The Public Works Research Institute (PWRI) is a national research and development agency that can trace its history back to the Road Materials Research Center of the Ministry of Internal Affairs, established in 1921, and the Research Laboratory of the Civil Engineering Department of the Hokkaido Prefectural Government, established in 1937. Thus, in 2018, PWRI is celebrating the 96th anniversary of the foundation of the Road Materials Research Center and the 81st anniversary of the Hokkaido Civil Engineering Department. Throughout the intervening years, PWRI has been continually engaged in the resolution of various civil engineering technological issues, offering technical support after disasters, providing technical advice for national and local government, and engaging in research related to public works, such as rivers and roads.

The third year of the PWRI's fourth six-year plan, starting on April 1, 2016, is to be embarked on this year. The primary aim of a national research and development agency like PWRI is to maximize research and development achievements; in other words, to maximize, for the nation as a whole, research and development that will contribute to further progress of the Japanese society in the people's livelihood, economy and culture. Based on this primary aim, in our six-year plan, our mission is indicated by the Minister of Land, Infrastructure, Transport and Tourism and the Minister of Agriculture, Forestry and Fisheries. This mission is to return the benefits of research to society, and by doing so to i) contribute to the effective provision of high-quality social infrastructure and to the development of Hokkaido; and ii) to properly perform tasks related to the Land, Infrastructure, Transport and Tourism Ministry's strategy and to the promotion of agriculture, forestry, and fisheries by the Hokkaido development authorities. In addition, PWRI aims to engage, in a focused and intensive manner, in research and development activities that will contribute to:

1. Realization of a safe and secure society
2. Strategic maintenance, management, and renewal of public infrastructure
3. Realization of a sustainable and vibrant society

Based on the abovementioned goals, our fourth six-year plan contains 17 intended research and development programs that will allow us to respond in a focused and intensive manner to issues that will affect society in the future. These programs involve exploratory research and development initiatives that take into account the current situation (a declining trend in the working age population, a reduction in workers with construction skills, and an increase in the number of people retiring from work). We aim to pursue these programs in an effective and efficient manner by incorporating procedures such as offering technical advice, disseminating research and development results, utilizing civil engineering skills to make international contributions, and cooperating with other research institutes.

PWRI has long been involved in civil engineering technology research and development activities that will contribute to the efficient provision of high-quality social infrastructure. In the future, we intend to work diligently on research and development projects that meet both the short- and long-term needs of Japanese society. Alongside this, we intend to make an international contribution as a global center of civil engineering research and development. We would appreciate your continued support and cooperation in these regards.

April 1, 2018

Kazuhiro Nishikawa
President
National Research and Development Agency
Public Works Research Institute (PWRI)
Contents

1  What is the Public Works Research Institute?
2  Number of Staff • Budget, Research Concepts & Attitudes of Researchers
3  Organization
4  Medium to Long-term Objectives / Plan
5  R&D Program

23  Introduction of institutions

Tsukuba Central Research Institute
Construction Technology Research Department, Geology and Geotechnical Engineering Research Group,
Water Environment Research Group, Hydraulic Engineering Research Group, Erosion and Sediment
Control Research Group, Road Technology Research Group

Civil Engineering Research Institute for Cold Region
Cold-Region Construction Engineering Research Group, Cold-Region Maintenance Engineering Research
Group, Cold-Region Hydraulic and Aquatic Environment Engineering Research Group,
Cold-Region Road Engineering Research Group, Cold-Region Agricultural Development Research Group,
Director for Cold-Region Technology Development Coordination, Director for Special Research

International Centre for Water Hazard and Risk Management (ICHARM)
Water-related Hazard Research Group

Center for Advanced Engineering Structural Assessment and Research (CAESAR)
Bridge and Structural Engineering Research Group

Innovative Materials and Resources Research Center (iMaRRC)
Materials and Resources Research Group

34  Joint Research and Partnership with Other Organizations
35  Creation / Protection / Utilization of Intellectual Properties
36  Introduction of PWRI-Developed Technologies Utilized at Construction Sites
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48  Introduction of Facilities
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53  Open House
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The National Research and Development Agency Public Works Research Institute (PWRI) conducts high-quality studies as a core institution of civil engineering research in Japan. PWRI was founded to improve civil engineering technology by conducting research and development on civil engineering techniques, providing technical support, disseminating research results, etc., and to contribute to society by improving infrastructure and promoting development of Hokkaido.

PWRI began anew in April 2006, when the Civil Engineering Research Institute of Hokkaido, which had been established in 1937 as the Testing Laboratory of the Civil Engineering Department of Hokkaido Agency, was integrated into PWRI, which itself had been established in 1920 as the Road Materials Testing Department of the Ministry of Internal Affairs, and was transformed into a “national research and development agency” in April 2015.

The PWRI has been working towards the major objective of the National Research and Development Agency, which is to maximizing the effectiveness of the outcome of R&D, committing to the R&D to;

1. Realization of a safe and secure society
2. Strategic maintenance and renewal of public infrastructure
3. Realization of a sustainable and vibrant society

### History of PWRI

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>May 1921</td>
<td>Established as the Road Materials Testing Department in the Ministry of Internal Affairs.</td>
</tr>
<tr>
<td>Sep. 1922</td>
<td>Reorganized as the Civil Engineering Laboratory in Komagome, Tokyo.</td>
</tr>
<tr>
<td>Aug. 1937</td>
<td>Founded as the Testing Laboratory of the Civil Engineering Department, Hokkaido Agency.</td>
</tr>
<tr>
<td>Sep. 1947</td>
<td>Became independent as the Hokkaido Civil Engineering Institute.</td>
</tr>
<tr>
<td>July 1948</td>
<td>Renamed as the Public Works Research Institute, Ministry of Construction.</td>
</tr>
<tr>
<td>July 1951</td>
<td>Attached to the newly established Hokkaido Development Bureau and renamed as the Civil Engineering Research Institute.</td>
</tr>
<tr>
<td>Apr. 1988</td>
<td>Reorganized the entire body.</td>
</tr>
<tr>
<td>Apr. 2001</td>
<td>Established the Independent Administrative Agency Public Works Research Institute. The Niigata Experimental Laboratory and the Aqua Restoration Research Center remained with PWRI.</td>
</tr>
<tr>
<td>Mar. 2006</td>
<td>Established the International Centre for Water Hazard and Risk Management.</td>
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<tr>
<td>Apr. 2006</td>
<td>Integrated as the Incorporated Administrative Agency Public Works Research Institute.</td>
</tr>
<tr>
<td>Apr. 2008</td>
<td>Established the Center for Advanced Engineering Structural Assessment and Research.</td>
</tr>
<tr>
<td>Apr. 2015</td>
<td>Transformed into the National Research and Development Agency Public Works Research Institute.</td>
</tr>
<tr>
<td>Apr. 2015</td>
<td>Established the Innovative Materials and Resources Research Center.</td>
</tr>
</tbody>
</table>
Number of Staff - Budget

Number of Staff

- Staff: 452
  - Research staff: 324
  - Administrative staff: 124
  - Executives: 4
  - Full-time staff: 448
  - Part-time executives: 1

Budget

- Total Budget: 9,442 (Unit: one million yen)
  - Grants for operating expenses: 8,577
  - Income from commissioned research (projected): 382
  - Facilities expenses: 375
  - *Income from rented facilities and others (projected): 108

Research Concepts & Attitudes of Researchers

Research Concepts

1. Research that can assume the responsibility for society for the coming one hundred years
2. Research that is recognized by academia and trusted by local communities and practical engineers
3. Research that respects traditions and has enterprising spirit

Attitudes of Researchers

- Work on research with a view to society for the coming one hundred years.
- Remember that a wonderful study is an impressive one.
- Endeavor to cultivate insight and culture at all times based on a broader vision.
- At a critical moment, always consider the responsibility to coming generations.
- Be enthusiastic and carry out discussions as much as you can without leaving any doubts.
Medium to Long-term Objectives

Medium to long-term objectives are the objectives national research and development agency must achieve during a period of not less than five years and not more than seven years, decided by the competent minister and instructed to relevant national research and development agency. The Minister of MLIT and the Minister of MAFF announced the PWRI the 4th medium-and long term objectives on February 29, 2016.

Medium to Long-term Plan

Medium to long-term plan was planned to achieve the medium to long-term objectives, and created by a national research and development agency for a purpose of obtaining the authorization for such a plan from the competent minister. In PWRI we created a medium to long-term plan based on the 4th medium to long-term objectives and received the approvals from the Minister of MLIT and the Minister of MAFF on March 31, 2016.

The 4th medium to long-term objectives of PWRI

- **Period for the medium to long-term objectives**
  For 6 years from April 1, 2016 to March 31, 2022

- **Role of PWRI (mission)**
  "Maximization of research and development achievements" is the mission of the Public Works Research Institute. In other words, we, as the entire nation, “maximize” creation of research and development achievements that contribute to people’s lives, economy, healthy development of culture and other public interest. Based on the primary purpose of the national research and development agency, as a core research base for civil engineering in Japan, we will contribute to the promotion of efficient maintenance and the development of Hokkaido for quality public infrastructure through giving research results back to society and disseminating results. We execute our mission following the national policy for the land, infrastructure and transportation as well as for the promotion of agricultural and fishery industries.

  We will conduct research and development to gain the technological knowledge that could be used for establishing the relevant policies and technical standards, thus we will maximize results of research and development. These are the examples: the risk management technology for water-related disasters occurring more frequently and severely, damage mitigation technology for snow and ice disaster due to climate change, effective implementation method of maintenance responding to aging of the stock of infrastructure, approach to river channel planning technology for the conservation of the river environment. These will contribute to building sustainable national land against disasters and also maintain, organize and use the foundation of the national land. They also contribute to formation of sustainable national land with safety and security by appropriate management.

  We will strive to understand the needs of infrastructure particularly in order to fulfill its mission to support the national and local governments, which are responsible organizations of public infrastructure for road/rivers. We work closely with the business of the Regional Development Bureau of MLIT and the Hokkaido Regional Development Bureau. We also maximize the research and development efforts of the entire Japan, including research results of universities and private sectors. Therefore, we will make even more efforts to promote cooperation with people-to-people exchanges and joint research.

  Taking into account of PWRI’s strong points, during this medium to long-term plan period, we will focus on our R&D efforts on:
  1. Realization of a safe and secure society
  2. Strategic maintenance and renewal of public infrastructure
  3. Realization of a sustainable and vibrant society

  We also promote R&D on civil engineering technologies adjusting to effective improvement of caliber social infrastructure in snowy and cold regions, covering approximately 60% of Japanese areas.
R&D Program

PWRI will work on the following issues revealed at the medium to long-term objectives to focus on socially demanding issues while looking at the future.

