

## Introduction of institutions

# Tsukuba Central Research Institute



Tsukuba Central Research Institute aims at improving civil engineering technology by conducting studies on civil engineering techniques, experiments, research and development, as well as giving technical instruction and disseminating research achievements.

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



## Introduction of institutions

# Civil Engineering Research Institute for Cold Region

SAPPORO CITY

Civil Engineering Research Institute for Cold Region, as only one laboratory core of civil engineering technology for cold regions, actively disseminates research results and development technologies to cold regions both in Japan and other countries. It also takes leading role as an organization to offer information about the civil engineering technology for cold regions in Japan.

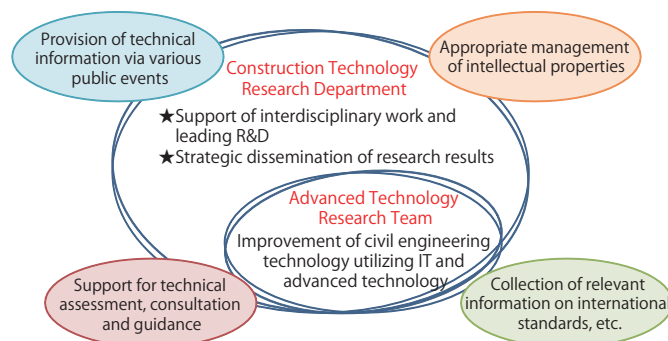




# Construction Technology Research Department

PWRI is responsible for high-quality research and development showing leadership in the innovation of civil engineering technology, turning research results into “technologies utilized”, and widely disseminating them. Based on this aim, the Construction Technology Research Department supports interdisciplinary work including that which involves non-civil engineering areas and leading R&D, and is actively committed to the dissemination of research results in Japan and overseas.

Specifically, the department releases technical information at various public events, appropriately manages intellectual properties, supports technical assessments, consultations and guidance, and collects relevant information on international standards to appropriately introduce civil engineering technologies to sites and meet the needs for internationalization. The Advanced Technology Research Team provides support for these activities, and carries out research and development for advanced technologies related to civil engineering, construction machinery, and civil engineering machinery/equipment including information and communication technology, robotics technology, and environmental technology and safety technology.



► **Advanced Technology Research Team** <https://www.pwri.go.jp/team/advanced/top.html>



# Geology and Geotechnical Research Group

The Geology and Geotechnical Research Group is conducting extensive research targeted survey, design, construction and management that including disaster prevention and environmental protection measures in ground and rock, slopes, earth structures, soil environments, and other areas.

The Geology and Geotechnical Research Group is comprised of the Geology Research Team, Soil Mechanics and Dynamics Research Team, and Construction Technology Research Team.

The Geology Research Team develops objective criteria and methods to find out properties of foundation ground.

The Soil Mechanics and Dynamics Research Team conducts research using model test and numerical analysis for the development of design methods including seismic design and reinforcement methods for earth structure.

The Construction Technology Research Team conducts research for the development of construction and maintenance/management technologies used in earth structures.

We also develop and promote innovative techniques to investigate and evaluate soil pollution and integrated geophysical exploration technologies, which are combined solutions to survey and analyze the internal structure of ground and earthworks.

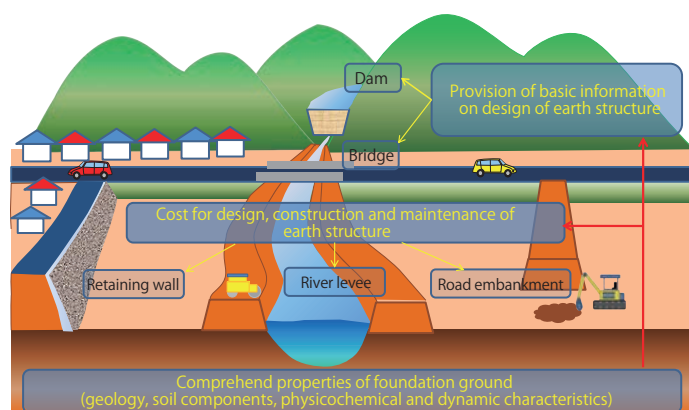


Image of research field of the Geology and Geotechnical Research Group

► **Geology Team** [http://www.pwri.go.jp/team/tishitsu/index\\_e.htm](http://www.pwri.go.jp/team/tishitsu/index_e.htm)

► **Soil Mechanics and Dynamics Research Team** <http://www.pwri.go.jp/team/smd/index.htm>

