－Priority Research Project－

Research on prevention and mitigation of flood-related disasters in the world by utilizing integrated risk management approach

Research Period: FY2005-2010
Project Leader: Director of Water-related Hazard Research Group
TERAKAWA Akira
Research Group: Water-related Hazard Research Group
Cold-Region Hydraulic and Aquatic Environment Engineering Research Group

Abstract:
In order to make contribution for preventing and mitigating flood-related disasters in the world, this project covers several topics for integrated risk assessment and risk management in various natural and social conditions. The research topics in FY2006 include analysis of social vulnerability to flood disaster, flood forecasting and warning making use of satellite information, flood hazard mapping and experimental/analytical study on the behavior of tsunami wave running up into rivers. The outputs from the project are expected to be used as training materials for practical engineers of developing countries in charge of flood related disasters management.

Key words: flood, tsunami, risk management, capacity building, forecasting, warning, hazard map

－Individual Themes－

A case study on asistance for strengthning flood damage mitigation measurers

Budged: Grants for operating expenses
General account
Research Period: FY2006-2008
Research Team: Disaster Prevention
Author: YOSHITANI Junichi
TAKEMOTO Norimichi

Abstract:
This study is to summarize analyses of local vulnerability for water hazards and tangible measurers for strengthening damage mitigation systems on a regional basis. In fiscal 2006, we selected two countries of Philippines and Sri Lanka and did factor analysis of flood damages by means of literature research. Furthermore, regarding Bangladesh, we collected additional information mainly by hearings, formed a hypothesis and verified it by field survey.

Key words: flood damage, risk management, case study, factor analysis, overseas research

A study on Flood Hazard Mapping for developing countries

Budged: Grants for operating expenses
General account
Research Period: FY2005-2008
Research Team: International Technical
Exchange Team
Author: TANAKA Shigenobu
TOKIOKA Toshikazu
Rabindra Osti

Abstract:
To identify the situation and issue of Flood Hazard Mapping in the developing countries, field survey and documentation was carried out in East and South East Asian countries. As a result of this investigation, it was identified that some of the countries made their own Flood Hazard Map in each pilot area, but not yet published. And also, Community Based Flood Hazard Mapping including dissemination process might be effective to make and disseminate Flood Hazard Map.

Key words: Flood Hazard Map, developing countries, flood, anticipated inundation area, dissemination

Study on the development of a basic system for flood forecast and alert based on the information provided by satellites

Budged: Grants for operating expenses
General account
Research Period: FY2006-2008
Research Team: Hydrologic Engineering
Author: FUKAMI Kazuhiko
INOMATA Hironori

Abstract:
In order to promote flood forecast and alert in developing countries which has few hydrological observation data, the applicability of satellite-based rainfall data was examined and Integrated Flood Analysis System (IFAS) was developed. IFAS is based on a distributed runoff model and can simulate river discharge through globally arranged GIS data and use-friendly interface. Object oriented modeling was introduced to this system to reduce the difficulty of incorporating other runoff models to the system.

Key words: satellite-based rainfall data, Integrated Flood Analysis System, user-friendly interface, object oriented modeling

A study on tsunami wave in river and mitigation of its dameges

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: River Engineering
Author: WATANABE Yasuharu
YASUDA Hiroyasu

Abstract:
Hydraulics experiments showed that under undular bore, the maximum. water level rise was 1.4 times that under still water without flow and the water level was up to twice the initial wave height at the downstream end. One-dimensional calculations using conventional shallow-water-theory equation unestimated the calculated wave height and over estimated the wave velocity, relative to experimental measurements.

Calculations using a Boussinesq-type equation produced good agreement with experimental data.

Key words: undular bore, hydraulic experiments, numerical analysis, nonlinear dispersive, wave theory

－Priority Research Project－

Development of technologies for strengthening river levees against floods

Research Period: FY2006-2010
Project Leader: Director of Construction Technology Research Department
MINAMI Kiyoshi
Research Group: Construction Technology Research Department
Material and Geotechnical Engineering Research Group
Hydraulic Engineering Research Group

Abstract:
More frequent concentrated rainfall caused by recent climatic change has increased damage caused by the breaching of river levees. Purpose of this project is to improve flood safety by strengthening of levees. Goals of the project are shown as follows;
1) To improve river levee vulnerability assessment methods and prepare the Manual of River Levee Investigation Using Integrated Physical Investigation Technology.
2) To improve levee strengthening measures against seepage.
3) To improve levee strengthening measures against erosion due to overflow of river water.

Key words: river levees, flood safety, vulnerability assessment, integrated physical investigation technology, levee strengthening measures

－Individual Themes－

A study on vulnerable point detection method and reinforcement method for river levee

Budged: Grants for operating expenses
River account
Research Period: FY2006-2008
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
FURUMOTO Kazushi
SAITO Yukiko

Abstract:
From the inspection of river levees, there seems to be vulnerable points in some river levees. In this research, we have tried to improve the evaluation method of levee's stability and develop the reinforcement method for a river levee. From the field investigation, numerical analysis and model tests, the parameters influencing the river levee stability are figured out. And the effect of sheet-pile method with slope protection for river levee was clarified.

Key words: river levee, seepage, water leak, stability evaluation, reinforcement method

Development of integrated geophysical investigation technique for vulnerability assessment of levee

Budged: Grants for operating expenses
River account
Research Period: FY2006-2008
Research Team: ConstructionTechnology
Research Department
Author: INAZAKI Tomio

Abstract:
Geophysical investigation is expected to play an important role in the vulnerability assessment of levee, because the conventional visual inspection and spot drilling technique is inadequate to detect internal anomalies of levee. Geophysical investigations have been undertaken to establish an integrated geophysical survey method helpful for detecting anomalies and characterizing them in the viewpoint of permeability and stiffness along the actual levees. Field tests showed that the combination of capacitively coupled resistivity method and high resolution surface wave method had high potentiality as a continuous levee investigation technique.

Key words: river levees, vulnerability assessment, integrated geophysical investigation, capacitively coupled resistivity method, surface wave method

A study on countermeasure for cavity around sluice pipe in river levee

Budged: Grants for operating expenses
River account
Research Period: FY2006-2008
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
FURUMOTO Kazushi
SAITO Yukiko

Abstract:
The sluice pipe which is installed across the river levee is important structure for flood control. However, it may be found a void between the sluice pipe and its basement/levee, especially which is supported by pile. Such cavity may generate the piping phenomenon around sluice pipe. In this research, we figured out the generating mechanism of the cavity and evaluated the structural health of the river levee around sluice pipe by the model tests and the field tests.

Key words: river levee, sluice pipe, seepage, water leak, cavity

To improve levee strengthening measures against erosion due to overflow of river water

Budged: Grants for operating expenses
River account
Research Period: FY2006-2008
Research Team: River and Dam Hydraulic Engineering
Author: HAKOISHI Noriaki
SAKANO Akira

Abstract:
In recent years, there are concern that the increasing in the levee break damage by the excess flood and the flood below the plan scale on the maintenance way. And the improvement in the degree of flood control safe by qualitative strengthening of a levee serves as pressing need. And so, we reviewed case analysis of levee break examples. Moreover, the approach and the examination object of future research were clarified.

Key words: levee, levee break, erosion, strengthening measures, hydraulic study

To improve levee strengthening measures against erosion due to overflow of river water (2)

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
FURUMOTO Kazushi
SAITO Yukiko

Abstract:
In recent years, there are concern that the increasing in the levee break damage by the excess flood and the flood below the plan scale on the maintenance way. And the improvement in the degree of flood control safe by qualitative strengthening of a levee serves as pressing need. In this research we investigated the effect of the drain work, the enlarge method (low-gradient) and short-fiber reinforced soil method.

Key words: levee, levee break, erosion, strengthening measures, model test

－Priority Research Project－

Development of seismic resistant technologies for road and river facilities to prepare for the anticipated big earthquakes

Research Period: FY2006-2010
Project Leader: Director of Earthquake Disaster Prevention Research Group
MATSUO Osamu
Research Group: Earthquake Disaster Prevention Research Group
Structures Research Group
Hydraulic Engineering Research Group

Abstract:
Big earthquakes are expected to occur in Japan in the coming few decades. They are likely to hit the major areas where population and properties are highly accumulated, and the expected damage loss by the individual earthquake amounts to as large as some tens- to a hundred- trillion yen. In order to reduce the damage loss, seismic retrofitting of existing structures is one of the most crucial tasks. The research project aims to develop/improve technologies to seismically assess and strengthen existing engineering structures, including bridges, embankments, dams and river facilities.

The typical outputs from the FY2006 research are given in the following:

1) For the development of performance based design of long-span bridges and special structural type bridges, a procedure for assessing the seismic capacity of each structural member was developed.

2) It was verified from a series of model shaking tests that well soil compaction and placement of subsurface drainage system are very effective to mitigate earthquake-induced damage to road fills on mountain slope areas.

3) Effectiveness of damage evaluation system using sensors was verified for the shear failure type and repaired reinforced concrete columns through shake table tests. Also, the prototype model of the damage evaluation sensing system was developed and it was installed at an actual bridge to study the practical applications.

4) Mechanical properties of concrete crack interface in gravity-type concrete dams were identified through direct shear tests of the concrete specimen and a series of dynamic analysis. Then, the dynamic behavior of a full-scale gravity-type concrete dam with a height of 100 m during a very strong earthquake was simulated.

5) It was experimentally verified that a deep mixing method that is used as a seismic

countermeasure for soil embankments and is designed with a conventional design procedure against the L-1 earthquake is effective even against the L-2 earthquake.

Key words: seismic resistant technologies, assessment, retrofit, road, bridge, dam, river

－Individual Themes－

Seismic retrofit strategy for existing highway bridges

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2009
Research Team: Earthquake Engineering
Author: UNJOH Shigeki
SUGIMOTO Ken
Mohammd Reza Salamy

Abstract:
In this research, to develop effective seismic retrofit strategy for existing highway bridges, seismic vulnerability assessment of the long-span bridges and improvement of seismic performance evaluation method applicable to long-span bridges have been studied. The applicability of seismic control devices for the retrofit of truss/arch type bridges was analytically studied. Moreover, analytical study to evaluate seismic performance of existing bridge piers and foundations was made.

Key words: long-span bridge, arch bridge, seismic performance, seismic retrofit

Seismic performance assessment of existing highway bridge foundations

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2008
Research Team: Foundation Engineering
Author: NAKATANI Shoichi
SHIRATO Masahiro

Abstract:
As increase with the likelihood of severe earthquakes, public demands are extremely high for mitigating the obstruction of emergency activities after a severe earthquake. The retrofit and reinforcement of existing structures in highways is essential so that designated highways continue to work as emergency road networks after such an earthquake. However, there are literally many existing highway bridges that were not design in accordance with the latest design requirements in codes, including the seismic performance of foundations. However, no systematic decision making strategy is available to prioritize existing foundations from the viewpoint of the needs for seismic retrofitting and reinforcing, because it is unclear how much we can expect the seismic performance in the existing foundations. Therefore, the missions of this study are 1) to develop the multi-level seismic performance demands for existing foundations and 2) to guide the prioritization of the needs for seismic retrofitting and reinforcing of existing foundations.
In the fiscal year of 2006, 1) we investigated the current practice of the seismic retrofitting and reinforcement of existing highway bridges, 2) we investigated damage case histories of highway bridges, 3) studied past design requirements and developments of construction technology, 4) we established theories about the failure mechanism of foundations and characterized the foundations that potentially have higher risk against earthquakes, and 5) we investigated the design years and types and materials of existing highway bridge foundations, considering the results obtained in the items 2) to 4). In the next phase, we will make a criterion that classifies the levels of seismic performance of existing foundations using available design information.

Key words: existing foundation, earthquake resistant, risk mitigation

Seismic retrofits for bridge abutments over liquefiable ground

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2009
Research Team: Ground Vibration
Author: SUGITA Hideki
TAKAHASHI Akihiro
TANIMOTO Shunsuke

Abstract:
Aim of this project is to develop methods for seismic performance assessment bridge abutment considering displacement demands and seismic retrofits for bridge abutments over liquefiable ground under strong earthquake motions. In the first fiscal year of the project, major forces that dominate seismic behavior of bridge abutments over liquefiable ground under strong earthquake motions were determined by means of numerical and physical model tests. The numerical and physical model tests reveal that conventional design methods may underestimate the permanent abutment displacements unless the following two items are considered: (1) softening of the soil beneath the liquefiable layer, due to cyclic shearing of the soil surrounding the piles, and (2) the forces acting on the abutment side faces. Further data analyses are needed to identify required seismic performance of bridge abutments as well as “strut effects” of bridge(s) for the seismic abutment behavior.

Key words: bridge abutments, liquefaction, finite element analysis, centrifuge model tests

Seismic retrofits for road embankments on mountain side

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2010
Research Team: Ground Vibration
Author: SUGITA Hideki
SASAKI Tetsuya
MIZUHASHI Masanori

Abstract:
Purpose of this study is to develop seismic retrofits for road embankments on mountain side under strong earthquake motions. In the first fiscal year of the study, major factors affecting seismic behavior of road embankments were examined by case histories of road embankments damaged by the past earthquakes and a series of centrifuge model tests on road embankments on a stiff base slope. The results demonstrated that compaction density and elevation of seepage water strongly affected the magnitude of earthquake-induced permanent deformation of embankment. Furthermore, the results of centrifuge model tests were compared with conventional stability analysis and Newmark method in order to verify applicability of those method.

Key words: road embankments, earthquake, centrifuge model tests

Development of quick repair method for seismic damage of bridge structures

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2009
Research Team: Earthquake Engineering
Author: UNJOH Shigeki
Mohammd Reza Salamy
SAKAI Junichi

Abstract:
The objective of this study is to develop a method that evaluates the seismic safety of damaged structures for aftershocks and a quick repair method of seismic damage of bridge structures. In FY 2006, a series of shake table tests was conducted to evaluate the effect of aftershocks on the seismic safety of damaged reinforced concrete bridge columns, and the effectiveness of a quick repair method using quick hardening mortar and resin. The tests revealed that the seismic performance of reinforced concrete columns for aftershocks is not significantly affected by the seismic damage, and that the quick repair method can recover the seismic performance of damaged columns within one day.