1. Contribution to realization of a safe and secure society
2. Contribution to strategic maintenance and renewal of public infrastructure
3. Contribution to realization of a sustainable and vibrant society

For achieving these issues effectively and efficiently, PWRI categorizes these issues as “R&D programs” by the subjects to be solved, or the method of such as technical instruction and technological dissemination. By these units of methods, we establish 17 research and development programs and proceed efficiently.

<table>
<thead>
<tr>
<th>R&amp;D Program</th>
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<tbody>
<tr>
<td><strong>1. Contribution to realization of a safe and secure society</strong></td>
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<tr>
<td>(1) Development of design technique for disaster prevention facilities against recently more frequent and intense water hazards</td>
</tr>
<tr>
<td>(2) Development of technology to support risk management for water-related disasters occurring more frequently and severely in Japan and overseas</td>
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<tr>
<td>(3) Development of technology to prevent or mitigate damages from sediment-related disasters caused by sudden natural phenomena</td>
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<tr>
<td>(4) Development of seismic technology for strengthening earthquake resilience of infrastructure facilities</td>
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<tr>
<td>(5) Development of technology for the mitigation of snow and ice disasters caused by extreme weather</td>
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<tr>
<td><strong>2. Contribution to strategic maintenance and renewal of public infrastructure</strong></td>
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<tr>
<td>(6) Development on the efficiency and reliability of the maintenance cycle</td>
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<tr>
<td>(7) Research on renewal and new construction technology aiming at longer-life and efficiency of maintenance for public infrastructure</td>
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<tr>
<td>(8) Research on the maintenance and reconstruction of the infrastructure subject to frost damage and combined effect of deterioration</td>
</tr>
<tr>
<td><strong>3. Contribution to realization of a sustainable and vibrant society</strong></td>
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<tr>
<td>(9) Development of technology for public infrastructure construction to achieve sustainable construction recycling</td>
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<tr>
<td>(10) Research on effective use of resources/energy focusing on sewer facilities</td>
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<tr>
<td>(11) Development of river channel management technology that satisfies both flood control and environmental sustainability</td>
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<tr>
<td>(12) Development of sustainable sediment management technology in sediment transport system</td>
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<tr>
<td>(13) Development of water quality management and control techniques for regional water use and aquatic ecosystem conservation</td>
</tr>
<tr>
<td>(14) Research on ensuring the safety and reliable road transport services in winter</td>
</tr>
<tr>
<td>(15) Study on improving landscapes and the efficient use of infrastructure for attractive local development</td>
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<tr>
<td>(16) Research on maintenance and management of agricultural infrastructure in the snowy cold regions contributing to improving food supply</td>
</tr>
<tr>
<td>(17) Study on the development and conservation of fishery infrastructure of cold waters that contribute to strengthening food supply capacity</td>
</tr>
</tbody>
</table>
(1) Development of design technique for disaster prevention facilities against recently more frequent and intense water hazards

Research Summary

Research background

Levee breach by overflow beyond the designed level
Levee breach by piping
Collision by tsunami debris
Future risk for extreme waves and storm surge

Technical evaluation using full-scale experiment

Progress of failure verified by the permeation model experiment

Development of numerical calculation method for collision/fracture of tsunami debris such as sea ice floes

Understanding the effect on structures by experiment of tsunami running up a river

In recent years, intensive and heavy rainfalls in local areas cause frequent floods that is beyond the capacity of facilities. Levees are destroyed by overflow and seepage, and river structures are damaged by high-speed flow. In addition, due to the 2011 Great East Japan Earthquake, working on tsunami disasters has become an urgent issue.

Furthermore, the technology capable of responding to hydrographic changes such as massive waves caused by the low-pressure is required, because frequent low-pressure system developing into a powerful level equal to typhoon due to climate change is expected to approach the coastal area facilities.

However, the research has not been fully conducted to establish technologies to make higher resilience against devastating destruction. For this reason, in this research, we develop technology for structural measures to mitigate damages against the new stage of water-related disasters and massive earthquakes/tsunami caused by climate change in consideration of the external force of disaster at the level of reaching maximum and causing shocking destruction. In order to achieve these goals we will work on the following research topics.

(1) Development of technology for evaluation/strengthening river levees against overflow and erosion
(2) Development of technology for evaluation/investigation of safety of river levees against water permeation.
(3) Development of technology for evaluation of impact of tsunami on structures and design method
(4) Development of technologies appropriate for hydrographic changes due to climate change
In recent years, rainfall events have become more localized, intensive, and extreme; for example, more events with an hourly rainfall of over 50 mm have been observed throughout Japan. In the future, due to the impact of global warming, more regions of the country will suffer from extreme rainfall that may be even more intensified and frequent. In contrast, snowy cold regions are projected to have a shorter snowfall period and, as a result, less snowpack.

In this research project, we aim to develop technologies to characterize water-related disasters in terms of meteorology, hydrology and resulting damage. We will also develop technologies for various organizations to cope better with disasters using technologies for collecting and providing information. The following are the main research goals:

(1) Development of technologies and models for improving accuracy of flood forecasting and long-term water balance analysis

(2) Development of technologies for analyzing water disaster hazards in various natural and local conditions, methods for water-related disaster risk assessment using highly accurate, advanced estimation approaches, and indicators for evaluating the effectiveness of disaster prevention measures

(3) Development of methods for producing, utilizing and communicating useful information on disaster prevention and disaster status to assist efforts in disaster prevention and mitigation

These technologies and methods will be used to establish systems to estimate damage and risk using real-time observation information. Such systems will make reliable disaster information readily available for municipal disaster management personnel, who will thus be able to make well-informed decisions for effectively fighting floods and leading safe evacuation in time of disaster.
In recent years, the impact of climate change has caused more adverse events than statistically expected, and the risk of sediment-related disasters has increased. Moreover, sediment-related disasters have required emergency response after unexpected natural phenomena, such as volcanic eruptions, large-scale earthquakes, sudden heavy rain, or rapid snowmelt. Technological countermeasures are therefore required to minimize damage, speed up the initial disaster response, and make responses more effective.

This study lists the following three targets needed to speed up and make more effective the initial response aimed at preventing or mitigating the damage or impact from such a sediment-related disaster:

1. Development of technology for monitoring sediment-related events and for inspecting and maintaining roadside slope
2. Development of technology to estimate the range of sediment movement and technology to assure safety of road traffic.
3. Development of the design technology and the robot technology to prevent/reduce sediment-related disasters.

(1) We conduct research on technology that is able to identify, at an early stage, locations at risk of a sediment-related disaster, methods of inspecting roadside slope with regard to sudden heavy rain and snowmelt, and relevant monitoring and management technology. (2) Our research relates to improvement in the accuracy of technology that estimates the likely area of debris-flow damage, methods of evaluating the safety of roadside slope during sudden heavy rain or snowmelt, and evaluation of the risk of soil movement. (3) We conduct research on unmanned construction technology for use at dangerous disaster sites, including near volcanic eruptions, and on technological measures for dealing with sediment-related disasters.

We aim to develop countermeasures against sudden sediment-related disasters by reflecting the results of this research in technical standards.
Contribution to realization of a safe and secure society

(4) Development of seismic technology for strengthening earthquake resilience of infrastructure facilities

Research Summary

Research background • Needs
◆ Imminent occurrence of large-scale earthquakes such as massive earthquake in the Nankai Trough and Tokyo Inland earthquake is pointed out.
◆ Based on the lessons learned from the 2011 Great East Japan Earthquake, it is necessary to develop structural and non-structural countermeasures aiming to protecting human life, maintaining essential functions, minimizing damages, and quick recovery.

Research contents
◆ Development of seismic technology to strengthen earthquake resilience of infrastructure facilities (technologies for minimizing damage and quick recovery, performance evaluation and countermeasures).
◆ Targeted structures: roads and river structures (bridges and embankments).
◆ Hazards to be taken into account: shaking, tsunami, flood, liquefaction.

In the Great East Japan Earthquake of 2011, the wide areas of Pacific Ocean coast from Hokkaido to Kanto suffered the extensive damage by the strong shaking and huge tsunami. Moreover, strong vibrations and greatly changing ground situations had serious impacts on public infrastructure struck by the 2016 Kumamoto earthquake. It is pointed out that there is a high probability of the imminent occurrence of large-scale earthquakes, such as Nankai Trough Earthquake and Tokyo Inland Earthquake, all over in Japan.

For such earthquakes, pressing issues are to prevent and minimize the earthquake damage, and to improve the earthquake resilience (strong and resilient against earthquakes) of infrastructure facilities including: road facilities which play a key role for emergency/life-saving activities and transportation of emergency goods; river facilities to prepare for the tsunami or flood occurred in a complex way after earthquakes.

This research consists of the following three segments for the purpose of development of the countermeasure technology to prepare for large-scale earthquakes and complex disasters after the earthquake that exceeds the past experience.

(1) Development of technology for minimizing damage of structures against earthquakes and recovering the damage quickly
(2) Development of seismic design technology consistently applicable for ground, underground, and aboveground structures.
(3) Development of liquefaction evaluation method for soil layers considering the effect on structural responses.

We develop and improve the evaluation method of seismic performance and seismic measures for road bridges, road soil structures, soft ground, and river structures.

With proposing practical application of developing technology and the reflection to the technical standards and manuals, we aim to contribute to the realization of earthquake resilient society by minimizing damage of infrastructures and recovering functions quickly at the time of disasters for future large-scale earthquakes.
(5) Development of technology for the mitigation of snow and ice disasters caused by extreme weather

Research Summary

In recent years, a large number of vehicles stranded on the roads, traffic closure for long hours and isolation of communities have caused by unusual snow storm, snow falls, and avalanches due to effect of climate change. Therefore, in this research program, we are committed to realizes the three goals below based on "technology development in order to reduce the damage caused by snow and ice disasters that extreme weather will bring".

(1) Identification of the actual condition of snow and ice disasters caused by extreme weather and development of risk assessment technology

- Proposal of indicators offering appropriate evaluation of the severity of single-event snowstorms or heavy snow.
- Proposal of development of hazard maps for snow storm and heavy snow, risk evaluation method of the avalanche caused by large amount of snowfall in short period of time.

(2) Development of technology for prediction of poor visibility occurred on various winter roads

- Development of technology for forecasting visibility in blizzards under different climatic environments.
- Proposal of management approach towards stable performance of snow protection for the snowbreak woods.
- Proposal of methods for countermeasure selection at the end of and at gaps in snow fences, where visibility changes suddenly.
- Proposal of technology to support snow removal work by preventing collisions and lane-departure at the time of poor visibility.

(3) Development of technology to improve performance of snowstorm countermeasure facilities and snow removal vehicles

- Proposal of development of hazard maps for snow storm and heavy snow, risk evaluation method of the avalanche caused by large amount of snowfall in short period of time.
- Proposal of countermeasures for the lower dead branches in the snowbreak woods.
- Examples of countermeasures for the end of the snow fences

We will give research result of above goals back to society and continue to support reduction of traffic interruption or damages to communities caused by snow and ice disaster which have occurred more frequent and complex.
Contribution to strategic maintenance and renewal of public infrastructure

(6) Development on the efficiency and reliability of the maintenance cycle

Research Summary

Currently, aging of public infrastructure has been progressing rapidly. The serious damage due to deterioration occurred in Sasago tunnel and it caused the accidents. Aging of social capital has become major social problem.

