National Research and Development Agency

Public Works Research Institute

Current the Public Works Research Institute

Current the Civil Engineering Research Institute


Former by known as the Pulblc Words Research Institute


Former by known as the Cilil Engineering Research Institute

Greetings from the President

Purpose of Civil Engineering

The Earth is irreplaceable to humanity. However, in its raw form, it remains remarkably wild. Therefore, since the dawn of civilization until today, humanity has strived to establish an “interface” or “cushion” between the Earth and human beings in order to create human societies that can thrive for a long time and where everyone can live a safe and active life and enjoy the blessings of nature, while pursuing a thoughtful use of the land on the basis of a good understanding of its local nature and geography. This “interface” or “cushion” is what is referred to as infrastructure.

Civil engineering technology plays a crucial role in the skillful construction of infrastructure that fits in with each region and in the proper maintenance of their essential functions, which are desperately needed by regions for a long period.

FUJITA Koichi, President of Public Works Research Institute

藤田光一

Central thinking and action principle of PWRI

For over 100 years since its establishment as the Civil Engineering Laboratory in the Ministry of Internal Affairs in 1922 (with the Hokkaido Civil Engineering Institute established in 1947), the Public Works Research Institute (PWRI) has contributed to the efficient development of high-quality infrastructure as a core institute responsible for advancing civil engineering technology. Ultimately, these contributions have supported the development of the nation.

Our central thinking is that the fundamental mission of PWRI is to contribute to public interest to create a better society. In other words, our actions must always be unselfish, ethical, and oriented toward public good. Furthermore, we set the following action principles under the central thinking.

1) Grasp the essence of phenomena, issues, and needs, applying scientific thinking thoroughly to investigate phenomena. 2) Always organize acquired knowledge systematically and share it widely. 3) Respect “reality.” 4) Be aware that implementation is a critical part of our mission. 5) Present sensible judgments with reasoning, if necessary, even when the available information is limited. 6) Maintain a deep sense of responsibility in applying technologies, as well as in making technical judgments.

Integrating the needs of the times into an unshakable foundation

The purpose and importance of civil engineering technology remain unchanged, but the topics to pursue evolve with time. PWRI, while maintaining its central thinking and principles, is also exploring necessary actions for each occasion, and pioneering its own way of being and working.

The Fifth Medium- to Long-Term Plan (introduced from p. 18 onwards) has opened a new chapter in this pursuit. Implementing this plan will involve addressing the increasing severity and frequency of natural disasters, aging of our vast infrastructure, rapid decline of the working-age population, and effects of climate change that we face today. As we continue to expand existing technologies, we will also occasionally break through their “ceilings” by incorporating emerging technologies, alongside crossing and integrating various fields, to move forward with a goal-oriented approach without being bound by conventional thinking and frameworks.

Taking a bird’s -eye view of the issues and serving as a base for collaboration

PWRI places the highest priority on yielding research results to solve actual problems, being conscious that insights for identifying essential needs and relevant research targets are our great strength. Accordingly, it has been collaborating closely with the Ministry of Land, Infrastructure, Transport, and Tourism, as well as other organizations in charge of handling various infrastructure projects.

Furthermore, from a bird’s-eye view, we have identified research and technological areas that cannot be achieved only through our own efforts and have focused on exchanges, collaborations, and cooperation with various organizations through initiatives like launching of a joint research system among industry, academia, and government in 1980 to ensure on-time delivery of results needed by the public. This is also related to the current theme of science and technology policy*, namely, creating an environment in which research and development that brings innovation in society is widely stimulated.

A place where researchers and engineers can grow in various ways

People are the driving force behind the activities of the institute. Researchers belonging to PWRI are at its core, but the involvement does not stop there. Various individuals outside PWRI are connected to it in multiple ways, through opportunities such as exchanging knowledge and information to create “chemical reactions”, collaborating to create something, receiving technical support and training, finding ways to address on-site issues and disasters together, and bringing together experts to execute projects. These connections are also steadily expanding internationally**. There is currently a strong desire to cultivate individuals who understand the essence of civil engineering technology and who will lead the next generation; in this context, PWRI is becoming increasingly important as a place where researchers and engineers can be stimulated, inspired, and nourished for growth.

PWRI will fulfill its mission in recognizing and maximizing the characteristics rooted in the above-mentioned foundations.

*) Role as a research promotion corporation in the SIP of the Cabinet Office and as an operating support corporation in the SBIR Phase 3 Fund Project, Ministry of Land, Infrastructure, Transport and Tourism (see p. 45)

**) ICHARM’s capacity-building and international networking efforts (see p. 15, 42)

Table of contents

01. What is civil engineering?

PWRI is a research institution for civil engineering. PWRI could be written 土木研究所 (Doboku-Kenkyusho). 土木 (Doboku) means civil engineering and 研究所 (Kenkyusho) means research institute. “土” means earth or soil and “木” means tree or timber.

The reason we use the term “earth and timber” instead of civil engineering is that it is generally believed to originate from “築土構木” (lit. “construct with earth, compose with timber”), which is a term that appears in Chinese classics. Given its literal meaning, it is easy to understand when imagining a river embankment (Sayama Pond) or a wooden bridge (Kintai Bridge). Earth and timber have been essential materials for developing rivers and roads since long before the dissemination of concrete and steel. Naturally, stone has also been used as a material. For example, it is said that pavement technology began when three-branches and -bones were lined up on animal paths that had been compacted by humans easier to make them easier to walk on. Thus, it can be said that civil engineering technologies, which utilize materials such as earth and wood, have supported the evolution of humankind since its origins.

Since the dawn of civilization, humanity has sought to create an interface or cushion between the Earth and humans to **“achieve a state where human society can develop and everyone can live safely and actively anywhere while enjoying the blessings of nature.”** This is referred to as infrastructure. The general technology required to create, integrate, and maintain infrastructure, so that the functions necessary to achieve this goal can endure both nationally and regionally is referred to as “earth and timber” technologies in Japanese. This is why the Japanese name of PWRI uses this term.

<Dam-type reservoir>

Sayama Pond is the oldest dam-type reservoir in Japan, renovated by Gyoki over 1,300 years ago. It has been designated a National Historic Site. The area around Sayama City, Osaka, today is distant from abundant rivers such as the Ishikawa River and the Yamato River, making irrigation a challenging task. Sayama Pond is such an essential piece of infrastructure for the region that the city is named after it ; a life-size model of the embankment is on display at the neighboring Osaka Prefectural Sayamaike Museum.

<Arch bridge structure>

Kintai Bridge is a five-arch bridge built during the Edo Period, with a total length of 193.3 m and a width of 5.0 m. The main structure was constructed using joinery techniques without iron nails. Through periodic rebuilding, it has retained its beautiful appearance to this day.

<Erosion control projects>

Before the Asuka and Nara Periods, the area around Mt. Tanakami was densely covered with large trees. However, repeated deforestation caused by successive capital relocations, combined with the weathered granite geology, left the mountain bare. The large amount of soil and sand flowing from the barren mountain raised the riverbed of the Seta River, causing major flooding around Lake Biwa.

In the Meiji era, under the guidance of foreign engineers, such as Johannis de Rijke, slope stabilization works and check dam construction projects for greening were carried out until recent years. Consequently, Mt. Tanakami has regained its greenery.

Slope stabilization works

Yoroi Dam

*Photograph taken from Ministry of Land, Infrastructure, Transport and Tourism website

<Paved road>

The Appian Way is the most famous Roman roads still in existence. Over 2,000 years have passed since it was built, yet it remains in use for traffic.

The basic pavement structure is not significantly different from modern asphalt pavement, with basalt stone slabs laid on top of multiple layers of gravel.

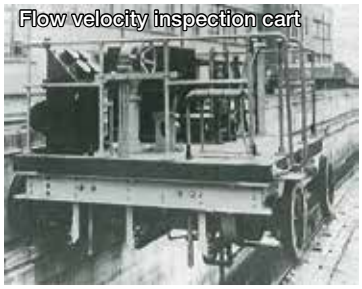
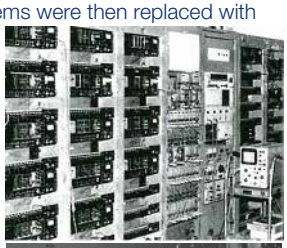
Although it still exists today, it has not been continuously maintained for 2,000 years, resulting in a quite uneven road surface . However, during the Roman Empire, the road surface had almost no unevenness, suggesting that it contributed to maintaining the empire by enabling the smooth movement of troops and supplies.

02. History of the Public Works Research Institute

	Public Works Research Institute	Civil Engineering Research Institute for Cold Region
1922	Became an independent government office as the Civil Engineering Laboratory, Ministry of Home Affairs	
1926	Established the Akabane Branch Office (renamed the Akabane Branchin 1967)	
1937		Established the Testing Laboratory of the Civil Engineering Department, Hokkaido Agency, Ministry of Internal Affairs 
1947		Became independent as the Hokkaido Civil Engineering Institute
1948	Renamed as the Public Works Research Institute, Ministry of Construction 	
1951		Renamed as the Hokkaido Development Bureau Civil Engineering Research Institute
1952	Established the Shinozaki Branch Office (renamed the Shinozaki Laboratory in 1967)	
1960	Established the Chiba Branch and Niigata Laboratory for Landslide Experiments (renamed the Niigata Experimental Laboratory in 1962, now the Snow Avalanche and Landslide Research Center)	
1961	Established the Kashima Hydraulics Laboratory (renamed Kashima Laboratory in 1967)	
1979	Relocated all facilities to the new Tsukuba Science City	
1988		Renamed as the Hokkaido Development Bureau Civil Engineering and Development Institute 
1998	Established the Aqua Restoration Research Center	
2001	Became Independent Administrative Institution Public Works Research Institute (succeeding the Niigata Experimental Laboratory and Aqua Restoration Research Center) *National Institute for Land and Infrastructure Public Works Research Institute established to handle tasks that must be directly implemented by the government	Became the Independent Administrative Institution the Civil Engineering Research Institute of Hokkaido
2006	Established the International Centre for Water Hazard and Risk Management (ICHARM)	
	Integrated both organizations to form the Independent Administrative Institution Public Works Research Institute	
2008	Established the Center for Advanced Engineering Structural Assessment and Research (CAESAR)	
2015	Became the **National Research and Development Agency Public Works Research Institute (PWRI)** Established the Innovative Materials and Resources Research Center (iMaRRC)	
2022	Celebrated its 100th anniversary	
2023	Established the Strategic Innovation Research Promotion Office	

03. 100 years of the Public Works Research Institute

Since its founding, the Public Works Research Institute has consistently returned the results of its research and development , along with its accumulated technological capabilities, to the field and has systematically organized and implemented the means to achieve this.

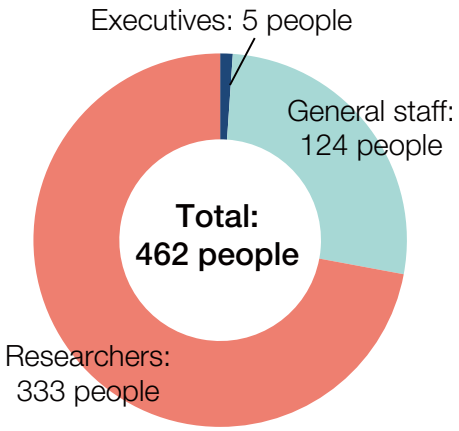
	Public Works Research Institute	Civil Engineering Research Institute for Cold Region
1923	**Completion of the asphalt testing laboratory at the Public Works Research Institute, Ministry of Home Affairs**: Conducting tests on bituminous materials (asphalt, coal tar, etc.)  Image provided by: Civil Engineering Library of the Japan Society of Civil Engineers	
1933	**Installation of a flow rate test channel at the Akabane Branch Office:** PWRI conducted flow rate meter tests to ensure the accuracy of flow rate data, which are the basis for flood control and water utilization planning and river management	**Development of wood-concrete bridge:** A bridge type developed to overcome the steel shortages during and after World War II. These bridges were built over a wide area of Hokkaido as replacements for RC and steel Bridges.
1938	 Flow velocity inspection cart	
1954		**Utai wave recorder:** This wave height meter was developed by Engineer Utai of the Hydraulic Engineering Research Laboratory and used for wave observations Nationwide. 
1956	**Development and introduction of analog computers for rivers**: The basic equations of hydraulic systems were simulated with electrical systems, and the phenomena that appeared in the electrical systems were then replaced with hydraulic systems to confirm hydraulic phenomena	
1960		**Construction of Bibi test road:** This test road was used to investigate the replacement method for frost heave prevention that is currently widely used throughout Hokkaido. 
1998	**Large-scale wind tunnel testing of the Akashi Kaikyo Bridge** 	
2014		**Large-scale testing aimed at practical use of roundabouts:** Roundabouts not only improve safety and convenience, but are disaster-resistant, as traffic can continue to pass even during power outages; therefore, roundabouts are expected to reduce CO_2 emissions. 
2016	**Guidelines created following the road collapse in front of Hakata Station:** The PWRI served as the secretariat for the investigation committee to investigate the road collapse, contributing to identifying the cause. Guidelines were then created to prevent recurrence.	
2021	 Source: Cited from Fukuoka City Transportation Bureau website	**Widespread use of wire rope barriers leads to a significant decrease in fatalities and injuries** (p. 37) 

See “100th Anniversary Commemorative Book: History of Research” and “100th Anniversary Commemorative History of the Public Works Research Institute”.

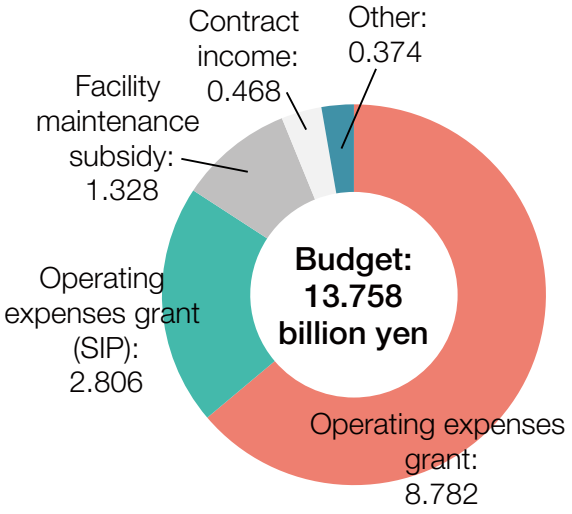
▶Publications

04.Personnel / budget / locations

Personnel

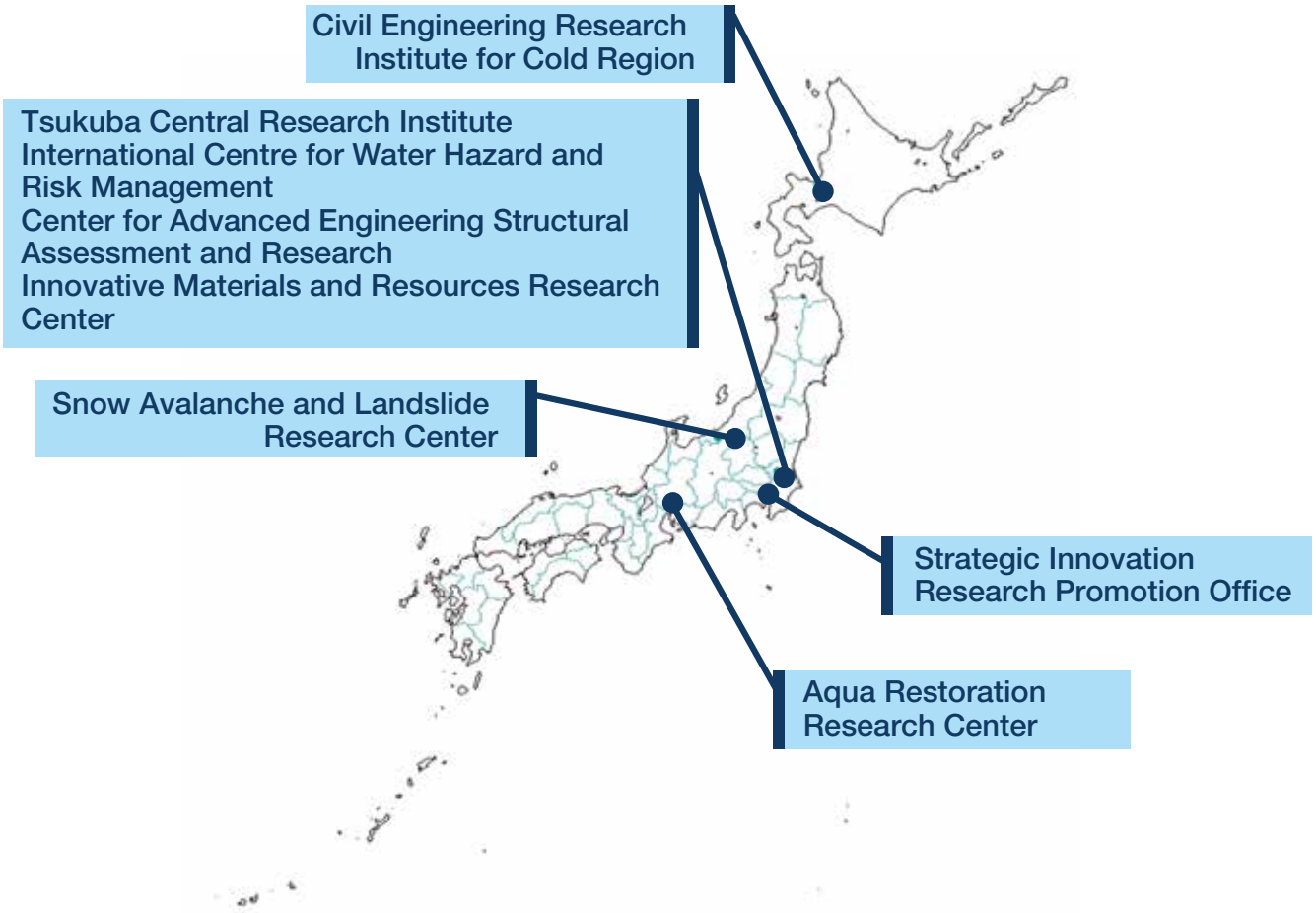


Budget

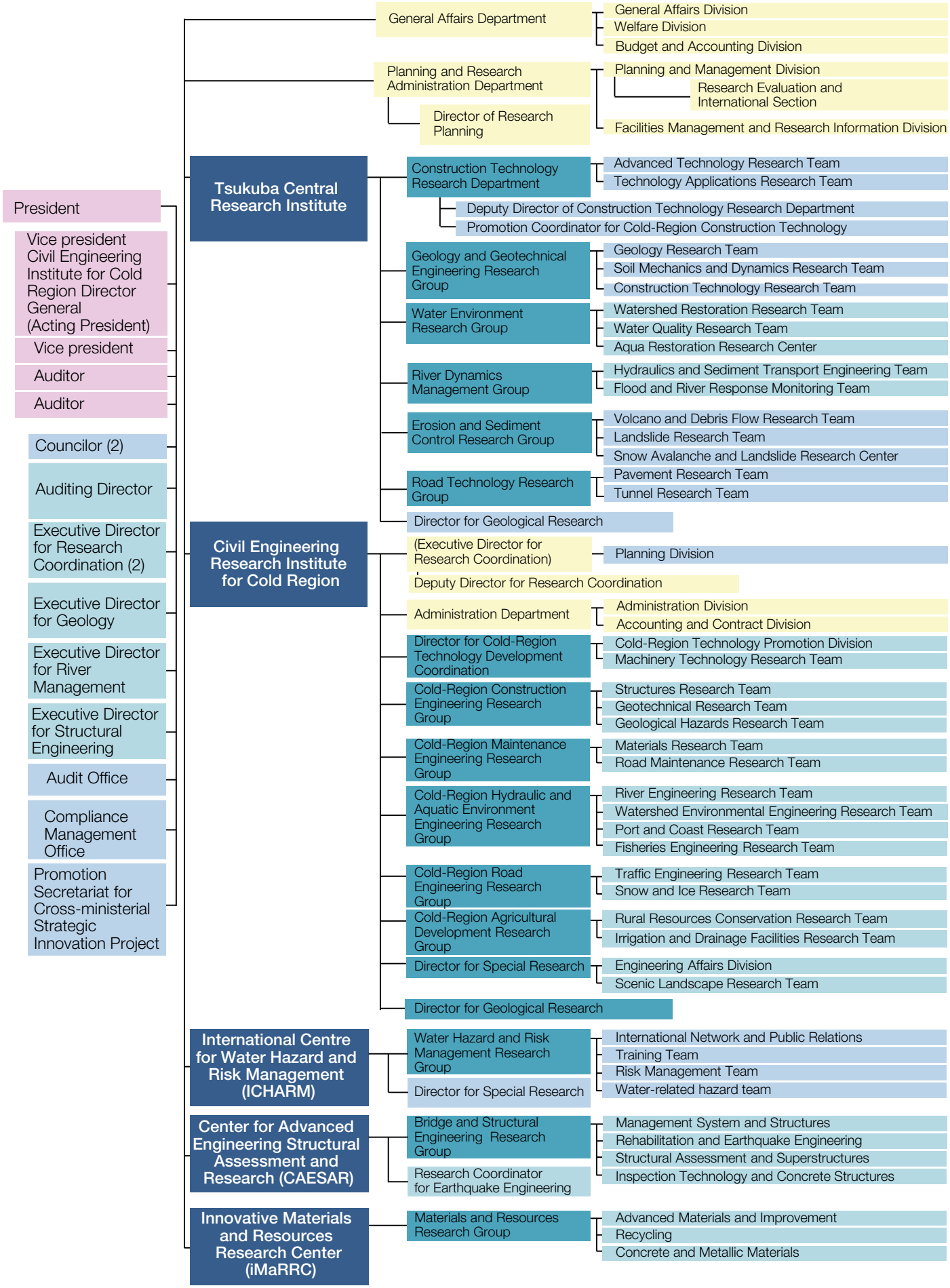


As of April 1, 2024

Locations



05. Organization of the Public Works Research Institute



* As of April, 2024

PWRI is a leading research institute in Japan for civil engineering technology. It was established to improve civil engineering technology and contribute to the efficient development of high-quality social capital , as well as the promotion of development in Hokkaido through research and development, technical guidance, and dissemination of results in civil engineering technology.
PWRI aims to accurately understand social demands and national and international needs for civil engineering technology, and to give back to society by producing excellent results. The Management and Research Divisions collaborate to achieve these goals.
The research conducted by PWRI is closely related to various natural objects and types of local infrastructure, and is useful for developing, maintaining, and troubleshooting related technologies.

General Affairs Division

The General Affairs Division manages organization, awards, ceremonies, personnel, training, building management, public relations, information disclosure, hygiene, health management, welfare, budgets, accounting, contracts, bidding, inventory management, and overall coordination of operations within PWRI to provide foundational support for the institute's activities .

Planning Division

The Planning Division oversees affairs related to planning, drafting, and coordinating these actions; the creation of mid-to-long-term and annual plans; research and development evaluation; procedures for contracted, joint, and competitive research funding; results presentations; planning, drafting, and coordinating international cooperation; disaster response; recruitment; public relations; editing and publication of materials such as books and literature; maintenance and design of machinery and facilities; wastewater management; building management; information system maintenance; and business order management to ensure that PWRI's surveys, tests, research, and development are conducted smoothly.

Tsukuba Central Research Institute

The Tsukuba Central Research Institute contributes to the efficient development and promotion of high-quality social capital and effectively carries out its mission related to land, infrastructure, and transport policy with the aim of improving civil engineering technology by conducting surveys, tests, research, and development of civil engineering construction technology, while also providing guidance and disseminating the results.

▶Tsukuba Central Research Institute

Civil Engineering Research Institute for Cold Region

The Civil Engineering Research Institute for Cold Region (CERI) is the only testing and research organization in Japan dedicated to civil engineering technology for cold regions. The institute is engaged in surveys, tests, research, and development: provides technical guidance; and disseminates research results related to civil engineering technologies applicable in snowy and cold regions including Hokkaido. The aim is to research these technologies in order to contribute to the efficient development of high-quality social infrastructures and to promote the sustainable growth while effectively fulfilling its mission in support of land, infrastructure, and transport policy.

▶Civil Engineering Research Institute for Cold Region

International Centre for Water Hazard and Risk Management

The International Centre for Water Hazard and Risk Management (ICHARM) was established in March 2006 as an international center supported by UNESCO, with the approval of the UNESCO General Assembly. The aim of ICHARM is to transfer technology developed in Japan to countries and regions affected by water disasters while considering local conditions and supporting damage reduction.

▶ICHARM

Center for Advanced Engineering Structural Assessment and Research

The Center for Advanced Engineering Structural Assessment and Research (CAESER) was established on April 1, 2008, as a comprehensive research institute related to structural technology for road bridge safety management. This includes the design and construction of new bridges, advanced maintenance and management technologies, long lifespans , reducing the total costs associated with such measures, and enabling faster disaster recovery.

▶CAESAR

Innovative Materials and Resources Research Center

The Innovative Materials and Resources Research Center (iMaRRC) was established in April 2015 to facilitate effective research and development by fostering collaboration with external parties, streamlining the collection of information on advanced materials, and centralizing knowledge on various research topics related to civil engineering materials and resource circulation. iMaRRC aims to support the effective maintenance and renewal of civil engineering structures, as well as contributes to the development of a low-carbon, recycling-oriented society.

▶iMaRRC

PWRI has two research institutes and three centers, under which 16 groups conduct research and technological development. The overall relationship between the groups and civil engineering technology goals are shown in the table below, where a colored box(■) indicates that the relation between the group and the goal connected is particularly close. Since each goal needs multiple contribution from various groups, cross-group research and development is actively done, as well. We also place an emphasis on project management to promote outstanding R&D and to practically apply their results in society.

