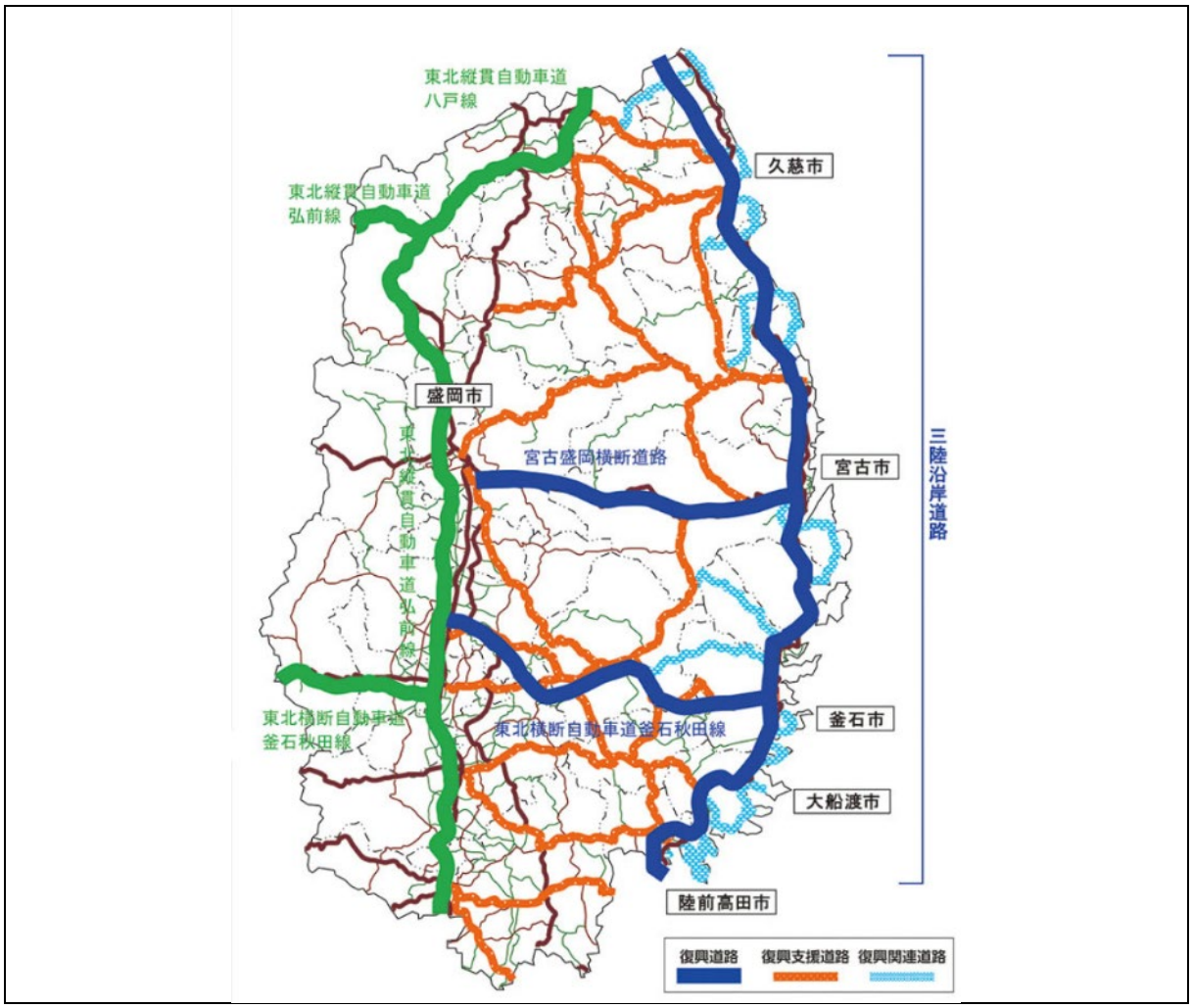
(2) Road Projects Implemented by the Prefectures (Iwate, Miyagi, and Fukushima)

1) Iwate Prefecture

In Iwate Prefecture, 68 locations on 50 national and prefectural roads managed by the prefecture were completely closed to traffic due to the damage caused by the Great East Japan Earthquake and tsunami. Roads in coastal areas, including the arterial National Route 45, were cut off by debris and flooding. In addition, bridges including the Kesen Ohashi Bridge (National Route 45) in Rikuzentakata was washed away by the tsunami.

In response, the prefecture included a Sanriku reconstruction road development project in the Reconstruction Implementation Plan (Phase 1) of the Iwate Prefecture Great East Japan Earthquake and Tsunami Reconstruction Plan formulated in August 2011. In addition to "reconstruction roads" aimed at creating a disaster-resilient and reliable road network, roads connecting inland areas to Sanriku coastal cities and those linking north-south between east-west corridors were newly designated as reconstruction support roads. Additionally, roads providing access to disaster response hubs, medical hubs in the Sanriku coastal region, and those that support the rebuilding of the fisheries industry were designated as reconstruction-related roads. Traffic bottlenecks were eliminated, disaster prevention measures were implemented, and seismic reinforcement was carried out for bridges.

Figure 5-5-15 Map of the Sanriku Reconstruction Road Development Project Network



Source: Department of Prefectural Land Development, Iwate Prefecture, "Iwate Roads (2022 Edition)" (published April 2022)

In addition, as part of the Urban Development Promotion Initiative for Multilayered Disaster Prevention, Coordinated Urban Development and Road Improvement Projects were promoted in an integrated manner with urban development efforts for each municipality.

As for reconstruction roads, high-standard highways and regional high-standard roads have been developed as part of national government projects, focusing on the longitudinal routes along the Sanriku coast and transverse routes connecting inland areas with the coastal region. The following section provides an overview of road development projects in Iwate Prefecture and the results thereof, with a focus on reconstruction support roads and reconstruction-related roads that have been developed through prefectural projects.