In order to respond to these challenges, we need to implement maintenance cycle without fail and ensure to keep the health of social capital.

In this research we work to solve the following technical problems that we face at each phase of maintenance cycle (inspection, investigation, diagnosis, measures (repair and reinforcement)).

1) Inspection/Investigation: technology to improve efficiency and reliability of monitoring and investigation contributing to improvement of the reliability at time of diagnosis

2) Diagnosis: determining methods to identify area/parts where countermeasures are needed and the degree of urgency (priority)

3) Countermeasures: optimal maintenance and repair method (evaluation of new technologies) appropriate for previous events and on-site conditions

We also work on the development of maintenance technology appropriate for the various management levels, such as consideration for the service level of properties that the municipality managements control.

Thus, we will continue to contribute to the health of the social capital in order to achieve a spiral up in the technical aspects of the maintenance cycle.
Research Summary

Japan’s stocks of public infrastructure were intensively improved during the period of rapid economic growth and now the increasing aging infrastructures are concerned. It is important to renew or enlarge the service life for these existing infrastructures without interrupting their service. Under the severe fiscal situation, in order to ensure renewal or repair of infrastructure and, it is essential to conduct strategic maintenance work with consideration of priority and consequences of the infrastructures. For structures which have high priority, we need to achieve high durability to reduce their lifecycle costs. On the other hand, management level is not really high but for a huge number of simple structures, it will be advantageous to achieve structures that can clearly show you timing of renewal and locations needed for renewal using simple inspection methods.

In addition, decline of working-age population has affect the construction sector. Even if workers engaged in the construction industry is declined, we need to realize an improvement of productivity in order to efficiently renew public infrastructure. For example, we will need engineering development to build high quality structures efficiently using the precast concrete products.

This research program aims to establish evaluation methods necessary for development of material and construction in order to commercialize the new technology that can adapt to society’s needs. We will also propose such research results reflected in the standards of various design guidelines.
**Research on the maintenance and reconstruction of the infrastructure subject to frost damage and combined effect of deterioration**

**Research Summary**

For the aging of public infrastructure, we need to understand the conditions of deterioration according to various effects such as environmental conditions and make a plan of maintenance and renewal based on the importance of facilities. We also need to establish a series of systematic engineering. Particularly for the public infrastructure in the snowy and cold regions, frost damages and deterioration by combined effect such as low temperature, snow, frost, frost heave, freeze-thaw, snowmelt water, salt occur due to harsh environments. However, countermeasures for these deterioration caused by combined effect has not fully developed yet.

For bridges, rivers and coast of concrete structures, paving, heave cut slope, in this research we develop structure-specific technology and common technology targeted at frost damage and its deterioration by combined effect/damage mechanism with related to the following 4 items;

1. Establish efficient methods for inspection, diagnosis and evaluation
2. Establishment of reliable technology for repair and reinforcement
3. Establishment of technologies for reconstruction and new construction with higher durability
4. Systematization of inspection, diagnosis, assessment, repair/reinforcement, reconstruction/new construction related to the infrastructures due to frost and combined effect of deterioration.

Propose application in standards and disseminate research results through technical guidance

**Soundness of infrastructure is severely deteriorated under cold and snowy environment due to combined effect of deterioration mainly of frost damage**

**Countermeasures for frost damage/ deterioration by combined effect are undeveloped**

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Propose application in standards and disseminate research results through technical guidance

**Prolonging the service life of infrastructures in the snowy and cold regions and ensure safety/security**

For the aging of public infrastructure, we need to understand the conditions of deterioration according to various effects such as environmental conditions and make a plan of maintenance and renewal based on the importance of facilities. We also need to establish a series of systematic engineering. Particularly for the public infrastructure in the snowy and cold regions, frost damages and deterioration by combined effect such as low temperature, snow, frost, frost heave, freeze-thaw, snowmelt water, salt occur due to harsh environments. However, countermeasures for these deterioration caused by combined effect has not fully developed yet.

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We support to help maximize and extend the life of infrastructures in the snowy and cold environment by applying these technologies to the infrastructure, which will contribute to maintenance, development and utilization of the land structure to support the safety and security and economic growth.
Establishment of a sustainable society has become an important proposition that we are responsible on a global scale. Among other things, our nation with poor natural resources needs to effectively use the wastes and strive to build a recycle-oriented society.

The construction sector generates construction by-products due to update of the structures, such as concrete blocks, asphalt blocks, and surplus soil. Efficient use of these construction by-products without disposal reduces burden of the disposal sites and also helps conservation of natural resources. So far, such construction by-products have been utilized and we have obtained certain results, however, the amount of construction by-products will continue to increase in the future along with the full-scale constructions of the 2020 Summer Olympics and Paralympics in Tokyo and full-fledged maintenance and renewal work for existing structures. Further expansion of utilization is expected in order to properly maintain the resource circulation including the construction by-products. Specifically, we conduct research on further expansion of utilization of concrete recycled aggregate, clarification of applicable conditions in case of using a lot of recycled aggregate, and expansion of utilization of warm mix asphalt pavement technology for recycled asphalt pavement.

On the other hand, due to the large-scale tunnel construction, surplus soil occurrence from construction is expected. It is necessary to enhance environmental safety assessment and countermeasures for surplus soil. We conduct research on development of regulations for surplus soil including natural heavy metals, evaluation for sources in accordance with the environmental characteristics of the element type, and practical use of efficient countermeasure at low costs.
There is a growing expectation for renewable energy towards building of a recycle-oriented society. "Basic Energy Plan" that was approved by the Cabinet in 2014, shows the promotion policy of effective use of the sewage sludge as one of the renewable energy. The Ministry of Land, Infrastructure, Transport and Tourism has set "New sewage works vision" and it shows resource-intensive, energy supply base and self-reliance sewage treatment plants as a medium-term goal. It includes facilitation of new technological development such as mixing process of sewage sludge and other biomass and extraction methods of useful algae using nutrients in the sewage. On the other hand, for example, biomass such as mowed grass and logging produced in rivers are required to be used without simply disposing.

In particular the sewage treatment facilities are expected to accept biomass and use as energy required for sewage treatment.

In this program, in light of these circumstances, we develop production methods for biomass energy and aim to achieve highly efficient alga culture using the treated wastewater and embark on the studies in advanced technologies for collection, concentration and dehydration for algae culture. We also examine the applicability of mixture of algae culture/water plants and sewage sludge to the coal alternative solid fuel. Technology for utilization of wood chips and pellets as dehydration agent for sewage sludge is also a part of our research.
(11) Development of river channel management technology that satisfies both flood control and environmental sustainability

Research Summary

Large rivers (sections administered by the Ministry of Land, Infrastructure and Transport)

Achievement Goals (1)
- Development of techniques for extracting the district of high diversity from surface data for the river topography, vegetation and flood frequency

Achievement Goals (2)
- Terrestrial area
  - Utilization of prior data Census for waterside river channel physical environment data
  - PHABSIM by spawning environmental evaluation model (before mid-term)
  - Study for methods of evaluating the spawning floor within home range of fish
- Develop methods for prediction and evaluation for various aspect of discharge capacity and biodiversity using the concept of community cluster located in the middle of the landscape and community

Achievement Goals (3)
- Water area
  - Conservation of spawning floor
  - Conservation of spawning environment of fish using the river bed topography/sediment
  - Implementation of the field survey
- Not only ensure the discharge capacity but also develop river channel excavation technology to contribute to conservation and restoration of the diversity of plants, good fish habitat/spawning environment in the land. Also develop technology for subsequent maintenance methods.

Small and medium-sized streams (sections administered by municipality)

Achievement Goals (2)
- Development plan (goal)
  - Acquisition of the current river channel
  - Quantitative assessment for river channel is carried out from both aspects of flood control and environment
- Qualitative assessment for landscape formation and conservation area including the hinterland
  - Habitat of living organisms determined based on the physical environment
  - Water level vertical check judgement of necessity for bank protection

Achievement Goals (3)
- River channel planning and design process (draft)
  - Improvement of design processes and tools
  - Trial of river engineers
  - Extraction of problems

Goal is implementation in the field working on improvement

Water system such as rivers and lakes is an important foundation of biodiversity and its loss has continued. In the future we need to set the management objectives of the specific river environment. The urgent tasks are recovery of biodiversity from the losses and maintenance of good conditions. On the other hand, a huge increase of risks resulting from water disasters are also expected. So, it is necessary to promote the river management by taking disaster prevention/mitigation and the natural environment as an integral part while clarifying management objectives.

This research consists of the following three segments for the purpose of development of planning, design, maintenance technology for river channels based on a set of conservation/formation area of the river environment.

(1) Development of space management technology with a focus on the river landscape, biological growth and habitat.
(2) Development of response/prediction techniques for vegetation and fish towards for human alteration such as a river channel excavation
(3) Development of river channel excavation technology that satisfies flood control and environment as well as maintenance technology

Through these, we aim to satisfy both flood control and environment and propose river channel planning/design for easy maintenance and maintenance/management techniques to maintain the river environment in good condition. Research results will be reflected in basic guidelines and technical standards to disseminated to the sites.
Consistent comprehensive sediment management from the mountains to the coast is required to solve the safety and operation issues caused by the flow of sediment, and preserve the natural environment and landscape formed by sediment.

The development of technology that contribute to the realization of the development and effective sediment management of technology to contribute to the collection and analysis of data related to sediment transport can be found in the still developing stage. For promotion of comprehensive sediment management, we are still in the process of developments of technology for data collection/analysis about sediment movement and technology for realization of efficient sediment management.

(1) Development of technology for monitoring sediment dynamics

(2) Development of technology for prediction and evaluation for impacts of changes in sediment dynamics on aquatic and terrestrial environments

(3) New sediment management technology (the burrowing type sediment removal suction pipe)
Development of water quality management and control techniques for regional water use and aquatic ecosystem conservation

Although various improvement measures for water quality have been implemented, serious issues are still found in water environments, such as infectious diseases that influence social activities, ecological effect of chemical substances derived from products for daily use, and occurrence of algal bloom and musty odor in reservoirs. Therefore, new strategies for evaluation, monitoring and management are required to respond to these issues. In addition, it is important to apply these techniques to the basins in an integrated manner to improve environmental quality.

In this R&D program, in order to respond to these challenges we will promote researches towards achieving the following 3 goals:

1. Development of assessment and monitoring methods to understand the water environments of basins with accuracy and speed.
2. Development of adequate water treatment technology for the mitigation of water quality risks.
3. Development of water quality management focused on the bottom layer environment and the inflow change in stagnant water areas.

