Aiming for a Beautiful, Safe and Vital National Land

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We of the National Institute for Land and Infrastructure Management (NILIM) are aiming to create beautiful, safe, and vital national land by conducting surveys and research necessary for the Ministry of Land, Infrastructure, Transport and Tourism to be able to technologically, appropriately, and quickly implement its policies.

In regard to safety in particular, we are conscious that this is the most important challenge we must face to establish the infrastructure and prerequisite conditions in all fields.

On March 11, 2011, the Great East Japan Earthquake taught everyone in Japan many lessons. In light of these lessons, we are conducting research in areas where improvements are essential to enact necessary standards and apply them to restoration projects etc. We are also conducting research needed to introduce hard and soft measures to prepare to respond as effectively as possible to the imminent giant Nankai Trough Earthquake and an earthquake directly under Tokyo. At the same time, as the deterioration of public capital is emerging as a social problem, in cooperation with other concerned organizations, we are feverishly researching methods, technologies etc. needed to efficiently and sustainably maintain our public capital.

1. Comprehensive inter-disciplinary initiatives

To respond appropriately to these urgent challenges, it is necessary that instead of blindly continuing past initiatives, we conduct comprehensive studies aiming at faster resolution of all challenges by adopting an overall view including surrounding conditions. Regarding public capital deterioration countermeasures which involve various challenges and risks such as implementation systems or financial problems of management bodies, it is vital that from now on into the future, we adopt a policy of comprehensively planning the most appropriate problem resolution policies guided by awareness of the overall risk and closely linking organizations in all disciplines, in addition to conducting research to clarify existing conditions, rationalize and increase the efficiency of inspection, diagnosis, and record keeping methods and to improve repair and renewal methods etc. in individual fields based on the characteristics of each field such as sewage works, rivers, roads ports and harbors, building construction and urban affairs. At the NILIM, specialized groups encompassing a wide range of diverse disciplines related to public capital conduct research in their respective areas of expertise, but we have also formed project teams to flexibly take comprehensive initiatives spanning many disciplines. Such inter-disciplinary comprehensive initiatives are counted on to achieve unprecedented success by taking advantage of various networks established both inside and outside of Japan.

2. A humble attitude toward technology

As a person who has long been involved in administrative and technological policies concerning public capital, I have recently reached two conclusions.

The first concerns a humble attitude toward technology. Generally, science and technology have evolved with each acquisition of knowledge through humanity's various experiences. Present knowledge is the result of our unflagging efforts of the past, but it will not continue to improve in the future; we must adopt a humble attitude without being overconfident in today's science and technology, and at the same time, based on present knowledge, we have to imagine everything that could possibly occur in the future, or even imagine the "unimaginable", to continuously devote ourselves to the task of preparing for these events with both hard and soft measures.

It is extremely interesting to look back at the evolution of seismic technologies of bridges for example. The first technical standards for road bridges in Japan were stipulated in the Home Ministry Order of 1886, National Highway Construction Standards, but the first which specifically considered the impacts of earthquakes were presented in the Notification, Bridge Abutment and Bridge Pier etc. Seismic Methods issued in 1924 by the Civil Engineering Bureau of the Home Ministry in response to damage

caused by the Great Kanto Earthquake of September 1923. Later Japan experienced many disastrous earthquakes such as the Niigata Earthquake of 1964, Miyagi Prefecture Offshore Earthquake of 1978, and the Hyogo-nanbu Earthquake of 1995, and after each one, we conducted various tests to obtain new knowledge which we applied to evolve design methods, seismic standards and seismic technologies[1)]. Today's seismic standards are based on research conducted in response to the Hyogoken-Nanbu Earthquake, and almost all bridges newly constructed or retrofitted in line with these standards were free of fatal damage caused by earthquake motion of the later Niigata Chuetsu Earthquake of 2004 and the Great East Japan Earthquake of 2011. But damage caused by the tsunami has revealed new challenges. We must humbly and steadily continue research considering these new challenges.

3. Pursuing dreams

The second is to constantly pursue our dreams.

In the spring of 2012, approximately 162km of the Shintomei Expressway opened in Shizuoka Prefecture. It is reported that this sharply cut congestion on the existing Tomei Expressway at the same time as it normalized the sharing of functions among the arterial roads—the Shintomei, existing Tomei and National Highway No. 1—and achieved an approximately 80% level of satisfaction among users with the safety, security, and comfort of the Shintomei Expressway[2)]. This road which, although only partly opened, has quickly begun to function as a major new artery of Japan, was constructed according to new geometric structure standards intended to create roads which are safer and more pleasant to use than past expressways. This structural standard is based on experimental research that started about 30 years ago on the 6km test course at the NILIM. As a result of various later circumstances, it took the people of Japan an extremely long time, more than 30 years in fact, to truly benefit from our experimental research's effectiveness and achievements. For us who were directly involved in the project to varying degrees, this unexpected and unnecessary long delay was deeply regrettable. We had worked feverishly to realize our shared dream of building a network of roads to serve as major arteries needed to support Japan in the 21st century.

Later, the test course was used for a variety of tests related to ITS, and ITS technologies, intended to let people use roads more safely, pleasantly, and more intelligently, will continue to evolve further as we compete with the U.S. and Europe for leadership in this field.

Everything conceived of and planned in the Showa Period (1926 to 1989) has been generally completed, and some people say, "The future will be an age of maintenance instead of an age of construction." Throughout their long history, the Japanese people have devised various measures to improve their national land, with its harsh natural environment, in which we have suffered flood disasters of various kinds every year and occasional massive earthquakes while enjoying the blessings of its rich natural setting. If people continue to live on this land for hundreds or for thousands of years into the future, they will have to work hard to continuously and steadily maintain and renew the public capital, which is resistant to earthquakes and other disasters and will reliably perform the functions demanded by each age, and when they do so, it will be vital to harbor warm feelings and dreams for the people who live on the national land now and in the future. We must never forget to dream of and remain constantly excited about the future.

In the future, we of the NILIM are determined to act as groups of experts in a wide range of disciplines by applying our overall abilities to carry out surveys and research needed to aim for a "beautiful, safe, and vital national land" with humility and dreams and to continue to work to enable the people of Japan to genuinely feel our achievements as each appears.

[Sources]

1) Japan Road Association: Road Earthquake Disaster Manual (Pre-quake countermeasures) 2006 Revision, Sept. 2006

2) Shintomei (Shizuoka Prefecture) Impact Adjustment Committee: One year after opening of the Shintomei Expressway (Gotenba Junction – Mikkabi Junction), --Traffic Conditions and Improvement Effects of the Expressway 1 Year after opening, April 12, 2013.

Messages from Departments and Centers of NILIM

Greater Achievement in Studies of Disaster Prevention / Maintenance / Environment by Strengthening the Incorporation of Vertical and Horizontal Structures

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Keywords: cross-sectional approach, bird's-eye view of whole picture, count back from a goal, national land system

NILIM studies connect with the field for real management and cover a wide range of infrastructure

The NILIM is "vertically structured" in that each research department directly supports technological policy for a different kind of infrastructure or area (e.g., sewerage, rivers, roads, buildings, housing, urban areas, coastal and marine areas, ports and harbors, or airports). It is also "horizontally structured" in that each research center addresses cross-sectional issues that fall under the headings of management and informatization. Uniquely, the NILIM maintains good communication with engineers who are implementing technological policy in the field, while also researching a broad scope of highly specialized issues in land and infrastructure management (**Fig. 1)**.

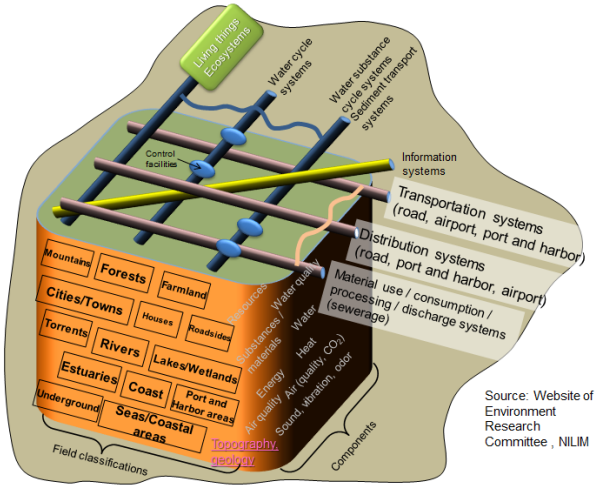

Figure 1: Bird's-Eye View of National Land System ---
Research projects of NILIM cover about 70% of the items above.

Reasons for increasing importance of incorporation between vertical and horizontal structures

As **Fig. 1** shows, the national land system consists of various fields, factors, and systems. For example, each type of social infrastructure is greatly different from others, much in the way that giraffes, hippos, and lions are different. They are so different that we might be perplexed to think whether they need to be handled by a cross-sectional approach. However, just as giraffes, hippos, and lions share a common ecosystem, various kinds of infrastructure have common characteristics and are connected with each other—constituting a national land system.

There are considerable differences in the current approaches to maintain different kinds of infrastructure such as sewerage systems, river hydraulic structures, and roads, which is becoming an important issue. However, a comparison of commonalities among types of infrastructure reveals that there are approaches that can and should be mutually adopted in order to appropriately maintain our infrastructure.

Furthermore, in continuing to promote technology policy for land and infrastructure management, it is necessary to overcome various issues under ever more challenging conditions, such as excessive external forces and climate change, rapidly aging infrastructure, and complicated matters that must be coordinated when implementing environmental conservation / restoration projects. Under such circumstances, while upgrading the skills on each kind of infrastructure -- "giraffe," "hippo," and "lion," it is necessary to pay attention to other matters, look at them as groups, and then work out well-conceived visions and measures.

In 2014, the NILIM will further strengthen the framework for incorporating its vertical and horizontal structures, both in terms of organization and administration. As reflected in the title of this paper, the primary targets of such efforts are disaster prevention (disaster reduction and crisis management), maintenance (maintenance of social infrastructure), and the environment (conservation and restoration).

Points for leading horizontal function to achieve

It is not so easy to crosslink each research field. Sometimes, the connection itself mistakenly becomes the objective. For a horizontal structure to really demonstrate a true effect, the following three points are essential.

(1) To assemble a complete picture of the issues, identify targets, study approaches, and maintain perspective.

The complete picture should be founded on an underlying basic principle that is in turn based on an understanding of real situations; no effort should be organized abstractly or superficially. **Figure 2** attempts to

show the overall composition of social infrastructure maintenance from a viewpoint of "what should we work out." If any of the requirements, flows or cycles shown in this figure is unsatisfied or inactive, an issue will occur with maintenance.

As known from this figure, there are various points where an issue could occur, e.g., technology development processes, interfaces between needs and seeds when applying such technology, the acquisition of technical knowledge that constitutes the core of maintenance, and the dissemination and practice of maintenance engineering which necessarily includes building institutional systems and securing human resource. In each of these cases, the responsive measures will be different. Looking at the situation as a whole, it is necessary to make constant efforts to clarify what issues a project aims to address. With such approach, it should become easy to identify the matters for which a horizontal structure is particularly useful, matters accumulated in past studies, results of approaches in other fields, etc. Hence, a "next-best approach" can reasonably be chosen.

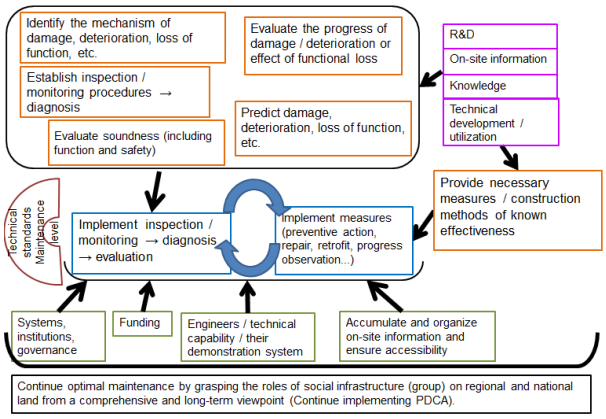

Figure 2: Attempt to Map the Conditions for Continuous Good Quality Maintenance of Social Infrastructure (In reference to discussions made by the stock management workshop, which is an internal cross-functional approach.)

(2) Activities should be arranged by counting back from the goal.

Figure 3 shows a composition (the upper half of a figure) wherein an event (external force) acts on the national land system shown in **Fig. 1** and causes a disaster that impacts people and society. The lower half of the figure shows a situation wherein various technical measures are developed and arranged in a well-coordinated way based on an understanding of the response of the national land system. These measures contribute to preventing or mitigating damage.

To address a serious disaster, such as a Nankai Trough Earthquake or earthquake directly under Metropolitan Tokyo, which is expected to be broad and complex, it is particularly important to establish specific objectives that will minimize the damage in target areas, and choose an approach that takes in all possible measures, combines them organically and make the best use of them, without taking the approach of merely bundling the existing results (i.e., what we know we can do) accumulated in individual technical fields. Working backward from the goal in **Fig. 3** will upgrade the policy on individual studies and automatically help provide perspective across individual studies.

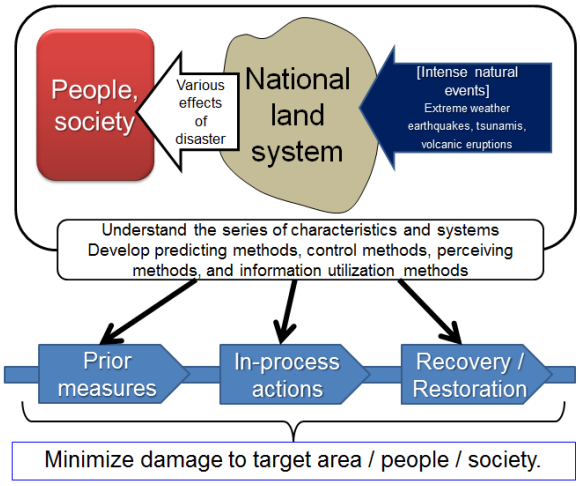

Figure 3: Relationship between Study of Disaster Prevention and Mitigation Based on an Understanding of Responses of the National Land System to Events and Implementation of Countermeasures (In reference to discussions made by the crisis management workshop, which is an internal cross-functional approach.)

Vertical and horizontal structures working hard together

This is the third point. As a major premise for horizontal structures to achieve results, vertical structures, that is to say, technologies in each field should be firmly established on the ground. It is difficult to accurately assemble an overall approach and also advance each technical field. Yet, we have to do just that. We must face this mission straightforwardly and work hard together so that the two structures will strengthen each other. I would like to believe that an approach with such a goal will lead to greater achievement in studies of "technology policy for land and infrastructure management."

Aiming at Improvement in Sewerage Management

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Keywords: comprehensive strength, management, total balance

1. Sewerage system provides ultimate service

Treatment of excrement and wastewater is very important for communities. With sewerage systems, these can be easily treated. With an urban piping network, waste matter can be transported utilizing water and gravity.

Sewerage system users are required to pay a sewerage service charge for the benefit of using the system and a fee based on the polluter-pays-principle for treatment of pollution in public waters. Sewerage service covers not only communities but also the natural outdoors and environments, such as aquatic eco-systems.

Sewage consists of wastewater and rain water, as the treatment of rain water is also essential for communities. In Japan, a tax is used to fund measures to drain rain water, but that tax and sewerage service charge are the same in that they are both paid by residents. Waste water and rain water are quite different in how quantity is measured and how they are treated, as well as in quality, so sewerage personnel must have broad knowledge about them.

Sewage contains biomass energy, resources such as nitrogen and phosphorus, and heat, which are discharged as a consequence of human activity. Technologies for recovering and utilizing these resources are progressing. Such technologies should be further developed and expanded by solving cost problems in order to contribute to the formation of a recycling society.

2. Some specific areas of sewerage management

The key to management must be comprehensive strength. Without a total balance amongst organization, planning, construction and reconstruction, operation, maintenance, and financial considerations, it is difficult to sustain the management of works in the future.

Moreover, there are some specific areas of sewerage system management. This section highlights keywords and matters of interest concerning these areas.

(i) Stock management: Safety assurances, function maintenance, reduction of life-cycle costs, cost equalization, etc.

As a special note, total length of sewage pipes laid has reached about 450,000 km, equivalent to slightly more than 11 circles around the earth, and a sharp increase in old pipes is henceforth expected. It is, therefore, an important priority to establish efficient measures in order to prevent disasters by studying past cases of road subsidence due to deteriorated sewage pipes, as well as data concerning pipeline degradation. It is also necessary to accelerate the planning of efficient measures that are affordable even to local governments with small budgets. Such measures may include the development, introduction, and evaluation of accurate, quick, and cost-efficient methods for surveying and diagnosing deterioration, as well as life extension measures such as partial restoration.

(ii) Water environment management: Water quality conservation in public waters, improvement of water use systems, rain water management, etc., required from a broad / recycling viewpoint.

It is necessary to keep a good balance between the amount of energy used for water quality improvement / water utilization and the level of water treatment. For what regards the water quality of public waters, such as bays, management has recently been required considerations for balanced ecosystems, fishery resources and other facets rather than focusing entirely on reducing nutrients. In addition, to control damage caused by inland water inundation, it is required to properly assess the capability of existing infrastructure and establish measures to mitigate inundation damage caused by localized heavy rains, etc. in cooperation with sewerage and river projects, and other organizations.

(iii) Energy resource management: Recovery of nutrients and energy from sewage, control of greenhouse gases (CO2, N2O, etc.), and recovery of urban waste heat.

The Breakthrough by Dynamic Approach in Sewage High Technology (B-DASH) Project is underway to demonstrate advanced technologies. From 2014, the projects, such as producing hydrogen from sewage sludge and developing energy-saving water treatment, have begun.

(iv) Risk management / Crisis management

As a risk related to water quality, there is the potential harm to people and ecosystems from chemicals or pathogenic microbes contained in sewage. When reutilizing sewage treatment water, it is necessary to manage water quality risks according to application, and show consideration for such standards. The spread of sewerage systems has improved the control of water-borne infectious diseases such as cholera, which had killed many people, and extreme water pollution. However, it is still necessary to evaluate and take measures against an enormous number of chemical substances and medicines in sewage. These substances are used not only by factories but also at home, and flow into the environment via sewerage systems.

It is also necessary to take preventive steps as well as responsive action for emergency cases, such as the overflow of wastewater from sewerage systems, which occurred in the Great East Japan Earthquake. It is also an urgent issue to take structural and non-structural measures assuming the occurrence of major earthquakes and tsunamis.

3. Reinforcement of financial thinking

For sewerage projects, corporate accounting has been introduced by local governments and the practice is spreading. Depreciation costs are important for industries with very large fixed assets such as a sewerage system. To depreciate costs means to account for the annual decrease in the value of newly installed fixed assets based on usage as non-cash expense in annual profit and loss statements. It is also necessary to account for revenue against costs in a given year. Depreciation costs are calculated based on the predetermined length of life of the asset, so if the asset is used in excess of the predetermined life, it will produce profits.

In some cases, however, life extension may be inappropriate for some sewerage infrastructure and it may be more appropriate to rebuild the said infrastructure at relatively short intervals in line with technological innovation. Infrastructure for resource / energy recycling is of this type. The materials should be simplified in light of the recovery of initial costs during the life of the infrastructure.

The payment of interests arising from a loan for constructing the asset is also recognized as an expense on profit and loss statements. Since interests accrue every day once the construction funds have been borrowed, efforts should be made to deliver the best possible effect as early as possible.

With such financial thinking, it is important to either ensure adequate income against expenses (maintenance + depreciation + interest expenses) or adjust expenses in response to the estimated income.

The financial situation of most local governments is bad. As depopulation and aging progress, water usage will fall and subsequently income derived from that usage is expected to decrease. Under such circumstances, it would be difficult to ensure business sustainability without addressing stock management, risk management, etc.

Accordingly, it is increasingly necessary to simplify matters by applying past experience to reduce costs and set priorities, etc. However, it should be noted that failure to ensure financial resources for proper maintenance will shorten the life of the infrastructure and cause problems.

Furthermore, measures to increase the value of existing infrastructure should be aggressively considered. Such measures might include energy generation using local biomass other than sewage.

4. Roles of NILIM

Local governments take charge of sewerage projects and their financial and technical capabilities are various, ranging from big cities to small municipalities.

The roles of our department in NILIM are as follows. (1) Raising technical capability across the country by means of analysis, evaluation, and development of advanced findings and technologies. (2) Utilization of a wide range of information, including existing maintenance results, from all over the nation. (3) Introduction and evaluation of technical developments that particularly lead to cost reductions. (4) Making such information available to local and regional governments and other stakeholders.

Therefore, we will promote the study of technical policies for sewerage systems with the aim to improve management in ways that maintain a total balance.

Messages from Departments and Centers of NILIM

Structural Measures That Promote Non-structural Measures

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Keywords: comprehensive disaster prevention measures, non-structural measures, structural measures, durability, resident participation

1. Introduction

Damage from the massive earthquake and tsunami in the Great East Japan Earthquake revealed the limit of conventional disaster prevention measures, which were too much dependent on tide embankments, etc. Consequently, two levels of tsunami were newly established as a magnitude basis for disaster prevention / mitigation measures, i.e., "Level 2" tsunami, which is the maximum level, and "Level 1" tsunami, which is more frequent and lower in height than Level 1 but causes major damage.

For a Level 1 tsunami, countermeasures focus on structural measures such as tide embankments, while countermeasures for a Level 2 tsunami focus on non-structural measures place a priority on protecting the safety of people thus center on the evacuation of local residents, etc.

For disaster prevention and other infrastructure, it is possible to maintain the original disaster prevention function when the infrastructure manager provides maintenance. In contrast, non-structural measures that mainly constitute the countermeasures for a Level 2 tsunami are premised on the evacuation of residents, which gives rise to uncertainties, such as whether people can remain aware of disaster prevention or whether it is possible to establish a system that lasts for 1,000 years.

So far, disaster prevention education and other efforts have been made to reduce such uncertainties. This paper introduces and discusses a number of cases concerning the possibility of reducing such uncertainties of non-structural measures by using structural measures.

2. Green tide embankment

Figure 1 shows the cross-section adopted in the Iwanuma Coast Restoration Project on the southern coast of Sendai Bay. This is called a "Green Tide Embankment," where an embankment is constructed on the slope of a "resilient coastal dike," as studied by NILIM, covered with trees, and further provided with means for increasing the effect of disaster mitigation.

In building this dike, the project owner (Tohoku Regional Bureau) constructed the embankment, while other concerned organizations and associations undertook the initiative of planting trees and many local people from wide areas actively participated in the planting.

It is important to provide local residents opportunities to actively participate in the development of disaster prevention infrastructure in order to keep the aware of disaster prevention and future developments of disaster prevention infrastructure.

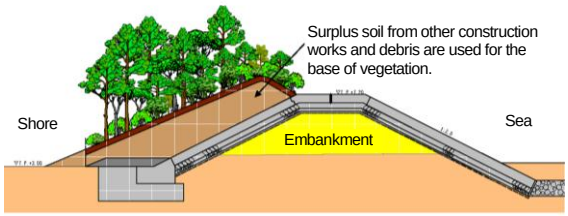

figure 1: Greed Tide Embankment (Future image with grown trees) [1)]

3. Hill of Hope for One Thousand Years

Iwanuma City, Miyagi Prefecture, suffered serious damage and 181 deaths, when about 48% of the city area was flooded by the tsunami of the Great East Japan Earthquake. In addition, many trees planted for protecting the shoreline were also swept away.

As a restoration project and effort in disaster reduction, Iwanuma City developed the "Hill of Hope for One Thousand Years", which built a tsunami breakwater that reduces the force of tsunamis as new social infrastructure for protecting multiple coastal areas. The City is also proceeding with a plan [2)] to develop the area including the "Hill of Hope for One Thousand Years" as a memorial park with the aim of educating future generations about the magnitude of the tsunami that hit and what they thought about it.

According to Iwanuma City, "it is necessary to construct hills using earthquake debris (recycled material) and planting trees to reduce / disperse the force of tsunamis and to develop, grow, and maintain them as evacuation areas and a base for biodiversity. Also, the Hill of Hope for One Thousand Years is an opportunity to realize an advance model of restoration as well as a historical project for conveying the thoughts and prayers of individual citizens and the many lessons learned from this disaster to children one thousand years from now." [2)]

According to the plan, 15 hills, each T.P.+8.0-10.0 m in height, and a garden road extending about 10 km will be constructed as a disaster prevention park with the functions to reduce the force of tsunamis, serve as an evacuation area, etc.. For the first hill and garden road

were constructed using donations from across the country, and trees were planted by about 4,500 volunteers.

