

## Chapter 4 Summary of the approaches of Public Works and the results in fiscal year 2007

In fiscal year 2007, which was the 2nd fiscal year of the 2nd Mid-term Plan, the Institute worked on settling down the research concepts set in the 2nd Mid-term Plan, promotion of cooperation between the research institute based in Tsukuba (Tsukuba) and Civil Engineering Research Institute for Cold Regions (CERICR) based in Hokkaido, steady promotion of research and development in the new frameworks such as the research evaluation system, etc, and distribution of results. The Institute also actively worked on building an organization to deal with research and development in future.

Below is the Institute's approach in 2007 in accordance with the research concepts of Public Works Research Institute set in 2006.

### Research concept

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

### **1. Research that the Institute can take responsibility even for the society 100 years later.**

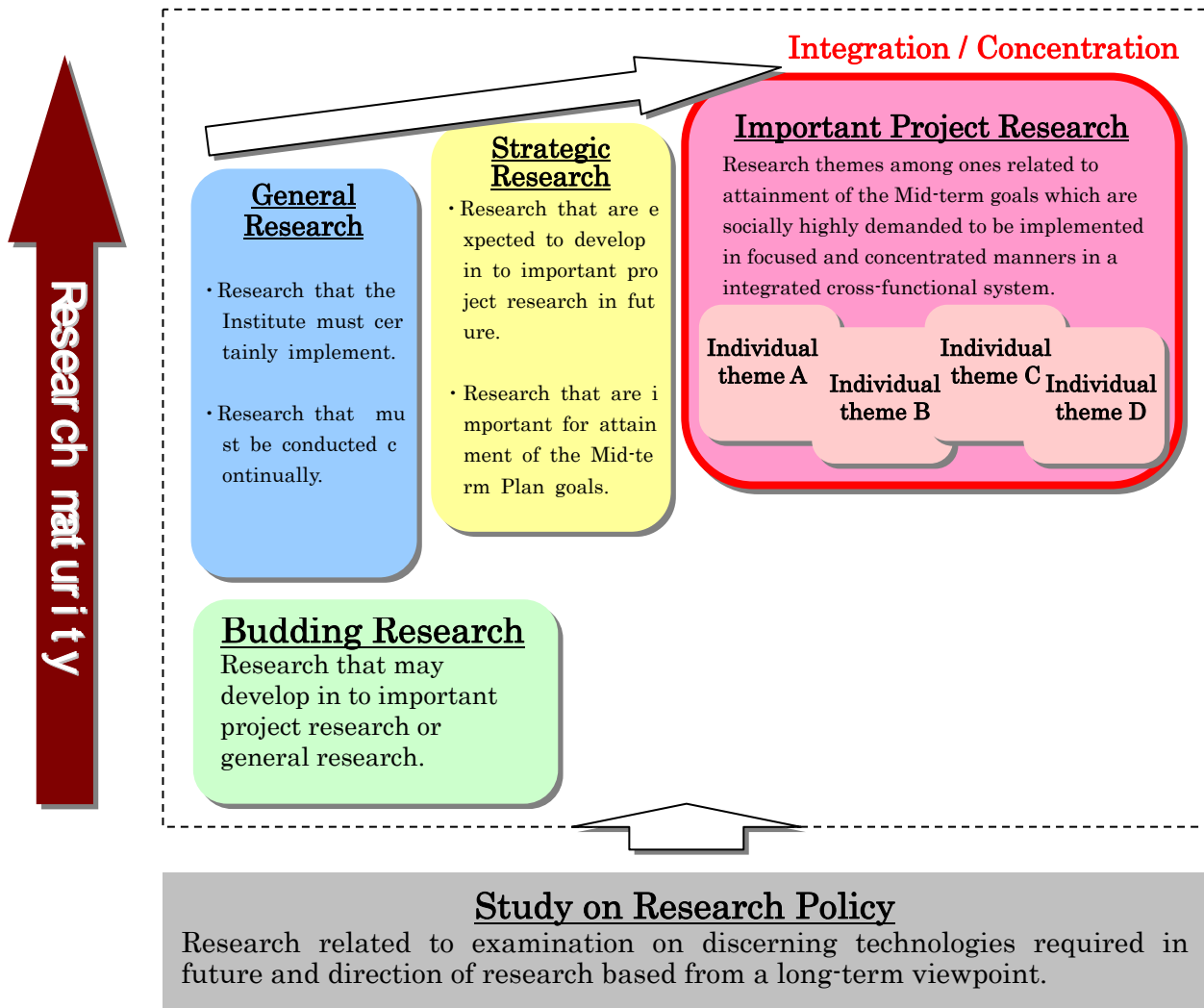
Considering that public works structures are used over tens and hundreds years, the Institute, at the same time as it promotes strategic/ systematic research from a long-term viewpoint, implements development of engineers through adopting technological instruction and engineers. In fiscal year 2007, the Institute, at the same time as it continually reviewed research organization based on current social requirements, promoted reinforcement of research cooperation beyond the borders of organizations.

### **Emphasizing systematic promotion and development of research**

From fiscal year 2007, the Institute newly established "Study on research policy", to systematically promote research alongside with the existing "Important Project Research", "Strategic Research", "General Research" and "Budding Research". Among those, to the important project research themes and strategic research themes, which are related to attainment of the mid-term goals and so important, 69% (the ratio of important project research in the 2nd Mid-term Plan is 60%) of the budget was allocated.

### **Towards development of systems to fulfill the Institute's social assignment.**

In fiscal year 2007, the Institute shared three themes mainly of important project research with Tsukuba and CERICR and further proceeded with information exchange on research results and research facility sharing through 11 cooperative research themes. The Institute also strived for integration of organization operation across the distance between Tsukuba and CERICR by utilizing TV conference system.



Public Works Research Institute's research promotion structure

Furthermore, the Institute has determined that it shall take an integrated approach with Tsukuba and CERICR in terms of budget management beyond organizational borders and establish "Special Reserve of the Chairman of the Board" for fiscal year 2008 and onward, which allocates research budget intensively on research themes which Public Works Research Institute should takes initiative of and ones that contribute to further integration of Tsukuba and CERICR.

As "Special Reserve" themes for 2008, research themes on measures against aging of structures/ soundness evaluation/ diagnosis policies and ones on flood disaster prevention/ reduction.

Due to the transfer of projects such as technological development that Hokkaido Regional Development Bureau had been working on and 20 staff members from the institute, the Institute prepared in fiscal year 2007 the organizational system, etc, for accommodating them. Also the Institute carried out revision of Mid-term plan in relation to the transferred projects.

**Towards establishment of soundness evaluation for public works structures and maintenance management technology.**

In Japan, the structures constructed in numbers during the high economic growth period are altogether entering the highly aged phase. With such a reality as a background, major disasters, such as and the part material breakage of Kiso Ohashi on National Highway 23 and Honjo Ohashi on National Highway 7, occurred in Japan, just as the collapse of a state expressway in Minneapolis in Minnesota, U.S. did. In such circumstance, “Establishment of a research organization that deals with social requirements including appropriate maintenance and management of existing structures” was demanded in “Independent Administrative Organization Readjustment and Rationalization Plan” decided by the Cabinet on December 24, 2007. In order to swiftly respond to this demand, from fiscal year 2008, Public Works Research Institute, at the same time it endeavor to establish structural soundness evaluation and maintenance and management technology by on-site research, etc, decided to establish “Center for Advanced Engineering Structural Assessment and Research”, which also trains engineers, and carried out preparation towards its establishment, reflecting it in the Medium-term Plan.

**2. Research that will be highly evaluated by academic organizations and can win trust from the local areas and the actual work sites.**

The Institute aims to contribute to promotion of efficient development of quality social capital and development of Hokkaido through improvement of public works technology by carrying out research on technology related to public works among construction technology and technology related to Hokkaido Regional Development Bureau’s office tasks, examination, research and development, instruction and distribution of research results. In fiscal year 2007 also, at the same time it was highly evaluated for its academic approach to research, the Institute contributed to Japan and the world through its active approach to technological instruction and distribution of research results such as the research related to technological adaptability to each public works construction site, which had been consigned to the Institute by regional development bureaus and Hokkaido Regional Development Bureau, initiative in decision/ revision tasks concerning technological standards and hosting lectures at each work site.