We aim to reflect these developments to the planning of the administrative measures and technical standards by the national government towards the improvement of water environmental quality, conservation of regional water use in basins, living environment and the aquatic ecosystem.
Japan is facing the nationwide problems such as population decline, aging population, large-scale disasters, and financial shortage. In the snowy and cold regions, it has been more difficult for the government to continue to provide the same winter road services due to the financial deterioration. Therefore, the Ministry of Land, Infrastructure and Transport, has launched a compact + network of the national land structure (National Spatial Planning approved by the Cabinet, August 2015). We must have the inter-regional cooperation and sharing functions by strengthening of the transportation network in order to realize this national land structure in the cold and snowy region. We also need to ensure the safe and reliable winter road traffic service.

In this research program, we have 3 achievement goals and set the "development of management technology techniques contributing to the safety and reliability of the winter road traffic services" as a program goal.

(1) Development and establishment for the reasonable level of the winter road management based on the cost-benefit performance evaluation

(2) Development of labor-saving operation technique using ICT and efficient maintenance technology for winter maintenance equipment

(3) Development of effective and efficient countermeasures for winter traffic accidents using risk management

By giving these research results back to society we will support safe and reliable winter load traffic services in the snowy and cold regions.
Scenic landscape is an essential element in rich living environment and also plays a significant role in making regions more attractive and in promoting tourism and interaction among them. Regeneration to a characteristic region requires the creation, protection, maintenance, and utilization of good public spaces. The following are three goals of this project.

1. The development of a landscape evaluation technique for infrastructure in public works
2. The development of planning, design and management techniques to promote the landscape improvement of outdoor public spaces which enhance regional attractiveness
3. The development of technical support for the application and use of utility infrastructure in light of regional revitalization

We will contribute to enhancement of Japan’s image and conduct a community support to create a rich living environment by maximizing the result of our studies.
Contribution to realization of sustainable and vibrant society

(16) Research on maintenance and management of agricultural infrastructure in the snowy cold regions contributing to improving food supply

Research Summary

The target of the self-sufficient rate was set a 45% with the calorie-base in the "Food, Agriculture and rural basic plan (March 2015)" of Japan while the relationship between food supply and demand has become tight. The importance of the agriculture in Hokkaido, with the large food supply capacity, is increasing to achieving this. The urgent need of the development of food production infrastructure using the new technology is required. For this reason, we develop technology for the following topic related to implementation and maintenance of the agricultural infrastructure.

(1) Development of technology for maintenance and management of large-sized paddy fields

- Accommodating with decline of workforce/aging population and expansion of the farming scale, we propose the following technologies; improvement of large-sized paddy field in accordance with the soil properties, advanced utilization technology of groundwater level control system in large-sized paddy field, irrigation and drainage technology harmonized with the surrounding hydrological environment in the maintenance section of large-sized paddy field.

(2) Development of maintenance and renewal technology of irrigation facilities

- Deterioration of irrigation facilities have been progressing and now appropriate maintenance for these facilities are required. We develop methods of diagnosis and evaluation for deterioration by combined effect of freezing damages and wear occurred in the irrigation facilities in the snowy and cold regions. We also develop methods of repair and reinforcement appropriate for these problems, and planning technology for disaster response to risks needed for large-scale disasters.

(3) Development of technology for irrigation considering harmony with the environment

- With requirement of agriculture in harmony with the environment, we propose the energy-saving type of treatment technique for dairy cattle manure slurry in slurry irrigation facilities, and evaluation technology and measures of water quality environment in dairy farming area.

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Study on the development and conservation of fishery infrastructure of cold waters that contribute to strengthening food supply capacity

Research Summary

With increase of the world population, dietary changes and the frequent occurrence of abnormal weather, there is a possibility that the relationship of food supply and demand in the world is tightening. In the future, the role of the fishery industry in Hokkaido, which has the country’s largest food supply capacity, increases even more than ever before. It is essential to improve resource productivity of Hokkaido in surrounding waters and strengthen fishery products. For this reason, in rivers, coastal areas and surrounding ocean of Hokkaido, we will improve the protection/nurturing function of coastal structures and develop the technology to support the sustainable use of fishery resources. We also promote cultivating fisheries by aquaculture that takes advantage of the quiet fishing port harbor waters, and maintain and improve productivity of the fisheries by large-scale fisheries development. This makes it possible to raise the productivity of the entire ecosystem and promote the fishing area by support of cultivating fisheries. We work in the following research topics to achieve these objectives.

(1) Develop and maintain assessment technology for the protection/nurturing function of fishery living organisms in coastal facilities.
(2) Create comprehensive assessment methods concerning the development effectiveness of large-scale fisheries
(3) Develop effective use and maintenance technology of the fishing harbor to strengthen support of the firming fishery
(4) Create impact assessment and improvement methods concerning the river structures and costal structures by understanding of swimming behavior of high-valued fish.
Tsukuba Central Research Institute aims at improving civil engineering technology by conducting studies on civil engineering techniques, experiments, research and development, as well as giving technical instruction and disseminating research achievements.

It also aims at contributing to society by efficiently improving infrastructure and appropriately accomplishing the duties in land, infrastructure, transport and tourism policy.

Civil Engineering Research Institute for Cold Region, as only one laboratory core of civil engineering technology for cold regions, actively disseminates research results and development technologies to cold regions both in Japan and other countries. It also takes leading role as an organization to offer information about the civil engineering technology for cold regions in Japan.
The Geology and Geotechnical Research Group is conducting extensive research targeted survey, design, construction and management that including disaster prevention and environmental protection measures in ground and rock, slopes, earth structures, soil environments, and other areas. The Geology and Geotechnical Research Group is comprised of the Geology Research Team, Soil Mechanics and Dynamics Research Team, and Construction Technology Research Team.

The Geology Research Team develops objective criteria and methods to find out properties of foundation ground. The Soil Mechanics and Dynamics Research Team conducts research using model test and numerical analysis for the development of design methods including seismic design and reinforcement methods for earth structure. The Construction Technology Research Team conducts research for the development of construction and maintenance/management technologies used in earth structures. We also develop and promote innovative techniques to investigate and evaluate soil pollution and integrated geophysical exploration technologies, which are combined solutions to survey and analyze the internal structure of ground and earthworks.

▶ Geology Team http://www.pwri.go.jp/team/tishitsu/index_e.htm
▶ Construction Technology Research Team http://www.pwri.go.jp/team/sekou/eng_index_33.html
▶ Geophysical Exploration http://www.pwri.go.jp/team/geosearch/english.html
Water Environment Research Group

Water environment research group, targeting the rivers and lakes that receive a variety of impact due to human activities, conducts research to understand the mechanism of ecosystem and its anthropogenic impact, and mechanism of water pollution. It also conducts research on the river management techniques which are for both flood control and the environment, monitoring of pollutants and measures/ approach.

Concerning biological, ecological and environmental conservation and restoration of rivers/lakes, the River Restoration Research Team uncovers the relationship of the terrain, the physical environment and material dynamics and ecosystems and conduct research on impact assessment method and approach to ecosystem. The Water Quality Research Team is engaged in the development of methods for analyzing and monitoring chemical substances in rivers, lakes, reservoirs, dam reservoirs, and sewage effluent in order to reduce regional water quality risk. It also develops methods for understanding the behavior of contaminants and for evaluating and mitigating the impact on aquatic ecosystems. The Aqua Restoration Research Center (ARRC) located in Kagamihara, Gifu Prefecture has full-scale model rivers and ponds for experiments and using these facilities the center carries out research on multi-natural river development and flow and sediment management such as river flow, sediment supply, and response of ecosystems to the structural modifications of the river.

- River Restoration Research Team http://www.pwri.go.jp/team/rrt/eindex.html
- Water Quality Research Team http://www.pwri.go.jp/team/suisitsu/index_e.htm
- Aqua Restoration Research Center http://www.pwri.go.jp/team/kyousei/eng/index.htm

Hydraulic Engineering Research Group

Hydraulic Engineering Research Group engages in the following developments; (1) Development of accurate sediment supply technology, which can supply necessary quantity and quality sediment to downstream from dam reservoir, which is the technical issues to carry out the comprehensive sediment management, (2) high-performance sediment supply technology to overcome the shortcomings of the existing sediment supply from structural point of view, (3) elucidate the behavior of the river run-up tsunami and assess the external force associated with this behavior. With consideration above, the team develops design and engineering for these river structures, (4) development of advanced technology using the sensor, which has been significantly improving in recent years, to observe the river flow rate at the time of the flood, that becomes the basis of the flood defense plan, (5) technology to monitor riverbed fluctuations such as the river bed waves that occur at the time of the flood in real time. River and Dam Hydraulic Engineering Research Team is responsible for (1)～(3), and (4) and (5) are for Hydrologic Engineering Research Team

- River and Dam Hydraulic Engineering Research Team http://www.pwri.go.jp/team/dam_hydraulic/english.htm
- Hydrologic Engineering Research Team http://www.pwri.go.jp/team/hydro_eng/index_e.htm
The Japanese archipelago is vulnerable in terms of the nature of its terrain, with around 70% of its area being mountainous or hilly and containing many fast-flowing rivers. Each year, there are debris flow, drift wood, and landslides after sudden heavy rainfall, earthquakes, volcanic eruptions, and sediment-related disasters, such as slope failures. Furthermore, as well as snow avalanches after heavy snowfall, landslide disasters could be occurred when snow melts. Such sediment-related disasters have a significant impact on communities, not least in terms of harm to human life, houses, and social infrastructure. In recent years, there have been many serious disasters caused by unprecedented sudden heavy rainfall and large-scale earthquakes.

The Erosion and Sediment Control Research Group conducts research and development related to the mechanisms of sediment-related disasters, risk evaluation, and countermeasure methods. This is with the aim of effectively implementing advance countermeasures, emergency response measures immediately after the event, and permanent countermeasures. In addition, immediately after a disaster has occurred, the group is active at the scene; for example, technical support related to subsequent investigations and countermeasures.

▶ Volcano and Debris Flow Research Team  [http://www.pwri.go.jp/team/volcano/eindex.html]
▶ Snow Avalanche and Landslide Research Center  [http://www.pwri.go.jp/team/niigata/english.html]

The Road Technology Research Group conduct research to resolve the ways of efficient construction and maximum utilization of roads with the objective of providing safe and comfortable road space. The Pavement Research Team conducts research on the pavement technologies by investigating performance evaluations of pavement and design methods, analyzing the economical management of pavement, improving the roadside environment and promoting energy conservation and recycling. The Tunnel Research Team carries out field-based research through experiments, numerical analyses, and on-site measurements to establish rational and economical methods for investigations, design, construction, maintenance and management of tunnel structure and attached facilities such as ventilation and emergency facilities.