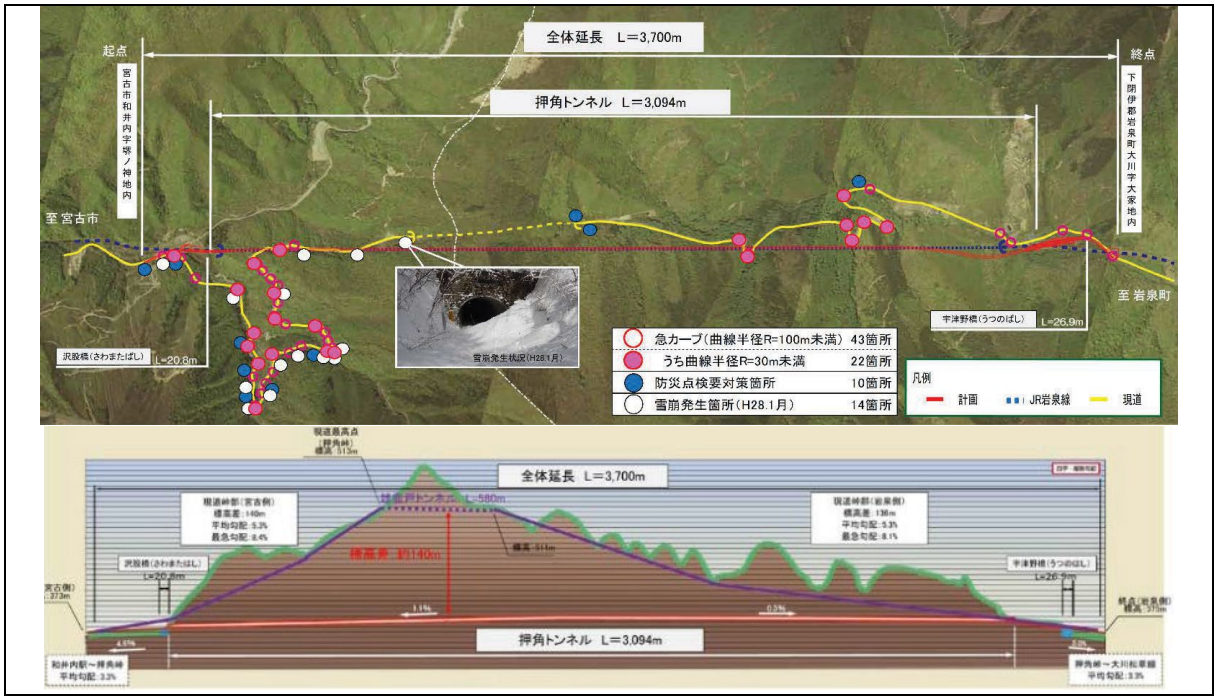
a. Reconstruction support roads

Of the roads developed as part of Sanriku reconstruction road development projects, 14 roads were designated as reconstruction support roads, including National Route 281. Projects were implemented to eliminate traffic bottlenecks, implement disaster prevention measures, and carry out seismic reinforcement for bridges on roads that connect inland areas to cities along the Sanriku coast, roads that link north-south between east-west corridors, and roads that connect to interchanges.

As a representative example of the developed routes, an overview of the National Route 340 project (Oshikado Pass section) and its benefits are introduced below.

National Route 340 is an arterial road that starts in Rikuzentakata City, Iwate Prefecture, passes through Miyako City and Iwaizumi Town, and extends to Hachinohe City, Aomori Prefecture, crossing the Kitakami Mountains. In Iwate Prefecture, it is designated as both a reconstruction support road and an emergency transportation road (primary route) in the Iwate Prefecture Regional Disaster Prevention Plan. It is also an important route that was designated in April 2019 as an alternative route to vulnerable sections of key logistics roads, as well as an alternative/supplementary route that serves as an additional route to disaster sites.

Figure 5-5-16 Project Overview and Longitudinal Profile of National Route 340 (Oshikado Pass Section)



Source: Department of Prefectural Land Development, Iwate Prefecture, "Beautiful Prefectural Land Creation News December 2020 Issue" (published December 28, 2020)

Located between Miyako City and Iwaizumi Town on this route, Oshikado Pass is narrow, poorly aligned, and has numerous steep slopes. In the winter, the pass was often closed due to avalanches or other factors.

Furthermore, a derailment accident caused by a landslide that occurred in 2010 led to the decision to discontinue

the JR Iwaizumi Line, which ran parallel to the pass. Buses served as an alternative means of transport, but they came at a cost in terms of safety and efficiency. For example, it took longer to travel by bus than by rail.

For these reasons, Iwate Prefecture promoted road development to fix the areas of Oshikado Pass that were characterized by narrow widths, poor alignment, steep slopes, and avalanche risk. Additionally, efforts were made to strengthen its role as an emergency transport road during disasters, ensure smooth traffic for alternative transportation, and promote interregional exchange and cooperation.

As a result of this road improvement, the length of the section has been shortened from about 6.1 km to about 3.7 km, and the travel time has been significantly reduced from about 18 minutes to about 4 minutes. In addition, by eliminating areas that were affected by narrow road widths, S-curves, steep slopes, and avalanche risk, safe, efficient, and reliable passage has been ensured, allowing the road to fulfill its important role as an emergency transport route.

This pass contributes to the efficiency of logistics in agriculture and forestry, which are the key industries in the region. Moreover, because National Route 340 is the only route that cuts across the Kitakami Mountains, the improved route is expected to promote interregional exchange by improving access to sightseeing spots.

b. Reconstruction-related roads

Of the roads developed as part of Sanriku reconstruction road development projects, 22 roads were designated as reconstruction-related roads, including Omoe Peninsula Route Major Regional Road. Projects were implemented to eliminate traffic bottlenecks, implement disaster prevention measures, and carry out seismic reinforcement for bridges on roads that connect to disaster prevention hubs (e.g., town halls and fire departments) and medical centers (secondary and tertiary emergency medical facilities) in the Sanriku coastal area, as well as roads that support the rebuilding of the fisheries industry.

As a representative example of the developed routes, an overview of the Omoe Peninsula Route Major Regional Road project and its benefits are introduced below.

