国土交通省
Ministry of Land, Infrastructure, Transport and Tourism
国総研ニューズレター
NILIM News Letter
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Contents

New Project Researches in Fiscal 2012

Planning and Research Administration Department, Planning Division

In fiscal 2012, the National Institute for Land and Infrastructure Management (NILIM) began the following four new Project Researches (some researches started in fiscal 2011) in the fields of earthquakes, tsunamis, etc.

Project Researches are selected by NILIM independently and implemented preferentially. Each Project Research is implemented by a project leader gathering a group of researchers in necessary fields to achieve its goals under an approximately 3 to 5 year plan.

« New Research Project Table »

1. Research on tsunami damage mitigation systems using multifaceted protective mechanisms.
2. Research on risk and crisis management strategies for excessive and multiple actions of natural disasters
3. Research on effective sediment management in catchment basins after huge scale sediment production
4. Research on fire safety of 3-story wooden school building

NILIM website (press conference documents)
http://www.nilim.go.jp/lab/bcg/kisya/journal/kisya20120406.pdf

Shaking Table Tests on Cross Laminated Timber Panel Structure

Research Center for Land and Construction Management, Evaluation System Division

To establish a structural design method for panel construction using cross laminated timber made with domestically produced Japanese cedar, shaking table test of a three-story full-size model specimen was performed.

The Act for Promotion of Use of Wood in Public Buildings (Law No. 36 of 2010) was enacted and enforced, and the research and development to relax the building regulations of the national government itself will now be done. Cross laminated timber (CLT) is a material made by placing each layer with its wood fibers perpendicular to those of adjacent layers. The CLT panel structural method is a wall construction which originated in Europe, where it is used to build walls with openings cut out of large panels. In this case, a construction method executed by connecting relatively small panels with bolts and plates has been adopted to suit domestic manufacturing equipment.

This method is expected to lead to the use of a relatively large quantity of wood, thus helping to use domestic forest resources effectively.

The shaking table test was conducted in order to develop a structural design method for such CLT panel structures. The model specimen was designed to be identical to a five-story building based on test data concerning its joints and wall elements, but as a result of restrictions imposed by the test equipment, only weight was added for the top two stories, so it was provided as a three-story model specimen (see Photo).

Photo: CLT panel structure specimen

The CLT building based on this construction method did not exceed its damage limit (1/120 rad) under the seismic input provided to occur only rarely under the Building Standard Law, and it did not exceed the safety limit (1/30 rad), even under the seismic input provided to occur extremely rarely. Even when the ground motion recorded at JMA Kobe on 1995 in the NS direction was applied as an extreme earthquake, the specimen did not fail. These results show that the CLT method based on this construction method provides sufficient earthquake resistance and safety.

Experiment for Anti Soil Liquefaction of Housing Sites

Urban Planning Department, Urban Planning Research Division

In order to find practical anti soil liquefaction technology for developed housing areas where detached houses are built and located, research projects including seismic tests and simulations are underway.

Soil liquefaction hit housing areas with unprecedentedly huge scale during the Great East Japan Earthquake Most of the areas severely damaged are detached housing districts. The MLIT established a new subsidy system in the third supplementary budget of 2011 to support the area wide anti land liquefaction project which includes both alley roads and housing lots. However, the technologies usable to build up housing areas have not been developed because there is no practical example, though the technologies for vacant land are already established, so that the research for technology development has, in practice, to be conducted simultaneously with planning and implementation of the restoration projects in damaged districts.

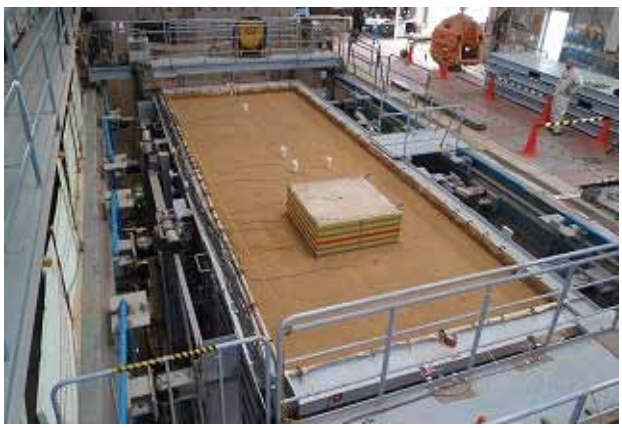

Photo: Large scaled specimen of sand ground for the seismic liquefaction test

The NILIM launched a research program in order to, as quickly as possible, find practical anti soil liquefaction technologies implementable in both technical and economic terms in real situations where detached houses are densely located. This experiment is a seismic shaking test as conducted as part of the research program, using a large scale shearable box 10m x 3.6m x 5m depth, whose purpose is to measure the horizontal distance from the center of a vertical drainpipe inserted into the sand ground which effectively prevents soil liquefaction.