Research Organization of the Public Works Research Institute

The Purpose of Civil Engineering

To achieve human societies that can thrive for a long time, and where everyone can live a safe and active life, and can enjoy the blessings of nature, while pursuing a thoughtful use of the land on the basis of a good understanding of its local nature and geography.

With this purpose in mind, civil engineering technology can be categorized according to its goals as shown below, each of which has its own importance.

		Tsukuba Central Research Institute						Civil Engineering Research Institute for Cold Region							International Center for Water Hazard and Risk Management ★3	Center for Advanced Engineering Structural Assessment and Research	Innovative Materials and Resources Research Center	Strategic Innovation Research Promotion Office ★2
		Construction Technology Research Department ★1 ★2	Geology and Geotechnical Engineering Research Group	Water Environment Research Group	Hydraulic Engineering Research Group	Erosion and Sediment Control Research Group	Road Technology Research Group	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	Organization led by Director for Technological Development ★1	Organization led by Director for Special Research				
Fundamentals	Developing transportation infrastructure		■			■	■	■	■		■		■			■		
	Developing infrastructure for water and energy supply		■	■	■					■		■			■			
	Developing infrastructure for securing fishery resources			■						■								
	Developing agricultural infrastructure											■						
	Controlling natural phenomena and preventing disasters	■	■		■	■		■		■	■		■		■			
	Restoring and Enhancing the soundness of water and material cycles to secure a healthy and hygienic life			■						■								■
	Technologies of designing and constructing infrastructure in a proper and rational manner	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	
	Technologies for endowing infrastructure with resistance, toughness, and reparability under extreme events (strong earthquakes, storms, etc.), and for enhancing these capabilities		■		■	■	■	■		■		■				■		
	Comprehensive understanding of the formation of natural features and natural systems including disaster occurrence, and to develop engineering-based methods for treating them		■	■	■	■	■	■		■	■	■			■	■		
	Exploring new materials available to infrastructure construction and developing practical methods for their use		■				■		■							■		■
Expansion and extension	Preservation and improvement of the environment for people, living organisms, ecosystems, and places that are the source of the region's charm			■						■				■				
	Increasing the interaction of people, things, events, and information, and stimulating "chemical reactions" that lead to various improvements in people's vitality			■										■				
	Dealing with global and local constraints concerning greenhouse gas emissions, resource and energy procurement, waste disposal, etc.)	■	■	■			■	■	■	■		■	■					■
	Adapting to global climate change	■		■	■	■		■	■	■	■	■	■		■			
	Dealing with social constraints accompanying shrinking productive population, low birth rates, and an aging population	■					■			■	■	■	■	■		■	■	■
	Wise management of aging infrastructure to realize its sustainability	■	■		■	■	■	■	■	■		■	■			■	■	■
	Managing how natural disasters occur so that people in affected areas can cope with their impacts wisely	■		■	■	■				■	■			■	■	■		

★2 Base serving the role of promoting research on the topic of the "Smart Infrastructure Management System", one of 14 challenges addressed in the 3rd period of SIP (the Cross-ministerial Strategic Innovation Promotion Program)

★1 IImplementation of technology management aimed at disseminating research and development results, advancing on-site implementation of new technologies, promoting technology transfer, and continuing and developing these trends

★2 Implementation of project management (see p. 45)

★3 Organization that not only conducts research, but also effectively develops capabilities and builds efficient information networks internationally based on the agreement between the Japanese government and UNESCO for the International Centre for Water Hazard and Risk Management supported by UNESCO

Tsukuba Central Research Institute

Construction Technology Research Department

(organization that conducts research into advanced technologies related to civil engineering and disseminates the results of civil engineering technology and social implementation)

▶Advanced Technology Research Team

The Construction Technology Research Department seeks to promote high-quality research and development that leads to innovation in civil engineering technology, develop these results into “practical technologies,” and disseminate them widely in society by actively supporting and promoting cross-disciplinary and advanced research and development while working to share the results extensively both domestically and internationally.

The Advanced Technology Research Team utilizes cutting-edge technologies such as robotics, measurement technologies, communication technologies, and artificial intelligence in research and development to improve productivity in the construction and management fields, strengthen national resilience, and protect the global environment. For example, the Team collaborates with the national government, local governments, private companies, and universities on research and development projects related to the automation of construction machinery operations, quality control using construction process data, unmanned construction, and the operation and management of mechanical equipment such as pumps and gate equipment.

The Technology Applications Team conducts research and development focusing on the application of civil engineering technologies at work sites; provides technical information through various public relations communications and events; supports technical evaluations, consultations, and guidance; appropriately manages intellectual property rights; and collects related information such as international standards to respond to internationalization. The activities of The Technology Applications Team are also described on p. 35-39 and 46.

○ Examples of cross-disciplinary and advanced research and development

Developing an open research and development platform (OPERA) to promote open innovation and accelerate research and development in autonomous construction

Conducting joint research project with private companies and universities

Planning a technology challenge for human resource development

Open Platform for Earthwork with Robotics and Autonomy (OPERA)

Introduction of “Condition-Based Maintenance”, which has a proven track record in regular-use equipment, to pump equipment, as pump equipment is considered “emergency equipment”

Development of technology to detect abnormalities in equipment and predict remaining service life based on monitoring data using AI and generative AI

Pump equipment condition monitoring system

Geology and Geotechnical Engineering Research Group

▶Geology Research Team ▶Soil Mechanics and Dynamics Research Tea ▶Construction Technology Research Team

Most civil engineering facilities utilize geological features and the ground as-is or after modifications to ensure their functionality. Many facilities also use soil and rock as materials.

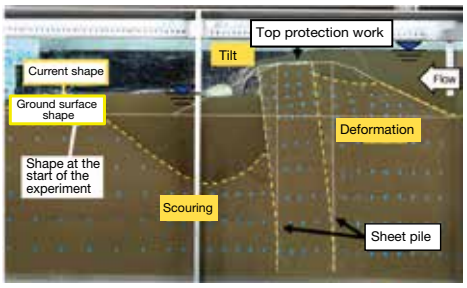
Geological features and soil are natural, and therefore they contain considerable uncertainty; these characteristics must be considered when conducting geological and ground surveys, construction design, construction, and maintenance management of the geology and ground of civil engineering facilities, as well as during accident and disaster responses.

The Geology and Geotechnical Engineering Research Group conducts extensive research on geological and ground conditions at every stage of a project, from surveys and design to construction and management.

The Geology Research Team develops and disseminates survey and testing methods for determining the properties of foundation ground, as well as survey and evaluation techniques for soil contamination and integrated geophysical exploration methods for comprehensive surveying and analysis of ground and earthwork structures.

The Soil Mechanics and Dynamics Research Team develops design and reinforcement methods for earthwork structures such as river levees and culverts, while also exploring the seismic design of earth structures, survey methods for liquefaction, and countermeasures.

The Construction Technology Research Team conducts research on design and construction methods of earthwork structures such as retaining walls and ground anchors, while also developing technologies related to soft ground countermeasures and drainage for earthwork structures.



◀Overflow experiment for a “resilient river embankment”

▶PWRI-type rainwater exposure test method for evaluating the environmental safety of rocks

◀Experimental reinforced soil wall (8 m height) for long-term observation

▶Survey and technical guidance at a road collapse site in Yonezawa City, Yamagata Prefecture (2022)

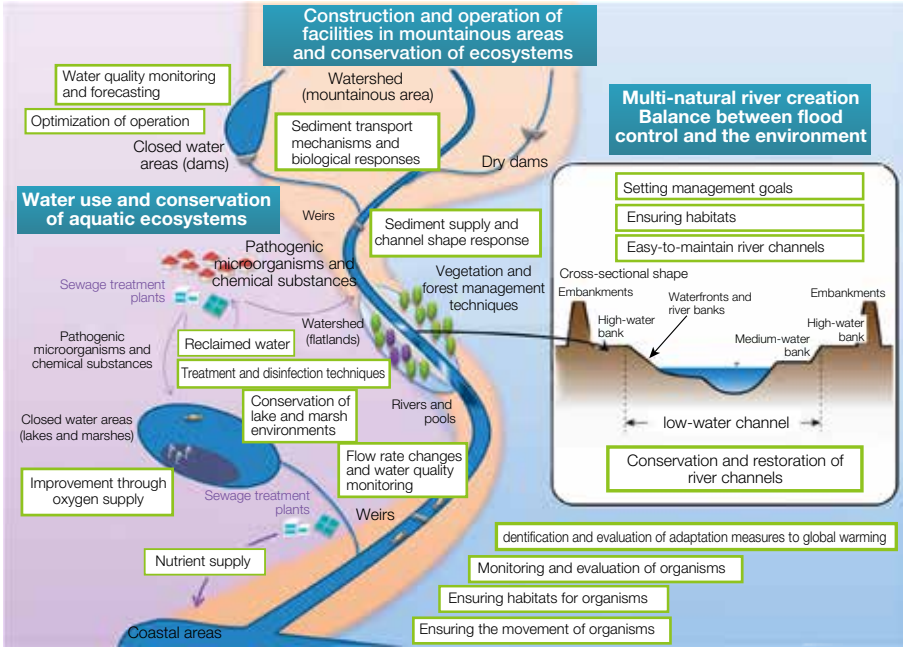
Water Environment Research Group

▶Watershed Restoration Research Team ▶Water Quality Research Team ▶Aqua Restoration Research Center

The Water Environment Research Group conducts research and technological development focused on the conservation and restoration of water environments in rivers, lakes, and basins (including mountainous and urban areas), such as preserving ecosystems and ensuring the safety of water quality.

The Watershed Restoration Research Team focuses on research and technological development for river management that balances flood control with environmental conservation and restoration of ecosystems, utilization of riverfront spaces, and social implementation of environmental DNA, aiming to improve and preserve the environments of rivers and basins.

The Water Quality Research Team strives to achieve a safe and rich water environment by focusing specifically on water quality. The Team conducts research on analysis and monitoring methods for chemical substances and pathogenic microorganisms in rivers, lakes, dam reservoirs, and sewage treatment water; impact assessments for aquatic ecosystems; water quality safety of reclaimed water use; and nutrient management in water bodies.



Moreover, the Aqua Restoration Research Center in Kakamigahara City, Gifu Prefecture, features full-scale experimental rivers and experimental ponds. These facilities are employed to conduct research on restoring natural rivers, managing flow and sediment, and studying ecosystem responses to structural changes in rivers.

River Dynamics Management Group

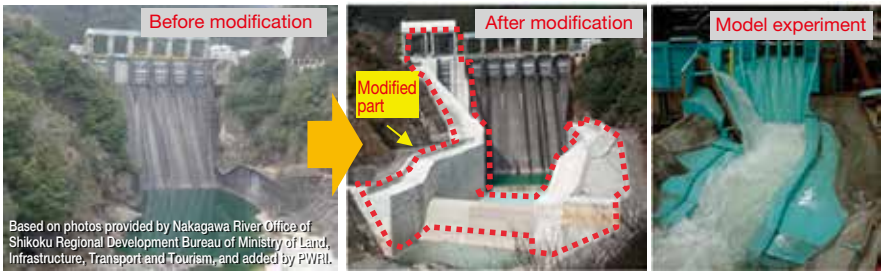
▶Hydraulics and Sediment Transport Engineering Team ▶River Channel Research Unit ▶Flood and River Response Monitoring Team

River Dynamics Management Group consists of two teams: ①Hydraulics and Sediment Transport Engineering Team (HSTE) including River Channel Research Unit (RCRU) and ②Flood and River Response Monitoring Team (FRRM). Through field surveys, observations(monitoring), hydraulic experiments, and numerical simulation ,our group mainly conducts research on dams, river structures, reservoirs, and river channels to clarify (1) rainfall-runoff-flood flows, (2) flood response of river channels, (3) flood response of flood control structures, and (4) structural deformation. In addition, we utilize these results and findings to contribute to 1) design and life extension of various facilities, 2) preventive maintenance of structures, 3) river channel management, and 4) disaster prevention and mitigation.

The roles each team or division plays in is as follows;

①HSTE is engaged in <1> hydraulic and technical support for new dam designing (including dry dams) and existing dam rehabilitation (for functional improvement) and <2> development of sediment control measures for reservoirs service-life extension.

②FRRM is engaged in research on advanced monitoring technology for rainfall runoff, river channel flow, sediment transport, and riverbed changes during floods. They also research the use of remote sensing data from satellites for these tasks, and develop equipment that can perform unmanned and labor- saving flow observation tasks.



Evaluation of hydraulic impacts on existing facilities due to modification of an existing dam (dam rehabilitation) through hydraulic expriments

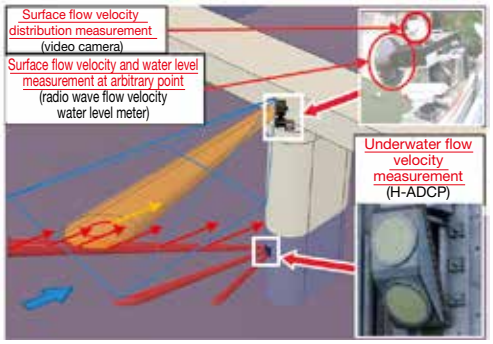
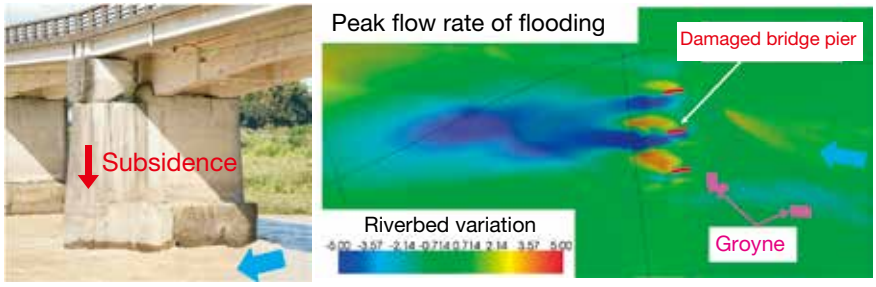


Diagram of 'Hydrological observation robot'



Hydraulic analysis aimed at clarifying the scouring damage mechanism of bridge piers that subsided due to flooding (Riverbed variation around the damaged bridge pier expressed by two-dimensional riverbed variation calculations)

Erosion and Sediment Control Research Group

▶Volcano and Debris Flow Research Team

▶Landslide Research Team

▶Snow Avalanche and Landslide Research Center

The steep and geologically fragile Japanese archipelago is subject to landslides, driftwood, and other debris flow events every year due to heavy rain, earthquakes, and volcanic eruptions. Also, heavy snowfall causes avalanches, and snowmelt triggers landslides. These landslides have significant long-term impacts on human life, homes, and infrastructure.

The Erosion and Sediment Control Research Group conducts surveys, research, and technological development focused on the mechanisms of landslide occurrence, risk assessments, and countermeasure methods to enable the rapid implementation of pre-disaster measures or emergency and permanent measures immediately after a disaster. The Group also provides on-site technical support upon request immediately after a disaster occurs.

The primary research currently being conducted by the Group includes the development of a method to assess the impact of debris flows during large-scale eruptions, a method to predict collapsing landslides that cause human damage, and technology for the evaluation of avalanche disaster hazard areas. The Group is also working on research related to maintenance and inspection methods for erosion control facilities, landslide prevention facilities, and avalanche control facilities. They also conduct basic research, such as studying surface runoff changes on pyroclastic deposit slopes. In their research, the Group utilizes not only on-site surveys of disaster sites but also surveys using UAVs, digital transformation-related technologies such as BIM/CIM and 3D FEM, and databases on facility inspections in an aim to further improve countermeasure technologies.

Sakurajima Arimura River, where debris flow observation is being carried out (photographed by Osumi River and National Highway Office)

UAV electromagnetic survey at the Komatsubara Landslide, Nagano City

On-site observation of avalanches in the Maseguchi area, Itoigawa City

Road Technology Research Group

▶Pavement Research Team

▶Tunnel Research Team

The Road Technology Research Group includes the Pavement Research Team and the Tunnel Research Team. This Group aims to create a safe, secure, comfortable, and sustainable society by efficiently developing and maximizing the use of road stock, as well as conducting research to address these issues.

The Pavement Research Team conducts research and development on new pavement technologies, including the performance evaluation and design methods for pavement, next-generation pavement management and recycling methods to achieve a carbon-neutral society.

The Tunnel Research Team conducts experiments and on-site research through on-site measurements and other methods to establish rational and economical approaches for the investigation, design, construction, and maintenance of tunnel structures and tunnel facilities, such as tunnel ventilation and emergency systems .

Accelerated loading experiment and evaluation test equipment for pavement

Application example of tunnel inner reinforcement

Civil Engineering Research Institute for Cold Region

Cold-Region Construction Engineering Research Group

▶Structures Research Team ▶Geotechnical Research Team ▶Geological Hazards Research Team

Efficient and effective maintenance, renewal, and management practices that appropriately account for the conditions unique to snowy and cold regions are essential for aging infrastructure such as roads and bridges. Furthermore, the increasing frequency of natural disasters has heightened the need for the development of safe and reliable road facilities. The Cold-Region Construction Engineering Research Group is engaged in research activities aimed at addressing these critical issues and challenges.

The Structures Research Team conducts research and development on maintenance and management methodologies for road bridges in snowy and cold regions, as well as design and construction techniques for road structures engineered to withstand rockfall hazards. In addition, the Team collaborates with the Bridge and Structural Engineering Research Group to advance research and development on design and construction techniques for road structures that are resilient to earthquake disasters.

The Geotechnical Research Team conducts research and development on technologies aimed at enhancing the safety and durability of civil engineering facilities constructed on soft peaty ground, which is widely distributed in cold regions; earth structures susceptible to frost heave and freeze-thaw cycles; and on technologies for mitigating the liquefaction of volcanic ash soils.

The Geological Hazards Research Team conducts research and development on technologies for mitigating landslides during snowmelt periods and for reducing hazards associated with rock slopes. In addition, the Team collaborates with the Geology and Geotechnical Engineering Research Group to advance research and development on technologies for assessing and mitigating naturally occurring heavy metals in excavated rock materials.

Gravel formation and collapse of road bridge RC slabs due to frost damage

Damage to residential areas due to liquefaction

Landslides during snowmelt

Cold-Region Maintenance Engineering Research Group

▶Materials Research Team ▶Road Maintenance Research Team

Civil engineering facilities in snowy and cold regions are exposed to freezing and thawing induced by low temperatures, salt from seawater and antifreeze agent, and other environmental factors. These conditions contribute to deterioration caused by frost and salt damage, as well as reduced functionality resulting from frost heave and insufficient bearing capacities.

The Cold-Region Maintenance Engineering Research Group comprises the Materials Research Team and the Road Maintenance Research Team. The group is engaged to a wide range of cross-sectional research on the design, construction, and maintenance of facilities, including quality control to improve durability in snowy and cold environments, as well as maintenance and repair technologies to sustain the functionality of civil engineering facilities appropriately for longer while constructing a low-carbon, recycling-oriented society.

The Materials Research Team conducts research and development on repair, durability improvement, and investigation and diagnosis techniques that can adapt to severe environments as a countermeasure against the rapid deterioration of concrete surfaces caused by the effect combined with frost damage.

The Road Maintenance Research Team conducts developing pavement techniques to address issues unique to snowy and cold regions, such as freeze-thaw cycles, frost heave, low temperatures, icy road surfaces, and abrasion. The team focuses on a wide range of research and development projects related to road maintenance techniques, such as inspection and diagnosis techniques, environmental conservation techniques, and snow melting techniques.

Evaluation of concrete surface quality through surface water absorption tests

Pavement distress caused by freeze-thaw cycles

Cold-Region Hydraulic and Aquatic Environment Engineering Research Group

▶River Engineering Research Team
▶Watershed Environmental Engineering Research Team
▶Port and Coast Research Team
▶Fisheries Engineering Research Team

The Cold-Region Hydraulic and Aquatic Environment Engineering Research Group is engaged in the development of "disaster prevention and mitigation technologies", as well as "water utilization and environmental management technologies" with the aim of fostering a safe and resilient society in river basins and coastal areas, conserving the rich natural environment, and supporting vibrant social activities. In particular, the Group seeks to contribute to the advancement of development projects related to social infrastructures, such as rivers, harbors, and fishing ports in Hokkaido, by conducting surveys, tests, and research and development to elucidate and assess hydrospheric phenomena and associated development and management methods. The Group carries out these activities while leveraging the distinctive characteristics of a snowy, and cold region endowed with abundant natural resources.

The River Engineering Research Team and the Watershed Environmental Engineering Research Team conducts river systems. The Port and Coast Research Team and the Fisheries Engineering Research Team conducts harbor and fishing port systems. In recent years, concerns have grown regarding the increasing frequency and severity of disasters in the Hokkaido region attributable to climate change, as well as their associated impacts on weather patterns and the natural environment. The Teams are conducting research on water-related disasters caused by floods, high waves, and storm surges; on river and tsunami disaster countermeasures involving freezing phenomena; environmental enhancement for the habitats of living organisms; and on the efficient and effective operation and maintenance of river and port management facilities.

The above research is being conducted using methods such as field surveys, model experiments, and numerical analysis, together with new information technologies such as AI and big data, which have become increasingly prevalent in recent years.


Breaking of the Sorachi River levee in the Ishikari River system


Damage to coastal revetments due to high waves


Ice jams on the Uryu River in the Ishikari River system


Tsunami with sea ice reaching the ship docking point


Re-sprouting from stumps after felling of riparian forests (upper left), invasion of vegetation that is a management obstacle (giant knotweed)


Implementation of environmental surveys and surveys of the state of seaweed bed overgrowth in fishing port waters

Cold-Region Road Engineering Research Group

▶Traffic Engineering Research Team
▶Snow and Ice Research Team

Ensuring the functionality of road traffic during winter and implementing effective measures against snow and ice disasters are essential to supporting a rich and high-quality life in snowy and cold regions and enhancing the vitality of the area. Accordingly, the Cold-Region Road Engineering Research Group is engaged in research on winter road management, snow and ice countermeasures, traffic safety, road geometric structures, and related infrastructures to address challenges arising from the snowy and cold natural and traffic environments unique to Hokkaido.

The Traffic Engineering Research Team conducts research issues to overcome the snowy and icy road surfaces and traffic congestion that occur in winter, ensuring safe and reliable winter road traffic services.

The Snow and Ice Research Team conducts research issues that contribute to reducing traffic disruptions caused by snow and ice disasters, such as visibility impairments and snowdrifts, which have become increasingly severe due to the extreme winter weather of recent years.


Cold weather and snowfall in winter lead to snowy roads and traffic jams


Development and testing of an antifreeze spraying support system, with the aim of operation by a single driver


Extreme winter weather has led to traffic disruptions due to impaired visibility and snowdrifts


Measuring the effectiveness of snow fences using a mobile observation vehicle with impaired visibility to develop a method for evaluating the performance of snow fences

Cold-Region Agricultural Development Research Group

▶Rural Resources Conservation Research Team

▶Irrigation and Drainage Facilities Research Team

Japan's food self-sufficiency rate has been declining over the long term, raising significant concerns about food security. Even in Hokkaido, which plays a crucial role in sustaining Japan's food supply, there is growing apprehension about the weakening of the food supply system due to labor shortages and contributing factors. The importance of irrigation water has also been increasing as a result of climate change, yet the agricultural water facilities that supply this irrigation water are rapidly aging. Additionally, the imminence of large-scale disasters caused by major earthquakes and the increasing severity and frequency of water-related disasters and landslides, present urgent and pressing challenges.

In response to these challenges, the Cold-Region Agricultural Development Research Group is engaged in research related to the development of agricultural production infrastructure with the aims of overcoming labor shortages by improving productivity, ensuring a stable supply of irrigation water by properly maintaining agricultural water facilities, and achieving agricultural production that is resilient to natural disasters.

The Rural Resources Conservation Research Team conducts research to develop technologies for the creation and effective utilization of large-scale, high-productivity farmland, such as construction techniques to maintain favorable soil physical properties in large-area farmland, advanced utilization methods for groundwater-level control systems, and techniques to prevent uneven subsidence.

The Irrigation and Drainage Facilities Research Team conducts research to develop strategic utilization and conservation management techniques for agricultural irrigation facilities in cold regions. The Team is also developing technologies to strengthen agricultural land and irrigation facilities, such as methods to reduce damage to agricultural pipes caused by dynamic water pressure during earthquakes and technologies to mitigate and lessen the impact of frequent landslides.

Field in which large-scale partitioning is carried out when the soil moisture is appropriate to prevent the worsening of soil physical properties such as drainage

Survey of the deterioration of agricultural open canals caused by freeze-thaw effects unique to cold regions

Director for Cold-Region Technological Development Coordination

(organization for disseminating technology and researching machinery technology in cold region)

▶Cold-Region Technology Promotion Division

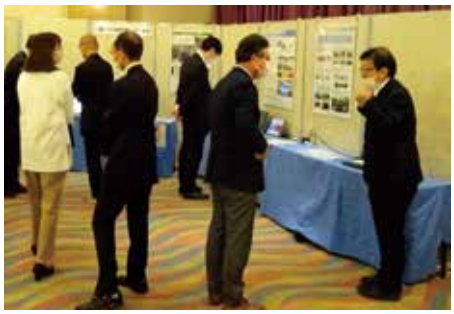
▶Cold-Region Machinery Technology Research Team

The Director for Cold-Region Technological Development Coordination oversees the Cold-Region Technology Promotion Divisions and the Machinery Technology Research Team. The organization effectively and efficiently implements solutions and countermeasures to technical issues that are necessary to promote development in snowy and cold regions (mainly Hokkaido) and ensures the dissemination of research outcomes. It also responds promptly to urgent issues at construction sites, such as a shortage of skilled workers or machine operators, as well as the increased risk of machine failure, while also focusing on digital transformation, improving productivity through automation, and achieving carbon neutrality.