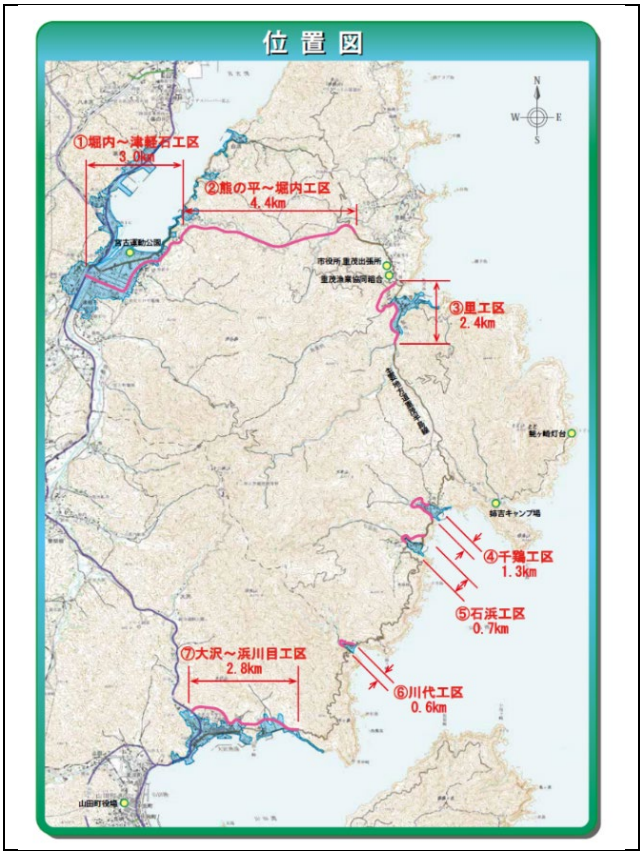
Omoe Peninsula Route Major Regional Road is the only road that loops around the Omoe Peninsula. However, the Great East Japan Earthquake and tsunami caused road collapses, flooding, debris accumulation, and bridge failures in seven sections of this road. In response, the prefecture carried out improvements on these seven sections of Omoe Peninsula Route Major Regional Road, and all sections were completed by December 2020.

The roads were improved to bypass areas flooded during the Great East Japan Earthquake. As a result, in the event of a tsunami of a similar scale, the risk of isolating villages will be mitigated, and the roads will be able to reliably serve as emergency transport routes.

In addition, the distance between Tsugaruishi and Kumanotaira was shortened from approximately 10.5 km to 7.4 km, reducing the travel time by around 7 minutes (from 18 minutes to 11 minutes). This has also improved access to Tsugaruishi Station on the Rias Line, which resumed operation in March 2019.

Furthermore, narrow roads, S-curves, and steep slopes were eliminated, ensuring safe and efficient traffic and providing routes for the transport of marine products.

Figure 5-5-17 Map of Omoe Peninsula Route Major Regional Road



Source: Yamada Town, Miyako City, Iwate Prefecture, "Completion Ceremony for the Omoe Peninsula Route Major Regional Road" (published January 29, 2021)

c. Coordinated Urban Development and Road Improvement Projects

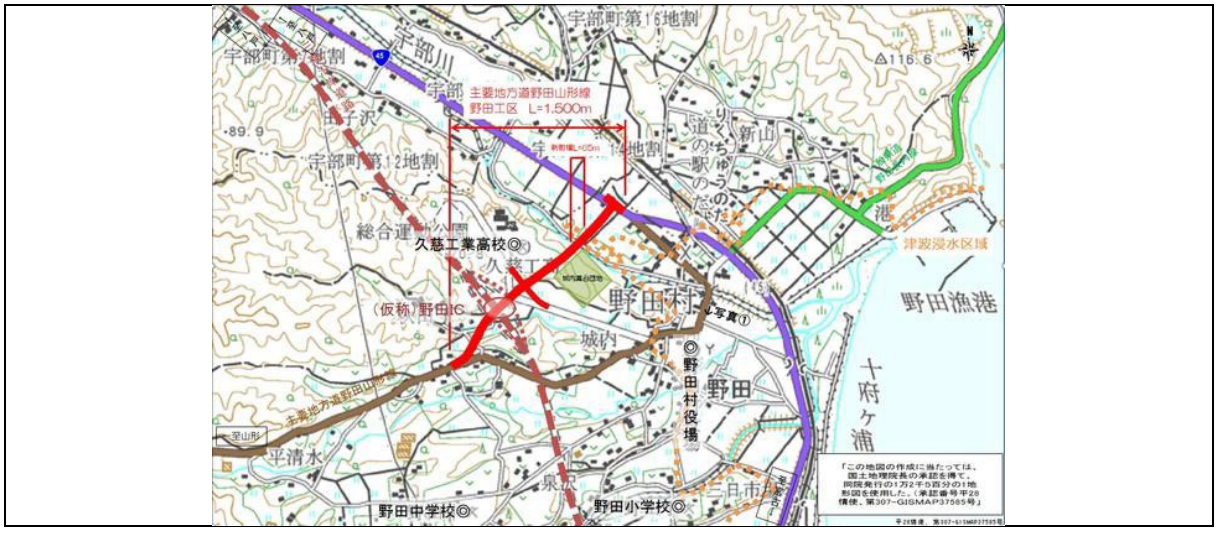
Based on fundamental tsunami countermeasure principles (coastal protection facilities, urban development, and non-physical infrastructure measures) and the approach of disaster mitigation, which aims to minimize damage from tsunamis and other natural disasters as much as possible, Urban Development Promotion Initiative for Multilayered Disaster Prevention were included in the Reconstruction Implementation Plan (Phase 1) of the Iwate Prefecture Great East Japan Earthquake and Tsunami Reconstruction Plan formulated in August 2011 to promote the creation of safe and secure disaster-resilient cities and regions. As part of the initiative, Coordinated Urban Development and Road Improvement Projects were implemented to enhance road functionality by improving tsunami-inundated roads in conjunction with reconstructive urban development efforts carried out by municipalities.

As a representative example of the developed routes, an overview of the Noda-Yamagata Route Major Regional Road (Noda section) project and its benefits are introduced below.

The tsunami accompanying the Great East Japan Earthquake caused the urban area of Noda Village to flood, severing the network of critical roads such as national and prefectural routes. To address this, a 1,500-meter road improvement project (including a 65-meter bridge) was carried out, relocating the Noda-Yamagata Route Major Regional Road outside the expected tsunami inundation zone to create a disaster-resilient road. This effort was also integrated with the collective relocation promotion project for disaster prevention in Jonai District managed by Noda Village.

This project has produced a road that will function as an evacuation route that will not be affected by tsunamis of the scale of the Great East Japan Earthquake, ensuring reliable emergency transportation and alternative routes during disasters while enhancing a highly reliable, disaster-resilient road network to support the recovery of industries like fisheries. Furthermore, the road's role as a secondary arterial route was enhanced, improving access from Noda Fishing Port to inland areas and contributing to greater logistical efficiency.