**Contribution to the international flood disaster prevention measures.**

Public Works Research Institute also works abroad on flood disaster prevention centering International Center for Water Hazard and Risk Management (ICHARM). At the 1st Asia Pacific Water Hazard Summit held in Beppu, Oita Prefecture, on December 3~ 4, 2007, which focused on a variety of themes related to water hazard caused by the climate change in the countries in the Asia Pacific region, ICHARM contributed to compiling a proposal that included the main proposals of the summit meeting by leading in one of the three agendas, “Water Related D Management”.

ICHARM also started a water hazard risk management course in October 2007 under the Disaster

Management Policy Program in cooperation with Japan International Cooperation Agency and graduate schools, which are studying water hazard measures. This program aims at training of personnel who can participate in proposal of comprehensive water disaster reduction plans and implementation of them with expertise, and so actively recruits engineers to be involved with management tasks of development and preservation of government-owned estates, water and cities. Those who have acquired required credits by the end of the course are given the master's degree.



Mr. Takeuchi chairing the subcommittee meeting on “Water Related Disaster Management” at Asia Pacific Water Hazard Summit



Opening ceremony of Water Related Disaster Management Course under “Disaster Management Policy Program”, which started in 2007.October,

**Technological support in disaster incidences**

In 2007, to deal with the incidences including earthquake disasters such as Noto Peninsula earthquake and Chuetsu Offshore earthquake, and collapse of roads due to torrential rain, landslide and waves, the Institute members entered disaster sites from an early stage to actively carry out on-site research and to provide technological advice for early recovery. The Institute also offered technological instruction and advice in relation to analysis on the cause of the disaster and deliberations on remedial work at the time of the rock collapse on the seaside of Oshoro, Otaru-shi and the breakage of a structure on Seisho Bypass caused by the 9th Typhoon.



Technological support applying emergency measurement techniques at the collapse site in Noto Peninsula earthquake.



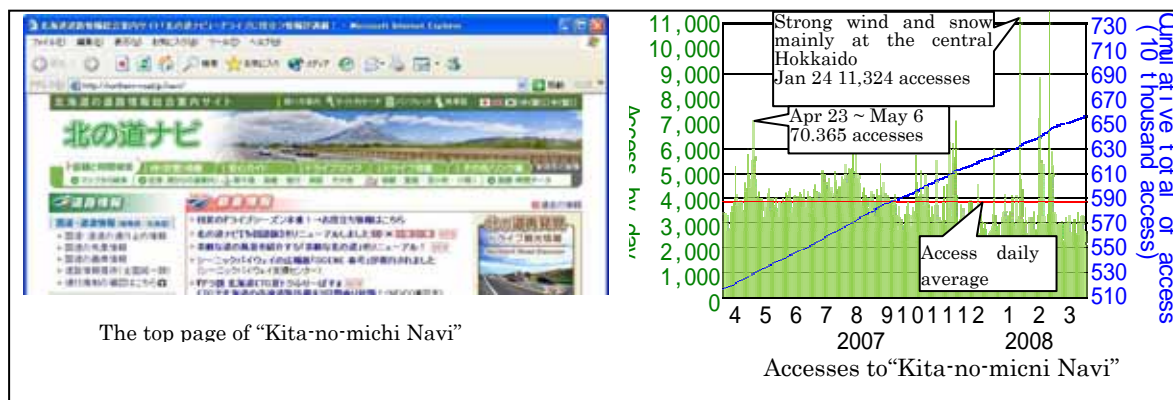
PWRI's researchers conducting investigation at Chuetsu Offshore earthquake disaster site.



PWRI's researchers conducting investigation at the seaside rock collapse disaster site of Oshoro, Otaru-shi. area by returning the benefit of research

results and by feeding back the local needs to its research.

CERICR is developing research on methods to provide safe and pleasant route information by the advanced combination of road information and local information the information provision system that may be uses accordingly at each site. As a part of the institute’s research, it offers multi-lingual road information on roads, weather and routes in the comprehensive road information site, “Kita-no-michi Navi” it operates in cooperation with road management companies and received 1.4 million accesses in 2007, which illustrates its significant contribution to the local interest such as support for the driving tourism. In the strong wind and snow in 2008, the Institute contributed to disaster prevention for drivers by offering road images. The access log and the results of the online questionnaires were fed back to research as important data concerning road users’ needs.



Provision of road information through the website “Kita-no-michi Navi”

### Evaluation of research achievements

As the result of its active efforts to present the achievement of the research at academic meetings, etc, many of the Institute’s academic papers and technology developed it had developed were highly evaluated with prizes and so on. Particularly remarkable among them is the Prime Minister Prize, the top honor to be given at “The 2nd Monodzukuri Nihon Taisho”, for an environment-compatible on-site coating removal technology for steel structures including steel bridges, which had been jointly developed in cooperation between Public Works Research Institute and a private company.



At the “ Monodzukuri Nihon Taisho” prize presentation. Then Prime Minister Shinichiro Abe and PWRI’s researcher (2<sup>nd</sup> from left)



The "Monodzukuri Nihon Taisho" winner, an environment-compatible on-site coating removal technology.

### **3. Research that respects tradition but has frontier ethos**

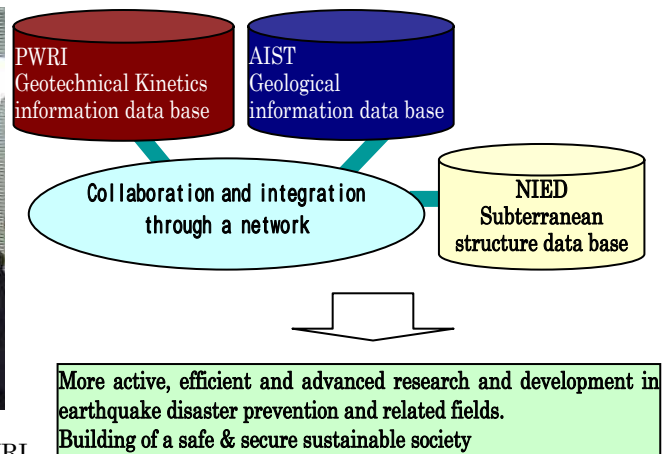
Public Works Research Institute, which is a long established research institute with history of over 80 years, is expected to maintain the high standard of its accumulated research work and to flexibly deal with the needs of the people and society. In fiscal year 2007 also, in order to further improve the research quality, the Institute actively collaborated with research fields other than public works and implemented collaboration and cooperation with the regional development bureaus that use technology, Hokkaido Regional Development Bureau and regional public entities.

#### **Promotion of links with other fields in research and development.**

The Institute and Independent Administrative Agency National Institute of Advanced Industrial Science and Technology (AIST), aiming to contribute to promotion of academic studies and industrial technologies and building of safe and secure sustainable society, signed connection and cooperation agreement on July 26,



Chairman of AIST Yoshikawa and Chairman of PWRI Sakamoto shaking hands at the signing ceremony.



The image of comprehensive subterranean data base

Under this agreement, by sharing their assets and areas of studies they are strong at, PWRI and AIST are developing connection and cooperation in a wide range of research, and are promoting sharing of their research facilities/ equipments and research exchange between researchers mainly in the fields of geology, ground, materials, environment, information and biology. For example, the institutions are promoting “Comprehensive subterranean database” that integrates geological information and geotechnical kinetic information, which they have been working on with at the same time as systematically matching each others research themes. The institutes are aiming to promote diverse forms of connection with each other, to produce unprecedented and advanced innovations and to contribute to innovation delivered from Tsukuba through cross-field integration.