▶ Pavement Research Team  [http://www.pwri.go.jp/team/pavement/eindex.html]
▶ Tunnel Research Team  [http://www.pwri.go.jp/team/tunnel/index-e.htm]
Civil engineering structures in cold snowy regions are subject to the actions of freezing and thawing caused by low temperatures, and chloride ions from seawater and antifreezing agent. So they are deteriorated by frost or combined frost and chloride attack etc., and their functions are reduced by frost heaving or insufficient bearing capacity. In order to improve durability and to appropriately maintain the functions of civil engineering structures for a longer period of time, in the Cold-Region Maintenance Engineering Research Group, Materials Research Team (mainly concrete structures) and Road Maintenance Research Team (mainly pavement structures) are conducting research to develop technologies to preserve structures such as quality control and maintenance, repair, reconstruction and other technologies to improve durability in the cold snowy environment.

When concrete structures are subjected to combined deterioration of the frost and salt damages cracking and scaling will occur. It accelerates quality deterioration of concrete and reinforcing steel. So we conduct research to predict its degradation progress and selection of appropriate repair method to perform efficient maintenance and reconstruction. In addition, pavement in snowy, cold regions has been deteriorated and damaged uniquely by frost heaving and low-temperature cracking in midwinter, decreased subgrade bearing capacity and freeze-thawing in snowmelt season as well as snow removal and spraying of anti-freezing agents in winter, we also conduct research on countermeasure for deterioration in these cold environment.

▶ Material Research Team http://zairyo.ceri.go.jp/research/research_eng.htm
▶ Road Maintenance Research Team http://www2.ceri.go.jp/eng/iji.htm
Cold-Region Hydraulic and Aquatic Environment Engineering Research Group

Cold-Region Hydraulic and Aquatic Environment Engineering Research Group conducts research and technology development necessary to strike a balance among securing a safe and sound living, maintaining vigorous socio-economic activities and preserving the rich natural environment in the river basin and coastal zone of the cold, snowy regions. Cold-Region Hydraulic and Aquatic Environment Engineering Research Group consists of four teams and has collaboration among teams to conduct basin-based research on disaster prevention, environment and fisheries from headwater area to coastal zone. River Engineering Research Team conducts engineering development for flood mitigation and river management by the hydraulic experiments and numerical analyses. Watershed Environmental Engineering Research Team develops technologies associated with the conservation of aquatic ecosystems and monitoring and management of water resources and sediment dynamics at the watershed scale. Port and Coast Research Team develops assessment of storm surge and high waves by tsunami and climate change with a large amount of flotsam like ice and damage mitigation. Fisheries Engineering Research Team conducts research on development of fisheries infrastructure engineering to improve productivity and promote fisheries in the cold coastal water.

▶ River Engineering Research Team  http://river.ceri.go.jp/
▶ Watershed Environmental Engineering Research Team  http://kankyou.ceri.go.jp/
▶ Port and Coast Research Team  http://cecore.ceri.go.jp/
▶ Fisheries Engineering Research Team  http://suisan.ceri.go.jp/

Cold-Region Road Engineering Research Group

In cold, snowy regions, it is essential to secure and effective snow and ice disaster measures of winter road traffic function to support rich and quality of life and bring out the vitality of the regions. For this reason, Cold-Region Road Engineering Research Group conducts research on winter road management, snow and ice protection, traffic safety and road geometric structure in order to solve these problems due to the cold, snowy natural environment and unique traffic environment in Hokkaido.

The Cold-Region Road Engineering Research Group consists of the Traffic Engineering Research Team and the Snow and Ice Research Team. The Traffic Engineering Research Team is involved in research programs that aim to ensure safe and reliable wintertime road traffic services, even under the current social circumstances of a declining population, aging society, lack of financial resources. Meanwhile, the Snow and Ice Research Team is involved in research programs that contribute to mitigation of transport disruption because of snow and ice events, which have become more frequent and complex in recent years in terms of location, type, and scale.

▶ Traffic Engineering Research Team  http://www2.ceri.go.jp/eng/koutsu.htm
▶ Snow and Ice Research Team  http://www2.ceri.go.jp/eng/bousai.htm
Cold-Region Agricultural Development Research Group

Cold-Region Agricultural Development Research Group consists of Rural Resources Conservation Research Team and Irrigation and Drainage Facilities Research Team. These teams have been conducting research on civil engineering technology necessary to advance the state-owned agricultural and rural development projects in Hokkaido that deploys the large-scale agriculture with high productivity. In recent years, natural and socio-economic conditions of agriculture in Hokkaido region are changing greatly due to the situations including global warming, lack of manpower, and international food distribution under TPP etc. In response to such environmental changes, it is necessary to maintain and develop agriculture by taking advantage of abundant land and water resources of Hokkaido. Therefore, we develop technologies for the reclamation and water management of large-sized fields, the improvement of longevity of irrigation and drainage facilities and the conservation of water environment in rural areas.

▶ Rural Resources Conservation Research Team http://hozen.ceri.go.jp/
▶ Irrigation and Drainage Facilities Research Team http://suiri.ceri.go.jp/

Director for Cold-Region Technology Development Coordination

The organization solves technical issues and disseminates research result efficiently which is needed for development and promotion in the cold and snowy regions mainly in Hokkaido. The Cold-Region Technology Promotion Division disseminates research results inside and outside of Hokkaido and promotes use of intellectual properties. Machinery Technology Research Team conducts research on mechanical technology for snow removal machine in snowy cold regions and inspection technology that contributes to stock management of civil engineering facilities and machinery equipment.

▶ Cold-Region Technology Promotion Division http://chouseikan.ceri.go.jp/suishin/
▶ Machinery Technology Research Team http://kikai.ceri.go.jp/

Director for Special Research

The 1st century BC Roman architect Vitruvius described “solidity”, “usefulness” and “beauty” as the three essentials for structures. This is why, in addition to considering durability and function, we must consider landscape when developing infrastructure. In recent years in Japan, the need to ensure favorable landscapes when maintaining infrastructure is increasing, as is the need to contribute to tourism promotion. The promulgation of “The Landscape Act” and “The Basic Act for Promoting a Tourism-Oriented Country” are among the responses to such needs. Also, tourism has become an important industry in Japan, including in Hokkaido. In response to such needs, the Scenic Landscape Research Unit was established under the Director for Special Research. We conduct research that supports communities in raising the quality and utility of their public spaces and in creating a rich living environment.

▶ Scenic Landscape Research Unit http://www2.ceri.go.jp/eng/keikan.htm
Introduction of institutions

International Centre for Water Hazard and Risk Management under the auspices of UNESCO (ICHARM)

Introduction of institutions

Center for Advanced Engineering Structural Assessment and Research (CAESAR)

Introduction of institutions

Innovative Materials and Resources Research Center (iMaRRC)
Having been approved at a UNESCO general session, ICHARM was established in March 2006 as an international centre under the auspices of UNESCO. Its aim is to transfer relevant knowledge and technology fostered in Japan to nations and regions impacted by water disasters based on their needs and conditions and to support their efforts to mitigate future disaster damage.

The mission of ICHARM is to serve as the Global Centre of Excellence for water hazard and risk management by observing and analyzing natural and social phenomena, developing methodologies and tools, building capacities, creating knowledge networks, and disseminating lessons and information in order to help governments and all stakeholders manage risks of water-related hazards at global, national, and community levels. To fulfill this mission, we construct effective information networks globally and carry out practical action tailored to local needs and conditions while combining innovative research with effective capacity building.

### Innovative Research

Our current research projects cover the following five areas:

1. Data collection, storage, sharing, and statistics on water-related disasters.
2. Risk assessment on water-related disasters
3. Monitoring and prediction of changes in water-related disaster risk
4. Proposal, evaluation and application of policy ideas for water-related disaster risk reduction
5. Support in constructing the applicability of water-related disaster management

### Effective capacity building

We support practitioners, mainly from developing countries, in building their capacity to resolve problems based on scientific and engineering knowledge and to take a lead in disaster prevention and mitigation measures.

### Effective information networking

We maintain and strengthen a global network of researchers, which contributes to the collection, analysis, and sharing of information and experience related to major water disasters around the world. We are also committed to mainstreaming disaster risk reduction in countries around the world by organizing and managing international networks, such as the International Flood Initiative (IFI). One important IFI project is the establishment of a platform on water and disasters in each country, based on the 2016 Jakarta Statement. We assist Asian countries in organizing this platform to reduce water disaster risk in the region in cooperation with other IFI partners and report on this activity at special UN sessions to share information with other countries.

Introduction of institutions

Center for Advanced Engineering Structural Assessment and Research (CAESAR)
Bridges and Structural Engineering Research Group

Civil engineering structures in Japan have been exposed to severe traffic demand and the natural environment, and aging of many structures to have begun already. To evaluate the soundness of the structure, there is an urgent need to assess the soundness of structures and establish technology for maintenance, management and update those structures. In order to achieve this, “Center for Advanced Engineering Structural Assessment and Research” was established on April 1, 2008. The center, along with the road administrator, works on maintenance and management of proper maintenance of the structure of the road bridges and earthquake response which will lead to problem-solving. It also provides standardization for maintenance of the road/bridges, technology related to design and construction, knowledge of accumulation, research results and integrated technology to contribute society. Bridges and Structural Engineering Research Group, with mainly developing technology to assess and predict performance of the bridge structure accurately and promptly, conducts research on comprehensive technologies of design/construction, maintenance/management, inspection/diagnostic, techniques, and repair/ reinforcement. The group also conducts research on comprehensive maintenance management technology and establishment of disaster recovery technology system. Of the issues related to the bridges, material including soil and specific events unique to the cold regions are studied together with staff of Tsukuba Central Research Institute and Civil Engineering Research Institute for Cold Region. The road administrator and engineers/scientists from universities and private sectors join our team aiming improvement of technical capabilities, and cooperate with related fields for solving problems.

Research that saves “Japan from devastation”

We will work on solving problems by the clinical research approach to prevent collapse and damage due to deterioration of the existing bridges.

- Developing inspection technology to detect conditions of bridges efficiently and reasonably.
- Developing technology to assess impact on soundness of the entire bridge by damage of the material.
- Developing maintenance and management system of accumulation and use of information.

Research that saves “Japan from becoming fragile country for a disaster”

We develop and gather technology of comprehensive countermeasure for large earthquake.

- Developing technology to accurately assess resistance and vulnerability of structures and behavior of the structure at time of earthquakes.
- Developing technology to quickly recover the function in case damages or a suitable reinforcement.

Presentation of required performance and assessment criteria

We present the criteria and guidelines on performance required for individual element technology and how to meet its criteria.

- Realizing the design system which establishes safety factors and a limited value based on reliability.
- Establishing assessment technology to evaluate for required performance.