The experiment clarified that the effective distance that migrates water pressure to prevent liquefaction is approximately within 50cm from the center of drainpipe in response to the seismic input similar to the observed wave in the reclaimed housing area in front of Tokyo Bay.

For further information, please visit
http://www.nilim.go.jp/lab/jbg/takuti/takuti.html

Development of Life Cycle Environmental Assessment Methodology for Infrastructures
—Definition of Life Cycle Environmental Assessments—

Environment Department, Road Environment Division

The National Institute for Land and Infrastructure Management published "the Report on Development of Life Cycle Environmental Assessment Methodology for Infrastructures —Infrastructure LCA Implementation Methods—" in February 2012. The calculation methods and environmental load units given in this report made it possible to calculate the carbon dioxide (CO_2) emission of infrastructure development and building construction work.

In recent years, global warming has become an extremely serious problem. To overcome this problem, it is necessary to work hard to reduce the quantity of CO_2 emissions and achieve a low carbon society.

The construction industry only directly emits about 1% of all CO_2 emitted in Japan, but if the quantities of CO_2 emitted by the manufacture of building materials and transport of materials and wastes are added, its share rises to about 14% of all CO_2 emitted in Japan. In order to appropriately evaluate and reduce the CO_2emissions of the construction industry, it is necessary to study CO_2 emissions throughout the life cycle of buildings, including emissions other than direct emissions. Environmental impact assessments which calculate the environmental load of the entire life cycle including obtaining raw materials, transportation, manufacturing, constructing, demolition, and disposal of wastes etc. is called a Life Cycle Assessment (LCA).

The National Institute for Land and Infrastructure Management carried out the comprehensive technology development project "Development of Life Cycle Assessment Methodology on Sustainability of Infrastructure (Infrastructure LCA)", from 2008 to 2010, and then, as the results of its research, it announced the CO_2 Emissions Calculation Method and the Environmental Load Units used by the methodology in February 2012. Our goal is to help achieve a low carbon society by widely disseminating infrastructure LCA presented in the report and lowering the quantity of CO_2 emitted by infrastructure development and building construction work.
http://www.nilim.go.jp/lab/dcg/lca/top.htm

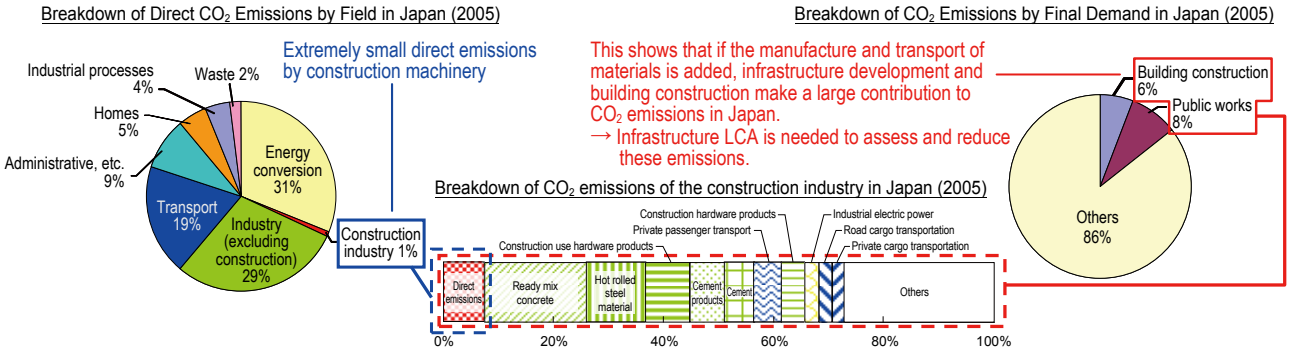

Figure: Breakdown of CO_2 emissions in the construction field

Latest Trends in Tsunami Countermeasures for Sewage Treatment Systems

Water Quality Control Department

The Sewerage and Wastewater Management Department of the Ministry of Land, Infrastructure, Transport and Tourism has, based on the results of a one-year study, announced methods of appropriately restoring sewage system facilities damaged by the Great East Japan Earthquake and future countermeasures for giant tsunami.