Figure 5-5-18 Map of the Noda-Yamagata Route Major Regional Road (Noda Section)



Source: Iwate Prefecture, "On December 25, 2018, the Noda section of the Noda-Yamagata Prefectural Road was opened!"

2) Miyagi Prefecture

In Miyagi Prefecture, the tsunami that accompanied the Great East Japan Earthquake caused extensive damage, washing away roads and bridges and leaving numerous routes blocked. Offshore islands and peninsular areas suffered particularly severe damage, leaving many communities isolated. Roads near the prefectural border were subject to winter traffic restrictions, forcing detours and highlighting major challenges in maintaining road functionality in the event of a large-scale disaster.

In response, the prefectural government formulated the Miyagi Prefecture Earthquake Disaster Recovery Plan. As part of this plan, the Miyagi Prefecture Social Capital Revitalization and Reconstruction Plan was formulated as a sector-specific plan for the civil engineering and construction administration field. With the aim of achieving sustainable prefectural land development to bring prosperity to future generations, the plan promoted efforts to bring

disaster recovery and reconstructive urban development projects to completion and “build back better.”

Figure 5-5-19 Miyagi Prefecture High−Standard Road Network

Source: Miyagi Prefecture

a. Construction of disaster prevention road network

The tsunami that accompanied the Great East Japan Earthquake washed away roads and bridges and left numerous routes blocked, leaving some offshore island and peninsular communities isolated. Furthermore, roads near the prefectural border were subject to winter traffic restrictions, forcing detours and highlighting major challenges in maintaining the roles of the roads in the event of a large-scale disaster.

Drawing on the lessons learned from this experience, the following four measures were taken to build a disaster-resilient road network capable of functioning effectively during large-scale disasters: the development and strengthening of the coastal north-south route (construction of a core expressway network for the prefecture), the development of east-west transportation routes (construction of a wide-area road network to support regional

development), the development of prefectural and district border roads to strengthen interregional cooperation, and the development of disaster-resilient roads on offshore islands and in peninsular areas.

The development and strengthening of the coastal north-south route (construction of a core expressway network for the prefecture) involved clearly designating the Sanriku Coast Expressway as a coastal disaster prevention road, taking into account how it was not impacted by the massive tsunami during the Great East Japan Earthquake and played a key role in emergency rescue and the transport of relief supplies. This measure was directly implemented by the national government with the aim of bringing the entire route into service as soon as possible through accelerated development.

The following section presents an overview and the benefits of the three measures, which were promoted by the prefecture.

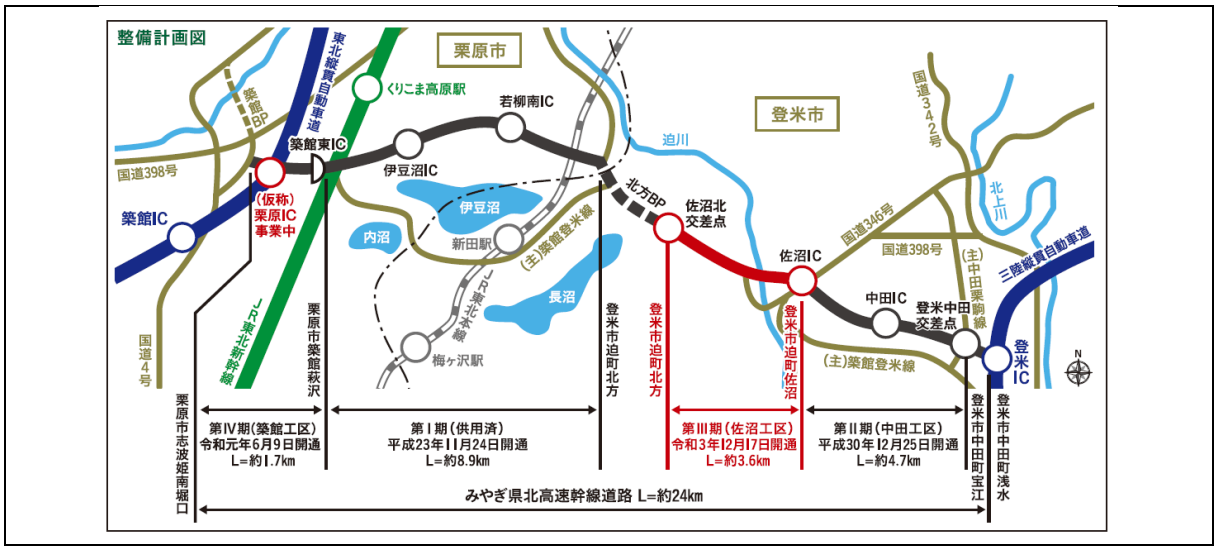
ア） Development of east-west transportation routes (construction of a wide-area road network to support regional development)

During the initial phases of recovery efforts following the earthquake, road clearance work for Operation Teeth of a Comb started from the Tohoku Jukan Expressway and National Route 4 and extended toward the coast. This demonstrated how crucial it is for north-south routes to be linked by east-west routes in order to function organically.

Miyagi-Kenpoku Road was developed as a reconstruction support road to strengthen the east-west routes in the northern part of the prefecture by connecting the Sanriku Coast Expressway, which is being developed in the coastal area, with the Tohoku Jukan Expressway and National Route 4 in the inland area, thereby ensuring access to a detour route on high-standard roads in the early stages of a large-scale disaster.

Of the total length of approximately 24 km, 8.9 km (Phase I) were opened in FY 2011, 4.7 km (Phase II) in FY 2018, and 1.7 km (Phase IV) in 2019. An additional 3.6 km (Phase III) came into service in December 2021.

Figure 5-5-20 Miyagi-Kenpoku Road Project Overview



Source: Miyagi Prefecture, “Miyagi Roads in 2023” (published April 2023)

The development of the Miyagi-Kenpoku Road is expected to provide quick and reliable access to the Sanriku Coast Expressway in the event of an emergency, which would have a significant impact on disaster response.

In addition, this will reduce the travel time to Tome City, which is located between the inland and coastal areas. Moreover, the reduction in traffic in urban areas is expected to alleviate traffic congestion and reduce traffic accidents.