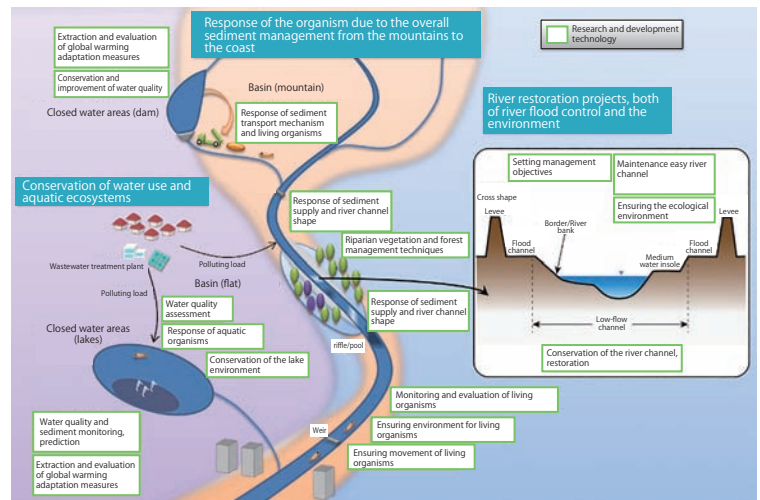
► **Construction Technology Research Team** [http://www.pwri.go.jp/team/sekou/eng\\_index\\_33.html](http://www.pwri.go.jp/team/sekou/eng_index_33.html)

► **Geophysical Exploration** <http://www.pwri.go.jp/team/geosearch/english.html>

# Water Environment Research Group

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

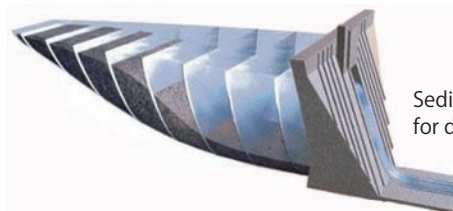
Concerning biological, ecological and environmental conservation and restoration of rivers/lakes, the River Restoration Research Team uncovers the relationship of the terrain, the physical environment and material dynamics and ecosystems and conduct research on impact assessment method and approach to ecosystem. The Water Quality Research Team develops analysis and monitoring methods of chemical substances of environmental water and sewage treatment water, identifies the behavior of pollutants, evaluates the impact on the aquatic ecosystem, and develops countermeasures and methods. The Aqua Restoration Research Center (ARRC) located in Kagamihara, Gifu Prefecture has full-scale model rivers and ponds for experiments and using these facilities the center carries out research on multi-natural river development and flow and sediment management such as river flow, sediment supply, and response of ecosystems to the structural modifications of the river.



- ▶ **River Restoration Research Team** <http://www.pwri.go.jp/team/rrt/eindex.html>
- ▶ **Water Quality Research Team** [http://www.pwri.go.jp/team/suisitsu/index\\_e.htm](http://www.pwri.go.jp/team/suisitsu/index_e.htm)
- ▶ **Aqua Restoration Research Center** <http://www.pwri.go.jp/team/kyousei/eng/index.htm>

# Hydraulic Engineering Research Group

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



Sediment simulation technology for dams

Sediment bypass tunnel (Outlet of Miwa Dam facility)



Flow rate observation technology using the ADCP

- ▶ **River and Dam Hydraulic Engineering Research Team** [http://www.pwri.go.jp/team/dam\\_hydraulic/english.htm](http://www.pwri.go.jp/team/dam_hydraulic/english.htm)
- ▶ **Hydrologic Engineering Research Team** [http://www.pwri.go.jp/team/hydro\\_eng/index\\_e.htm](http://www.pwri.go.jp/team/hydro_eng/index_e.htm)



# Erosion and Sediment Control Research Group

Located as it is on plate boundaries, Japan is typified by a fragile geology resulting from active crustal movement. With frequent earthquakes and numerous active volcanoes, the movement of sediments such as mud flows, debris flow, slope failure, pyroclastic flows, and snow avalanches readily. Moreover, because Japan is also in the monsoon zone, it is frequently affected by typhoons and torrential rains. In winter, the coast along Sea of Japan is subject to heavy snowfalls and these factors combine to create an environment that causes sediment disasters easily. Japan's living and industrial areas extend beyond the flat regions into hilly and mountainous areas, so social factors also contribute to the general vulnerability to natural disasters. The Erosion and Sediment Control Research Group studies the mechanisms behind disasters caused by volcanoes, debris flow, landslides, and snow avalanches, conducting research into prediction, detection, and monitoring of their emergences, methods of warning and evacuation, and risk management in order to prevent and mitigate these disasters, and to ensure safe and secure local communities.