※ For more information about the CAESAR, please refer to the following HP.
http://www.pwri.go.jp/caesar/index-e.html
In recent years, cases in which deterioration of civil engineering materials affects safety of the structure have occurred. With respect to public infrastructures which will further get older, it is required to repair, apply reinforcing materials and improve the durability of civil engineering materials for prolonged life of infrastructures. It is also necessary to improve durability as well as performances or functions of civil engineering materials. In these circumstances, “realization of effective and efficient maintenance and renewal of infrastructures” was positioned as a focused goal to be achieved in 2030 in “Comprehensive Strategy on Science, Technology and Innovation 2014” adopted by the Council for Science, Technology and Innovation, i.e. it was determined to promote the development of technologies to improve the durability of structural materials for infrastructures. It is also required to examine the applicability of advanced materials to be developed here to the civil engineering sector and carry out research toward practical use of them.

On the other hand, it is also necessary to promote research and development toward a low-carbon recycling society, e.g. promoting effective utilization of construction waste and those derived from other public works and streamlining energy use relating to this utilization. In order to conduct research in these fields, the Innovative Materials and Resources Research Center (iMaRRC) was established. iMaRRC promotes research and development of sophisticating and diversifying material resources in collaboration with other research institutes, and contributes to efficient maintenance and renewal of civil engineering structures as well as building of a low-carbon recycling society. In particular, iMaRRC conducts research on engineering evaluation and suggestion for improvement of advanced materials for site application, as well as studying sophistication of overall civil engineering materials such as durability improvement.

iMaRRC develops advanced structural materials such as FRP or materials which function as sensors for structural monitoring. iMaRRC conducts research on commonly-used materials such as concrete and asphalt as well. For example, developments of durability verification method for concrete through long-term exposure test under severe environmental condition. The research results are reflected in the revision of national design standards and specifications for concrete structures.

With regard to construction waste, iMaRRC examines new recycling techniques and carries out research on evaluation and improvement of environment safety/energy efficiency.

With respect to technology development, iMaRRC offers required standards to be uniformly applied across the country such as securing of safety and reduction in environmental impact, streamlines safety and environmental preservation measures utilizing regional characteristics and techniques to improve individual and regional energy efficiency and realizes technologies which are able to respond to Japan’s various local environments and changes in the local society in the future.

We also realize technologies that will deal with changes in a variety of regional environment and the future of the community of our nation.

▶ http://www.pwri.go.jp/team/imarrc/english/top.html
Joint Research and Partnership with Other Organizations

Joint Research

Joint research is a system that PWRI concludes the joint research agreement with private companies and/or research institutes such as universities to conduct research in collaboration. Although measures have been taken in recent years on coastal reclaimed land to counter soil liquefaction near major facilities, such as the main body of oil tanks, comprehensive measures for peripheral facilities, such as roads, are insufficient; when an earthquake has occurred in the past, a large amount of damage has been caused by soil liquefaction. Thus, PWRI is developing liquefaction countermeasures based on large-scale field experiments at an industrial complex on coastal reclaimed land, with the aim of avoiding or mitigating serious impacts on economic activity. This research project is a part of the Cross-ministerial Strategic Innovation Promotion Program (SIP)*, Strengthening Disaster Resilience and Damage Mitigation.

Development of liquefaction countermeasure technology is being conducted jointly with the National Institute of Maritime, Port and Aviation Technology, the Port and Airport Research Institute, the National Research Institute of Fire and Disaster, and the National Research Institute for Earth Science and Disaster Resilience. In FY2017, a large-scale proof-of-concept experiment was conducted using a full-scale 3D earthquake simulation test facility (E-Defense) to verify the effectiveness of liquefaction countermeasure technology suitable to use with bridges and roads.

* SIP is a national project tackling 10 themes, which are critical social issues for Japan, and are able to contribute to the resurgence of the Japanese economy.

Alliance with other organizations

Under the comprehensive cooperation relates to a civil engineering technology, we concluded a cooperative partnership agreement regarding civil engineering technology with research institutions such as universities and local governments aiming to contribute to the efficient development of high-quality public infrastructure and strive to create further research results. We have the cooperative partnership agreement with foreign and domestic research institutes and the Nation and local governments to exchange variety of information.

Conclusion of agreements on innovative and practical R&D and cooperation in the human resources development and exchange for next-generation with the Graduate and Undergraduate Courses of the Department of Civil Engineering College of Industrial Technology, Nihon University on December 13, 2016 (left) and the Graduate School of Science and Technology and the Faculty of Science and Technology, Tokyo University of Science on March 24, 2017 (right).
PWRI manages intellectual properties appropriately based on an Intellectual Property Policy to bring the best possible value to society as a whole in a strategic and active manner.

**Concepts of the Intellectual Property Policy**

![Diagram showing Strategic Creation, Active Utilization, Appropriate Protection with arrows and concepts like Comprehend the utilization state at all times, Actively promote utilization, Conduct R&D by utilizing intellectual information, Secure excellence of technology, Bring useful valuable intellectual property to light, Periodic reviews based on usage status, etc.]

For more information about intellectual property rights of Public Works Research Institute, please see below.

**Industrial property rights such as patents**
Tsukuba Central Research Institute, ICHARM, CAESAR, iMaRRC
http://www.pwri.go.jp/jpn/results/patent/index.html
Civil Engineering Research Institute for Cold Region
http://www.ceri.go.jp/contents/research/research03.html

**Program works/Guidelines**
Tsukuba Central Research Institute, ICHARM, CAESAR, iMaRRC
http://www.pwri.go.jp/jpn/results/offer/index.html
Civil Engineering Research Institute for Cold Region
http://www.ceri.go.jp/contents/center/center07.html

**Corporate works** (also posted on page 44 in this handbook) http://www.pwri.go.jp/eng/about/pr/publication/index.html#publications

We recommend transfer of technology to private companies so that the new technology with a focus on intellectual property rights is widely used.

**Examples of use of industrial property rights**

**[Invairowan Method]**
(Pat. No. 5,534,233, the other 1)
Removing method for protective coating film prior to repainting works by means of environment-friendly coating disbonder

**[Fluidized Bed Incineration System with Turbocharger]**
(Pat. No. 5,482,792, the other 12)
Energy/space-saving and low environmental load incinerator for sewage sludge

**Research Consortium**
As a national research and development agency, the Public Works Research Institute is actively involved in the promotion of on-site utilization of their own research results. And we are strongly required to contribute to promotion, utilize new technologies, and improve quality of the public infrastructures and reduce costs, etc.
For this reason, for some of the new technologies that the Public Works Research Institute has developed, active follow-up will be carried out until achieve certain level of to self-reliance, through a new attempt of such research consortium.

For overview and use of each intellectual property, please contact Tsukuba Central Research Institute, ICHARM, CAESAR, iMaRRC (Construction Technology Research Department), CERI (Cold-Region Technology Promotion Division). We will provide further information.
Received the Monozukuri Nippon Grand Award / Infrastructure Technology Development Award

Invairowan Method
(iMaRRC (Advanced materials and improvement))

In order to prolong the lifespan of steel structures, it is necessary to peel off conventional coating materials and switch to longer lasting heavy-duty anti-corrosion coating materials. In joint research with a private sector company, PWRI has developed a new removal method that can safely and efficiently remove and collect the old coating film softened in the form of sheet without scattering coating dust in the surrounding area; it is much better than conventional mechanical methods such as blasting, disk sanding, water jetting, etc. This method received the 8th Infrastructure Technology Development Award (MLIT Minister’s Award) in 2006 and the 2nd Monodzukuri Nippon Grand Award (Prime Minister’s Award) in 2007. So far, it has been applied to a total of 349 bridges and other structures throughout Japan, exceeding 500,000 m² in total area, by the national government, local governments, and government-affiliated corporations.

Gravity thickening technology that uses ‘Water Path Forming Poles’
(iMaRRC (Recycling))

In order to efficiently treat sewage sludge, it is necessary to remove as much water as possible from the sludge and thicken it. This technique increases the sedimentation rate of sewage sludge using ‘Water Path Forming Poles’ (WPFPs). Specifically, by slowly rotating a sludge collector fitted with WPFPs vertically in a gravity thickener, ‘water paths’ where liquid moves easily form immediately behind the poles. This draws out the water between sludge particles and high density thickened sludge precipitates to the bottom of the thickener. This technique received the 7th Infrastructure Technology Development Award (MLIT Minister’s Award) and the 1st Monodzukuri Nippon Grand Award (Prime Minister’s Award) in 2005. This technique has been introduced at wastewater treatment plants in 13 municipalities including Tomakomai, Kumamoto, and Imabari, resulting in higher-density thickened sludge at all of the plants.
PCL construction method using a partially-thinned reinforcing plate
(Tunnel Research Team)

PCL construction method is a technology to reinforce an aged tunnel with inner reinforcing precast concrete. There was a problem when lining concrete of a tunnel in service is deformed by external force, etc., the cross section is too small to provide inner reinforcement and the clearance limit is not secured. Therefore, this team has developed a reinforcing slab with a partially-thinned shoulder in which the clearance limit is hard to be secured and a PCL construction method using it. The team won the 16th Infrastructure Technology Development Award 2014 (podium) for this technology. This method has been adopted to Naruko Tunnel on Route 47 and Tashiro Tunnel on Niigata prefectural road.

ALiCC (Arch Action Low Improvement Ratio Cement Column) Method
(Construction Technology Research Team)

Reducing the improvement ratio of ground improvement is an extremely efficient way to reduce the construction cost and construction period of mitigation measures for soft ground. The Arch Action Low Improvement Ratio Cement Column (ALiCC Method) is one method for this, and it is being increasingly applied to sites. This method enables us to rationally evaluate the embankment loads that are acting on cement improved soil columns and unimproved ground, by considering the arch action generated in the embankments and from there thusly allocate improved soil columns in spans of a greater distance than those needed for conventional methods. As a result, it serves to reduce construction costs and the construction period, while also minimizing the settling of the embankment and differential settlement, by placing numerous improved soil columns in the ground immediately beneath the embankment at equidistant intervals.

This method was awarded the 15th Infrastructure Technology Development Award in 2013. It has been adopted in constructions of Maibara Bypass and Maruyama River by the Kinki Regional Development Bureau and a road-widening work on Route 57 in Moriyama region by the Kyushu Regional Development Bureau. As of December 2015, the number of constructions is 118 and the constructed volume is more than 730,000 m³.

