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N I L I M

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Result of Full-scale Fire Experiment of a Three-story Wooden School Building

Building Department, Fire Standards Division

In order to revise the Building Standards Law, a fire experiment (preliminary experiment) using a three-story wooden school building has been conducted.

On February 22 of this year, a preliminary experiment to prepare for a full-scale fire experiment using a three-story wooden school building was carried out in the presence of many observers on the grounds of the NILIM (purpose and plan were already reported in [News Letter No. 39](#)).

The experiment started with the ignition of the fire in the first story teachers' room at 9:00 a.m., then about 2 minutes and 50 seconds after ignition, flames burst out of an opening in the room where the fire started, and at about 5 minutes and 20 seconds after ignition, the fire had spread throughout the entire room. From the story where the fire started, it spread through exterior openings to the upper stories at a relatively early stage (to the second story at about 3 minutes 30 seconds after ignition and to the third story at about 6 minutes 20 seconds after ignition). The timber frame construction part in the room where the fire started collapsed at about 76 minutes after ignition, followed by the collapse of the wood frame structure part at about 95 minutes after ignition and of the fire walls at 96 minutes after ignition (there was a delay between the start of the fire and its spread).

This preliminary experiment, which was an experiment of unprecedented scale, provided valuable data used to evaluate the spreading routes, state

of collapse, and the impact of the heat on the building's surroundings: factors which could not be learned without a full-scale experiment, and also confirmed the way that sparks were scattered. The fire spread through a fire wall at about 18 minutes after ignition on the first story, confirming that fire doors installed in fire walls are opened by the increase in pressure inside a room during the early stage of a fire. An outline of the experimental building and reported results including typical temperatures inside its rooms, and video recordings have been published on the NILIM web site.

After adjusting the specifications and experiment methods in light of the results of this preliminary experiment, a full-scale fire experiment will be performed based on building specifications which, it is predicted, will be standardized in 2012.



View 34 minutes after ignition, when the fire had spread to the entire building.

<http://www.nilim.go.jp/lab/bbg/kasai/h23/top.htm>

Promoting Research to Mitigate Congestion Through Cooperation between Advanced Vehicle Technology and Road Infrastructure

Research Center for Advanced Information Technology, Intelligent Transport Systems Division

To mitigate congestion at sag section, where about 60% of congestion occurs on expressways, the ITS division and auto makers are working together to formulate new congestion countermeasures by harmonizing advanced automobile technologies with roadside infrastructure.

Drivers may drive in the overtaking lane because they are eager to drive faster to keep up with the increasing traffic flow rate. At sag sections, where the gradient of the road changes gradually from a descending to an ascending slope, driving speed tends to slow because drivers may not realize the gradient is changing. This slowdown may cause headway fluctuation, disturbing the traffic flow and causing traffic congestion. This process is considered to be the mechanism of congestion at sag sections. Therefore, drivers should keep the following time-gap stable and each lane should be used at the same rate to achieve a stable traffic flow. Since 2010, NILIM and auto makers have been conducting a series of research projects to formulate new ITS services to mitigate traffic congestion at sag sections: 1) Roadside detectors detect the possibility of congestion occurring. Then the ITS Spots provide information suggesting how to

drive (e.g. to keep the following time-gap stable, or not to drive in the outer lane). 2) ACC (adaptive cruise control) equipped vehicles might be able to move appropriately to mitigate congestion at sag sections because their functional features make the following time-gap consistent with that set by the driver. The potential of these services to mitigate traffic congestion were examined by traffic simulations and field operational tests.

This year, to conduct research in depth to make the services more feasible, driving tests will be carried out on public roads in order to verify the extent to which ACC vehicles and ordinary vehicles (not ACC equipped) maintaining following time-gap and whether complying with the rule to keep to the left (outer) lane impacts the surrounding traffic flow. The ITS World Congress will be held in Tokyo in 2013 and demonstrations of these services will be given for delegates to the congress.



View of Test Drive on the NILIM Test Track

Revision of “Specifications for Highway Bridges”

Road Department, Bridge and Structures Division

In February 2012, the technical standard for highway bridges, “Specifications for Highway Bridges”, was revised for the first time in about 10 years. This revision completes maintenance related provisions based on the recent state of highway bridges at the same time as it reflects the results of research conducted since the previous revision.

Highways are the most basic public infrastructure supporting the lives and the economic activities of the people. During large-scale disasters such as the Great East Japan Earthquake of 2011, we have been reminded of the vital roles they play as infrastructure which supports rescue, recovery, and restoration activities. Japan now has highway bridge assets equal to about 650,000 bridges. And bridges 15m long or longer (about 160,000 bridges) are aging rapidly, with about 30% completed more than 40 years ago, and about 50% completed more than 30 years ago. This has been accompanied by increasing damage caused by deterioration over time. This includes severe damage such as broken diagonal bridge bracing in steel truss bridges, severe fatigue cracking of steel main girders, and breakage caused by corrosion of prestressed concrete bridge tension members. Maintaining this vast quantity of road assets in good condition for a long period of time under present tight financial conditions is a major challenge facing society. Consequently, it is necessary that newly built bridges be serviced in the future on the

premise that they will be maintained while efforts are made to reduce maintenance and operation costs through countermeasures such as preventive maintenance of highway bridges.