Key words: bridge, seismic damage, quick repair, reinforced concrete column, shake table test

Development of estimation method for seismic damage using advanced sensor

Budged: Grants for operating expenses
General account
Research Period: FY2003-2007
Research Team: Earthquake Engineering
Author: UNJOH Shigeki
Mohammd Reza Salamy
SAKAI Junichi

Abstract:
The objective of this study is to develop sensing technology to estimate the seismic damage of structures using advanced sensors. The method that evaluates seismic damage of reinforced concrete columns that fail in flexure had been developed in the past study. In FY 2006, to evaluate the applicability of the method to other type of structures, a series of shake table tests was conducted for reinforced concrete columns that fails in shear, and that were repaired with carbon fiber sheets after seismic damage. The damage detection system using the method is developed, and applied to actual bridges.

Key words: seismic damage, damage detection, reinforced concrete column, shake table test

Research on integrity evaluation of dams

Budged: Grants for operating expenses
General account
Research Period: FY2004-2007
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
SASAKI Takashi
KOBORI Toshihide
SASAKI Susumu
HAYASHI Naoyoshi

Abstract:
The cost reduction and labor-saving are strongly required in safety management and soundness evaluation for dams because of the limited personnel and budget. The deterioration of existing dams, and the appearance of new-fashioned dams such as trapezoid-shaped CSG dam and CFRD make the dam behavior more complicated. In addition, on March 30, 2005, notification regarding the "Draft of Guidelines for Seismic Safety Evaluation of Dams" systematically describing methods of evaluating seismic safety of dams subjected to large-scale earthquakes was proposed by Ministry of Land, Infrastructure and Transport. Therefore, dam managers should pay attention to the damage due to large earthquake motions.

In this study, we will propose the new measurement methods corresponding to the complicated behavior of aged and new-fashioned dams, and soundness evaluation method in consideration of damage generated by large earthquake motions.

Key words: Dam, Concrete Face Rockfill Dam (CFRD), slide type inclinometer, Global Positioning System (GPS), integrity evaluation, safety management

Research on rehabilitation and reinforcement of concrete dams

Budged: Grants for operating expenses
River account
Research Period: FY2005-2007
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
SASAKI Takashi
KOBORI Toshihide

Abstract:
There are many effective methods for rehabilitation and reinforcement of the concrete structures in the field of bridges and tunnels, and a lot of actual cases are reported. In the dam engineering field, there are many cases of rehabilitation methods against the water leakage through concrete dam bodies. However, the strengthening measures have not been established. Because the crack damages are expected in concrete dams due to large-scale earthquake motions, it is strongly desired to develop rehabilitation and reinforcement method for the purpose of the recovery or the increment.

In this fiscal year, numerical simulations were conducted to evaluate add-on concrete method and anchoring method. In addition, pulling tests were performed using concrete specimens sampled from an existing concrete gravity dams to evaluate the friction drag between concrete and the anchored body.

Key words: concrete dam, rehabilitation, add-on concrete method, anchoring method, nonlinear analysis

Evaluation of ultimate limit resistance of concrete gravity dams against large earthquakes

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
SASAKI Takashi
KOBORI Toshihide
SASAKI Susumu

Abstract:
The seismic safety of concrete dams is a major concern due to the catastrophic consequences of a sudden release of the reservoir if the dam fails under strong earthquake motions. The seismic safety of concrete dams should be periodically evaluated considering the latest assessment of their strengths and the ground motion intensity to which they might be subjected.

The purpose of this research is to establish an evaluation method of ultimate limit resistance of concrete gravity dams against large earthquakes considering dynamic rocking and sliding behaviors of concrete block separated by dynamic tensile cracking.

In this fiscal year, we conducted the reproducing analysis of dynamic behavior of a concrete specimen during a shake table test and shear tests on concrete specimens with a tensile crack, in order to input physical properties for numerical simulation using distinct element method. In addition, we performed numerical simulation of a 100-m concrete dam using the above-mentioned input physical properties to show its seismic behavior.

Key words: concrete gravity dam, tensile crack penetration, distinct element method, ultimate limit resistance

Seismic retrofits for river facilities considering structure ductility under strong earthquake motions

Budged: Grants for operating expenses
River account
Research Period: FY2006-2009
Research Team: Ground Vibration
Author: SUGITA Hideki
TAKAHASHI Akihiro
TANIMOTO Shunsuke

Abstract:
Aim of this project is to develop seismic retrofits for river facilities considering structure ductility under strong earthquake motions. In the first fiscal year of the project, seismic performance of cement-treated soil in grid pattern was examined by means of physical model tests and case histories of river facilities damage in the past earthquakes were collected. For the former, centrifuge model tests on levees whose foundation are susceptible to liquefaction and are retrofitted by cement-treated soil were performed to investigate the seismic performance of the system, as improvement of liquefiable foundation ground by cement is often adopted to mitigate liquefaction-induced settlement of levees. Test results reveal that the remedial measure designed for moderate earthquakes performs well even for strong earthquakes and local failure of the treated soil does not affect much on overall stability of the improved zone.

Key words: river facilities, levees, cement-treated soil in grid pattern, centrifuge model tests, case histories

－Priority Research Project－

Development of technologies for predicting or mitigating sediment-related risks posed by severe rainfalls or earthquakes

Research Period: FY2006-2010
Project Leader: Director of Erosion and Sediment Control Research Group
TERADA Hideki
Research Group: Erosion and Sediment Control Research Group
Material and Geotechnical Engineering Research Group

Abstract:
In this study the following studies have been executed 1) The advancement and the practical application of the risk evaluation method to predict the time and the area where rainfall-induced sediment-related disasters occur; 2) the clarification of the mechanism of landslide at the time of the Chuetsu earthquake and the development of the risk evaluation method and the development of the method to predict the temporal change in the sediment yield and discharge from the seismically-disturbed watersheds based on the clarified mechanism; 3) the development of the practical monitoring method and the emergency response method for the prevention of the secondary disasters after landslides and other hazardous phenomena.

Key words: sediment-related disaster, risk evaluation method, regulation time for the road traffic, earthquake-induced landslide, remote monitoring technique, emergency response technique

－Individual Themes－

Study on the method to evaluate risks of landslide-induced debris flows using new geological data

Budged: Grants for operating expenses
River account
Research Period: FY2005-2007
Research Team: Volcano and Debris Flow
Author: KURIHARA Junichi
SAKURAI Wataru
SAKAI Naoki

Abstract:
In the FY 2006, the authors evaluated risks of shallow-landslide-induced debris flow in torrents using numerical shallow-landslide prediction model. This model was applied to the Niihama in Ehime prefecture where many shallow-landslide and debris flows occurred in 2004. In this study, it has been shown that the torrents where this model marked relatively high risks nearly corresponded to those where landslides and debris flows had actually occurred. On the other hand, the authors studied the method to find deep-sheeted landslide-prone torrents geologically or geomorophologically. Some quantitative geomorphological indices such as curvature of slopes and relief index were effective to find deep-sheeted landslide prone torrents.

Key words: new geographical data, shallow landslide, deep sheeted landslide, debris flow, risk evaluation

Research on road traffic management for reduction of regulation time due to slope failure (1)

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2008
Research Team: Geology
Author: SASAKI Yasuhito
ASAI Kenichi
KURAHASHI Toshiyuki
YAJIMA Yoshinori

Abstract:
Data of disasters which occurred on the national roads were analyzed statistically. The results are as follows: 1) Many disasters occurred especially in Kyushu and Hokkaido. Concerning the disaster type, most of the disasters were slope failure of surface soil, and secondly rock falls and debris flows were many. 2) The volume of soil and rocks which reached on the road was relatively large in Shikoku. 3) The number of disaster which occurred out of the regulation section was larger than that occurred in the regulation section. 4) 30 percent of the disasters occurred due to the continuous rainfall under 25 mm in total. 5) Disasters were easy to occur in the region of Tertiary sedimentary rocks and Miocene submarine volcanic rocks in Japan. And many disasters were occurred also in the region of Paleozoic and Mesozoic sedimentary rocks in the west Japan. Regional characteristics are also recognized, for example, many disasters occurred in the region of Quaternary volcanic rocks in Kyushu.

Key words: road, slope, disaster, regulation, rainfall

A research on road traffic management for reduction of regulation time due to slope failure

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2008
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
KATOU Shunji
YOSHIDA Naoto

Abstract:
The direct loss of road network by the slope disaster is regulation time on road traffic. On the risk analysis of road slope disaster, simple calculating method for the regulation time has been required. Then, we analyzed the relationship between recovery time of road traffic and collapse soil volume using disaster records of direct control national road. As the result, it was confirmed the correlation between recovery time of road traffic and collapse soil volume. In addition, it was confirmed that the recovery time corresponded to the disaster prevention inspection rank.

Key words: road slope disaster, risk evaluation, the recovery time of road traffic, the disaster prevention

Research on strength change characteristic of sliding soil mass with earthquake

Budged: Grants for operating expenses
River account
Research Period: FY2005-2007
Research Team: Snow Avalanche and
Landslide Research Center
Author: HANAOKA Masaaki
MARUYAMA Kiyoteru
SUZUKI Shigeru
HAS Baator

Abstract:
Although it is assumed that earthquakes do not cause existing landslide ground to suddenly begin to slide, the Chuetsu Earthquake that triggered violent shaking, caused large landslide soil masses to slide abruptly, either striking hamlets directly, blocking their access roads, or cutting off other lifelines, and blocking rivers at many locations in the disaster region. These landslides had a serious impact on the disaster region, including prolonged isolation of hamlets. The Center has, since 2005, taken the Chuetsu Earthquake as a sample case to clarify the mechanism by which an earthquake causes existing landslide ground to slide with reference to the topography and geology clarified by a detailed survey and analysis and to the characteristics of the shear strength of a landslide soil mass during an earthquake, and to study typical landslides to develop a method of assessing the risk of a landslide caused by an earthquake.

This became a priority project research in 2006, and this report presents the research results since 2005. In 2005, typical cases of the sliding of existing ground inside landslide topography were selected, and the factors causing the landslides were determined based on the results of detailed field surveys, including the internal geological structure and clarification of the slip surface obtained by boring done as part of countermeasure work on the Shiotanikamisawa River, at Tamugiyama-Kotaka, and at Amayachi. In 2006, we used DEM to analyze the topography before and after the earthquake to study the characteristics of the landslide caused by the earthquake in the Imo River Basin. In addition, samples were taken from the landslide ground and used for dynamic ring shear testing.

Key words: earthquake, landslide, causal factors, dynamic ring shear test

Study on the method to evaluate the risks of the post seismic sediment-related disasters in moutainous catchments

Budged: Grants for operating expenses
River account
Research Period: FY2006-2009
Research Team: Volcano and Debris Flow
Author: KURIHARA Junichi
SAKURAI Wataru
YAMAKOSHI Takao

Abstract:
In the F.Y.2006, the authors have investigated post-seismic sediment yield processes in the Imokawa basin where many landslides had occurred at the time of the Chuetsu Earthquake in 2004. In addition, the authors have also studied monitoring methods which would be suitable to watch natural dams. As a result, the following are clarified.
1) Some technical problems have been revealed to be necessary to be improved to watch natural dams against dam breaks;
2) Applicability of equipments to measure erosion of natural dams have been shown through some field experiments;
3) Post-seismic sediment yield processes have been shown as of the year 2006.

Key words: sediment yield, sediment discharge, natural dam, seismic motion, the Imo river

Development of monitoring methods and techniques for emergency measures of currently activated landslides

Budged: Grants for operating expenses
River account
Research Period: FY2005-2008
Research Team: Landslide
Author: FUJISAWA Kazunori
FUJIHIRA Dai

Abstract:
Once landslides are activated, they should be treated as soon as possible to minimize damage to the environment. The features of landslides, however, are various, and the same emergency measure is not always applicable. In this project first landslides occurred in the past are classified from geomorphic and geological views, and then applied emergency measures and their effects to control the movement are examined for each landslide type. In addition, a remote monitoring system of unstable landslide surfaces is developed for the purpose of fast grasp of landslide behavior.

Key words: landslides, emergency measures, remote monitoring system, estimation of slip surface, aero-photograph

－Priority Research Project－

Research on efficient utilization of sea fronts in the cold region

Research Period: FY2006-2010
Project Leader: Director of Cold-Region Hydraulic and Aquatic Environment Engineering Research Group
ISHIDA Kyohei
Research Group: Cold-Region Hydraulic and Aquatic Environment Engineering Research Group

Abstract:
Because Hokkaido is in the subarctic climate zone, the ports and harbors here are subject to frigid conditions and snowfall. This research aims to promote the efficient utilization of sea fronts in the cold region. In fiscal 2006, an experiment to clarify the relationship between working environment and work efficiency was conducted. Basic features of ice force acting on sea ice control facilities are clarified. Ports and harbors in cold regions ware categorized in accordance with environmental conditions, then methods of appropriate maintenance and efficient development of such waters were verified. It contributes to the improvement of the productivity of the coastal zone, and environmental conservation in the ports and harbors.

Key words：working environment, ice force, ice control facility, artificial reef for fish habitat, submarine forest

－Individual Themes－

Study on improvement of utilization of coastal facilities in the cold region

Budged: Grants for operating expenses
General account
Research Period: FY2006-2008
Research Team: Port and Coast
Author: ATSUMI Youichi
KIOKA Shinji

Abstract:
Working environments at fishery ports and harbors during the winter in cold, windy regions are very severe for workers. To examine the necessity of facilities such as the wind and snow shelters, we should quantitatively evaluate in terms of human sensation. We conducted sensory experiments on subjects to examine the practical application of some thermal indices and “work efficiency” under cold condition. The WCI seems to be the most useful index from a practical point of view. We also clarified influences of thermal environment and time (exposure period) on “work efficiency”.