On March 8, 2012, the Sewage System Earthquake/Tsunami Countermeasure Technology Study Committee (Administrative Office: National Institute for Land and Infrastructure Management), based on its analysis of the characteristics of damage caused by the Great East Japan Earthquake, published its Fourth Recommendations, which summarize concepts of sewage treatment system facility design to be applied to tsunami-resistance countermeasures for implementation at nationwide sewage systems that are likely to be damaged by future tsunami.

The concepts are organized into the categories: (1) predicted tsunami, (2) tsunami resistance of sewage system facilities, and (3) tsunami-resistant countermeasures, all of which are considered necessary to design facilities. Major points related to (1) to (3) are introduced below.

[1] Predicted tsunami

The predicted tsunami for each region is set by prefectures based on the Law Concerning Creation of Tsunami Disaster Prevention Regions. The law calls for tsunami resistance countermeasures for sewage treatment systems to be planned to achieve the required tsunami resistance considering the Top Class Tsunami set by each prefecture in order to prevent secondary disasters.

[2] Tsunami resistance of sewage system facilities

The tsunami resistance countermeasures required by sewage system facilities differ according to the degree of importance of the pipelines, pumping stations and treatment plants. It is therefore necessary to study effective protection and restoration methods categorized by function.

In order to set tsunami resistance, as shown in Table 1, tsunami countermeasures are decided by classifying the overall performance of sewage treatment systems as "functions which must be ensured (basic functions)" during disasters and as "other functions". "Other functions" are further sub-categorized as "functions which must be restored immediately", and "functions which must be restored quickly" although these functions may be temporarily disabled by the Top Class Tsunami.

[3] Concept of tsunami resistance countermeasures for sewage treatment plants

To efficiently take tsunami resistance countermeasures for sewage treatment system facilities, it is necessary to set countermeasures according to the tsunami resistance (Table 1) required for each function based on risk management.

A suitable protection level must be selected from the following three

levels, based on the results of a complete study of the sewage system facility focusing on the importance of its functions, cost-effectiveness, and feasibility of execution.

These three protection levels are classified as shown in Table 2 according to tsunami resistance.

[1] Risk avoidance

This means installing a facility above the inundation level or protecting it by constructing a protective wall higher than the inundation level, and requires a structure which prevents inundation even when a tsunami strikes. This is the highest level of tsunami protection and the safest type of countermeasure.

[2] Risk reduction

This means providing solid water-resistant structures by installing waterproof gates or by waterproofing equipment, thus protecting functions even when equipment is inundated by a tsunami.

[3] Risk retention

This means building a structure which allows inundation, and means trying to reduce damage with non-physical structure countermeasures.

The Sewage System Earthquake/Tsunami Countermeasure Technology Study Committee concluded all its deliberations at its seventh meeting on March 22, 2012. In the future, the four proposals discussed by the committee will be made more specific and design methods which permit sewage system operators to easily tsunami-proof their facilities will be established. These will then be reflected in guidelines on tsunami-resistant design, etc.

On April 2, 2012, the Sewerage and Wastewater Management Department of the Ministry of Land, Infrastructure, Transport and Tourism announced the Sewage Treatment System BCP Enactment Manual (Earthquakes, Tsunami Volume), which hypothesizes tsunami damage as non-physical structure tsunami resistance countermeasures.

Table 1. Standard Tsunami Resistance of Sewage Treatment Facilities Under the Top Class Tsunami

Facility category	Pipeline	Pumping station	Treatment plant		
Function category	Overall functions				
	Basic functions			Other functions	
	Backwash prevention	Pumping up	Pumping up Sterilization	Settlement Dewatering	Others
Tsunami resistance	Must be guaranteed even during a disaster			The function may be temporarily disabled, but must be restored immediately.	The function may be temporarily disabled, but must be restored quickly.