- ▶ **Volcano and Debris Flow Research Team** <http://www.pwri.go.jp/team/volcano/eindex.html>
- ▶ **Landslide Research Team** <http://www.pwri.go.jp/team/landslide/english%20pages/index.htm>
- ▶ **Snow Avalanche and Landslide Research Center** <http://www.pwri.go.jp/team/niigata/english.html>

# Road Technology Research Group

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

- ▶ **Pavement Research Team**  
<http://www.pwri.go.jp/team/pavement/eindex.html>
- ▶ **Tunnel Research Team**  
<http://www.pwri.go.jp/team/tunnel/index-e.htm>



Accelerated load test and non-destructive test for pavement



Example of field test to establish rational inspection and diagnosis



## Cold-Region Construction Engineering Research Group

As aging of the public infrastructure is progressing, efficient and effective maintenance, update and maintenance of the public infrastructure with consideration of specific environmental conditions which is unique to the cold and snowy regions is required. In addition, there is a growing demand for responses to landslides and earthquake disasters which frequently occur and public infrastructure to protect safety for lives of people.

Cold-Region Construction Engineering Research Group conducts research in order to address these challenges. Structures Research Team develop design and construction technology for road structure to prevent disasters caused by falling rocks and earthquakes. It also develops maintenance technology of road structure in the snowy cold environment. Geotechnical Research Team conducts research on improving technology for safety and durability of civil engineering facility built on peaty soft ground which is widely distributed in the cold climates, and development of technology related to strong soil structure which is durable to frost heave and freeze-thaw. Geological Hazards Research Team conducts research on development of technology to avoid landslides and rock slope disaster of the snowmelt season and development of assessment and countermeasures of natural origin of the heavy metals.

- ▶ **Structures Research Team** [http://kouzou.ceri.go.jp/ev/index\\_en.html](http://kouzou.ceri.go.jp/ev/index_en.html)
- ▶ **Geotechnical Research Team** <http://jiban.ceri.go.jp/index.html>
- ▶ **Geological Hazards Research Team** <http://chishitsu.ceri.go.jp/>



Deterioration of the road bridge deck due to frost damage



Collapse of embankment on the peat ground due to liquefaction



Massive rockfall disaster



Landslide disasters occurred in snowmelt season



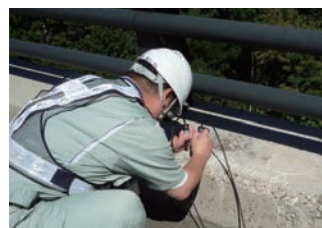
## Cold-Region Maintenance Engineering Research Group

Civil engineering structures in cold snowy regions are subject to the actions of freezing and thawing caused by low temperatures, and chloride ions from seawater and antifreezing agent. So they are deteriorated by frost or combined frost and chloride attack etc., and their functions are reduced by frost heaving or insufficient bearing capacity.

In order to improve durability and to appropriately maintain the functions of civil engineering structures for a longer period of time, in the Cold-Region Maintenance Engineering Research Group, Materials Research Team (mainly concrete structures) and Road Maintenance Research Team (mainly pavement structures) are conducting research to develop technologies to preserve structures such as quality control and maintenance, repair, reconstruction and other technologies to improve durability in the cold snowy environment.

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

- ▶ **Material Research Team** <http://zairyo.ceri.go.jp/index.htm>
- ▶ **Road Maintenance Research Team** <http://www2.ceri.go.jp/jpn/iji/index.htm>



Investigation of concrete structures deteriorated by combined effect

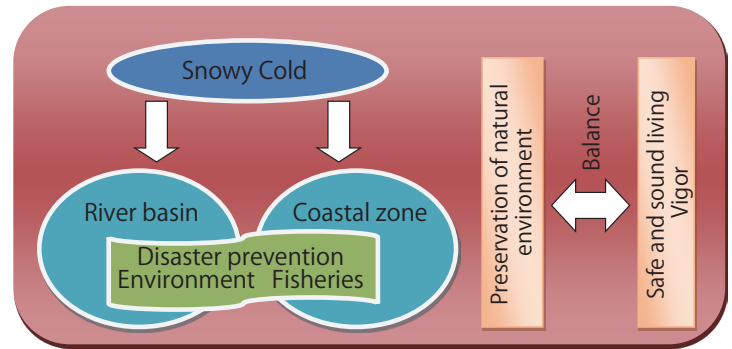


Measures against deterioration/damage unique to cold region

## Cold-Region Hydraulic and Aquatic Environment Engineering Research Group

Cold-Region Hydraulic and Aquatic Environment Engineering Research Group conducts research and technology development necessary to strike a balance among securing a safe and sound living, maintaining vigorous socio-economic activities and preserving the rich natural environment in the river basin and coastal zone of the cold, snowy regions.