Thus, developing the hill as a memorial park and providing citizens with an opportunity to participate in tree-planting are expected to keep people aware of disaster prevention.

Figure 2: Image of Hill of Hope for One Thousand Years (Taking a walk in "Hill of Hope for One Thousand Years") [2)]

4. Hiromura Embankment

After the tsunami caused by the 1854 Ansei Nankai Earthquake, Goryo Hamaguchi, famous for setting rice sheaves on fire as a beacon that guided residents to safe ground, started the construction of a tide embankment 5 m high and 600 m long in 1855 at his own expense. He employed village residents, and completed it in 1858. Consequently, village residents were directly involved in the construction of the embankment.

Then, in 1903, 50 years after the Ansei Nankai Earthquake, volunteers of Hiromura started to the ceremony by piling up the soil on the embankment in order to remember the tsunami victims and honor the achievements and virtue of Goryo Hamaguchi, who constructed the embankment. This is said to be the beginning of the current "Tsunami Festival." [3)]

This festival cements the relationship of residents with the Hiromura Embankment that was built more than 100 years ago.

5. Comprehensive tsunami disaster prevention measures

In 1983, 50 years after the Showa Sanriku Earthquake, the Ministry of Construction and the Fisheries Agency reviewed the disaster prevention measures for Sanriku Region and formulated "Guidelines for Comprehensive Disaster Prevention Measures for Tsunami-Prone Areas (Draft)." These guidelines presented the concept of prevention by means of structural measures for earthquakes equivalent to the Showa Sanriku Earthquake and non-structural measures for the Meiji Sanriku Earthquake; these concepts are similar to the concepts of Level 1 and 2 tsunamis introduced herein. Furthermore, in 1997, the Cabinet Office, Fire Defense Agency, Meteorological Agency, and coastal authorities formulated the "Guide for Reinforcing Tsunami Disaster Prevention Measures in Local Disaster Prevention Plans." In 2011, the "Law for Development of Tsunami Disaster Prevention Regions" was established, stipulating comprehensive tsunami disaster prevention as a combination of structural and non-structural measures.

In the future, improvements to evacuation and non-structural measures will be essential to prevent large-scale damage by tsunamis, high tides, and flooding as well as to restore the areas stricken by the Great East Japan Earthquake. The issue will be how to keep awareness of disaster prevention high among residents.

Meanwhile, structural measures have been supposed to demonstrate the effect of the designed external forces. However, since the Great East Japan Earthquake, tide embankments are expected to be resilient to excess external forces in order to gain as much time as possible to mitigate disaster.

The example introduced herein speaks to a disaster mitigation system that can be sustained for a thousand years through maintenance of structural measures. In order to ensure evacuation, which is an important factor of major flood events, it is essential to strengthen the relationship between structural and non-structural measures, in which more development in study and on-site approach is expected.

1) Website of Sendai Office of River and National Highway: "Leading to Tomorrow," Southern Sendai Bay Embankment Restoration Project ---- "Green Tide Embankment" Iwanuma Coast Tree Planting Ceremony
http://www.thr.mlit.go.jp/sendai/kasen_kaigan/fukkou/pdf/130711syokujyu.pdf
2) Website of Iwanuma City: Tsunami Breakwater "Hill of Hope for One Thousand Years"
http://www.city.iwanuma.miyagi.jp/kakuka/040700/sennnennkibounooka.html
3) Website of "Inamura No Hi No Yakata": Data room, tsunami disaster prevention
http://www.town.hirogawa.wakayama.jp/inamuranohi/siryo_bousai.html

Towards effective use and appropriate maintenance of the road stock —Initiatives under a new organization—

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(Key words) Road, road traffic, road structure, stock, effective use, maintenance

1. New Organization

During the past period of more than half a century since the beginning of full-scale road construction, roads have played a role as the infrastructure supporting social and economic activities centered on automobiles while forming a quantitative stock. But, the environment surrounding roads has been greatly changed and will continue to change. This change means that the stock which has been formed should be used more effectively and the stock should be appropriately maintained.

For road users, problems remain; namely road traffic accidents and congestion. Taking traffic accidents as an example, 4,373 fatalities occurred in 2013, which is 1/4 of the record-setting 16,765 fatalities which occurred in 1970, but fatalities of pedestrians and cyclists has risen from about 38% of all road traffic accident fatalities in 1993, which it was at its lowest level, to about 50% in 2013. Annual congestion loss time is about 5 billion hours, or about 40 hours per person. There are many problems related to the use of the stock which has been formed, requiring that the stock be used more effectively, by improving road space or effectively use networks and so on.

Regarding the appropriate maintenance of the stock which has been formed, problems with technology methods, standards, systems, technological capability etc. for the maintenance of aged and deteriorated structures have been pointed out, requiring that technology methods be established and support systems be constructed quickly. The Great East Japan Earthquake showed the importance of opening roads and of overlapping and alternate networks. To improve wide area disaster prevention, it is necessary to manage roads so that they can function as networks immediately after a natural disaster.

Road related departments and centers of the NILIM have worked in cooperation with concerned bodies such as the headquarters of the Ministry of Land, Infrastructure, Transport and Tourism in order to technologically support such effective use and appropriate maintenance. But to be able to respond more flexibly and appropriately, as shown in the figure, beginning in FY2014, the Road Traffic Department and the Road Structures Department which include necessary research coordinators and divisions have been set up to conduct surveys and research.

Figure. New Organization of Road Related Departments in FY2014

2. For effective use of the stock—Road Traffic Department

To reduce traffic accidents involving pedestrians or cyclists and relieve congestion, road space planning and improvement methods centered on pedestrians and cyclists and bottleneck countermeasures are being taken. The accident rate on expressways is about 1/10 of that on ordinary roads, and CO_2 emissions of a small-size car on an expressway are about 2/3 of that on ordinary roads when the traveling speed on each type of road is assumed to be 80km/h and 20km/h respectively. Improving safety measures and reducing congestion on the existing ordinary roads, and conversion of trips from ordinary roads to expressways according to their purposes, origin/destination and so on both help reduce traffic accidents, congestion on ordinary roads, and CO_2 emissions, and the Panel on Infrastructure

Development , Road Committee, Basic Policy Sub-committee and National Arterial Road Sub-committee have, as one theme, discussed the intelligent use of networks.

ITS Spots have also been placed along ordinary roads, so road managers can now obtain more information about road traffic. Furthermore, there is information about the movement of automobiles and people that private companies collect, process, and provide. Various ways of using these types of information are considered, and effective applications are expected to be constructed in order to effectively use the existing stock including networks.

In order to effectively use such existing stock, the Road Traffic Department will mainly undertake the following research.

(1) Improvement of safety for pedestrians and cyclists

- Methods of promoting safety countermeasures for roads in residential districts
- Methods of designing bicycle paths

(2) Effective use of information and of information communication technologies

Information and information communication technology studies are undertaken assuming that these can be applied to improve many aspects of road traffic, and we wish to continue these initiatives in the future. Specifically, the following are given as examples, Studies will include system design considering necessity.

- Methods of clarifying the state of movement, such as OD, of automobiles, bicycles, and pedestrians
- Methods of clarifying and evaluating the levels of road services
- Methods of clarifying hazardous spots
- Methods of clarifying congestion locations, causes, and range of impacts
- Methods of smooth traffic and safe driving assistance on expressways
- Methods of clarifying state of use of road networks including their use after disasters

(3) Road structures adapted flexibly to regional conditions

3. For appropriate maintenance of the stock—Road Structures Department

In deteriorated road structures, problems have appeared including breakage of steel, fallen concrete slabs, breakage of suspension bridge cables, crumbling of concrete lining of tunnels, and so on.

In response to the 2013 revision of the Road Act, technology standards for maintenance were enacted in March 2014, and inspections, diagnosis, recording and other maintenance will be conducted according to these standards including that done by cities, towns, and villages. But to perform rational maintenance under harsh financial conditions, inspection methods which are economical and rational, accurate methods of assessing soundness, and asset management methods are needed.

In order to maintain the functions of roads or to rapidly restore them after a disaster, there must be no structures on the road which have sustained fatal damage. For this purpose, it is necessary to develop soundness evaluation methods with concepts common to all types of road structures. This is not simply soundness evaluation for maintenance purposes; it is a problem that should be considered from the design stage.

In order for road structure maintenance to be a method rational and systematic from the structure perspective and network functions perspective, the Road Structure Department will conduct the following researches.

(1) Appropriate inspections and evaluations

- Monitoring methods
- Inspection methods using non-destructive inspection
- Soundness evaluation methods

(2) Asset management

- Public risk evaluation method
- Comprehensive maintenance indices common to most types of structures

(3) Coordination design and maintenance concepts among structures

(4) Safety evaluation methods for non-structural members which work united with structural members , and new technologies and new materials etc.

We will clarify concepts of performance required concepts of setting safety factors and concepts of ensuring safety (only safety factor/introducing fail safe) to study the adoption of new technologies and new materials.

4. For Support for road administration—common to both departments

Both the Road Traffic Department and Road Structures Department will, in addition to the above, work to spread research results at academic conferences, and coordinate with the MLIT headquarters and other concerned organizations so the results are reflected in technology standards and policies.

And of course, we will accept engineers from road administrations including those from cities, towns, and villages, and aggressively provide them with technology consulting services.

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Efforts for Improvement of Standards in the Building Sector

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(Key words) *Project research, Technical standards original draft*

1. Introduction

The Building Department has been carrying out administrative support for structure, fire prevention, and planning/projection and formulation/revision of each sector of environment/equipment based on technological knowledge of the technical standards such as the Building Standards Act, Housing Quality Security Act (law in referent to the promotion of quality securement), Energy Conservation Act (law in regard to streamlining for energy uses). I will refer to the research issues for the improvement of technological standards for which the Building Department has been addressing and the deliberation system of technological standards original draft.

2. Project research

I will indicate the outline of project research for which the building department proactively has been tackling in the following.

(1) Development of urban energy system technology heading for low carbon/hydrogen energy system utilization society (2011 – 2014)

Using hydrogen as energy media and heading for structuring urban energy system where excessive dependence on fossil fuels can be avoided and safe hydrogen piping, in addition, we developed a technology or the like to realize a reduction in emission volumes of carbon dioxide. In respect to these results, we intend to compile them as a project research report.

(2) Development of seismic capacity evaluation technology for buildings corresponding to upgrading of earthquake vibration information (2012 – 2015)

In parallel with the improvement of seismic networks and the development of seismology, the characteristics at a random spot are being clarified. Among earthquake actions observed or forecast, there are those to exceed the levels of seismic forces assumed by the current seismic design. Meanwhile, it is acknowledged that there are cases where seismic forces affecting building structures decrease to a considerable extent more than cases to regard as seismic vibration on the ground surface input into building structures as it is. In order to appropriately evaluate the earthquake resistance capability, it is crucial to carry out a thorough observation on relations between "seismic vibration" and "seismic force," in addition to accurately forecasting earthquake vibration.

Accordingly, this research collects and analyses as many earthquake observation records to clarify relations between "earthquake vibration" and "seismic force," we are tackling the development of more rational earthquake resistance capability evaluation technology for building structures.

(3) Research on introduction of new technology for building structures focusing on renewable energy (2013—2015)

In tandem with living standards, the energy consumption of buildings is on the rise. As well as proceeding with the thermal structure of buildings and instrumental efficiency still further, it is crucial to utilize natural energies existing in the building premises, and the formulation of new standards adopting renewable energy has been required for the future. In this respect, positioning of renewable solar light and earth thermal are targeted.

(4) Research on safety for timber structure three story schools (2011 -- 2015)

In October 2010, the law relevant to the promotion for utilization of timber for public architectural structures came into effect. With reference to this, the Ministry of Land, Infrastructure, Transport and Tourism commenced research to collect the necessary data for reviewing fire prevention related provisions of the Building Standards Act with respect to timber three story schools.

The existing Building Standards Act requires making a building fireproof or semi-fireproof according to the number of stories or areas requirements for the safety of evacuation safety of buildings with a multitude of visitors. For instance, in regard to schools, a three story building is required to be a fireproof building structure (major structures shall be required to be fireproof or the like.) and according to the restriction of a major structural part, the use of timbers is restricted as a whole. Furthermore, in reference to a large scale timber structure whose total area exceeds 3,000m2, due to the risk of extending tremendous effects on its peripheries, it is stipulated to make part of the major structure fire resistant. However, in a case when the building satisfies the capability to resist fire until visitors' safe evacuation/rescue are finished, even for a large scale timber structure or the like, when the fire spread does not expand to the scale exceeding 3.000m2, in order to make it a semi-fire proof

building structure for which timber is readily utilized, deliberations based on experiments have been carried out.
(5) Development of evaluation and design technology for building structure contributing to decrease in the degree of dependence on electric power (2013 – 2017)
Optimization has been effected byy verifying the effect on peak countermeasures against the peak consumption of electricity, evaluation technology for the degree of dependence on electric power for countermeasures, integrating various technologies such as equipment system including housing, contraption for frame structure, introduction of special building members and carrying out the development of revolutionary design system. Furthermore, in building structures, we have carried out technological development relevant to methods to evaluate the effect of peak shift and technological development in regard to design method to optimize peak shift, and promoted peak countermeasures in the demand side.
(6)Development of function continuing technology for disaster preparedness buildings (2013 –1016)
In the Tohoku District Pacific Ocean Coastal Earthquake which occurred on March 11, 2011, structural damages by tsunami, loss of continuous using capability in parallel with damages on nonstructural members (nonstructural wall, ceiling and so on) and damages on government office buildings expected to act as disaster preparedness lodgments emerged. With regard to structural safety against tsunami, the capability of exterior members against blown objects by tornado and in respect to damage mitigation method, we will carry out proposals for new technological development and evaluation methods with respect to damage mitigation method.
Other than these project researches, we are grappling with the subjects of research on evaluation method/standards for seismic resistance of exterior members, research on technological standards for structural calculation program contributing to smoothing of practical business for architecture, calculation methods for evacuation safety capability in building fire of structure and research on the target level and so forth.

3. Deliberation/preparation/posting for technological standards original draft

In response to damage of the Great East Japan Earthquake, we have been carrying out problem configuration corresponding to individual research and development and implemented deliberations/preparations/postings for a technological original draft.
In particular, as major matters related to the Great East Japan Earthquake, the subjects are standards relevant to structural requirements for tsunami evacuation buildings, technical standards with reference to countermeasures or the like for ceiling collapses, and deliberations of corresponding methods for long-cycle earthquake vibrations. In addition, as a matter related to research and development, there is the review and deliberations for the fire prevention standards in regard to large scale timber building structures.
Regarding these, we have established/run the Building Structural Standards Commission, Building Fire Prevention Commission which are comprised of intellectuals from academic society, and we have improved the system to carry out reevaluations for technological standards based on working-level officials.
The Building Structural Standards Commission in particular has been carrying out Great East Japan Earthquake related deliberations. The deliberations in the Commission were reflected to in the Review of Guidelines on Structural Requirements in respect to Tsunami Evacuation Buildings, November 2011, and MLITT's Housing Bureau Director General's Notice, Technological Standards Announcement for Designated Evacuation Facilities based on the Tsunami Disaster Prevention Regional Creation Act, December 2011, MLITT's announcement of the case to prescribe to prescribe a specific ceiling and structurally safe structuring method for the specific ceiling, August 2013, and other MLITT announcements.
Concerning these, utilizing the building standards improvement promotion project (in regard to necessary matters for the state to formulate/revise technological standards in the building standards act, we publicly appeal for applicants to carry out collection/accumulation or the like for basic data on experiments, etc. with reference to assignments configured by the State, and subsidize for its expenses in this project. Established in 2007, deliberations have been carried out.

4. Assignment for the future

As problems related to disasters for the future, there are countermeasures for long-cycle earthquake vibrations. With regard to long-cycle earthquake vibrations, although we carried out an appeal for opinions by offering a draft proposal for a long-cycle earthquake vibration countermeasure in December 2008, prior to the Great East Japan Earthquake, we are carrying out reevaluation of the draft proposal, referring to observation data and deliberations in the central disaster prevention conference and deliberations in the earthquake survey research promotion headquarters.

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Reform Promotion of Existing Housing for Formation of High Quality Housing Stock

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(Key words) Stock type society, long term high quality housing, circulation of existing housing, market of housing renovation

1. Introduction

The housing stock of Japan is considered to be about 57,600,000 (2008) units. Of this, the number of new residential housing units per annum is about 800,000 (2012). In addition, the average life until demolition is short compared with other countries being more or less 30 years. Slated for the formation of high quality housing stock, the transformation from a housing market centering on new housing to a stock type housing market where high quality housing is cyclically utilized across generations, or in other words, as well as supplying quality new houses, accelerate the formation of high quality housing stock by reforming existing houses and realizing a society where things are used for a long period of time, to "produce a good thing, improve it and use it carefully over a long time" is assigned in order to realize the transfer to a new environment.

The four targets upheld in the Housing Life Basic Plan (revised in 2011), which is provided based on the Housing Life Basic Act (2008) indicate appropriate management and renewal for housing, and environmental improvement for the housing market where appropriately realizing a variety of residential needs, as well as development policies, of environmental improvement to promote appropriate maintenance and reform, the formation of high quality stock to be utilized for the future are described to carry out the development of policies.

2. For a society utilizing high quality housing long term

Using housing for a long duration of time restricts elimination of wastes in parallel with demolition and removal of housing, as well as decreasing the load on environment, reducing the burden of housing due to the reduction of expenses for replacement building, and links to shifting to more a affluent and more tendered livelihood.

For this realization, based on the Act on the Acceleration of Dissemination for Long High Term Quality Housing (2009), dissemination of long term quality housing contributing to the formation of quality housing stock has been promoted, and in respect to new residential buildings, quality housing supply by the long term high quality housing certification system currently is being carried out.

In the future, the shift to high quality stock durable for long term uses is a crucial subject for existing housing, it is required to promote efforts for the improvement of existing stock, as well as an increase in the capability of new residential housing.

In the total reform plan illustrated in the chart, support for reform and dissemination for long term quality housing for the promotion of the enhancement of existing housing stock shall be projected, as well as environmental improvement for reform market and existing housing distribution.

3. Efforts up until now

For the formation of quality housing stock by the reform of existing housing, we will carry out deliberations from a variety of viewpoints such as earthquake resistance, energy conservation, barrier-free construction or the like, and necessary reforms shall be carried out for quality housing capable of realizing comfortable long term inhabitation.

As aforementioned, although the formation of quality housing stock capable of being used for a long duration of years is being carried out through long term quality housing authorization, the following eight items are the evaluation items indicated in its authorization standards: degradation countermeasures, earthquake resistance, maintenance and management / easiness of renewal, variability, barrier-free property, energy conservation

property," living environment, housing area, and maintenance management conservation scenarios.

Regarding existing housing, although reform for stock durable to long term use shall be promoted from these view points, matters for which handling similarly to new residential building are difficult and deliberations suitable for existing housing will become necessary.

NILIM has implemented research and development aiming for configuration of a target level of capability to equip housing for utilization over a long duration of years, including the formation of multi-generation utilization type super-long-term housing and housing land, and the evaluation standard for long term quality housing has been prescribed based on its result. For the reform acceleration for existing housing, we have continually been grappling with preparing evaluation standards and arrangement for reform technologies.

Aiming for quality stock formation and distribution promotion, I will exemplify our research and development which have been carried out in regard to evaluation for existing technologies, reform technologies and so forth in the following.

1) Promotion of distribution for existing housing:

Development of capability evaluation technology for housing or the like (2011—2014)

In order to contribute to distribution of existing housing, market environment improvement, in cases where there is no plan or the like for existing housing, to readily comprehend its structure, materials or the like, and carrying out the development of technology to efficiently evaluate its performance and research and development to contribute to distribution of existing housing with appropriate information.

Specifically, we have been carrying out (1) improvement of design information using three dimensional measuring technology or the like, (2) establishment of methods to estimate materials/framing or the like for existing housing, (3) comprehension of degrading phenomenon in existing housing, (4) research and development for evaluating the performance of existing housing.

2) Development of energy consumption evaluation methods in accordance with categories of housing (2010 – 2014)

Of Japan's energy consumption, housing and building structure occupy 1/3, about half of it is regarded as stemming from energy for housing, so for the reduction of energy consumption, the promotion of reform for existing housing for energy conservation is a big issue.

However, the present status is a situation where the effect comparable to reform construction cannot be indicated, so for its promotion, the development of a method in which the reduction effect of energy consumption volume can quantitatively be illustrated in energy conservation construction is required.

For this reason, based on research or the like for casing/specification of equipment for each generation, we will develop a simple forecast method for energy reduction effects, as well as backing up deliberations for energy conservation reforms of housing owners, and carried out the development for more detailed analysis method of energy conservation reform and compiled it as a technological sheet.

We will publicize this result as an energy guideline, and urge energy conservation reform for existing housing.

4. Assignment for the future

The stock countermeasure is made a big subject for the latest policy related to the Ministry of Land, Infrastructure, Transport and Tourism. Not only civil engineering facilities, but also buildings and housing are the same.

As a measure at a view point of housing reform for the formation of quality housing stock, although I exemplified two research subjects above, there are plenty of research subjects to be tackled aiming for the formation of quality stock and its appropriate management in addition to those.

The evaluation for housing in the existing housing market in Japan is said not to reflect its capability held.

Quality housing is produced for the formation of quality stock, maintenance to keep its performance is firmly carried out; in addition, it is fairly evaluated and a market to reflect on the value of existing housing shall be formed.

If the market grows to a rewarding one responding to striving for maintenance, it is considered to stimulate investment for creating quality stock.

NILIM also considers contributing to realization of stock-type society through research and development.

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How are we Restructuring Fragile Cities Faced with Earthquake Disasters?

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(Key words) Tsunami disaster prevention urban development, Countermeasures against liquefaction of residential land,, Fire evacuation simulator

1. Foreword

Three years already have passed since the Great East Japan Earthquake, which brought on unprecedented damages, and the Act on Regional Development in Tsunami Disaster came into effect in December 2011, and a damage projection of a major Nankai Trough earthquake was publicized in fiscal 2012 from the Cabinet Office, predicting tremendous damages by earthquake tsunami in the coastal cities.

Furthermore, a damage projection of a Tokyo-area epicentral earthquake was publicized in December last year from the Cabinet Office, estimating a magnitude 7-class earthquake occurring with a probability of 70% within 30 years, predicting a death toll of 23,000, total collapse of 175,000 buildings and 415,000 to be burnt to the ground in the worst case.

In Japan's cities in which population and industries are concentrated, the enhancement in preventive strength against such earthquake disasters is an urgent issue; though a variety of disaster preventive countermeasures are constantly prepared, in order to enhance the cities' disaster prevention capabilities, further effective countermeasures must be taken expeditiously.

2. Current tasks and direction to be tackled by research and development.

Meanwhile, due to the existence of the following tasks to proceed with urban disaster prevention measures, R&D corresponding to these has been required as well as the activation of new scientific knowledge in technological development.

(1) A big change in social economy and diversification in urban disasters: From local cities faced with population decline to mega-cities complicated by high density, a variety of urban disasters have been presumed, under such circumstances a stance to always verify as to whether or not there are risks of new crucial disaster phenomena occurring is constantly required.

(2) Restriction of time and budget in disaster prevention measures: Despite how much time remains allotted until the occurrence of a huge scale earthquake, and in addition, with the rigorous budget restrictions, the key point is to what extent fragile areas can be fixed in place and concentrated and effective disaster preventive measures can be prepared.

(3) Interpretation is easy to understand for damage forecast and disaster preventive effect: In order to urge cities disaster prevention measures, the understanding of people involved such as regional inhabitants is indispensable, and from preconditioned damage forecasts to content of disaster preventive measures, and in regard to those effects, tools capable of explaining matters plainly is important.

(4) Limitations of damage forecast simulator and improvement efforts: Urban disasters cannot be reproduced and verified beforehand, inasmuch as there is no alternative but to depend on complementary experiments and forecasts by simulators based on damaged scenarios in the past, as well as endeavoring to improve simulators through experiments or the like for newly presumed disaster phenomena, not only by upgrading but also accelerated dissemination by simplification is necessary.

(5) A variety of countermeasures of hard/soft and urban restructuring: From hard countermeasures improvement for infrastructures or the like and reconstruction promotion for decrepit buildings to soft countermeasures such as smooth guidance for evacuees, urban reconstruction countermeasures, disaster prevention countermeasures are required to effectively be carried out among measures for urban reconstruction.