The Cold-Region Technology Promotion Division disseminates the developed civil technology for cold region by made the various opportunity include in Hokkaido and abroad in Japan and promotes the use of intellectual property.

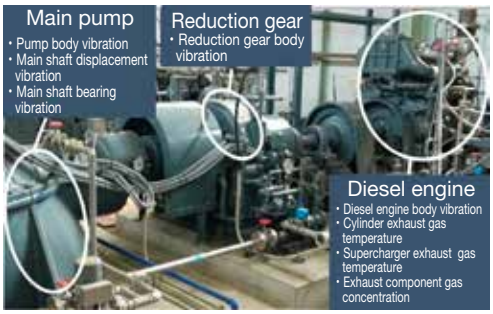
The Machinery Technology Research Team conducts research, development, and technical support for construction work, snow removal, disaster prevention, etc., in snowy and cold regions, making full use of machinery technology and information and communication technologies. The Team also conducts research on inspection techniques and survey methods that contribute to the consideration of stock management, including the maintenance and repair of snow removal machinery and civil engineering machinery equipment.

For example, loading work using rotary snowplows for transporting and clearing snow requires skill, and many people are also needed to measure snowbanks and the amount of snow removed. Therefore, the Team is working on technology development aimed at conserving labor and manpower conservation through digital technologies, snow volume measurements, and the automation of machine operation. In addition, as pump equipment at drainage pumping stations ages, there are concerns that breakdowns will become more severe and occur more frequently, making it necessary to reliably detect abnormalities. Therefore, the Team is building a condition monitoring system that can automatically collect operating data and is developing anomaly detection technology that utilizes AI.



Introduction of research results to local engineers through lectures and panel exhibitions held in various locations

Use of digital technology for the measurement of snow accumulation during transportation and disposal as well as the reduction of labor and manpower required for loading work



Use of digital technology for the measurement of snow accumulation during transportation and disposal as well as the reduction of labor and manpower required for loading work

Director for Special Research (research focusing on the landscape of public spaces and the utilization of public infrastructure)

▶Scenic Landscape Research Team

Social infrastructure has traditionally been described as requiring three key elements: utility (functionality), strength (durability), and beauty. In the field of civil engineering, however, the focus tends to be on the direct function, structural durability, and longevity of facilities. In contrast, good social infrastructure development strikes a balance between utility, strength, and beauty. The development of social infrastructure should not only ensure safety and security and develop facilities as a foundation for socio-economic activities, but it should also develop facilities as a foundation for a rich life for future generations.

Therefore, the Scenic Landscape Research Team was established under the Director for Special Research. This Team seeks to contribute to the formation of rich social infrastructure and regional development/tourism promotion by conducting research and development aimed at improving the quality of public spaces affected by social infrastructural development and increasing their value.

Specifically, the Team is engaged in research and development focused on redesigning public spaces to realize comfortable and high-quality lives. This research and development encompass a wide array of themes, including planning and designing pedestrian spaces that enrich the region, suburban road spaces that meet diverse needs, evaluation technology to facilitate landscape improvement efforts, “Michi-no-Eki” (a Japanese roadside facility model) street trees, the removal of utility poles, the landscape design of roundabouts, and civil engineering heritage. The Team also dispatches lecturers and provides technical consultations on activities related to the region's landscape, tourism, and urban development, working to support the creation of a positive infrastructure environment.

Development of suburban road spaces to meet diverse needs by improving the landscape and utility value

Explanation of spatial design using models in a training session for “Michi-no-Eki”(a Japanese roadside facility model) conducted by JICA, where the lecturer is working

Administration Department

The Administration Department handles administrative work related to general affairs, documents, personnel, salaries, employee management, and welfare, as well as accounting work related to expenses and income settlement, bidding contracts, capital, and goods management to enable CERI to carry out its research and development, technical guidance, and results dissemination roles safely and efficiently.

Planning Division

The Planning Division handles administrative work related to research activities, such as creating medium to long-term and annual plans, R&D evaluations, procedures for joint research and competitive research funding, disaster response, recruitment, public relations, library management, budget management, information system maintenance management, and design reviews, as well as various other planning and coordination activities that enable the research groups in CERI to perform their research activities smoothly.

Chishima Cherry Trees

The Chishima Cherry Trees at CERI were established in 1984 when a staff member planted saplings from Kiritappu, Hamanaka Town, Akkeshi District, in eastern Hokkaido, with the desire to “plant trees that everyone can enjoy for a long time to beautify the premises.” Approximately 30 years have passed since the trees were planted, and trees that do not flower well have become noticeable. Therefore, in 2013, efforts began to restore the Chishima Cherry Trees by cutting down and pruning diseased trees to protect the existing cherry trees and by growing new saplings. A “Memorandum of Understanding on the Chishima Cherry Tree Fund” was also signed with the Sapporo Green Lions Club in March 2015 to utilize the Chishima Cherry Trees as a treasure of the region and to contribute to the promotion of greening projects. On April 26, 2017, a tree was planted to commemorate the 80th anniversary of the founding of CERI.

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

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

Water-Related Hazard Research Group

ICHARM

▶ICHARM

ICHARM is an international centre supported by UNESCO which was established in March 2006 as part of PWRI under an agreement between the Government of Japan and UNESCO, with the approval of the UNESCO General Assembly. The Center is an integral part of PWRI, which possesses the necessary legal personality and capacity to carry out its mission in accordance with the laws and regulations of Japan.

The mission of ICHARM is to “serve as a global hub for water-related hazard and risk management through observation and analysis of natural and social phenomena, development of methods and tools, capacity building, intellectual networking, and dissemination of lessons learned and information to support governments and all stakeholders involved in water-related hazards and risk management at the international, national, and local levels.” To achieve this mission, the Centre is building a global “efficient information network” and promoting “on-site practices” while focusing on both “innovative research” and “effective capacity building.”

■Innovative research

The Centre conducts end-to-end, integrated research by developing and applying the RRI-WEB model, which calculates flood runoff volume, flooded areas, and water energy balance ; a rainfall-sediment runoff model that calculates the amount of sediment and driftwood; a low-cost and easy-to-use flood forecasting system for small and medium-sized rivers in Japan; a Virtual Flood Experience System (VFES) that allows users to virtually experience flood disasters; a “Collection of Critical Situations during Flood Emergence Response;” and an Online Synthesis System for Sustainability and Resilience (OSS-SR).

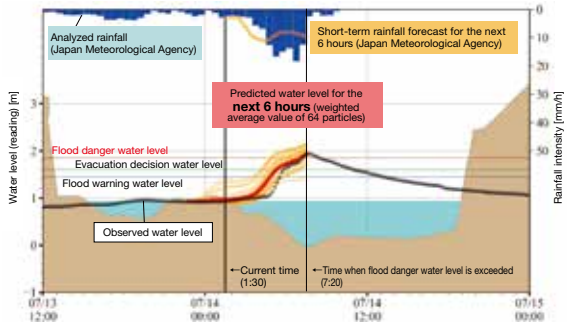
This research focuses on five themes: ① Data collection, storage, sharing, and statistics on water-related disasters; ② Risk assessment on water-related disasters; ③ Monitoring and prediction of changes in water-related disaster risk; ④ Proposal, evaluation, and application of policy ideas for water-related risk reduction; ⑤ Support in improving the applicability of water-related disaster management

■Effective capacity development

The Centre offers a one-year master’s course called “Water-related Disaster Management Course of Disaster Management Policy Program” (195 students have completed the course), which is aimed primarily at practitioners from developing countries. The Centre also offers a three-year doctoral course “Disaster Management Program” (20 students have completed the course), which aims to develop the abilities to solve problems based on scientific and engineering knowledge and to act as leaders in disaster prevention and mitigation measures.

■Efficient information network

The Centreis working to bring disaster prevention into the mainstream in various countries by planning and convening major international conferences , as well as building and managing international networks such as the International Flood Initiative (IFI). IFI collaborates with international organizations such as UNESCO, the World Meteorological Organization (WMO), and the United Nations Office for Disaster Risk Reduction (UNDRR) to establish “Platforms on Water Resilience and Disasters” aimed at reducing water disaster risks in the world. ICHARM also enhances the presence of Japan and ICHARM by leading the Working Group of Hydrology of the Typhoon Committee and contributing to the committee's projects.



Using the RRI (rainfall, runoff, and inundation) model, ICHARM developed inexpensive and easy-to-use real-time water level prediction systems for 200 rivers in Japan and published a manual of the system development.

Example of a screen from the Virtual Flood Experience System (VFES) A simulated flood video is overlaid on 360° real-life footage taken at multiple locations in urban areas, allowing users to experience a simulated flood while moving through the virtual space over time and changing their perspective.

Master’s degree graduation ceremony (September 13, 2023)

Hosting the 9th International Conference on Flood Management (ICFM9). Approximately 400 people from Japan and overseas participated (February 19, 2023)

Center for Advanced Engineering Structural Assessment and Research

Center for Advanced Engineering Structural Assessment and Research

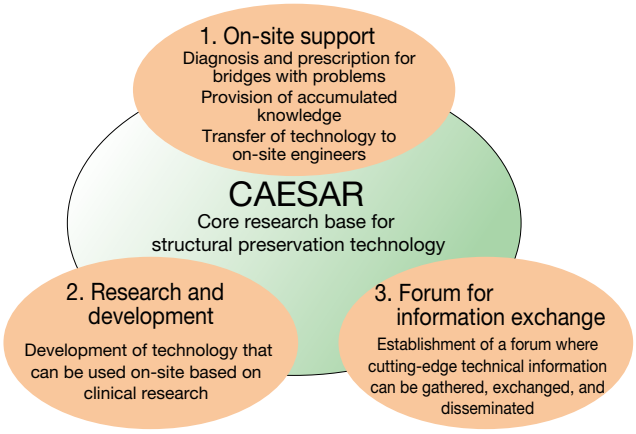
Bridge and Structural Engineering Research Group

CAESAR

▶CAESAR

In Japan, infrastructure development was rapidly promoted during the period of high economic growth from 1955 to 1973. However, more than half a century has passed since then, and measures to prevent the deterioration of structures have become an important issue. Natural disasters such as heavy rain and earthquakes have also become more frequent and severe, creating an even greater need for advanced disaster prevention and mitigation technologies for structures to match the advancement of socioeconomic activities. CAESAR is an organization that operates in the context of these increasing social needs and promotes comprehensive research on technologies such as the design, construction, maintenance, and disaster recovery of road bridges. To fulfill this role, CAESAR carries out various activities based on the three pillars of “on-site support,” “research and development,” and “information exchange.”

At CAESAR, experts from various fields work together to conduct research and technological development on areas such as design and construction, maintenance, and disaster recovery, including bridges and other structures. The Center utilizes the comprehensive capabilities of PWRI to conduct research on bridge-related soil quality, painting, riverbed scouring, and phenomena specific to cold regions in collaboration with other research groups. The Center also collaborates with external organizations to solve problems, such as developing technology to measure the salt content inside concrete using neutron rays.



Three pillars of CAESAR’s activities

Research to prevent a “devastated Japan”

CAESAR is developing technology that contributes to the preventive maintenance of structures.

- Development of diagnostic technologies using AI and preventive maintenance technologies (use of drones, preventive maintenance for salt damage, foundation scouring, bearings, etc.).
- Clarification of requirements for new technologies to support maintenance and presentation of performance verification methods

Trial of a diagnostic technology using AI (bridge diagnostic support AI system)

Research to realize renewal and new construction of structures with longer lifespans

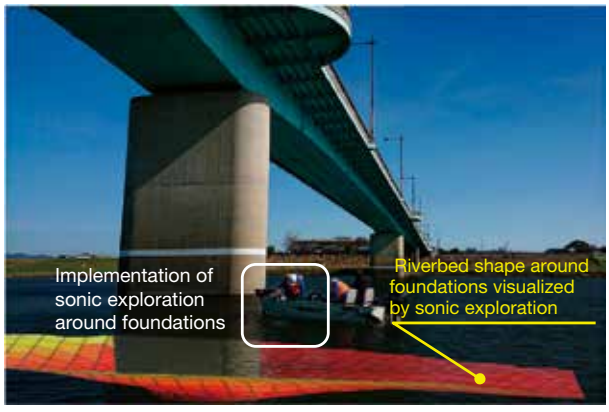
CAESAR aim to extend the lifespan of infrastructure and optimize it.

- Improved fatigue durability verification methods for steel bridges using 3D FEM.
- Establishment of universal performance verification methods that can accommodate new construction methods for expanding the lifespans of infrastructures and optimizing it.

Research to prevent a “disaster-vulnerable Japan”

CAESAR is developing to ensure the functionality of infrastructure facilities against large-scale earthquakes.

- Establishment of earthquake-resistance countermeasure technologies to ensure bridge functionality
- Clarification of requirements for new technologies to assist in understanding and monitoring the damage state and presentation of performance verification methods



Trial of preventive maintenance technology (underwater visualization technology to determine the state of foundation scouring)

Innovative Materials and Resources Research Center

innovative Materials and Resources Research Center

Materials and Resources Research Group

iMaRRC

▶iMaRRC

A green transformation (GX) is underway to achieve carbon neutrality. When developing social infrastructures, addressing social change is also an urgent task that must be tackled. Meanwhile, as more infrastructure continues to age, a digital transformation (DX) is accelerating in civil engineering field to tackle the shortage of maintenance workers. The adoption of DX technology in maintenance of social infrastructures has full prospects to enhance the quality of materials and the efficiency of construction management.

iMaRRC aims to address changes in social infrastructures, such as GX and DX, from a material resources perspective by focusing research on (1) achieving carbon neutrality, (2) technologies to counteract the aging of social infrastructures, and (3) improving the quality and construction efficiency of construction materials. For example, iMaRRC contributes to achieving a carbon - neutral society through the development of asphalt substitute materials that do not use fossil resources as raw materials, as well as through the research and development of efficient energy recovery technologies from sewage systems. The Center also promote the efficient maintenance and management of social infrastructures by developing highly durable repair materials that infrastructures maintenance efficiency and by developing AI-based technologies for material quality inspection.

The Center conducts these research and development projects in collaborating with other research institutes that are engaged in cutting-edge research across various fields, aiming to achieve results more efficiently and rapidly.

Research toward achieving carbon neutrality

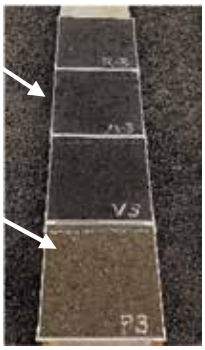
- Development of durability evaluation methods for low-carbon concrete
- Development of paving materials made from plant-derived raw materials
- Research for the advancement of pavement recycling
- Research on the effective utilization of biomass discharged from various commercial sectors at sewage treatment plants
- Development of coating systems to reduce environmental impacts on steel structures

Research on technology to prevent the deterioration of social infrastructures

- Research on repair materials and construction methods to prevent re-deterioration
- Development of waterproofing methods and materials to prevent early damage to pavement
- Development of sewage pipe rehabilitation methods that ensure long-term durability
- Development of high-durable steel coating systems for weather conditions

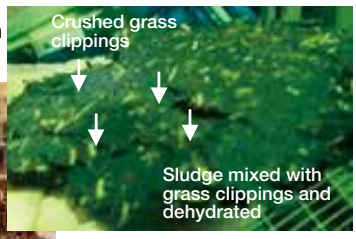
Research on quality improvement and the construction efficiency of construction materials

- Development of methods to ensure the quality of concrete using ICT
- Research on methods to improve productivity in concrete construction



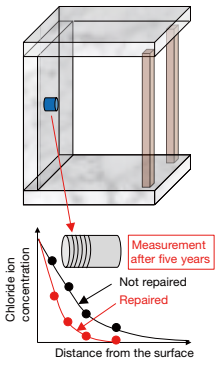
Development of paving materials using plant-based binders (photo:outdoor exposure testing for weather resistance)

↓Crushing pruning branches to use as an alternative to auxiliary fuels such as heavy oil, natural gas, etc.

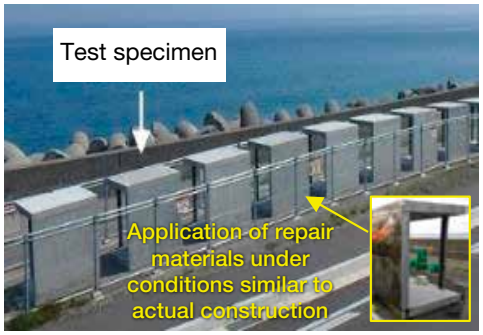


↑Grass clipping as a dehydration aid in sewage sludge dehydration process

Use of biomass (pruned branches, grass clippings)



Evaluation of chloride ion penetration after exposure



Exposure test of Concrete test specimens with application of 11 types of repair materials

Evaluation of repair effects under conditions similar to actual structures (confirmation of the durability of chloride ion penetration prevention effects of repair materials on the concrete surface)

Verification of durability of highly weather-resistant paints and corrosion-resistant metal via exposure testing

06. Mid-to-long-term goals and plan

▶Mid-to-long-term goals and plans

Fifth Mid-to-Long-Term Goals

Mid-to-long-term goals are related to the operations of National Research and Development Agencies and must be achieved over a period of five to seven years . These goals are set by the each competent minister and directed toward National Research and Development Agency. For PWRI, the fifth mid-to-long-term goals were communicated by the competent ministers namely the Minister of Land, Infrastructure, Transport and Tourism and the Minister of Agriculture, Forestry and Fisheries on February 25, 2022.

Fifth Mid-to-Long-Term Plan

A mid-to-long-term plan for achieving the mid-to-long-term goals is prepared by National Research and Development Agency and approved by the competent ministers. A mid-to-long-term plan was prepared based on the fifth mid-to-long-term goals for PWRI, which received approval from the Minister of Land, Infrastructure, Transport and Tourism and the Minister of Agriculture, Forestry and Fisheries, on March 31, 2022.

PWRI aims to focus on and respond to issues with high social demand while looking to the future by promoting and evaluating research and development that contributes to points ① to ③ bellow through a set of specific projects. PWRI is organizing a research and development program for each policy issue to be resolved to proceed effectively and efficiently.

■Period of mid-to-long-term goals

Six years from April 1, 2022, to March 31, 2028

■Mission of the Institute*

Based on the primary objective of National Research and Development Agency, which is to “maximize” R&D results that contribute to the healthy development of the national livelihood, economy, culture, and other public interests, the mission of the PWRI is to return the results of research and development to society to contribute to the efficient development of high-quality social capital and the promotion of Hokkaido's development. PWRI also aims to effectively perform its duties related to the promotion of agriculture and fisheries industries, land infrastructure, transport, and tourism policies, and Hokkaido development administration. To achieve this mission, PWRI is working closely with the Regional Development Bureau of the Ministry of Land, Infrastructure, Transport and Tourism, and the Hokkaido Regional Development Bureaux.

Specifically, given the reduction target for FY2030 toward carbon neutrality by 2050 and social conditions such as the decline in the working-age population, the efforts during this mid-to-long-term target period will focus intensively on research and development that contributes to the following:

① Creation of national land where lives and livelihoods are protected against natural disasters

② Smart and sustainable management of infrastructure

③ Vibrant and attractive communities and lifestyles

In addition, when conducting research and development, the organization will also consider the efficient development of high-quality social capital in snowy and cold regions, which account for approximately 60% of the land area.

* Excerpt from “Goals for business operations to be achieved by National Research and Development Agency PWRI”

07. Research and development program

The research and development program has defined 15 topics across three research and development themes.

▶Research and development program

Research and development theme 1

1. Contribution to development of national land that protects lives and livelihoods against natural disasters

Due to climate change, natural disasters has become severe and occurre more frequently. To address these issues, we will work on a development of disaster prediction technology, the development of facilities resilient to a massive external force and R&D on technologies that can promptly respond to new technical challenges.

(1) Development of Technologies for Promoting "River Basin Disaster Resilience and Sustainability by All"
(2) Development of Risk Reduction Technologies for Emerging Sediment-related Disasters
(3) Development of Disaster Prevention and Mitigation Technologies for Extreme Snow and Ice Disasters
(4) Development of Advanced Technologies to Ensure the Functions of Infrastructure from Large Earthquake

Research and development theme 2

2. Contribution to management of smart and sustainable infrastructure

We face an accelerated deterioration caused by an aging infrastructure and a shortage of workforce for an infrastructure management associated with the fast shrinking working-age population. To deal with these issues and dramatically innovate how to work for infrastructure, we will work on research and development of technology for more efficient facility management by utilizing 3D data and digital technology such as AI, transformation to preventive maintenance, and productivity improvement on construction sites. New value and increased sustainability of infrastructure are expected through these efforts.

(5) Development of Technologies for Continuous Monitoring and Management of Rivers and River Basins under Climate Change
(6) Development of Technologies for Infrastructure Improvement
(7) Development of Technologies for Preventive Maintenance of Infrastructure
(8) Development of Efficient Maintenance and Management Technologies for Infrastructure under Snowy and Cold Environment
(9) Research and Development to Improve Productivity in Infrastructure Construction and Maintenance

Research and development theme 3

3. Contribution to realization of vibrant attractive region and living

Vibrant and attractive communities and lifestyles are essential to establishing emotionally enriched and comfortable society and to improving the quality of life.

We will work on promoting adaption measures against climate change, technology development on carbon neutral, and research development of technology for a maintenance of beautiful landscape and for a maintenance and a prevention of agricultural and fisheries infrastructure that can sustain their economic viability.

(10) Development of Methods for Sustainable Management of Water Resources and Environment to Cope with Climate Change
(11) Research and Development on Providing Winter Road Services that Support Regional Communities
(12) Development of Technologies for the Better Use of Local Resources and the Reduction of Environmental Load
(13) Research and Development on Redesign of Public Spaces for Comfortable and High-quality of Life
(14) Development of Technologies for Maintenance and Management of Agricultural Infrastructure in the Snowy Cold Regions Contributing to being Growth Industry and Resilient
(15) Study on the Development and Conservation of Fishery Infrastructure of Cold Waters that Contribute to Increasing Productivity of Fishery Resources

(1) Development of Technologies for Promoting “River Basin Disaster Resilience and Sustainability by All”

Keywords ▶ River basin flood control, dam operation method, future precipitation, water cycle model, embankment reinforcement, sea ice, waves

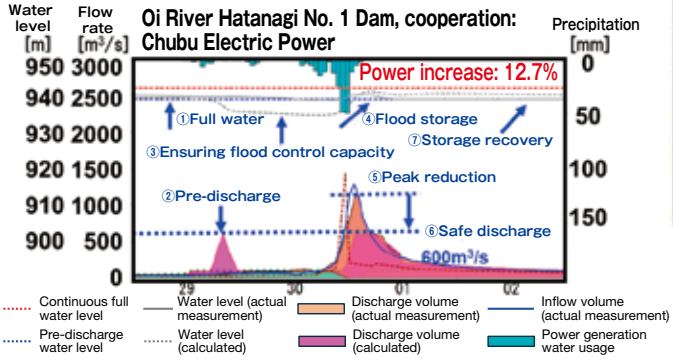
Research period: 2022-2027
Program leader: Director of Water Hazard and Risk Management Research Group

Research summary

The effects of climate change have increased the external forces of natural disasters, made water disasters more severe, and heightened the frequency of such disasters; consequently , water disasters cause significant damage almost every year. Minimizing damage requires sharing knowledge and information about water disasters with society, promoting river basin flood control through the active participation of all stakeholders, and transforming our society into one that is aware of water disaster prevention. This research and development program focuses on ① developing and improving technologies to anticipate future external forces of water disasters such as floods, ② establishing methods to accurately evaluate and realize river basin flood control efforts, ③ developing appropriate flood inundation risk assessment methods, and ④ developing technologies to strengthen society against water disasters.

Research into technologies to strengthen and realize the flood control functions of existing dams based on flood predictions

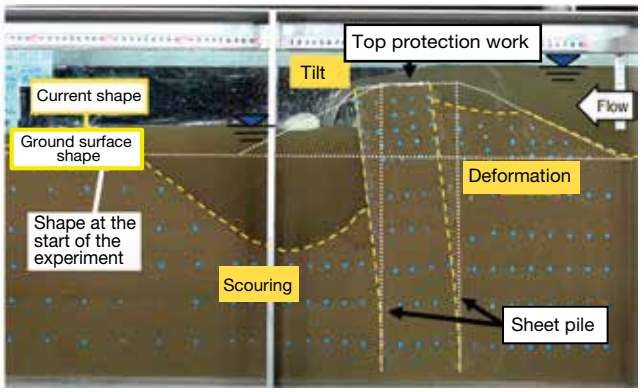
Unprecedented flood disasters caused by heavy rains are increasing across Japan as global warming becomes more evident . Simulations are employed to consider the effective use of dam discharges as a measure to prevent or reduce flooding as much as possible by determining the scale of external forces.



Simulation results when peaks are reduced by pre-discharge from the full water level at the time of prediction and safely discharged

References: Koike et al.: An operation supporting system for hydroelectric dams to improve flood control and power generation, Journal of the Japan Society of Civil Engineers Ser. B1 (Hydraulic Engineering), Vol. 77, No. 2, p. I_79-I_84, 2021.