Key word: working environments, the wind and snow shelters, WCI, work efficiency

Sea ice observation and interaction between sea ice and structures

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Port and Coast
Author: KIOKA Shinji
MORI Masaya

Abstract:
As results of the sea ice observation using IPS and ADCP in Okhotsk sea, large-scale deformed ice with draft depth of 4m or deeper even in Okhotsk Sea known as the southern limit of sea ice, which formed by dynamic actions.

In order to investigate the application of the wave gauge, which established permanently at Okhotsk Sea of Hokkaido, to sea ice observation, we made preliminary experiment on its performance. The results were encouraging and such trials will be in progress.

Finally, we made the experiments on interaction between sea ice floes and ice booms. The mechanisms of behavior and action of sea ice floes against ice boom and ice forces acting on the ice booms were clarified.

Key words: Sea ice, ice force, echo, Okhotsk sea, ice boom

Improvement of water areas in ports in cold regions as habitats for aquatic organisms, and development of water environment preservation technologies

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Fisheries Engineering
Author: YAMAMOTO Jun
KITAHARA Shigeshi
MAKITA Yoshimi
SATO Akemi

Abstract:
This research tries to develop methods to improve the sediment quality in mooring basins and to foster seaweed beds that provide for a sound coastal environment. Researches in 2006 are categorizing waters in ports in cold regions in accordance with environmental conditions, and verification of a method of appropriate maintenance and efficient development of such waters.

Key words: live fish stock, sediment contamination, artificial reef of scallop shell, submarine forest, swinging texture for adhering seaweed, nutrients, fermented fish scraps to fertilize seawater, seawater exchange

－Priority Research Project－

Research for improving road safety standards against large-scale rock slope failures

Research Period: FY2006-2010
Project Leader: Director of Cold-Region Construction Engineering Research Group
NISHIKAWA Jun'ichi
Research Group: Cold-Region Construction Engineering Research Group

Abstract:
Since the rock failure which caused the fatal collapse of Toyohama Tunnel in 1996, surveys of slopes along roads have been performed and safety measures have been conducted eagerly. Despite this, large-scale rock slope failures have continued, such as those in the Hokuyo district of Kitami City in 2001 and in Erimo Town in 2004, in addition to frequent rockfalls. It is necessary to implement measures for the safety and stability of roadside slopes. To prevent such disasters by improving road safety standards, this research aims to develop a system for inspecting roadside slopes and for assessing their likelihood of failure by further incorporating geographical and geological data. In this year, records of recent slope failures in Hokkaido were collected and were analyzed from geographical, geological and other technical points of view. The new screening plan to choose checkpoints of periodical slope inspection along national road for slope failure disaster prevention was proposed. Rock fall occurs frequently at slopes along roads. It needs new design methods for safer, more effective disaster prevention works which satisfy site conditions and their changes, and more effective methods for the repair and reinforcement of existing disaster prevention works along roads should be developed. In this year some experiments assuming rock fall were conducted to check shock resistance of RC arch culvert tunnel mouth. The results of these experiments showed the limits of arch effect of RC arch culvert against rock fall. And the new retaining wall against rock fall, which has the double shock absorbing structure and piles, was developed in this research.

Key words: large-scale rock slope failure, road disaster prevention inspection, road disaster prevention structure

－Individual Themes－

Research for upgrading of estimation and examination of rock failure and slope failure

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Geological Hazards
Author: ITOU Yoshihiko
KUSAKABE Yuuki
ITO Noriaki
OKAZAKI Kenji
AGUI Katsuhito

Abstract:
Since the collapse of Toyohama Tunnel in 1996, there have been several other large-scale rock slope failure in Hokkaido, such as those in Daini-Shiraito Tunnel in 1997, in Kitami-Hokuyo in 2001 and in Erimo in 2004. For keeping road safety from slope failure, construction of more precise system for research, estimation, check and countermeasure of slope along road are needed. In this research, aiming to keep road safety and upgrade of estimation and examination of rock failure and slope failure, collection and analysis of recent records of slope failure, proposal of estimation plan of rock failure and slope failure, study for application of survey and watch technique of wide area, plan making of new system of research, watch and check of slope failure, inspection of applicability of the plan for actual slope, summarization by putting together the above mentioned study, are needed to carry out. In 2006, recent records of slope failure in Hokkaido were collected and analyzed from geological, geographical and technological points of view. New screening plan of check point of slope failure along national road was proposed.

Key words: large-scale rock slope failure, road disaster prevention inspection

Research for efficiency and upgrading of the road disaster prevention structures

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Structures
Author: NISHI Hiroaki
KONNO Hisashi
OKADA Shinya

Abstract:
In order to investigate the impact resistant behavior of an arch-type structure, static and falling-weight impact tests for a small scale RC arch-type model were conducted taking arch width as variable. Total eight specimens were used for this study, in which four specimens are for 200 mm width and the other four specimens are for 800 mm width. Here, impact load was surcharged using a 300 kg falling heavy weight. The results obtained from this study are as follows: 1) in spite of loading way, specimens with a 200 mm width were failed with a flexural failure mode and specimens with a 800 mm width were failed with a punching shear failure mode; 2) it was confirmed that arch effects were not remarkable in case accompanying with punching shear failure. In addition, the impact experiment used a real RC arch-type structure was conducted, and the impact response characteristic of the real scale structure was examined.

Moreover, we proposed the rock-falling defensive retaining wall with piles as a new technical method of the road disaster prevention facilities. To understand the impact behavior when two layer absorbing system was applied for this structure, the heavy weight impact experiment was conducted. As the result, it is clarified that this structure is excellent for the rock-falling energy absorption performance and the impact defensive performance can be evaluated with safety margin by using 2D frame analysis.

Key words: road disaster prevention structure, falling-weight impact test, arch-type structure, rock-falling defensive retaining wall with piles

－Priority Research Project－

Research on winter road safety and efficient use

Research Period: FY2006-2010
Project Leader: Director of Cold-Region Road Engineering Research Group
OGASAWARA Akira
Research Group: Cold-Region Road Engineering Research Group

Abstract:
In cold, snowy regions, snow plowed to the roadside reduces the effective road width, low temperatures induce road-surface freezing, and snow storms cause poor visibility. The phenomenon causes traffic congestions, accidents and road closures. The Cold Region Road Research Group performs research on technological development that improves the winter road safety and efficient use in cold, snowy regions. In FY 2006, the group performs researches as below.
1) Research on winter road management
2) Research on cold-region traffic accident countermeasures
3) Study on evaluating performance of snow-protection facilities
4) Study on snowstorm-induced poor visibility

Key words: winter road management, cold-region traffic accident, snow-protection facility, poor visibility

－Individual Themes－

Research on winter road management

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Traffic Engineering
Snow and Ice
Author: TOKUNAGA Robert Aburahamu
FUNAHASHI Makoto
MATSUZAWA Masaru

Abstract:
In this research, Traffic Research Engineering Research Team and Snow and Ice Research Team perform research on technological developments that improve the efficiency and effectiveness of winter road management to secure road safety and mobility in cold, snowy regions. In FY 2006, the teams perform research on development of a road-icing forecasting system, measurement method of skid resistance of winter road surface and examination of new anti-freezing agents and abrasives such as “lime cake” reproduced from residual dross of sugar manufacturing.

Key words: heat balance modeling, road-icing forecast, anti-freezing agent, skid resistance

Research on cold-region traffic accident countermeasures

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Traffic Engineering
Author: HIRASAWA Masayuki
KOTERA Shinichi
TAKEMOTO Azuma

Abstract:
In this research, Traffic Research Engineering Research Team performs technological developments that enhance cold-region traffic accident countermeasures based on the scientific analysis. In FY 2006, the team performs research on upgrading the traffic accident analysis system to conduct scientific traffic accident analysis and countermeasures against fatal and winter specified accidents taking into account regional characteristics.

Key words: traffic accident analysis system, traffic accident countermeasures, regional characteristics, rumble strips

Study on evaluating performance of snow-protection facilities

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Snow and Ice
Author: KAJIYA Yasuhiko
MATSUZAWA Masaru
ITOU Yasuhiko
YAMADA Takeshi

Abstract:
In Hokkaido, snowstorms can cause road closures in winter. In this study, a method for evaluating the performance of snow-protection facilities was investigated for effective planning and construction. In FY2006, previous studies on the performance of snow-protection facilities were reviewed. The items for evaluating the performance of snow-protection facilities (e.g., measurement location and height) were determined. In addition, wind speed and visibility on both sides of the snow fence were measured in the Ishikari Blowing Snow Test Field.

Key words: snow fence, snowbreak woods, performance evaluation, visibility

Study on snowstorm-induced poor visibility

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Snow and Ice
Author: KAJIYA Yasuhiko
MATSUZAWA Masaru
ITOU Yasuhiko
TAKECHI Hirotaka

Abstract:
Aviation meteorology defines visibility in terms of distance. For road traffic, there is no general agreement on the definition of visibility. To examine methods of determining visibility for road traffic, meteorological observations were done at four sites. It was found that the longer is the observation period, the greater is the ratio of mean deviation in range of visibility fluctuation to mean visibility, and that this ratio is 0.3 or less when the observation period is 10 minutes.

Key words: snowstorm, visibility, poor visibility, visibility measurement

－Priority Research Project－

Development of technologies for decreasing risk of life environment

Research Period: FY2006-2010
Project Leader: Director of Material and Geotechnical Engineering Research Group
WAKISAKA Yasuhiko
Research Group: Material and Geotechnical Engineering Research Group
Water Environment Research Group
Cold-Region Construction Engineering Research Group

Abstract:
It is said that the 21st century is the century of the environment, so it is impossible to do public works without consideration of the environment. Water and ground is necessary for human life and social activities, and they are the base of the ecosystem. Therefore, careful consideration of water and ground environments is needed; consideration of them is required for public works. This project carries out the elucidation of occurrence and behavior of pharmaceuticals and microbes, development of measurement methods for them in the water environment, and development of countermeasures, evaluation and analyzing methods for geopollution.

Key words: water environment, ground environment, pharmaceuticals, microbes, geopollution

－Individual Themes－

A study on behavior of physiological active substances and their adverse effects on ecosystem

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Water Quality
Author: SUZUKI Yutaka
KOMORI Koya
KITAMURA Kiyoaki
KITAMURA Tomokazu

Abstract:
In recent years, physiological active substances (e.g., antibiotics) resident in the water environment have become an emerging public concern. However, limited knowledge is available on the significance of their occurrence in the water environment from the viewpoints of biological adverse effects. The objectives of this research were to determine the occurrence of selected antibiotics, namely levofloxacin (LVFX) and clarithromycin (CAM). We developed a novel analysis method for LVFX and CAM in wastewater, and evaluated the concentration in the treated wastewater. We also conducted evaluation of the impacts of physiological active substances onto aquatic organisms.

Key words: antibiotics, levofloxacin, clarithromycin, analytical method, bioassay

A study on occurrence and control of physiologically active substances in sewage system

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Water Quality
Author: SUZUKI Yutaka
KOMORI Koya
OKAYASU Yuji

Abstract:
Batch anoxic and anaerobic examinations using activated sludge from aeration tank effluent were conducted and dissolved free estrogen were formed during the batch examination. Result shows that estrogen removal efficiency depends on oxidation-reduction condition in secondary clarifier.

The field surveys were conducted at five wastewater treatment plants (WWTPs) for the purpose of determining occurrence of physiological active substances (e.g., anti-inflammatory drugs) in wastewater and its fate in WWTPs. Reduction ratios of ibuprofen and triclosan in WWTPs were more than 90%, those of naproxen, ketoprofen and diethyltoluamide were approximetry 50%, and, that of crotamiton was less than 20%.

Key words: estrogen, 17-estradiol, estrone, drugs

Study of the fate of pathogens in water environment

Budged: Grants for operating expenses
General account
Research Period: FY2006-2008
Research Team: Recycling
Author: OZAKI Masaaki
SUWA Mamoru
TOYAMA Akiko

Abstract:
The widespread use of antibiotics for human and livestock has increased the risk of contamination in water environment by bacteria which has resistance to antibiotics. In order to prevent the outbreaks of infectious diseases by pathogenic microorganisms which contained in water bodies, it is required to ensure that the natural water would be safe with respect to pathogenic microorganisms. The aim of this study is to clarify the antibiotic resistance to bacteria in water environment by investigating the concentration of antibiotic resistant bacteria in treated wastewater, etc. Additionally, the molecular biology technology (particularly the Polymerase Chain Reaction method) is adopted for the pathogen detection method. Because it is important that measuring method is developed for the detection of trace level of pathogenic microorganisms (such as Norovirus and Cryptosporidium).

In FY2005, we investigated the Antibiotic resistant E.coli in water environmental and wastewater. Also, the examination of trace level concentration was performed for Antibiotic resistant E.coli in treated wastewater. Furthermore, the effect of inactivation by chlorination for Antibiotic resistant E. coli was examined. And the sample from each of this E.coli has been analyzed about the gene of antibiotic resistance.

As a result, the concentration of ABPC, LVFX and TC resistant E.coli was correlated with that of E.coli in wastewater. However, the concentration of the Antibiotic resistant E.coli did not show the correlation with that of E.coli in river water sample. As for ABPC resistant E.coli in river and wastewater, the ratio of the multi-drug resistance was high. The Antibiotic resistant E.coli was added to treated wastewater to investigate the change of resistance. Multi-drug resistant E.coli which added to treated wastewater did not have the change in a resistant ability. Multi-drug resistant E.coli, which was compared with Antibiotic non resistant E.coli, had 1.1-1.4 fold increase about the Ct value which was necessary for 3-log inactivation by chlorination. It was confirmed that these E.coli had the resistance gene of antibiotic.