I will introduce the content of research currently being carried out in the Urban Planning Division and visions for the future in the following.

3. Tsunami prevention urban construction and development for assistance tools for liquefaction countermeasures

In the Great East Japan Earthquake, in the damaged coastal cities, evacuation against tsunami, security of functions for disaster prevention preparedness facilities, a broad array of fragility of liquefaction or the like was clarified. For this reason, coastal cities nationwide are deliberating preparedness against these problems, and to reflect to the project of configuring tsunami prevention city has become imperative.

Accordingly, in a study on disaster prevention structuring

assistance technology, we have been engaging with earthquake proof safety for important lodgment facilities and resilience of lifelines, substitution by other facilities and the development of methods for ensuring of cooperative network.

In addition, in the onslaught of a tsunami, adding in the collapse of buildings and effects of fires, in order for inhabitant including vulnerable people such as the elderly to smoothly and safely evacuate, a case study is being implemented in the multiple coastal cities facing the Nankai Trough, as well as developing tsunami evacuation simulators by road and vehicles. Hereafter, we will verify the efficiency of simulators, and reflecting this in tsunami disaster prevention urban creation plan formulation in each city and utilization in the urban area can be expected.

Furthermore, based on the liquefaction damage occurring in the Great East Japan Earthquake, in addition to calculation software capable of judging easily in regard to possibility of liquefaction damages from ground conditions or the like, as a countermeasure against liquefaction for housing land, we will develop a calculation software capable of judging an effect in conformity with the ground condition of underground water level declining construction method and grid underground wall construction method to be publicized. By utilizing these, in addition to configuration of liquefaction risk degree maps as a pre-earthquake countermeasure, as a post-earthquake countermeasure, configuration of an effective liquefaction countermeasure cam be expected.

4. Development of a bloc performance forecast evaluation tool for improvement promotion of congested urban districts

In case of large scale earthquakes or the like, in view of presuming tremendous damage of congested urban districts, the housing life basic plan (nationwide plan) aims to mostly eliminate “conspicuously dangerous congested urban districts” of about 6,000ha (for fiscal 2012) in fiscal 2020.

At the same time, since roads in congested urban areas are narrow and residential land is also narrow and small and due to the difficulty to adapt to the restrictions of the Building Standards Law, cases of difficulty in reconstruction are many, and there are problems with difficulty in the replacement construction of decrepit timber housing due to high risks of fire spreading and collapse.

In this regard, in the Development of Coordinated Replacement Building Rule Formulation Technology in the Congested Urban Districts, we investigated the environmental level of existing congested urban districts, and are currently proposing a tool for calculating the condition of sun shadow hours prescribed in the Building Standards Law and daylight conditions in addition to evaluation tools for safety, using fire and evacuation simulations based on buildings in urban districts and conditions or the like of roads.

Utilizing these research results, we are proceeding with deliberations for guidelines of coordinated replacement building in the congested urban districts; we have already held repeated hearings targeting academic experts and local public authorities, when using preferential measures such as consolidated building design system, and will prepare an evaluation tool to compare how far the bloc performance varies, advancing deliberations with reference to conditions to carry out designated permission in the Building Standards Law.

According to this research, the coordinated replacement buildings in the congested urban districts will appropriately be carried out utilizing the designated method of the Building Standards Law, and the promotion of the disaster prevention measure and the enhancement of living environment in regular life will be expected.

5. Future efforts for the improvement of fragile urban structure

Furthermore, on the assumption of changes in situations in the urban districts and complexity in escaping in evacuation actions in case of disasters, we will verify the scope of fragile parts of cities in view of disaster prevention, stemming conditions, the degree of effects or the like and a study on fragile part of cities against fire in the urban districts in earthquakes and evaluations for disaster preventive effects, which will implement evaluation and verification for disaster prevention countermeasures based on those, to be carried out in three years from the next fiscal year.

This study corroborates the features of new materials in fire in urban districts by fire experiment or the like, as well as reflecting to a fire evacuation simulators, carrying out a case study reflecting the actual state of fragile congested urban districts, effects of fire on the decrepit congested land with wooden houses and effects of fire on sloping land, complexity situations in evacuation and the relevancy to disaster prevention effects for those, we have made to develop a method for evaluation/verification in respect to disaster prevention effects for those.

Regarding measures for restructuring of cities in each city and responding to various problems, we would like to actively engage with research and development (R&D), so as for fire prevention measures to be promoted with a focus placed on priority and effectiveness.

Improvement of ability of coastal regions to withstand large-scale tsunami

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(Key words) Large-scale tsunami, marine radar, tsunami evacuation

1. Introduction

The Nankai Trough Giant Earthquake Model Research Committee established in the Cabinet Office has defined the maximum class tsunami that could possibly occur as a tsunami with maximum height of 34m inundating a maximum of 100,000 hectares of land. The Central Disaster Prevention Council published Nankai Trough Giant Earthquake Countermeasures (Final Report) in May 2013, in which, concerning its basic views concerning tsunami it states, "The goal of tsunami countermeasures is to 'protect human life' from tsunamis. And premised on building and maintaining coastal preservation facilities etc., focusing on the evacuation of residents by including establishing information transmission systems, evacuation sites, evacuation facilities, and evacuation routes, with their most important goal being ensuring that every resident voluntarily, promptly, and correctly evacuates. This requires that comprehensive measures including disaster prevention education, evacuation training, and support for persons requiring assistance during disasters be promoted".

The legal framework concerning measures for protection from large-scale earthquakes and tsunami was established with the proclamation in November 2013 of the *Act* For Special Measures Against a Capital Inland Earthquake (Capital Inland Earthquake Measures Act) and Act to Partially Revise the Act on Special Measures concerning Advancement of Countermeasures against Disasters of Tonankai and Nankai Earthquakes (Tonankai and Nankai Earthquake Measures Act), followed in December with the proclamation of the Basic Law to Strengthen the National Land to Contribute to Prevent or Mitigate Disasters to Realize Strong and Flexible Life for the People (Strengthening the National Land Act).

In the future, earthquake and tsunami countermeasures will be taken in conformity with the Capital Inland Earthquake Measures Act, Tonankai and Nankai Earthquake Measures Act, and Strengthening the National Land Act. So to prepare for tsunami, it is considered important to ensure that evacuation be performed and that it be effective in saving human lives by ensuring a stipulated level of protection based on facilities that prevent the occurrence of damage. To technologically support these, the Coastal, Marine and Disaster Prevention Department is making efforts to develop [1] tsunami measurement technologies based on marine radar, and [2] tsunami evacuation simulation technologies.

2. Measuring tsunami with marine radar

The NILIM successfully used marine radar to clarify the flow velocity field of the tsunami triggered by the Great East Japan Earthquake (2011). This verified tsunami detection using marine radar, which had been theoretically and numerically studied by many researchers since the 1970s. The NILIM analyzed the data from marine radar installed in the Minato District of Wakayama City, areally clarifying the height, speed of advance etc. of the tsunami, and determining that tsunami waves 1 to 3 were traveling waves, and that it is highly likely that later waves were caused by secondary undulations in the channels.

If it were possible use marine radar to stably measure approaching tsunami or secondary undulations in real time, this ability would be extremely useful in preparing tsunami countermeasures. For example, if tsunami traveling offshore could be measured, it would be possible to use the results to prevent over or under-estimation of Meteorological Agency predictions or to support residents' evacuation. In coastal seas (channels or enclosed inner bays), water level fluctuations caused by secondary undulations continued for several days after the earthquake. In the Kii Channel, there are places where the maximum water level was measured the next day on March 12. In this way, along the coast, monitoring secondary undulation is useful for judging the correct time to cancel alerts or start work to reopen channels. The fact that the earthquake or tsunami caused the discharge of heavy oil or chemicals from shoreline industrial zones into coastal waters is also considered. To clarify these dispersions, it is important to measure wind-blown currents, density currents, or tidal currents, which fluctuate on time scales ranging from several hours to several days, rather than tsunami or secondary undulations. This means that it is necessary to simultaneously measure short-cycle tsunami or secondary undulations and long-cycle flows.

3. Evacuation simulation

In ports and fishing harbors, outside the seawall there are sections used for loading and unloading or boarding or getting off ships, for parking vehicles visiting the port, disposing or storing cargoes or fish products, and sections where shoreline business offices stand. These sections are submerged even by tsunami that would not be described as huge, so it is important to plan them carefully considering evacuation from tsunami and to closely follow this plan.

In December 2004, a giant magnitude 9.1 earthquake struck offshore west of the northern part of the Island of Sumatra in Indonesia, causing large-scale tsunami that resulted in about 300,000 fatalities or missing in the countries surrounding the Indian Ocean. In August 2005, large-scale Hurricane Katrina struck the southeastern United States. It breached the dykes in the City of New Orleans, submerging 80% of the city. More than 1,400 people died in the center of New Orleans and more than 1 million were forced to evacuate, making it one of the most destructive natural disasters in American history.

In response to such tragic events outside of Japan, the NILIM has developed tsunami evacuation simulation technology. Thanks to later research, in 2011, it became possible to perform a specified level of tsunami evacuation simulations. An investigation of the reproducibility of tsunami evacuation simulations developed to obtain actual tsunami evacuation data based on the tsunami caused by the Great East Japan Earthquake has confirmed that it they can perform highly realistic reproductions.

Tsunami evacuation must be strengthened to prepare for the feared Tonankai and Nankai earthquake tsunamis. In order to ensure more reliable tsunami evacuations, it is necessary to enact effective tsunami evacuation plans, to execute them, and increase the effectiveness of evacuations by providing regular training or by constructing facilities. Tsunami evacuation simulations are tools of great use when conducting studies or performing verifications to enact effective tsunami evacuation plans, or plans for evacuation training or evacuation facilities. At this time, we are making improvements to more realistically reproduce evacuation activities in port and harbor districts.

4. Responding to mega-risk type coastal disasters

In response to the Indian Ocean tsunami of December 2004 and to the Hurricane Katrina disaster of August 2005, the NILIM conducted “research on evaluation of countermeasures with diverse effects taken to deal with low-frequency mega-risk type coastal disasters”, and completed the manuscript of a project research report immediately before the Great East Japan Earthquake of March 2011.

When a tsunami with extremely low probability of occurring actually does occur, it inflicts catastrophic damage in regions it strikes, endangering the lives and economies of the people of the region. Concepts of response were organized assuming that such damage is a “low-frequency mega-risk type coastal disaster”.

Firstly, regarding a tsunami that causes catastrophic damage even though its occurrence frequency is extremely low, it is not the case that countermeasures for it are not studied only because its occurrence frequency is extremely low. Secondly, excessive investment is not made in order that it be impossible to accept later that it was investment matched to needs, just because it was done to prepare for a giant tsunami. Considering the result of combining these two administrative policies to be a Japanese version of a “No regret policy”, it was the foundation of studying countermeasures in preparation for giant tsunamis. In order to realize preparations for giant tsunami, considering the various problems which Japan faces, application to policy development with a high degree of freedom and double-track organization use with priority on workability is probably more necessary than ever.

5. Conclusions

Fears of the occurrence of a giant tsunami following the Nankai Trough Earthquake and people’s shared memories of the tsunami triggered by the Great East Japan Earthquake of 2011 have increased public interest in strengthening the ability of coastal regions to withstand giant tsunamis. The tsunami which would be caused by the predicted Nankai Earthquake would be far higher than any tsunami considered up till the present time. How to protect people’s lives and property and regional economies and industries from this tsunami, and how to overcome the time against time scale said to be once every thousand years, are questions which are not easily answered. Concrete initiatives to deal with such problems from a number of perspectives are beginning. It is difficult to take initiatives predicting the answer from the beginning, but we wish to exercise our imaginative powers and apply our capabilities to proceed one step at a time to resolve the problems.

Tsunami-Resistant Design Guideline for Breakwaters

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(Key words) Design tsunami, Technical Standards and Commentaries for Port and Harbour Facilities in Japan, hydraulic model experiment

1. Introduction

The Great East Japan Earthquake damaged many breakwaters, primarily because the giant horizontal force of the tsunami acting on the breakwater and the overflow of the breakwater by the tsunami scoured the foundation mound behind the breakwater, destabilizing the breakwater. If a breakwater is a tough structure which is not overturned even when it is deformed by a large-scale tsunami, damage behind the breakwater will be mitigated, because its toughness will restrict the flow rate of the tsunami behind the breakwater, delaying the arrival of the tsunami in the land behind the breakwater. So breakwaters must be tough structures, which are as resistant as possible to overturning, even by a tsunami that is larger than the design tsunami.

The Ports and Harbours Bureau, National Institute for Land and Infrastructure Management, and the Port and Airport Research Institute of the Ministry of Land, Infrastructure, Transport and Tourism have cooperatively conducted a comprehensive study of the results of surveys of damage to breakwaters and of the results of a series of hydraulic model experiments conducted since the earthquake disaster, have organized basic concepts of the design of tough breakwaters, then in September 2013, they partially revised the Ministerial Ordinance for the Technical Standards for Port and Harbor Facilities and other technical standards, defined design tsunami and prescribed toughness against tsunami for structures such as breakwaters, seawalls etc., and at the same time, the Ports and Harbours Bureau has proclaimed the Tsunami-Resistant Design Guideline For Breakwaters. Below the major revisions to technology standards and major contents of this Guideline are introduced.

2. Basic concepts

Past concepts of tsunami-resistant design of port and harbour structures have been revised from their foundations. Two levels of tsunami are hypothesized and based on its concept, the aim is, for tsunamis which occur frequently, to provide disaster protection using structures to do all possible to protect human lives and property, and for the largest class of tsunami, which occur extremely rarely but have catastrophic damage when they do occur, the aim is to minimize damage under the goal of, at the very least, protecting human lives. If a structure has toughness which prevents its overturning even as it is deformed under a tsunami large enough that it exceeds tsunami which occur frequently, it will restrict the quantity of water flowing into the area behind the structure, delaying the arrival of the tsunami behind the structure, and thereby reducing damage. So structures that can provide this toughness are necessary in cases of a tsunami higher than the design tsunami.

3. Definition of the design tsunami

The definition of a design tsunami considering tsunami resistant design is clearly stipulated as a tsunami which is unlikely to occur during the design service life of the facility but would have severe impacts on the facility if it did occur. The design tsunami used for performance verification and a tsunami with strength greater than the design tsunami are considered to be at least the tsunami scale which occurs relatively often with a recurrence period from several decades to one hundred years plus several decades, and is set appropriately for the degree of importance of the facility. The Guideline stipulates that the design tsunami is set as the tsunami with design external force from the highly frequent tsunami to the maximum class of tsunami according to the importance of the structures behind the breakwater based on a regional disaster prevention plan or a basic plan for coastal preservation.

4. Breakwater performance verification

The overall stability of a breakwater in the case where the tsunami and the earthquake motion preceding the tsunami act on the breakwater first sets the initial section under actions other than the tsunami or other waves. Next, the section specifications are set based on the wave design for the design tsunami. Finally, for a tsunami with scale greater than that of the design tsunami, the section of the tough structure is set based on an overall judgment made considering the importance of the facility and cost-benefit performance. The structure analysis factor when stability under the design tsunami is verified can be set with reference to a value in Table 1, because

according to the example of damage shown in Figure 1, damage occurs when the slip safety factor is lower than approximately 1.2.

Figure 1. Occurrence/non-occurrence of Damage to a Breakwater in the Overflow Depth – Slip Safety Factor Relationship

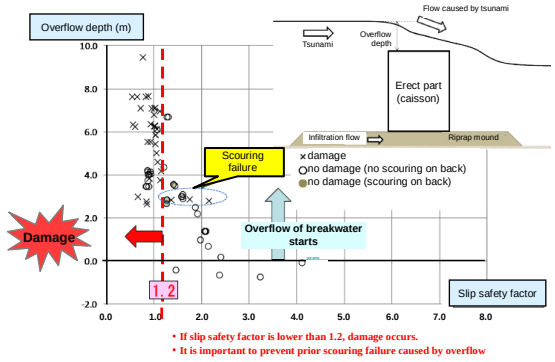
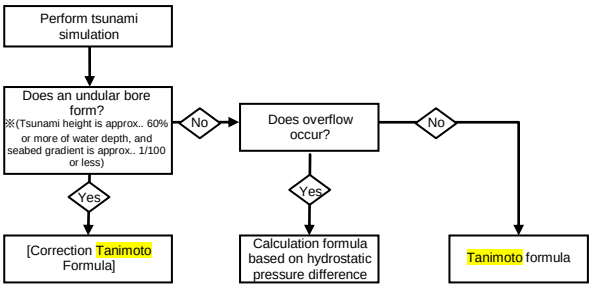


Table 1. Reference Values of Structural Analysis Factor

Item verified	Structural analysis factor
Slip of erect part	1.2
Overturning of erect part	1.2
Bearing capacity of foundation	1.0

The tsunami wave force calculation method used is the appropriate wave force formula obtained by the procedure shown in Figure 2, considering whether or not a tsunami simulation is done, and whether or not an undular bore or overflow occurs.

Figure 2. Tsunami Wave Force Calculation Procedure for Breakwaters



5. Toughness of a structure against tsunami

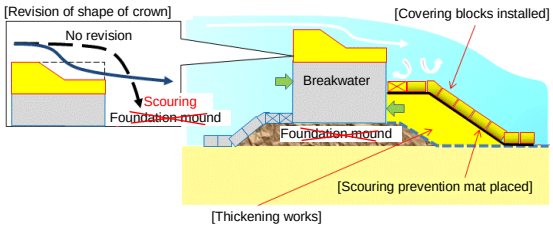
Among breakwaters, seawalls, etc., highly important facilities which, if damaged, would have a severe impact on human life, property, and public economic activities, are required to have toughness which will maintain stipulated stability under tsunami with action of a scale exceeding that of the design tsunami.

Required performance is stipulated so that in a facility which, if damaged, might have a severe impact on human life, property, and public economic activities, even in the case where a tsunami with strength of a scale exceeding that of the design tsunami occurred at a location where the said breakwater is installed according to the structure, severe impact on the stability of the structure of the said facility of damage from the action caused by the action of the tsunami etc., can be delayed as long as possible.

It is stipulated that a breakwater, which is a facility prepared for accidents, have a structure devised to ensure the maximum possible stability so that even when it is subject to the action of a tsunami which scale greater than that of the design tsunami for that location, it displays its disaster mitigating effects and ensures calmness in the port immediately after the disaster.

The Guideline stipulates that as a result of taking supplementary measures according to the importance of the facility and cost-effectiveness etc. at weak points revealed by full studies of the form of damage and weak points in the structure of breakwaters according to the scale of the tsunami while using hydraulic model experiments, the breakwater must be a structure with toughness which prevents it from overturning while deforming, and to the greatest possible degree, maintains its overall stability under a tsunami of a scale exceeding that of the design tsunami.

Figure 3. Breakwater scouring countermeasures



6. Future research

The partial revisions to technology standards and the Tsunami-Resistant Design Guideline for Breakwaters, were prepared based on comprehensive study of survey and research etc. done immediately after the earthquake, but not all of the many challenges have necessarily been clarified. In the future, as new knowledge is obtained, it must be reflected in the Guideline, and we must promote further research and technology development in the field of tsunami-resistant design.

Photo 4. Breakwater Model Experiment

[Sources]
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http://www.mlit.go.jp/common/001012142.pdf
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With airport infrastructure that supports growth

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(Key words) Demand forecast, low cost carrier, maintenance, risk management

1. Aviation and airport policies that lead to national growth strategies

The genuine implementation of the Open Sky and aviation deregulation policies, which had been pending Japanese aviation policies for many years, has been made possible by expansion of the airport capacity of the Tokyo region by the opening of the fourth runway at Haneda Airport in October 2010 and the start of simultaneous independent departure at Narita Airport by the end of FY2014. Furthermore, this expansion has been accompanied by the other pillar of the so-called three-in-one revolution, namely the creation of an environment to promote the reform of strategic airport management through encouraging the entry to the market of new airlines including low cost carriers (below called "LCC"), flexible and expeditious setting of landing fees, and privatization of airports.

Eliminating restrictions on routes, number of flights etc. of scheduled international service encourages the stimulation of airlines and promotes the opening of new routes, establishing a foothold for the incorporation of booming economic growth in Asia and elsewhere overseas.

At the same time, in an interim report issued by the Council of Transport Policy, Aviation Committee, Basic Policy Subcommittee in June 2013, priority is placed on the following four points concerning the future roles of aviation in social and economic activities in Japan.

(1) Appropriately responding to future new importance of international aviation demand etc.
(2) Ensuring provision of smooth and reliable service under price competition among airlines
(3) Future airport management in response to shift from establishment to operation
(4) Future effective regional air networks

From among concrete challenges from these perspectives, matters closely linked to present research challenges of our research department in particular are discussed below.

2. Studying the strengthening of functions at Tokyo region airports

Strengthening the functions of Tokyo region airports as part of the Japan Revitalization Strategy: Japan is Back in June 2013 is positioned as a matter which should be tackled preferentially in National Strategic Special Zones as a policy to further strengthen Japan's competiveness as a business hub. At the same time, at the end of FY2013, it was decided to continue studies to further strengthen functions, while steadily introducing 30,000 additional international slots at Haneda Airport and raising annual flights at Narita Airport to 300,000 during FY2014.

Turning to air transport, against a background of the advance of near eastern airlines and stimulation of new demand by the entry to the market of LCCs, it is predicted that throughout the Asia and Pacific region, average annual growth of 6.6% will make the region the world's largest aviation market by 2025.

Aviation handling capacity of the entire Tokyo region will increase to about 750,000 flights at the end of FY2014, the largest among major airports in the countries of Asia. But with such demand predicted to continue to grow, it is also forecast that growth of passenger carrying capacity will strengthen as a result of construction and expansion of major airports in the countries of Asia, further intensifying competition among hub airports in the region. The fact that Narita Airport was already passed by Incheon Airport in Korea in terms of both total passengers in 2010 and in terms of connecting passengers in 2011 is simply one example.

Related to these points, in a document from the Basic Policy Subcommittee announced in September 2013, the following problems concerning predicted aviation demand in the Tokyo region of Japan which should be tackled in the future are pointed out below.

(1) Overall aviation demand (total domestic and international) in Tokyo region airports will continue to show a rising trend, and international route demand in particular is predicted to rise by between about 60% and 80% during the 10 years beginning in 2012.
(2) Overall aviation demand in Tokyo region airports in the first half of the 2020s is predicted to reach the limit of present planned capacity of about 750,000 flights.
(3) It is possible that predictions will be surpassed through the creation of new demand by LCC etc.
(4) Landing and take-off capacity by time period at

Narita Airport shows that supply and demand are tight and there are still time periods when it is not necessarily possible to meet the numbers demanded by the airlines.

3. Ensuring safety and security of aviation service users –Airport safety measures

As users of Tokyo region airports continue to increase in this way and LCC and other new entrants expand use, it is essential to specifically introduce measures to improve the reliability of airport infrastructure and to respond to emergency situations including large scale disasters such as the massive Nankai Trough Earthquake, so that airport users can use airport services without anxiety.

(1) Large-scale earthquake disaster countermeasures

When the Nankai Trough Earthquake has occurred, 18 airports will be temporarily shut down for inspections, and it is predicted that among these, Kochi Airport and Miyazaki Airport will be submerged by tsunami. It is estimated that at Kochi Airport, more than half of the airport will be submerged, to a maximum of 2.5m in front of the terminal building, and that the maximum depth throughout the airport will be about 5m at its south end. And at Miyazaki Airport, about half the airport will be submerged and the maximum submersion depth will reach 5m, which is the same depth as at Kochi Airport.

When an earthquake occurs, and particular when a tsunami is predicted, the first need is to ensure the safety of airport users and surrounding residents, but adequate measures including those to rapidly restore private aviation are demanded so that the ability of aircraft to move disaster victims out of the disaster area and to bring in materials and machinery and emergency provisions can be restored as quickly as possible.

And as a measure to prepare for an earthquake directly under the capital, liquefaction countermeasures are being steadily taken under basic facilities such as runways at Haneda Airport etc., but preparations for the Nankai Trough Giant Earthquake have just started. Tsunami evacuation plans have been enacted, but the immediate challenge is to create scenarios based on the form of airports able to contribute to the early removal of drifting wreckage or to reconstruction activities.

(2) Airport facility maintenance measures

In light of background events such as the Sasago Tunnel accident on the Chuo Expressway in December 2012, not only runways, taxiways, and basic facilities directly related to aircraft operation, but comprehensive inspections of facilities from the perspective of their impacts on human life have been carried out, and basic policies and long-term renewal plans to steadily perform preventive type maintenance will be enacted for each airport.