#### **Participation in innovative research and acquisition of external funds.**

Public Works Research Institute is actively working on acquisition of external funds such as competitive research funds. In 2007, the Institute successfully acquired funds such as the one it acquired when ICHARM’s “Evaluation of flood risk to the whole earth and some specific fragile regions caused by the climate change and reduction of disasters” was approved as “The 21st century Innovative Program for Climate Change Prediction”. Under the 3rd Science and Technology Policy Basic Plan, this program by the way is implemented by Ministry of Education, culture, Sports, Science and Technology in a 5 year plan from 2007 due to its expected contribution to IPCC’s the 5th evaluation report and its provision of scientific foundation for climate change measures.

#### **Studies on direction of research from a long-term viewpoint.**

In fiscal year 2007, the Institute worked on 11 themes in the newly established research category “Studies on research policies”. Many of these themes were based on novel ideas by researchers who are not confined in traditional research categories, and some of them have progressed so much that they may become proper category depending on their outcomes.

On the other hand, following fiscal year 2006, some research themes the Institute should work on and the promotion system for such themes were further examined by group leaders as “large scale research themes”. They examined the range and the direction of research from a viewpoint unaffected by the conventional framework, and presented the outcomes to researchers to guide them through discussion on research seeds and enthusiasm for research into the direction they should go in setting research themes and deciding important project research.

## Fiscal Year 2008 List of cooperative research between Tsukuba Central Research Institute and Civil Engineering Research Institute of Cold Regions

April 21, 2008

(Revised February 25, 2008)

New: Items with “New” next to No. represent new cooperative research

\* T in charge: Indicate team name with brackets ( ) if the team is in charge of the theme by not cooperating with CERICR.

1	Research theme	Research on snow avalanche risk discernment method in heavy snow		
	Research period	H18-20	Research category	Strategic research
	T in charge	Snow Avalanche & Landslide Center	T in charge	Snow and ice
2	Research theme	Research on continual measures against Tsunami in developing countries		
	Research period	H18-22	Research category	Important project research
	T in charge	International Distribution, Disaster Prevention	T in charge	Cold region rivers
3	Research theme	Development of technology for heavy metal contamination of natural origin		
	Research period	H18-22	Research category	Important project research
	T in charge	Geology	T in charge	Disaster prevention geology
4	Tsukuba		Cold region	
	Research theme	Research related to improvement on complex ground	Research theme	Research related to optimization of peaty soft round disaster preventive work
	Research period	H18-21	Research period	H18-22
	Research category	General research	Research category	Important project research
	T in charge	Geology	T in charge	Cold region ground
5	Tsukuba		Cold region	
	Research theme	Research related to durability evaluation method for non-standard frame materials	Research theme	Research related to of combined decaying behavior of frost damage and salt damage and evaluation
	Research period	H18-21	Research period	H18-22
	Research category	Important project research	Research category	Important project research
	T in charge	Structure management technology	T in charge	Low temperature-proof materials
6	Tsukuba		Cold region	
	Research theme	Research related to recycling of decayed asphalt pavement	Research theme	Research related to quality control method for pavement in snow piling cold regions
	Research period	H18-21	Research period	H18-21
	Research category	Important project research	Research category	General project research
	T in charge	Pavement, new materials	T in charge	Road preservation in cold regions
7	Tsukuba		Cold region	
	Research theme	Research related to advanced performance evaluation method for paved surface	Research theme	Research on decay, etc, of paved road surface in cold regions
	Research period	H18-22	Research period	H18-22
	Research category	Important project research	Research category	Important project research
	T in charge	Pavement, new materials	T in charge	Road preservation in cold regions



8	Tsukuba			Cold region		
	Research theme	Research related to water/ substance circulation management support model for basin scale	Research theme	Development of technology to control environmental load flow from large scale farming areas to rivers	Research theme	Research on interaction between substance with snow melting property and outflow mechanism
	Research period	H18-22	Research period	H18-22	Research period	H18-22
	Research category	Important project research	Research category	Important project research	Research category	General research
	T in charge	Water quality, (Hydrology, recycling)	T in charge	Basin load control unit	T in charge	Water environment preservation
9	Tsukuba			Cold region		
	Research theme	Research on riverbank treatment method	Research theme	Development of technology to design desirable river tack for reproduction of cold water fish		
	Research period	H18-20	Research period	H18-22		
	Research category	Important project research	Research category	Important project research		
	T in charge	Aqua Restoration Research Center	T in charge	Water environment preservation		
10	Tsukuba			Cold region		
	Research theme	Experimental research related to anti-seismic reinforcement technology for embankment on mountain roads	Research theme	Research on anti-seismic reinforcement technology for embankment on peaty soft ground		
	Research period	H18-22	Research period	H18-21		
	Research category	Important project research	Research category	General research		
	T in charge	Vibration	T in charge	Cold region ground		
11	Tsukuba			Cold region		
	Research theme	Research related to anti-erosion repair work for steel bridges	Research theme	Research on effect of anti-freeze agents on weather proof steel materials		
	Research period	H18-22	Research period	H18-22		
	Research category	Important project research	Research category	General research		
	T in charge	New material	T in charge	Materials for cold regions		
12	Tsukuba			Cold region		
	Research theme	Research on technology to turn biomass of public enterprise origin into resource and to utilize it.	Research theme	Research on combined water treatment technology for excess organic substances and urban sewage water.	Research theme	Development of technology to turn biomass into fertilizer and energy and investigation on efficient transfer methods
	Research period	H18-20	Research period	H18-20	Research period	H18-22
	Research category	Important project research	Research category	Strategic research	Research category	Important project research
	T in charge	Recycling	T in charge	Recycling	T in charge	Resource preservation
13	Tsukuba			Cold region		
	Research theme	Research related to reduction of road closure time caused by road slope disaster, etc.	Research theme	Research on advanced evaluation and inspection for rock ground/ slope collapse.		
	Research period	H18-20	Research period	H18-22		
	Research category	Important project research	Research category	Important project research		
	T in charge	Geology (Soil properties)	T in charge	Disaster prevention and geology		

14	Tsukuba		Cold region	
	Research theme	Research related flow of reservoirs and downstream flow of reservoirs and debris transfer model	Research theme	Effect of river structures on debris transfer in implementing consistent debris management and measures against it
	Research period	H18-22	Research period	H18-22
	Research category	Important project research	Research category	General research
	T in charge	River/ dam hydraulics	T in charge	Cold region ground
15 New	Tsukuba		Cold region	
	Research theme	Research related to evaluation of anti-seismic properties of complex foundation integrated with improved materials	Research theme	Research on design method for foundation structures on special soil ground of Hokkaido
	Research period	H20-23	Research period	H18-21
	Research category	Strategic research	Research category	General research
	T in charge	Foundation	T in charge	Cold region ground
16 New	Tsukuba		Cold region	
	Research theme	Research related to advanced performance evaluation method for paved surface	Research theme	Development of technology to design desirable river tack for reproduction of cold water fish
	Research period	H20-23	Research period	H18-22
	Research category	General research	Research category	Important project research
	T in charge	River ecology	T in charge	Water environment preservation
17 New	Tsukuba		Cold region	
	Research theme	Development of technology to improvement of anti-erosion functions of river embankment	Research theme	Development of technology to design desirable river tack for reproduction of cold water fish
	Research period	H18-22	Research period	H20-22
	Research category	Important research	Research category	Strategic research
	T in charge	River/ dam hydraulics	T in charge	Cold region rivers
18 New	Tsukuba		Cold region	
	Research theme	Research related to technology to improve fatigue durability of existing steel decks	Research theme	Research on design / construction of structures such as bridges with new structural styles in snow piling cold region
	Research period	H16-20	Research period	H20-22
	Research category	Important project research	Research category	General research
	T in charge	Bridges	T in charge	Cold region structures

## **Examples of approaches in the past 7 years since PWRI became an independent administrative agency**

In order to fulfill its assignment, Public Works Research Institute is actively implementing distribution of research results and offering technological instruction at the same time as it implement efficient research and development and improve its quality. The Institute is also aims at efficient project management and is striving for securing non-subsidy income.

### **Technological instruction that covers the whole public works.**

In addition to instruction on disaster prevention, the Institute offers technological instruction in diverse fields concerning problems work sites may have.