Key words: antibiotic resistant E.coli, resistance gene of antibiotic, Cryptosporidium, Norovirus, real-time PCR method

Research on management method of ground pollution

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Soil Mechanics
Author: KOHASHI Hidetoshi
FURUMOTO Kazushi
MASUYA Yugo
YOSHIDA Naoto

Abstract:
There occasionally exist soil and groundwater contamination in construction sites. The aim of this study is to establish the management method of ground pollution by evaluating the exudation of heavy metals from contaminated soil.

In this research, the exudation characteristic of the contaminated soil is studied and the simple leaching test is proposed. In addition, we consider basic idea of ground pollution management.

Key words: ground pollution, contamination, leaching test, exudation

Development of countermeasures for heavy metal pollution by natural causes （1）

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2010
Research Team: Geology
Author: SASAKI Yasuhito
ASAI Kenichi
SHINAGAWA Shunsuke

Abstract:
In order to develop the methods to evaluate the exudation of heavy metals caused by natural rocks and sediments, the state analysis using sequential chemical extraction method was carried out. A comparison between the results of the official exudation test and the state analysis suggests that marine sediments which contain the form of lead easily to exudates are one of the possible causes of the high concentration of lead exudates. As to arsenic, no correlation was found between the results of the official exudation test and those of the state analysis. From a comparison between the results of the official exudation test and the long-term exposure test which was conducted by the device originally designed by the PWRI, the official exudation test may be unsuitable for the evaluation of the heavy metal pollution risk for samples which exudates acidic water.

In addition to these experimental works, a literature survey was conducted on the subject to facilitate the efforts to cope with heavy metals exudation in natural environment.

A temporary manual for assessing the heavy metals pollution in natural environment has been compiled on the basis of the research results by PWRI up to the last fiscal year.

Key words: natural factors, heavy metals, acidic water, state analysis using sequential chemical extraction method, long-term exposure test

Development of countermeasures for heavy metal pollution by natural causes (2)

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Geological Hazards
Author: ITOU Yoshihiko
KUSAKABE Yuuki
TAMOTO Syuuiti

Abstract:
When we encounter rock including natural heavy metals in construction, its estimation and countermeasure is performed based on “Provisional manual for dealing with ground contamination by heavy metal encountered in construction”, published in September 2003. As the manual was edited in accordance with the Soil Contamination Countermeasures Law enforced in February 2003, which is enforced originally for soil contamination not for rock contamination by natural heavy metals, more suitable standard for estimation and countermeasure for natural heavy metals in rock is required. Recently, in Hokkaido, occurrences of natural heavy metals or acid water from rock are considerably reported in construction sites, and occurrences of them become the problem from the viewpoint of public cost and environmental pollution.

The study aims to develop a suitable standard for estimation and countermeasure for natural heavy metals in rock. Then, proposal of researching methods of area or zone with high concentration of heavy metals, development of simple estimation methods of contamination risk, and suitable countermeasure for natural heavy metals are carried out. In 2006, a GIS map of heavy metals distribution in Hokkaido was geologically constructed as a part of proposal of effective methods of researching area or zone of high concentration of heavy metals. And comparison of leaching concentration of heavy metal among rock specimen with various maximum grain sizes was carried out as a part of development of simple estimation methods of contamination risk.

Key words: rock muck, heavy metal contamination, contamination risk, leaching test

－Priority Research Project－

Research on improvement of design methods for efficient construction of highway infrastructures

Research Period: FY2006-2010
Project Leader: Director of Road Technology Research Group
HAGIWARA Roji
Research Group: Construction Technology Research Department
Material and Geotechnical Engineering Research Group
Earthquake Disaster Prevention Research Group
Road Technology

Abstract:
Investment capability for new infrastructures will decrease because of the falling birthrate, population aging, and increasing cost for maintenance and renewal of old infrastructures. Therefore, it is called for constructing highway infrastructures more efficiently with keeping good quality. With this background, design methods are to be improved for raising the reliability and flexibility of design and making it easy to develop and use new technologies for the construction of highway structures. In the research project, a partial factor design method for highway bridges and a theoretical structure design method based on reliability and performance evaluation methods for pavement are being developed.

Key words: highway bridge, partial factor design method, pavement, theoretical structure design method, performance evaluation method

－Individual Themes－

A study on partial factor design method for steel bridges

Budged:
Research Period: FY2005-2008
Research Team: Bridge
Author: MURAKOSHI Jun
YANADORI Naoki

Abstract:
On the next revision of the specifications for highway bridges, partial factor design method is planned to be introduced in order to adapt the present design to international reliability-based design. This research aims to propose design method on the basis of the partial factor format for the superstructures of steel highway bridges.

In FY2006, based on selected statistical parameters of live/dead load and resistance model, reliability analysis were conducted to clarify the reliability indecies of steel I-girders in the current design code, focusing on their flexural/shear capacity. The procedures to derive reliability index ß and resistance factorφ were investigated. Using the procedures, following results were also obtained;

1) ßs of steel I-girder designed according to the current design code were among 3.0 to 7.5, approximately, when live load factor was 2.0 to B class live load.

2) On the assumption of 3.5 of target reliability index ßT , resistance factorsφwere calculated as 0.90 for tensile strength and 0.85 for compressive strength, both in flexural bending.

For further investigations in FY2007, additional design cases using the suggested partial factors will be conducted in order to examine and optimize the factors through comparison with conventional bridge cross section.

Key words: partial factor design, steel I-girder, reliability analysis, reliability index, partial factor

A study on partial factor design method for concrete bridges

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2008
Research Team: Structure Management Technology
Author: WATANABE Hiroshi
MORIHAMA Kazumasa
KOGA Hirohisa
NAKAMURA Eisuke

Abstract:
This study aims to propose the specifications for concrete highway bridges based on the partial factor design. The study focuses on the examination for the flexural crack width, the permissible crack width and the introduction of the partial factor formant. The loading test of RC beams has been launched to clarify long-term changes in crack width induced by dry shrinkage and creep. Also, RC specimens exposed outside were inspected to grasp the correlation between corrosion of reinforcement and cracks.

Key words: partial factor design, reliability based design, concrete bridge, durability, cracking

A study on partial factor design method for highway bridge substructures

Budged:
Research Period: FY2006-2008
Research Team: Foundation Engineering
Author: NAKATANI Shoichi
SHIRATO Masahiro
KONO Tetsuya

Abstract:
The Japanese Specifications For Highway Bridges are now being revised toward implementation of the partial factor design or load and resistance factor design method, improving the accountably of the design philosophies and backgrounds. This paper presents a first approximation of the elastic limit displacement of soil resistance to horizontally loaded piles. 37 field test data sets were consistently chosen from a vast database. Both mathematical and graphical approaches were adopted to interpret the elastic limit of soil resistance from the measured load-displacement curve. The data sets indicate that the mean value of the elastic limit displacement is 5% to 6% of the pile diameter, and its coefficient of variation is approximately 40% to 60%. A design horizontal threshold displacement can be also proposed as 2% to 4% of the pile diameter, considering the variation in elastic limit displacement.

Key words: horizontally loaded piles, elastic limit displacement of lateral soil resistance, reliability

A study on partial factor design method for seismic design of highway bridges

Budged: Grants for operating expenses
Road account
Research Period: FY2004-2008
Research Team: Earthquake Engineering
Author: UNJOH Shigeki
NISHIDA Hideaki

Abstract:
The objective of this study is to propose the partial factor design method for the bridge structure based on reliability theory. The results of this study in FY 2006 are summarized as follows;
1) Seismic reliability evaluation method for bridges which were designed based on dynamic response analysis was proposed. Based on this method, seismic reliability of RC piers which were designed by current seismic design and partial factors of ductility ratio were computed.
2) To induce the damage control point to bottom of the bridge pier, allowable shear strain of the rubber bearing has to be limited 200% (damage control factor which is defined as dividing factor for current allowable shear strain is approximately equal to 1.2) even if hardening effect has been considered.

Key words: seismic design, partial factor design method, dynamic response analysis, bridge pier, bearing

A study on improvement of theoretical structure design method for pavement

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2010
Research Team: Pavement
Author: KUBO Kazuyuki
INOUE Tadashi

Abstract:
This study aims at establishment of the design method in order to construct road pavements efficiently under the budget limitation. The traffic load and material properties, which are input conditions for theoretical structure design of pavement, were examined. Number of equivalent 49kN　wheel load was found to be influenced by the social situation. By the examination about material properties, it was found that the variation in elastic modulus has large influence on pavement structure design. Therefore, a standard method of resilient modulus test was proposed to obtain an accurate elastic modulus.

Key words: theoretical structure design, wheel load, elastic modulus, resilient modulus test

A study on performance evaluation method for pavement

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2010
Research Team: Pavement
Author: KUBO Kazuyuki
TERADA Masaru

Abstract:
Pavement performance evaluation methods for six indicators, number of wheel load for fatigue failure, number of wheel load for plastic deformation , surface smoothness, permeable water volume, noise value, and skid resistance, are described in "Pavement Performance Evaluation Method" which was published in 2006. In this study, performance evaluation methods for number of wheel load for fatigue failure, noise value, and skid resistance among the six performance indicators are to be improved. Performance evaluation methods for other necessary performance indicators are also to be developed. In FY 2006, calibration method of FWD (falling weight deflectometer) which is used for the estimation of number of wheel load for fatigue failure, relation between pavement road surface noise measured by a RAC vehicle and roadside environmental noise, and application of a handy skid resistance measuring device are examined.

Key words: performance evaluation method, number of wheel load for fatigue failure, noise value, skid resistance, performance indicator

A study on performance evaluation method for pavement (2)

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2010
Research Team: Advanced Materials
Author: NISHIZAKI Itaru
NITTA Hiroyuki
KATO Yuya

Abstract:
With the diversification of needs for pavement, asphalts are diversified. And the former material evaluation remains at the core of the evaluation methods of asphalts while the performance regulations of the pavement are enforced. Therefore evaluation methods of asphalt properties based on the pavement performance corresponding to diversified asphalt are required. Proposal of new performance evaluation methods for pavement binder and mixture for surface course of pavement is the subject of this study. In FY 2006, we gained information about performance evaluation methods for polymer-modified asphalts from several documents and papers and classified it. Moreover, we examined new test methods for evaluation of properties at high and low temperature of polymer-modified asphalts. As a result, the possibilities of application of binder shear test as alternative viscosity test at 60℃ and DTT as alternative Fraas breaking point test were clarified.

Key words: polymer-modified asphalts, viscosity at 60℃, DSR, binder shear test, Fraas breaking point, DTT

－Priority Research Project－

Research on advancement of maintenance technology for highway structures

Research Period: FY2006-2010
Project Leader: Director of Structures Research Group
FUKUI Jiro
Research Group: Construction Technology Research Department
Material and Geotechnical Engineering Research Group
Road Technology Research Group
Structures Research Group

Abstract:
Now with the decreasing funds available for new infrastructure because of the falling birthrate and aging society, we need to carry out rational repair and reinforcement that is based on the result of the precision inspection and diagnosis done on damaged highway structures which support our life and economic activities. However, because there are many highway structures under various conditions, we are being asked to make more advances in maintenance technology.

Key words: maintenance, bridge, earth structure, tunnel, pavement, management

－Individual Themes－

Improvement of drainage system for road embankments and retaining walls

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2009
Research Team: Construction Technology
Author: OSHITA Hiroshi
MIYATAKE Hiroaki
NAKASHIMA Shinichiro

Abstract:
The final aim of this study is 1) to establish performance based design method of drainage system for road embankments and retaining walls, and 2) to develop surveying and maintaining method for existing embankments and walls. Stability of slopes in heavy rainfall was tested by circular arc calculations in this year. The effects of slope height, soil type and groundwater level was discussed based on the calculation results.

Key words: road embankments, retaining walls, drainage, circular arc calculation

Research on the desalination method for the concrete structures deteriorated by salt attack

Budged: Grants for operating expenses
General account
Research Period: FY2005-2007
Research Team: Structure Management Technology
Author: WATANABE Hiroshi
KOGA Hirohisa
NAKAMURA Eisuke

Abstract:
In this project, the desalination method is discussed as a repairing technique for concrete structures deteriorated by salt attack. In the 2006 fiscal year, some experiments were carried out to discuss the relationship between the effects of desalination and estimated electric current in concrete during desalination. As a result, the amount of remaining chloride ions in a section can be predicted by the strength of electric current that runs through it.

Key words: desalination, repair method, concrete structure, salt attack

Research on durability of coating system for concrete repair and reinforcement materials

Budged: Grants for operating expenses
Road account
Research Period: FY2005-2009
Research Team: Advanced Materials
Author: NISHIZAKI Itaru
MORIYA Susumu
KISHIMA Takeshi
KATO Yuya

Abstract:
Various materials and methods are developed for repair and reinforcement for concrete structures, and life cycle cost evaluation is required to select them reasonably. Although their life cycle cost evaluation needs information about their durability data corresponding to application environment, such basic information is not enough yet. In this research, we have investigated long-term exposure specimens and repaired structures, and gained durability data of repair and reinforcement materials such as surface coating to evaluate and improve their durability. In 2006, we investigated samples gathered from a repaired salt damage bridge in Miyazaki and exposed specimens in Shizuoka, Ishikawa, and Ibaraki. As a result of the tests, we gained some data of durability and resistance to chloride ion penetration of used surface coating materials.

Key words: salt damage, ASR, surface coating, continuous fiber sheet, carbon fiber, exposure test, structure investigation, durability of concrete

A study on repair of steel bridge anti-corrosion method

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2010
Research Team: Advanced Materials
Author: NISHIZAKI Itaru
MORIYA Susumu

Abstract:
The new painting system is a paint system that the painting piling frequency was reduced after the anti-corrosion performance and the weather resistance of the heavy duty anti-corrosion painting system are maintained and the coating cost reduced. There were 18 kinds of new painting systems that had the same anti-corrosion degree of the performance as a present heavy duty anti-corrosion painting system, and were 17 kinds of one to have weather resistance.