And at Tokyo region airports, under conditions such as restricted hours during the night set accompanying extension of airport operating hours, greater efficiency of daily inspections, repair works etc. and facility maintenance of runway tarmac, which are all indispensable to ensure the safe operation of aircraft, will become increasingly big challenges.

4. Initiatives and prospects by the Airport Department

The following are the major initiatives now being taken by the Airport Department, including priority policy challenges such as those described above.

(1) Further elaboration of aviation demand prediction methods, such as considering the creation of demand by the entrance of LCC to the market.

(2) Verifying an airport's roles in and effects on its surrounding region.

(3) Developing a risk management method for airport functions which contribute to the enactment of airport management plans and the enactment of business continuity plans for use in the event of a large-scale disaster.

(4) Development of high speed tarmac performance evaluation technologies for runways etc. to contribute to the maintenance and restoration of airport functions after a disaster.

(5) Study of methods of advancing and improving efficiency of inspection and repair technologies under time restrictions imposed on maintenance work.

Tokyo has been selected as the site of the 2020 Olympics and tourists using the airports to visit Japan and business demand are predicted to increase, so a reform of airport management through concessions may open new prospects for the promotion of the use of airports. On the other hand, achieving more efficient airport facility maintenance, which must be done by managers of airports operated by local governments, which face harsh financial conditions, will probably become an important challenge from perspectives different from those characteristic of airports in the Tokyo region.

Without losing sight of these various changes, we wish to continue to deepen our research activities concerning study challenges regarding airports as public infrastructure while considering the broad interrelationships linking the people, regions, industry, culture and so on, while not being held back by conventional itemization and technology development frameworks.

Messages from Departments and Centers of NILIM

Establishment of a new research center

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*(Key words) Disaster prevention, maintenance, building construction management, information infrastructure, l*andscape ,*ecology*

1. New research center

On April 1, 2014, the Research Center for Land and Construction Management will begin operating as a new organization inside the NILIM. Originally, research centers of the NILIM were established to conduct interdisciplinary research on rivers, roads, buildings and other areas. Until this year, there were three research centers at the NIILM: the Research Center for Land and Construction Management, Research Center for Advanced Information Technology, and Research Center for Disaster Management. The three research centers will be abandoned, then the new research center will be established to organize the contents to be addressed by an interdisciplinary method, to respond to changes in social conditions and meet the expectations of the people concerning the development of infrastructures, including the preparation for disaster prevention and disaster mitigation in response to Great East Japan Earthquake, the importance of maintaining infrastructure in response to the Sasago Tunnel accident, and the effective form of construction systems , such as the information infrastructure and public procurement etc that supports these infrastructures.

Thus, its configuration will be diverse, a large organization including 6 divisions: the Construction System Division, Construction Economics Division, Construction Management Division, Disaster Prevention Division, Maintenance and Information Technology Division, and Landscape and Ecology Division. It will be led by a Center Head and three Research Coordinators.

2. Scope of the new research center

(1) Disaster prevention related

Disaster prevention related research is undertaken by several departments; flooding by the River Department, sediment disasters by the Sabo Department etc. There are , however, issues that span various disciplines; Disaster Prevention Division will conduct research on such issues including preparation for the Nankai Trough Earthquake or the Tokyo Metropolitan Earthquake and accompanying tsunami.

For example, immediate damage estimation technology will be developed to support the initial responses of facility to administrators shortly after an earthquake, when there is little information on the damage to facilities. In addition, earthquake motion information will be collected from strong motion observation facilities installed at civil engineering structures such as river levees or bridges throughout Japan. The information will then be stored and managed in a database and provided upon request. These data are also used for research on design earthquake motion.

(2) Maintenance related

While facing many problems including the deterioration of public capital facilities, falling birth rate and aging of society, growing shortage of technicians, and financial restrictions, continuing appropriate maintenance of public capital will be important for Japan in the future. Research on individual technologies used for maintenance will be done by departments specializing in various disciplines, but the new Research Center will aim to abstract and organize common evaluation matters related to stock management in order to be able to continue the PDCA cycle of maintenance related to “Research on Methods of Improving Sustainability of Maintenance Including the Perspective of Risk Management”, which will began as new project research in 2014 under the leadership of the Research Coordinator for Construction Management.

In addition, maintenance related research will also be conducted in the Maintenance and Information Technology Division and the Landscape and Ecology Division.

(3) Civil construction system related

The new research center will be called the Research Center for Land and Construction Management, but another major activity of the center will be research on civil construction systems Procurement methods change along with changing social conditions, and it is necessary to organize systems to reflect the current social background. Estimation has changed as totaling based on productivity has been replaced by the execution package method based on execution units. The tendering system has also changed from the invitational tender method to the more competitive open tender method. To prevent the negative effect of competition based on the price only approach, the Act

on Promoting Quality Assurance in Public Works (Quality Assurance Act) has come into force, permitting the application of the Overall Evaluation Method, which evaluates both price and technical quality . At the same time, a variety of issues of tendering for maintenance have recently been raised.

For reasons such as this, the Construction System Division will conduct research on estimation methods for maintenance work, an area in which serious challenges have appeared: expanding and following up execution package work categories for more efficient estimation, speeding up change of execution methods to keep pace with technology development by increasingly diverse execution conditions and execution contents, rationalizing estimations or reducing labor required for estimations.

The Construction Management Division will perform research on tendering and contracting systems, for example, on the improvement of Quality and Cost Based Selection, in which issues have appeared in the period since it was introduced, or on design build (DB) or construction management (CM) etc.

But because of inadequate understanding of public capital, there is a deep rooted disbelief in the necessity of public works among the people. The Construction Economics Division will, therefore, study methods of effective expression in order to clarify and reveal in easily understood terms the latent roles and effectiveness of providing and managing public capital in various aspects of the lives of the people.

(4) Information infrastructure related

The Ministry of Land, Infrastructure, Transport and Tourism collects information to be shared from databases in various fields, in order to build a public capital information platform that facilitates the prompt, interdisciplinary use of information. This platform would be useful for improving efficiency in facility management, and providing facility information in the event of a disaster.

As well as supporting the development of this information platform, the Maintenance and Information Technology Division conducts research on information infrastructure for GIS, road communication standards and so on, where information necessary for national land management can be accumulated and managed efficiently, so it can be shared across various application fields . Also, the division has been working on standardizing 3D design data, so it can be utilized in construction management using a total station, as well as in computerized execution. In parallel, they continue to research applications in facility management, and to measure the degree of distortion and deformation of structures after being struck by a disaster such as an earthquake.

(5) Landscape and ecology related

When people hear “public capital maintenance” they tend to imagine bridges, tunnels, sewage treatment systems, dams, sluice gates and other civil engineering structures, but it is also necessary for urban green trees, along streets, in parks, and elsewhere. Consideration for biodiversity, necessary when providing public capital is, in a certain sense, maintenance of the ecosystem.

The Landscape and Ecology Division aims to set evaluation criteria to reconsider revegetation policies and to establish conservation and reclamation methods required by this policy, so that roadside trees with maintenance problems can fulfill their greenery function. And it will also research the conservation of ecosystems and of greenery.

3. Conclusions

Organizations must change to keep pace with changing social conditions. For this reason, we are carrying out a sweeping reorganization including this research center.

So no one will say that this is just a change of names or a change of affiliation, we wish to continue to conduct research that society demands to meet the expectations of the people, including past initiatives and new initiatives, so please give the new Research Center for Land and Construction Management your full support.

For the Prevention of Sediment Disasters

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Keywords: sediment disaster, deep-seated landslide, crisis management, technical support

1. Introduction

The Sediment Disaster Prevention Department will be launched on April 1, 2014. This new department has been organized by the former Erosion and Sediment Control Division of the Research Center for Disaster Management, the newly established Research Coordinator for Deep-seated Landslide Prevention, and the former Sediment Disaster Prevention Division.

The Erosion and Sediment Control Division had been studying causes of sediment disasters and planning and formulating countermeasures therefor and standards for warning and evacuation. It was, nevertheless, decided to strengthen the study of erosion and sediment control by launching a new organization in order to establish effective measures for major sediment disasters, including the deep-seated landslide that occurred on the Kii Peninsula.

The Erosion and Sediment Control Division was mainly in charge of structural measures including erosion and sediment control planning and infrastructure design methods, while the Sediment Disaster Prevention Division mainly engaged in non-structural measures including warning and evacuation systems and remote sensing technology, and the Research Coordinator for Deep-seated Landslide Prevention directed the focus of their studies on deep-seated landslide in coordination with both divisions.

2. Issues on recent sediment disasters

Sediment disasters occur repeatedly every year and cause loss of human lives and property damage, totaling about 1,000 cases on average and killing dozens of people every year. In recent years, Typhoon No. 12 in 2011 caused serious damage to the Kii Peninsula, heavy rains in July 2012 including the Kyushu Heavy Rain caused disasters, and the Great East Japan Earthquake in 2011 caused large-scale sediment disasters in many places including Shirakawa in Fukushima Prefecture. As a volcanic disaster, Mt. Shinmoe in Kirishima erupted in January 2011 and many residents around the mountain were forced to evacuate. Furthermore, still fresh in our memory is Typhoon No. 26 that hit Izu-Oshima in October 2013 and caused large-scale mudflows and serious damage including 39 people dead or missing.

Looking back on these disasters, many of them were caused by record-high rainfalls. The continuous rainfall caused by Typhoon No. 12 in 2011 reached about 1,800 mm, the largest rainfall ever observed in Japan, and the 24-hour rainfall of 824 mm observed in Izu-Oshima in 2013 was also the highest as an observation point value since 1938. There is concern that climate change may lead to frequent occurrences of abnormal weather. Accordingly, we have to think that the trend of large-scale sediment disasters will continue under intense weather conditions.

Furthermore, in hilly and mountainous areas, which are prone to sediment disasters, resistance against natural disasters is declining due mainly to a progressive low birthrate and aging, while the development of erosion and sediment control infrastructure is limited due to financial constraints. Thus, disaster prevention projects are faced with a difficult situation because of social factors.

Under such circumstances, in order to prevent sediment disasters and ensure the safety of people, multiple measures should be promoted in both structural and non-structural aspects, including efficient development of erosion and sediment control infrastructure and the advancement of warning and evacuation systems. Also, to enhance the effectiveness of such measures, it would be necessary to conduct technical reviews. This paper introduces the direction of research and studies into the aforementioned issues by Sediment Disaster Prevention Department.

3. Erosion and sediment control plan for deep-seated landslides, etc.

The slope failure that occurred on the Kii Peninsula was very large in scale and resulted in the formation of a huge natural dam, so it was necessary to take different actions from that of the past. For this reason, in order to formulate a method for drafting an erosion and sediment control plan in consideration of the debris flow resulting from this deep-seated landslide, the study is proceeding by identifying locations vulnerable to deep-seated landslides, external force settings for infrastructure, etc.

We will also continue to study methods of long-term assessment of sediment discharge to the downstream after large-scale collapses.

Not only deep-seated landslides but also simultaneous frequent occurrence of shallow landslides could cause a major disaster as occurred in Izu-Oshima. In response to this Izu-Oshima disaster, the Erosion and Sediment Control Department of the MLIT held its first meeting of the "Workshop for Strengthening Sediment-related Disaster Prevention Measures" in December 2013, in order to reinforce structural measures for phenomena not contemplated in existing plans and for large amounts of debris, as well as non-structural measures including warning and evacuation measures. The workshop identified some new issues, including measures for areas without clear valley topography, such as volcano areas, and measures for debris, which increases the damage of sediment disasters, and is urgently discussing these measures.

It is also a major issue to establish strategic maintenance approach for existing erosion and sediment control infrastructure. Conventionally, maintenance of existing infrastructure has not been of a satisfactory level mainly because sites are separately located in mountainous regions, so we plan to study ways to strengthen management in order to utilize existing facilities effectively.

4. Crisis management in major disasters

There is concern that an earthquake in the Nankai Trough or directly under Metropolitan Tokyo would cause catastrophic disaster across a wide area. To minimize damage in such cases, it is necessary to act appropriately. Since sediment disasters often occur in remote isolated locations, it is important to grasp the whole picture of a disaster including the location and scale at an early stage.

Individual disasters were conventionally grasped by reporting or patrols, but the conditions of area-wide disaster are understood using helicopters deployed to each Regional Development Bureau. Moreover, in verifying the damage in the Great East Japan Earthquake, Typhoon No. 12 of 2011 and other disasters, attempts were made to obtain pictures and information collected by synthetic aperture radar from an airplane or satellite and use them for addressing disasters. This approach achieved a certain level of success.

In addition, the development and utilization of technologies that contribute to crisis management are proceeding, including efforts to develop a seismograph for instant pinpointing of the location of large-scale collapses, efforts to estimate collapse-prone areas from seismic intensity distribution, efforts to estimate upstream channel blockage from water gauge data, and systems to collect information from residents using SNS. Thus, study is underway to grasp of large sediment migration phenomena in real-time.

In the future, we are going to improve the accuracy of such information and study the development of information transfer systems to support resident warning and evacuation systems. The findings from the aforementioned studies are used not only for crisis management in disasters but also for long-term land monitoring through constant monitoring of mountainous areas and the logging of that data.

5. Technical support in sediment disasters

Sediment disasters frequently occur in Japan, but local governments have few technical experts with thorough knowledge of sediment disasters. In the event of a sediment disaster, personnel of NILIM and PWRI often provide technical advice, as experts, at the site since it is urgently required to prevent secondary disasters in search activities, etc., ensure the safety of residents, and take emergency measures. In fiscal 2012, a total of 12 persons were dispatched from NILIM to 10 disaster stricken areas, and 8 persons were dispatched as Tec-Force in fiscal 2013 to Izu-Oshima to support the activities of Tokyo and Izu-Oshima.

Regional Development Bureaus also need personnel familiar with disaster response in order to provide active support to local governments in the event of a disaster. In order to support the development of such personnel, the Erosion and Sediment Control Division has been receiving personnel from the Regional Development Bureaus since fiscal 2013, who concurrently serve both organizations. We provide such personnel with opportunities to study and discuss issues on disaster response and support them in acquiring the required capabilities, including how to grasp the flow of on-site response and technical viewpoints, by introducing our know-how when they accompany us on visits to provide technical guidance on disaster response.

We would like to continue efforts to reflect the findings of our division in the policies on sediment disaster prevention measures, to contribute to the improvement in disaster response capability of MLIT in general, and to eliminate disasters.

Preparation of Sediment Balance Map by Grain Size Group for Promotion of Comprehensive Sediment Management

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Keywords: sediment transport system, sediment balance, grain size group

1. Importance of organization of basic information for comprehensive sediment management

Comprehensive sediment management means to take drastic measures that connect different areas from a viewpoint of "sediment transport system," i.e., a group of areas connected in terms of sediment transfer, by removing the limitation of area-specific measures, such as for mountains, river channels, and coastal areas with regard to sediment-related issues including disaster prevention and environmental conservation. This concept was proposed a long time ago but is not yet established in the practice of river management.

One reason for that is that it takes much time to collect and organize the data from previous surveys and analyses, and identify sediment movement for the scale of a sediment transport system that is based comprehensive sediment management. The circumstances giving rise to such reason are as follows.

1) Record periods, resolutions (spatial / temporal observation intervals, data acquisition methods, etc.), and quality (e.g. planned value or actual value) of the observations and other data are not unified mainly because different entities performed projects in different areas, and the scale and location of projects changed according to social, economic, or other situations.

2) Under such constraints, it requires experience to organize and analyze data with an approach to identifying the relevance between each issue and sediment movement according on the scale of a sediment transport system.

Therefore, we decided to collect relevant data in a retrospective and comprehensive manner, and create a sediment balance map that reflects the status of sediment transfer in mountainous area (including dams) and coastal areas based on the sediment balance of river channels connected to those areas in the 109 river systems managed by the country.

2. Preparation of sediment balance map by grain size group as basic information

A sediment balance map indicates dam sedimentation, branch river sedimentation, transfer of sediment from the river channel in river development or maintenance, gravel extraction, increase in channel volume calculated from changes in river channel shape, and sediment yield estimated from geology, etc. Each of these quantities is classified according to grain size groups (gravel, sand, silt / clay) and indicated as an annual average value. When the color of a bar indicating the amount is "red," it means increasing transfer from mountain to river channel or from river channel to coast, and when "blue," it means decreasing for the same. Accordingly, for example, in mountainous area (including branch rivers), the amount of transfer to a river channel is obtained by deducting the amount of "blue" from "red."

With this method, it is possible to grasp the relations between sediment balance in a river channel and the amount of transfer between areas. In the figure, for gravel, gravel extraction from the river channel is estimated to have a greater effect on degradation of the riverbed compared with dam sedimentation. Furthermore, for sand and silt / clay, gravel extraction from the river channel has little effect and dam sedimentation is estimated to have a direct effect on the amount of transfer to coastal areas.

In the future, we plan to prepare sediment balance maps for each of the 109 river systems with analyses similar to above and utilize them for promoting comprehensive sediment management for each river.

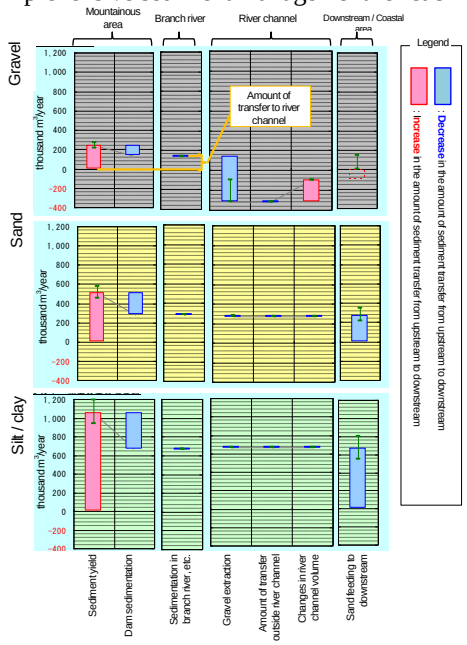

Fig.: Example of Sediment Balance Map by Grain Size Group

River Tsunami Simulation Experiment with Large Hydraulic Model

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Keywords: river tsunami, flood, water level

1. Characteristics of River Tsunami to Consider in Studying Measures

The water level of tsunami is essential information in considering various measures for tsunami disasters, such as determination of levee height and discussion on town development / evacuation. Water levels in rivers or flooded areas are generally obtained through tsunami analysis by tracing a series of events including arrival at the coast and run-up along the river channel. In such tracing, characteristics of rivers should be taken into consideration.

One of such characteristics is topographic changes in river channel. As flood control measures, a sand bar and other areas where river bed is high may be dug down to lower the water level in case of flood or flood plane may be dug to widen the river. If such digging causes any change to tsunami water level, it should be considered in determining the height of levee.

Another characteristic is that whether tsunami water could overtop from the river or magnitude of tsunami may change according to the condition of levee breakage. The reason for mentioning this is that if tsunami water breaks the levee and overtops and floods, the level of water that further runs upward from the breakage point may be lowered. Since such events occur in various ways, it is important to consider them and observe the condition of flood at various points in the upstream and downstream.

2. River tsunami simulation experiment using a large model

In order to deepen the understanding of such characteristics of river tsunami, we conducted a simulation experiment [1)] by running water up a large scale model of an actual river to obtain data on various tsunami scales and terrains, in addition to the data on the actual tsunami caused by the Great East Japan Earthquake. We made a 1:330 model of the area of 10 km x 11 km, as shown in the **Photo**, which includes the protected lowland up to the point about 10 km upward from the mouth of Kitakami River.

Digging a sand bar or flood plane was expected to facilitate the run-up of tsunami and consequently raise upstream water level, which was, however, not observed in the simulation, and the water level was lower than before digging at some points.

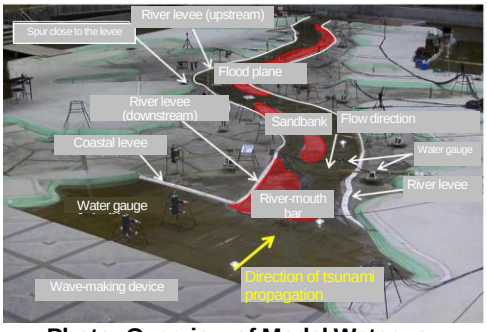

Photo: Overview of Model Waterway

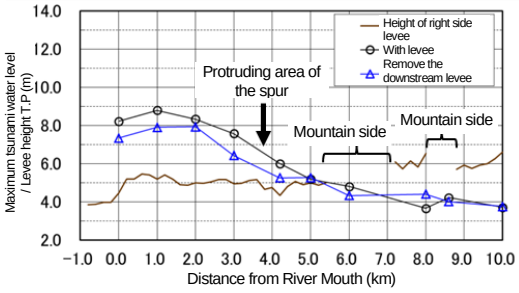

Figure: Measurement of Maximum Water Level of Run-up Tsunami

To simulate a situation where the downstream levee shown in the Photo was broken, we also conducted the experiment by removing the same levee. The result showed the water overtopped about 1 m from the levee upstream the river in the protruding area of the spur, while the water overtops about 2 m in the experiment simulating a situation where no breakage of the levee occurs (see the **Figure**).

3. Future study

It is not yet clarified what conditions of tsunami and topography cause such phenomena but they would suggest the necessity of study under various conditions according to locations, scales of topographic changes, etc. In order to study such issues more simply and accurately, we are further considering with tsunami experts aiming for further improvement of analytical methods and presentation of how to set conditions.

[Reference] Masaki FUKUSHIMA, Tatsuro MATSUURA, Atsushi HATTORI, "Experimental Study on the Characteristics of River Tsunami," Journal of Japan Society of Civil Engineers, Ser. B2 (Coastal Engineering), Vol. 60, No. 2, pp. I_261-265, 2013.

Resilient Structure for Coastal Dikes -- Structural Device Considering the Effect of Pressure Increase in Dike Body --

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Keywords: tsunami, coastal dike, resilient structure

1. Background and objective

Engineers have long sought a coastal dike structure that can be resilient even in the case of a tsunami exceeding the designed tsunami height of the dike. When tsunami waves overtop a three-face-armored concrete dike, saturated surface in the dike body increases as water penetrates the body; the force of the overtopping water results in scouring on the landward side. To protect the landward slope toe from scouring, soil improvement and other remediation methods were found to be effective [1)], and soil improvement was adopted in the disaster restoration project for the Southern Coast of Sendai Bay. This study examined a resilient structure against tsunami overtopping for coastal dikes with flat laid concrete armor, for which the pressure rise in the dike body is a concern, by conducting experiments with a large model to detect pressure rises in the dike body in the case of tsunami overtopping. [2)]

2. Results of study

First, pressure gauges were attached under the concrete armoring to measure the pressure inside the dike body during overtopping. It was found that, when the tsunami overtopped the coastal dike, pressure under the concrete armoring increased and reached a level at which the concrete armoring on the landward slope could become unstable. This would depend on conditions, since a filter layer is provided under the concrete armoring or seaward slope toe to accelerate saturation into the dike body.

Next, assuming an area where the space on the land side of the dike was limited, an experiment with a large model was conducted. The purpose of this experiment was to study the impact of the filter layer under the concrete armoring and the effect of sheet piles (e.g., sheet piles installed under the foundation of a coastal dike with concrete armoring to control scouring). Movement of the landward slope armoring was controlled when no filter layer was provided under the armoring, and movement of the foundation was controlled by combining the landward slope armoring with the embankment soil by an iron frame.

The disaster mechanism of coastal dikes with concrete armoring that was confirmed by this experiment is illustrated in Fig. 1. Considering this mechanism, as shown in Fig. 2, a filter layer that facilitates saturation in the dike body between the armor and dike body soil should be avoided. It is also effective to provide a device that controls the movement of the landward slope armoring, and thus, reduces the force with which the landward slope armoring pushes the foundation when the pressure increases inside the dike body. It is also effective to install sheet piles in the foundation to control its movement, although they are not as strong as soil improvement.