Research on embankment reinforcement technology against the overtopping of river embankments



A resilient river levee can withstand collapse even when overtopped. This research aims to reduce disasters by extending the time it takes for the levee to fail . Resilience against overtopping can be improved by installing sheet piles inside the levee, and hydraulic model experiments are conducted to understand and examine the collapse behavior in this scenario . The image illustrates a model experiment in which the sheet piles were scoured by overtopping and became tilted.

Social contribution

Technologies are being developed that contribute to the accurate prediction of future external forces driving water disasters, measures to prevent or minimize flooding, initiatives to reduce the number of victims, and strategies to enable rapid recovery and rebuilding without causing catastrophic damage even if effects occur . This will help achieve sustainable social and economic activities in the future when weather phenomena will become more extreme, and unprecedented water disasters are anticipated.

Spotlight!

Reference Materials for the Development of Resilient River Levee Technology [Standalone Type] was published in FY2022. This document can serve as a reference for private companies when developing resilient river levees. It is expected that the development of resilient river levees will be promoted in the future.

Efficient operation methods are also being proposed for water utilization dams that enable flood control downstream while enhancing power generation efficiency, such as pre-discharge strategies considering the uncertainty range of ensemble inflow forecasts and the water level of the reservoir at the time of the forecast.

Research Teams >>Water-Related Hazard Research Group, Soil Mechanics and Dynamics Research Team, River Engineering Research Team, Port and Coast Research Team

(2) Development of Risk Reduction Technologies for Emerging Sediment-related Disasters

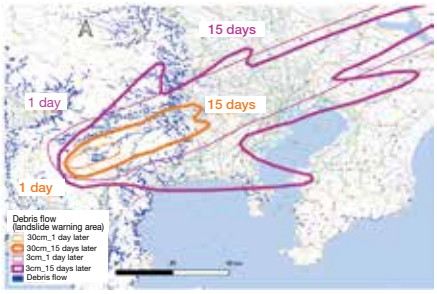
Keywords ▶ Heavy rain disaster, volcanic eruption disaster, large-scale earthquake disaster, emergency response

Research period: 2022-2027
Program leader: Director of Erosion and Sediment Control Research Group

Research summary

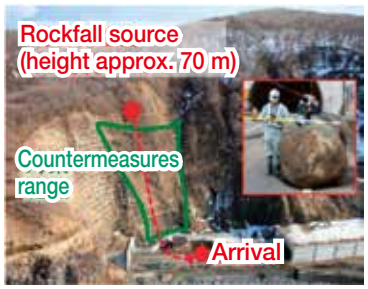
There is an increasingly apparent need to respond to natural disasters , such as heavy rain and snowfall events, which are becoming more severe and frequent, as well as impending volcanic eruptions and large-scale earthquakes. For example, debris flows are more likely to occur after ashfall from a volcanic eruption, raising concerns that debris flow damage will affect a wide area in the event of an eruption of the same magnitude as the Hoei eruption of Mt. Fuji. In addition, in some areas, heavy rain and earthquakes have caused collapsing landslides with high movement speeds, even on gentle slopes. Meanwhile, rockfalls have also occurred from slopes that were previously difficult to inspect. Methods to identify dangerous areas for landslides and technology to define hazard areas are being developed to prepare for these landslides in advance. Technologies are also being developed to evaluate preventive measures and provide rapid emergency responses for rockfalls.

Example of the eruption of Mt. Ontake in 2014 and the resulting debris flow

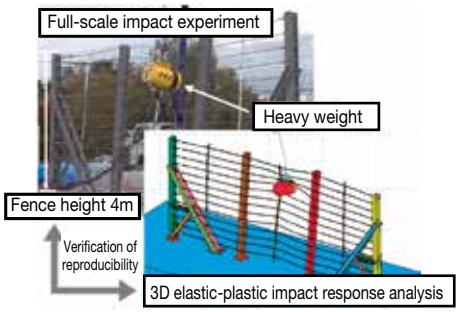


Area of ashfall caused by an eruption of the same magnitude as the Hoei eruption of Mt. Fuji (Cabinet Office estimate for 2020)

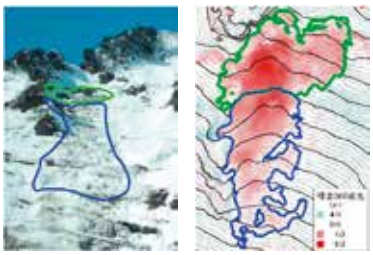
Geomorphic analysis using BIM/CIM to understand the mechanism of collapsing landslides



Example of rockfall from a slope that was difficult to inspect



Construction of an analysis model using heavy weight impact experiments and reproducible analysis



Avalanche observation (left) and identification of avalanche occurrence areas using UAV (right)

Social contribution

The technology that will be developed will enable the investigation and identification of high-risk areas for disaster phenomena that were previously inadequately addressed. It will also facilitate the investigation and numerical analysis of rockfalls from road slopes that are difficult to access and could not previously be examined during road disaster prevention inspections. The developed dangerous spot extraction method and hazard area identification technology are also reflected in the Ministry of Land, Infrastructure, Transport and Tourism's technical guidelines, river erosion control technical standards, and rockfall countermeasures handbook.

These technologies meet administrative needs and contribute to the implementation of appropriate warning, evacuation, emergency, and advance disaster prevention measures.

Spotlight!

The developed technology utilizes digital technologies such as UAVs, AI, BIM/CIM, and ICTFor example, the use of UAVs allows for the acquisition of more detailed topographical data more rapidly, frequently, and inexpensively than before. This enables an understanding of “what kind of weather conditions cause slope collapses and landslides,” which was previously difficult to determine, by obtaining topographical data for each rainfall. The work thus far has focused on debris flows and avalanches; in the future, the causes and triggers of occurrence areas will be analyzed while accumulating cases to clarify the conditions of the sites.

Research Teams >> Volcano and Debris Flow Research Team, Landslide Research Team, Snow Avalanche and Landslide Research Center, Structures Research Team, Geological Hazards Research Team

(3) Development of Disaster Prevention and Mitigation Technologies for Extreme Snow and Ice Disasters

Keywords ▶ Extreme weather, road snow and ice disasters, tsunami disaster prevention

Research period: 2022-2027
Program leader: Director of Cold-Region Road Engineering Research Group

Research summary

Snowstorms, heavy snowfall, and avalanches caused by rapid snowmelt in snowy and cold regions , have led to vehicles becoming stuck and roads closing for extended periods in recent years, severely impacting people's lives and socioeconomic activities. Therefore, the development of disaster prevention and mitigation technologies to address increasingly extreme snow and ice disasters has become an urgent issue.

This research and development program employs advanced technologies to support winter road management decisions during extreme weather conditions, evaluate the performance of snowstorm prevention facilities considering blizzards, ensure snow protection functions, and assist in tsunami prevention and mitigation for coastal areas in snowy, cold regions.

[Research background]

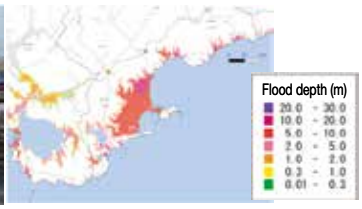
Frequent snow and ice disasters due to extreme weather in winter

▲Snowstorms in Hokkaido

▲ March 2018 R236 Nozuka Pass: Avalanche disaster due to heavy rain in severe winter

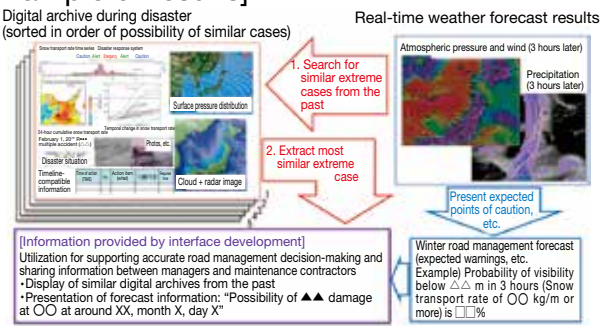
Possibility of disaster due to a tsunami and sea ice caused by huge earthquakes along the Japan Trench and Kuril Trench

▲ Example of sea ice run-up due to a tsunami (March 2011)

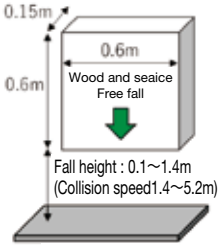


▲Assumption of tsunami flooding by "Japan Trench and Kuril Trench Model Study Group" (Cabinet Office) (April 2020)

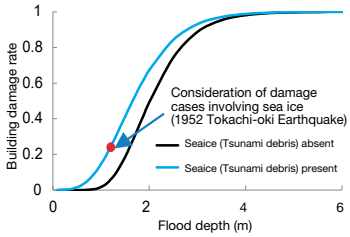
[Example of results]



▲Overview of the digital archive of past snowstorms and heavy snow disasters and the concept of their utilization



▲Collision experiment of sea ice and wood with drifting objects



▲Example of the tsunami damage function calculation considering drifting objects such as sea ice

Social contribution

This program addresses administrative needs and contributes to implementing appropriate measures by providing technical advice on strategies against avalanches, snowstorms, and tsunamis. In response to requests from road administrators, the program also offers technical guidance when an avalanche occurs on the road, aiding in accurately lifting road closures and implementing a rapid on-site response.

The results of the newly developed countermeasures will be reflected in technical documents, such as design standards and manuals for road snowstorm countermeasures.

Spotlight!

The Earthquake Specialist Committee of the Earthquake and Volcano Countermeasures Division of the Hokkaido Disaster Prevention Council has adopted the research findings for estimating damage from tsunamis associated with sea ice (Tsunami fragility curve). This method converts the normal Tsunami fragility curve , which does not account for Tsunami debris like sea ice , into a function that considers Tsunami debris by expressing the external forces of the tsunami (the collision forces of sea ice, etc. , and the resistance of seawater) as a function of the inundation depth . It then adjusts this to the inundation depth without sea ice. This is a very complex phenomenon with numerous uncertain factors, but a key feature of the research is its consolidation into a single coefficient and estimation based on the only existing record of tsunami damage related to drifting ice (the Tokachi-oki Earthquake in 1952).

Research teams >> Snow and Ice Research Team, Cold-Region Machinery Technology Research Team, Geological Hazards Research Team, Scenic Landscape Research Team, Port and Coast Research Team

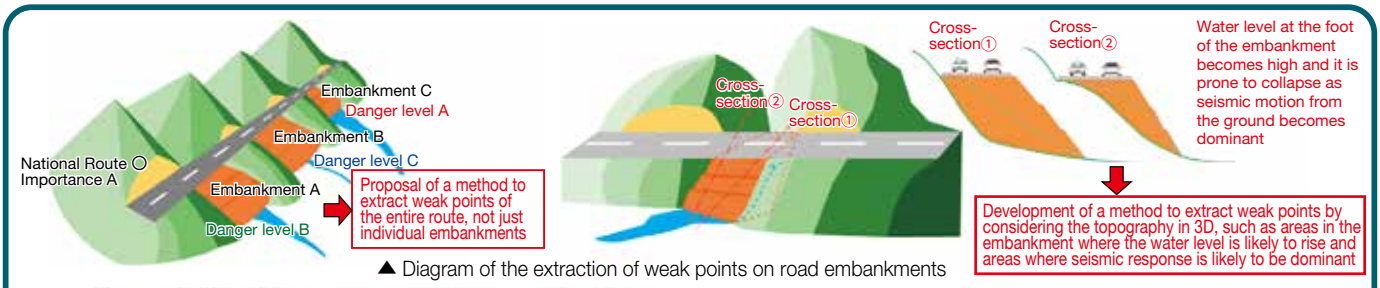
(4) Development of Advanced Technologies to Ensure the Functions of Infrastructure from Large Earthquake

Keywords ▶ Earthquake countermeasures, seismic performance evaluation, post-earthquake response, liquefaction prediction

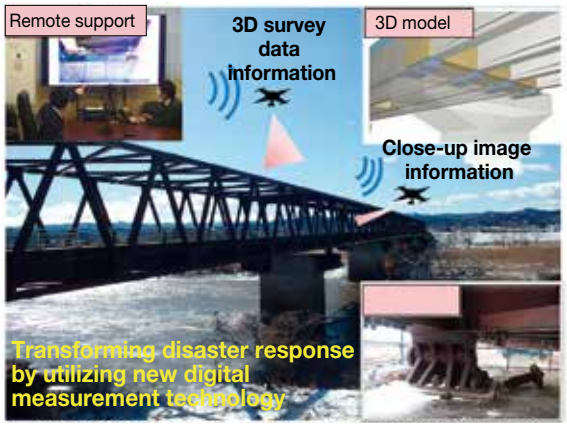
Research period: 2022-2027
Program leader: Research Coordinator for Earthquake Engineering

Research summary

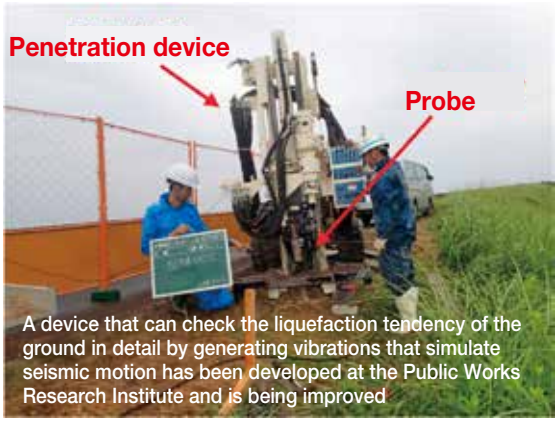
The urgency of major earthquakes threatening densely populated or economically critical regions—such as a massive event in the Nankai Trough or one occurring directly beneath the capital—continues to command serious attention. Drawing on lessons learned from past earthquakes, notably the 1995 Southern Hyogo Prefecture Earthquake and the 2011 Off the Pacific Coast of Tohoku Earthquake, PWRI has pursued research and development activities, revised technical standards for countermeasures in critical infrastructure (including bridges and earthwork structures), and thereby achieved notable progress. This program particularly emphasizes preserving the operational integrity of bridges and earthwork structures during major earthquakes, seeking to establish advanced countermeasure technologies that enable swift functional restoration in the event of damage, alongside sophisticated liquefaction prediction methods for enhanced seismic performance evaluations.



▲ Diagram of the extraction of weak points on road embankments



▲ Concept of a method to assess the condition of bridges after an earthquake using digital technology



▲ Diagram of a ground survey (in situ liquefaction test method) for evaluating liquefaction predictions

Social Contribution

Damage caused by earthquakes is becoming increasingly severe and diverse, raising concerns that it may occur in ways not previously experienced. The government is developing policies to prevent and reduce damage from such disasters and to support rapid recovery and reconstruction. PWRI is working to enhance the reliability of infrastructure facilities' functionality in the event of a major earthquake and improve resilience to enable early recovery, even if a malfunction occurs.

Spotlight!

Bridge bearings are particularly vulnerable to seismic damage. Yet their inaccessibility during inspections often requires the use of scaffolding - a requirement that prolongs post-earthquake assessments and can delay prompt restoration. In response, advanced technologies such as 3D laser scanners and UAVs are being used to develop inspection methods that can quickly collect the data needed to assess the condition of the structure without hands-on inspection.

We will propose detection indicators that facilitate effective post-earthquake assessments and evaluation methods for inspection-supporting technologies designed to identify these indicators.

Research Groups >> Bridge and Structural Engineering Research Group, Soil Mechanics and Dynamics Research Team, Geology Research Team, Structures Research Team, Geotechnical Research Team

(5) Development of Technologies for Continuous Monitoring and Management of Rivers and River Basins under Climate

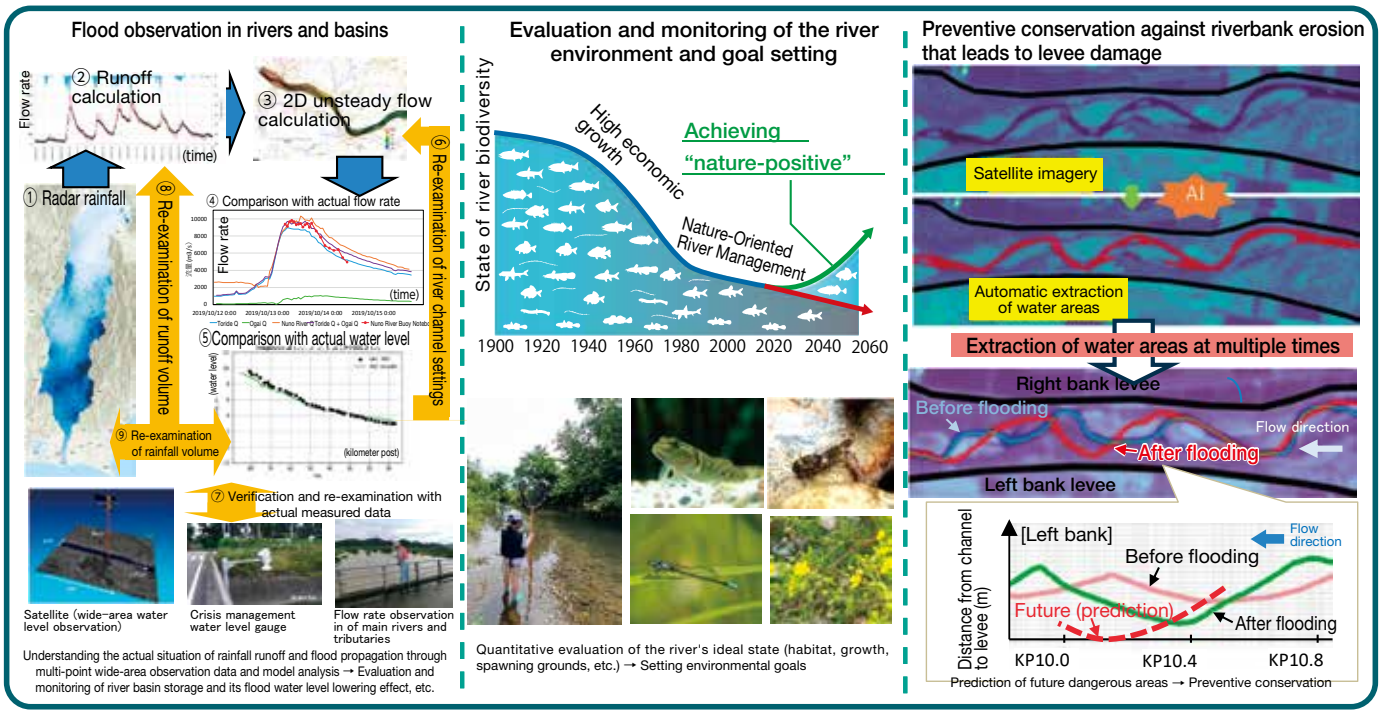
Keywords ▶ River Basin Disaster Resilience and Sustainability by All, sustainability, preventive conservation, nature positive, observation, monitoring, digital transformation

Research period: 2022-2027
Program leader: Director of River Dynamics Management Group

Research summary

"River Basin Disaster Resilience and Sustainability by All" increases resistance and resilience against water disasters through the comprehensive strengthening of various tangible and intangible disaster prevention/mitigation measures, which are based on collaboration among all parties involved in the river basin, including those who reside in the basin. Therefore, maximizing its effectiveness/efficiencies is essential, as is ensuring "sustainability." One crucial aspect is the continuous monitoring, observation, and management, which will sustain the functions of various measures, ensure their effective use when needed, and further improve them based on their performance. The other aspect of it is the promotion of rich and vibrant lives, and the implementation of maintenance and other measures throughout the river basin which will contribute to the restoration of the natural environment, preservation of beautiful scenery, establishment of a healthy environment, and creation of a livable region.

This research and development program considers the concepts of preventive conservation, nature-positive, and digital transformation to develop ① monitoring and evaluation technologies for river basins and river channels using new technologies, ② technologies for river channels and river structures that can respond to increasing external forces and diverse flow conditions under climate change, and ③ preventive conservation maintenance and management technologies for river channels and river structures.



Social contribution

Observation and evaluation methods are proposed to understand the flood management effects throughout a river basin and the resulting flood water level lowered areas; the results are applied to establish quantitative environmental goals related to the habitats of living organisms. New technologies are also being developed to improve the accuracy and efficiency of flood flow observation, as well as the efficiency of observing and analyzing wide-area river channels and levees. Furthermore, monitoring and preventive maintenance technologies are proposed for the lateral erosion of levees and damage caused by flood flow with gravel in dam sediment bypasses. These results will contribute to the development of a sustainable social infrastructure that allows for safe, secure, and prosperous lives.

Spotlight!

Further enhancements will be made to the strengths of PWRI, which provides research and technical support that is deeply rooted in the essence of real phenomena in the field, and extensive achievements in actual civil engineering projects. NASA has released data on the water levels of rivers, lakes, reservoirs, oceans, etc., observed by satellites. The Ministry of Land, Infrastructure, Transport and Tourism's "National Survey on Natural Environment in River and Watershore" which is a biological and environmental survey of rivers and watershores, has also accumulated data for more than 30 years (since its initiation in FY1990). Practical research and technology development that delves deeper into the essence and track record of these achievements will be conducted by the Institute.

Research Teams >> Watershed Restoration Research Team, Aqua Restoration Research Center, Flood and River Response Monitoring Team, Hydraulics and Sediment Transport Engineering Team, River Channel Research Unit, Watershed Environmental Engineering Research Team, Cold-Region Machinery Technology Research Team

(6) Development of Technologies for Infrastructure Improvement

Keywords ▶ Newly elucidated damage mechanisms, geological and ground risks, LCC

Research period: 2022-2027
Program leader: Director of Road Technology Research Group

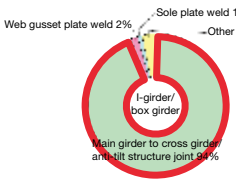
Research summary

Given Japan's severe financial constraints, it is essential to utilize the leverage gained through infrastructure development and maintenance to construct long-lasting and highly reliable leverage when renewing or building new infrastructure in the future.

This research and development program focuses on developing technologies for the renewal and new construction of structures that correspond to newly elucidated damage and failure mechanisms, new materials, and construction methods that enable the renewal and new construction of longer-lasting structures by considering the actual damage and failure conditions, and technologies that appropriately respond to geological and ground risks to improve the reliability of infrastructure from planning to management.

[Research background]

Need for design methods that reflect the actual circumstances of damage



Ratio of crack damage locations in steel girder bridges

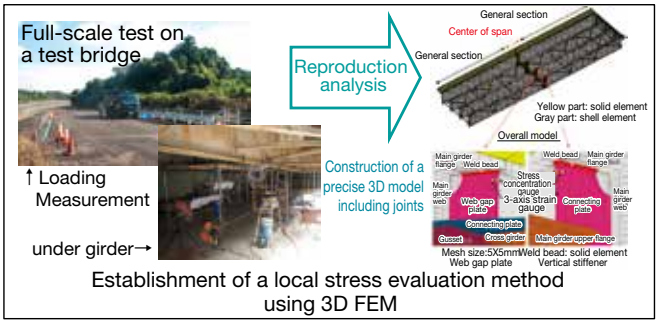
Damage due to local stress at the joints of bridge main girders and cross girders, etc.

Need to improve the reliability of infrastructure based on geological and ground risks

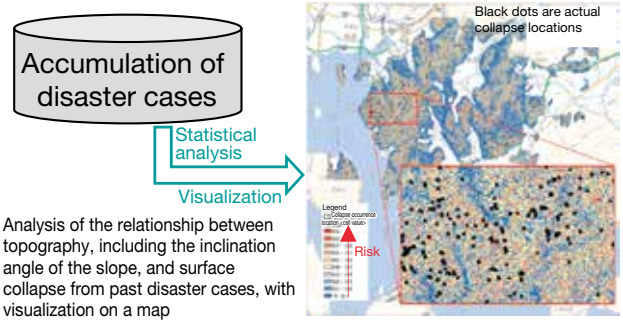
Example of heavy rains in northern Kyushu in July 2017

Various field surveys conducted

[Example of results]



Establishment of a local stress evaluation method using 3D FEM



Development of a surface collapse risk prediction method

Social contribution

On-site surveys and measurements are conducted in collaboration with other organizations, such as government agencies and universities, to maximize research results and accurately respond to on-site issues and needs.

The knowledge and research results gained from research activities to date are reflected in technical standards and manuals and used in study and training sessions for government officials, making a significant contribution to the smooth execution of government work.

Spotlight!

Previous research results have been utilized to develop a "one-pack heat insulator gabion" as a new frost-heave prevention measure for cut slopes (see p. 46). This construction method not only has a strong insulating effect, but also allows materials to be procured and assembled on-site, making it safer and easier to construct than conventional construction methods. The research results on this construction method were awarded the Outstanding Presentation Award at the 15th Ground Improvement Symposium and have been highly praised academically.