Fiscal Year	2001	2002	2003	2004	2005	2006	2007
Incidences of instruction	1,110	1,438	2,334	2,183	2,721	2,656	2,523

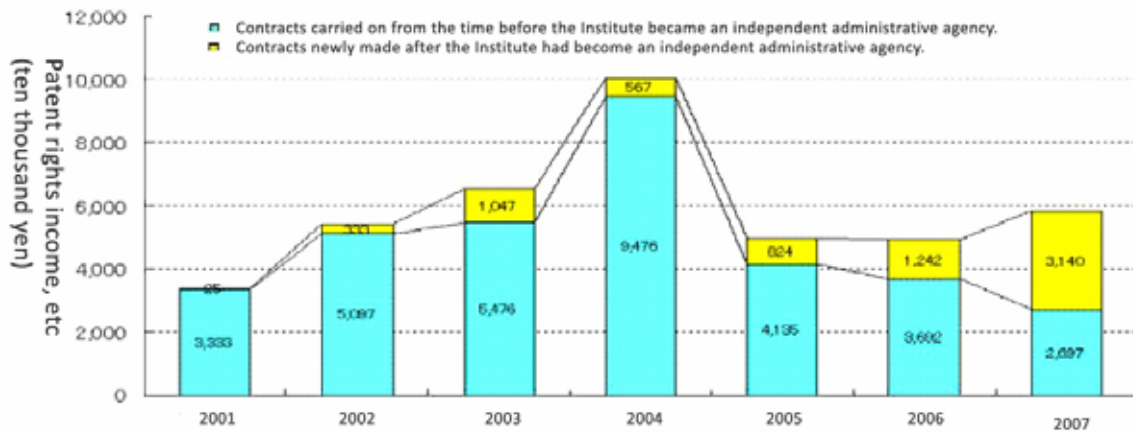
### **International distribution of results**

In order to distribute research results abroad and reinforce research cooperation, the Institute hosts or co-hosts international conferences at the same time as it actively participates in international conferences.

Fiscal Year	2001	2002	2003	2004	2005	2006	2007	
Number of research cooperation agreement	3	8	6	4	3	3	1	
International conference, Workshop etc	Conferences PWRI hosted	6	11	12	18	8	16	18
	Participants	282	386	650	520	525	1,137	826

### **Utilization of intellectual property**

The Institute appropriately secures intellectual rights regarding its research results and aims to promote use of such intellectual property at sites through intellectual right management that contributes to promotion of distribution and publicity activities.



Fiscal Year	2001	2002	2003	2004	2005	2006	2007
Patent pended	25	55	36	33	34	16	21
Patent registered	1	17	17	14	36	30	18
Patent right possessed	266	317	351	372	395	400	397
License agreement	10	47	51	56	52	57	58
(Rate of implementation)	3.8%	14.8%	14.5%	15.1%	13.2%	14.3%	14.6%
Right of exploitation	27	162	184	192	201	214	227

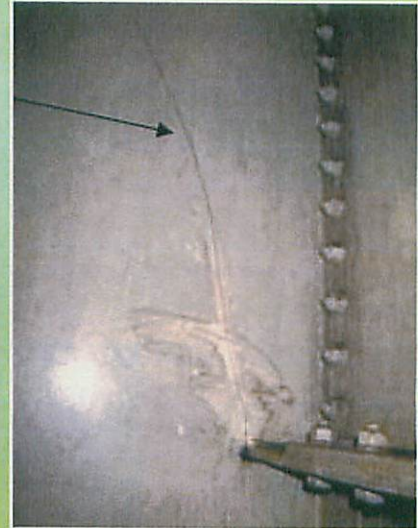
### Letting PWRI's facilities

So far as it does not affect the Institute's activities, it let its facilities to external entities including private companies.



# CAESAR

Center for Advanced Engineering  
Structural Assessment  
and Research,  
Public Works Research Institute



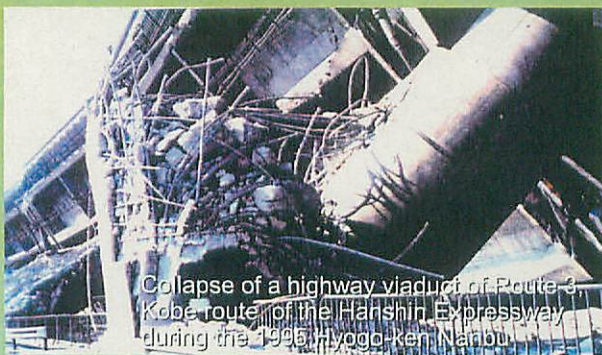
# CAESAR – Overseeing the Structural Safety of Japan’s Highway Bridges

Center for Advanced Engineering Structural Assessment and Research (CAESAR) is one of the four research institutes and centers of Japan’s Public Works Research Institute (PWRI).

In Japan, the number of highway structures began increasing rapidly in the 1960s in response to the rapid economic growth of the time, and now a significant number of those structures are more than 50 years old. Over the years, many such Japanese highway structures, including bridges, have been subjected to heavy traffic loading and have suffered from exposure to severe environmental and seismic conditions.



Failure in a truss chord member of Kisogawa-Oh-Hashi bridge



Collapse of a highway viaduct of Route-3, Kobe route of the Hanshin Expressway during the 1995 Hyogo-ken Nanbu

Therefore, there are urgent needs that demand comprehensive technology development as well as fast action to ensure their continuing safety and utility.

In response to these urgent needs, the PWRI re-organized its institutes in April 2008 to establish CAESAR.

## MISSION

### 1. Scientific Trial and Research

Working together with highway administrators, CAESAR formulates remedial treatments for bridges with serious structural deficiencies in situations where the current practical levels of inspection, diagnostic examination, and prognosis are not necessarily sufficient to fully rectify their conditions. Should a disaster occur, the Center is responsible for providing immediate emergency countermeasure support. Needless to say, CAESAR conducts basic laboratory research to find more reasonable and practical applications to the results obtained from such trials.

### 2. Collection and Dissemination of Technology

The encourages and supports networking between highway administrators engaged in (or otherwise concerned with) the inspection and management of existing highway bridges. The Center also collaborates in voluntary research and development activities with organizations such as universities and companies, as well as those undertaken by other national and foreign highway administrators and research institutions.