Being not able to judge the generation of protected rust from the outside girder externals alone because there was something where the stratified flaking off rust was caused in the girder during the water leak and the be dewy of the weather resistance steel bridge easily became clear.

Key words: steel bridge painting, painting cost reduction, new paints, various corrosion protection methods, repair methods

Research on improvement of fatigue durability for existing orthotropic steel decks

Budged: Grants for operating expenses
General account
Research Period: FY2004-2008
Research Team: Bridge
Author: MURAKOSHI Jun
YANADORI Naoki
UI Takashi

Abstract:
Fatigue cracks have been reported on several welded connection details of existing orthotropic steel decks which are vulnerable to fatigue damages due to rapid increase of traffic volume. In order to improve their fatigue durability, analytical and experimental studies have been conducted since FY2004. Focusing mainly on fatigue cracks which initiate at the root of the deck to U-rib weld and propagate inside the deck plate, FE analyses with solid element full models were conducted to clarify the fatigue mechanism. The analyses showed effects of parameters such as location of tires, distance of transverse ribs, thickness of deck plate and U-rib, weld penetrations, etc. And wheel running tests using full scale specimens resulted in crack initiation at the root of the deck to U-rib weld. In addition, several practical and efficient retrofit / reinforcement methods were examined for orthotropic steel decks.

Key words: orthotropic steel decks, fatigue cracks, reinforcement, retrofit

A study on institution of rational pavement management index

Budged: Grants for operating expenses
Road account
Research Period: FY2005-2009
Research Team: Pavement
Author: KUBO Kazuyuki
YABU Masayuki
KANO Takashi

Abstract:
The purpose of this research is to indicate a technical source of pavement management index, and it's to gather the way of thinking to establish pavement management index according to the real state of affairs of the area. It's necessary to consider the angle of the user service by which setting of pavement management index is safety and comfort, etc., and the preservation of the social overhead capital which aimed at the structural strength of the pavement. It's based on these things, the psychological influence by which pavement performance index gives it to the road user was considered in fiscal year 2005. As a result, the psychological influential pavement performance index which gives it to the road user could be grasped.

In fiscal year 2006, we conducted various investigations in the road which is being used to find the present service ability index which has a close relation with the structural strength of the pavement. As a result, we found out that “cracking ratio” and “the form of the crack”, “crack width” is related to pavement structural strength.

Key words: crack, FWD (Falling Weight Deflectomater), structural strength, pavement management

A study on maintenance mending technique of efficient pavement

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2010
Research Team: Pavement
Author: KUBO Kazuyuki
YABU Masayuki
TERADA Masaru
AYABE Takayuki

Abstract:
Efficient management of the road structure is requested. It is necessary to promote the decrease of the life cycle cost by the selection of an appropriate repair industrial method including maintained industrial method etc. also in the pavement field.

The current state of the technology such as the crack seals that are maintained industrial methods is arranged In FY 2006. It also proposed the quality index. Moreover, because the damage form was different from the close grain degree asphalt pavement, a peculiar management index to the drainage pavement was examined about the drainage pavement.

Key words: pavement, maintenance mending, crack seal, preventive mending, material standard

Study on selection method for countermeasures against deformation in current tunnel

Budged: Grants for operating expenses
Road account
Research Period: FY2005-2007
Research Team: Tunnel
Author: MASHIMO Hideto
KADOYU Katsunori

Abstract:
In this research, the method to predict the cause of deformation from tunnel inspection data and the effect of countermeasures against tunnel deformation were discussed through loading experiment and numerical analysis.

This year, the characteristic of tunnel deformation was extracted and full-scale loading experiments were performed to evaluate effect of inner reinforcement of steel plate.

The result from experiments was that load-carrying capacity of tunnel lining increased 15% and deformation of tunnel was restricted by inner reinforcement of steel plate.

Key words: tunnel, prediction of cause of tunnel deformation, countermeasures against tunnel deformation, inner reinforcement of steel plate, loading experiments

－Priority Research Project－

Research on durability of civil engineering structures against cold weather

Research Period: FY2006-2010
Project Leader: Director of Cold-Region Construction Engineering Research Group
NISHIKAWA Jun'ichi
Research Group: Cold-Region Construction Engineering Research Group
Cold-Region Road Engineering Research Group

Abstract:
In cold, snowy Hokkaido, the distinctive weakness of peaty soft ground, heavy snowfall in winter and cold temperatures greatly affect the construction and maintenance of civil engineering structures. It is aimed to develop technologies for the construction and maintenance of civil engineering structures which are tailored to cold region conditions. The first aim of this research is to establish effective and economical design methods for stabilization of peaty soft ground, and have these incorporated into the manual for measures against peaty soft ground. Site settlement observation was conducted on this matter and it revealed that residual settlement of road bank on peaty soft ground significantly affects life cycle costs. The second is to examine and evaluate deterioration of concrete from combined frost and salt damage. Investigation to review the past papers introduced to the fact that the following influence factor of environment in the progress of frost damage and in the progress of deterioration from the combined action of frost and salt are number of freeze-thaw cycle, temperature, salinity, moisture content, dryness, and solar radiation. The third is to improve the durability of concrete in cold, snowy regions. For this aim improved cement was developed and field tests for applicability of surface pentrant materials were conducted in this year. The fourth is to improve load capacity of structures by considering their reduced performance under cold, snowy conditions. In order to confirm effects of cold weather deterioration on the fatigue durability of bridge deck slabs, wheel-tracking tests were performed on slabs and a formula for estimating the remaining lifespan according to the level of damage to the slab was explained. The fifth is to study on measures against pavement deterioration in cold, snowy region. This study addresses the development of asphalt pavement designs that are adopted to the thermal and soil conditions of cold, snowy regions, and the use of new pavement materials and pavement methods that afford improved pavement performance. In this year, the applicability of large-grain asphalt

mixture for snowy and cold condition was evaluated by laboratory tests and some other investigations were conducted. The last is to establish management system of civil engineering facilities in cold, snowy regions. Management systems for bridges and road pavement are treated in this study. The aim of management system for pavement is to develop a method for prediction of pavements deterioration, and to develop an evaluation approach of pavements healthiness. The other objective is to establish a pavement management system suitable for cold and snowy regions which could provide most relevant maintenance and rehabilitation scenario based on the life-cycle cost analysis. In this year the accuracy of the Markov decision process model for pavements deterioration prediction and the performance curves based on rehabilitation methods was investigated. Furthermore, the prototype pavement management sub-system was improved to meet the concept of preventive maintenance. In bridge management system which has been made in the past study, conventional studies revealed that preventive repair is optimal for long-term cost reduction. This study proposed a quantitative method for determining which bridges should be given top priority in the shift from conventional management to management by preventive repair.

Key words: durability, cold weather, civil engineering structures

－Individual Themes－

Optimizing ground improvement of peaty soft ground

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Geotechnical
Author: NISHIMOTO Satoshi
HAYASHI Hirochika
HASHIMOTO Hijiri

Abstract:
Peaty soft ground, which is commonly found in cold regions, is extremely soft and has unique engineering properties. The purpose of this study is optimizing the ground improvement, including its life cycle costs for peaty soft ground. Concretely the following issues are examined.
1) Development of the prediction method of long-term settlement for peaty soft ground
2) Proposal of the design and the quality control method for new ground improvement technology

In this financial year as the first year, an investigation of the field settlement was conducted. It was found that residual settlement of an expressway constructed on peaty soft ground significantly affects life cycle costs. An effect of new ground improvement technology such as the trencher mixing method and the plastic drain with reinforced fill using iron wire netting was evaluated.

Key words: peaty soft ground, long-term settlement, life cycle cost, trencher mixing, plastic drain

Examination and evaluation of deterioration of concrete from combined frost and salt damage

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Materials
Author: HAYASHIDA Hiroshi
ENDOU Hirotake
KUSAMA Syougo

Abstract:
The most common damages sustained by concrete structures in cold regions are deterioration from frost damage and deterioration from the combined effects of frost and salt damage. Such phenomena have caused the penetration rates of water and of chloride ions to increase, raising concerns about accelerated corrosion of the steel members in concrete. Because frost damage results from the complex interactions of many factors, it is difficult to predict deterioration; therefore, no practical predicting model has been developed. Such a model is needed because of the difficulty in verifying the durability of existing concrete structures. Toward a method of predicting deterioration and developing durability verification, the authors reviewed the papers of the past twenty years. As the results, the following influence factor of environment in the progress of frost damage and in the progress of deterioration from the combined action of frost and salt were identified: number of freeze-thaw cycle, temperature, salinity, moisture content, dryness, and solar radiation.

Key words: frost damage, salt damage, combined deterioration, influence factor of environment

Improving the durability of concrete in cold, snowy regions

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Materials
Author: YOSHIDA Susumu
ENDOU Hirotake
KURIHASHI Yusuke

Abstract:
Concrete structures constructed in cold, snowy region usually suffer from not only frost damage but also the combined effects of frost and salt damage. Therefore, durability of structures deteriorates due to these factors. It is necessary to improve the durability of these concrete structures. From these back grounds, in this study, to investigate the improvement method of durability for new concrete structures, various tests of modified cements and field tests for applicability of surface penetrant materials were conducted. Moreover, to establish a rational repair and strengthening method for existing concrete structures, proposing the method combining short-fiber mixed shotcrete and FRP mesh, some performance tests were conducted taking the sorts of materials of short-fiber and FRP mesh as variables. From these test results, it was confirmed that modified cements and surface penetrant materials can be improved the durability of concrete. And also, it was recognized that proposed repair and strengthening method can be applied regardless of the kinds of short-fiber and FRP mesh materials.

Key words: modified cement, surface penetrant materials, repair and strengthening, improving a durability

Improving the load capacity of structures by considering their reduced performance under cold, snowy conditions

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Structures
Author: ISHIKAWA Hiroyuki
NISHI Hiroaki
MITAMURA Hiroshi
SATO Takashi
ADACHI Yutaka

Abstract:
Many bridges in Hokkaido were constructed during the period of high economic growth from the 1960s to the mid 70s, and these bridges are rapidly nearing the end of their expected lifespan, which is regarded as fifty years. The scale of such aging raises the need for more efficient maintenance and management. This research focuses on the reinforced concrete deck slab, which is the most vulnerable part of a bridge. We studied the effects of cold weather deterioration on the fatigue durability of such deck slabs. Sample slabs with cold-weather deterioration were cut from bridges in Hokkaido, and wheel-tracking tests were performed on the slabs. This paper analyzes the process of deck slab deterioration in a cold, snowy region, examines the fatigue durability of such slabs, and proposes a formula for estimating the remaining lifespan according to the level of damage to the slab.

Key words: cold, snowy region, reinforced concrete deck slab, fatigue durability, wheel tracking test, estimating the remaining lifespan

Study on measures against pavement deterioration in cold, snowy regions

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Road Maintenance
Author: TAKO Jun
ISHIDA Tateki
ABE Ryuuji
MARUYAMA Kimio

Abstract:
This study addresses the development of asphalt pavement designs that are adopted to the thermal and soil conditions of cold, snowy regions, and the use of new pavement materials and pavement methods that afford improved pavement performance. In this fiscal year, the applicability of large-grain asphalt mixture for snowy and cold condition has been evaluated by laboratory tests. The performance of composite pavements has been evaluated by data from test sections in service. The results of these are quite substantial. Characteristic of fatigue breaking of pavements is key issue to improve the durability of pavements. The energy dissipation theory is expected to be useful for evaluating characteristic of fatigue breaking. To compare theoretical strains and measured strains in the test pavement field, loading test with a heavy vehicle and a falling weight deflectometer has been carried out. The test showed that theoretical strains were approximately consistent with measured strains. In addition, elastic coefficients of each layer of asphalt pavements were calculated by the back-calculation method with surface deflections which were measured in FWD tests. The study also showed that the finite element method is useful to estimate elastic coefficients of asphalt pavement under several thermal conditions.

Key words: pavement design, high-performance materials and methods

Management of civil engineering facilities in snowy, cold regions

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Road Maintenance
Author: TAKO Jun
ISHIDA Tateki
MARUYAMA Kimio
SEINO Masataka

Abstract:
Deterioration prediction method and rehabilitations in the view of preventive maintenance is absolutely imperative for pavements life cycle costs reduction under cold climate conditions. One of the objectives of this study is to develop a method for prediction of pavements deterioration such as rutting, wearing and cracking, and to develop an evaluation approach of pavements healthiness. The other objective is to establish a pavement management system suitable for cold and snowy regions which could provide most relevant maintenance and rehabilitation scenario based on the life-cycle cost analysis. The road administrative costs, such as pavement maintenance and rehabilitation costs, and the road users' costs are considered for the analysis. In this fiscal year, the accuracy of the Markov decision process model for pavements deterioration prediction and the performance curves based on rehabilitation methods have been investigated. Furthermore, the prototype pavement management sub-system has been improved to meet the concept of preventive maintenance. The influences of rutting to vehicle behavior have been examined on the rutted test track.

Key words: pavement management system, deterioration prediction, life-cycle cost analysis

Management method for civil engineering infrastructures in cold, snowy regions

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Structures
Author: ISHIKAWA Hiroyuki
NISHI Hiroaki
MITAMURA Hiroshi
SATO Takashi
ADACHI Yutaka

Abstract:
Many of the 3,600 bridges managed by the Hokkaido Regional Development Bureau of the Ministry of Land, Infrastructure and Transport have been in service for three or four decades, and they are approaching the end of their life-spans. Large increases in costs for their maintenance and repair are expected in the near future, but financial constraints of the Bureau make replacement, which is cost-intensive, an unrealistic solution to aging. Instead it is necessary to reduce life-cycle costs by extending the bridge lifetime through repairs and by introducing efficient bridge management plans. In light of this, the Structures Research Team of the Civil Engineering Research Institute for Cold Region (CERI) has been developing a system called the CERI Bridge Management System (CBMS). Conventional studies have revealed that preventive repair is optimal for long-term cost reduction. However, shifting to such repair for all bridges maintained by the Bureau would require huge initial expenses, because a bridge must already be very sound for such a repair strategy to be applied. The Bureau's current budget for infrastructure development and maintenance allows only a phased shift in management systems. To support the prioritization of bridges for CERI's new management system, this study proposes a quantitative method for determining which bridges should be given top priority in the shift from conventional management to management by preventive repair.