Research Teams >> Geology Research Team, Soil Mechanics and Dynamics Research Team, Construction Technology Research Team, Pavement Research Team, Bridge and Structural Engineering Research Group, Materials and Resources Research Group, Materials Research Team, Geotechnical Research Team

(7) Development of Technologies for Preventive Maintenance of Infrastructure

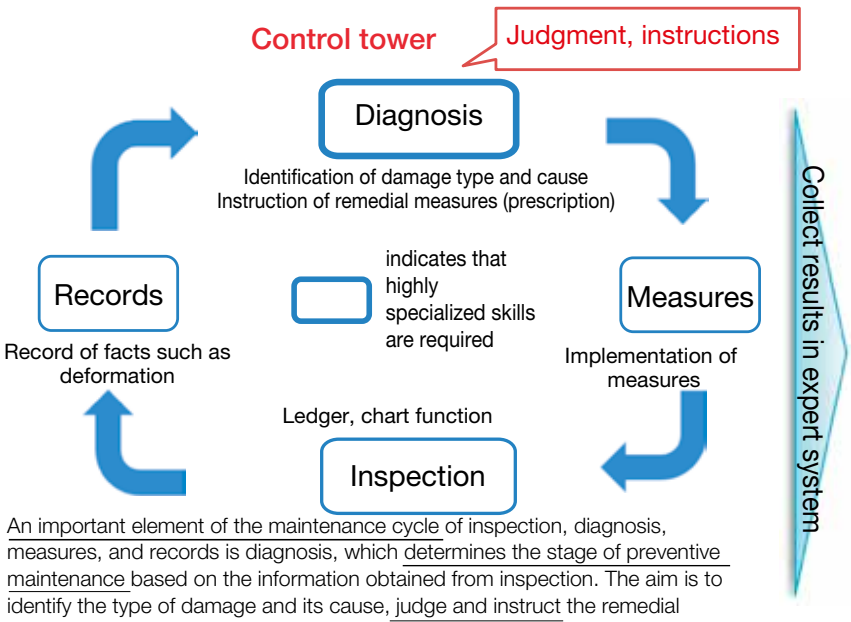
Keywords ▶ Maintenance cycle, preventive maintenance, expert system

Research period: 2022-2027
Program leader: Director of Bridge and Structural Engineering Research Group

Research summary

The progressive deterioration of infrastructure indicates the importance of promoting preventive maintenance to extend the lifetime of infrastructure, which can minimize maintenance and renewal costs while ensuring the continued functionality of the infrastructure.

This research and development program focuses on developing inspection technology that can accurately and rationally capture deformations, to enable appropriate diagnosis in road bridges, tunnels, river structures such as sluices, and concrete structures. This program also develops diagnostic techniques and support systems that indicate status assessment and treatment methods according to damage mechanisms while offering effective countermeasure technology corresponding to the installation environment of structures and restrictions on construction.



An important element of the maintenance cycle of inspection, diagnosis, measures, and records is diagnosis, which determines the stage of preventive maintenance based on the information obtained from inspection. The aim is to identify the type of damage and its cause, judge and instruct the remedial measures (prescription) as the control tower, and take effective measures. For example, a bridge diagnosis support AI system is being developed to improve the reliability of diagnosis.

Maintenance cycle

Bridge diagnosis support AI system

Social contribution

The major technical issues at each stage of the maintenance cycle are being solved, and the results are collected to the expert system. Evaluation technology is also being developed for new technologies proposed by the private sector.

The aim of the above research is to improve the reliability of inspection, diagnosis, and measurement technology and reduce the labor required through “DX (digital transformation) of infrastructure maintenance,” thereby contributing to the realization of preventive maintenance of structures.

Spotlight!

Previous research results are reflected in “Manual for the design and execution of the repair of concrete structures, the 2022 edition” (see p. 38), various technical standards have been revised, and efforts are being made to disseminate the results at lectures and other events.

Technical advice to Kumamoto Prefecture regarding the early emergency restoration of the Kuma Ohashi Bridge following its subsidence was provided in response to a request from the prefecture. Not only is technical assistance provided during normal times, research-based technical assistance is also provided during disasters.

Research Teams >> Bridge and Structural Engineering Research Group, Materials and Resources Research Group, Hydraulics and Sediment Transport Engineering Team, River Dynamics Management Group, Tunnel Research Team, Soil Mechanics and Dynamics Research Team, Geology and Geotechnical Engineering Research Group, Materials Research Team

(8) Development of Efficient Maintenance and Management Technologies for Infrastructure under Snowy and Cold Environment

Keywords ▶ Frost damage and combined deterioration, bridge RC slab, pavement

Research period: 2022-2027
Program leader: Director of Cold-Region Maintenance Engineering Research Group

Research summary

Maintenance of infrastructure in snowy and cold regions poses technical challenges due to the severe environment, including low temperatures, snow, frost heave, freezing and thawing, melting snow water, and salt.

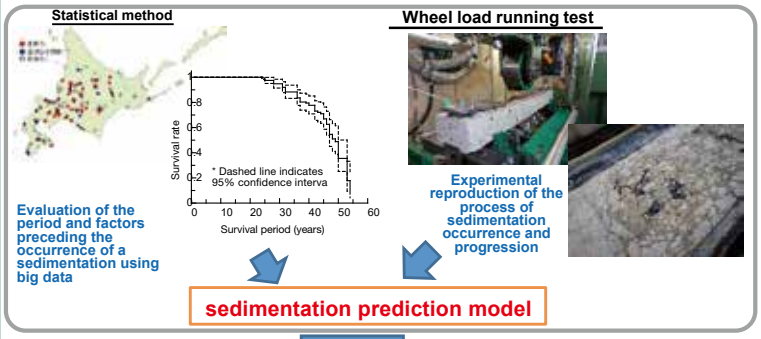
This research and development program develops efficient methods for investigating and determining the deterioration status of infrastructure, highly accurate prediction and diagnosis technology for the progression of deterioration, and highly durable and effective countermeasure technologies (prevention and post-distress) that correspond to the deterioration and distress unique to snowy and cold regions.

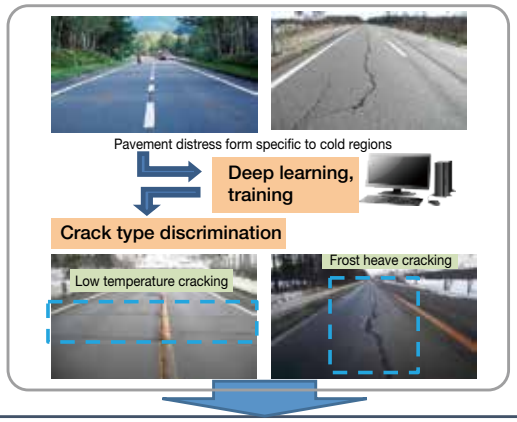
Research background

◆Infrastructure in snowy and cold regions requires the development of technology that can respond to the unique deterioration and distress caused by the severe environment.
◆Managers particularly need efficient and effective measures against deterioration and distress to RC slabs and pavements in snowy and cold regions.


Sedimentation of a bridge deck　Potholes

Example of results





Accurate prediction of the progression of bridge deterioration

Development of a model to predict sedimentation in RC slabs based on statistical evaluation methods and experimental results

Improved efficiency of pavement inspection and diagnosis

Development of technology that can efficiently detect and distinguish pavement cracks (low temperature, frost heave) unique to cold regions

Social contribution

Technology that can rapidly determine deterioration and distress to RC slabs and pavements caused by the severe environment unique to snowy and cold regions, technology that can accurately predict the progression of deterioration, and highly durable countermeasure technologies are being developed and implemented on-site to achieve efficient and planned maintenance of infrastructure, which will allow roads to be repaired at the appropriate time and extend their lifespans even in snowy and cold environments.

Spotlight!

The increase in distress to pavement, such as potholes, during the snowmelt period in early spring in snowy and cold regions has attracted social attention, and road managers increasingly need technology to suppress the occurrence of potholes and provide effective countermeasures. This program is developing technology that utilizes information and communication technology (ICT) and deep learning to efficiently detect pavement distress such as potholes with high accuracy from images taken by in-vehicle cameras.

Research Teams >> Structures Research Team, Materials Research Team, Road Maintenance Research Team

(9) Research and Development to Improve Productivity in Infrastructure Construction and Maintenance

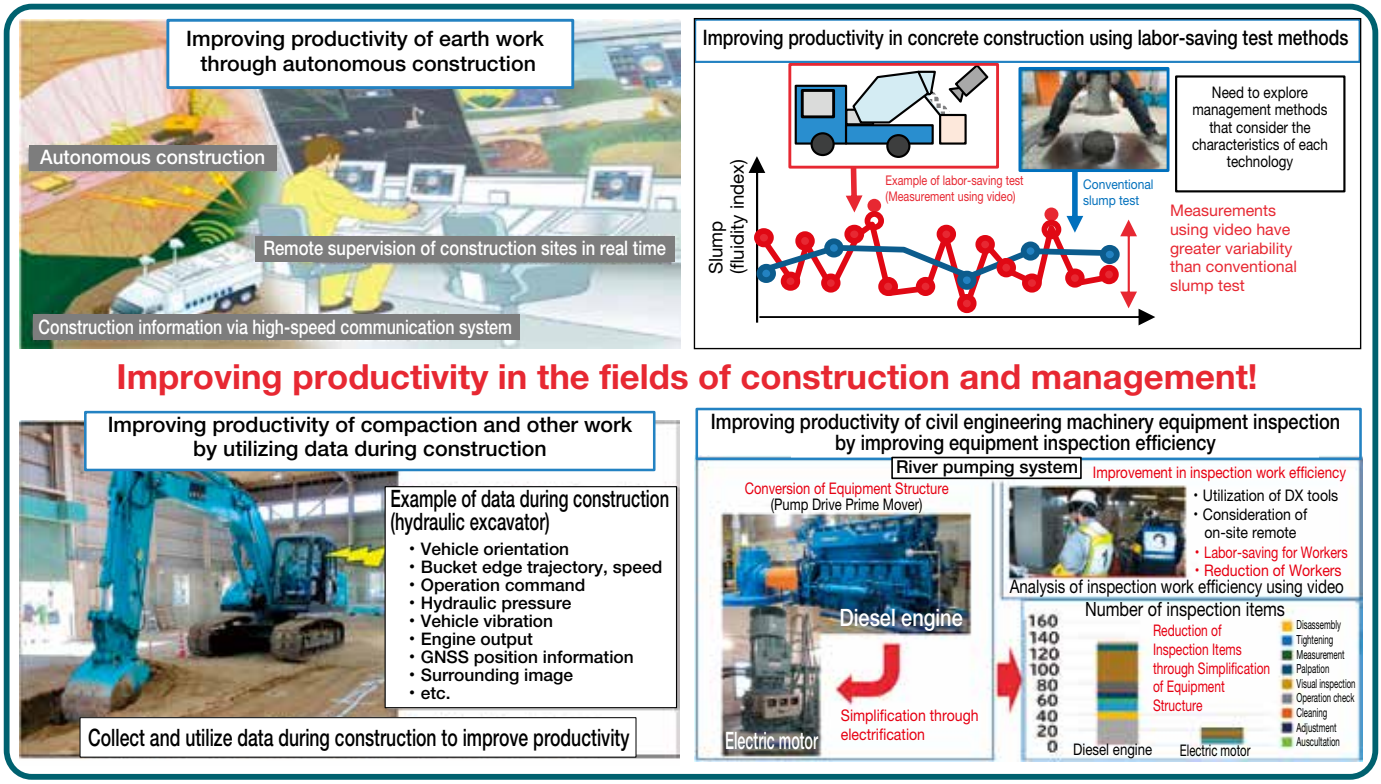
Keywords ▶ autonomous construction, data utilization quality control, equipment inspection, remote support

Research period: 2022-2027
Program leader: Director of Construction Technology Research Department

Research summary

Japan is facing declining birth rates and an aging population, necessitating a response to the aging of construction workers and the resulting serious labor shortage. Meanwhile, the rapid development of advanced technologies such as ICT in recent years has made it easier to automate construction and management sites and collect various data. Therefore, this research and development program focuses on innovatively improving productivity by utilizing the latest technologies in infrastructure construction and maintenance management.

Specifically, the program conducts research to achieve “improving productivity of earth work through autonomous construction,” “Improving productivity of concrete work by utilizing materials and evaluation test methods that contribute to labor savings,” “Improving productivity of compaction and other work by utilizing data during construction,” and “Improving productivity of civil engineering machinery and equipment inspection by enhancing the efficiency of equipment inspection.”



Social contribution

The aim of conducting this research is to improve the productivity of construction and management sites and contribute to the realization of sites that can accommodate with aging workers and labor shortages.

- Earth work: Promote the introduction of autonomous construction at sites.
- Compaction and other work: Propose productivity improvement technologies using various data during construction, etc.
- Concrete work: Suggest the use of high fluidity concrete that contribute to labor savings and new technologies for evaluating construction quality.
- Civil Engineering Machinery and Equipment Technology: Consider the use of DX tools and equipment structures that simplify inspections.

Spotlight!

We are developing an open research and development platform (OPERA) that consist of actual construction machinery, experimental field, simulators, and more. This OPERA is easy utilized by anyone to promote open innovation and accelerate research and development in autonomous construction. Some joint research projects are ongoing with companies and universities, utilizing OPERA. We are the first in the world to propose 'common communication rules' that enable the control of each construction machinery through a unified communication interface. We are currently in discussions with construction machinery manufacturers to establish this rule as an industry standard.

Research Teams >> Advanced Technology Research Team, Innovative Materials and Resources Research Center (Concrete and Metallic Materials), Geotechnical Research Team, Cold-Region Machinery Technology Research Team

(10) Development of Methods for Sustainable Management of Water Resources and Environment to Cope with Climate Change

Keywords ▶ climate change, rivers, dam reservoirs, lakes, sewage systems, prediction, monitoring, adaptation measures

Research period: 2022-2027
Program leader: Director of Water Environment Research Group

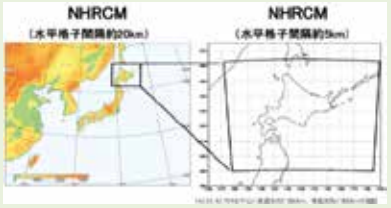
Research summary

Concerns have been raised about the impact of changes in river flows, such as droughts (which are becoming more frequent and severe due to climate change), on water resources, the aquatic environment, and natural ecosystems. Ensuring and maintaining a healthy and comfortable living environment through proper management of water environment and conservation of natural environment is necessary, especially under a changing climate. This research and development program will develop technologies to characterize spatio-temporal variations in river flow and drought phenomena, and predict future river flow and water temperature conditions using climate forecast data to more accurately assess the effects of climate change and facilitate management practice. This program also promotes the development of monitoring technologies using digital transformation, as well as the prediction of biological impacts and risk assessment under future climate regimes. In addition, the program aims to propose adaptation measures in the water environment field, such as for rivers, dam reservoirs, lakes, and sewage treatment plants.

Major results of this research program

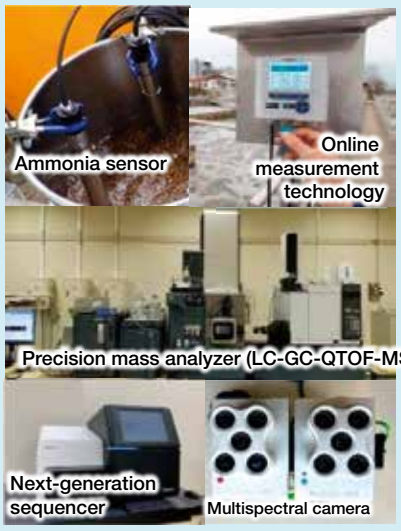
① Development of prediction technology for river flow conditions and water temperature

Integration of a snow accumulation and melting model, distributed runoff model, and river water temperature model



Future predictions for each river basin in Hokkaido, where snowfall and snowmelt have large impacts

② Development of risk assessment and monitoring technology for changes in flow conditions



Development of water quality monitoring technology (DX)

③ Development of effective adaptation measures under climate change

Example of technology to ensure the safety of reclaimed water (UV-LED disinfection device)

Example of a bottom environment improvement measure (WEP system)

Social contribution

This program contributes to the maintenance and management of healthy water environments in rivers and river basins for the future by clarifying prediction technologies and adaptation measures to address the impacts of climate change on the water environment, such as flow rates, water temperatures, and water quality in rivers, dam reservoirs, lakes, and sewage treatment plants. The program also contributes to creating vibrant, attractive regions and nature-rich lifestyles through the social implementation of technologies that meet governmental needs, such as more efficient and effective river management and sewage treatment technologies, including technologies for evaluating impacts on natural ecosystems and monitoring technologies.

Spotlight!

In the current National Census on River Environments, fish are directly captured, and the species is identified based on their appearance. A new survey method under development aims to standardize technology that can identify species from DNA information (called “environmental DNA”) obtained from fish tissue fragments present in water collected from rivers. This approach eliminates the need for direct fish capture (see p. 39). Technology is also being developed to enhance the effectiveness of sewage treatment by utilizing DNA analysis technology as a method for understanding the microorganisms in treatment facilities.

Research Teams >> Water Quality Research Team, Aqua Restoration Research Center, Watershed Environmental Engineering Research Team, Watershed Restoration Research Team

(11) Research and Development on Providing Winter Road Services that Support Regional Communities

Keywords ▶ road surface freezing, snow removal machinery, winter road surface management

Research period: 2022-2027
Program leader: Director of Cold-Region Road Engineering Research Group

Research summary

Daily snowfall and road surface freezing in snowy and cold regions cause traffic jams and slip accidents, affecting the lives of local residents and socioeconomic activities. Furthermore, the deterioration of snow removal machinery and the shortage of workers are becoming more severe as the working-age population declines due to financial constraints and aging, making it difficult to respond as effectively as in the past.

This research and development program utilizes advanced technologies to support decisions on winter road management and diagnose the extent of deterioration of snow removal machinery. This program also focuses on the practical application of slip prevention measures using rough-surface pavements.

Traffic jams caused by daily snowfall and frozen roads

Snow removal work to prevent traffic disruptions caused by heavy snow and ensure road traffic

Snow removal equipment breakdowns due to aging are becoming severe

Estimation of the road surface condition and friction coefficient from CCTV images

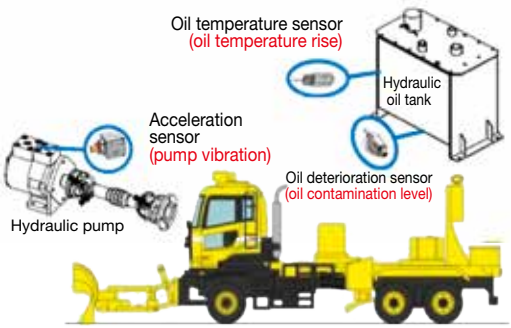
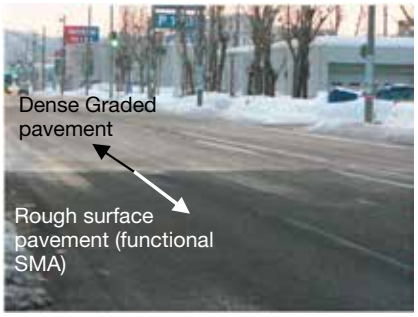


Diagram of sensor placement to monitor the deterioration of snow removal equipment parts



Example of winter road surface measures using rough-surface pavement

Social contribution

This program is developing technology that uses AI to estimate road surface conditions from images recorded with smartphones and other devices; it also aids winter road management decisions by determining road surface conditions over a wide area, thereby contributing to reducing vehicle stoppage and slippage accidents.

The development of a system that uses sensor technology to monitor the deterioration of snow removal machine parts will also enable preventive and efficient repairs of snow removal machines, thus contributing to extending their long service life.

Furthermore, the development of on-site implementation technology for rough-surface pavement ensures the skid resistance of winter road surfaces and contributes to improving safety on winter roads.

Spotlight!

An “antifreeze spraying support system” is being developed to enable even inexperienced operators to work safely and reliably. This system allows the operator of the sprayer vehicle to spray automatically by simply touching the software screen once before work, without the need to operate the control console.

The Hokkaido Regional Development Bureau of the Ministry of Land, Infrastructure, Transport, and Tourism has trialed one unit per development and construction department (a total of 10 units) and is conducting on-site demonstrations.

Research Teams >> Traffic Engineering Research Team, Road Maintenance Research Team, Cold-Region Machinery Technology Research Team

(12) Development of Technologies for the Better Use of Local Resources and the Reduction of Environmental Load

Keywords ▶ recycling, greenhouse gas reduction, environmental load reduction

Research period: 2022-2027
Program leader: Director of Materials and Resources Research Group

Research summary

Building a sustainable local community amidst ongoing social and environmental changes, such as population decline and global warming, requires the promotion of reusing and effectively utilizing of waste materials in the development and operation of social capital. It also necessitates the development of construction technologies that are responsive to changes in social structure and the advancement of technologies aimed at minimizing environmental impacts.

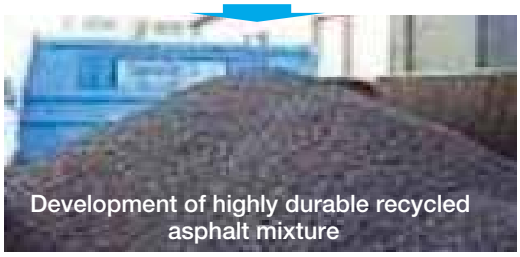
This research and development program focuses on construction materials generated in relatively large quantities and seeks to propose effective utilization methods for recycled materials and locally sourced materials and resources, such as reusing pavement waste materials for heavy-traffic roads and developing pavement recycling technologies that adapt reductions in number of plants. This program also suggests methods to promote the use of locally sourced materials, such as concrete waste, slag, and volcanic ash in concrete, and aims to establish rational safety evaluation technologies for generated soils that require environmental load measures.

Additionally, this program strives to propose technologies that reduce the environmental impact of construction materials and resources through their effective utilization. This includes developing technologies to optimize resource use and mitigate the environmental effects of sewage treatment plants, which can further decrease carbon dioxide emissions. This program also focuses on creating technologies to minimize the environmental impact of painted steel structural components.

Implementing technologies to lower CO_2 emissions from sludge incineration facilities by integrating locally sourced biomass, such as pruning branches, etc.

Utilization of a portion of recycled asphalt aggregate (this method utilizes only old aggregate, and old asphalt is trapped in the base course without being utilized)

Reduce unused portions and develop higher value recycling materials



Consideration of expanding use to heavy traffic roads where the use of recycled materials has previously been difficult

Social contribution

Demonstrating the evaluation of construction materials made from construction waste such as asphalt blocks, concrete blocks, and waste soil promotes their proper use in public works and supports the development of sustainable local communities. Our research institute develops manuals on technologies that utilize local resources, such as plant biomass, in sewage treatment plants, energy recovery technologies, and environmentally friendly painting technologies for steel structures. The goal of these manuals is to promote the use of these technologies in public works projects and to help reduce their environmental impact, including lowering carbon dioxide emissions.

Spotlight!

Soil from construction waste contains naturally occurring heavy metals and other substances, which require careful consideration of environmental impacts. Traditional evaluation methods and environmental safety measures have often been costly. PWRI's research highlight methodical survey technologies, accurate assessments, and optimized utilization approaches, providing valuable insights for practical applications in public. These findings have been incorporated into a manual published by the Ministry of Land, Infrastructure, Transport and Tourism, supporting effective soil utilization and lowering countermeasure costs. There is also a need to address the quality deterioration caused by repeated recycling of pavement materials. Technology that is compatible with repeated recycling, which has been PWRI has developed incorporated into the revised version of the "Pavement Recycling Handbook," which is contributing to higher-quality recycling.

Research Teams >> Geology Research Team, Pavement Research Team, Materials and Resources Research Group, Geological Hazards Research Team, Materials Research Team, Road Maintenance Research Team

(13) Research and Development on Redesign of Public Spaces for Comfortable and High-quality of Life

Keywords ▶ landscape formation, public space, redesigning

Research period: 2022-2027
Program leader: Director for Special Research

Research summary

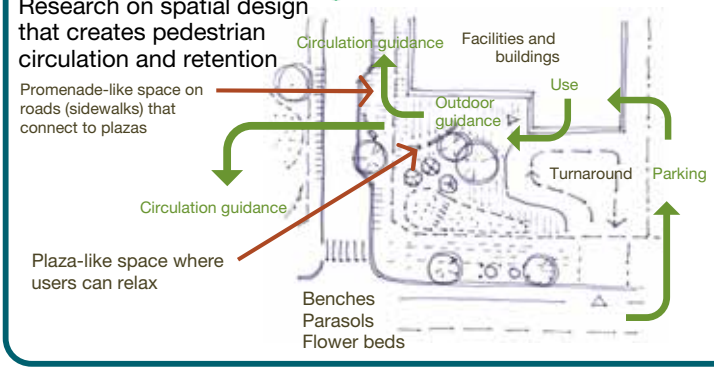
People's attitudes toward work and living are changing rapidly as their outlooks on life and lifestyles become more diverse. Local communities also need to be established, where people can live fulfilling lives even in an era of severe population decline. Public spaces must also undergo a process of "redesigning" to meet diverse needs and to be optimized in line with these changes.

This research and development program focuses on "redesigning" public spaces, including planning and design technologies for pedestrian areas that enrich communities; planning, design, and maintenance technologies for suburban roadways that address diverse needs; and evaluation technologies to facilitate improvements in infrastructure landscapes.

Redesigning pedestrian spaces


Pedestrian spaces and rest facilities with few users

Research on spatial design that creates pedestrian circulation and retention



Redesigning road spaces


Example of road functions and landscapes impaired by excessive use of signs


Easy-to-understand, easy-to-drive road spaces that allow enjoyment of roadside scenery

Social contribution

These research results are being used as a basis to publish our manuals, which are also incorporated into the technical materials of government agencies. Support is provided through committee members, lecturers, and technical guidance for landscape development, tourism, and town planning undertaken by government and local communities. The program emphasizes resolving the issues of individual projects with high on-site needs, such as roadside stations, pole-free construction, and street trees. These efforts contribute to realizing comfortable and high-quality lives through the multifaceted and complex use of infrastructure and the formation of good environments and landscapes.

Spotlight!

This program promotes research and development in underground construction technology and conducts outreach activities to encourage the elimination of utility poles. In terms of construction technology, the program demonstrates the feasibility of laying underground pipes in narrow trenches using a trencher, which contributes to faster construction and reduced costs. For outreach activities, the program is creating an exhibition model for use as teaching material during citizen events and outreach classes at elementary schools, with the aim of fostering understanding, particularly among children and other local residents. These efforts have been well received.