In Miyagi Prefecture, progress in road development has attracted many businesses to areas throughout the prefecture, including areas along the roads. The opening of Miyagi-Kenpoku Road is expected to bring even more businesses to areas along the road, creating a major ripple effect across the entire prefecture. In Tome City, development is underway for the Naganuma No. 2 Industrial Park and the Tome Interchange Industrial Park. In Kurihara City, all lots of Tsukidate Interchange Industrial Park have been sold.

In addition, the travel time from Tome City Hall, which marks the center of the Tome region, to Japanese Red Cross Ishinomaki Hospital, a tertiary emergency medical institution, has been shortened by 17 minutes, from about 60 minutes to about 43 minutes. (For patients suffering from heavy bleeding, shortening the travel time by 17 minutes increases the chance of survival by 25%.)

Figure 5-5-21 Left: Completed Nakata Interchange; Right: Opening Ceremony for Phase II Project Section

Source: Miyagi Prefecture

イ) Development of prefectural and district border roads to strengthen interregional cooperation

After the earthquake, damage to interregional routes necessitated the selection of detour routes for the transport of goods to coastal areas, and winter closures of prefectural border roads limited the routes that could be used to transport goods from neighboring prefectures, resulting in traffic congestion and longer transportation times.

To address these issues, the development of key arterial roads has been promoted to link major cities across wide regions that transcend prefectural and district borders, with the aim of strengthening and expanding interregional connections for disaster prevention, industrial growth, and tourism. In order to strengthen regional cooperation and build multiple supply routes, the Ishinomaki Bypass on National Route 398 and other such roads were developed. In addition, cooperation with neighboring prefectures was enhanced by keeping roads in service year-round.

On National Route 347, which connects Miyagi Prefecture and Yamagata Prefecture, there is a section of road that links to Nabekoshi Pass, which is located on the prefectural border. A 17.7 km section of this road stretching on both sides of the pass used to be closed in winter due to its narrow and winding shape, as well as its location in one of the heaviest snowfall areas in the prefecture, which posed a risk of snow damage. Immediately after the Great East Japan Earthquake, the importance of this route was brought to light when it could not be used for the transport of emergency goods. Road improvement and disaster prevention projects were carried out starting in FY 2012 with the aim of making this route usable throughout the year, including winter, as a transport route during disasters and emergencies, and improvements were completed in December 2016.

This is expected to lead to the expansion of the exchange population between Miyagi and Yamagata Prefectures, the creation of jobs, and the promotion of tourism, as well as the strengthening of east-west connections to complement National Routes 47 and 48 and the enhancement of the road network.

Figure 5-5-22 Map of National Route 347 (Nabekoshi Pass)

Source: Northern Civil Engineering Office, Miyagi Prefecture "National Route 347 to Open Year-Round: One Road, Prosperity Through Connection"

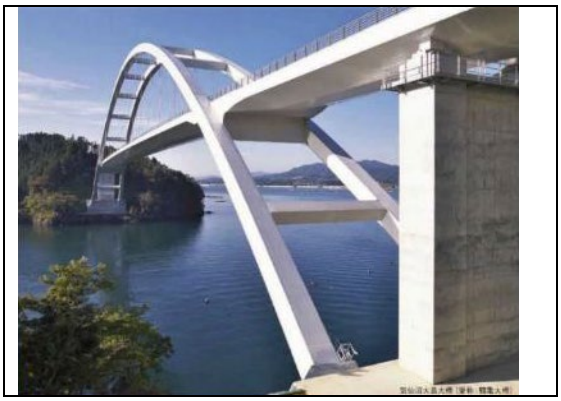
ウ) Development of disaster-resilient roads on offshore islands and in peninsular areas

On the offshore islands and in the peninsular areas of the Sanriku coastal rias, roads were cut off, and communities were isolated until roads were cleared and emergency construction was carried out, providing road access. This highlighted the need to prevent isolation during disasters and improve road functionality.

Miyagi Prefecture promoted the development of a new network of roads with disaster prevention functions to provide redundancy in the event of a widespread disaster affecting offshore islands and peninsular areas, which were left temporarily isolated by the Great East Japan Earthquake. The aim was to ensure that in particular, roads that connect disaster-affected areas with areas that were unharmed by the disaster would be able to serve as evacuation routes.

Kesennuma Oshima Island, the largest offshore island in the prefecture, relied solely on ships for transportation to the mainland. This highlighted the need for a bridge, leading to the promotion of the Oshima-Namiita Line Oshima Bridge Construction Project. Hailed as a "symbol of reconstruction" by the prefecture, the project started in FY 2011. With the opening of a 5.5 km section of road including the Kesennuma-Oshima Bridge in FY 2019, a land route was established between Kesennuma-Oshima Island and the mainland.

Figure 5-5-23 Kesennuma Oshima Bridge



Source: Miyagi Prefecture, "Bridge of Hope: Oshima Bridge Project"

b. Promoting road development to aid in reconstructive urban development

To provide support for reconstructive urban development in coastal cities and towns devastated by the tsunami, roads with multilayered defense functions were developed, as were roads that established access between collective relocation sites for disaster prevention.

Roads that contribute to multilayered defense include the Arahamako – Imaizumi Route Prefectural Road and the Soma – Watari Route Major Regional Road. These routes were constructed as elevated embankment roads to connect disaster-affected cities and settlements along the Pacific coast, while also serving as a defense and mitigation measure against tsunami damage.

Furthermore, roads that link collective relocation sites for disaster prevention have been developed in line with the progress of coastal urban development. A notable example is the Shizugawa section of National Route 398, which was constructed in coordination with urban development efforts in Shizugawa District in Minamisanriku Town.

3) Fukushima Prefecture

Fukushima Prefecture suffered multiple disasters. Not only was the entire coastal area of Hamadori hit by the tsunami, but the accident at TEPCO Fukushima Daiichi Nuclear Power Station triggered a nuclear disaster. This combination of a large-scale natural disaster and a nuclear disaster forced many residents to evacuate to other parts of the prefecture.