Table 2. Protection Level and Countermeasure According to Tsunami Resistance (Case of Top Class Tsunami)

Tsunami resistance	Must be guaranteed	Restored immediately	Restored quickly
Protection level	High ←	Medium	→ Low
	Risk avoidance * When unavoidable, "risk reduction"	Risk reduction	Risk retention
Countermeasure	Structure that is not inundated (Installed above inundation height or protected by a protective wall higher than inundation level) * When unavoidable, solid waterproof structure	Strong water-resistant structure (Waterproofing by waterproof gates or equipment, etc.)	Allows inundation

Webcam Monitoring of Amounts of Plastic Litter on Beaches

Coastal, Marine and Disaster Prevention Department,
Coastal Zone Systems Division

The amount of beached plastic litter can be remotely observed using webcams installed on multiple beaches.

Plastic litter has disfigured the beaches of the world's coastlines and caused pollution on coastal and marine environments. Most of the plastic litter is transported from far away by ocean currents along with that floating from locations near the coast where it is beached. Thus, to find a solution to this problem, it is important to clarify the process by which plastic litter is transported. As a first step to clarifying the transportation process in East Asian seas, we have sequentially monitored the amount of beached plastic litter (hereafter "beached plastic quantity") using webcams at multiple sites. In the paper, the time series of the beached plastic quantity at four sites on the Japan Sea Coast along the Tsushima Current (● in Figure 1(a)) is introduced.

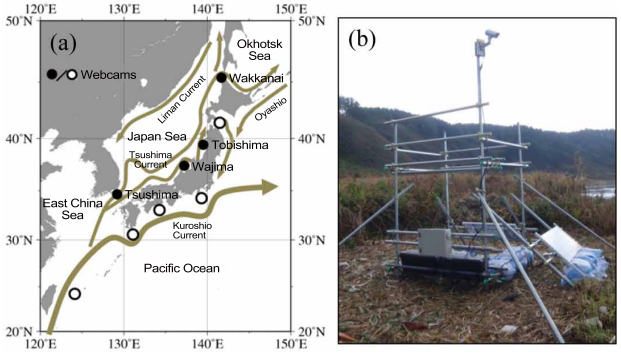

Figure 1. Monitoring Sites by Webcam and Ocean Currents around Japan (a); Webcam Installed on Tobishima (b)

An area of the beach covered with plastic litter was used as an index of the beached plastic quantity and was calculated by image processing images taken by webcams. First, the pixels of plastic litter were detected (Figure 2(b)) from the webcam image using the CIELUV color space (Figure 2(a)). The covered area was calculated from the number of the pixels of plastic litter in the image after applying a projective transformation.

A time series of the beached plastic quantity was obtained by sequential image processing of webcam images from the time the webcams were installed to August 2011 (Figure 2(c)). The variability of the beached plastic quantity on four beaches differed. For example, the beached plastic quantity at Tsushima greatly fluctuated during the analysis period, but at Tobishima, it was consistent during the same period.

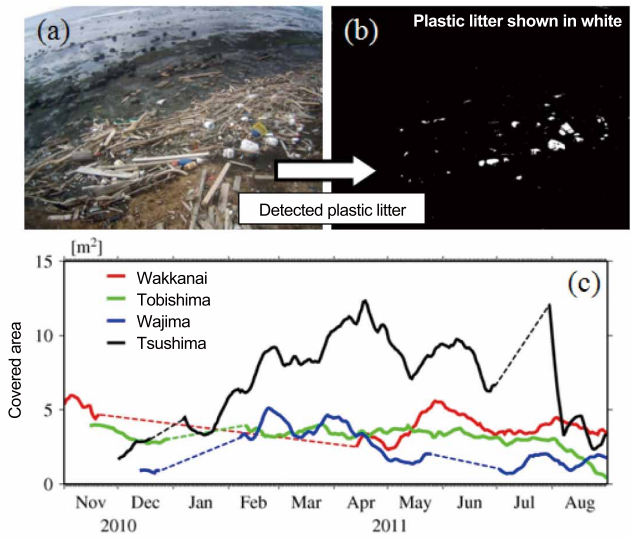

Figure 2. Webcam Image at Tobishima (a) and Detected Image of Plastic Litter (b); Time Series of Beached Plastic Quantity at Four Sites (c)