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



Research images of Cold-Region Hydraulic and Aquatic Environment Engineering Research Group

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

## Cold-Region Road Engineering Research Group

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

Cold-Region Road Engineering Research Group consist of Traffic Engineering Research Team and Snow and Ice Research Team. In 4th medium- to-long-term plan (2016-2021 fiscal year), the group works on research programs to ensure secure and reliable winter road transportation services even under the social conditions of the population decline, aging, and insufficient financial resources. Regions, forms and sizes of disaster occurred in recent years have become more complex and more frequent therefore, the group works on research programs that contribute to reduction of traffic failure due to snow and ice.



- ▶ **Cold-Region Road Engineering Research Group** <http://www2.ceri.go.jp/eng/index.htm>

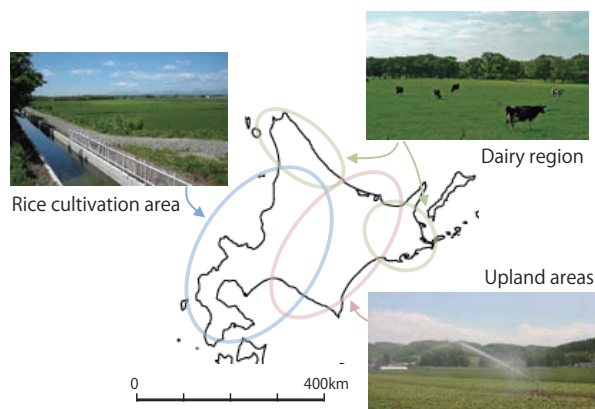




## Cold-Region Agricultural Development Research Group

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

- ▶ **Rural Resources Conservation Research Team** <http://hozen.ceri.go.jp/>
- ▶ **Irrigation and Drainage Facilities Research Team** <http://suiiri.ceri.go.jp>



Using Hokkaido as a field, where the large-scale agriculture has been running, we develop various technologies such as maintenance and management of large sized field, improving longevity of irrigation facilities, disaster response planning to handle risks at the time of large-scale disaster, assessment and maintenance of water quality environment.

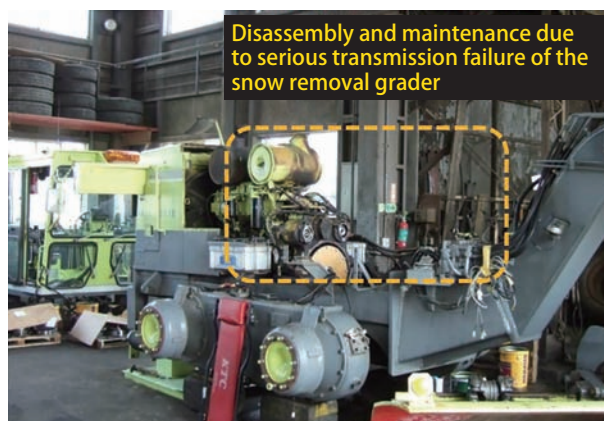
Outreach and dissemination of results to other regions



## Director for Cold-Region Technology Development Coordination

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

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



## Director for Special Research

The 1<sup>st</sup> century BC Roman architect Vitruvius described “solidity”, “usefulness” and “beauty” as the three essentials for structures. This is why, in addition to considering durability and function, we must consider landscape when developing infrastructure. In recent years in Japan, the need to ensure favorable landscapes when maintaining infrastructure is increasing, as is the need to contribute to tourism promotion. The promulgation of “The Landscape Act” and “The Basic Act for Promoting a Tourism-Oriented Country” are among the responses to such needs. Also, tourism has become an important industry in Japan, including in Hokkaido. To respond to the above needs, the Scenic Landscape Research Unit has operated under the Director for Special Research since 2006. We conduct research that supports local governments and communities by improving the quality and usability of infrastructure and public spaces.