This revision to the “Specifications for Highway Bridges” is, considering the above circumstances, focused on certainty and ease in bridge maintenance. The revised technical standard is required to avoid factors which make maintenance difficult. And in this connection, provisions concerning the maintenance equipment necessary for scheduled maintenance during bridge’s service period in the design were stipulated.

And because it is recognized that these kinds of information are important for measures to diagnose, repair, or reinforce damage to existing bridges, it is clearly stipulated that various information on bridges from design stage to construction stage must be preserved to utilize the information at the maintenance stage.

For the design stage, bridge design considering the impact on damage to overall bridge structure caused by the loss of the functions of some members was stipulated. In response to the collapse of a deck truss bridge in the United States in 2007 and damage of major bridge members in Japan.

In addition, this revision reflects the achievements of surveys and research conducted in various fields since the previous revision, for example, revising steel slab thickness allowance in friction connection joints with high tension bolts, quality control of construction the Design Earthquake Ground Motion, and so on.

Development of Life Cycle Environmental Assessment Methodology for Infrastructures -How to calculate CO₂ emissions from construction-

Environment Department, Road Environment Division

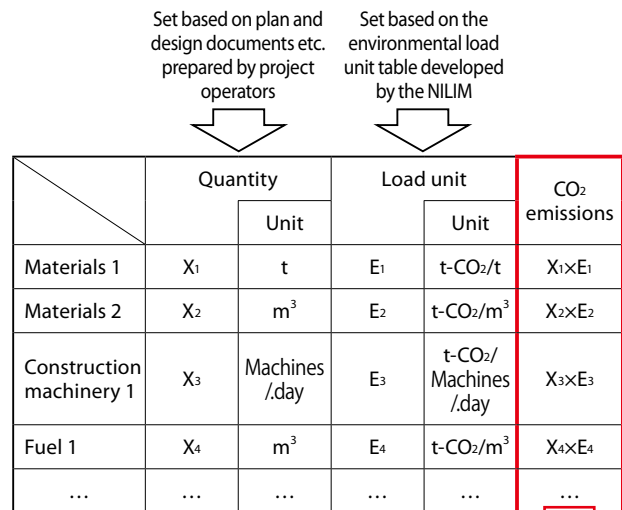
Life Cycle Assessments (LCA) for infrastructure can assess the carbon dioxide (CO₂) emission from construction works by organizing quantities written on planning and design documents at each decision-making stage (planning, designing, constructing, and material selection) of a public infrastructure provision project.

The infrastructure LCA developed by the National Institute for Land and Infrastructure Management (NILIM) is an environmental assessment technology developed to calculate the CO₂ emissions from various construction works including infrastructure construction. The CO₂ emissions calculation method is basically to sum up products of “quantities” of materials or work etc., which can be organized based on planning and design documents, and their respective “environmental load units (CO₂)”.

$$CO_2 \text{ emission} = \sum_i (\text{quantity}_i \times \text{environmental load unit (CO}_2)_i)$$

The provision of infrastructure is conducted by the following procedure: [1] planning an overall project at the planning stage, then [2] deciding forms of structures at the designing stage, and [3] detailed construction methods at the constructing stage, and finally by [4] selecting each material according to each construction method.

In order to assess CO₂ emissions by an infrastructure, it is necessary to develop a method applicable to each decision-making stage, but the types of quantities organized based on planning and design documents etc. differ at each decision-making stage. In the case of road construction,



CO₂ emissions of projects and buildings whose totals are assessed

Image of the calculation of CO₂ emissions based on the infrastructure LCA

the used load unit differs at each stage: at the planning stage it is the length of each type of road (earthwork road, bridges, tunnels etc.) and at the constructing stage it is the quantity of materials or the days of use of construction machinery.

The NILIM has developed “formulas” and “environmental load units” for all decision-making stages, and at the same time, has devised “unifying system boundaries” of formulas and load units to permit comparisons of calculation results at different stages.