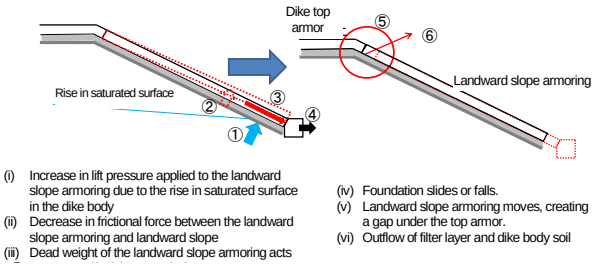

Figure 1: Disaster Mechanism of Landward Slope Armoring by Rise in Saturated Surface

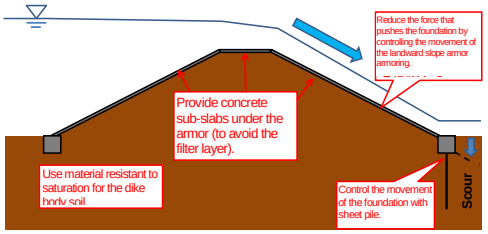

Figure 2: Structural Device for Coastal Dike with Concrete Armors in Limited Space

[Reference]
1) NILIM: A Study on Resilient Structures for Coastal Dikes, NILIM Technical Bulletin, 2012
http://www.nilim.go.jp/lab/fcg/labo/02_02.html
2) Kato, Suwa & Hatogai: Structures for Coastal Dike with Concrete Armors Resilient to Tsunami Overflow, Journal of JSCE, Series B2 (Coastal Engineering), Vol.69, No.2, pp.I_1021-I_1025, 2013.

Deprivation/Recovery of coastal cities' disaster-prevention facilities functions by the Great East Japan Earthquake tsunami and the construction of disaster-prevention cities' lodgment functions and creation of disaster-prevention cities

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KATSUMATA Wataru (Dr. Eng.), Senior Researcher
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(Key words) Tsunami disaster-prevention city creation, Coastal city. Disaster-prevention facilities, Great East Japan Earthquake

1. Foreword

In the Great East Japan Earthquake, due to massive tsunami said to occur once in several hundred years or a thousand years, many of disaster preparedness facilities such as local government offices and hospitals, fire stations, shelters or the like became dysfunctional caused by flood and interference occurred in independently dealing with disasters as cities. In the "Research on disaster structuring support technology for coastal cities." being tackled by the Urban Planning Department (fiscal 2012 – 2014), research has been proceeded with disaster preparedness facilities against massive tsunami and the method for ensuring functions by disaster-prevention urban city structuring.

2. Location of disaster preparedness facilities and urban planning

According to an assumption of the biggest class of tsunami flood being carried out in each region currently, many of disaster preparedness facilities have been included in the flood zone, and its relocation to highlands has been deliberated. Meanwhile, many of such facilities are located adjacent to central urban districts, contributing to the convenience for inhabitants in normal times.

In order for fast and sloppy relocations of disaster preparedness facilities not to invite cities' declination in parallel with decrease in population, increase in earthquake/inundation resistances for these facilities and relocation to safer districts and identification of alternative facilities to replace existing functions, preferential functional recovery after disaster, enhancement in resilience for lifelines, ensuring delivery networks or the like, shall integrally be carried out in harmony with the future images of cities.

3. Survey results in afflicted cities

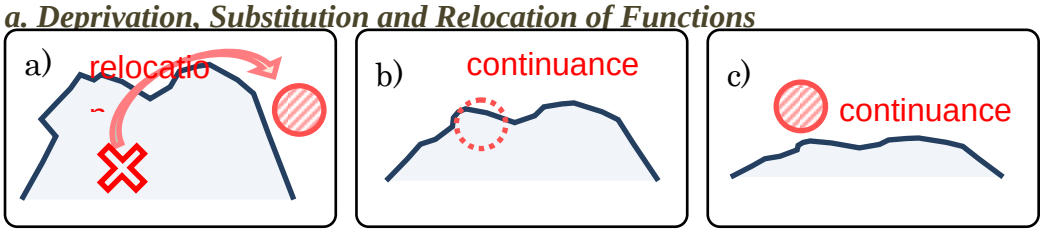
Last fiscal year, targeting devastated cities by tsunami in the Great East Japan Earthquake, we investigated damages of disaster preparedness facilities and resulting interferences on ensuring functions, the situation of functional recoveries by compiling literatures and hearing or the like. Due to tsunami damages surpassing presumption, although the measures prescribed in existing regional disaster-prevention plans varied in many cities, as a result, the facilities' spatial allocations of urban disaster preparedness facilities (including substitute facilities) and spatial allocations in urban/regional levels and locational relations with each facility and arterial roads or the like have been found affected to not only facilities' damaged conditions but also to its functions in its emergency response and recovery / restoration periods. If aligned phenomena seen in urban/regional levels with reference to ensuring disaster-prevention functions, it leads to the following charts.

4. Preparation for Nankai trough giant earthquake

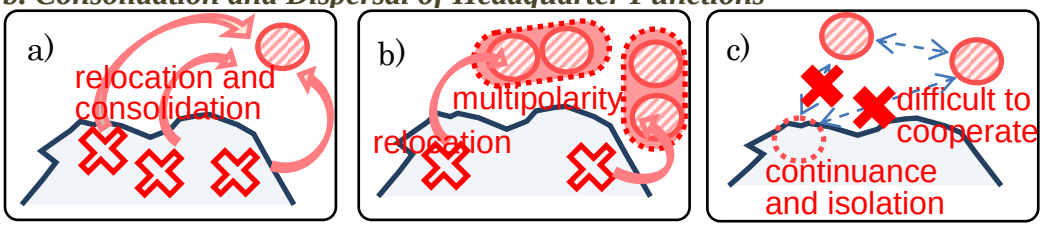
Currently, deliberating a scenario for ensuring disaster preparedness facilities' functions in Tokushima and Wakayama Prefectures where indicated presumption of tsunami flooding by Nankai trough giant earthquake and we are discussing methods to boost its effects.

[Reference] Urban Disaster Mitigation Division Home Page: Current Study
http://www.nilim.go.jp/lab/jdg/index2.htm

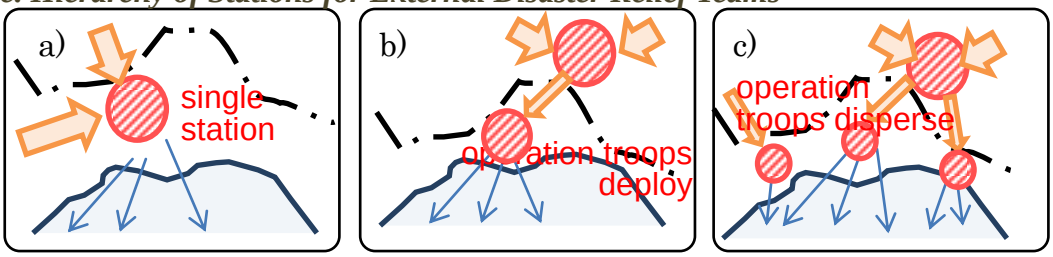
a. Deprivation, Substitution and Relocation of Functions



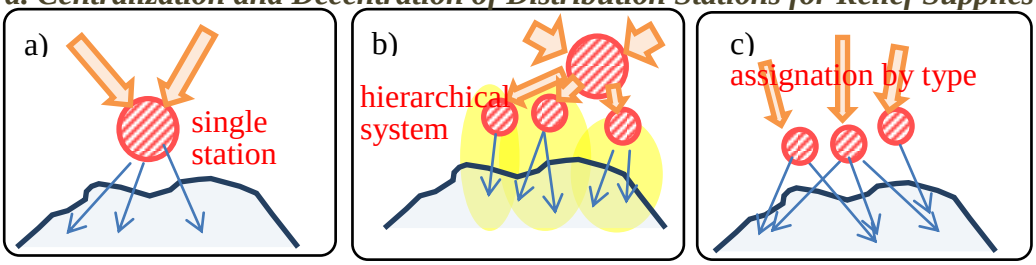
b. Consolidation and Dispersal of Headquarter Functions



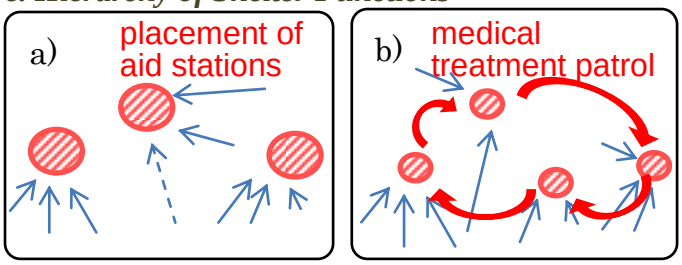
c. Hierarchy of Stations for External Disaster Relief Teams



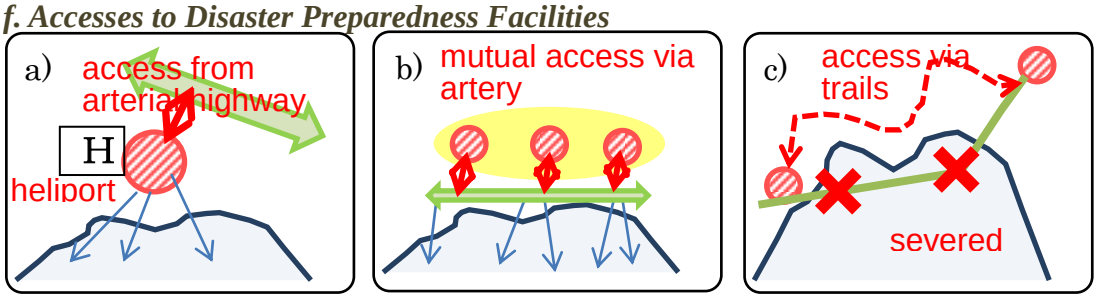
d. Centralization and Decentration of Distribution Stations for Relief Supplies



e. Hierarchy of Shelter Functions



f. Accesses to Disaster Preparedness Facilities



g. Different Use of Public Facilities according to Locations

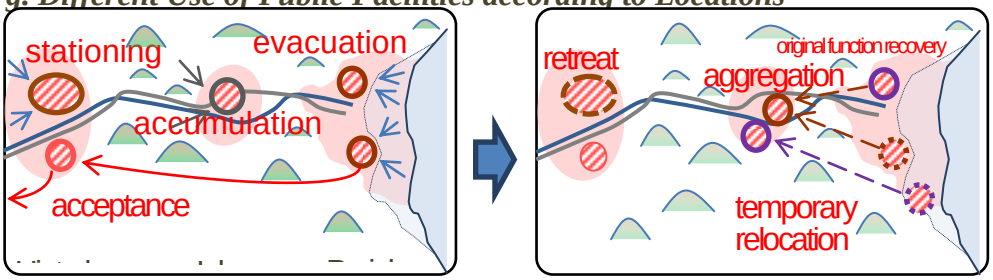


Figure Phenomena at cities' and regional levels observed in reference to ensuring disaster preparedness functions in tsunami disaster preventive cities

Development of Tsunami Evacuation Safety Evaluation Method Aiming at Improvements for Safe Urban Districts

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(Key words) *Tsunami evacuation, Simulation, Improvement for urban districts*

1. Foreword

In the Great East Japan Earthquake, the importance of countermeasures against tsunami was highlighted due to the multitude of deaths that occurred. However, the tsunami evacuation safety evaluation method based on aspects of urban district improvements cannot be said to have sufficiently been deliberated.

NILIM has been dealing with the development of the tsunami evacuation safety evaluation method necessary for planning urban district improvement projects, and we shall herewith introduce the outline of the research and the perspective of R&D (research and development) for the future centering on the tsunami evacuation simulator being deliberated as its series.

2. Outline of the tsunami evacuation safety evaluation method

The tsunami evacuation safety evaluation method is formulated by deliberating the following three items.

- Development of tsunami evacuation simulator
- Development of method to identify places/factors disturbing evacuation
- Development of planning methods

Of these, the tsunami evacuation simulator is a program to pursue solutions as to whether each person in a region can reach a safety shelter by calculating their evacuation behavior, maximally utilizing existing research results (fire evacuation models, vehicle transport models, and tsunami retroaction models). We have been carrying out deliberations introducing new knowledge and technologies. (Figure 1)

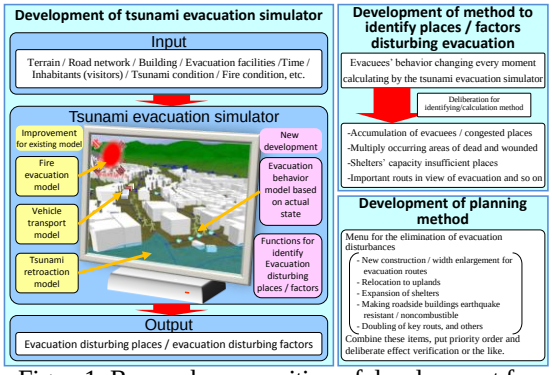

Figure1: Research composition of development for tsunami evacuation safety evaluation method

3. Tsunami evacuation simulator

As a calculation model for evacuation behavior, in decision-making for evacuation commencement / destination selection / transferring route selection, evacuation is initiated at a point when an evacuation risk by tsunami and fire is in excess of a set level, so we established an evacuation behavior model making it a basic point to select destinations and transfer routes with minimal risks, and have prepared a program coordinated with tsunami retroacting calculation results and fire, building collapse and the like. (Figure 2, 3)

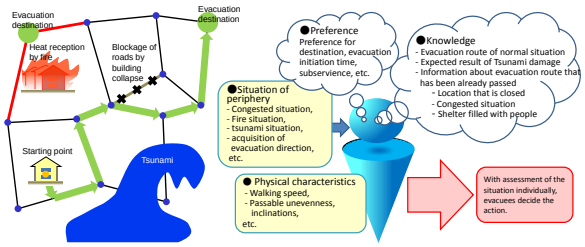

Figure2: Conceptual chart for evacuation behavior model

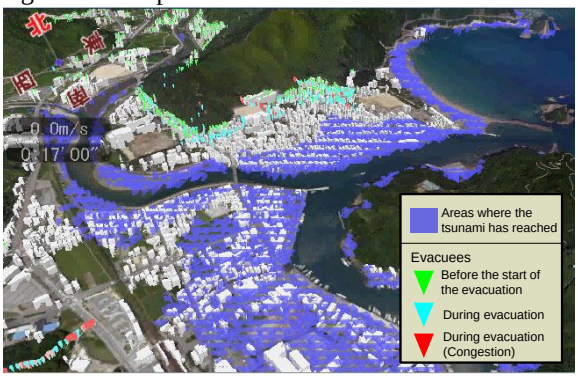

Figure 3: Calculation examples

4. Conclusion

We have carried out the development of an evacuation simulator with consideration to risks of tsunami, fire or the like. In the future, we will verify the effectiveness of the simulator in the design process of urban district improvement, as well as incorporating calculations for evacuation behavior using vehicles.

[Reference]

IWAMI Tatsuya, TAKEYA Shuichi, KIUCHI Nozomu:

Fundamental Study of Evacuation Safety Assessment Method in Accordance with the Tsunami Evacuation Risk,, Proceedings of Infrastructure Planning, Vol.48, November 2013.

Functions road networks need to support disaster victims of a large-scale earthquake

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(Key words) Earthquake, disaster response, road network

1. Introduction

When an earthquake occurs, many disaster response organizations take a variety of disaster response actions including searching for missing people, first aid and life-saving, fire-fighting activities, medical treatment, and supplying water, food, and medical supplies in order to assist the victims of the disaster.

In order to take these disaster response activities, it is necessary for the people who perform first aid and life-saving activities, water food and other materials to be moved or transported from outside the disaster area into the disaster area; an activity in which road networks play an important role.

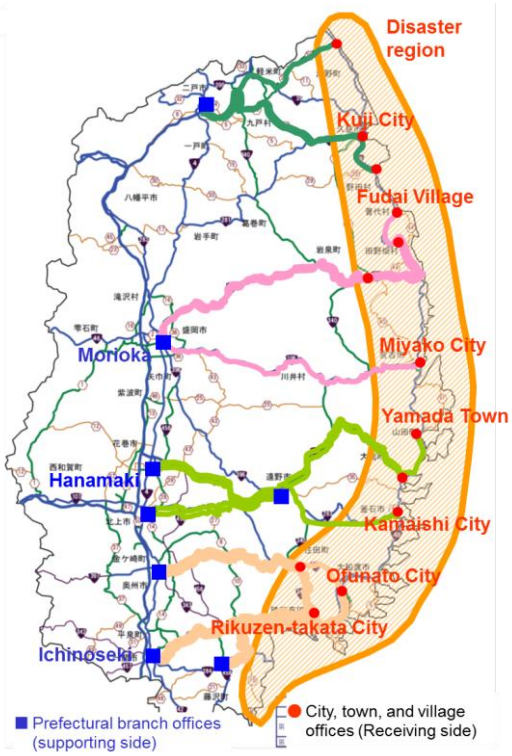
This research was done by collecting information about various types of disaster response activities by many organizations, organizing the correlation of various disaster response activities with moving and transporting people and materials, and evaluating the functions which a road network must have to ensure smooth movement and transport.

2. Organizing response activities by different organizations during a disaster

Based on the 9 categories of disaster emergency measures in the Basic Disaster Prevention Plan(edited by the Cabinet Office), the researchers comprehensively collected all kinds of disaster response activities from legally required plans of all organizations that respond to disasters (prefectures, cities, police, fire departments, Self-defense Forces etc.), from disaster prevention related plans (guidelines, BCP, disaster prevention work plans, disaster prevention project plans etc.) and from actual actions taken in response to the Great East Japan Earthquake, and abstracted and organized about 250 activities that roads can support based on the characteristics of various modes of transportation (speed, capacity, mobility, etc.).

Next, they categorized the abstracted activities according to purpose such as “ensuring traffic to perform emergency transport”, and organized the question, “What is transported from where (base) to where (base)?” for all the approximately 250 activities.

Example of Response Activities in Iwate Prefecture



3. Evaluation of road networks focused on disaster response activities

An attempt was made to evaluate the functions of a road network as emergency transport roads[1)] in Iwate Prefecture. Here, the range of the hypothetical disaster region was set with reference to the Great East Japan Earthquake.

The figure presents a case of evaluation of functions done by selecting, as the example of a disaster response activity, movement from a base (regional office of a prefecture outside the disaster region) to a base (city, town or village office in the disaster region) as the “movement of people to support the opening of roads”.

The combination of the bases (regional offices of a prefecture) (■mark) and bases (city, town or village offices) (●mark) was set based on distance and the degree of relevance at normal times, and the roads for

movement between the bases were selected as the shortest routes. And the degree of overlapping of roads linking the bases was represented by the thickness of the lines in each section of the road network.

Roads represented by thick lines in the figure are roads necessary for “movement of people to support the opening of roads”, and sections are evaluated assuming that the thicker the lines, the more important the section. By representing other actions on the map in the same way, for example, using those which represent these superimposed on other purposes, it is possible to evaluate the functions a road network needs to support disaster victims

[Sources]

1. Iwate Prefecture Regional Disaster Prevention Plan (March 2012)

Survey of impact of road disasters on traffic and countermeasure effectiveness

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KANEKO Masahiro, Head
MABUCHI Toshiaki, Senior Researcher
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(Key words) Road disaster prevention countermeasures, impact on road traffic, road disaster prevention inspection items, evaluating countermeasure effectiveness

1. Introduction

Road managers work to implement efficient countermeasure projects with limited budgets based on documents such as the results of comprehensive inspections of road disaster prevention, in order to maintain and manage roads in ways appropriate to the harsh natural conditions found in Japan. This survey collected and analyzed cases of disasters caused by road slope disasters to organize conditions that cause road disasters at the same time as it studied a method of evaluating the impacts of road disasters on road traffic and the effectiveness of road disaster prevention countermeasures, in order to provide information that will contribute to the efficient implementation of disaster prevention countermeasure projects

2. Estimating distances to roads and evaluating impact on traffic

To study the impact of road slope disasters on traffic, the relationship between the state of occurrence of disasters and road disaster prevention inspection items on roads operated by the national government from 1990 to 2004 was organized, and an effort was made to use an existing formula[1)] to calculate the soil traveling distance at two locations where it is hypothesized based on the organized conditions that a complete road closure would occur, revealing that in all cases, the discharged soil would cover the entire road surface.

The above formula was used to calculate the distance the discharged soil would travel to reach the road and at the same time, its impact on closure of the road to traffic was evaluated considering the road width, and the distance between the slope and the road (Fig. 1). The result reveals that at slope height of 20m or less, regardless of the depth of the collapse (zone [1]), and even at slope height higher than 20m, at collapse depth of 1m or less (zone[2]), the collapsed soil would stop by one lane of the road.

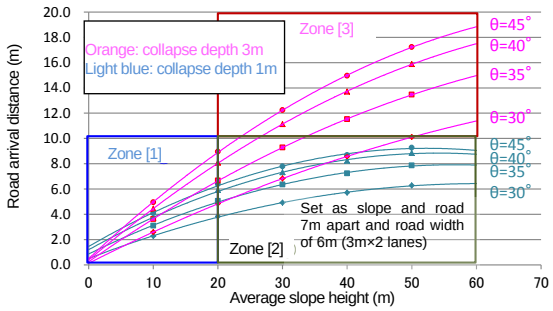

Figure 1. Relationship of Average Slope Height with Road Arrival Distance

Next, the relationship of the quantity of collapsed soil with the road closure time in past disaster cases was organized by selecting 54 cases from past disasters on national government operated roads throughout Japan, revealing that although scattered, as the approximate quantities of collapsed soil increases, the length of time the road is closed tends to increase (Fig. 2).

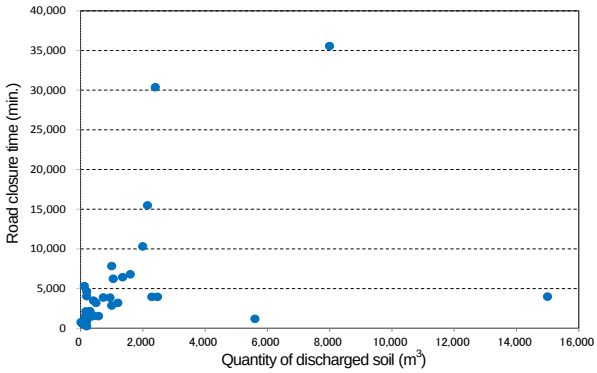

Figure 2. Organization of Relationship of Quantity of Discharged Soil with Traffic Closure Time

3. Evaluation of countermeasure effectiveness

From the disaster cases selected in 2 above, focusing on the quantity of soil reduced by countermeasures, the state of appearance of effects of various countermeasure works and the reduction of the quantity of soil that can be counted on to occur were

organized. As examples, for “protective net works” and “safety barrier works + revetment works”, it was observed that they do prevent some of the soil from being discharged onto the road, but in the case of a huge quantity of soil that would cover the entire road surface, it is impossible to capture it all. So to select countermeasure work methods, it is considered to be necessary to also consider adding conditions such as the estimated quantity of collapsed soil shown in 2, its impact on traffic, etc.

4. Summary

Methods of estimating the scale of a disaster and its impact on road traffic, selecting countermeasure works, and evaluating the effectiveness of the works were successfully studied by collecting and analyzing cases of road slope disasters. In the future, we will analyze cases focusing on topographical and geological conditions for example to continue to study the improvement of the method and its applicability to various types of locations.

[Sources]

1) Notification stipulating the method etc. that the Minister of Land, Infrastructure, Transport and Tourism stipulates based on the provisions of Article 2 item (2) of the Enforcement Order of the Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas, 2001

Efforts to Minimize Damage to Sewerage Infrastructure in the Event of a Major Earthquake

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Keywords: sewerage pipeline, major earthquake, database, disaster support system

1. Introduction

In the Cabinet Office Central Disaster Prevention Council, there is concern about a massive earthquake that may occur in the Nankai Trough or directly under Metropolitan Tokyo. Should such an earthquake occur, sewer pipelines, one of the critical lifelines, are expected to suffer serious damage. It is, therefore, urgently required to establish pre- and post-earthquake measures to minimize damage, ensure toilet functions after earthquake and preserve water quality in public waters. Since damage simulations of higher accuracy are required to implement effective measures, it is effective to analyze and utilize damage trends based on data on pipeline damage caused by past earthquakes including the Great East Japan Earthquake.

NILIM is organizing data on pipeline damage caused by past earthquakes in a unitifed format in order to utilize the data for simulating damage to sewer pipeline infrastructure in the event of a massive earthquake such as a Nankai Trough Massive Earthquake. Using this data, NILIM is performing simulations of damage to sewer pipeline infrastructure in the event of a massive Nankai Trough Earthquake, studying disaster support systems and effective earthquake-proofing for infrastructure, and evaluating priorities in disaster mitigation measures.