Technique Selected as an effective and Serviceable method on the NETIS

Rumble Strips
(Traffic Engineering Research Team)

The installation of rumble strips is a technique to prevent vehicle-departure head-on collisions by excavating and recessing the centerline pavement surface. This recessed centerline generates sound and vibrations to awaken/remind the driver when a running vehicle passes over the centerline. It is highly effective in preventing lane-departure. This technology was used over 1,655 km as of the end of 2009 and has been selected to NETIS recommended technology in FY2009. On 43 routes in Hokkaido which accounted for a total length of 641 km and were improved with rumble strips from FY2002 to 2007, the fatalities from head-on collisions for two years after installment are compared with that for two years before installment; the fatalities from head-on collisions decreased from 59 to 19, or, in other words, by 68%. This technique is highly economical and easy to construct, and can reduce the cost per meter significantly compared to the center divider. This technique is used for 2,100 km as of the end of FY2014.
Fluidized Bed Incineration System with Turbocharger
(iMaRRC (Recycling))

This system improves incineration efficiency by incinerating the composite of sewage sludge and other biomass at approximately 0.15 MPa, and allows utilization of compressed air generated by operating a turbocharger with exhaust gas. It can reduce power consumption by 40%, fuel by 10% and CO₂ by 40%. It can also reduce a great amount of N₂O, which has more of a greenhouse effect than CO₂ when the combustion temperature is adjusted to the high-temperature zone. Based on good results in an experimental plant located in Oshamanbe, Hokkaido, this system has been adopted at 9 wastewater treatment plants in Tokyo and other places. This technology received the 17th Infrastructure Technology Development Award (MLIT Minister’s Award) and the 41st Excellent Environmental Equipment Award (METI Minister’s Award).

Tunnel repair technologies (NAV method)
(Tunnel Research Team)

NAV method is a repair technology which attaches a newly-developed transparent sheet with cohesive resin to the cracked surface of lining concrete in order to prevent the concrete from spalling. It forms a high degree of transparent FRP (fiber reinforced plastic) by coating and impregnating an adhesive acrylic resin to nylon cloth and the progress of the cracks can still be seen after the sheet is installed, therefore it is possible to check the effects of the repair and the need for additional measures. This technology is an effective means of preventing damage to users caused by delamination or separation of lining concrete. Further, by using a glass fiber repair sheet, it also proposes further NAV-G method with improved fire resistance. As of March 2016, it has been used for approximately 43,000m² of road, railway, subway tunnels and others.

Gas-liquid dissolving apparatus (Technology for improving bottom water quality by supplying water with supersaturated dissolved oxygen)
(Water Quality Research Team)

The release of nutrients and metals from sediments as a result of oxygen-poor condition in the bottom layer caused by thermodine sometimes significantly compromises water quality in closed water body such as reservoirs. Therefore, PWRI developed a novel gas-liquid dissolving system: creating pure oxygen gas to supply water with supersaturated dissolved oxygen to the bottom layer at any depth and increasing DO in order to improve water quality. Because the technology can supply DO across a broad spectrum without destruction of the thermodine, unlike conventional aeration systems, water quality can be restored efficiently and effectively. To date, this technology has been adopted by the Chugoku and Shikoku Regional Development Bureaus for domestic dams and other areas, as well as dams in Jiangsu Province, China.
**Installed anchor tensile monitoring system (Aki-Mos)**

(Landslide Research Team)

Ground anchor for slope stability should be maintained properly. Especially, it is important to know any changes of the tensile stress in order to maintain ground anchor. However, the tensile stresses are not measured in many cases. We therefore developed continuous monitoring techniques of load for installed anchors. These techniques have enabled us to get the load data remotely by radio. By these techniques, it is possible to monitor the load, which it could hardly be done in the past. As of January 2018, 333 systems have been adopted in 71 locations, such as dams and roads managed by Regional Development Bureaus and NEXCO roads.

![Installation of the technology](image)

**Drainage system for the end of concrete bridge girders (CAESAR)**

A rubber or polyethylene gutter-shaped drainage available to insert into the expansion gap from the side of existing concrete bridges allows preventing salt damage of girders and substructures due to leakage water contaminated by deicing salt from expansion joints. This drainage can be easily installed from under the bridges without affecting to traffic flow. The drainage system has been applied to a highway bridge in Akita Prefecture.

![Schematic diagram of the drainage](image)

**Driving type water level observation device**

(Soil Mechanics and Dynamics Research Team)

An observation well is conventionally excavated by boring to observe underground water levels. This is a simple observation device that can be driven and installed using a simple penetration machine. Because a simple temporary scaffold is used to install the device, it can be easily installed in a short period of time at low cost, thereby enhancing work safety. Specifically, the device is used for verifying the effectiveness of river levee flood countermeasures and earthquake countermeasures, assessing the stability of road embankments, and measuring declining water levels around underground excavation sites.

This device has been installed in more than 65 places of 16 sites including Yonesiro River and Tokushima Expressway.

![Device](image)

**Installation of the technology**

1. Drive a casing as an observation well
2. Insert a rod into the casing, drive the edge and expose the perforated part.
3. Install a water-level gauge.
Wire Rope Guardrail System  
(Traffic Engineering Research Team)

The wire rope guardrail system consists of high toughness wire ropes and thin posts that break when they are hit by a car. By absorbing shocks of vehicle collision mainly with deflection of wire rope, it is expected to drastically reduce fatal accidents. There is no difference between shapes of both sides of the system, thus the width required for installation is narrow and the installation cost can be reduced. Since this guardrail system can be installed and removed by humans, it is possible to partially make opening sections in an emergency to allow car drivers to drive in the opposite lane and complete repair work in a short time. Temporary-two-lane expressways without median strips have higher risks of fatal collision accidents than four-lane sections. Therefore, as an emergency measurement to prevent these accidents, this system has been installed in over-100km temporary-two-lane areas from the 2017 spring for its feasibility assessment.

High-performance SMA (Pavement including both durability of SMA and permeable function)  
(Road Maintenance Research Team)

High-performance SMA is a new asphalt mixture that has both a porous pavement texture and stone mastic asphalt (SMA) superior in durability. Generally, pavement surface layer is designed, produced and placed so that the physical and mechanical quality is even in the vertical direction. On the other hand, in high-performance SMA, the layer near the surface is porous, the middle and lower layers are dense. Therefore, as a surface layer of pavement, it has sufficient durability (plastic flow resistance, wear resistance, aggregate scattering resistance, etc.), safety (drainage function, skid resistance, glare-proof, etc.), environmental preservation (low noise, etc.) and comfort (smoothness, etc.) in a balanced manner. This has been used more than 1,000,000m², for slopes, urban intersections and pavement repair in tunnels.

Attachment-type road sweeping device for rotary snowplow  
(Machinery Technology Research Team)

Road maintenance- and snow removal-dedicated cars are operated for only half a year in the snowy and cold regions. We developed an attachment-type road sweeping device focusing on the fact that rotary snowplows can be utilized throughout the year. Existing rotary snowplows with attachment-type road sweeping device allow you to utilize rotary snowplows throughout the year. It contributes cost reduction compared to conventional machinery. They were introduced, according to demand, by the Hokkaido Regional Development Bureau (Ministry of Land, Infrastructure, Transport and Tourism) from FY2012, and are used in road maintenance work.
Quality control of embankment with Impact Acceleration measuring Device
(Geotechnical Research Team)

This Impact Acceleration measuring Device can control quality of embankments that serve as the base for roads in a simple, prompt and inexpensive manner. The existing quality control method for embankments (sand replacement method/RI method) requires at least one whole day until the results are available and sometimes affects the progress of work. This Impact Acceleration measuring Device is easy to use and generates results immediately on-site to ensure quality control of embankments in a short time. This has been applied to the quality control of “Common Specifications on Road/River Construction Work” issued by the Hokkaido Regional Development Bureau, the Ministry of Land, Infrastructure, Transport and Tourism.

Frost damage deterioration inspection technology for concrete by ultrasound (surface scanning method)
(Materials Research Team)

The extent/degree of frost damage in cold climates is generally evaluated by collection and analysis of core. However, the structure is damaged by the collection and the significant cost, time, efforts are required in the wide range of investigation. In this technology, the time spent for inspection can be saved and the number of core collection and the amount of repair can be reduced which leads to saving costs and minimizing damage to the structure.

Method of estimating the run-up distance and run-up height by the river tsunami
(River Engineering Research Team)

The technology is used to estimate the run-up distance and the run-up height of the river tsunami and provide government workers in charge with the tsunami information for making decision of disaster prevention and mitigation. Specifically, the following need to be done in advance: 1) performing run-up calculations of the river tsunami under different conditions of tsunami height and river discharge with a small calculation load by one-dimensional computational model, and 2) creating the longitudinal diagram for river tsunami prediction that summarizes the result of the calculations. In case of an earthquake and a possibility of river tsunami, the government workers can instantly obtain the predictive value of the run-up distance and the run-up height from the diagram that shows the calculation result under the closest condition of expected tsunami height and the river discharge at the moment.
Maximization of research and development results

Technical Support

Technical support at the time of disasters

Our nation suffers from a lot of natural disasters such as human/material damages due to earthquake, heavy rain, landslides, and snow. Public Works Research Institute carries out emergency response in the event of a disaster in order to provide technical advice regarding survey of damages immediately after the disasters, the method to restore civil engineering structures that were damaged and technical support for lifesaving at the time of landslides.

In the earthquake that occurred in Kumamoto on April 14, 2016, many homes collapsed or were damaged, as was Kumamoto Castle. The highway to Aso was blocked by damage and major collapse of roadside sloping verges. Heavy rain and Typhoon No. 10 on August 20, 2016, caused landslides and damage to riverway facilities, such as river dykes, and to road facilities, such as bridges, in various areas. In addition, in the sudden heavy rain in northern Kyushu on May 5 and 6, 2017, debris flow damaged many buildings, and sloping roadside verges also collapsed.

The managers of damaged facilities (central and local government bodies) requested disaster response from PWRI. We sent personnel to the sites to deliver high-level technical guidance related to recovery.

Kumamoto Earthquake: Inspection of damages at the crossover in the City Road Chuo Line (17 Apr.)

Typhoon No.10 etc.: Field survey of the collapsed bridge in Hidaka Town (1 Sep.)

Kumamoto Earthquake: Field survey of the collapsed Aso-Ohashi Bridge and the landslide on the national highway No.57 (17 Apr.)

Typhoon No.10 etc.: Investigation of the overflow and the collapse of embankment in Kitami City (21 Aug.)

Northern Kyushu heavy rain: investigating landslide damage at a collapsed roadside slope (photo taken on July 13, 2017)

Typhoon No.10 etc.: Research status of the landslide in Rausu Town (10 Sep.)
Technical support relating to civil engineering technology in general

We provide technical support by the request from the national and local public organizations even at the time of the non-disaster for the purpose of supporting solution related to agriculture, fisheries and harbors and providing civil engineering technology in cold regions. We also participate in the technical committee, such as the government and relevant societies to provide technical support. Public Works Research Institute has accumulated knowledge and research results that are reflected in the formulation and revision of various technical standards.

![A road maintenance technical team assessing the earthquake resistance of a bridge](image1)

![Technical support on the maintenance and management of the snowbreak woods in Hokkaido](image2)

Dispatch of lecturers

We offer the trainings to engineers of College of Land, Infrastructure, Transport and Tourism, Regional Development Bureau, Hokkaido Regional Development Bureau, local governments, and universities. We also organize lectures for the general public including elementary, junior high, and high schools as well as dispatch a lecturer to institutions by request to give guidance and promote civil engineering technology.