### 3. Putting State-of-the-Art Treatments to Practical Use

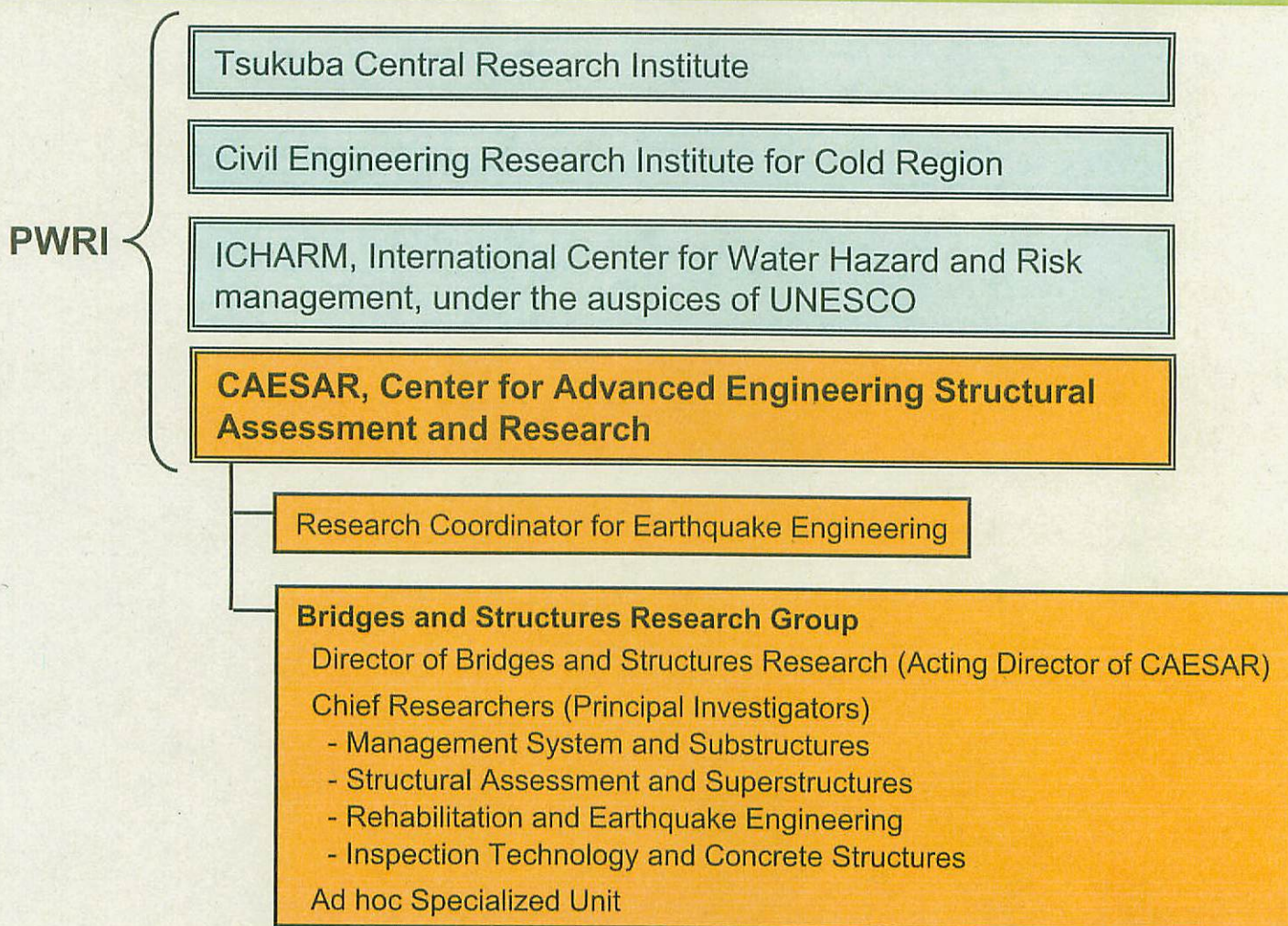
As national codes and recommendations, the Center feeds back information on the state-of-the-art experiences, and the trial results obtained, in a way that ensures the lessons are put to practical use.

### 4. Education and Training

The Center also continues to develop, maintain, and renew human resource programs that will ensure the continuing development and excellence of the national highway bridge maintenance system.

Cover Photos: Upper left = Unseating of the Showa-Oh-Hashi bridge during the 1664 Niigata Earthquake, Upper right = Fatigue crack in a main girder, Lower left = Alkali silica reaction observed in an RC bridge, Lower right = Survey of an overpass that has suffered from salt corrosion

# Organization



**The Research Coordinator for Earthquake Engineering** coordinates research on earthquake disaster prevention and mitigation for national infrastructure (including highway and river structures) while the Research Coordinator also covers Tsukuba Central Research Institute and Civil Engineering Research Institute for Cold Region in terms of earthquake engineering. When a large-scale earthquake occurs, the Research Coordinator will immediately organize an emergency investigation and support team from CAESAR researchers. The Research Coordinator also can ask researchers from the Tsukuba Central Research Institute and the Civil Engineering Research Institute for the Cold Region to work for the support team.

**Bridges and Structures Research Group** conducts research on improving highway bridge maintenance, disaster damage prevention and mitigation, and on design and construction methods. This group pays special attention to basic and applied inspection technology, structural condition assessment methods, object-related diagnostic examination methods, rehabilitation methods, and reinforcement methods. The Group is assisted by an ad hoc research unit flexibly composed of selected researchers whenever there is a need for CAESAR to focus intensively on an issue within their area of expertise.

## As of April 1, 2008

**People:** 23 in-house and 11 visiting researchers

**Projects:** 40 ongoing projects, including five collaborative research projects

**Large-scale test facilities:** 30 MN loading test machine, Large-scale continuous wheel load test machine, 1,000 kN fatigue test machine, Earthquake loading simulator and so forth.

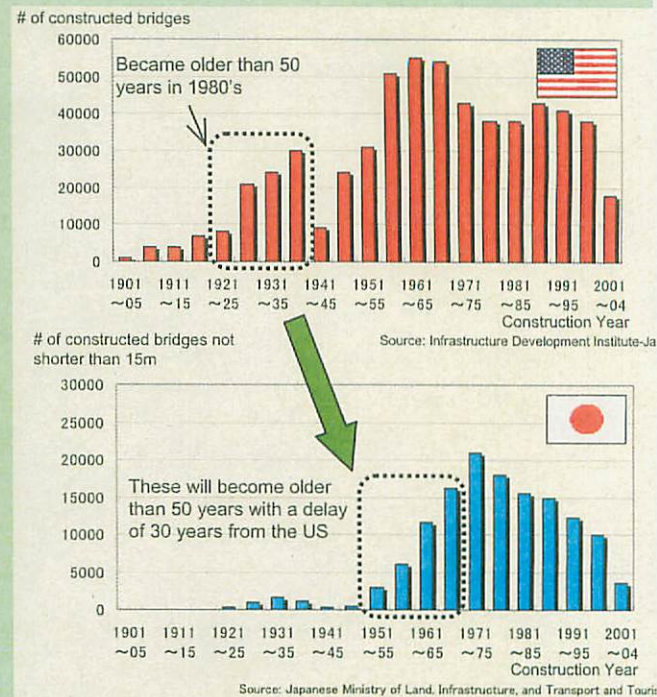
**Acronym CAESAR** —The acronym was inspired by Julius Caesar of the Roman Empire, who established and maintained the infrastructure of long empire-wide highway network – parts of which are still in use more than 2000 years later.

# Fighting the Nation's Decaying Infrastructure

In the US, vast numbers of highway bridges were constructed in the 1930s as part of that nation's New Deal public works program. Fifty years later, in the 1980s, infrastructure decay to such structures resulted in numerous traffic slowdowns and shutdowns – and emerged as an important social issue.

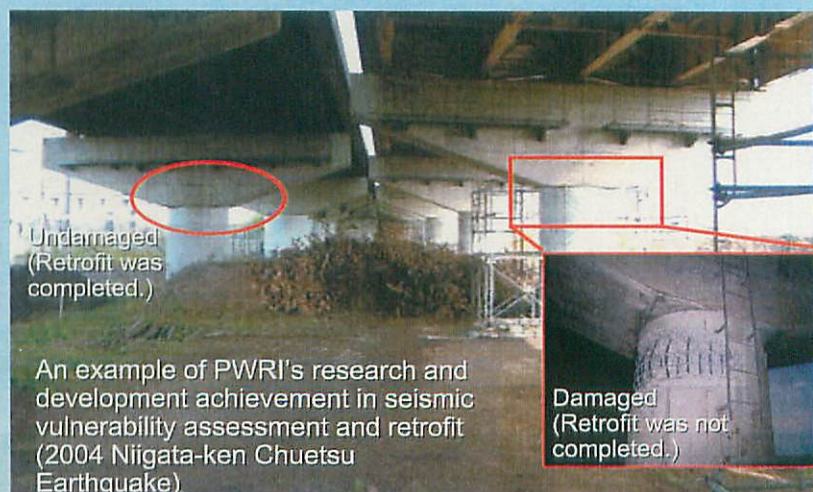
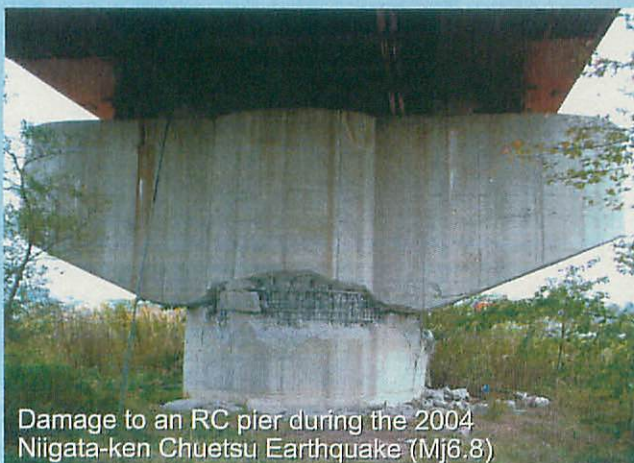
In Japan, a similar surge in infrastructure development took place alongside the nation's rapid economic growth period of the 1950s through the 1970s. This statistic is already raising concerns about three major types of distress that severely impact bridge strength capacity. They are fatigue in steel structures and deck plates, salt corrosion and alkali silica reaction (ASR) to concrete structures. We have to rush to stay ahead of the problems caused by such decay.