2. Establishment of a database of damage information on sewer pipeline infrastructure

Since earthquake-proofing of existing infrastructure requires a lot of money and time, it is necessary to promote earthquake-proofing efficiently and effectively by estimating areas prone to damage in advance, determining priorities amongst earthquake proofing measures, and focusing investment in areas of high priority.

In prioritizing earthquake-proof measures, it is necessary to consider the probability of damage to any sewer system and the social impact if the sewerage system is damaged. To consider the probability of damage, it is effective to analyze damage trends, but information on past damage is not well organized. NILIM is collecting information on damage to sewerage systems available since the 2000 Western Tottori Earthquake, to create a database in a unified format.

In fiscal 2013, data from about 130 local governments damaged by the Great East Japan Earthquake was collected to organize the data on the specifications of sewer pipeline infrastructure (pipe type, pipe diameter, year of installation, etc.) and level of damage thereto, damage information including the number of cases of manhole liquefaction, ground information including the nature of soil, N-value, etc., and turbulence information including measured seismic intensity, etc.

3. Simulation of damage to sewer pipeline infrastructure in the event of a massive Nankai Trough Earthquake and study on support systems

A massive Nankai Trough earthquake, which is expected to occur, is estimated to cause wide-spread damage across prefectures and Regional Development Bureaus. Support from national and local governments is essential to minimize damage to sewer pipeline infrastructure and restore functions promptly. It is, therefore, important to study in advance necessary support systems, rules of support, etc. based on damage simulations.

Based on the seismic intensity and flooding from tsunamis assumed by the Central Disaster Prevention Council for a massive Nankai Trough Earthquake, NILIM is simulating damage to sewer pipeline infrastructure and studying necessary support systems. In the future, after analyzing the factors that greatly affect damage quantity, such as earthquake-proofing of infrastructure and ground conditions, we are going to improve the accuracy of damage simulations and study technologies for immediate damage estimation.

4. Conclusions

Since the Great East Japan Earthquake, local governments throughout the country are reviewing their disaster prevention plans and earthquake-proofing infrastructure. There are various constraints on such efforts, but since it is essential in the future to simulate damage at low cost and to a high degree of accuracy, and carry out measures efficiently and effectively, NILIM will also advance research relating to the issues.

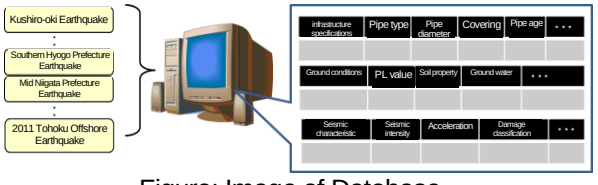

Figure: Image of Database

Analysis of damage to road bridges by the tsunami caused by the Great East Japan Earthquake

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YOKOI Yoshiteru, Researcher
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(Key words) Road bridge, tsunami, design

1. Introduction

The Great East Japan Earthquake damaged many road bridges, as the tsunami washed away their superstructures or washed away the soil behind the bridge abutments. Earthquakes accompanied by huge tsunami could occur again in the future, so to ensure the functions of road networks in the event of an earthquake disaster, establishing technology capable of appropriately evaluating the impact of tsunami when constructing or managing road bridges is an important challenge.

2. Study of design methods considering tsunami

For present day seismic design of road bridges, methods of verifying the impact of vibration considering restorability have been established, but specific required performance such as the allowed form of damage by giant tsunamis and methods of verifying this performance have not been established. So methods of considering tsunami acting force, forms of damage considering restorability, and verification standards that can control the progress of damage are being studied.

3. Study of tsunami acting force

It is necessary to correctly evaluate the acting force that a tsunami will inflict on a road bridge to perform design considering tsunami. Therefore, the NILIM has studied a method of evaluating tsunami acting force according to actual damage by the Great East Japan Earthquake.

Among the bridges struck by tsunami, 85 bridges that are typical bridge types and whose specifications have been clarified were selected for analysis. The acting force was obtained using the tsunami water level and flow velocity t the locations where each bridge was constructed and which were calculated by hydraulic simulations, to calculate the water pressure and hydrodynamic force acting on the bridge girders based on hydraulic formulae. And resistance force was assumed to be the self-weight and the shear strength of the bearing anchor bolts. The figure plots the tsunami acting force/resistance force (equivalent to the reciprocal of the safety factor) with the lateral axis representing the horizontal acting force and the vertical axis representing the vertical acting force. The plot distinguished cases where the Great East Japan Earthquake washed away the superstructures of actual bridges and cases where this did not occur. The predicted damage to the bridges that were washed away conforms generally to the actual damage, so it is possible to judge tsunami damage using the tsunami acting force calculated using the hydraulic formulae. Among the concrete T-girder bridges and concrete slab bridges, even if the tsunami acting force/resistance force was less than 1.0, the actual damage included some that were washed away, although only a few. In the future, various specifications such as the state of damage caused by the Great East Japan Earthquake or the girder shape

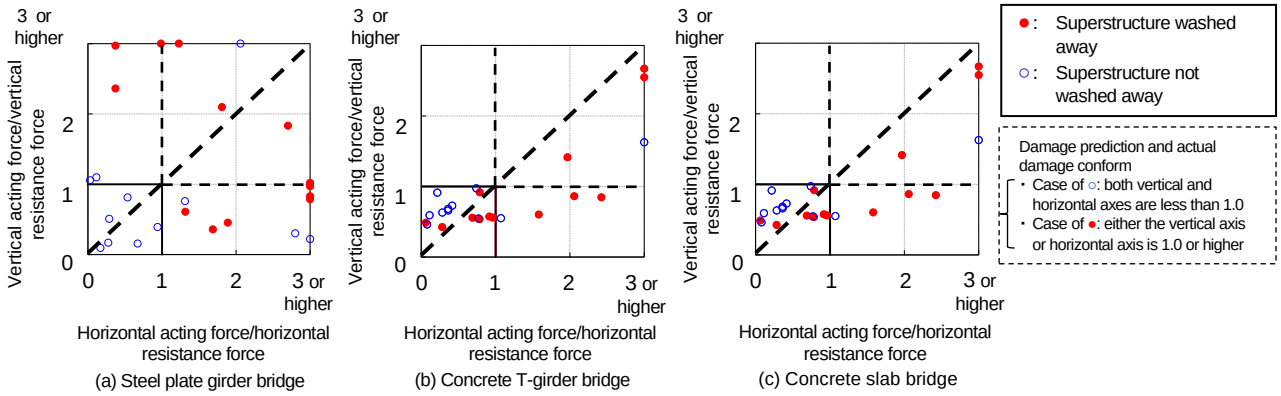

Figure. Evaluation of tsunami damage to a bridge

will be analyzed to abstract major factors determining the occurrence/non-occurrence of tsunami damage and to reflect the findings in the calculation of acting force.

4. Conclusions

The NILM will continue to conduct research to systematize required performance to resist tsunami according to the disaster prevention position of each road bridge or the emergency restoration period after the damage, and to reflect the findings in road bridge design standards.

[Sources]

Web page of the Bridge and Structures Division
http://www.nilim.go.jp/lab/gcg/index.htm

Efforts for Technical Development of Base Building for Post-disaster Operation (Research and Development Project)

HONDA Naomi (Dr. Eng.), Research Coordinator for advanced Building technology
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(Key word) Disaster-prevention building, functional continuation

1. Damage to government buildings and others by recent natural disasters

In the Great East Japan Earthquake, (1) structural damages by tsunami (photo 1) and (2) functional loss from damage of nonstructural members (nonstructural walls, ceiling and others) (photo 2) occurred and the damage was observed also in the government buildings which should have been base buildings for post-disaster operation. A tornado in Tsukuba City in May 2012 caused flying debris leading to massive damage to the windows and doors of a reinforced concrete building. This kind of damage may lead to the functional loss of base buildings.

2. Development of base building for post-disaster operation

In 2013, NILIM started 4-year project called Technical Development of Base Building for Post-disaster Operation as a research and development project in order to develop technology that enables base buildings to support emergency/restoration activities immediately after disasters.

For tsunami countermeasures, development shall be carried out on the reduction of tsunami wave force by façade drop-off or the blocking effect of peripheral buildings.

For earthquake countermeasures, development shall be carried out on the damage reduction of reinforced concrete nonstructural walls with appropriate arrangement of structural slits and others, and damage prevention of suspended ceilings without clearance between the ceiling and the surrounding parts and other objects.

For tornado countermeasures, development shall be carried out on a performance evaluation method for exterior wall materials.

In addition to these, development shall be carried out also on disaster preparation of equipment for operational continuity due to the importance of infrastructural continuity after a disaster, such as electricity, gas services, water supply and so on. The design guidelines of base buildings for post-disaster operation shall be made with the results of these technological developments and other current realizations.

Photo 1 Damages on building by tsunami

Photo 2 Damages on non-structural wall by earthquake

[Reference]
http://www.nilim.go.jp/lab/bbg/project/ppdf/pro-h25_5.pdf

Technological Support Software on Calculation of Land Liquefaction Hazard for General Users

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(Key words) *Liquefaction, Housing site disaster prevention, Great East Japan Earthquake*

1. Development of technological support software

In ground liquefaction, although harm to human lives is rare, in view of health damages such as headaches and dizziness or the like and damage to housing properties and so on, it brings on tremendously big costs. For this reason, the City bureau of the Ministry of Land, Infrastructure and Tourism officially announced its *Technical Guidelines in Respect to Judgment for Liquefaction Potential in Residential Land* (hereinafter referred to as Technical Guidelines) in April 2013.

However, in order to conduct judgment calculations in accordance with these Technical Guidelines, the mathematical formulas and graphs indicated in the *Architecture Foundation Design Guidelines* of the Architectural Institute of Japan and the *Specifications for Highway Bridges* of the Japan Road Association are very complex and require specialized knowledge.

In order to solve this problem, the Urban Planning Department of the National Institure for Land and Infrastructure Management has developed technological support software called *Judgment Calculation Sheet for Liquefaction Damage Potential of Residential Land* (hereinafter referred to as the calculation software) to simply conduct judgment calculations with data obtained from ground investigations. The calculation software has been configured based on Excel, with which most people have a general knowledge of.

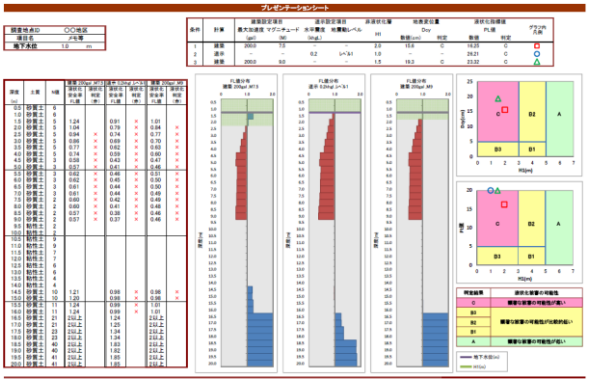

Figure: Output image of calculation software

As shown in the figure, the calculation results are indicated by visual graphs in tandem with numerical values to make it apparent whether or not there is a risk of liquefaction, using a scale with intervals of 50cm under the surface of ground (whether the FL value is smaller than 1 or larger than 1). Moreover, the calculation results are plot-indicated in the judgment chart shown in the technological guidelines, and copies of output sheets are contrived to be used for conference data of autonomous bodies.

2. For facilitation liquefaction hazard map

For the prevention of liquefaction damage, ensuring an environment under which everybody can be conscious about whether his or her land has a risk of liquefaction is important.

The number of local governments where liquefaction risk degree maps are prepared and publicized in one way or another is 40 prefectural and city governments and 282 municipalities as of April 2012, to the extent efforts have progressed. However, the content of efforts varies according to the local government. In particular, in quite a few cases the original sources to judge the risks did not utilize boring investigations but were prepared depending on simple methods such as visual judgment of terrain. In addition, although the existence or nonexistence of the occurrence of liquefaction and the scale of damage varies according to the scale of the presumed earthquake vibration, there is no integrated concept; furthermore, in the current situation the color coding for maps varies considerably.

The Technical Guidelines prescribe the input earthquake vibration to be the medium earthquake vibration of Level 1 (maximum acceleration 200 gal, magnitude in the epicenter 7.5). Although this is considered to be an integrated scale in the future, since this is not a great earthquake, it should be considered to be the lowest limit of the level of the countermeasure against liquefaction.

Inasmuch as the calculation software we developed currently can readily be downloaded from the Homepage of the National Institute for Land and Infrastructure Management, we expect it to be utilized by many local governments and citizens and that the configuration and publication of liquefaction risk maps will progress based on accumulated ground investigation information.

[Reference]

Homepage of the National Institute for Land and Infrastructure Management
http://www.nilim.go.jp/lab/jbg/takuti/takuti.html

Case Studies and Dynamic Centrifuge Tests to Evaluate Earthquake Related Damage of Special Levees of Rivers

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Keywords: special levee of river, liquefaction, dynamic centrifuge tests, seismic retrofit

1. Introduction

For a river levee, a soil embankment is in principle constructed. In some cases, however, special levees (Independent type structure: Concrete retaining wall [“retaining wall”]), steel sheet pile ["sheet pile"], or parapet structure) are constructed due to land conditions, etc. Most of these special levees have a complicated structure due to extension / alteration works, etc. Since such special levees are expected to demonstrate complicated behavior during an earthquake, it is required to implement advanced earthquake-proof diagnoses and measures. Thus, considering that the first step to solve this issue is to understand their behavior during an earthquake, we collected data on the cases of damage of special levees in order to analyze the causes and conducted dynamic centrifuge tests to clarify the damage mechanisms.

2. Case study on the condition of special levees and seismic damage

The special levees in the river sections under the direct administration of MLIT (209 locations, about 190 km in total) are mostly composed of parapet structures (approx. 80%), followed by retaining walls (approx. 20%), and sheet piles (less than 10%). Moreover, about 70% of them are concentrated in the three major metropolitan areas, so it is important to ensure earthquake resistance.

Twenty nine damage cases on special levees located in the sections under the administration of MLIT, prefectural control, etc., were compiled. It was observed that major damage occurred where the thickness of the liquefaction layer was more than approx. 3 m for the retaining walls and more than approx. 2 m for the sheet piles, as shown in Fig.1.,which shows the relationship between displacement and the liquefaction layer during an earthquake. Thus, the liquefaction layer is considered to be the main cause of damage.

3. Implementation of centrifuge tests

Model tests were conducted by setting a 1:50 scale model (Fig. 2) on the dynamic centrifuge of the cooperating Public Works Research Institute (PWRI) and subjecting it to excitation under centrifugal acceleration of 50 G. In these tests, the thickness of liquefaction layer was changed to 3 types for both retaining walls and sheet piles.

The mechanism of damage of special levees was identified from the centrifuge tests. The pore water pressure of the liquefaction layer increased under excitation, following which the ground lost the effective stress and was liquefied, causing flow force to be directed to the frame. The flow force made the balance of applied force unstable, consequently causing horizontal/vertical displacement and/or rotation (tilt) of the frame. In addition, the displacement of the retaining walls and the sheet piles showed the same tendency as the compiled damage case: horizontal displacement increased as the liquefaction layer became thicker, and vertical displacement was minimal in the cases where the foundation of the retaining walls and the sheet piles were supported by the non-liquefaction layer.

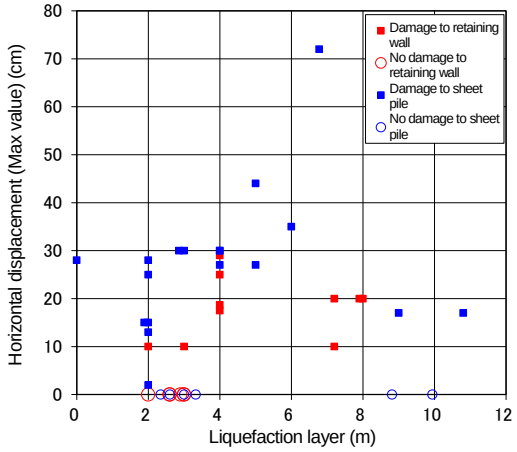

Figure 1: Relation between Horizontal Displacement in Frame and Thickness of Liquefaction Layer in Damage Cases

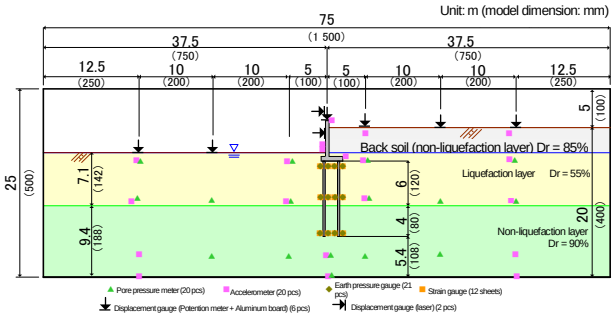

Figure 2: Schematic Diagram of the Model (Case where the liquefaction layer is 7.1 m below the river bed.)

4. Future study

We plan to study seismic retrofit methods using two-dimensional static analysis and promote studies that will resultantly propose effective seismic retrofit methods by implementing model tests .

Development of tsunami damage reduction technologies by linking oceanographic radar with numerical simulations

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(Key words) Tsunami, oceanographic radar, tsunami inversion

1. Background and purpose of the research

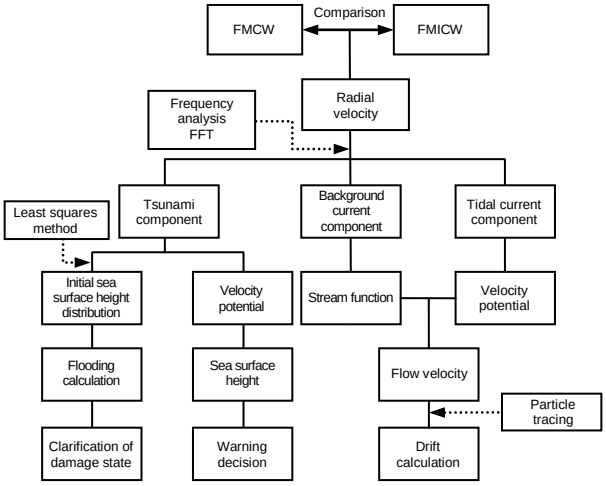
The Great East Japan Earthquake clarified two major problems concerning the reduction of tsunami damage: [1] underestimation of tsunami height, and [2] delayed identification of regions that will be severely damaged. [1] was a result of technical limits of present tsunami warning system based only on analysis of seismic waves and [2] was caused by slow clarification of the state of damage by prefectures as a result of catastrophic damage to administrative organs of cities, towns, and villages by the Great East Japan Earthquake. In the event of a giant earthquake such as the predicted Nankai Trough Earthquake, these problems could recur.

Oceanographic radar is land-based remote sensing equipment that measures flow on the ocean surface up to 100km offshore. We developed technology to resolve the above two problems by linking oceanographic radar with numerical simulations. To overcome challenge [1], we developed a method of calculating the sea surface height (SSH) distribution based on tsunami flow velocities offshore measured by the radar, and to deal with challenge [2], we developed a method of estimating tsunami initial SSH distribution with high precision by taking advantage of the characteristics of the radar, specifically its ability to obtain spatial distribution of a flow field. If it is possible to predict initial SSH distribution with high precision, it is also possible to clarify the state of damage over a wide area using existing tsunami models.

2. Analysis procedure

The figure shows the observed data processing flow chart. The double lines indicate technologies already developed, including existing technologies. The oceanographic radar transmits radio waves to the sea surface and receives the backscattered signals from the ocean surface. Frequency analysis (FFT) of the signal can obtain the velocity component caused by the tsunami (tsunami component) and the background current component unrelated to the tsunami (wind-induced current, density-driven current and tidal current components). Based on knowledge of fluid mechanics, the tsunami component is converted to water level distribution, and compared with tsunami warnings (resolving challenge [1]). This tsunami component and the least squares method are used to estimate the initial tsunami water level distribution[1]. In other words, it statistically estimated the degree of SSH that ought to be formed in the hypocenter region to create the tsunami distribution measured by the radar. Then the SSH is applied to the tsunami model to perform flooding calculation and to clarify the state of wide-area damage (resolving challenge [2]). The background current component will be used to calculate drift of heavy oil etc. discharged into the ocean.

Figure. Measured Data Processing Flow Chart



3. Future challenges

A weakness of our present radar system (FMICW) is that it is susceptible to the impacts of various kinds of noise resulting in weakening tsunami signals. To improve this, our research group is now developing radar that uses another transmission/reception system (FMCW). comparative tests of the present radar and the new radar system will be performed in the next fiscal year.

[Sources]
Fuji et al. doron, Journal of JSCE, Ser. B2 (Coastal Engineering) NO. 69, I_436-I_440, 2013

Issue of Guideline to Tsunami Evacuation Measures for Ports and Harbors and Guideline to Design of Tsunami Evacuation Facilities for Ports and Harbors

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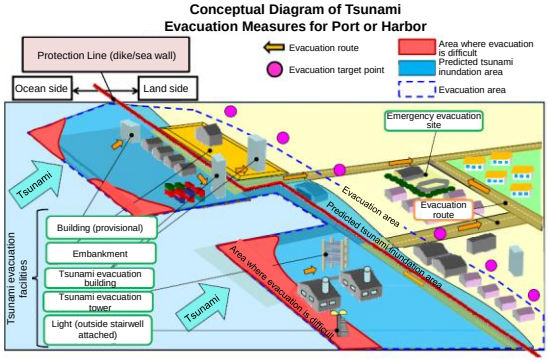
(Key words) Tsunami evacuation measure, outer levee area, tsunami evacuation simulation, tsunami evacuation facility

1. Background

Ports and harbors play important roles as centers of industry, logistics and maritime transport, where many kinds of stakeholders, such as workers, passengers etc., are active in their respective roles. But many of the areas in ports face the shoreline on the ocean side of the protection line (sea wall etc. that protects the landside area from storm surges and tsunamis). These areas, so-called outer levee areas, are at high risk of inundation by tsunami, where measures must be taken to ensure the victims safe and prompt evacuation.

So tsunami evacuation measures must be taken considering the characteristics of ports and harbors. In the same manner, the tsunami evacuation facilities must be constructed so they are effective for emergency or temporary evacuation of evacuees from areas where evacuation is difficult.

Figure. Conceptual Diagram of Tsunami Evacuation Measures for Port or Harbor



2. Guideline to Tsunami Evacuation Measures for Ports and Harbors

Since February 2013, a study committee has held five meetings to issue the guideline, established by Ports and Harbours Bureau, Ministry of Land, Infrastructure, Transport and Tourism, (Chairman: Professor ISOBE Masahiko, Vice President, Kochi University of Technology).

The guideline, as a reference to establish the tsunami evacuation measures for individual ports, stipulates basic concepts concerning the roles of port administrators, related members and organizations, and related and coordinating regional disaster prevention plans and tsunami evacuation plans of surrounding local governments. The guideline also shows tsunami evacuation methods, including extracting methods for areas where evacuation is difficult and methods of laying out tsunami evacuation facilities.

Our divisions provided information about the results of research on the evacuation activities in ports and harbors and the application of tsunami evacuation simulation.

3. Guideline to Design of Tsunami Evacuation Facilities for Ports and Harbors

Since March 2013, a working group has held four meetings to issue the guideline established by the Ports and Harbours Bureau, Ministry of Land, Infrastructure, Transport and Tourism, (Chairman: Professor KIYOMIYA Osamu, Waseda University)

The guideline shows basic concepts for design of each item of tsunami evacuation facilities for ports and harbors: representative conditions required by tsunami evacuation plans (e.g. identifying areas where evacuation is difficult, estimating the number of people to be evacuated, arranging the layout of tsunami evacuation facilities, etc.), conditions required for evacuation, required structural conditions, and required administrative conditions. The guideline is intended to support the proper design of tsunami evacuation facilities for ports and harbors under evacuation measures applied by the Guideline to Tsunami Evacuation Measures for Ports and Harbors.

Our divisions have shown the basic concepts of objects of tsunami evacuation facilities in ports and harbors, with reference to related laws, regulations, and standards. We have also provided technical

support for the establishment of tsunami evacuation facilities design methods.

4. To Promote Tsunami Evacuation Measures

Our divisions will hereafter provide lectures for a training course to help port administrators understand the guideline, and provide technical assistance to help them establish specific tsunami evacuation plans or tsunami evacuation facility plans, and to promote tsunami evacuation measures for ports and harbors.