<http://www.nilim.go.jp/lab/dcg/lca/top.htm>

50th Estuarine, Coastal and Shelf Association (ECSA) Conference

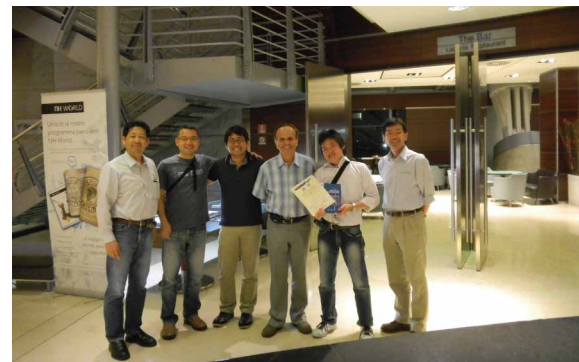
Coastal, Marine and Disaster Prevention Department,
Coastal Zone Systems Division

Our researcher won the “Best Student Oral Presentation Award” for a presentation of research results given at the Fiftieth ECSA Conference.

The 50th ECSA Conference, “Today’s science for tomorrow’s Management”, sponsored by ECSA and Elsevier was held in Venice in Italy from June 3 to 7, 2012.

This conference was held to gather the most advanced scientific knowledge about coastal region environments and ecosystems. Researchers from various countries presented the results of their research work by giving 389 oral presentations and displaying 238 posters.

We presented the results of two research projects titled, “Numerical estimation of floating macro-debris inflow flux into Tokyo Bay” and “A new technique for detecting colored plastic debris on beaches using webcam images and CIELUV”. Researcher Kataoka, a doctor course student at the Toyohashi University of Technology and a member of our division was awarded the Best Student Oral Presentation Award for presenting these two reports.



Photos: (Top) View of the 50th Estuarine, Coastal and Shelf Association (ECSA) Conference and (Bottom) Commemorative Photo Taken after Award Presentation

Research on traceability technology for ready-mixed concrete with IC-Tags

Housing Department, Housing Production Division

We have conducted joint research on technology to ensure the traceability of concrete by embedding IC tags containing information about its production and its qualities inside ready-mixed concrete.

Ready-mixed concrete product made using illegal unauthorized materials was shipped and executed in 2008, causing problems for some buildings and increasing the need for traceability.

IC tags were already introduced in the food products industry as a tool permitting visualization of information such as what kinds of materials, methods, and processes were applied to make a product. This use is counted on to encourage safe and secure purchasing. Aware of this use, universities and industry organizations began joint research intended to study the technical challenge of ensuring traceability of ready-mixed concrete using IC tags.

First, experiments to confirm the communication performance of IC tags embedded inside concrete were done using full-size specimens shaped like columns and slabs. The results have shown that even ordinary IC tags sold on the open market can transmit if they are within 25 to 30cm of the surface of the concrete. In response to the results, with the cooperation of industry organizations, a traceability system using IC tags achievable at this time has been proposed and a prototype application has been developed experimentally in compliance with this proposal.

The application utilization time measured inside an actual ready-mixed concrete production plant was about 70 seconds. There were no serious problems operating the system, and the experiment results show that the time load is small and it is a feasible system.

As results of the joint research, we have confirmed the system through a survey at the same time as we have summarized remaining challenges and prospects.

<http://www.nilim.go.jp/lab/idg/index.htm>



Photo 1. Full size specimens being prepared



Photo 2. Full-size specimens



Photo 3. View of experiments in a ready-mixed concrete production plant

Schedule of Principal Events (November-December, 2012)

Scheduled Dates	Event Name
November. 10	Open House (Public Works Day)
November. 14	The 10th Environmental Research Symposium
December. 4	2012 Conference of the National Institute for Land and Infrastructure Management

RESEARCH REPORT of National Institute for Land and Infrastructure Management (May-July, 2012)

No.	Title of Paper	Names of Divisions
50	A Consideration for Precision Improvement of Official Port Cargo Statistics in the World	Port Planning Division Port Systems Division

TECHNICAL NOTE of National Institute for Land and Infrastructure Management (May-July, 2012)

No.	Title of Paper	Names of Divisions
668	The present situation of the road cave in sinkholes caused by sewer systems(FY2006~FY2009)	Wastewater System Division
675	Study of effects on tsunami evacuation safety of the mitigation measures and research of the evacuation building location method	Coastal Disaster Prevention Division
676	Comparative analysis of berth occupancy rate of the world's leading container terminal by using AIS data	Port Planning Division
677	Damage and Recovery Process of Industries and Logistics in Port Cities Caused by the Great East Japan Earthquake	Port and Harbor Department
678	Study on International Air-Cargo Traffic from/to East Asia	Airport Planning Division
679	Portfolio analysis of customer satisfaction survey on Airport Terminal	Airport Terminal Division
680	Report on Damages of Pavement at Sendai Airport due to 2011 Tohoku Region Pacific Coast Earthquake	Airport Department
681	Effect of Rehabilitation Design Methods on Overlay Thickness of Airport Asphalt Pavement	Airport Facilities Division
682	The data analysis regarding the warning and evacuation information against sediment-related disaster	Erosion and Sediment Control Division
686	Manual on hydrologic and sediment measurements on mountainous river	Erosion and Sediment Control 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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