An advantage of monitoring the beached plastic quantity using the webcam is that the time series of beached plastic quantity with high temporal resolution can be obtained at multiple sites. Most of beached surveys conducted around the world were in-situ surveys by personnel. However it is impossible to obtain the time series of the beached plastic quantity at multiple sites as shown in Figure 2(c) by in-situ surveys. Mechanisms of the variability of the beached plastic quantity can be clarified by comparing the time series of beached plastic quantity obtained by the image processing using the webcams with wind and wave observed at near site. We installed the webcams at five sites beside the four sites analyzed in this study and have monitored the beached plastic quantity (○ in Figure 1(a)). In the future, we will identify the time series of the beached plastic quantity at each site and mechanisms of the variability of the beached plastic quantity by processing images taken by the nine webcams. In addition, we will identify the transportation process of plastic litter in East Asian seas using an ocean circulation model and the beached plastic quantity observed by the webcams.

Webcam website.
http://www.ysk.nilim.go.jp/kakubu/engan/enganiki/umigomi/index.html

PROJECT RESEARCH REPORT of National Institute for Land and Infrastructure Management (February-April, 2012)

No.	Title of Paper	Project Leaders
35	Studies on Cooperation between the Maintenance of Traffic Network Functions and Business Continuation Plans (BCP) of the Industrial Sector in Large-Scale Disasters	Research Coordinator for Road Affairs
36	Development of Life Cycle Assessment Methodology on Sustainability of Infrastructures	Director of the Environment Department
37	Research on Evaluation Technologies and Measures to Protect People from Accidents inside Buildings in Daily Life(Part1)	Director of the Building Department
	Research on Evaluation Technologies and Measures to Protect People from Accidents inside Buildings in Daily Life(Part2)	Director of the Building Department

RESEARCH REPORT of National Institute for Land and Infrastructure Management (February-April, 2012)

No.	Title of Paper	Names of Divisions
49	Model Development on Estimating Import and Export Port Cargo Volume considering the International Trading and Industrial Structure	Port Systems Division

TECHNICAL NOTE of National Institute for Land and Infrastructure Management (February-April, 2012)

No.	Title of Paper	Names of Divisions
657	Report of the 1st Evaluation Committee of NILIM in FY 2011	Research Administration and Evaluation Division
658	Field Survey of the 2011 off the Pacific coast of Tohoku Earthquake and Tsunami on Shore Protection Facilities in Ports	Coastal Disaster Prevention Division
659	A Study on Deformation Characteristic of Composite Caisson Type Breakwater Using Hydraulic Model Experiment Result	Port Facilities Division
660	Practical Research on Methods of Survey, Analysis and Evaluation of Travel Time Reliability in Road Traffic	Traffic Engineering Division
661	Annual Report of Road-related Research in FY 2011	Traffic Engineering Division
662	Effect of Dimensions of Specimen on Elongation of Structural Steel (Joint Research Report on the Elongation of Structural Steel for Determination of Specified Design Strength)	Building Department
663	Landscape and Ecology Division, Annual Research Report (26th)	Landscape and Ecology Division
664	A study on creation specification of three dimension geographical data for road design	Information Technology Division
665	Investigation of Practice Examples of Flood Damage Mitigation Measures in step with River Basin Management	River Division
666	Standards for Reference Road Sections and Reference Intersections for Traffic Surveys	Traffic Engineering Division, Construction Economics Division
667	Preliminary Study on the Minimum Required Standards of Horizontal Alignment and Longitudinal Grade of Small-Scale Roads	Traffic Engineering Division
669	Manual of the countermeasures for tree failure of street trees	Landscape and Ecology Division
671	Grounds for the Calculation of Motor Vehicle Emission Factors using Environment Impact Assessment of Road Project etc. (Revision of FY 2010)	Road Environment Division
672	Verification of the Influence on Roadside Air Quality Concentration and its Prediction by happened Atmospheric Stable Calm	Road Environment Division

■ Visit the following website for documents published by the NILIM: (http://www.nilim.go.jp/lab/bcg/siryou/index.htm)

■ NILIM research activities and achievements are now available on the following website as NILIM Annual Report 2012: (http://www.nilim.go.jp/english/annual/annual2012/ar2012e.html)

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