[Sources]

1) Guideline to Tsunami Evacuation Measures for Ports and Harbors, September 2013
http://www.mlit.go.jp/kowan/kowan_tk7_000013.html
2) Guideline to Design of Tsunami Evacuation Facilities for Ports and Harbors, October 2013
http://www.mlit.go.jp/report/press/port05_hh_000054.html

Research on airport disaster risk quantitative evaluation methods

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(Key words) Inventory analysis, loss probability factor, predicted maximum loss (PML)

1. Use of capabilities of the private sector to operate airports

The Law for the Use of Capabilities of the Private Sector to Operate Government Managed Airports (Law No. 61 of 2013) has been enacted, and the Basic Guideline to Using Capabilities of the Private Sector to Operate Government Managed Airports (Notification of November 2013) issued under the same law legally obligates private companies with operation rights to set disaster phenomena caused by earthquakes and tsunami and the degrees of damage they cause and to purchase insurance, so research and development of methods of quantitatively evaluating disaster risk is an urgent challenge.

2. Introduction of inventory analysis

Based on damage caused at the Sendai Airport by the Great East Japan Earthquake, resulting conditions were hypothesized, a sample airport and earthquake etc. were set, a cause-consequence diagram of the restoration and operation process was prepared, and inventory analysis, which is a method used in the safety engineering field, was performed. For example, regarding the loss when one sample earthquake occurred, the occurrence probability (loss probability factor) and the loss 10% threshold value non-exceedance probability (predicted maximum loss: PML) were calculated by damage and form of operation.

It is possible to interpret Figure 2, which superimposes damage phenomena on Figure 1 and the cause-consequence diagram, as showing that there is a 49% probability of a case where shaking damage to the perimeter security fence or to the terminal building closes the airport for 20 days, and a 51% probability of damage to fuel supply facilities or electric power equipment of closing the airport for 30 days. In this way, a method of visualizing or quantifying risk to provide material on which decision-makers can base countermeasure decisions was proposed.

In addition, a method of showing the probability of the occurrence and quantity of loss of each earthquake in the coming year at one airport, a method of calculating the funding necessary to measure countermeasure effectiveness, and a method of computing the restoration curve necessary to prioritize countermeasures were proposed.

Figure 1. Loss Probability Factor/PML Calculation Example

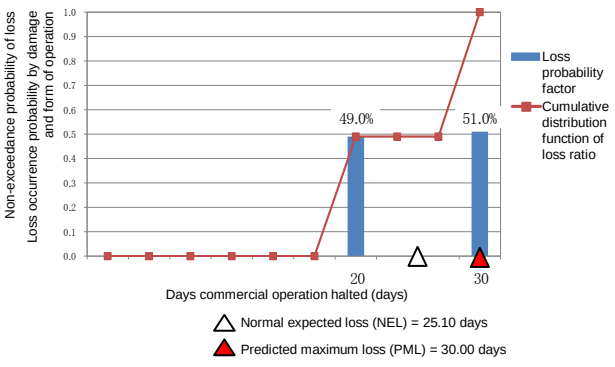
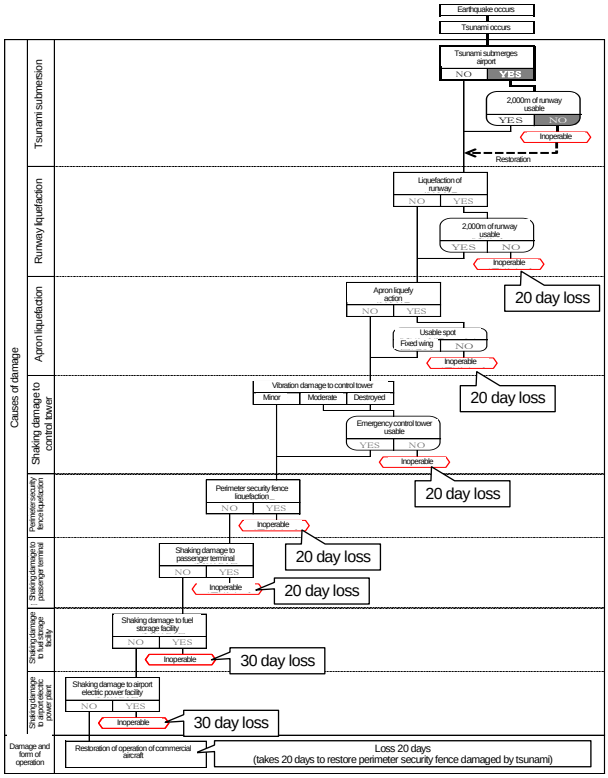


Figure 2. Cause-Consequence Diagram Overlapping Damage Phenomena



3. Future challenges

We wish to continue research and development while obtaining the understanding of concerned persons in order to promote the use of the private sector: preparing more realistic predictions of

conditions considering disruption of access, fire and so on, or methods of analyzing the financial impact of an earthquake and tsunami on a company with operation rights.

[Source]
TECHNICAL NOTE of NILIM NO. 756
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn756.htm

Arrangement/Analysis for earthquake observation records aiming for enhancement in accuracy for evaluating earthquake intensity of buildings

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(Key words) Earthquake observation, Dynamic Interaction of Structure/Ground, Earthquake force evaluation

1. Foreword

We introduce the outline of arrangement/analysis methods deliberated in the comprehensive technological development project titled Development of aseismic capacity for buildings corresponding to the sophistication of earthquake vibrations information. With respect to the earthquake behavior of actual buildings, since the dynamic interactive effects of structures/grounds have affect, we have made it a subject to comprehend this quantitatively.

2. Outline of method

We will illustrate the flow of method in the Figure 1. According to simultaneous observation for ground and the inside of building (apex and bottom), the Fourier spectrum ratio, which indicates relations between the ground surface and the inside of building, is obtained. From the Fourier spectrum ratio, the original dimension of sway model or sway rocking model is fixed including input loss effects. Using identification results, coupled system responses receiving foundation fixation and dynamic interaction effects can be obtained by analysis using the random vibration theory and compared.[1)]

For instance, in regard to the observation building shown in Figure 2, the Fourier spectrum ratio is indicated in Figure 3 from observation records. In proportion to the ratio of massive deformation of ground spring, the building deformation of the coupled system is clarified to greatly be reduced in comparison with the foundation fixed system.

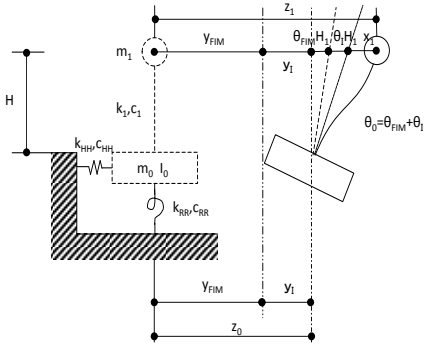
3. Conclusion

In order to make technological data for deliberating designing earthquake intensity for buildings, we have currently been applying the methods illustrated herewith to still more observation buildings and compiling its results.

[Reference]

1) Okano, Azuhata, others: Building response decreasing effects presumed from observation records, collected papers of the Architectural Institute of Japan

① Fourier Spectrum ratio calculation for (building apex/ground surface, building bottom/ground surface, building apex/building bottom.)



Sway Rocking model

② Identification and original dimensions and input loss effects of Sway Model (S. Model) or Sway Rocking Model (SR Model) from Fourier Spectrum ratio.

※Spectrum Fitting method

③Obtain earthquake response of series model (S model or SR model) earthquake responses receiving foundation fixed model and dynamic interactions and compare using the random vibration theory.

*Deliberate two cases: A case to consider dynamic interactions of inertia only (II); a case to consider both interactions of inertia and input (II+KI).

Figure 1 Flow of method

Height：14.03m

Flat surface size：8.06m×65.7m

Class of ground：2nd class

Upper part structure：Wall type RC structure

Foundation structure：PC pile (PC 杭)

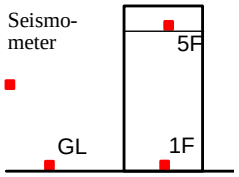
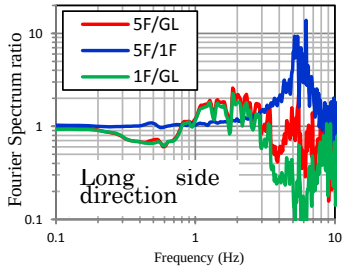


Figure 2 An example of observation building



(The 2011 off the Pacific coast of Tohoku Earthquake)

Figure 3 Fourier Spectrum ratio

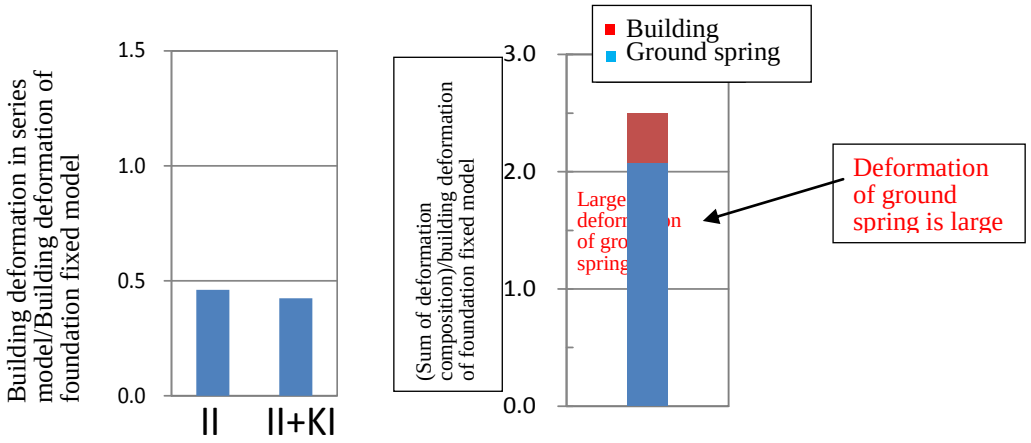


Figure 4 Examples of analysis results

Evaluation for danger of falling tiles / finished exterior wall in earthquakes

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(Key words) Tile finished exterior wall, falling prevention, earthquake resistance safety, evaluation method

1. Foreword

In the existing earthquake damages, wet tile finished exterior walls used often for mid-to-high-rise RC buildings (hereinafter referred to as tile exterior wall) have a high occurrence rate of damage in spite of the mild level of earthquake vibrations. In particular, based on many damage involving peel-offs, falling or the like occurring to tile exterior walls in the Great East Japan Earthquake, this study proposes a convenient peel-off danger evaluation method and testing method, and specifications capable of ensuring certain earthquake prevention safety.

2. Outline of deliberations

We investigated and put damage occurring to the tile exterior walls of mid-to- high-rise RC buildings by earthquakes in order, sampled materials that seemed effective for preventing peel-off/falling and carried out performance tests of material levels. In addition to direct tensile tests to measure adhesion strength of tile finished layers (photo 1) and shearing tests (photo 2), we carried out deformation suppleness tests (photo 3) by putting loads on concrete foundations.

3. Result and conclusion

The tile exterior wall is worked on concrete structures; using plaster mortar, organic adhesive sheathing and adhesive materials (chart 1). In view of the result of deformation suppleness tests, while the plaster mortar prevents peel-off in adaptation to brandering due to its adhesive strength, organic adhesives prevented peel-off according to deformation flexibility due to its elasticity. Furthermore, while the tiles affixed by organic adhesives do not generate cracks and peel-offs when the concrete base is fractured due to elasticity, in case of direct external forces such as a tensile strength test, even though it clears the prescribed value 0.4N/mm2, it cannot be expected to have strength as high as plaster mortar (chart 2). Moreover, in reference with adhesion strength between ready-made blending mortar and blending mortar made onsite relevant to subsurface for plaster mortar, it currently has turned out that the onsite blending surpassed the ready-made blending by about 1.5 times (chart-3). For fiscal 2014, we carry out deliberations for simplified earthquake resistance test method using diagonal test bodies and verification using 1/2 wall testing bodies.

Photo 1 Direct tensile test

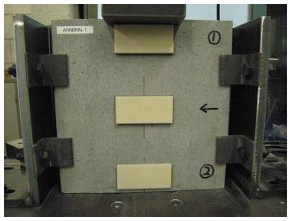

Photo 2 Direct shearing test

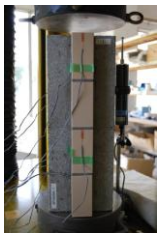

Photo 3 Deformation suppleness test

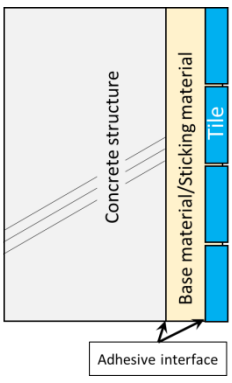

Figure1 Tile outer wall cross section

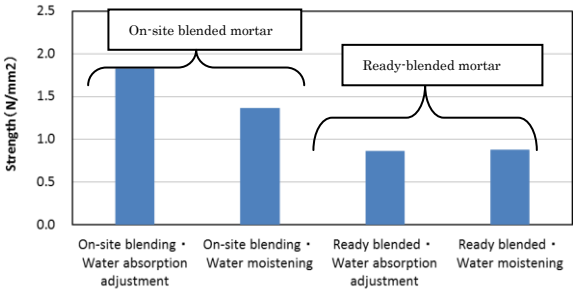

Figure2 The direct tensile test of tile direct tension

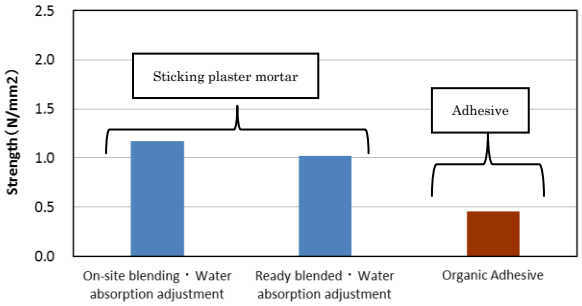

Figure3 The direct tensile test of a three-layer coating tile base for plastering mortar

Real-scale fire test of a Three-Story wooden School Building (final experiment)

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(Key words) Timber construction, real-scale fire experiment, fire safety

1. Foreword

In October 2010, a law with regard to the acceleration of timber utilization in public building structures and so on was enforced. Taking this into account, NILIM collects data necessary for re-examination of fire prevention related provisions of the Building Standards Law in regard to three-story wooden school building and has been carrying out studies to prepare a basic draft based on it.

2. Objective of final experiment

To start with, with specifications presumed as a school, and in addition, using a building with the lowest level required for buildings including other usage, we carried out a real-scale fire experiment of three-story wooden school building in NILIM's site, on February 22, 2012, and fire spread to the upper floor in the early stage of fire, via external openings from the room on the ground floor where the fire broke out, then quickly spread to the next rooms through external and internal openings of fire prevention walls, and problems of the collapse of fire prevention walls to independently be erected after fire and so forth were made clear. In consideration of these problems, we carried out a real-scale fire experiment (preparatory experiment) on November 25, 2012 in Gero City, Gifu Prefecture, and confirmed the effectiveness of countermeasures such as use of fire prevention material for interior finishes, installation of balconies and canopies and changes in structure of fire prevention walls and fire prevention doors.

Based on this result, we prepared requirements for performance for three-story wooden school building to prevent the rapid spread of fire to upper floors, prevent the fall of structures during the period required for evacuation and rescues and prescribe specifications necessary for those, and we implemented an real-scale fire experiment (herein after referred to as "final experiment") in order to finally corroborate the performance, on October 20, 2013, in Gero City, Gifu Prefecture. In this experiment, in order to prevent rapid spread of fire to upper floors, we provided a specification to make the interior, from which the fire broke out, fireproof to prevent fire spread.

3. Outline of final experiment's result

After the fire broke out in the room on the ground floor, although it spread to the periphery of the combustible materials from the fire source, and continued to the extent flames reached to the ceiling, it took 48 minutes until the fire widely spread in the room where the fire broke out to confirm the effect of fire spread which was one of the objectives of the experiment. The fire spread to the inside of a room on the second floor 15 minutes thereafter via exterior openings and spread to the inside of a room on the third floor via exterior openings four minutes after that. At a point in time more than an hour after the spread of fire, fire extinguishing was carried out.

In view of this result, the fire spreading to upper floors via external openings could be prevented, fire spreading from the room the fire broke out to the stair room and fire spreading via the fire prevention wall did not occur, despite columns and beams in the room from which the fire broke out being chared to a depth up to 4-7cm, and the test body did not collapsed, and besides, in consideration of the fact that there was no disruption of fire prevention walls, effective specifications with regard to the

required performances for the standards draft could be corroborated and other data could be collected.

4. Conclusion

As a result of three real-scale fire experiments including final experiment implemented so far, and based on experiment results of relevant members, we are prepared to compile details of a standards draft.

This experiment was carried out under the collaborative studies with Waseda University, Akita Prefectural University, Mitsui Home Co., Ltd., Sumitomo Forestry Co., Ltd., Gendai Keikaku Kenkyusho Co., Ltd., Building Research Institute and National Institute for Land and Infrastructure Management.

[Reference]

In reference to the results of the three real-scale fire experiments, we would like you to refer to the following URL.

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

Photo 1: Fire spread to the 2nd floor

Photo 2: Fire spread to the 3rd floor

Research on External Force and Experiment Method contributing to Structural Performance Verification for Building Structure Members

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(Key words) Non-Structural members, Structural performance verification, External force evaluation, Experiment method

1. Background of research

Seismic performance of buildings has been improving with the development of earthquake resistant performance evaluation technology through many earthquake disasters, and damage to building structures by earthquake vibrations have been decreasing. On the other hand, damage prevention for nonstructural building members, such as nonstructural components, is subject to decrease earthquake damage. There is more damage observed that is assumed to affected not by the story drift due to structural deformation but by the out-of-plane deformation and inertia force to nonstructural component due to deformation/vibration of structural/nonstructural members. In order to prevent such damage, appropriate evaluation of external force to nonstructural component and appropriate testing method for structural verification are required to be studied with regard to the observed damage.

Photo: Damage assumed to be affected by out-of-plane vibration.

2. Contents of research

This research is aimed to provide technical data for structural performance verification of building members through evaluating external force to building members by earthquake vibration and examining testing methods with the evaluation considering the nonstructural damage observed in recent earthquakes. Of research subjects for the three years from 2013 to 2015, the following contents are planned.

- Survey on testing method for structural performance evaluation for building structural members at home and abroad.
- Examination of experimental method with full scale specimen.
- Implementation of full scale experiment for subject building member.
- Summary of the points for structural performance verification.

The anticipated research objects of this research are nonstructural components, such as AAC(Autoclaved Aerated Concrete) external wall, large sheet glass and tall partition, which have possibilities to be damaged by out-of-plane vibration in future earthquakes.

3. Research schedule

For fiscal 2013, we carried out study on experimental methods at home and abroad, configuration of an object for a full scale experiment (large sheet glass) considering damage in the past and preparation of steel support frames for the next year. For fiscal 2014, we will carry out full scale experiment with a shaking table. For the final fiscal year, the points will be summarized for structural performance verification on external force evaluation, experimental method and the like.

Formulation of Technical Standards concerning Measures to Prevent the Fall of Ceilings in Buildings

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(Key words) Ceiling, Building Standards

1. Backgrounds

Technical standards concerning measures to prevent the fall of ceilings in buildings issued in August 2013 based on the Building Standards Law (Notification No. 771 and others the Ministry of Land, Infrastructure, Transport and Tourism in 2013) , following the human/physical damage by the fall of ceilings of gymnasiums, large scale halls or the like by earthquakes in the past, in particular the Great East Japan Earthquake.

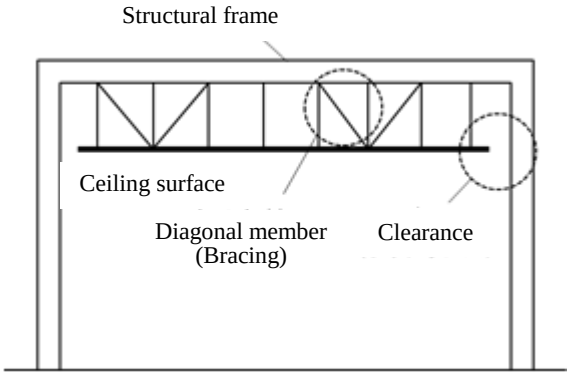
The National Institute of Land and Infrastructure Management proposed an original draft on the occasion of formulating the technical standards, obtaining support from the Building Research Institute.

2. Outline of technical standards

The technical standards prescribe safe ceiling structural methods in regard to structural bearing force to be adapted for ceilings feared possible to generate critical harm by fall (specific ceilings). As a specific ceiling, it is a suspended ceiling with the height of over 6m, horizontal projected area of over 200m^2 and unit area mass of over 2kg/m^2 and is stipulated to be installed in the site usually utilized by people.

Furthermore, inasmuch as the feature of ceilings in a huge earthquake is difficult to clarify according to current knowledge, the technical standards of this time are formulated with the aim of reducing possibility of the fall of ceilings in a certain earthquake surpassing the medium scale by preventing damage to ceiling materials in medium earthquakes.

In addition, the ceilings of existing buildings correspond to specific ceilings, and when implementing certain improvement construction, it is required to conform to this technical standard or the measures to temporarily prevent the collapse of ceiling with nets, wires or the like (fall preventing measure)



3. Interpretation of technical standards

.The National Institute for Land and Infrastructure Management has prepared and publicized an introductory manual for the technical standards in collaboration with the Building Research Institute to make it a reference for actual operations of design and examinations for the enforcement of technical standards from April 2016.

The introductory manual has posted the corroboration of closely connected conditions of reciprocal ceiling members and standard experimental methods of the evaluation for allowable bearing force of ceiling (bearing forces of ceiling and its members/bearing forces of connected parts/configuration method of rigidity), as well as interpretations of each provision and clause by clause explications which compiled important matters.

[Reference]

TECHNICAL NOTE of NILIM(No.751) /Building Research Data (No. 146) “
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0751.htm

Upgrading Radar Precipitation Data by Converting C-Band Radar into MP Radar

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Keywords: radar precipitation data, C-band MP radar

1. Introduction

The Water and Disaster Management Bureau of the MLIT monitors rainfall across the country to use precipitation data for river management, disaster prevention information to the public, etc. For this, it uses 26 radar rain gauges ("existing radar") that operate on the C-band (wavelength of approx. 5 cm), and 35 dual-polarization radar rain gauges ("XMP radar") that operate on the X-band (wavelength of approx. 3 cm). The existing radar has a wider range of observation but is less accurate than XMP radar. In order to upgrade radar precipitation data, the existing radar, which is a single polarization radar that transmits and receives one type of radio wave, will be replaced by dual-polarization radar ("CMP radar") that can transmit and receive two types of polarized waves, horizontal and vertical. (At present, two units have been converted to MP [multi-parameter].) This paper examines the effort to convert radar observation data into precipitation in order to improve the accuracy of observation of existing radar infrastructure, by converting the existing radar into MP radar.

2. Rainfall observation with C-band MP radar

The Figure shows radar rainfall images from the 2012 Northern Kyushu Heavy Rain, taken by the existing radar (left), XMP radar (middle), and CMP radar (right). The precipitation measured by CMP radar was calculated with the precipitation calculation method studied by the NILIM. Note that the existing radar data was corrected using the precipitation data measured on the ground but no corrections were made to the data of XMP and CMP radars. With XMP radar, the whole rainy area was not captured due to the unobservable area formed by radio waves attenuated by intensive rain, while CMP and XMP radars provided mostly consistent shapes of rainy areas and variations in the distribution of rainfall. In addition, as a result of comparison between the ground precipitation and the time series precipitation by XMP and CMP radars, it was found that CMP radar is less accurate than XMP radar, but its data on precipitation at the beginning, peak, and end of the rain was almost consistent with the ground precipitation data, which verifies that observation was done with good accuracy.

3. Future perspective

Since CMP radar allows for accurate observation without the need for correction based on ground precipitation data, distribution cycle, the time required from observation to distribution can be reduced, which is expected to lead to improved precipitation information. In addition, joint use of CMP radar and XMP radar to supplement unobservable areas under XMP radar or due to rain attenuation is expected to improve wide-area observation accuracy across the country, as well as stable and highly accurate observation of urban areas where XMP radar is provided. The existing radar units are to be converted into MP radar as they come up for replacement. In fiscal 2013, four units were converted and, in fiscal 2014, one unit will be converted. The rainfall calculation parameter of converted units will be tuned by the NILIM and will be examined to ensure observation accuracy.