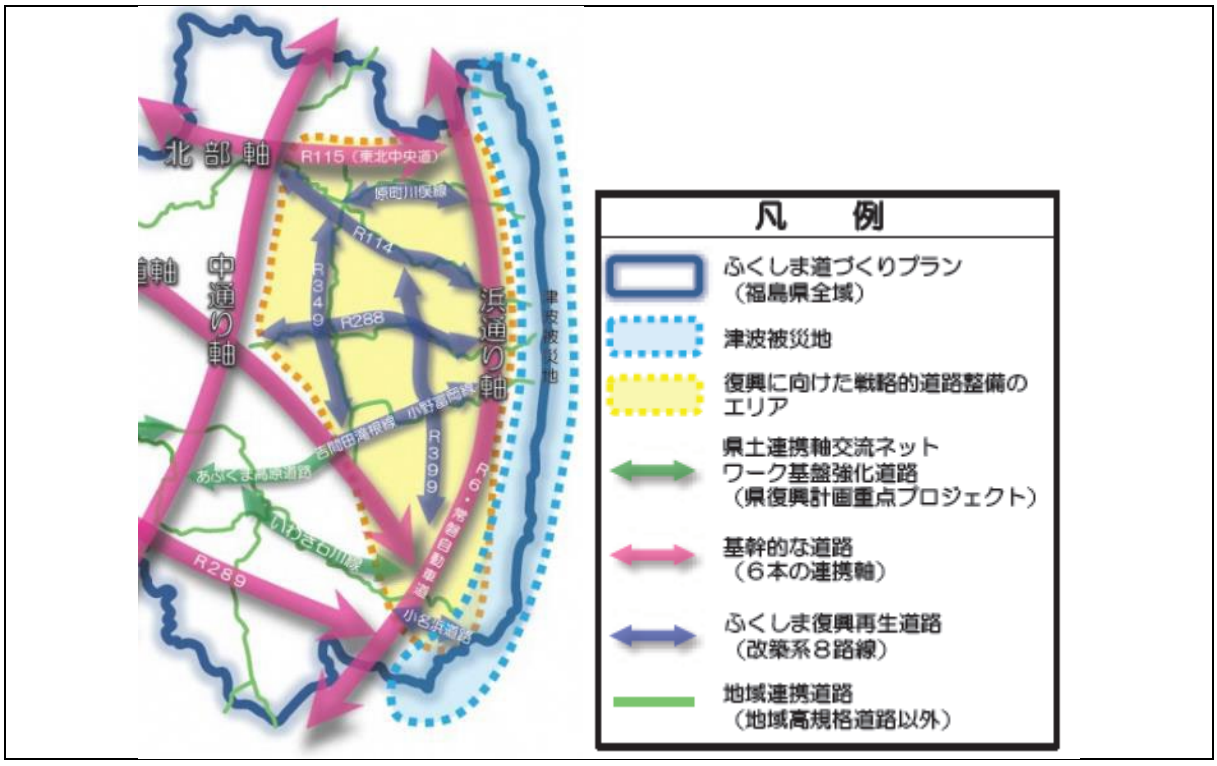
In response, the prefecture formulated the Plan for Revitalization in Fukushima Prefecture (First Version) in December 2011 and the Plan for Revitalization in Fukushima Prefecture (Second Version) in December 2012 in accordance with the three basic principles of the Vision for Revitalization in Fukushima Prefecture announced in August 2011. The prefecture proceeded to promote road development for restoration and reconstruction based on these plans.

Under the Prefectural Connectivity and Exchange Network Infrastructure Enhancement Project, key roads like the Tohoku-Chuo Expressway (Soma–Fukushima) were developed, along with roads connecting Hamadori to the Nakadori and Aizu regions, in an effort to build a safe and highly reliable road network and support reconstruction efforts.

Furthermore, main roads connecting areas where evacuation orders have been lifted to major surrounding cities were designated as Fukushima Reconstruction and Revitalization Roads, and their development was prioritized. Efforts also included road construction integrated with reconstructive urban development in tsunami-affected areas, as well as the development of access roads to specified reconstruction and revitalization bases, such as the Reconstruction Symbol Axis.

Within the Jumonji construction section of National Route 399 (6.2 km in total length), which was designated as a Fukushima Reconstruction and Revitalization Road, a 3.3 km section including a tunnel was developed under the direct authority of the Ministry of Land, Infrastructure, Transport and Tourism on behalf of the prefectural government, which is tasked with managing the road. The heads of the relevant local governments highly praised the direct role of the national government in facilitating the early completion of the section.

Figure 5-5-24 Fukushima Prefecture Road Network



Source: Public Works Department, Fukushima Prefecture, “Fukushima Road-Building Plan” (March 2022)

a. Fukushima Reconstruction and Revitalization Roads

The main roads connecting areas where evacuation orders have been lifted to major surrounding cities were designated by Fukushima Prefecture as Fukushima Reconstruction and Revitalization Roads, which aimed to promote restoration and reconstruction in areas where evacuation orders had been lifted, encourage residents to return, and promote sustainable development in the region. As such, development proceeded with a focus on 29 sections on eight routes.

The completion of these routes has eliminated traffic bottlenecks, greatly improved intercity access and access to important facilities, and helped promote the return of residents and enhance logistics. The following section presents an overview and the benefits of one notable project to build the Iwaki-Kamimisaka–Ono Route Prefectural Road (Onahama Road).

The Iwaki-Kamimisaka–Ono Route Prefectural Road, hereinafter referred to as "Onahama Road," is an 8.3-kilometer motorway in Iwaki City located at the southern end of Hamadori in Fukushima Prefecture, extending from Izumimachi to Yamadamachi in Iwaki City. This road links the major Onahama Port directly to the Joban Expressway, enhancing the wide-area logistics network and serving as an access road to tourist spots near Onahama Port, thereby supporting local industries.

Onahama Road has one interchange connecting to the Joban Expressway and three interchanges connecting to prefectural roads. Construction of a section of about 2.5 km, including the junction with the Joban Expressway, was entrusted to NEXCO East.

As a result of the development of Onahama Road, Onahama Port will now be directly connected to the high-standard road network, including the Joban Expressway. This means that all important ports and airports in Fukushima Prefecture will then be connected by high-standard roads. By reducing the travel time from the Joban Expressway to Onahama Port to less than half (from 29 minutes to 13 minutes), lead time and costs due to detours and transshipment of international standard containers for overland transportation have been minimized, thereby supporting regional revitalization through logistics.