Research Teams >> Scenic Landscape Research Team, Traffic Engineering Research Team, Road Maintenance Research Team

(14) Development of Technologies for Maintenance and Management of Agricultural Infrastructure in the Snowy Cold Regions Contributing to being Growth Industry and Resilient

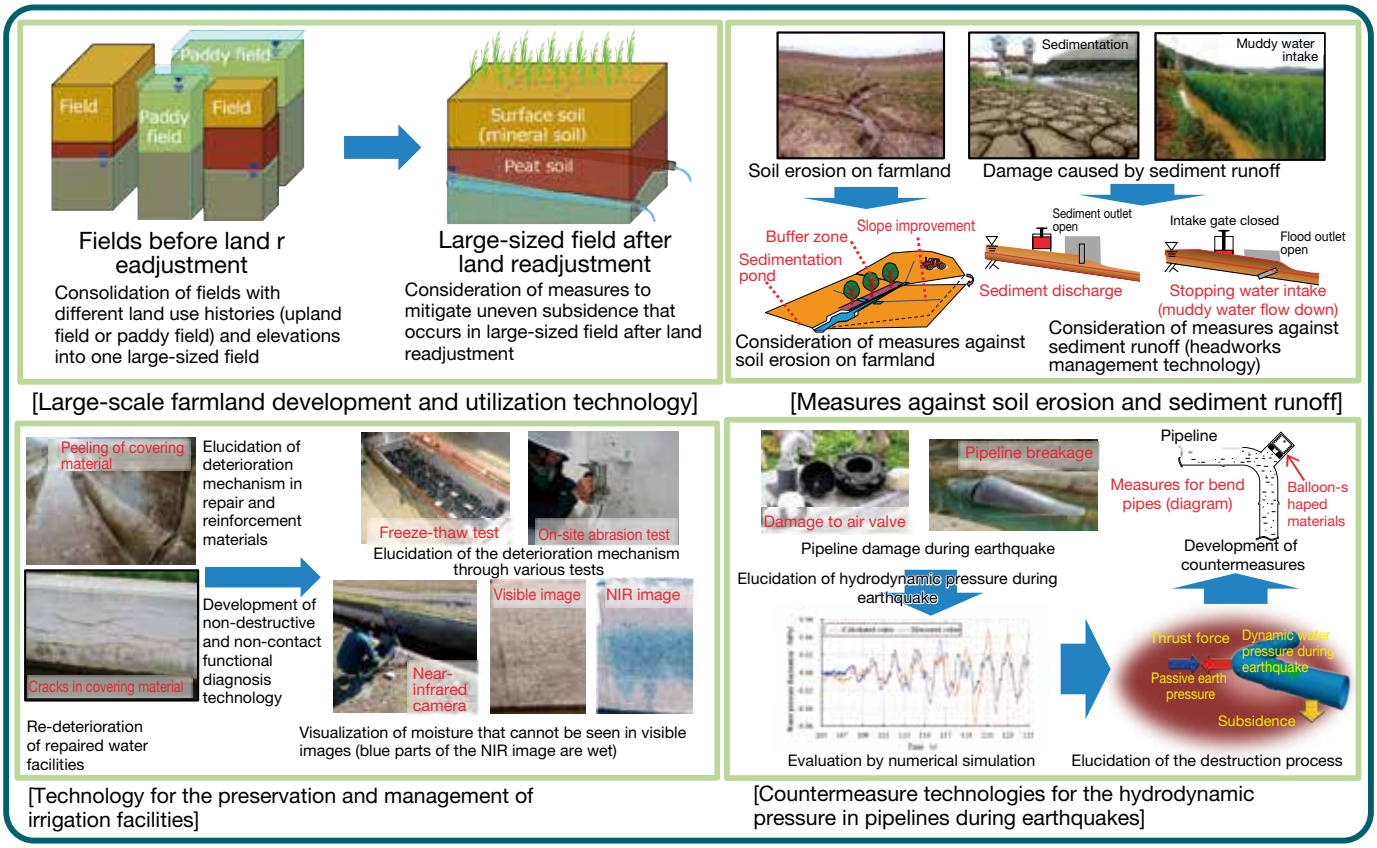
Keywords ▶ large-scale farmland, resilience of irrigation facilities, climate change

Research period: 2022-2027
Program leader: Director of Cold-Region Agricultural Development Research Group

Research summary

As food security becomes a global issue, there are concerns that Hokkaido, which supports Japan's food supply, will experience a weakened food supply capacity due to a decrease in the number of agricultural workers. Abnormal weather and natural disasters have also become more severe and frequent, while irrigation facilities are rapidly deteriorating in the snowy, cold climate of Hokkaido.

This research and development program seeks to address these issues and ensure that Hokkaido continues to play a key role in Japan's food supply by developing technologies for the creation and utilization of profitable large-scale farmland, the strategic use and conservation management of irrigation facilities, and the improved resilience of farmland and irrigation facilities to natural disasters and climate change.



Social contribution

Technologies for farmland improvement, adapted to the large-scale division and generalization of farmland in Hokkaido, are proposed alongside technologies to utilize groundwater level control systems, contributing to profitable agricultural production. Elucidating the deterioration mechanisms of irrigation facilities, such as frost damage, as well as developing functional diagnostic methods and high-durability construction strategies, will also contribute to the preservation and longevity of these facilities. Furthermore, proposals for countermeasures against the hydrodynamic pressure generated in agricultural pipes during earthquakes and mitigation measures against soil runoff from farmland due to frequent heavy rain will aid in the construction of an agricultural production base that is resilient to natural disasters and climate change.

Spotlight!

A near-infrared camera was used to monitor moisture, which is related to frost damage in concrete. Laboratory tests employed partial least-squares regression on spectral data in the near-infrared region, enabling accurate estimation of the moisture content in concrete. Outdoor tests confirmed that it was possible to detect the presence or absence of moisture in open concrete channels that could not be seen with the naked eye. This non-destructive, non-contact monitoring technology can streamline the functional diagnosis of irrigation facilities.

Research Teams >> Irrigation and Drainage Facilities Research Team, Rural Resources Conservation Research Team

(15) Study on the Development and Conservation of Fishery Infrastructure of Cold waters that Contribute to Increasing Productivity of Fishery Resources

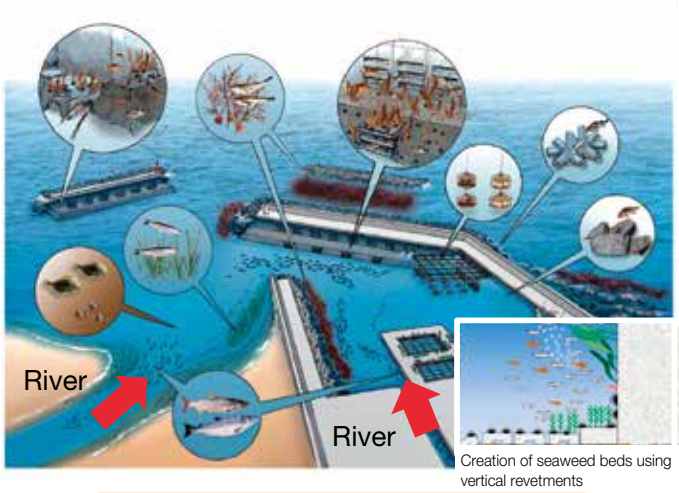
Keywords ▶ seaweed beds, red tide, nutrients, habitat improvement, offshore structures, feed culture effect

Research period: 2022-2027
Program leader: Director of Cold-Region Hydraulic and Aquatic Environment Engineering Research Group

Research summary

Hokkaido is an important base for the fisheries industry, accounting for nearly 30% of the national landing volume. However, in recent years, this has decreased to half of its peak, making the recovery of fishery resources and the maintenance of stable production an urgent issue. In responding to this situation, it is important to properly conserve and manage the fishing environment while considering aquaculture, which contributes to a stable supply of fishery products.

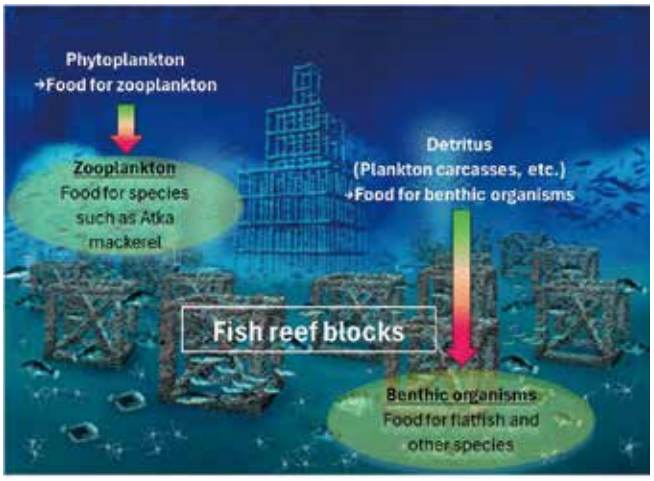
This research and development program develops technologies for the utilization and maintenance of marine structures that will contribute to increased fishery resources in coastal areas, including estuaries and offshore regions.



Creation of seaweed beds using vertical revetments

Improving habitats using fishing port waters

Improvements in the habitats of aquatic organisms can be achieved by developing substrates that contribute to strengthening the protective and nurturing functions of fishing port structures as well as adopting technologies to efficiently absorb nutrients from rivers.



Fishing ground improvement using offshore structures

Fishing grounds can be improved by installing artificial structures that have the effect of enhancing the fishing ground environment, such as feed cultivation, fish swarming, and fish body fattening, for offshore fishing, which accounts for a large part of the fishing production.

Social contribution

The program is contributing to improving fishing productivity by developing technologies to create seaweed beds in fishing ports. These beds can supply microorganisms that suppress the growth of harmful plankton in response to the unprecedented red tide damage occurring in the coastal areas of Hokkaido due to the effects of climate change.

The program also promotes the fishing industry through the appropriate conservation of the fishing ground environment. These conservation efforts nurture fishery resources by improving habitats in cold estuarine coastal areas and establishing evaluation and development methods for fishing grounds based on the enhancement of the fishing ground environment through the installation of offshore structures.

Spotlight!

In the fall of 2021, an unprecedented red tide occurred in the cold seas of Hokkaido's coastal areas, causing large-scale damage to the fishing industry. Meanwhile, recent research has revealed that microorganisms living symbiotically with seaweed can suppress the growth of harmful plankton such as red tides. Therefore, this program aims to develop substrates and verify the harmful plankton suppression effect resulting from the creation of seaweed beds using fishing port facilities, thus enabling a sustainable supply of seafood even as the distribution area of harmful plankton expands.

Research Team >> Fisheries Engineering Research Team, Watershed Environmental Engineering Research Team

08. Dissemination of research results

Publications

We issue reports from PWRI, CERI*, joint research reports, etc.; these are posted on the PWRI website and are generally available for viewing.

▶Research results reports

▶Presented papers and publications database

▶Cold Region Civil Engineering Technology Information Center

*Back issues of the monthly report prior to the December 1989 issue are held by the CERI Information Center.

Publications by Institute

PWRI effectively manages copyrights and strives to disseminate its results. We publish a variety of books, which can be purchased at bookstores.

Inspection and Maintenance Manual for Ground Anchors: Tokyo, Gihodo Shuppan Co., Ltd.

Handbook for Handling Rocks and Soils Containing Naturally-occurring Heavy Metals at construction works: Tokyo, Taisei Shuppan Co., Ltd.

Practical Guide to Water Drainage Boring for Preventing Landslides: Kajima Institute Publishing Co., Ltd.

Numerous other publications

▶Publications

Paper presentations

▶Papers / publications (Tsukuba)

▶Papers / publications (CERI)

We publish approximately 900 papers annually, including those presenes at international conferences and related academic societies, as well as contributions to proceedings and technical journals. More than 200 of these have been peer-reviewed, and we strive to publish high-quality results.

Reflections in standards

The research results are reflected in various standards related to social capital development (see below for an excerpt)

■ Ministry of Land, Infrastructure, Transport and Tourism
- "BIM/CIM Utilization Guidelines (Draft)"

■ Hokkaido Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism
- "Hokkaido Regional Development Bureau Road Design Guidelines"

■ Rural Development Bureau, Ministry of Agriculture, Forestry and Fisheries
- "Land Improvement Project Planning and Design Standards, etc. (and Operation /Commentary (Planning, Design))"

■ Related organizations
- "2022 Enacted Standard Specifications for Concrete Structure [Maintenance and Management]" etc.
  Japan Society of Civil Engineers
- "Technical Standards and Commentaries for Port and Harbors Facilities"
  Ports & Harbors Association of Japan
- "Manual for Dealing with Rocks and Soils Containing Naturally Originating Heavy Metals in Construction Work (2023 Edition)" Revision Committee for the Manual for Dealing with Rocks and Soils Containing Naturally Originating Heavy Metals in Construction Work

PWRI Technology Showcase

▶Event information Tsukuba CERI

The PWRI Technology Showcase is a lecture-style presentation of technologies developed by the Institute, featuring panels and models on display, along with technical consultations available for application to actual work sites. This event is held annually in Tokyo and other locations around the country, allowing direct interaction with engineers in each region and promoting the spread of technologies.

The PWRI Technology Showcase features venues for lectures (a) and exhibitions (b, c, d).
Inquiries regarding the lectures or technical consultations can be addressed to PWRI staff (speakers) directly at the exhibition hall.

PWRI Technology Seminars and site visits

PWRI Technology Seminars carefully select technologies that are highly effective in reducing costs and shortening construction periods, offering lectures on the latest technological trends in the field while providing the detailed technical information necessary to apply the presented technologies on-site. These events occur annually in Tokyo and every other year in Sapporo.
Site visits are conducted whenever possible at locations where the technologies developed by PWRI are actively used, allowing participants to observe the application methods and effects of the technologies and deepen their understanding.

Technology Briefings

Technology briefings are held in snowy and cold regions nationwide, with lectures on topics of interest to engineers in each region. These events facilitate the adaption of new technologies developed specifically for snowy and cold areas and promote public works and other on-site projects.

Engineer Exchange Forums

The Engineer Exchange Forum is held annually in various locations throughout Hokkaido for engineers active in the region. The aim is to disseminate technologies developed by the CERI and share the latest technical information. (Co-hosted by “Development and Construction Departments of Hokkaido Regional Development Bureau” and “Hokkaido branch of The Institution of Professional Engineers, Japan”)

09. Technologies used on-site

Since its establishment, PWRI has actively applied its research findings and technical expertise to practical fields. This section highlights technologies recognized for their outstanding results and contributions, technologies addressing critical social issues, and recent innovations that PWRI is prioritizing for widespread implementation.

100 years of implementation!

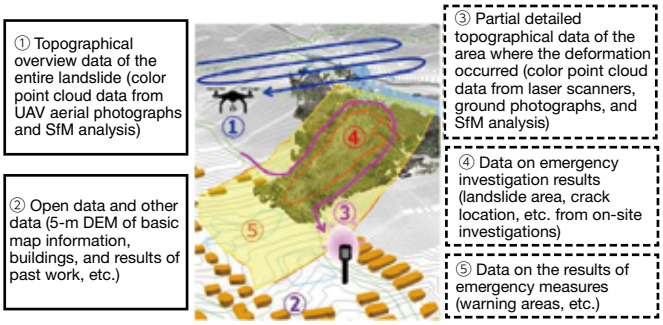
Next-generation disaster response using 3D virtual disaster sites: BIM/CIM model for landslide disaster response

An essential component of landslide disaster response is ensuring effective collaboration among relevant organizations by sharing a comprehensive understanding of the disaster. To address this need, we developed a 3D model, the “BIM/CIM model for landslide disaster response,” which virtually replicates the disaster site. This model is created using color point-cloud data generated from UAV-captured photographs, enabling rapid visualization and communication of the disaster's overall scope.

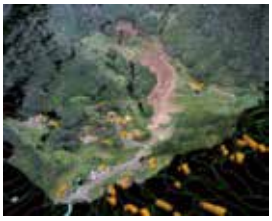
This technology has been successfully implemented in real disaster scenarios, such as the heavy rain event in July 2020, significantly enhancing the efficiency of technical support. In recognition of these advancements and their contributions to the construction field, the institute received the prestigious 24th Land Development Award.

Press conferences using BIM/CIM models

It is expected that understanding of the landslide disaster situation will be improved and communication will be accelerated through the utilization of BIM/CIM models in press conferences, meetings with stakeholders, and public information sessions.



BIM/CIM model configuration for landslide disaster response



Overall understanding from a bird’s eye view

At-a-glance understanding of the overall situation and ability to check even when a bird's eye view is difficult to realize during on-site investigations

Detailed analysis from a bug’s eye view

Clear observation of detailed situation of each part and the ability to check places that are dangerous and cannot be approached during on-site investigations

Reproduction of virtual site on a computer

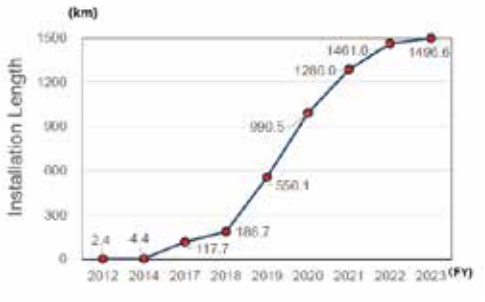
Wire rope barriers that reduce impact of vehicle collisions

Wire rope barriers have thin posts that reduce the impact of vehicle collisions. Moreover, they require only a narrow space for installation. Thus, they have become the standard lane divider for earthwork sections of temporary two-lane sections of expressways. The results of developing specifications for existing bridges and concrete pavements have also led to the installation of approximately 1,500 km of barriers as of the end of March 2024. In the 743 km of road on which these barriers were installed, nine fatal accidents were caused by vehicles crossing into the oncoming lane in the year before installation; however, not a single such accident occurred in the five years after installation, confirming the high safety of the barriers.

This technology was awarded the 20th Land and Infrastructure Technology Development Award for Excellence in recognition of its widespread use in temporary two-lane sections of expressways nationwide and its contribution to the development of excellent new technology in the field of traffic safety. In 2019, it received the Japan Society of Civil Engineers Technology Development Award.

Installation status: Hamada Expressway

Performance verification test (large vehicles)



Length of sections on which wire rope barriers were installed (PWRI survey)

Addressing the shortage of flow observation workers: non-contact flow meter

In recent years, floods have become more severe, and localized heavy rains have occurred with increasing frequency. Simultaneously, a decline in the number of river observation engineers has raised issues such as time constraints during observations, increased burdens on observers (e.g., nighttime responses), and challenges in maintaining observation systems due to the shortage of experienced personnel. To address these challenges, a “non-contact flow meter” was developed, which utilizes the Doppler effect of radio waves directed at the river water surface to measure surface flow velocity without physical contact. Flow rates can be measured remotely and automatically by applying a correction coefficient and the river cross-section to the measured flow velocity. Consequently, the need for securing personnel, as required in conventional float observations, has been eliminated. By the end of FY2023, this technology had been implemented at more than 20 locations, contributing significantly to the establishment of a sustainable flow observation system.

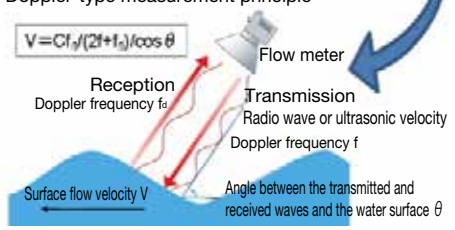
Types of non-contact flow meters

○Use of the Doppler effect
- Radio wave flow meter (microwave)
- Ultrasonic flow meter

Installation status of equipment

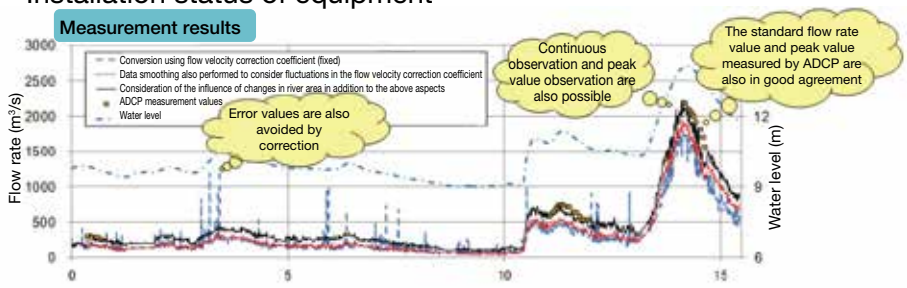
Measurement method

Doppler-type measurement principle



Measurement mechanism of the non-contact flow meter

Measurement results



Concrete Structure Repair Measures Construction Manual 2022 Edition

This manual summarizes key considerations for setting repair policies for concrete structures and selecting appropriate repair methods. Additionally, it provides an organized overview of methods for verifying the quality of repair materials and highlights critical aspects to consider during construction for representative repair measures, including surface coating / impregnation methods, concrete restoration methods, and crack repair methods. Case studies of malfunctions after repair are introduced and referenced in the creation of the manual.

The 2022 edition comprises a common section, a section dedicated to individual repair methods, and a collection of post-repair defect cases. This edition also incorporates new insights on silane-based surface impregnation materials and concrete restoration methods, which are expected to contribute to the effective maintenance and management of concrete structures.

Common section : Selection of Appropriate Repair Methods

- Surface coating / impregnation methods section — Key considerations for executions
- Concrete restoration section — Key considerations for quality control
- Crack repair section — Key considerations for quality control and executions

Specifying the selection of materials and methods for various repair techniques, along with key points for executions

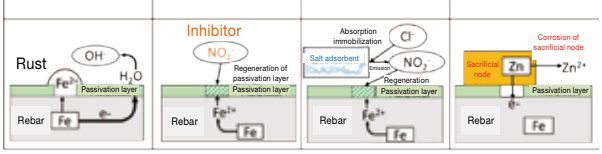
Case studies of malfunctions after repair

Manual composition

Concrete restoration section

■ Evaluation methods for wet and dry spraying repair and key considerations for preparing specimens

■ Characteristics and considerations of various steel corrosion protection methods



■ Method for improving brittle regions of concrete substrate

Major revisions (**concrete restoration method**)

Determining the presence of fish from a bucket of water: Standardization of biological surveys using environmental DNA technology

The National Census on River Environment (hereinafter referred to as NCRE) , primarily conducted by the Ministry of Land, Infrastructure, Transport and Tourism, has initiated the use of environmental DNA technology for fish surveys that were previously carried out by capture survey. In order to practically use of environmental DNA, it is important to be able to compare survey results and accumulate data, regardless of the environmental conditions of the survey area or the survey implementation system. PWRI conducts research focusing on the application of environmental DNA technology at river management sites with diverse environmental and implementation conditions. Since 2020, PWRI has conducted environmental DNA surveys at approximately 3,000 nationwide locations in collaboration with regional development bureaus.

PWRI has utilized these results as a foundation to collaborate with other ministries and national research institutes, including the NCRE, where the introduction of environmental DNA technology is being considered for FY 2026. These collaborations aim to establish standardized survey implementation procedures essential for applying environmental DNA technology at river management sites and to provide the technical contributions necessary for the social implementation of environmental DNA technology in rivers.

Previous surveys involving direct capture

Fish are directly captured, and species are identified based on morphological characteristics (appearance)

Survey using environmental DNA

A species list is created by matching DNA information obtained from fish tissue fragments in the water with a DNA database

Environmental DNA

Does not involve direct capture of fish

No harm to fish or disturbances to their habitat

On-site work is limited to water sampling

Multi-site surveys possible

High detection sensitivity

Detection possible even with small numbers of individuals

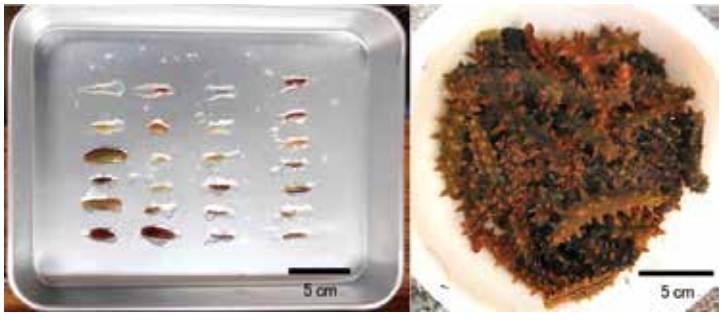
Cradle for Sea Cucumbers (intermediate rearing reef for sea cucumbers)

Japanese sea cucumbers, particularly those from Hokkaido, are considered the highest quality in the world and represent an important export fishery product. However, resource depletion remains a significant issue, prompting vigorous efforts to restore these resources through artificial seed release. To enhance the effectiveness of seed release for sea cucumbers, an intermediate rearing reef known as the Cradle for Sea Cucumbers was developed. This technology significantly improves survival and growth rates after release. It not only protects sea cucumber nursery stock from predators in the natural environment but also incorporates an internal structure optimized to reduce physical stress and provide a conducive feeding environment.

The newly developed Cradle for Sea Cucumbers is anticipated to serve as an extremely effective site for releasing and cultivating sea cucumbers. Furthermore, it is expected to contribute to the recovery of sea cucumber resources, boost production, and facilitate the revitalization of coastal areas and fishing communities as a whole.