Key words: priority, CERI Bridge Management System (CBMS), preventive repair, bridge management plan

－Priority Research Project－

Development of recycling technologies in construction for efficiently utilizing natural resources and reducing wastes

Research Period: FY2006-2010
Project Leader: Director of Material and Geotechnical Engineering Research Group
WAKISAKA Yasuhiko
Research Group: Material and Geotechnical Engineering Research Group
Road Technology Research Group

Abstract:
It is indispensable for global environment preservation to make full use of limited resources, to save natural re¬sources and energy, and finally to help establish a recycle-oriented society. Construction projects, which consume huge amounts of resources and energy, are also required to play a part. In this study, we are going to develop the recycling technology of organic waste materials produced in construction projects, construction by-products, sewage sludge and industrial waste materials.

Key words: recycle, melt-solidified slag, copper slag, ferronickel slag, life cycle cost, aged asphalt, repeated recycling, recycled asphalt mixture, biomass, biogas engine

－Individual Themes－

Recycle materials made of industrial byproduct for construction project

Budged: Grants for operating expenses
General account
Research Period: FY2006-2009
Research Team: Material and Geotechnical Engineering Research Group
Advanced Materials Recycling
Soil Mechanics
Author: MEIARASHI Seishi
NISHIZAKI Itaru
TOMIYAMA Tomonori
OZAKI Masaaki
MIYAMOTO Ayako
KOHASHI Hidetoshi
MORI Hirotoshi

Abstract:
The purpose of this research is renewing " Technical guideline for using recycle materials made from by-product out of construction industries for construction project" published in 2006. The important changes in the new version of the manual are reflecting the latest development in developing recycle materials and enhancing the estimation categories especially related to Economics. Results of an original research to use scallops oyster shell as fine aggregate of concrete products will be also published in the manual.

Key words: recycle materials, construction project, Economics, shell

A study on the applicability of molten slag to pavement materials

Budged: Grants for operating expenses
Road account
Research Period: FY2005-2008
Research Team: Advanced Materials
Author: NISHIZAKI Itaru
NITTA Hiroyuki

Abstract:
Recently, the development of the recycled resource such as molten slag is active in the background of effective use of the resource and the depletion of the final disposal dump, etc. Especially, the development of the technology used for the pavement of those recycled resources is active. Using these recycled resources comes to recycle certainly. However, whether it has contributed to the environmental load decrease in total until abandoning since using these manufactures it is not clarified. Then, the resource consumption, the saving resource, and the environmental load when using it for pavement were provisionally calculated for nonferrous metals slag, and applicability was examined in fiscal year 2006. As a result, the ratio of the environmental load by transportation is large, and if the transportation distance is a short part, it has been understood that the environmental load is comparatively small.

Key words: recycle, copper slag, ferronickel slag, LCCO2, LCA

A study on the applicability of melt-solidified slag to pavement materials

Budged: Grants for operating expenses
Road account
Research Period: FY2005-2008
Research Team: Pavement
Author: KUBO Kazuyuki
SASAKI Iwao

Abstract:
Recently, recycled materials including melt-solidified slag has been increasing due to exhaustion of final disposal sites. Particularly, waste producing industries other than the road sector have been developing recycled materials as pavement material increasingly. These recycled materials from other industries can contribute to recycle use for waste, but it is not clear that these materials can contribute reducing the effects on the environment throughout a lifecycle in total. In this fiscal year, durability of melt-solidified slag as recycled pavement materials was examined by literature research, water-immersed wheel tracking tests, and accelerated loading testing. According to the results, slag materials may be as durable as conventional materials though long-term durability has not been confirmed. Application costs such as manufacturing and execution of pavement with slag were estimated by calculation of material, equipment, and quality control prices.

Key words: recycle, melt-solidified slag, copper slag, ferronickel slag, durability, LCC

A study on aged asphalt pavement recycling

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2009
Research Team: Pavement
Author: KUBO Kazuyuki
SASAKI Iwao
KANO Takashi

Abstract:
Due to the increase of repeatedly recycled materials and polymer containing asphalt mixture, recently, penetration of asphalt binder in mixtures for recycling tend to decline. This means that asphalt mixtures applicable to hot-mix recycling could decrease in the near future. This study intends to the establishment of advanced recycle use techniques of low penetration asphalt mixtures including the revise of quality standards. In this fiscal year, this study conducts a survey of the trend of asphalt mixtures for recycling and the product methods of hot-mix recycling, and the long-term durability of pavements made of recycled porous asphalt mixtures as well. According to the results, the situation is confirmed that repeatedly recycled asphalt pavement materials increase rapidly in the coming decade. The follow-up research on trial pavements using recycled porous asphalt mixture shows no issue about durability.

Key words: recycle, repeated recycling, recycled asphalt mixture, porous asphalt pavement

A study on aged asphalt pavement recycling

Budged: Grants for operating expenses
Road account
Research Period: FY2006-2009
Research Team: Advanced Materials
Author: NISHIZAKI Itaru
NITTA Hiroyuki

Abstract:
Recently, the penetration of the asphalt concrete waste has decreased because the amount of the use of modified asphalt and repeatedly used asphalt increased. The way things are going, the asphalt concrete waste that can be used for the recycled asphalt will decrease in the future. In this research, the asphalt concrete recycling technology is developed including the revision of the material standard for more advanced reuse of low penetration asphalt concrete. In fiscal year 2006, the evaluating method of the asphalt pavement waste and the evaluating method of the rejuvenator for the recycle were examined. As a result, the possibility of the evaluation method with the asphalt mortar was found in the quality evaluation of the asphalt waste in one study, and the necessity of the evaluation method of the rejuvenator that considered recycling was found in another research.

Key words: recycle, repeated recycling, recycled asphalt mixture, recycled asphalt, rejuvenator

Technology and system on effective use of biomass resources which produced from the maintenance of public greens

Budged: Grants for operating expenses
General account
Research Period: FY2006-2008
Research Team: Recycling
Author: OZAKI Masaaki
OCHI Shuichi
YAMASHITA Hiromasa
MIYAMOTO Ayako
MAKI Takanori

Abstract:
Large amount of waste woods and grasses as biomass resources are produced from the maintenance of public green sites. The aim of this study is the forming of inventory system and the development of effective use technologies on the biomass resources. Kinds of forty woods and grasses were used for the chemical analysis to search fifteen constituents, the two experiments were carried out to develop the energy conversion system and the biogas-engine system.

Key words: biomass, public greens, energy, gas-engine, micro organic-pollutants

－Priority Research Project－

Development of techniques for conservation and restoration of aquatic ecosystems

Research Period: FY2006-2010
Project Leader: Director of Water Environment Research Group
NAKAMURA Toshikazu
Research Group: Water Environment Research Group
Material and Geotechnical Engineering
Research Group
Water-related Hazard Research Group

Abstract:
It is highly necessary to evaluate, conserve, and restore sound ecological functions of rivers and lakes to maintain locally native ecosystem. Five achievement goals are set to meet this necessity as follows; proposal of new aquatic biological survey method, evaluation of the ecological function of river morphology, development of watershed runoff model, elucidation of the correlation between material dynamics and aquatic ecosystem, and development of lake restoration method through the restoration of littoral vegetation. Major results of FY2006 include the development of automatic fish behavior tracking system that is suitable for small fishes, the evaluation of top down effect of herbivore fish on periphyton of river bed, and the development of numerical simulation for the evaluation of suppression effect of macrophytes on the sediment ressupension.

Key words: restoration, aquatic ecosystem, biological survey, river morphology, watershed model, nutrient dynamics, and littoral vegetation

－Individual Themes－

Methodology for evaluation of habitat conditions of aquatic organisms and clarification of ecosystem functions

Budged: Grants for operating expenses
General account
Research Period: FY2006-2008
Research Team: River Restoration
Author: AMANO Kunihiko
NAKANISHI Satoru
OJIMA Yurika

Abstract:
This research focuses on ecological function of aquatic lives such as insects. To estimate biomass, we need to know where aquatic lives settle into the riffle-pool structures, and how many of them exist there. Field survey was conducted on Chikuma River and Kinu River. Chikuma River is the gravel river and has distinct bars. It is suggested that we can distinguish the riffle-pool contracture into several patterns based on hydrological conditions. In Kinu River surveying sight located on mountain stream, we survey on bed rock distribution on and aquatic lives the river bed.

Key words: riffle-pool structures, river bed degradation, benthic lives, bed rock

Study on the prediction and monitoring method of the influence of river alteration on animal

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: River Restoration
Author: AMANO Kunihiko
DENDA Masatoshi

Abstract:
To apply ATS (Advanced Telemetry system) to ayu(Plecoglossus altivaelis), we have developed small radio wave transmitters. The dimensions and weight of transmitters were Dia.20(mm)x L 10 (mm), 1.5(g), respectively. The transmitters were small enough to attach to ayu.

To verify the performance of the transmitters, we carried out a demonstration experiment in pond. The experiment indicate that performances of transmitters are good enough to track the behavior of ayu.

To assess the differences by two attachment methods in survival rate, growth rate, and behavioral patterns, we carried on feeding test of ayu. The two attachment methods were external attachment and implant method. The influence of implant method is smaller than external attachment.

Key words: wildlife, telemetry system, ayu(plecoglossus altivaelis), attachment method of radio wave transmitter, fish swimming ability experiment

Study on the vegetation succession in river channel

Budged: Grants for operating expenses
River account
Research Period: FY2005-2009
Research Team: River Restoration
Author: AMANO Kunihiko
OISHI Tetsuya

Abstract:
Flood plain areas have been decreased and dried in many rivers. River plant communities have changed from marsh plant communities to land plant communities. Enlargement of forested area in rivers is known as one of these remarkable cases. In FY 2006, we traced the change of riparian vegetation by air photo interpretation in the Kokai river and related the change of plant communities and the height of trees to the typical human impacts.

The expansion and height of trees have rapidly increased over last 20 years. These changes mainly depend on human life style. Forest areas have increased and riparian plant species have decreased. Moreover, we have shown that there are two change patterns in plant communities where human impacts have been decreased and relatively high elevation is maintained. One is the evergreen broadleaf forest in succession controlled by climate. The other is finalized with bamboo grove communities.

Key words: river vegetation, vegetation succession system, floodplain, human impacts、abandonment of cultivation, control of maintenance

A study of river bank protection methods applied to river restoration project

Budged: Grants for operating expenses
River account
Research Period: FY2006-2008
Research Team: River Restoration
Aqua Restoration Research
Center
Author: KAYABA Yuichi
SAGAWA Shiro

Abstract:
The major findings of this study are: 1) Interstitial spaces underneath and between substrate functioned as an important fish habitat with species-specific preferences for each substrate size; 2) Stream-edge vegetation provided fish with refugia from high flows, whose effects were pronounced in September when vegetation density was high; 3) Fish restoration project in the Satetsu River, which aimed to preserve low-velocity edge habitat areas, had greater effects for the riffle reach than glide reach.

Key words: boulder habitat, cutoff channel, flood flow, lateral rehabilitation, woodpile structure

Study on environmental flow for maintaining ecological functions of river beds

Budged: Grants for operating expenses
General account
Research Period: FY2006-2009
Research Team: River Restoration
Aqua Restoration Research
Center
Author: KAYABA Yuichi
MINAGAWA Tomoko
SANADA Seiji
KATANO Izumi

Abstract:
This study focuses on the way the feeding behavior of freshwater fauna helps to keep riverbeds in a healthy condition, and seeks to offer ideas for river flow management that take into account such feeding behavior benefits. In academic 2006, the author conducted field surveys in a river section subjected to flow control below a dam to obtain basic data on the status of periphyton, benthic fauna and the feeding pressure of fish species in relation to flow, and also conducted experiments to investigate the relationship between periphyton condition and Plecoglossus altivelis feeding behavior.

The key results of this study are as follows:

1) Investigation of the periphyton in the river section below the dams to determine how silt sedimentation and abundance of filamentous green algae is related to environmental factors such as flow revealed that sedimentation is affected by unit-width flow and the density of filamentous green algae is affected by the age of dam (years since completion).

2) The study revealed that Plecoglossus altivelis feed even on periphyton covered by silt and rampant filamentous green algae and that this feeding behavior reduces the quantity not only of algae but also of silt. Results also suggest that Plecoglossus altivelis feeding behavior is affected by the species' preferences with regard to flow speed and condition of the periphyton.

Key words: flow regime, restoration, periphyton, Plecoglossus altivelis, feeding

Study on water and nutrient circulation model on basin scale

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: Hydrologic Engineering
Author: FUKAMI Kazuhiko
INOMATA Hironori

Abstract:
In order to make effective strategies to improve water quality in a river basin, recognition of causes and their mutual interrelationship which makes water quality worse is essential. For that purpose, a tool which can simulate general circulation processes of water quantity and quality comprehensively and quantitatively on a basin scale is required. In this study, the authors tried to incorporate nutrient (nitrate and phosphorus) models to WEP model which is a physically-based basin-wide hydrologic model. The verification of the model with in-situ data observed in a experimental basin is planned to be conducted in the next fiscal year.