![Training session for relevant officers in central and local government and for private businesses (58th sediment control and landslide prevention lecture meeting)](image3)

![Training sessions for civil engineers](image4)
Maximization of research and development results

Dissemination of Research Findings

Publications of the Public Works Research Institute
Research results of PWRI are published and/or posted on the internet as: Reports of PWRI, PWRI Materials, Joint Research Reports, Monthly Reports of the Civil Engineering Research Institute for Cold Region, etc.

Publications by PWRI
PWRI has published the below books under copyright. These books are available at bookstores.

<table>
<thead>
<tr>
<th>Book title</th>
<th>Publisher</th>
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<tbody>
<tr>
<td>Eco-cement Concrete Utilization Technology Manual</td>
<td>Gihodo Shuppan</td>
</tr>
<tr>
<td>Manual for Inspecting Soundness Level of Concrete Structures Using Nondestructive Tests</td>
<td>Gihodo Shuppan</td>
</tr>
<tr>
<td>Collection of Physical and Chemical Information Regarding Human Use Pharmaceuticals</td>
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</tr>
<tr>
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<td>Inspection and Maintenance Manual for Ground Anchors</td>
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<tr>
<td>Soil Pavement Handbook (for Pedestrian Pavement)</td>
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<tr>
<td>Manual for Landslide Measurements with Insertion Borehole Inclinometer</td>
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<td>Manual for Inspection of Concrete Structures by Nondestructive/Micro-destructive Tests</td>
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<td>Integrated geophysical exploration of levee systems – A Guideline for the application to the safety assessment</td>
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<td>Shape estimation method of landslides line</td>
<td>Kajima Publishing</td>
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<tr>
<td>Practical Guide to Water Drainage Boring for Preventing Landslides</td>
<td>Kajima Publishing</td>
</tr>
<tr>
<td>Handbook for Handling Rocks and Soils Containing Naturally-occurring Heavy Metals at construction works</td>
<td>Taisei Shuppan</td>
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Application in Standards
Research findings are reflected in new and revised standards for infrastructure.

- River Bureau, Ministry of Land, Infrastructure, Transport and Tourism
  - Preliminary Technical Guidelines for Landslide Investigation and Its Remedies for Reservoirs
  - Guidelines for Seismic Safety Evaluation of Dams for Large Earthquakes (Draft)
- Road Bureau, Ministry of Land, Infrastructure, Transport and Tourism
  - Highway Bridge Specifications and Instruction Manual
- Ministry of the Environment
  - Guidelines for Applying for Offshore Disposal of Waste
  - Guidelines for Topographical Changes to Final Disposal Sites
- Related Organizations
  - Standard Specifications for Concrete Structures etc. Japan Society of Civil Engineers
  - Engineering Bedrock Classification Method, etc. Japanese Geotechnical Society
  - Guidelines and Commentary on Earthquake Proofing Sewage Treatment Facilities, etc. Japan Sewage Works Association
  - River Earthwork Manual etc. Japan Institute of Construction Engineering
  - Manual of Design and Construction of Reinforced Earth Using Geotextiles, etc. Public Works Research Center
  - Electronic Delivery Methods for Geological and Soil Research Findings Japan Construction Information Center

Presentation of Papers
PWRI publishes approximately 1,500 papers each year, including the presentation of papers at international conferences and academic meetings, and the submission of papers for publication in collections of papers and specialist journals. We aim to present high-quality findings, with more than 300 of these papers undergoing peer review before publication.
The “PWRI New Technology showcase” is a seminar event to explain our new technologies. The panels and models are also exhibited at the events. The researchers provide consultation to introduce our new technologies into actual sites. The Showcases are held every year in Tokyo, Sapporo, and a few other cities. In FY2017, about 1850 participants attended the Showcase in the six cities, Tokyo, Sapporo, Nagoya, Sendai, Hiroshima, and Fukuoka.

The PWRI New Technology Seminar gives lectures about selected PWRI technologies for cost reduction, time shortening or other effect, so as to address current detailed technical trends in the respective areas as may be required for application at sites, etc. The seminar is held every year in Tokyo.

The On-site Tour is held on as many occasions as practical in the field where PWRI developed technology is being actually applied to ensure that the participants can actually see with their eyes, understand application methods and benefits.

PWRI holds briefing sessions on development technologies regarding subjects which are of interest to engineers in snowy cold regions on related institutions in order to promote the utilization of new technologies researched and developed in snowy cold regions on sites of public works.

On-site seminars are cosponsored in various areas of Hokkaido by the Civil Engineering Research Institute for Cold Region and the Hokkaido Regional Development Bureau so that survey methods and countermeasures in snowy cold regions can be effectively utilized at sites and such seminars contribute to the promotion of development in Hokkaido.
Maximization of research and development results

International Contribution

The Public Works Research Institute (PWRI) has been active in conducting research and on-site activities in collaboration with international organizations and research institutes in Asian and other regions. One example is an international project, “Transformation of Urban Management (TA8456 MYA),” in which the International Centre for Water Hazard and Risk Management (ICCHARM) has been involved since July 2014. The project is led by the Asian Development Bank and specifically developed for Myanmar. Assigned to strengthen the nation’s urban flood management capacity, ICCHARM has provided local government personnel with training and technical assistance needed to perform flood and storm-surge risk assessment and hazard mapping. ICCHARM is also involved in a UNESCO-funded project, "Strategic Strengthening of Flood Warning and Management Capacity of Pakistan Phase II." Furthermore, it has been the secretariat of the International Flood Initiative (IFI), a global framework to promote collaboration on flood management with major international organizations such as UNESCO, the World Meteorological Organization (WMO), and the United Nations University. PWRI will continue to plan and implement a wide range of activities in partnership with donor organizations such as the Japan International Cooperation Agency (JICA) and the World Bank.
Human Resource Development

The Public Works Research Institute accepts trainees of civil engineering technology field of more than 300 people every year from Africa, Asia, and Central and South America. We also dispatch a large number of instructors in specialized training of civil engineering that JICA organized to work on human resource development.

In particular, the three parties, ICHARM, the National Graduate Institute for Policy Studies (GRIPS) and JICA jointly launched a one-year Master’s course "Disaster Management Policy Program and water disaster risk management course". ICHARM also launched a three-years Ph.D. program "disaster prevention science program" with GRIPS.

Overseas Technical Support

As a reply for requests made by JICA, foreign governments, and foreign research institutes, PWRI dispatches engineers to foreign countries, and disseminates technical knowledge and research outcomes of PWRI, depending on the need.

At the end of May 2017, after flooding in Sri Lanka, we investigated the scene as part of a specialist international emergency assistance team. We observed and prevented secondary damage and provided guidance and assistance related to infrastructure recovery and improvement.
Introduction of Facilities

- Tsukuba Central Research Institute
- International Centre for Water Hazard and Risk Management
- Center for Advanced Engineering Structural Assessment and Research
- Innovative Materials Resources Research Center

Map of facilities and research areas.
Introduction of Facilities
Introduction of Facilities

Civil Engineering Research Institute for Cold Region

- Irregular oscillatory water tunnel
- Concrete combined-deterioration accelerating test apparatus
- High-speed hydraulic channel
- Centrifugal force load laboratory
- Low-Temperature Laboratory Examination Machine
- Large single-shear testing room
- Multipurpose Low-Temperature Laboratory

Concrete combined-deterioration accelerating test apparatus
Irregular oscillatory water tunnel
High-speed hydraulic channel
Off-Site Facilities

Ishikari Experiment Site

The Double Fence Intercomparison Reference (at the Ishikari Experiment Site)

Wind tunnel experimental apparatus (at the Ishikari Experiment Site)

Civil Engineering Research Institute for Cold Region (Sapporo City)

Kakuyama Experiment Site (Ebetsu City)

Cold-Region Test Track in Tomakomai (Tomakomai City)

Construction Test Field in Tomakomai (Tomakomai City)
Lease System of Facilities

PWRI leases test facilities and equipment in its possession to national institutions, local governments, universities, public-interest corporations and private research organizations as a rule. There are special civil engineering test machines that are expensive or difficult to maintain properly. Some of the lease-signers are from fields other than civil engineering.

Examples of lease

Civil engineering-related experimental research

Other experiments

Other facilities for lease

- 30 MN large-scale universal testing machine
- Earthquake engineering laboratory
- Current meter calibration channel
- Earth Structure Laboratory
- Differential settlement
- Earthwork experimental laboratory
- Large-scale Geotechnical Dynamic Centrifuge
- Dam hydraulics laboratory
- Pavement test field
- Large-scale box shear test apparatus

- Impact acceleration tester
- Wind tunnel experimental apparatus
- Ishikari hydraulic experimental station
- Wheel tracking test machine
- Ishikari Blowing-Snow Test Field
- Freeze-thaw testing machine
- Raveling testing machine
- Centrifuge
- Inclunable channel

Other civil engineering facilities

Please check our homepage for application procedures, forms and regulations.
Open House

We organize open house for the general public to get to know more about our research. Research institutions, corporate officials, university students and vocational school students as well as the residents of the region who have no contact to our research visit our facilities so they can observe part of our activities. We also accept the facility tour if it is pre-registered.

Public Works Research Institute

The research facilities of Tsukuba, Ibaraki Prefecture, has an open house during “Science and Technology Week (April)” and on the “Civil Engineering Day” (November) in collaboration with the National Institute for Land and Infrastructure Management. We introduce civil engineering in recent years and the mechanism of disasters through hands-on events and demonstration/experiment. We also introduce special vehicles used in the field in cooperation with Ministry of Land, Infrastructure and Transport Kanto Regional Development Bureau.

At open house in November, we hold the bridge making contest for elementally students with support from the city Board of Education cooperation. We display the bridges which elementally students create.

Civil Engineering Research Institute for Cold Region

CERI in Sapporo, Hokkaido has held open house every year in July since 1983 in conjunction with the “Land, Infrastructure, Transport and Tourism Day”. The purpose of this event is to provide the general public including children with understanding and outreach of our institution’s role, research result and research themes that we are correctly working on.

Every year each team displays unique exhibition and visitors can enjoy and play with hand-on exhibits. We also have the section dedicated to the professional civil engineers.

Aqua Restoration Research Center

Aqua Restoration Research Center (Gifu Prefecture Kakamigahara) offers “guided tour” (pre-registration is required) in spring and autumn in order to promote research result of the conservation and restoration of the river environment and give technical guidance of river engineering. In this tour, based on the research results of the experiment, you can learn about the practical content related to multi-natural river such as the form of a river, the relationship between the water/sediment flow and living organisms, revetment block with consideration of landscape and the concept of environment and the band of engineering investigated.
Access to Civil Engineering Research Institute for Cold Region

CERI is located on the eastern side of the Toyohira River that goes through the center of Sapporo City, in an area called Hiragishi in Toyohira-ku. The institute is about 200 meters north of, or 3 minutes walk from, the Nakanoshima Station on the Namboku Line of the Sapporo City Subway System.
Public Works Research Institute

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