Exterior of the Cradle for Sea Cucumbers

*Covering it with a protective net (left) protects the young sea cucumbers living in the main block (right) from predators



Sea cucumber nursery stock before release (left); Released nursery stock grown in the reef (right)

Patent No. 7298829: “Rearing reef for young sea cucumbers”

10. Provision of technologies

Technological support during disasters

▶Disaster support

Japan experiences significant human and material damage from natural disasters such as earthquakes, heavy rains, sediment-related disaster, and heavy snow. PWRI establishes disaster response headquarters immediately after a disaster occurs to respond promptly and accurately to disaster dispatch requests from national and local governments. Upon receiving requests for disaster relief from managers of affected facilities or other relevant authorities, the institute dispatches staff to the site to assess the actual damage and provide advanced technical guidance for restoring damaged infrastructures.

Heavy rain in July 2020: Sediment-related disaster investigation in Sasebo City (photographed on July 17, 2020)

June 2021 rock slope failure on National Route 229: On-site meeting with road administrators (photographed on June 7, 2021)

Heavy rain on July 1, 2021: Damage investigation at Kise River Bridge (photographed on July 6, 2021)

August 2022 slope collapse on National Route 277: On-site investigation of the mechanism of the surface collapse (photographed on August 17, 2022)

Total of 274 people/day dispatched (as of May 1, 2024)

January 1, 2024: response to reports on ground damage from the Noto Peninsula earthquake of 2024, tunnel damage investigation with the Self-Defense Forces (photographed in January 2024)

March 2023 avalanche disaster on National Route 40: Technical advice to road managers (photographed on March 9, 2023)

Technological guidance on general civil engineering

Even in the absence of disasters, the PWRI provides technical guidance at the request of national and local governments, etc., with the aim of supporting the resolution of problems related to civil engineering technology and agriculture, fisheries, and ports in cold regions.

We also participate in technical committees for various government agencies and relevant academic societies, where we offer technical support. The knowledge and research results accumulated by PWRI have been reflected in the formulation and revision of various technical standards.

Technical guidance for river managers on the upstream migration function of fishways

Technical guidance on pole-free construction

Please visit the website for inquiries about general technical guidance on civil engineering technology

▶Tsukuba Central Research Institute, ICHARM, CAESAR, iMaRRC

▶Aqua Restoration Research Center

▶Civil Engineering Research Institute for Cold Region

Lecturer dispatch

Lecturers are dispatched at the request of each institution, including the College of Land, Infrastructure, Transport and Tourism; regional development bureaus; the Hokkaido Regional Development Bureau; local governments; universities; and other organizations for lectures aimed at the general public. These lecturers strive to teach and disseminate civil engineering technology.

Seminar for civil engineers (on-site seminar at the Civil Engineering Research Institute for Cold Region)

Outreach lectures

PWRI conducts “outreach lectures” where staff members visit elementary and junior high schools and various public facilities to give easy-to-understand lectures on their areas of expertise.

▶How to use outreach lectures

Outreach lecture at a junior high school (students mixing concrete)

11. International contributions

PWRI utilizes civil engineering technology cultivated under Japan's unique natural and geographical conditions to actively promote research activities and local practical efforts, as well as collaborate with international organizations and research institutes in Asia and other countries worldwide. To this end, the institute conducts joint and cooperative research with overseas research institutes based on science and technology cooperation agreements to enhance the quality of our results. PWRI also actively participates in international conferences and other events to promote the dissemination of technology.

Here, we introduce examples of the international contributions of PWRI from the perspectives of “promoting technology dissemination,” “building international networks,” “human resources development,” and “technical support overseas.” We will continue to work on international contributions in the future, so please keep an eye on the activities of PWRI.

Dissemination of technology and building international networks

PWRI staff members participate as experts and committee members on technical committees of international organizations such as the ISO (International Organization for Standardization) and PIARC (World Road Association) on behalf of Japanese engineers and researchers. PWRI shares its knowledge and technology with the international community through these activities and contributes to strengthening Japan’s international competitiveness.

In particular, the International Centre for Water Hazard and Risk Management (hereinafter, ICHARM; see p. 15), which part of PWRI, had recently the opportunity to share the results of its yearlong activities with the world, as follows.

The 4th Asia-Pacific Water Summit was held in Kumamoto City on April 23–24, 2022. ICHARM was responsible for planning, managing, and coordinating the “Water and Disaster / Climate Change” session, the special session “Showcase,” and the integration session “Science & Technology.” Furthermore, in each session, ICHARM proposed three principles for cross-sectoral collaboration: ① promoting the integration of knowledge of the water cycle, ② developing facilitators, and ③ an end-to-end approach; these principles were reflected in the Chair's Summary.

ICHARM also hosts international conferences. On February 18–22, 2023, ICHARM hosted the 9th International Conference on Flood Management (ICFM9) in Roppongi, Tokyo, and Tsukuba, and compiled the “Statement of ICFM9” as a milestone toward the UN Water Conference described below.

Finally, at the United Nations 2023 Water Conference, held at the United Nations Headquarters in New York on March 22–24, 2023 for the first time in 46 years, the three principles advocated by ICHARM were included in the co-chairs’ proposal for Interactive Dialogue 3, “Water for Climate, Resilience, and Environment.” The summary by the President of the UN General Assembly, published after the conference, highlighted the Water Cycle Integrator (WCI), which ICHARM advocated by integrating the three principles, demonstrating ICHARM's presence in the international community.

Group photo of participants at Session 1 “Water and Disaster/Climate Change”, 4th Asia-Pacific Water Summit

UN 2023 Water Conference: Interactive Dialogue 3 “Water for Climate, Resilience and Environment” (Provided by the Ministry of Land, Infrastructure, Transport, and Tourism)

Human Resources Development

PWRI (e.g., ICHARM) endeavors to develop administrative officials from each country by sending lecturers to specialized civil engineering training courses organized by the Japan International Cooperation Agency (JICA) and accepting more than 300 trainees in civil engineering fields each year (excluding the COVID-19 period) from Asia, Africa, Latin America, and other regions. The trainees visiting the institute will have access to the experimental facilities actively engaged in technological development and will learn about Japan's cutting-edge technologies from staff with extensive experience in research and development, technical consultation, disaster response, and the formulation of technical standards.

ICHARM also offers a one-year master's course called the Water-Related Disaster Management Course of Disaster Management Policy Program in cooperation with the National Graduate Institute for Policy Studies (GRIPS) and JICA. It also offers a three-year doctoral course called the Disaster Management Program jointly with GRIPS. After completion of the courses, ICHARM hold annual follow-up seminars for trainees who have returned to their home countries, both domestically and overseas, to provide ongoing support.

The Disaster Management Policy Program was awarded the JAPAN Construction International Award (Minister of Land, Infrastructure, Transport and Tourism Award) in June 2023 in recognition of its activities.

Experimental facility tour
(Dominican Republic administrative staff)

Field visit of the Disaster Management Policy Program

Technical support overseas

At the request of JICA, the government, overseas research institutions, and other organizations, we send staff overseas to disseminate the knowledge that PWRI has accumulated over the years, as well as the latest research results and technologies.

In response to the damage caused by the earthquake that occurred in southeastern Turkey in early February 2023, JICA dispatched staff to Turkey as members of the JICA Japan Disaster Relief Expert Team in response to a request for assistance from the Turkish government to the Japanese government. As soil and ground experts, the team inspected the condition of damaged buildings and infrastructure and provided technical advice for recovery and reconstruction.

Staff members were also dispatched to JICA's field survey team on “Michi-no-Eki” (a Japanese roadside facility model) implemented in Guatemala and Paraguay in February 2023. The staff members provided technical support to “Michi-no-Eki” model and related parties with the aim of introducing this concept. This support included seminar presentations and assistance with the formulation of action plans.

ICHARM is also actively providing technical support. Please refer to p. 15 for an introduction.

Lecture at the Roadside Station Seminar

Damage survey of buildings on soft ground (provided by JICA)

12. Collaboration with other organizations

PWRI is a leader in management that creates an environment fostering globally innovative research and development, primarily in the field of civil engineering, which is widely engaged and whose results are implemented. To achieve this, the institute has established and operates a platform where various individuals and organizations (industry, academia, and government), in addition to PWRI, can play an active role and produce results. With that goal in mind, funds from the government and other sources will be properly managed and utilized, and the institute's ability to lead the creation of the aforementioned environment will be developed and enhanced in cooperation with relevant organizations in industry, academia, and government from the perspectives of technology development as well as business, systems, social acceptance, and human resources.

This includes not only the joint research promoted by PWRI but also new developments (such as its role in SIP and SBIR (see p. 45)). Contributions will be directed toward making PWRI a hub in the industrial, academic, and government network of civil engineering, as well as a place where diverse researchers and engineers can grow in various ways.

Collaboration with domestic organizations

▶PWRI joint research

▶CERI joint research

PWRI seeks to maximize Japan's overal research and development outcomes including those from universities, private businesses, and other institutions. It aims to achieve this by promoting research and development while integrating technical expertise from other fields by fostering appropriate collaboration with domestic and international public research institutions, universities, and private research entities through regular information exchanges, active implementation of joint and cooperative research, and personnel exchanges, according to the characteristics of the research and development.

"Researchers from Japan are also actively welcomed based on the exchange researcher system and other programs."

Collaboration with international organizations

Collaboration and research cooperation with overseas research institutions and other organizations are carried out based on science and technology cooperation agreements. Engineers and researchers are actively exchanged, international conferences are held, and collaboration with overseas organizations is encouraged.

Fellowship programs and other methods are also actively utilized to accept outstanding researchers from abroad and send PWRI staff overseas.

Acquisition of competitive funds

PWRI is proactively striving to acquire external funds, such as competitive research funding, by collaborating with other research institutions and submitting strategic applications.

In addition to the Grants-in-Aid for Scientific Research (KAKENHI), the institute is proactively securing funds from the Ministry of Land, Infrastructure, Transport and Tourism's River Erosion Control Technology Research and Development System, the Cabinet Office's "Strategic Innovation Promotion Program (SIP) 3rd Phase," and other programs.

Funding name	Distributing agency	Project name
Science and Technology Research Partnership for Sustainable Development (SATREPS)	Japan Science and Technology Agency (JST)	Numerical Weather Prediction and Warning Communication System for Densely Populated and Vulnerable Cities (SATREPS)
3rd Research Announcement on the Earth Observations (EO-RA3)	Japan Aerospace Exploration Agency (JAXA)	Improving regional ensemble precipitation forecasts by assimilating land cloud water volume using AMSR microwave radiometer data
Moonshot R&D Program	Japan Science and Technology Agency (JST)	Research and development of open middleware to be installed in collaborative AI robots
Earth Observation Technology Research and Development Commission Project	Ministry of Education, Culture, Sports, Science and Technology (Contractor: Kyoto University)	Development of comprehensive hazard prediction models
Strategic Innovation Promotion Program (SIP)	Cabinet Office (the research promotion organization:National Research Institute for Earth Science and Disaster Resilience	Development of algorithms for remote control and automation of sluice gates, etc.
	Cabinet Office (the research promotion organization:PWRI	Establishment of an open research and development environment for automated construction machinery
River machinery equipment innovative technology research and development	Ministry of Land, Infrastructure, Transport and Tourism	Research and development of mass product type drainage pump equipment (high output type)
FY2023 River erosion control technology research and development		Project to accelerate nationwide deployment of IDR4M
Model demonstration to promote utilization of sewage sludge resources	National Agriculture and Food Research Organization	Elucidation of the fertilizer effectiveness characteristics of sludge fertilizer and construction and demonstration of a fertilizer effectiveness visualization system
Environmental Research and Development Fund	Environmental Restoration and Conservation Agency	Evaluation of the impact of exposure to microplastics via water and bottom sediment on marine life
FY2022 River erosion control technology research and development open call for applications in regional issue field (river ecology)	Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism	FY2023 Research on the conservation and creation of habitats for biodiversity and their evaluation from the perspective of river basin flood control
Grant-in-Aid for Scientific Research	Japan Society for the Promotion of Science	Research on the process of sediment and driftwood runoff in river basins during heavy rainfall
		River landscape genetic modeling using environmental DNA to contribute to the evaluation of habitat network fragmentation
		Development of sustainable recycling technology to rejuvenate aged asphalt by hydrothermal decomposition

Project management

PWRI manage entire projects. Solving social problems in recent years has required entrusting research to various organizations across fields to implement excellent research and development results in society; this has entailed reliably managing complete projects.

Cross-ministerial Strategic Innovation Promotion Program (SIP)

Cross-ministerial Strategic Innovation Promotion Program (SIP)

SIP is a national project established by the Cabinet Office Council for Science, Technology and Innovation to realize science and technology innovation through management that transcends the boundaries of ministries and traditional fields.

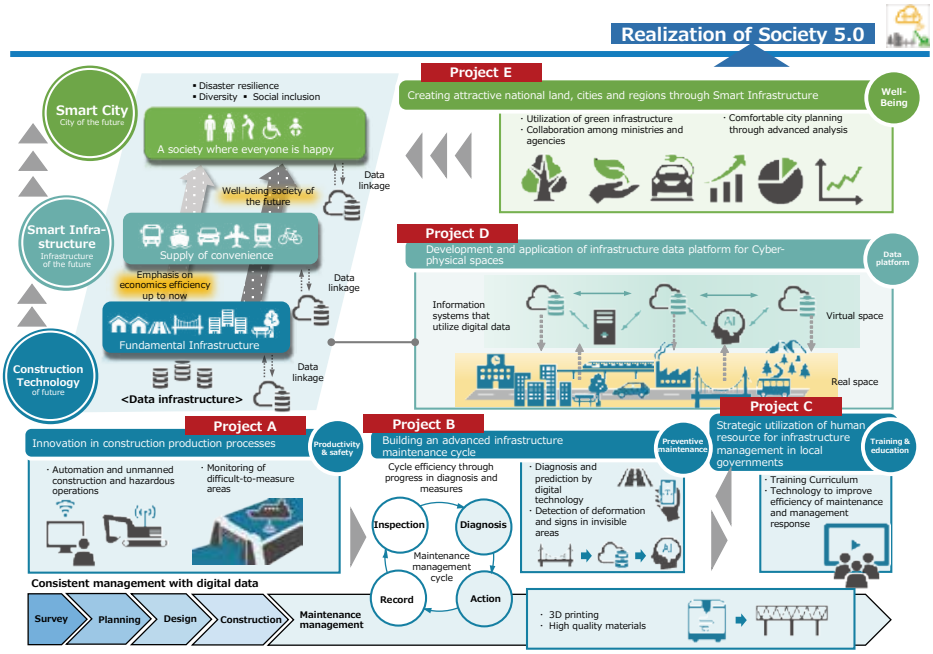
PWRI is in charge of the research promotion organization for the third phase of SIP

▶Cabinet Office SIP

▶PWRI SIP Research Promotion Office

"Construction of a Smart Infrastructure Management System"

PWRI, which serves as the research promotion organization for this theme, utilizes its own knowledge and network as a research promotion organization to support the business under the guidance of Program Director Makoto Hisada (Director of the Center for Infrastructure Management Research, Graduate School of Engineering, Tohoku University). The Strategic Innovation Research Promotion Office is the base for fulfilling this role as a research promotion organization.



Against the backdrop of the continuing deterioration of Japan's vast infrastructure and buildings, this theme involves the use of digital technology to comprehensively manage everything from design to construction, inspection, and repair; the establishment of a system that promotes the development of sustainable, attractive, and resilient land, cities, and regions; and engagement in technological research and development to achieve efficient infrastructure management. Because we are also involved in SIP research (p. 44), to avoid conflicts of interest, we have established a separate organization (Strategic Innovation Promotion Office: Akihabara) to carry out the work of the research promotion corporation; full-scale operations commenced in July 2023.

Small/Startup Business Innovation Research (SBIR)

Small/Startup Business Innovation Research (SBIR)

The SBIR system aims to promote research and development by startups and other businesses and smoothly implement the results in society, thereby promoting the creation of innovation in Japan.

PWRI serves as the operational support organization for the **"Disaster Prevention and Infrastructure Management"** field within the 'SBIR Phase 3 Fund Project' of MLIT(Ministry of Land, Infrastructure, Transport and Tourism).

▶Cabinet Office SBIR

Innovation Research Aid for Infrastructure Management (IRAIM)

Innovation Research Aid for Infrastructure Management (IRAIM)

This is a commissioned research program established by the National Research and Development Agency to support and promote innovative industry-academia research and development on infrastructure that contributes to national resilience and productivity improvement.

PWRI has been accepting applications for this program since FY2019.

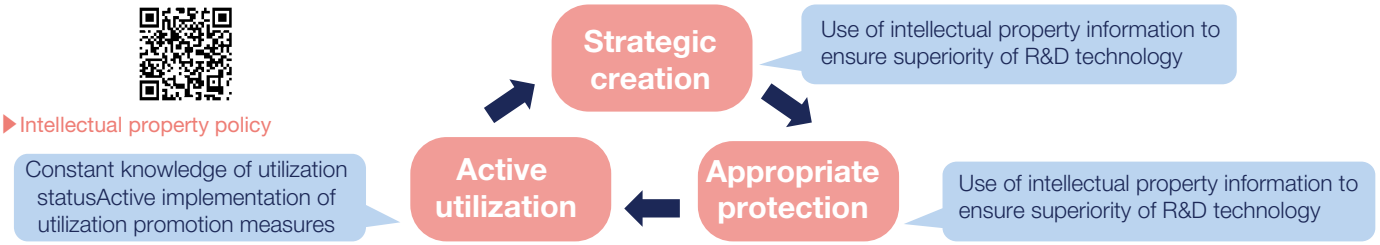
▶Innovation Research Aid for Infrastructure Management (IRAIM)

13. Intellectual property policy and utilization

PWRI manages intellectual property appropriately in accordance with its intellectual property policy and takes strategic, and proactive measures to maximize value for society as a whole.

Concept of the intellectual property policy

▶Intellectual property policy



Intellectual property rights are listed on the websites of PWRI and CERI.

Industrial property rights such as patents
Tsukuba Central Research Institute ICHARM, CAESAR, iMaRRC
Civil Engineering Research Institute for Cold Region

Program works and guidelines, etc.
Tsukuba Central Research Institute ICHARM, CAESAR, iMaRRC
Civil Engineering Research Institute for Cold Region

Institute works
See also p. 41

We are actively promoting the research and development outcomes, focusing on technologies that have added value through the acquisition of intellectual property rights, enabling them to be widely disseminated and utilized in society.

We are seeking partners who can develop, manufacture, and sell products to utilize unused patents, among other intellectual property with us.

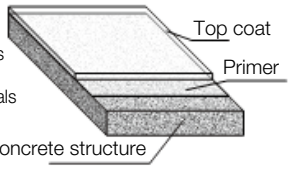
We will actively follow up through the research consortium until the developed technology is supplied to the field and becomes self-sufficient.

Examples of industrial property rights

[Transparent surface coating method for concrete]

Patent No. 6335092
Patent No. 6921713

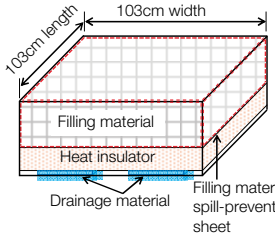
Repair technology for structures that allows the progression of cracks to be visually observed using transparent coating materials and protects the concrete surface from deterioration factors



[One-pack heat insulator gabion]

Patent No. 7142304

A new frost-heave prevention measure that is expected to reduce frost-have damage on cut slopes, reduce the labor required for maintenance, and improve workability and safety.



Standard cross-section of the one-pack heat insulator gabion

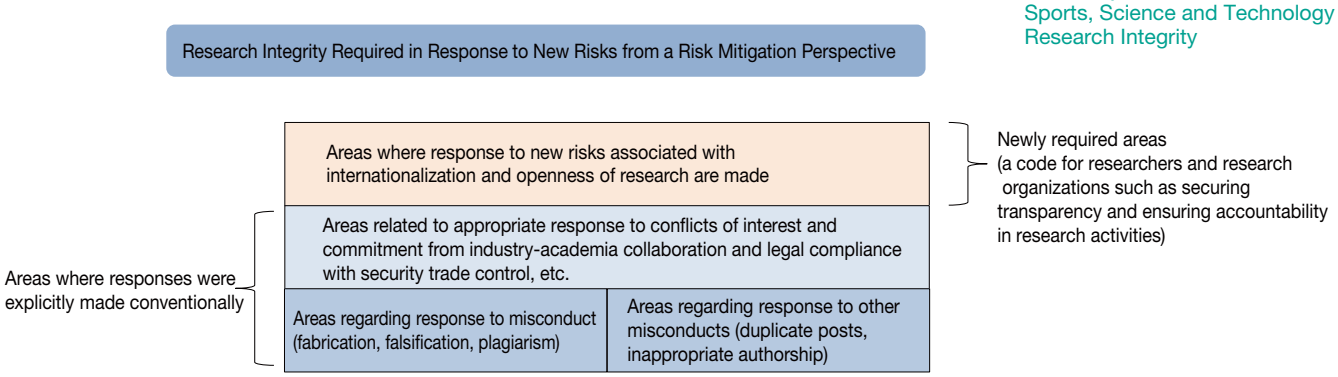
Construction status of the one-pack heat insulator gabion

For an overview of each item of intellectual property and its use, please contact the appropriate department:
Construction Technology Research Department, TEL 029-879-0884: Tsukuba Central Research Institute, ICHARM, CAESAR, iMaRRC
Cold-Region Technology Promotion Divisions, TEL 011-590-4046: Cold Region Engineering Research Institute

14. Ensuring research integrity

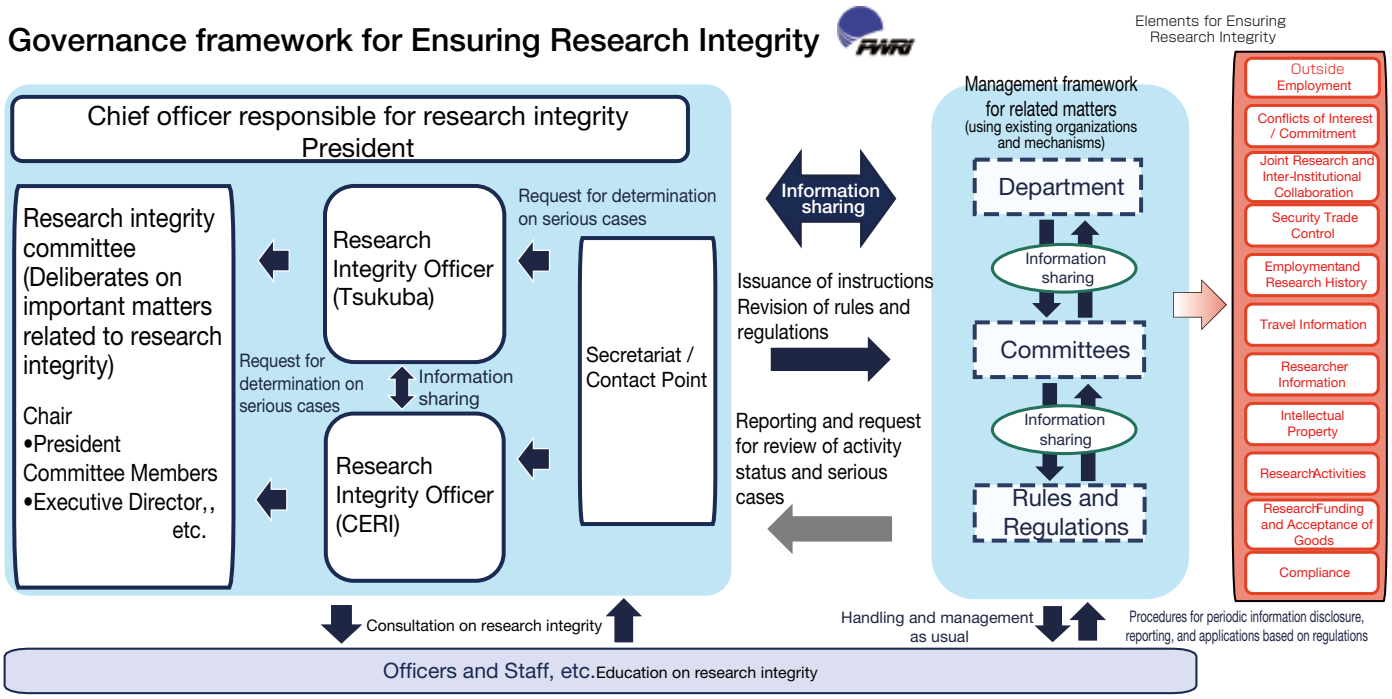
Promoting science, technology, and innovation in Japan necessitates a vigorous promotion of international collaborative research with diverse partners, with open science as the fundamental principle. Establishing a reliable international research environment is essential for advancing necessary international cooperation and exchange while safeguarding the values that underpin the research environment. The Integrated Innovation Strategy 2020 (Cabinet decision on July 17, 2020) and the Basic Plan for Science, Technology, and Innovation (Cabinet decision on March 26, 2021) were formulated considering this situation, and the government is supporting researchers, universities, research institutions, and other organizations to autonomously ensure the integrity and fairness of research (research integrity).

▶Ministry of Education, Culture, Sports, Science and Technology Research Integrity



Reprinted from the Ministry of Education, Culture, Sports, Science and Technology website

PWRI has aimed to ensure research integrity by establishing the necessary regulations related to the internationalization and openness of research activities. Therefore, the following management system has been established.



15. Public access

Public Works Research Institute (Tsukuba)

PWRI (Tsukuba) collaborates with the National Institute for Land and Infrastructure Management to hold an open day for the public in conjunction with Science and Technology Week (April) and Civil Engineering Day (November 18). Recent civil engineering technology and the mechanisms of disaster occurrence are introduced through hands-on events and demonstration experiments. A bridge contest is held on Civil Engineering Day in cooperation with the Tsukuba City Board of Education to award bridges created by elementary school students.
Facility tours are also conducted periodically to introduce the experimental facilities while explaining research cases. Please check the website for details.