Therefore CAESAR applies a scientific trial approach including anatomic and pathologic elements aimed at fighting decay in the nation's highway bridges and conducts its research projects using a microscopic level of management – that is, a customized diagnosis, prognosis, and rehabilitation for individual older bridges aimed at preventing critical failure.



# Facilitating a Disaster Resilient Nation

In Japan, the 1995 Hyogo-ken Nanbu (Kobe) earthquake (Mj7.3) damaged infrastructure and a number of bridges were toppled. The urgent possibility of future large-scale earthquakes is a national concern, many of which are predicted to occur with a magnitude order of 7 to 8 on the intensity scale. The PWRI has been the center of excellence in disaster mitigation technology for highway bridges against large earthquakes. Now CAESAR will continue to develop new comprehensive technologies to make Japan resilient against earthquakes.





## Assessing the internal condition of structural members

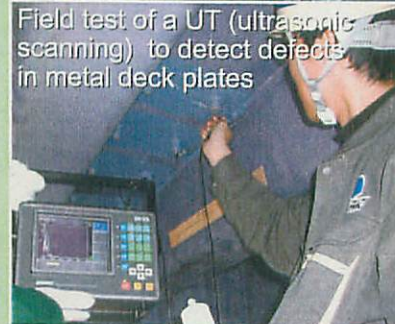
Currently, visual inspection is the standard used to make such determinations. This needs to be upgraded in order to locate problems in components which are not readily visible – such as those submerged in water.

In response, CAESAR has been testing nondestructive tools such as ultrasonic transducers (UTs) as part of efforts to detect defects in metal deck plates and a separate self-potential method to detect corrosion in concrete reinforcement bars.

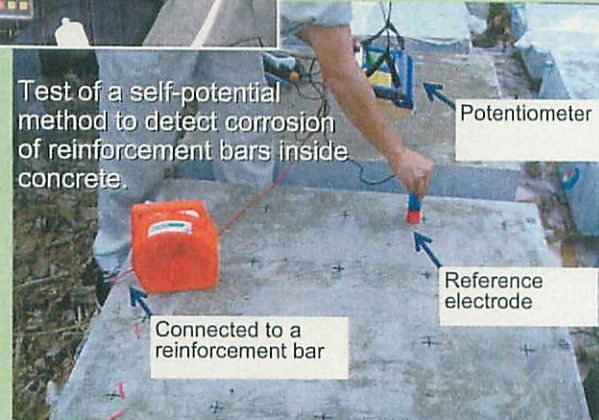
CAESAR also has projects dedicated to studying the mechanism of damage occurrences. Such efforts are necessary in order to invent cutting-edge diagnostic examinations that will accurately reveal the current structural condition and remaining performance of an existing highway bridge. A separate CAESAR project aims at measuring the influence of a particular part's structural deficiency on the overall bridge behavior.



Visual inspection is the standard used in current routine inspections



Field test of a UT (ultrasonic scanning) to detect defects in metal deck plates



Test of a self-potential method to detect corrosion of reinforcement bars inside concrete.

Potentiometer

Reference electrode

Connected to a reinforcement bar

## Improving seismic vulnerability assessment and retrofit techniques for existing bridges

In terms of disaster mitigation, CAESAR supports national initiatives, including the development of a systematic upgrade program for the seismic performance of the highway bridge group on emergency transportation highway networks.

Seismic vulnerability assessment and retrofit techniques for existing bridges include structural dynamics, nonlinear soil-foundation interactions, soil liquefaction and liquefaction-induced lateral soil spreading – all of which must be considered when evaluating seismic performance.

Needless to say, CAESAR will disseminate the results of all its research, as well as the information gained from its past experience in earthquake damage control, into its practical application of seismic vulnerability assessments and disaster mitigations as well as in the design of new and replacement structures.



A long span bridge that did not suffer damage during the 2007 Niigata-ken Chuestu-oki earthquake (Mj6.8) because of seismic retrofit guided by the PWRI.



Tests for bridge pier ductility



## Developing reinforcements and rehabilitation techniques

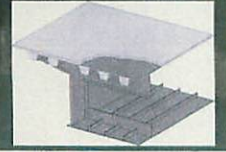
Still other CAESAR projects are aimed at developing reinforcements or rehabilitation techniques that will provide customized maintenance programs for individual bridges. CAESAR also has started a new project to conduct follow-up examinations for bridges that were rehabilitated or strengthened in the past in order to measure the effectiveness of such countermeasure works over time.

## Bridge types and structural details

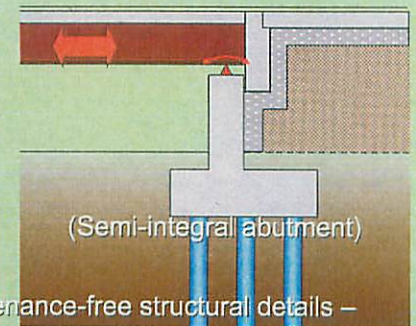
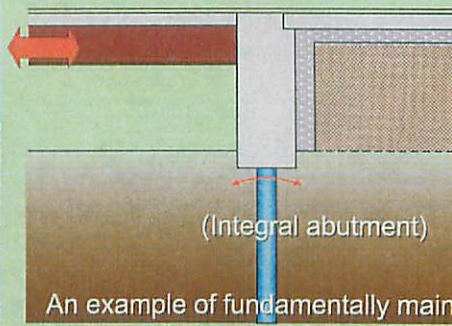
CAESAR also has projects for seeking bridge types and structural details for improving the long-term performance.



Asphalt pavement induces large localized deformation and stress



SFRC pavement has local deformation and smaller stress

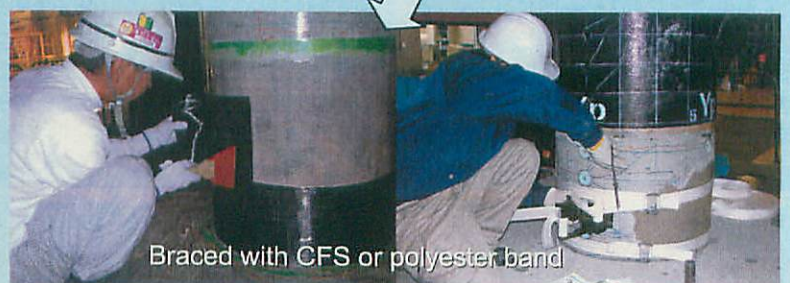
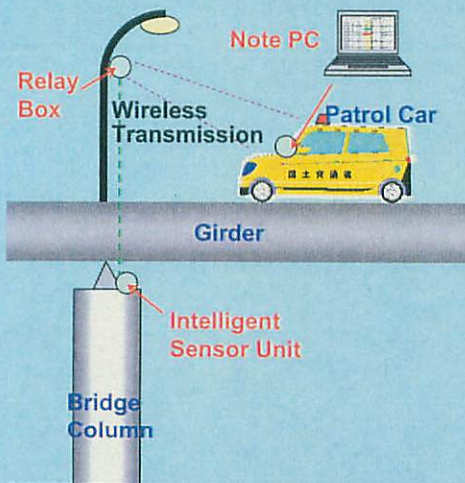


An example of fundamentally maintenance-free structural details – jointless abutments – integrating super and substructures while removing joints and bearings



## Providing post-earthquake emergency inspection and recovery tools

Another CAESAR's important goal is to provide post-earthquake emergency inspection and recovery tools for highway bridges that will allow them to return to emergency service quickly. This is necessary because, even though a large-scale earthquake causes damage to highway bridges, it is vital to return them to service as soon as possible in order to facilitate rescue efforts and transport emergency aid and supplies.