- ▶ **Scenic Landscape Research Unit** [http://scenic.ceri.go.jp/index\\_eng.htm](http://scenic.ceri.go.jp/index_eng.htm)



Proposal of planning, maintenance and management techniques of good public space

## Introduction of institutions

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



## Introduction of institutions

### Center for Advanced Engineering Structural Assessment and Research (CAESAR)



## Introduction of institutions

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





# International Centre for Water Hazard and Risk Management (ICHARM)

## Water-related Hazard Research Group



ICHARM was officially established in March 2006 as a category II center of UNESCO after the approval at its 33rd general conference in the aim of transferring technologies that Japan has developed for reducing water-related disaster risk to other flood-prone countries and regions based on local needs and conditions.

The mission of ICHARM is to serve as the Global Centre of Excellence for water hazard and risk management by observing and analyzing natural and social phenomena, developing methodologies and tools, building capacities, creating knowledge networks, and disseminating lessons and information in order to help governments and all stakeholders manage risks of water-related hazards at global, national, and community levels. To achieve the mission, we are committed to the following three principal activities:

### Innovative Research

Our current research projects cover the following five areas:

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

### Effective capacity building

We develop and execute capacity building programs mainly designed for practitioners in developing countries for them to become more effective practitioners and leaders with strong problem-solving skills backed by good theoretical and engineering insights.

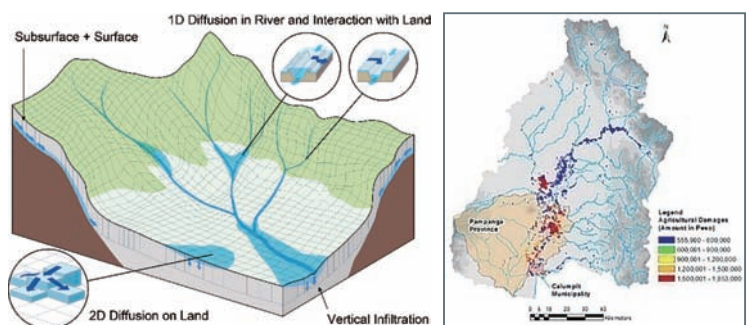
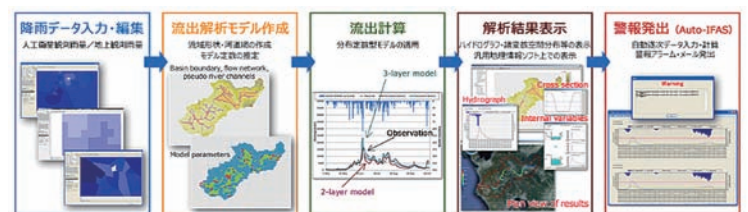
### Effective information networking

We strive to maintain and expand a worldwide network of researchers to collect, analyze and provide information and experience on major water-related disasters around the world. We have also been engaged in global efforts to mainstream disaster risk reduction through building and maintaining international networks such as the International Flood Initiative (IFI).

► <http://www.pwri.go.jp/icharm/index.html>



Three main activities of ICHARM



Process of flood analysis, conceptual image of a rainfall-runoff-inundation model, example of agricultural damage simulation



Capacity building training for practitioners in developing countries

# Center for Advanced Engineering Structural Assessment and Research (CAESAR)

## Bridges and Structural Engineering Research Group



Civil engineering structures in Japan have been exposed to severe traffic demand and the natural environment, and aging of many structures to have begun already. To evaluate the soundness of the structure, there is an urgent need to assess the soundness of structures and establish technology for maintenance, management and update those structures. In order to achieve this, "Center for Advanced Engineering Structural Assessment and Research" was established on April 1, 2008. The center, along with the road administrator, works on maintenance and management of proper maintenance of the structure of the road bridges and earthquake response which will lead to problem-solving. It also provides standardization for maintenance of the road/bridges, technology related to design and construction, knowledge of accumulation, research results and integrated technology to contribute society.

Bridges and Structural Engineering Research Group, with mainly developing technology to assess and predict performance of the bridge structure accurately and promptly, conducts research on comprehensive technologies of design/construction, maintenance/management, inspection/diagnostic, techniques, and repair/ reinforcement. The group also conducts research on comprehensive maintenance management technology system and establishment of disaster recovery technology system. Of the issues related to the bridges, material including soil and specific events unique to the cold regions are studied together with staff of Tsukuba Central Research Institute and Civil Engineering Research Institute for Cold Region. The road administrator and engineers/scientists from universities and private sectors join our team aiming improvement of technical capabilities, and cooperate with related fields for solving problems.