Experience with remote operation technology that allows construction work to be performed safely at dangerous sites

Explanation of how to protect the safety of familiar structures at a bridge health inspection experience booth

Explanation of the difference in fuel efficiency of automobiles depending on the mixture ratio of road pavement materials

Civil Engineering Research Institute for Cold Region

The Civil Engineering Research Institute for Cold Region has held an open day every July since 1983 in conjunction with Land, Infrastructure, Transport, and Tourism Day to allow the general public and children to better understand the role of the institute, its research results, and its current research themes. Each year, each team presents an elaborate exhibition that aims to introduce research in a manner that is enjoyable, fun, and hands-on.

Promoting interest in and understanding of civil engineering by giving the general public and children the opportunity to experience various civil engineering techniques (photo left: experience making things with cement, photo center: experience inspecting a bridge by tapping, photo right: touching sea creatures while learning about creatures that live in fishing ports)

Aqua Restoration Research Center

The Aqua Restoration Research Center in Kakamigahara, Gifu Prefecture, is open to the public, welcoming visitors interested in river environments. To date, over 40,000 people from Japan and abroad have visited the center, attending specialist lectures on ongoing research and techniques for preserving and restoring river environments, and exploring the center's experimental streams.
The center offers guided tours conducted by staff members, which require advance reservations. For more details, please visit the center's website.

An introduction to the latest research in Japanese river restoration for biodiversity enhancement, presented to visitors from the UK. (Photo: A movable weir inducing flooding in an experimental stream)

Hands-on environmental education for elementary school students in experimental streams.

▶Aqua Restoration Research Center website (application for guided tour)

16. Lease system of facilities

PWRI rents facilities to effectively utilize its experimental facilities and equipment while promoting research and development at other institutions. Generally, the institutions eligible to rent are national institutions, local governments, universities, public interest corporations, and private research institutes. Many facilities and specialized civil engineering testing equipment, which are expensive and challenging for private businesses to maintain, are available. We can also rent out equipment in fields beyond civil engineering, so please take advantage of our services.

Example of lease

Tsukuba

Sapporo

Civil engineering-rated experimental research

Testing using wheel load running test machines

Testing using the cold-region test track in Tomakomai (Tomakomai city)

Other experiments

Testing using a large three-dimensional vibration table

Testing using a large flat water tank

Other facilities for lease *Various other civil engineering test machines

30 MN large structural component universal testing machine	Earthwork experiment facility
Component seismic strength experiment facility	Flow meter inspection facility
Large dynamic centrifugal loading test equipment	Hydraulic experiment facility
Embankment experiment facility	Pavement test field

Wind tunnel experimental station (at the Ishikari experiment site)	Cold-region test track (at the Ishikari experimental site)
Ishikari hydraulic experimental station	Impact acceleration tester
Centrifuge	Irregular oscillatory water tunnel
Raveling testing machine	Wheel tracking test machine

Overview of all facilities available for rental, schedule, and contact information ▶

Specific procedures, forms, regulations, etc. are posted on the website

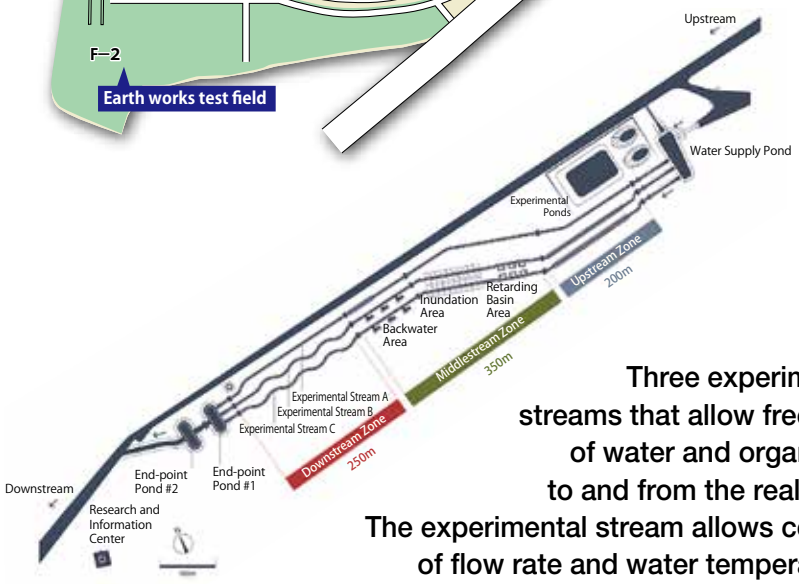
Check website → Application → Acceptance → Loan approval → Contract → Loan

17. Facility introduction

- Tsukuba Central Research Institute
- International Center for Water Hazard and Risk Management
- Center for Advanced Engineering Structural Assessment and Research
- Innovative Materials and Resources Research Center
- Aqua Restoration Research Center
- Snow Avalanche and Landslide Research Center

Contributing to the Majority of MLIT-Managed Dams!

The site area is approximately the size of 27 Tokyo Domes



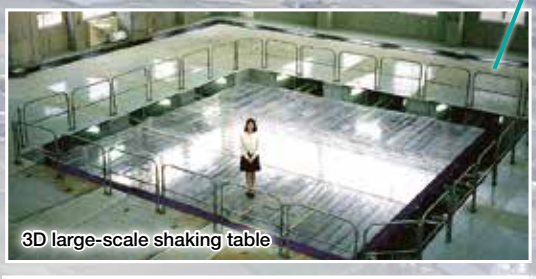
Three experimental streams that allow free flow of water and organisms to and from the real river. The experimental stream allows control of flow rate and water temperature.

Aqua Restoration Research Center (Kakamigahara, Gifu Prefecture)

One of World's Largest!


Loading test equipment for tunnel lining


30 MN large-scale universal test machine


3D large-scale shaking table

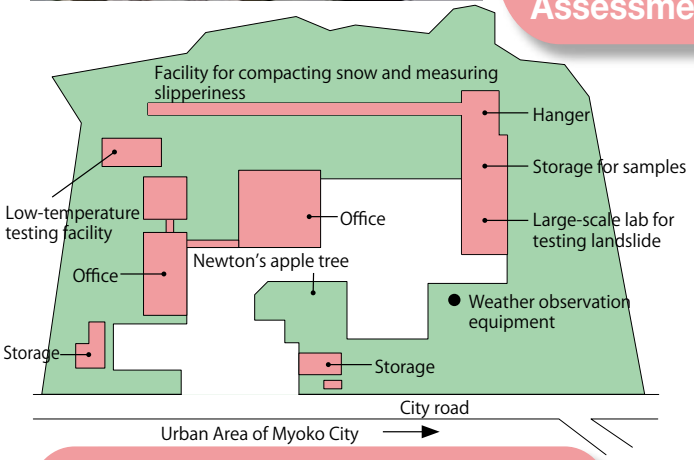

Wheel running machine

International Center for Water Hazard and Risk Management

Tsukuba Central Research Institute

Center for Advanced Engineering Structural Assessment and Research


Earth structure laboratory

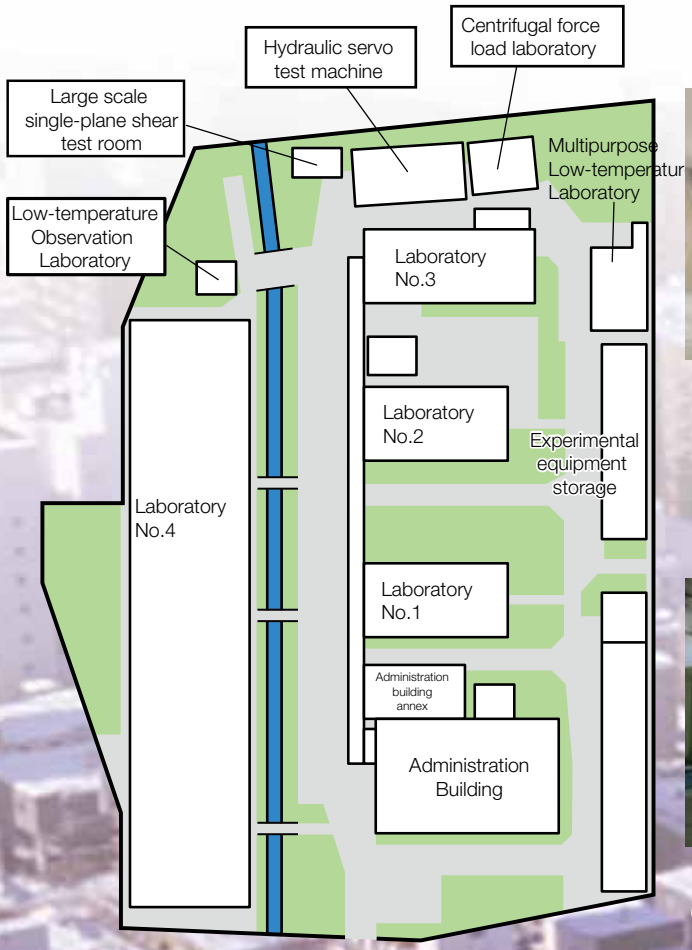


Snow Avalanche and Landslide Research Center


Large-scale Geotechnical Dynamic Centrifuge

One of World's Largest!

Civil Engineering Research Institute for Cold Region



Centrifuge (centrifugal force load laboratory)

Irregular oscillatory water tunnel (multipurpose low-temperature laboratory)

Concrete combined-deterioration accelerating test apparatus (experimental equipment storage)

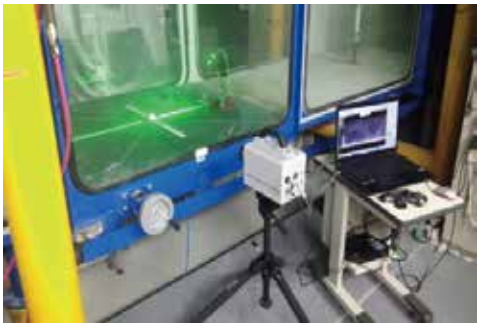
Frost heave determination test device (Laboratory No.2)

Off-Site facilities

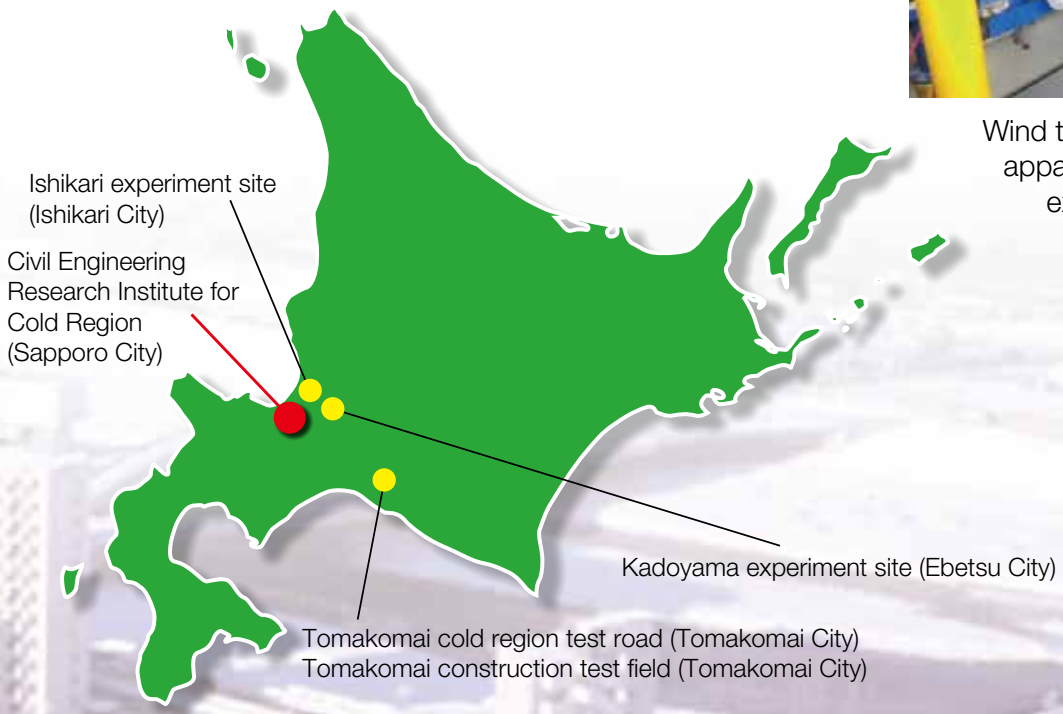
Ishikari experiment site

Ishikari hydraulic experiment site waterway (at the Ishikari experiment site)

Cold-region test track (at the Ishikari experiment site)



Wind tunnel experimental apparatus (the Ishikari experiment site)



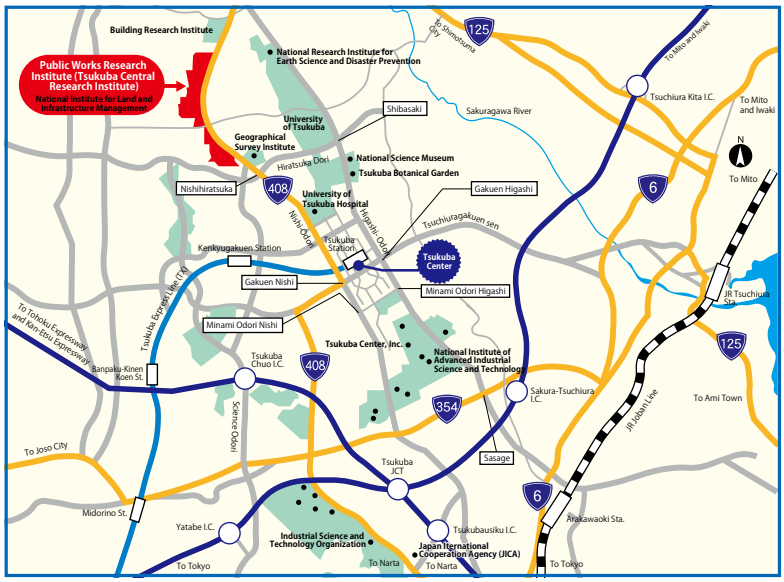
Cold-region test track in Tomakomai (Tomakomai city)

Construction Test Field in Tomakomai (Tomakomai City)

Kakuyama experiment site (Ebetsu City)

18. Guide to the Public Works Research Institute

Tsukuba Central Research Institute / ICHARM / CAESAR / iMaRRC

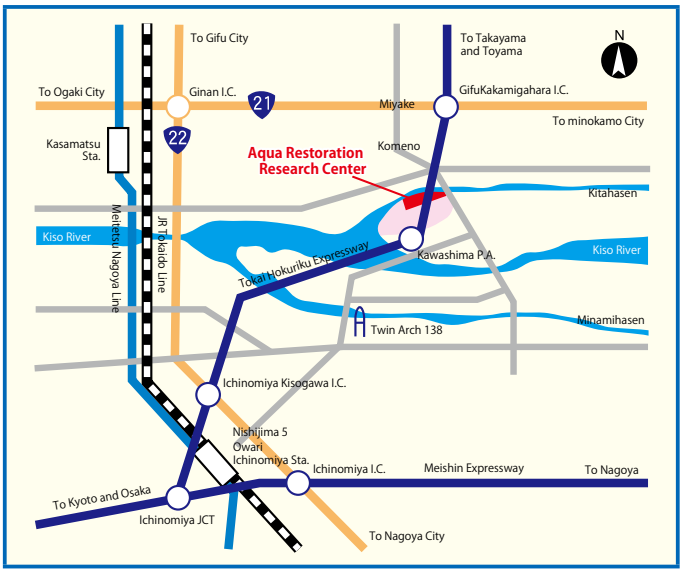


Train	Akihabara Sta.	Tsukuba Express Line (approximately 50 minutes by semi-rapid)			Kenkyu-Gakuen Sta.	Tsuku-bus [Yoshinuma Shuttle] (approximately 20minutes)
		Tsukuba Express Line (approximately 45 minutes by rapid) Tsukuba Sta.			Tsukuba Sta. (Tsukuba Center)	Kantetsu Bus, Gate No. 5 bound for Shimotsuma Sta. or Kenchiku Kenkyusho /Building Research Institute (approximately 25 minutes)
	Ueno Sta.	JR Joban Line (approximately 60 minutes)	Hitachinoushiku Sta.	Kantetsu Bus bound for University of Tsukuba (approximately 35minutes)		
Highway Bus	Tokyo Sta.	At Tokyo Station, go to bus gate No. 2 Yaesu South exit. Take Tokkyu (express) Tsukuba-Go bound for Tsukuba Center or University of Tsukuba (approximately 70 minutes).				
Car	Tokyo	Shuto Kosoku (Metropolitan Expressway)	Misato I.C.	Joban Expressway (approximately 30 minutes)	Yatabe I.C. or Sakura-Tsuchiura I.C.	Suitable route (approximately 15 minutes)

Doboku Kenkyusho Mae (PWRI)

Public Works Research Institute (Tsukuba Central Research Institute) 1-6 Minamihara, Tsukuba-shi, Ibaraki-ken 305-8516 Phone: +81 29-879-6700

Aqua Restoration Research Center

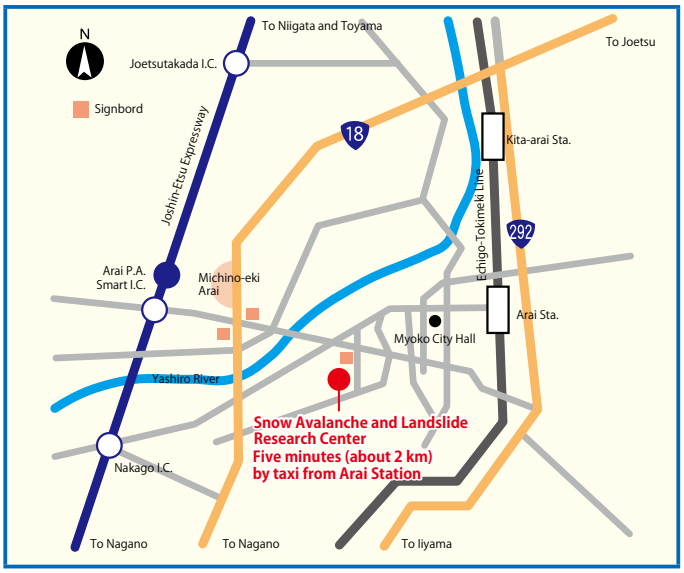


Kan-yuchi-mubanchi Kawashimakasada-machi, Kakamigahara-shi, Gifu-ken 501-6021
Phone: +81 586-89-6036

[Train]
- Meitetsu (Nagoya-Kasamatsu) Approximately 30minutes
- Taxi (Kasamatsu-ARRC) Approximately 10 minutes

[Car]
- Approximately 10 minutes from Gifu Kakamigahara I.C. on the Tokai Hokuriku Expressway (Use the west parking area in the Water Eco Park)
- The ARRC is also within a waking distance from Kawashima P.A. on the Tokai Hokuriku Expressway

Snow Avalanche and Landslide Research Center

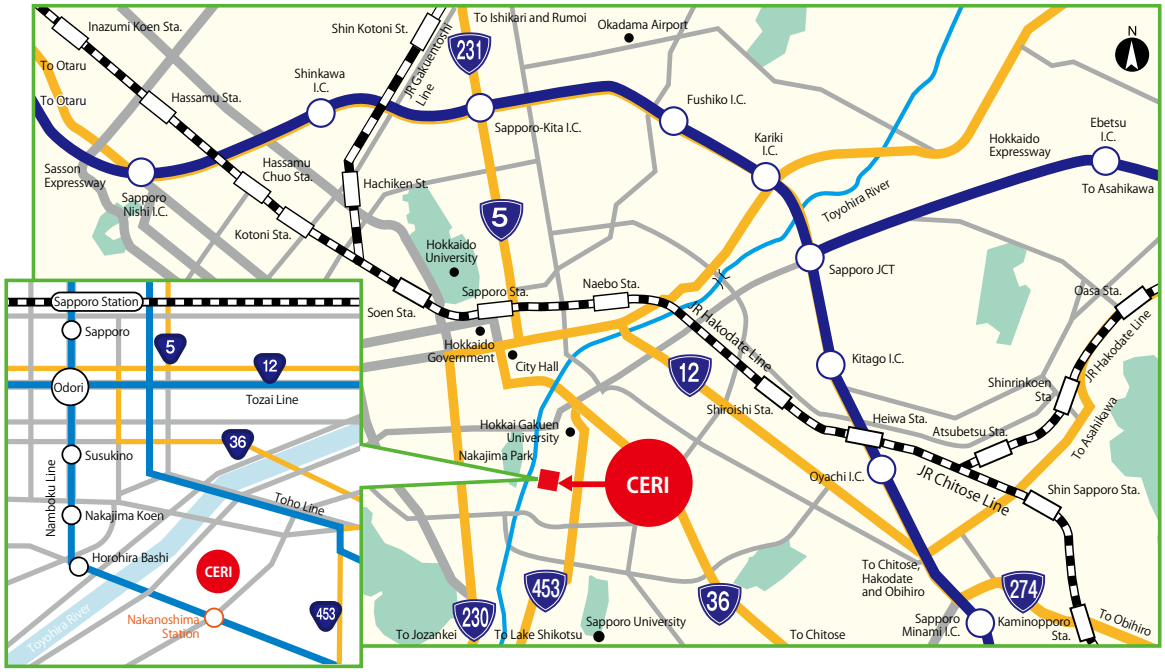


2-6-8 Nishiki-cho, Myoko-shi, Niigata-ken 944-0051
Phone: +81 255-72-4131

[Train]
- Hokuriku Shinkansen (Tokyo-JoetsuMyoko) Approximately 2 hours
  Echigo-Tokimeki Line (JoetsuMyoko-Arai) Approximately 10 minutes
  Total .....Approximately 2 hours and 10 minutes
- Niigata-Naoetsu-Arai.....Approximately 2 hours and 30 minutes
- Five minutes (Approximately 2 km) by taxi from Arai Station

[Car]
- From Arai Smart I.C. on Joshin-Etsu Expressway .....Approximately 3 km 7 minutes
- From Nakago I.C. on Joshin-Etsu Expressway .....Approximately 4 km 10 minutes

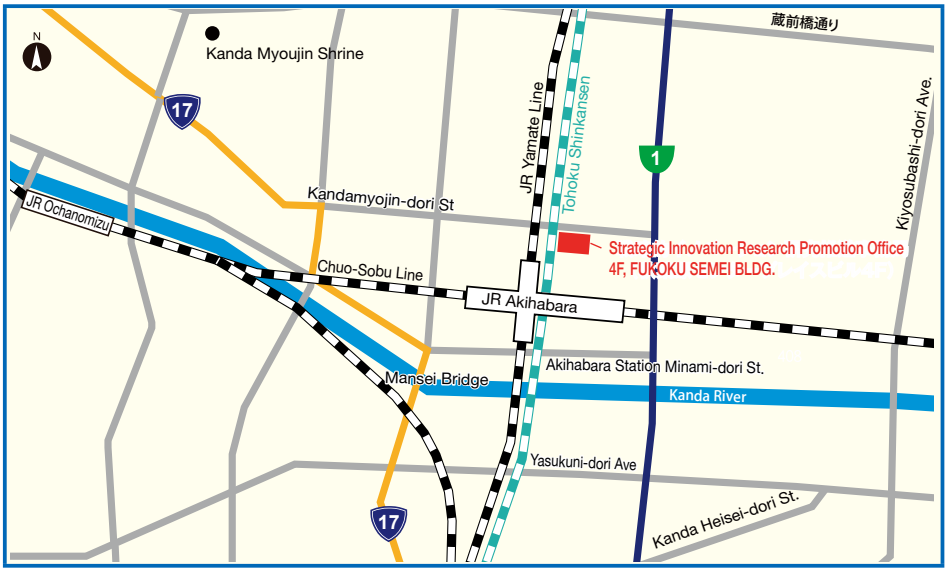
Civil Engineering Research Institute for Cold Region



Train	New Chitose Airport	Rapid train (approximately 36 minutes)	JR Sapporo Sta.	Walk (approximately 5 minutes)	Sapporo Sta. on Namboku Line	Subway (approximately 10 minutes)	Nakanoshima Sta. on Namboku Line	Walk (approximately 3 minutes)	Civil Engineering Research Institute for Cold Region
Express bus		Highway Bus (approximately 60 minutes)							
Car		Suitable route (approximately 10 minutes)	Chitose I.C.	Hokkaido Expressway (approximately 25 minutes)		Kitago I.C.	Suitable route (approximately 20 minutes)		

Civil Engineering Research Institute for Cold Region 3-1-34 Hiragishi Ichijo, Toyohira-ku, Sapporo-shi 062-8602 Phone: +81 11-841-1624

Strategic Innovation Research Promotion Office



4F, FUKOKU SEIMEI BLDG., 1 Kandaaioicho, Chiyoda-ku, Tokyo, 101-0029

- 1-minute walk from Exit A3 of JR Akihabara Station
- 1-minute walk from Exit A3 of Tsukuba Express Akihabara Station

National Research and Development Agency
Public Works Research Institute

Tsukuba Central Research Institute
International Centre for Water Hazard and Risk Management
Center for Advanced Engineering Structural Assessment and Research
Innovative Materials and Resources Research Center
1-6 Minamihara, Tsukuba, Ibaraki 305-8516
TEL 029-879-6700 (main)
E-mail:www@pwri.go.jp

Public Works Research Institute website

Public Works Research Institute X

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Sapporo, Hokkaido 062-8602
TEL 011-841-1111 (main)
E-mail:info@ceri.go.jp

Civil Engineering Research Institute for Cold Region website

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