Key words: WEP model, water and nutrient model, nitrate, phosphorus

Understanding of runoff-mechanisms of nutrient pollutant and development of runoff model

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: Water Quality
Author: SUZUKI Yutaka
KOMORI Koya
OKAYASU Yuji

Abstract:
In order to understand runoff-mechanisms of nutrient pollutant from watershed to receiving water body, concentrations of a tracer and nutrients in domestic wastewater and occurrence of their runoff in dry weather were studied. By analyzing ratios of nutrient to the tracer, it was possible to estimate existence of point source except for domestic wastewater.

Key words: runoff, tracer, nutrient, domestic wastewat

Study on water and nutrient circulation model on basin scale (3)

Budged: Grants for operating expenses
River account
Research Period: FY2006-2009
Research Team: Recycling
Author: OZAKI Masaaki
YAMASHITA Hiromasa

Abstract:
This research examined the impacts of wastewater treatment plants (WTPs) and storm-water discharge on the fate of essential elements, such as dissolved iron (D-Fe) or silicon (D-Si) in an urbanized watershed. D-Fe concentration was high compared to dissolved nitrogen (D-N) and phosphorous (D-P) concentrations in rivers, but decreased to half or less in WTPs. D-Si concentration did not change in WTPs, but the ratio D-Si/D-N may be lower than the Redfield ratio (around 1 to 3) in rivers.

Key words: dissolved iron, dissolved silicon, silica, river, wastewater

Study on the relationship between river ecosystem and material cycling in a river

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: River Restoration
Author: AMANO Kunihiko
NAKAMURA Keigo
NAKANISHI Satoru
OJIMA Yurika

Abstract:
This study focuses on the quantitative evaluation of the influence of physical condition to nutrient material cycling by the operations of field survey on the Gonokawa River and the Toyo River, and the investigates relationship between physical condition and river ecological systems. At Gounokawa River, we investigated the influence of gravel-bed river restoration by benthic aquatic organisms. At Toyo River, the analysis of stable isotope of macro invertebrates was performed.

Key words: gravel-bed river restoration, the Gonokawa River, the Toyo River, macro invertebrates, BOM, attached algae, stable isotope

A study on restoration of river ecosystems in downstream region of dam by the gravel augmentation

Budged: Grants for operating expenses
General account
Research Period: FY2006-2009
Research Team: River Restoration
Aqua Restoration Research Center
Author: KAYABA Yuichi
KATANO Izumi
MINAGAWA Tomoko

Abstract:
To provide ecological information about physical environment (i.e. riverbed habitat) and aquatic organisms in downstream region of a dam, we performed thorough field investigations near the Agi-gawa Dam. The findings suggest that the changes in sediment transports and energy base of drifting matter are the most important physical environmental factors for the changes in macroinvertebrate communities along the longitudinal area of the Agi-gawa Dam. The reduction of sediment supply was moderately recovered by a tributary inflow at 2.8 km downstream of the dam.

Key words: riverbed materials, substrate, armor coat, sediment supply, macroinvertebrate

Study on the restoration techniques for lakes and wetlands

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: River Restoration
Author: AMANO Kunihiko
NAKAMURA Keigo
OISHI Tetsuya

Abstract:
Lake restoration should be pursued by combining the improvement of water quality of inflow river and lakeshore restoration. Through these experiences we have found out that restoration of submerged plants and ecologically sound water level fluctuation a

Key words: lakeshore, submerged plants, GIS, modeling, water level fluctuation

－Priority Research Project－

Development of technologies on dams that reduce effects on the natural environments

Research Period: FY2006-2010
Project Leader: Director of Hydraulic Engineering Research Group
YOSHIDA Hitoshi
Research Group: Construction Technology Research Department
Material and Geotechnical Engineering Research Group
Hydraulic Engineering Research Group

Abstract:
We bear responsibility for conserving the irreplaceable natural environment for the next generation. A dam impacts the natural environment in various ways: transforming the topography during construction and sedimentation after completion.

This research aims to conserve the natural environment and permit the smooth construction and sustained use of dam reservoirs by developing technologies that create dam structures that conserve the natural environment, minimize change of the topography during dam construction, and restrict sedimentation and control sediment movement that sediment is supplied to downstream rivers.

Key words: natural environment, dam construction, dam structure, sedimentation

－Individual Themes－

Study on single purpose dams for flood mitigation with minimizing inpact on environment

Budged: Grants for operating expenses
River account
Research Period: FY2006-2007
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
SASAKI Takashi
SASAKI Susumu

Abstract:
From the viewpoint of preserration of river enviornment, we are strongly required to construct a dry dam, which is a dam for the single purpose of flood mitigation. Large-scale conduits should be instralled near the bottom of dam bodies to allow the river channel to flow freely during nomal conditions.

In this study, we conduct numerical simulations considering types and structures of concrete dams, in order to investigate the maximum possible scale for conduits.

Key words: concrete dams, single purpose dams for flood mitigation, block division of dam body, 2-dimensional structural analysis, joint element

Study on single purpose dam for flood control with minimizing environment load

Budged: Grants for operating expenses
River account
Research Period: FY2006-2007
Research Team: River and Dam Hydraulic Engineering
Author: HAKOISHI Noriaki
MIYAWAKI Chiharu

Abstract:
Single purpose dam for flood control, taking environment aspects into consideration, draws attention recently. Ordinarily, this type of dam does not store any inflow discharge, however, in case of flooding it stores inflow discharge and releases small outflow though the outlet installed in the lower part of dam body near the level of river bed to mitigate flood disasters downstream effectively. People's concern for environment problem against flood disaster prevention projects becomes higher, so a progress of projects coordinating flood control on environment aspects is required; nevertheless, because of the structural limitation of dam facilities, further consideration on environment can not be taken for the present flood control dams. For the purpose of minimizing environment load, the studies from the deferent viewpoint on the design of dam structures and outlet facilities are indispensable. Items of study are as follows: the study of size, shape and the operation of outlet facilities for minimizing environment load, the investigation of new type flood control dam which does not block ordinal river flow ,however, stores inflow discharge while large flooding. In 2006/07 fiscal year, the first term of period, it choose target dam and has done a feasibility study. In order to promote effective use of existing dams, additional installations of outlet facilities seem to be increase. Additional facility is installed inside of a tunnel if there is not sufficient space for it in a dam body, and rational design methods of this kind of facilities are required. Goals of this investigation are to elucidate the hydraulic characteristics and phenomena of air entrainment, and to propose design methods of tunnel dimension and air supply system. Items of the investigation are flow conditions in a tunnel, pressure reduction at the upstream end of a tunnel without air supply system, influence of model scale on above phenomena, effect of air supply system on the pressure reduction phenomena and methods for deciding tunnel section and air supply system. These items were examined through hydraulic model experiments using one outlet and uniform section tunnel model. Influences of two outlets and contacted tunnel section were also investigated.

Key words: single purpose dam for flood control, numerical analysis for flood control

Study on design and physical properties of trapezoid-shaped CSG dam

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: Dam Structure
Author: YAMAGUCHI Yoshikazu
SASAKI Takashi
KOBORI Toshihide
SASAKI Susumu

Abstract:
The trapezoid-shaped CSG dam is a new type of dam that combines the merits of a trapezoid shape and CSG, and simultaneously rationalizes the design, execution, and materials.The raw material for CSG covers a wide range of materials such as riverbed gravel, excavation muck obtainable at the dam site, terrace sediment, or weathered rock.CSG is based on no gradation of raw materials except that large aggregate may be crushed. As a result, the gradation of CSG materials varies widely, even for materials obtained at the same place. Furthermore, the variation of gradation makes it difficult to stabilize the unit water content. Thus, these variations in materials and water content make it difficult to maintain stable CSG quality, especially strength. Therefore, the design and quality control methods for such materials should be established.

In this fiscal year, we conducted cyclic loading tests for CSGs to precisely evaluate the strength and deformation characteristics of CSGs, and analyzed the results of quality control tests for a CSG structure construction to establish an advanced quality control method.

Key words: dam, CSG(Cemented Sand and Gravel), cyclic loading test, quality control

A study on durability test method of low quality aggregate for dam concrete

Budged: Grants for operating expenses
River account
Research Period: FY2006-2009
Research Team: Structure Management
Technology
Author: WATANABE Hiroshi
KATAHIRA Hiroshi

Abstract:
The purpose of this research is development of effective utilization of low quality aggregates for dam concrete.We proposed a simplified test method to assess recycled aggregate performance against freezing-thawing action in 2005. We conducted research on applicability of the simplified test method also for low quality river gravels in 2006.The test result showed possibility to assess concrete durability with the result of the simplified test for three kinds of low quality river gravels.We also proposed a test method to assess concrete performance against wet and dry action.

key words: concrete, low quality aggregate, freezing and thawing test, freezer, drying and wetting test

Development of strength evaluation method for a weak layer of dam foundations

Budged: Grants for operating expenses
River account
Research Period: FY2006-2009
Research Team: Geology
Author: SASAKI Yasuhito
KURAHASHI Toshiyuki
YAJIMA Yoshinori

Abstract:
This research showed the geotechnical evaluation of a weak layer for dam foundations. A weak layer has been avoided or removed as dam foundation because of its low share strength. We purpose to development of strength evaluation method in order to utilize rock-masses with weak layers from the either view of cost reduction or natural preservation in this study.

We classified weak layers based on its strength evaluation method. And we tested techniques using for precisely measuring a weak layer roughness, showed the advantage and the problem.

Key words: dam foundation, weak layer, low angle joint, direct shear test, form measurement

A study on the simulation modeling for water flow and sediment transport in reservoirs and downstream rivers

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: River and Dam Hydraulic Engineering
Author: HAKOISHI Noriaki
SAKURAI Toshiyuki
HOSHINO Kimihide

Abstract:
It is necessary to establish simulation method for estimating environmental changes caused by dam construction and related measures appropriately so that dam project will make progress smoothly, moreover, environmental impact caused by existing dams will also be reduced. Although a large number of studies have been made on the simulation method, it has not been established yet, because the phenomena are complicated and field observation data are few.

This study aims to develop simulation model for water flow and sediment transport in reservoirs and downstream rivers. The contents of the study are as follows; (1) Clarification and modeling of settling condition and erosion condition for small particle sediment, (2) Clarification and modeling of inflow sediment discharge to reservoir and sediment transportation in the downstream rivers, (3) Clarification and modeling of climate impacts affecting to the reservoirs and the downstream rivers, (4) Development of high dimensional numerical simulation model that represents flow phenomena in the reservoirs and the downstream rivers.

In 2006, following items were conducted: investigation on settling and erosion condition for fine sediment, development of two-dimensional river bed movable simulation model, field investigation on upstream and downstream of a reservoir for inspecting sediment transport characteristics. As a result, the characteristics of analysis methods for grain size distribution and erosion characteristics of fine sediment were revealed. Furthermore, the developed two-dimensional numerical simulation model was confirmed to be applicable for simple phenomena.

Key words: dam reservoir, sediment transport, fine sediment, settling velocity, erosion rate, two-dimensional river bed movable model

A study on the sediment supply measures from a reservoir considering control of A sediment discharge and grain sizes

Budged: Grants for operating expenses
River account
Research Period: FY2006-2010
Research Team: River and Dam Hydraulic Engineering
Author: HAKOISHI Noriaki
MIYAWAKI Chiharu
SAKURAI Toshiyuki
HOSHINO Kimihide

Abstract:
Recently, in order to conserve an environment of river bed and sediment transport downstream of the reservoir, a control of quality and quantity of sediment discharge from a reservoir is required. However, it is extremely difficult to control them accurately by the conventional measures such as sediment bypassing and flushing, because they are greatly affected by the operational conditions, situation of a sedimentation and inflow conditions. Then, this study aims to develop sediment supply measures that are able to control sediment discharge and grain sizes with high accuracy according to the outflow discharge.

In 2006, the simple prediction model for erosion phenomena of resettled sediment was proposed by considering the results of physical model tests. And an investigation on hydraulic function of two types of sediment flushing measures using water head energy; sheet and suction pipe flushing and air valve flushing was carried out.

Key words: dam reservoir, countermeasures for sedimentation, sediment resettlement, sheet and suction pipe flushing, air valve flushing

－Priority Research Project－

Development of design techniques for environmentally sound river basins and channels in cold region

Research Period: FY2006-2010
Project Leader: Director of Cold-Region Hydraulic and Aquatic Environment Engineering Research Group
ISHIDA Kyohei
Research Group: Cold-Region Hydraulic and Aquatic Environment Engineering Research Group

Abstract:
This research will address 1) the development of technology for river environment restoration, such as the current meander restoration, 2) river channel design for restoration of sound river environments by quantitatively understanding the physical habitat of organisms, and 3) clarification of the mechanism of saltwater intrusion in ice covered rivers, which strongly influences the ecosystem at the lower reaches. Additionally, techniques for reducing the environmental load from large-scale farmland in the basin will be established.

Key words: river environment restoration, river channel design, saltwater, environmental load, large-scale farmland

－Individual Themes－

Create diverse river environments through meander restoration and improvements in maintenance methods

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: River Engineering
Author: WATANABE Yasuharu
ABE Shuya

Abstract:
The project of re-meandering channel is advanced at the Shibetsu river.

The straighten channel at the re-meandering section is remained for keep flow capacity at this part. One is a straighten channel and anoter is a meandering channel. The flow pattern becomes complicated at this section and it is difficult to maintain the river channel. The aims of this research are to clarify the maintenance of the 2way channels. We conducted field measurements and hydraulic experiments in this year. The results of this research in this year are as follows;

If the period, when large flood does not occur, will continue for a some years, vegetation invades on sandbars and the problems on river improvement and river environment will be generated. The condition of flow and bank erosion is influenced by the existence of a weir which is set at bifurcation point of 2 channels.