### Research that saves "Japan from devastation"

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

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

### Research that saves "Japan from becoming fragile country for a disaster"

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

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

### Presentation of required performance and assessment criteria

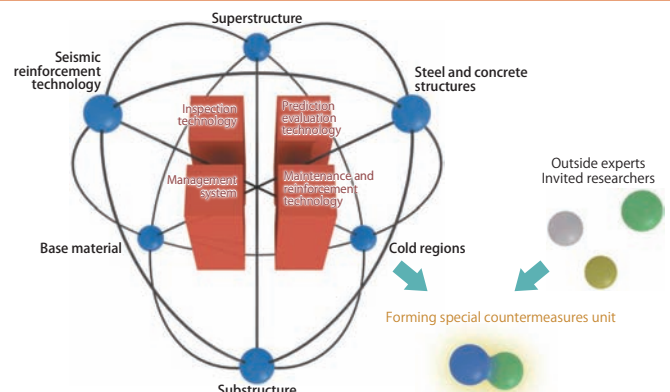
We present the criteria and guidelines on performance required for individual element technology and how to meet its criteria.

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

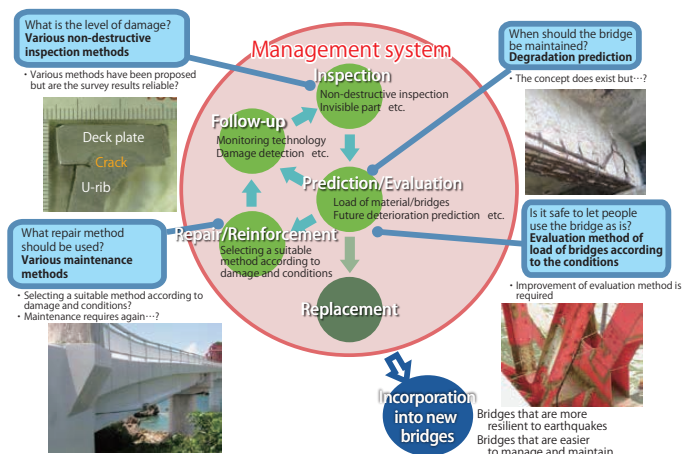
※ For more information about the CAESAR, please refer to the following HP.

▶ <http://www.pwri.go.jp/caesar/index-e.html>

#### Bridge and Structural Engineering Research Group Research organization image



#### Development of maintenance and management system that saves "Japan from devastation"



#### Research that saves "Japan from becoming fragile country for a disaster"



Development of design method on RC jacking using a high-strength rebar



Emergency restoration technology for shear fractures of the bridge seats (emergency restoration method using H-section steel that is easily available)





# Innovative Materials and Resources Research Center (iMaRRC)

## Materials and Resources Research Group



In recent years, cases in which deterioration of civil engineering materials affects safety of the structure have occurred. With respect to public infrastructures which will further get older, it is required to repair, apply reinforcing materials and improve the durability of civil engineering materials for prolonged life of infrastructures. It is also necessary to improve durability as well as performances or functions of civil engineering materials. In these circumstances, "realization of effective and efficient maintenance and renewal of infrastructures" was positioned as a focused goal to be achieved in 2030 in "Comprehensive Strategy on Science, Technology and Innovation 2014" adopted by the Council for Science, Technology and Innovation, i.e. it was determined to promote the development of technologies to improve the durability of structural materials for infrastructures. It is also required to examine the applicability of advanced materials to be developed here to the civil engineering sector and carry out research toward practical use of them.

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

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

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

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

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



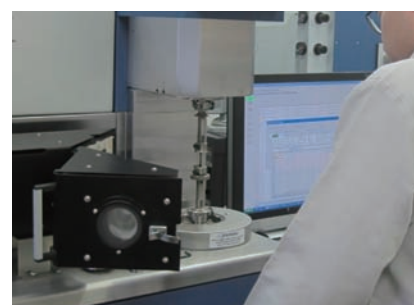
Full-scale model experiment of advanced structural materials (experiment of structural FRP)



Experiment of materials having sensing functions (neutralization detection sensor)



Outdoor exposure tests of concrete specimens



Experiment of asphalt materials for paving



Methane fermentation experiment using a mixture of sewage sludge and crushed cut grass

► <http://www.pwri.go.jp/team/imarrc/english/top.html>