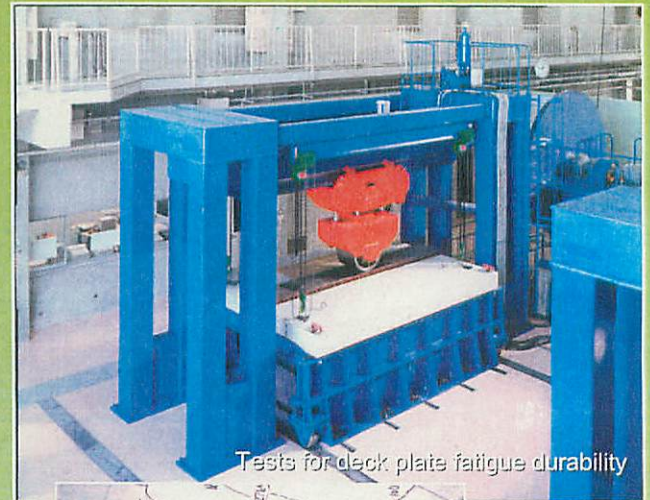
# Performance-based Design and Verification Measure

To ensure nation's bridges are structurally safe, the incorporation of ongoing technology developments from private and academic sectors is crucial.

To encourage such efforts, as well as to guarantee the quality level of individual technologies, the Center sets out not only the performance requirements, it also develops verification measures.

For example, the PWRI's standard tests for the fatigue durability of deck plates and the seismic ductility for piers have been gaining wide acceptance.

Furthermore, the Center has been preparing for the next revision of the Japanese Specifications for Highway Bridges, which will be based on a performance-based specification concept, involving a reliability design concept.



## International Collaboration

CAESAR serves as a portal site to facilitate the exchange of information and knowledge between Japan and international communities, as well as to collaborate with other foreign institutions. For example, under the framework of the Panel on Wind and Seismic Effects, UJNR (US-Japan Cooperative Program in Natural Resources), CAESAR co-organizes US-Japan Bridge Engineering Workshop with the US Federal Highway Administration and shares the knowledge, experience, initiatives, and research results with other US and Japanese highway administrators, national institutes, and academic and industry partners. CAESAR also has frequent communications with foreign government institutions and universities, in which some of them are under agreements. Furthermore, CAESAR also dispatches researchers and provides technical cooperation in response to requests from foreign highway administrators via the Japan International Cooperation Agency (JICA).



# Contact Us

Highway administrators

Guidance ↑ ↓ Needs for cutting-edge technology

**CAESAR**

Collaboration

Private sectors

Academic sectors

As the nation's primary promoter and guarantor of highway bridge excellence, the Center collaborates with voluntary public, academic and private sector organizations engaged in research activities.

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# Visiting CAESAR



## **Change of plan due to project transfer from Hokkaido Regional Development Bureau**

Civil Engineering Research Institute for Cold Region

### [Background of the project transfer]

- Due to "Regarding reduction of regular number of the staff at governmental administrative agencies"(Cabinet decision: June 30, 2006), the members of the staff of Hokkaido Regional Development Bureau shall be reduced by 1003 over 5 years by 2010.
- As a part of the reduction policy, some of Hokkaido Regional Development Bureau's projects and its 138 members shall be transferred to Civil Engineering Research Institute by 2008.

### [Contents of the transferred projects]

- On-site examination/ research, information collection, technological development
- Distribution of research results/ development technology, and development of technological instruction.

### [New system]

- Establishment of Technological Development Adjustment Department, Office for the Promotion of Technologies in Cold Regions, 4 branches, Cold Region Machinery Technology Team.

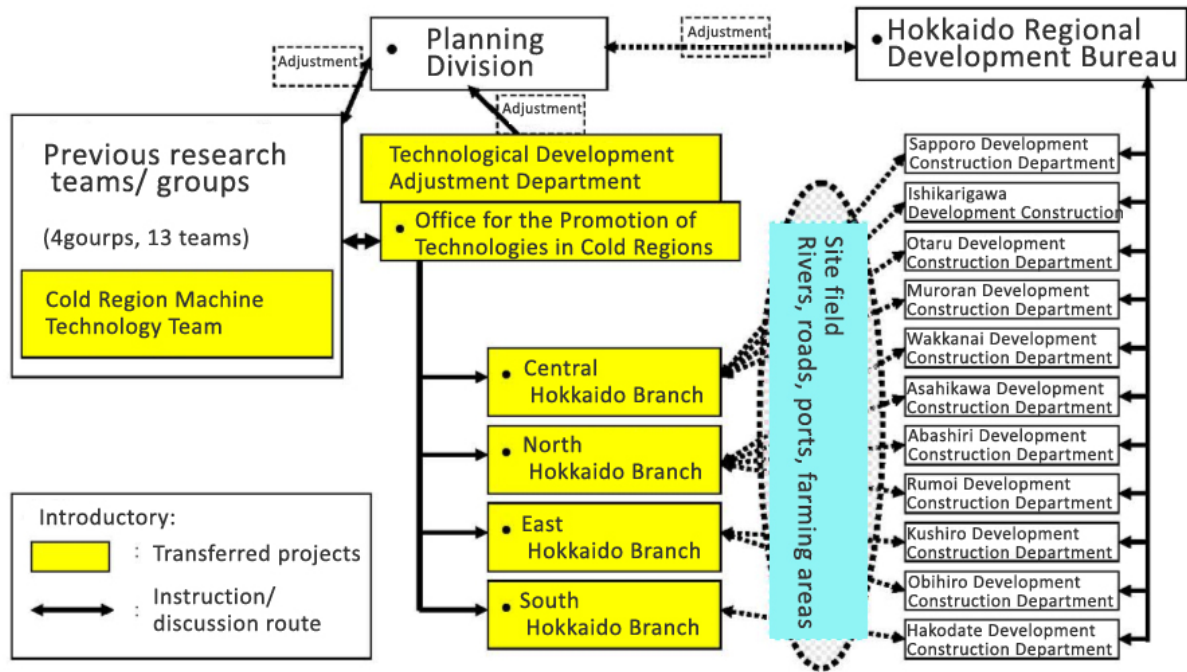
### [Changes due to the transfer]

- Research results with high local adaptability and generality achieved by cooperation among the existing research team and branches, development of on-site examination/ research sites and improvement on examination data accuracy, etc.
- Integrated implementation of identification of needs of sites and distribution of and instruction on research results and research and development.
- Increased management expenses grant due to the transfer.

### [Changes in Research plans]

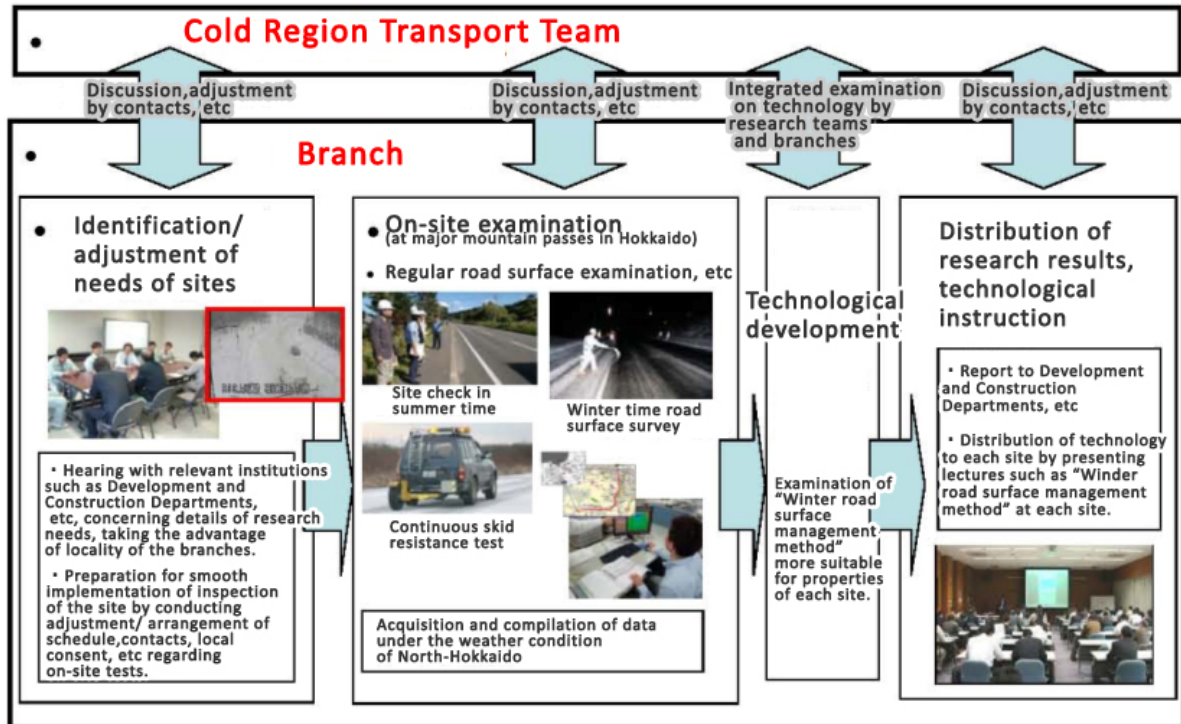
- Changes in Mid-term Plan and research implementation plan → Important Project Theme 24 (5 revised, 5 new)