Key words: re-meandering channel, 2way channels, Shibetsu river, field measurements, hydraulic experiments

Develop techniques for the design of river channels that promote inhabitation by cold-water fishes

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Watershed Environmental Engineering
Author: YAMASHITA Syouji
YABE Hiroki

Abstract:
There is the need for methods of assessing the physical habitat of cherry salmon, an indicator species that inhabits cold regions, and for river channel design that allows the creation of river environments that promote habitation by cold-region organisms. Longitudinal and transverse topographic analysis on the elevation of cherry salmon spawning beds in 2006 found that these beds tend to distribute between the upstream end of the alluvial fan and the mountain-torrent section. The analysis also found that there are river sections where there is no relationship between the amount of organic sediment and the bed grain size distribution, nor between the amount of organic sediment and the amount of organic matter. The lack of those relationships in those sections is attributed to differences in production and decomposition relative to other sections.

Key words: cherry salmon, young fish, wintering environment

Discharge measurement in the tidal zone of an ice-covered river

Budged: Grants for operating expenses
Research Period: FY2006-2010
Research Team: River Engineering
Author: WATANABE Yasuharu
YOSHIKAWA Yasuhiro

Abstract:
Data on river discharge is essential for basin-wide water resource planning. Hydraulic phenomena in the freezing waters of a river's tidal zone have not been sufficiently clarified, because it is difficult to observe river conditions under ice sheets and the flow regime in such zones with unsteady flow is complex. Discharge in the tidal zone of ice-covered rivers has been measured using the conventional discharge measurement method for ice-free rivers, even though the accuracy of such measurements is questionable. Toward achieving an improved discharge measurement method for ice-covered rivers, it is necessary to clarify the hydraulic phenomena in the ice-covered tidal zone. Our field observation in the tidal zones of two ice-covered rivers revealed two main findings: 1) Observations at the Tokoro River revealed that it might be possible to apply a discharge estimation equation for the tidal zone of an ice-free river (Sato, Nakatsugawa) to an ice-covered river. The discharge estimation equation for the tidal zone of an ice-covered river employed a different value for the coefficient. 2) In using an ADCP to measure the average discharge within a cross-section of a river channel with unsteady flow, prolonging the measurement duration did not improve measurement accuracy. The measured values showed little difference according to the measurement duration. We concluded from field survey at the Teshio River that 10-second measurement is sufficient for measuring discharge in the ice-covered tidal zone.

Key words: ice-covered river, tidal zone, discharge observations, Hokkaido, Teshio River, Tokoro River

Develop techniques for reducing the environmental load on rivers from large-scale farmland

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Watershed Environmental Conservation Research Unit

Author: YAMASHITA Syouji
YAMAMOTO Jun
NAKAYAMA Hiroyuki
UNOKI Keiji

Abstract:
This research aims to examine the influence of environmental loads from large-scale farmlands on rivers that run through such farmlands and to develop measures for preventing environmental loads from running into rivers in Hokkaido.

In FY2006, we examined the source of environmental loads in certain rivers, the runoff of environmental loads, and the behaviors of environmental loads in lakes into which the studied rivers flow.

Key words: large-scale farmland, suspended solids, nutrient salts, tidal exchange, excreta

－Priority Research Project－

Development of a local biomass recycling system based on a centralized biogas plant

Research Period: FY2006-2010
Project Leader: Director of Cold-Region Agricultural Development Research Group
HIDESHIMA Yoshiaki
Research Group: Cold-Region Agricultural Development Research Group
Regional Hydrogen Use Research Unit

Abstract:
In rural area of Hokkaido, the northernmost island of Japan, which is characterized by large-scale farming, the management of waste biomass has become a pressing issue because of environmental conservation and renewable energy. Gradually, Biogas-plant has the important role of them. The energy system centering on hydrogen attracts attention as the next generation energy system for the low environment load and the efficiency.

The study aims four goals of development of technologies to produce safe digested slurry which is applicable to the crops for the long-term, development of efficient fermentation techniques for each biomas, clarification of the physical properties of slurry and digested slurry for transportation and development of technologies for the conversion of biogas into hydrogen, and clarification of the properties of mixed fuels with the by-products of the conversion process. Main outputs in the study period of 2006 are given in the below.

1) Digested slurry originated from the co-substrate of cow slurry, sludge of urine treatment, sludge of purification tank, waste dairy products and waste fishery products has high contents of Nitrogen and Phosphoric acid. Digested slurry after co-fermentation is good for fertilization. Contents of heavy metals in digested slurry are lower than the standard indexes.

2) Trouble of co-fermentation didn't appear in survey period. Otherwise, under un-controlled of co-substrate, the production of biogas doesn't increase.

3)In the grass fields where the slurry produced by aerobic treatment has been fertilized for the long-term, the void volume and humus content of surface soil changes good for the grass growth.

4) The comparatively high conversion rate of hydrogenaration of 87.2% is obtained on the experiment where the hydrogenaration is carried out by the Benzene originated from biogas. The small obstacle contents of liquid and gas after dehydrogenation is

quantitative analyzed. The balance of mixed fuel with hydrogenarated product(cyclohexane) is examined.

Key words: biogas, cow slurry, recycling system, hydrogen gas, methane reforming

－Individual Themes－

Development of recycling method of biomass as fertilaizer and biogas energy and elucidation of effective conveyance skills for biomass and digested slurry

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Rural Resources Conservation

Author: ISHIWATA Teruo
YOKOHAMA Mitsuhiro
ISHIDA Tetsuya
IMAI Hiromu
YAMADA Akira

Abstract:
The object of the study is to establish co-fermantation method for recycling cattle slurry and regional biomass and to build up application way of digested slurry as fertilaizer. In FY 2006, we investigated the general characteristics of the regeonal biomass, the co-fermentation effects on the characteristics of the digested slurry and the biogas production, and the long-term application effects of aerobically digested cattle slurry on the physical and chemical properties of grassland soils.

Key words: centralized biogas plant, biomass, co-substrates, biogas, digested slurry

Development of effective utilization techniques of biomass originated products in the farming area

Budged: Grants for operating expenses
General account
Research Period: FY2006-2007
Research Team: Regional Hydrogen use
Research Unit
Author: HIDESHIMA Yoshiaki
SYUDOU Yuukou
OOKUBO Takashi

Abstract:
Gradually, Biogas-plant has the important role of the management of waste biomass in rural area of Hokkaido. The energy system centering on hydrogen attracts attention as the next generation energy system for the low environment load and the efficiency. The study aims to develop technologies for the conversion of biogas to into hydrogen, and clarify the properties of mixed fuels with the by-products of the conversion process. With the experimental results and researched data on material balance, energy balance and gross cost-performance, the blue print of BTH-system (Biogas to Hydrogen) of comparatively large-scale dairy farming can be considered. And furthermore, both of the preliminary view of aromatic hydrogenation and the characteristic of product to use as a mixed fuel are clarified.

Key words: Biogas, hydrogen and fuel cell, methane direct reforming, organic hydride, mixed fuel

－Priority Research Project－

Research on improvement of water conveyance/distribution and structural maintenance of irrigation and drainage facilities in cold, snow regions

Research Period: FY2006-2010
Project Leader: Director of Cold-Region Agricultural Development Research Group
HIDESHIMA Yoshiaki
Research Group: Cold-Region Agricultural Development Research Group

Abstract:
Many irrigation and drainage facilities in Hokkaido have started deteriorating due to the cold, snowy environment as well as from being in contact with water for long periods. To remain operative, these facilities must undergo preventive maintenance and scheduled renovations using appropriate measures and technologies. The study to improve the water conveyance and distribution of irrigation and drainage facilities and that maintain their functionalities is started. The study aims six goals of development of methods to analyze and improve water conveyance and distribution for cold-region rice paddy irrigation, development of technologies to evaluate the soundness of large-scale farmland irrigation systems and to enable preventive maintenance, proposition of methods for diagnosis of the structural functionality of decrepit irrigation and drainage facilities, development of technologies for repair and renovation of decrepit open concrete channels in cold regions, development of economical design methods for irrigation pipe-lines in area with peaty soil and proposition of planning methods for repair and renovation of irrigation and drainage facilities in cold regions. Main outputs in the annual study of 2006 are given in the below.

1) Using simulations, the allowable range of daily fluctuations in water distribution was clarified and procedures for analyzing the water transmission and distribution in an irrigation system were developed.

2) The causes of deterioration in aging, small-diameter pipelines and the locations of leakage were studied at a pipeline that had been in service for about 40 years. The main causes of the leakage were deterioration and deformation of the joints, and deformation of the pipe itself. Functional decline differed according to geology, with greater decline in pipeline sections laid on quaternary diluvial formations.

3) Concrete surfaces of some headworks that face south experienced differences between daily high and low temperatures of 30 degrees, fluctuating around the temperature of 0 ºC. To examine concrete irrigation facilities in terms of functionality and to evaluate

surface repair methods, it is necessary to consider how moisture conditions, daily variations in surface temperatures, and frequencies of cyclical freeze-thaw differ according to the position on the structure.

4) To develop surface-repair methods for open channels, test applications were performed using three different methods. Observations and follow-up surveys have been started to examine the methods on site.

5) Tests in an earth tank clarified that the shape of the slip plane caused by uplifting of the pipe and the uplift resistance acting on the pipe differed according to the type of soil and the form of geogrid (net type geotextile) application. An effective method for calculating uplift resistance according to different patterns of geogrid application will be studied in the future.

6) Examples of functional diagnosis of irrigation facilities in cold, snowy regions were analyzed and it was concluded that i) the causes and effects of various forms of deterioration, ii) patterns in the progression of deterioration according to the time frame, iii) the relationship between deterioration/deformation of facilities and their functional decline, should be studied to improve the diagnosis and preventive maintenance method.

Key words: irrigation and drainage facilities, maintenance, irrigation operation, freezing and thawing, peaty soft ground

－Individual Themes－

Development of technology for diagnosing and improving water conveyance and distribution systems for irrigation of cold-region rice paddies and large-scale upland fields

Budged: Grants for operating expenses
General account
Research Period: FY2006-2008
Research Team: Irrigation and DrainageFacilities

Author: NAKAMURA Kazumasa
OOFUKA Masanori
YAMADA Nobuhisa

Abstract:
In irrigation systems for rice paddies that were studied, fluctuating water levels and flow volumes in the main channel were causing unfavorable daily fluctuations in the amount of water distributed to branch open channels. Through simulations, this study clarified the allowable range of daily fluctuations in water distribution and developed procedures for analyzing the water transmission and distribution from the main channel based on the measured range of daily fluctuations. Upland irrigation pipelines in three regions were investigated in terms of functionality. It was found that in all three regions, valve corrosion caused made it difficult for sluice gates to open and close. The causes of deterioration in aging, small-diameter pipelines and the locations of leakage were studied by field surveys and reference surveys. Leakage occurred at various joints in a pipeline that had been in service for about 40 years. The main causes of the leakage were deterioration and deformation of the joints, and deformation of the pipe itself. Functional decline differed according to geology, with greater decline in pipeline sections laid on quaternary diluvial formations.

Key words: rice paddy irrigation, upland field irrigation, water management, functional diagnosis, asbestos cement pipe

Structural safety requirments for agricultural water facilities and technological developments to improve the durability of those facilities

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Irrigation and DrainageFacilities

Author: NAKAMURA Kazumasa
OOFUKA Masanori
TAGASHIRA Hidekazu
ONODERA Yasuhiro
SATO Daisuke
YOKOKI Junichi

Abstract:
The deterioration of each headwork and the temperatures to which each was exposed in winter were examined, to study methods for analyzing the functionality of aging agricultural irrigation facilities. Concrete surfaces that face south experienced differences between daily high and low temperatures of 30 degrees, fluctuating around the temperature of 0 ºC. Surveys of deterioration found local spalling and defects at the waterline that were caused by freezing, including cyclical freeze-thaw. To examine concrete irrigation facilities in terms of functionality and to evaluate surface repair methods, it is necessary to consider how moisture conditions, daily variations in surface temperatures, and frequencies of cyclical freeze-thaw differ according to the position on the structure.

To develop surface-repair methods for open channels, test applications were performed using three different methods. Observations and follow-up surveys have been started to examine the methods on site.

To establish design methods for the installation of economical pipelines in particularly weak soil, tests were preformed on geogrid (net type geotextile) in an earth tank toward preventing the uplifting of underground pipelines in peaty ground. Tests were performed with three types of backfilling and geogrid applications: 1) the backfill soil over the pipe was fully wrapped with geogrid in the shape of an inverted trapezoid, 2) the backfill soil was partly wrapped with geogrid and the upper part of the inverted trapezoid was left open, and 3) the backfill soil was not wrapped with geogrid. Three types of soil were used to simulate the ground: highly compressible artificial soil, peat and volcanic sand. The tests clarified that the shape of the slip plane caused by uplifting

of the pipe and the uplift resistance acting on the pipe differed according to the type of soil and the form of geogrid application.

An effective method for calculating uplift resistance according to different patterns of geogrid application will be studied in the future.

Key words: headwork, open channel, surface coat repair method, underground pipe, peat, geogrid

Research on repair and improvement planning of irrigation and drainage facilities

Budged: Grants for operating expenses
General account
Research Period: FY2006-2010
Research Team: Irrigation and DrainageFacilities

Author: NAKAMURA Kazumasa
OOFUKA Masanori
TAGASHIRA Hidekazu
ONODERA Yasuhiro
SATO Daisuke
YOKOKI Junichi
YAMADA Nobuhisa

Abstract:
Examples of functional diagnosis of irrigation facilities in cold, snowy regions were analyzed and it was concluded that 1) the causes and effects of various forms of deterioration, 2) patterns in the progression of deterioration according to the time frame, 3) the relationship between deterioration/deformation of facilities and their functional decline, were needed to be studied to improve the diagnosis and preventive maintenance method. Furthermore, it was pointed out that the annual number of freezing and thawing has regional variation in Hokkaido, and in addition, the number varies even in a concrete structure by the difference of the direction which the concrete surface faces and the difference of amount insolation. This fact suggests the necessity to consider the local temperature condition in a concrete structure.

Key words: irrigation facility, functional diagnosis, preventive maintenance, freezing and thawing