From a disaster prevention perspective, directly linking Onahama Port, which played a vital role in receiving emergency supplies following the Great East Japan Earthquake, with the expressway network that supported relief and emergency transport immediately after the disaster is expected to ensure smooth emergency transportation during large-scale disasters.

Figure 5-5-25 Left: Map of Onahama Road; Right: Progress in the Development of Onahama Road (Photographed August 2021)

Source: Fukushima Prefecture Iwaki Construction Office, "Onahama Road" (prepared October 2020)

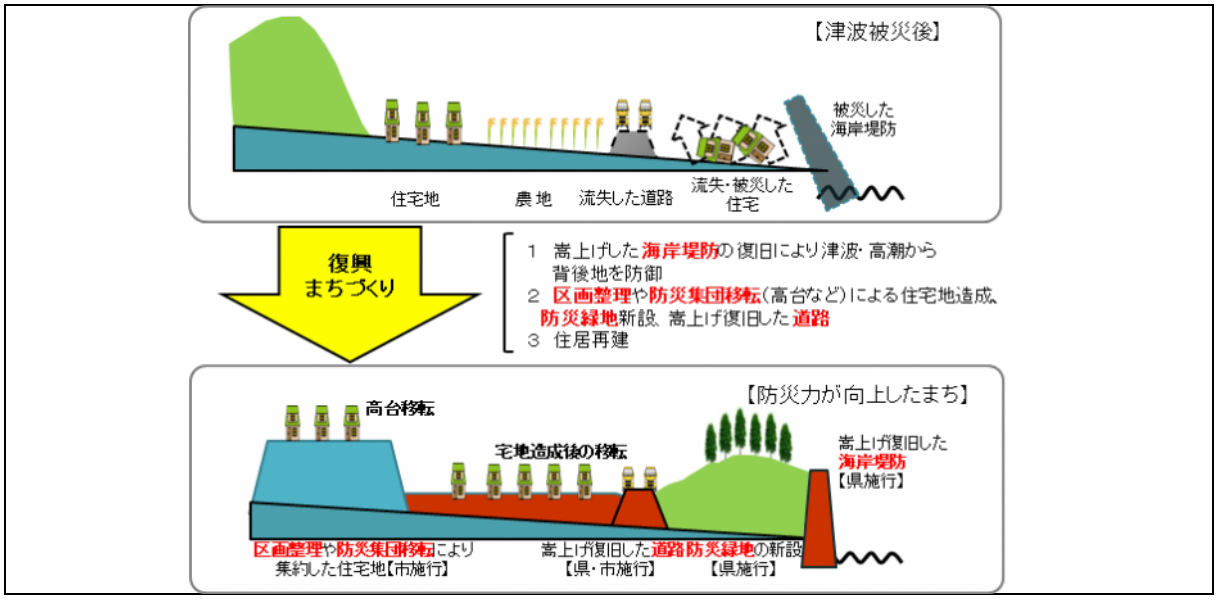
b. Integrating road development with reconstruction efforts in tsunami-affected areas

On the Pacific side of Fukushima Prefecture (Hamadori), which sustained severe tsunami damage, road development was carried out in an integrated manner with reconstruction efforts.

The damaged coastal levees were raised to protect the hinterland, and a combination of land readjustment projects and collective relocation projects for disaster prevention were applied to develop new residential land and disaster-prevention green spaces, thereby establishing multilayered defenses. Road development was similarly implemented in conjunction with reconstructive urban development to elevate and restore roads. In addition, this development included efforts to enhance comprehensive disaster resilience through both tangible and non-tangible measures,

including securing evacuation routes and improving communication networks.

Figure 5-5-26 Reconstructive Urban Development with Multilayered Defenses



Source: Public Works Department, Fukushima Prefecture, "Restoration and Reconstruction of the Hamadori Region: 10 Years of Efforts" (partially revised March 31, 2022)

One notable road, the Hirono–Odaka Route Prefectural Road, runs north-south through Hamadori. Commonly known as Hamakaido, this route supports reconstruction efforts in the Hamadori region. The following presents an overview and the benefits of the Hirono – Odaka Route Prefectural Road.

This route traverses north-south through the tsunami-affected area, which suffered severe earthquake damage. After the earthquake, the route was reorganized into 24 sections, incorporating the concept of multilayered defenses described above.

Commonly referred to as Hamakaido (meaning "main road along the shore"), the Hirono – Odaka Route Prefectural Road is cherished by the local community as a road that allows travelers to traverse the coast while enjoying the sea breeze of the Pacific Ocean. The road has played a role in supporting the vitality of the region. For example, marathons have been held on some completed sections of the road.

Furthermore, various key facilities in Fukushima Prefecture are located along this route, including J Village, Fukushima 3.11 Memorial Park, Fukushima Hydrogen Energy Research Field, and Fukushima Robot Test Field. It is therefore widely expected to play a vital role in supporting reconstruction efforts, not only by promoting industry but also by boosting tourism and regional exchange.

Figure 5-5-27 Map of the Hirono – Odaka Route Prefectural Road

Source: Fukushima Prefecture

c. Development of the Reconstruction Symbol Axis linking (Ide–Nagatsuka Route and Nagatsuka–Ukedo-Namie Route)