**Independent Administrative Agency Civil Engineering  
 Research Institute for Cold Region  
 Transferred Project Implementation System**



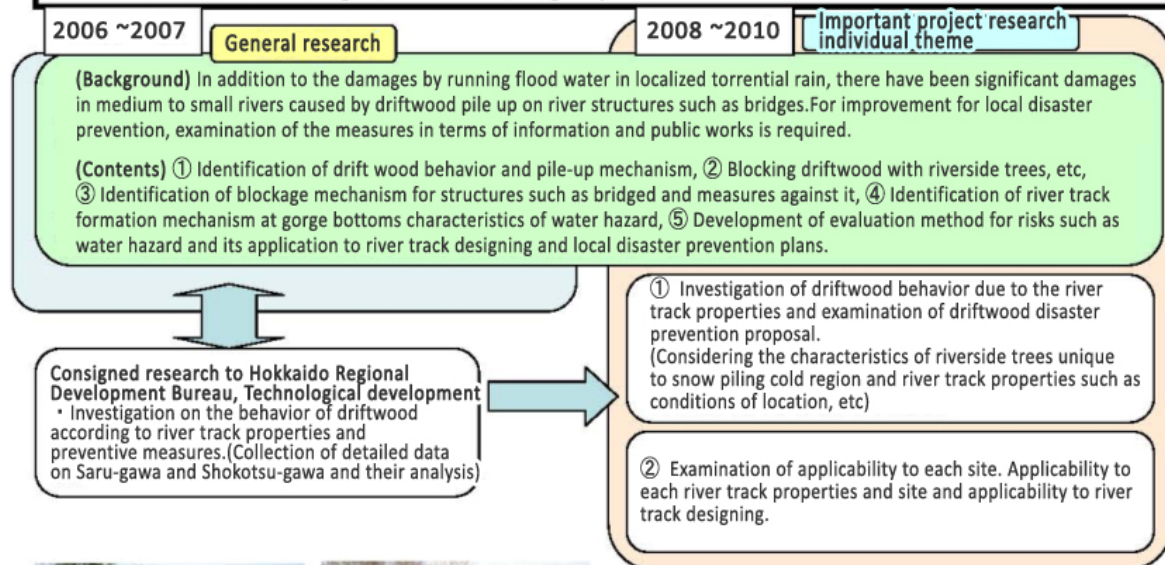
<Examples of more developed and efficient research activities due to the transfer>

## Important Project Research 7-1 Research on winter road management



<Important Project 15 Development of design technology for basin and river tracks that forms a part of the environment around cold region rivers>

## Research on investigation of river track formation mechanism and its application to measures against road blockage by driftwoods measures for



## Changes to research implementation plans due to the transfer

Subcommittee	Project leader	Priority research project	Priority research project individual themes or strategic themes	Themes jointly managed by Ministry of Agriculture, Forestry and Fisheries	
5	Director of cold region construction engineering research group	6	Change 1 Project summary	-	
			Change 2 Research on advanced evaluation/ inspection of rock/ slope collapse		
			Change 3 Research on more rational/ advanced road disaster preventive works		
		11	Research on the durability of civil engineering structures against cold weather		Change 1 Project summary
					Change 2 Research on optimization of peaty soft ground disaster preventive works
					Change 3 Research on decay behavior caused by frost-salt combination damage and its evaluations
					Change 4 Research on improvement of concrete durability in snow piling cold regions
					Change 5 Research on improvement of load carrying capacity of structures that takes lower performance in snow piling cold regions into consideration.
					Change 6 Research on decay prevention for pavement in cold regions
					Change 7 Research on public works facility management method in snow piling cold regions.
					Change 8
6	Director of Cold Region Hydraulic and Aquatic Environment Engineering Research Group	5	Change 1 Project summary	○ (from 2008)	
			Change 2 Research on improvement of utilization condition of seaside facilities in snow piling cold regions.		
			Change 3 Research on characteristics of emergence of drift ice and its effect on structures, etc.		
			Change 4 Research on improvement of functions of aquatic organism habitat in port area in cold regions and development of aqua environment preservation technology.		
			New 4 Development of technology to inspect under water structures in the port where water is supplied.		
		15	Development of design techniques for environmentally sound river basins and channels in cold regions	Change 1 Project summary	-
				Change 2 Development of technique to create and maintain diverse river environment by reconstructions of rivers, etc.	
				Change 3 Development of sound river track design technology for natural recreation of cold water fishes.	
				Change 4 Development of the salt water intrusion phenomenon in the freezing season and development of salt water intrusion control methods.	
				Change 5 Development of technology to reduce environmental burden on rivers caused by large scale farming areas and proposal of preservation management methods.	
				New 5 Investigation on river track formation and research on its application to bridge blockage by driftwood.	
-	Strategic	New 3 themes	-		

Items in blue are themes whose research plan as been revised due to the technological development related project transfer from Hokkaido Regional Development Bureau, while items in red are themes newly added due to the transfer.

## Changes to research implementation plans due to the transfer

Subcommittee	Project leader	Important project research theme	Important project research individual themes or strategic themes	Themes jointly managed by Ministry of Agriculture, Forestry and Fisheries	
7	Director of Cold region road Engineering Research group	7	Change 1 Project summary	-	
			Change 2 Research on winter road management.		
			Change 3 Research on measures against traffic accidents in cold regions.		
			Change 4 Research on performance evaluation of anti-snow facilities.		
			Change 5 Research on visibility obstruction by snow blizzard.		
			New 6 Research on reduction of anti-freeze agent spray amount.		
			New 7 Development of technology for faster snow/ ice removal.		
-	Strategic	Change 8 Research related to judgment methods for degree of snow avalanche risk in heavy snow fall	-		
8	Director of Cold region Agricultural Development Research group	16	Change 1 Project summary	○	
			Change 2 Development of technology to turn biomass into fertilizer/ energy and investigation on efficient methods of it transport.		
			2 Development of technology for effective local use of products of biomass origin.		
		17	Research on improvement of the water conveyance/distribution and structural maintenance of irrigation and drainage facilities in cold, snow regions.	New 3 Investigation of production environment improvement effect of fertilizing irrigation	○ (from 2008)
				Change 1 Project summary	○
Change 2 Development of technology for diagnosis/ improvement of water supply function suitable for paddy field/ farm land irrigation in cold regions.					
Change 3 Development of technology for stability/ durability improvement on structure/ functions.					
-	Strategic	Change 4 Research on technology for repair/ improvement planning for agricultural water supply facilities.	○ (from 2008)		
-	Strategic	New 2 themes	-		

Items in blue are themes whose research plan as been revised due to the technological development related project transfer from Hokkaido Regional Development Bureau, while items in red are themes newly added due to the transfer.