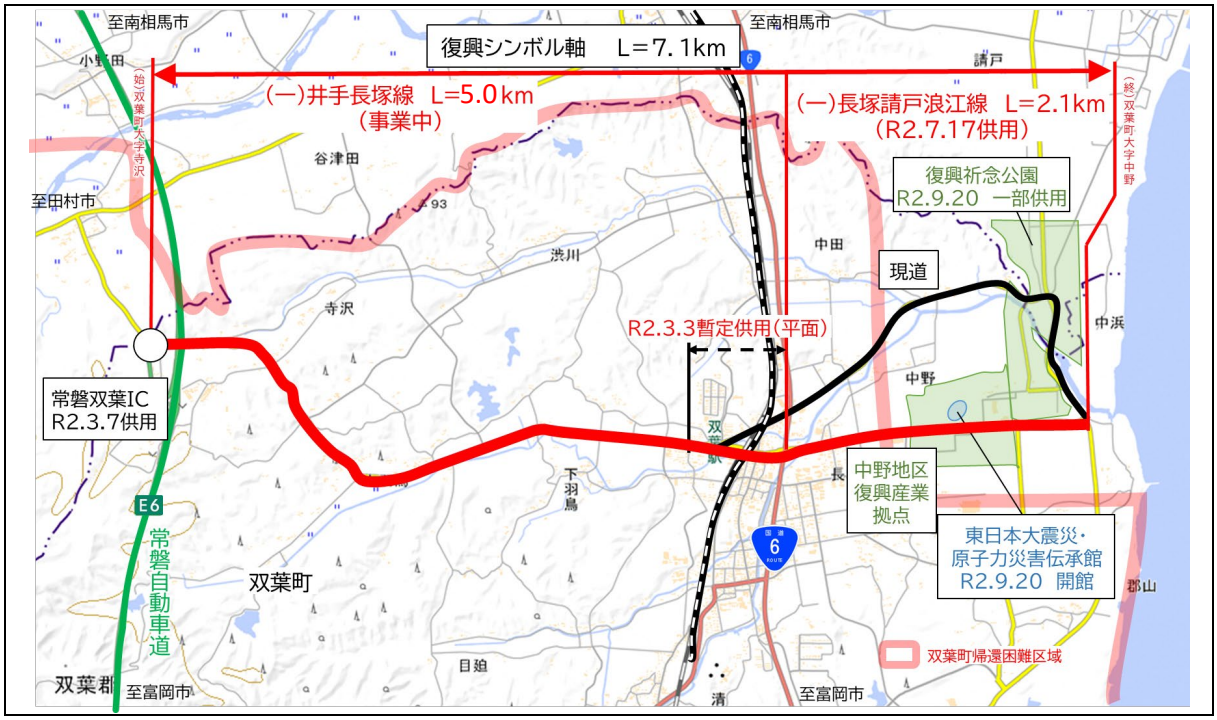
The Reconstruction Symbol Axis was developed to strengthen wide-area infrastructure and promote regional collaboration in preparation for the lifting of evacuation orders in areas designated as difficult-to-return zones. Spanning 7.1 km from the Joban Futaba IC on the Joban Expressway to the Hirono–Odaka Route Prefectural Road, the axis consists of the Ide–Nagatsuka Route (5.0 km) from the Joban Futaba IC to National Route 6 and the Nagatsuka–Ukedo-Namie Route (2.1 km) from National Route 6 to the Hirono–Odaka Route. The Nagatsuka–Ukedo-Namie Route became fully operational in July 2020.

In the Futaba Town Specified Reconstruction and Revitalization Bases Area Reconstruction and Revitalization Plan, this route is designated as an east-west access road connecting the Joban Futaba IC to the coastal area through the urban district near the station. Its purpose is to support reconstruction in areas under evacuation orders through integration with nearby projects, including residential urban area development, the Nakano District Reconstruction Industrial Hub, and Fukushima 3.11 Memorial Park.

The development of the Reconstruction Symbol Axis offers a number of benefits. It ensures new living spaces in specified reconstruction and revitalization bases area near JR Futaba Station, revitalizes existing urban districts, and creates new opportunities for industry and employment at the Nakano District Reconstruction Industrial Hub, thereby providing significant support for the reconstruction of Futaba Town.

In particular, in the ongoing new urban development efforts focused on public housing and residential in the district west of JR Futaba Station, these roads are becoming more important as a means of improving access for evacuees and relocating residents.

Figure 5-5-28 Map of the Reconstruction Symbol Axis



Source: Public Works Department, Fukushima Prefecture, “Fukushima Road-Building Plan” (March 2022)

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

(1) Issues that arose in project implementation and responses

1) Prompt emergency restoration

As a result of the Great East Japan Earthquake, the road network was disrupted, cutting off the flow of people and goods. In the immediate aftermath of the disaster, prompt emergency restoration efforts were required in order to allow emergency vehicles to pass through to save lives and supply goods. These efforts included establishing rescue routes by disposing of debris as soon as possible (clearing roads).

Disaster agreements had been concluded with local construction companies before the earthquake. As a result, the construction companies were able to cooperate immediately after the disaster, enabling road clearing efforts to proceed quickly. The consolidation of the clearance routes into 16 routes enabled targeted construction work. In addition, the use of TEC-FORCE and other means to quickly collect information also contributed to the speed of emergency restoration efforts.

2) Measures for the early completion of projects

In order to fulfill the functions of daily utility in times of non-emergency and protecting lives in the event of a disaster, reconstruction roads and reconstruction support roads were deemed key reconstruction projects and were thus required to be completed as soon as possible. Therefore, efforts were made to speed up the process throughout various phases, from planning and design to construction.

Concretely, design concepts were formulated from the standpoints of ensuring resilience, reducing costs, and integrating efforts with reconstructive urban development. Based on these concepts, routes were established, and the locations and shapes of interchanges were designed.

In addition, there were other factors that contributed greatly to the progress of restoration and reconstruction work, such as the introduction of public-private partnerships for project promotion to efficiently carry out enormous tasks with limited personnel, the establishment of a temporary ready-mixed concrete plant to provide a stable supply of depleted materials (cement), and the application of the reconstruction coefficients to promote the participation of construction companies in bids.

(2) Lessons learned and know-how gained

1) Initial phase

In this instance, the prior conclusion of disaster agreements with construction companies enabled a quick emergency response. In times of non-emergency, it is ideal to coordinate with various related organizations such as the prefectures, municipalities, the Self-Defense Forces, the Japan Coast Guard, and NEXCO, in anticipation of emergencies. It is also effective to conclude disaster agreements with oil companies in order to secure fuel in the event of a disaster, as well as to prepare satellite telephones and satellite communication vehicles in anticipation of the risk of losing access to real-time local information due to severed optical fiber cables and other factors.

Furthermore, to ensure passable routes during disasters, important logistics roads can be developed, and roadside stations can be utilized as hubs for accumulating supplies in the event of a disaster.

It is important that emergency restoration work be carried out quickly. At the same time, attention must also be given to planning for the full-scale restoration that follows.

2) Restoration and reconstruction phase

During the disaster, roads played a life-saving role in many places. In light of this, care must be taken during the planning and design phases to ensure that roads do not become cut off, such as by establishing routes that bypass areas that are prone to flooding.

Furthermore, route selections and IC placement must be planned in line with reconstruction urban development

plans so that roads can enhance living convenience, foster industrial growth, and promote tourism.