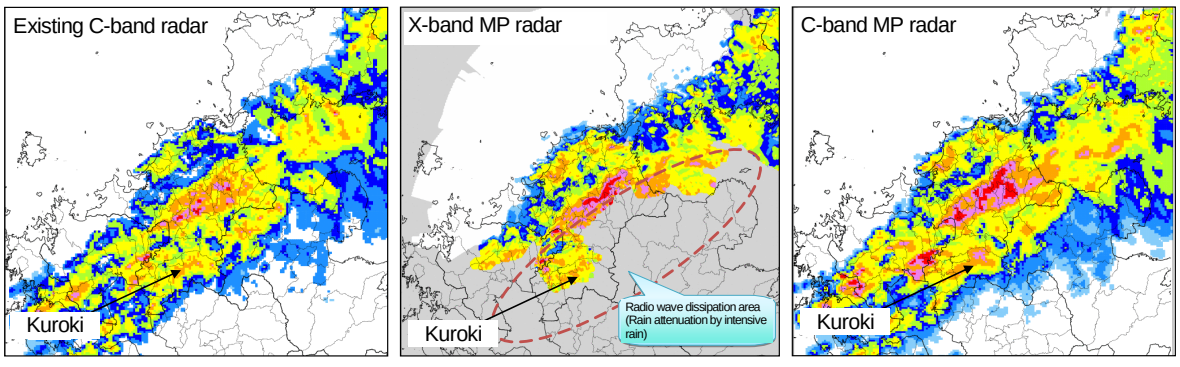

Figure: Radar Precipitation Image from 2012 Northern Kyushu Heavy Rain

Research on Technology for Real-time Flood Monitoring

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Keywords: flood monitoring, real time, private-sector probe data, big data

1. Trends and needs for flood monitoring technology

In the event of a flood due to overflow from a river, etc., information from real-time monitoring of actual conditions, as well as flood prediction, is very important for accurate evacuation guidance, flood control measures, prompt recovery, etc. In 2013, many places in Japan suffered damage from flooding as seen in the Yamaguchi-Shimane Heavy Rain (July) and Typhoon No. 18 (Sep.). It is, therefore, urgently required to develop technology for monitoring floods in real-time in order to reduce damage.

In the development of flood monitoring technology, various measures have been previously studied and some of them have actually been developed, including the use of CCTV, installation of flood detection sensors and flood level gauges, and a system for transmitting and receiving flood observation information using mobile phone lines or existing optical fibers. However, all of these technologies have issues, including how to manage investment and maintenance costs, ease of introduction, tracing of time changes in flooded area, and detection of flooded areas. This paper reports on a study on detecting flooded areas using private-sector probe data without new observation equipment.

2. Study on the feasibility of using probe data

(1) Characteristics and advantages in using private-sector probe data

Private-sector probe data refers to automotive traffic information obtained by private-sector companies, which is one of so-called "big data." All of the approaches already discussed directly observe flood water, but this study takes an indirect approach focused on the movement of goods susceptible to the effects of flooding. This approach uses technology that was developed to provide information on traffic congestion, etc. under normal conditions, and has the potential to monitor the expansion of flooded areas to a high degree of accuracy in urban areas where roads are densely arranged.

(2) Availability of private-sector probe data

In this study, spatiotemporal changes in the travel speed on each route obtained from probe data were examined using speed data as an indicator of automotive traffic characteristics, covering the areas flooded by the heavy rains that hit Nagoya City in September 2013 (originally estimated by integrating results of hearings from related organizations, SNS information, etc.) and surrounding areas. The figure shows an example of the study results. The right image shows traffic in the 17:00 - 19:00 time period when heavy rain or flooding occurred, while the left image shows the traffic in the same time period under normal conditions. Looking at the travel speed (time average) under normal conditions and flooding, a clear trend of decline is recognized in the flooded areas (estimated) and surrounding areas. With this data, it is found that traffic conditions are susceptible to flooding, etc. and those conditions are reflected in private-sector probe data.

3. Conclusions

The potential for using private-sector probe data for flood monitoring technology was obtained from this study. We will continue to examine ways to upgrade indicators, etc. by considering the effect of impassable cars at certain points I order to enhance the reliable of flood monitoring.

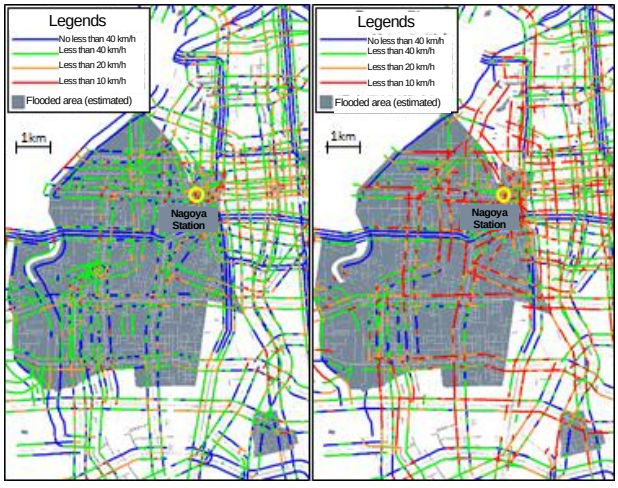

Figure: Comparison of Travel Speed under Normal Conditions (left) and Flooding (right)

Technical Study for Improving the Accuracy of Flood Forecasts --- Application of Particle Filter ---

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Keywords: flood forecasting system, actual measurement adjustment approach, granular filter

1. Introduction

Under Article 10 of the Flood Control Law, if a flood is likely to occur in a river under the direct control of the government or other large river, JMA and MLIT are jointly required to disseminate forecast information on water level, etc. from a base station ("flood forecast") to the prefectural governor and the public. It is, therefore, necessary to provide highly accurate flood forecasts to support flood fighting activities and minimize damage. However, the accuracy of flood forecasting models used for the rivers under the direct government control in direct control rivers is by no means adequate.

At present, it is difficult to determine a flood forecasting model with a parameter set that can calculate all floods to a satisfactory degree of accuracy. Given the circumstances, it is important to use real-time observation data on discharge, etc. to the extent possible, to estimate the best parameters in real-time and maintain the flood forecasting model suitable for the flood then likely to occur. (This process is called "real-time adjustment".) This paper introduces a flood forecasting calculation using particle filter, which is a real-time adjustment method based on the statistical theory and has often been used in recent years in the river management field.

2. Outline of Particle Filter

A particle filter generates multiple random quantities as statuses that are corrected in real-time (each random quantity is called a "particle"), and conducts simulations with the flood forecasting model for each of the particles to select the particles of high conformity between the calculation result and observed value. With this approach, the best parameters can be estimated in real-time for each flood.

3. Application example

Figure 1 compares the results of calculations using and not using the particle filter to forecast the discharge one hour after at the flood control point (B point). In this example, the roughness coefficient of the model is used as the target of sequential correction by the particle filter. As a result, the accuracy was higher in the case where the particle filter was applied than the case where not. Figure 2 shows the temporal changes in the optimal roughness coefficient estimated by the particle filter. Clearly, the particle filter enhances the forecasting accuracy of the flood forecasting model.

Figure 1: Forecast of One-Hour-After Discharge at B Point of River "A" Where Particle Filter is Applied

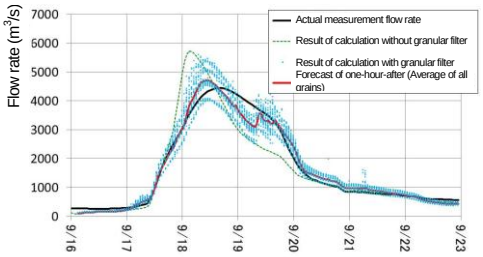
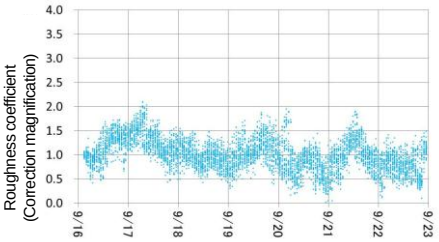


Figure 2: Temporal Changes in Roughness Coefficient



4. Conclusion and issues

As described, the particle filter estimates the optimal parameters for each flood through a process of repeating the calculations of the flood forecasting model the same number of times as the number of particles. It can be installed without substantially altering the flood forecasting model already adopted on site and is advantageous towards improving the accuracy of forecasts. For real-time operation, it is necessary to study the required calculation time and physical validity concerning temporal changes in the quantity of status. It is expected that particle filters will be widely used in on-site flood forecasting systems.

Urgent Determinant Investigation of Landslide Dams with SAR Satellite Images

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Keywords: SAR image, landslide dam, interpretation

1. Introduction

If abnormal phenomenon such as a large-scale collapse that may lead to the formation of a landslide dam is likely to occur in a wide area due to heavy rain, etc., it is necessary to prevent the occurrence of secondary disasters due to breaches or otherwise by quickly detecting the formation, position, and size of the landslide dam. This paper introduces a method of urgent determinant investigation of landslide dams using images obtained from synthetic aperture radar ("SAR"). Its aim is to investigate ways to detect landslide dams even at night or in bad weather where visual investigation using a helicopter is difficult.

2. Characteristics of SAR images

SAR is an activity sensor usually installed in artificial satellites and airplanes. It observes backscattered microwaves that are originally irradiated obliquely to the earth's surface. SAR images have unidentifiable elements due to shadows, reversing, or tilting (Fig. 1) since microwaves are irradiated obliquely downward, But, SAR has an advantage it that observations can be made without sunlight, i.e., observation at night or in bad weather, since microwaves penetrate clouds.

In addition, unidentifiable parts can be reduced using images observed from multiple directions, such as observation from ascending (northward) / descending (southward) orbit.

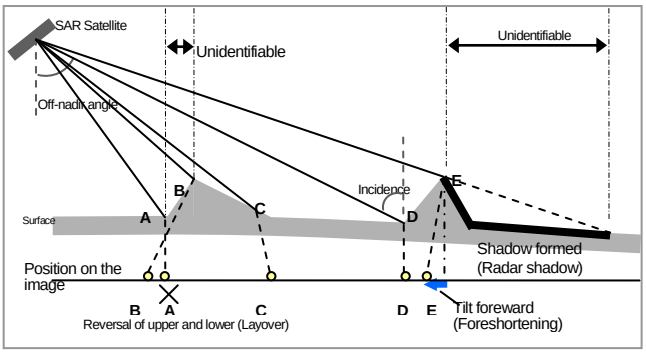

Figure 1: Geometric Characteristics of SAR Images (reversal of image, tilt)

3. Interpretation of SAR images

When using dual-polarization SAR images for interpretation, it is desirable to use wide-area images that have a resolution higher than HH + HV, i.e., 8 m (of the combinations of transmitted / received horizontally polarized wave H and vertically polarized wave V) and are observed at the incidence angle of approx. 35-50. Objects that can be identified with dual-polarization SAR images are mainly collapsed land with a plane projection area of about 1 ha or more. SAR images are read manually in accordance with the below check list by enlarging images. They are otherwise read in consideration of geomorphic characteristics of landslide dams (Fig. 2) such as dammed lakes, collapsed areas, and colluvial sediment blocking a river channel, and in consideration of the aforementioned geometric characteristics of SAR images.

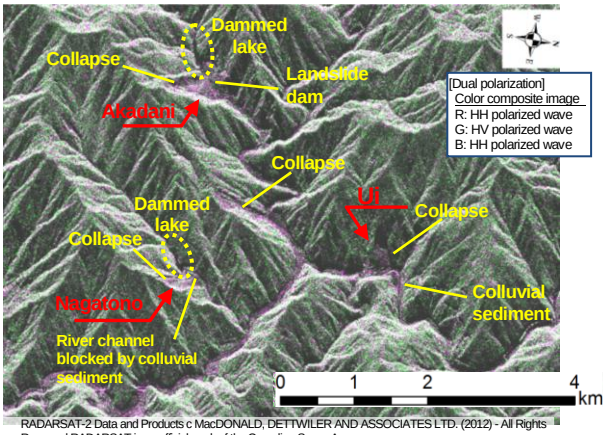

Figure 2: Example for SAR Image of Landslide Dam (Kii Peninsula in 2011)

Table: Check List for Dual-Polarization SAR Image Interpretation

Check areas	Check items	Decision criteria	Evaluation
Collapsed land	Bare ground	- Is red-purple bare ground in the dual-polarization image? - Located on a slope? (Colony or river channel on flat land or gentle slope?)	
	Main scarp	- Are any main scarps seen around dammed lakes? - Are any shadows / layovers due to level difference seen around the main scarp? - Is the shape of the main scarp circular to the direction of the slope?	
	Inside the collapsed land	- Are any collapsed shapes seen under the main scarp? - Is the collapsed shape consistent with the direction of the slope?	
	Colluvial sediment (Blocked river channel)	- Are colluvial deposits seen from inside the collapsed land to the lower area? - Is the colluvial deposit tongue-shaped? - Is the extent of the colluvial deposit consistent with the topographic shape? - Is the blocked river channel shaped to aggrade the valley? - Has a dammed lake formed upstream of the blocked river channel? - Is the shape of fallen trees, etc. seen on the colluvial deposit?	
	Scale of collapse	- Is the scale of collapse large enough to block the river channel?	
Scar of debris flow	Scar of flow down	- Is the transport area seen from the lower part of the collapsed land? - Is there scar of flow down of debris due to widening of the river channel, outflow of vegetation, etc.?	
	Debris flow deposit	- Is there debris flow deposition (debris flow terrace, alluvial cone) seen?	
Local terrain	Slope gradient	- Are there any slopes near the dammed lake? - Is the neighboring slope so steep it may collapse?	
Relative positional relation	Relation of upper and lower, etc.	- Are there any abnormalities in the positional relations of the main scarp, colluvial deposit, and dammed lake? - Is the extent of colluvial deposit consistent with the topographic shape?	
River channel	Dammed lake	- Is a dark area suspicious of a dammed lake seen? - Is the width abnormal compared with the water-route width upstream and downstream? - Is there flooding because of artificial structures, such as a dam or intake weir?	
Judgment	Collapse scar / Bare rock area		
	New collapse	Surface failure	
		Large-scale collapse: Deep-seated landslide	
		Large-scale collapse: River channel blockage	
	Scar of debris flow		

Evaluation index
○: Shape can be identified
△: Not clear but shape can be identified
X: No shape can be identified
-: Impossible to identify

4. Conclusions

Since engineers have started using SAR images in disaster response, as was the case following Typhoon No. 12 TALAS in 2011, we will continue to upgrade the investigation method into their practical use.

Detection of Landslide Dam Formation by Monitoring Flow Decline

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Keywords: river channel blockage, flow monitoring

1. Background

When water flow overtops a landslide dam formed by an earthquake or heavy rain, the result may be a drastic breach that seriously damages the downstream area (photo). To mitigate damage caused by landslide dams, it is essential to detect their formation and take action, including evacuation, as quickly as possible.

2. Objective

If landslide dams form at the stream of a mountain river channel, flow rate sharply decreases (compared with flow during normal flooding) downstream from the landslide dam. It was, therefore, considered that the formation of a landslide dam could be detected by identifying a drastic decrease in flow downstream from a landslide dam. However, there are few studies that have aimed to determine a method and criteria for judging landslide dam formation using flow variation (first issue) or evaluating sections where the landslide dam formation can be detected using flow data (second issue). Therefore, detection and/or confirmation of landslide dam formation using flow rate observation data has not actually been conducted. Therefore, NILIM, in cooperation with the Kanto Regional Development Bureau, proposed a new approach for analyzing these two issues ("proposed approach").

3. Outline of the proposed approach

Regarding the first issue, we proposed that the formation of a landslide dam can be judged by whether the degree of flow decline was larger than given criterion. However, setting a relatively small degree of flow decline as the criterion might suggest that a landslide dam had formed when it had not. To reduce this possibility, we used a flow dataset to clarify the degree of ordinal flow decline, then set the criterion at a point larger than the degree of ordinal flow decline.

Next, for the second issue, we proposed an approach in which we monitor a section of the river where a drastic and large decrease in flow beyond that expected under the above described normal conditions is considered likely if a natural dam is formed. The proposed approach assumed that the degree of flow decrease because a landslide dam is dependent on the ratio of the area of the river basin at the flow observatory to the area of the river basin upstream from the landslide dam, and on the distance from the flow observatory to the landslide dam. Based on these considerations, we proposed an approach in which we monitor the landslide dam formed at the sections where the catchment area is larger than a certain size (the smallest detectable catchment area) and the distance from the flow observatory is less than a certain distance (the longest detectable distance) (figure).

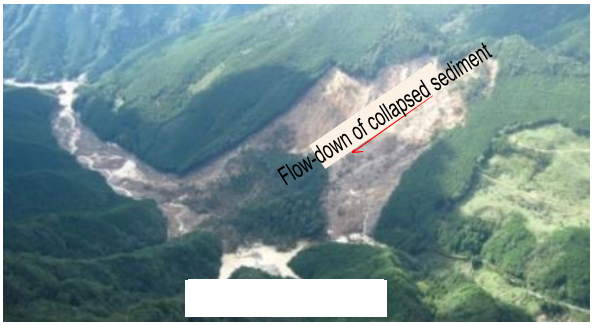

Photo: Example of Landslide Dam Formed in Typhoon No. 12 of 2011

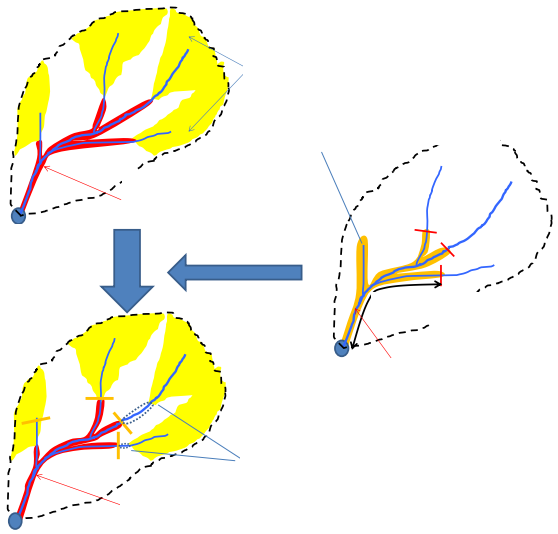

Figure: Diagram of Proposed Approach

[Reference]

"Manual on data analysis for detection of landslide dam occurrence using discharge data," NILIM Document No. 767, Nov. 2013.

"Manual for Sand Dune Scarp Control Works" Completed as a Deliverable of the Sand Pack Joint Research
-- First Full-scale Adoption in Japan for Miyazaki Coast ---

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Keywords: sand dune scarp control works, sand pack, manual, joint research

1. Joint research

As a deliverable of the joint "Research on Performance Evaluation of Sand Pack Structure for Coastal Protection Works," conducted from 2010 to 2012, Technical Note of NILIM No. 745 " Manual on Performance Evaluation, Construction and Maintenance for Sand Dune Scarp Control Works" was completed.[1)]

This joint research was conducted by the Coast Division of the NILIM and three geotextile manufacturers (Nakada Industrial Co., Ltd., Maeda Kosen Co., Ltd., and Mitsui Kagaku Sanshi). In the research, hydraulic model tests, full-scale tests and material tests were conducted, and field tests were conducted along the Hamaju Coast, Miyazaki Coast, etc.

On July 2, 2013, a reporting session was held at the Tsukuba Center for Institutes, which was attended by 92 persons from governments, universities, construction consultant companies, construction material manufacturers, etc.

2. Sand dune scarp control works and sand packs

Sand dune scarp control works consist of sand packs (sand pack structure) and beach fills (Figure). Using sand packs and beach nourishment to prevent erosion at the foot of sand dune scarps, which causes sand dune scarps to retreat, will control the retreat of sand dune scarps. For sand packs, local beach material and beach nourishment material are used as fill material, which results in faster construction work than concrete revetment work. Since the height of the top of sand packs used for sand dune scarp control works is as low as berm height, they are covered with sand under normal conditions, forming a landscape fit for the sandy beach (Photo 1).

Sand packs were fully adopted for the first time in Japan as buried shore protection works in the Oida District, Miyazaki Coast (Photo 2).

[Reference]

1) Technical Note of NILIM No.745 pp. I-1-1 - II-4-149
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0745.htm

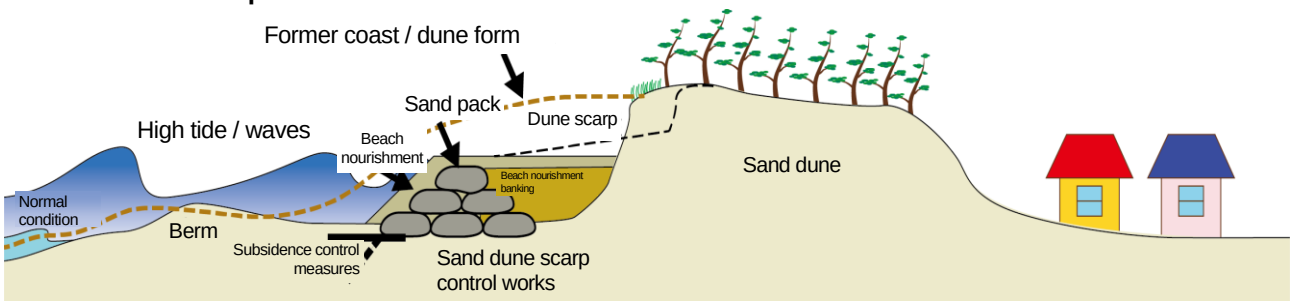

Figure: Sand Dune Scarp Control Works

Photo 1: Sand Dune Scarp Control Works Fit for Sand Beach (Hamaju Coast)

Photo 2: Sand Dune Scarp Control Works Adopted or Miyazaki Coast

Stability Review Procedure for Artificial Reef Armored Blocks --- First Step to Revising the "Artificial Reef Design Guide" ---

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Keywords: revision of artificial reef guide, armoring material stability test, performance assessment

1. What is an artificial reef?

Sea waves can be expressed as a sine wave in the offshore but become non-linear in shallow water and ultimately break. Since wave breaking converts the wave energy into various forms, wave energy and wave height decrease. Using this phenomenon, an artificial reef is constructed as a mound structure submerged farther out than the point where waves normally break in order to break waves and decrease (absorb) the energy of the waves that reach the protected area. (Photo 1). An artificial reef features an armored mound for structural stability and a wide crown to raise the efficiency of wave attenuation. It was developed in Japan in the 1980's and has been used since then, but less used outside Japan.

2. Background of revision

The "Artificial Reef Design Guide" was first issued in March 1992 and revised in March 2004, mainly to stipulate standard performance and expand the weight calculating method. As of 2004, 956 artificial reefs, totaling 143 km, had been constructed. This number increased to 1287 reefs totaling 175 km in fiscal 2013. During this period, there was also technical development, including a shift from offshore breakwaters to artificial reefs, and the emergence of different types of blocks (e.g. armored blocks of high stability and blocks with wave absorbing features).

Nonetheless, there are unresolved issues remaining, including no general method for selecting armored blocks or concepts on performance setting. To provide a reasonable selection method, it would be helpful to standardize performance assessment procedure and indication method (how to indicate performance values, damage condition, etc.) for each block brand, while to enable performance setting, techniques for evaluating the effect of erosion control measures are advised in particular.

Therefore, the Coast Division decided to prepare a "Stability Review Procedure for Artificial Reef Armored Blocks" and "Application Assessment Manual for Artificial Reefs with Topographical Changes," as core components of the second revisions to "Artificial Reef Design Guide."

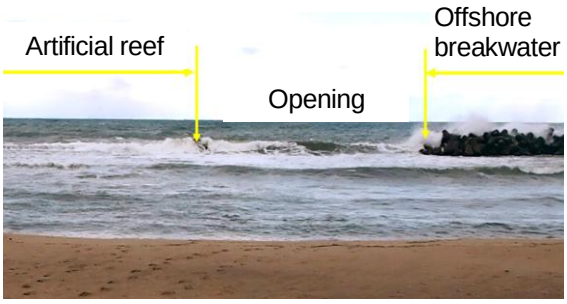

Photo 1: Wave Absorption by Artificial Reef (Kaike Coast)

3. Characteristics of "Stability Review Procedure for Artificial Reef Armored Blocks"

The key revisions to this procedure include standardized test conditions in order to facilitate performance comparisons among blocks, standardized review determinations, tests simulating site conditions, and the utilization of numerical calculation as support or substitution for empirical tests. A particular note in the review determination is that the causes of scattered blocks when hit by irregular waves and the end state of scattered chains will be checked also.

We plan to exchange opinions with block manufacturers in the course of formulating the procedure, and release the procedure in the summer of 2014.

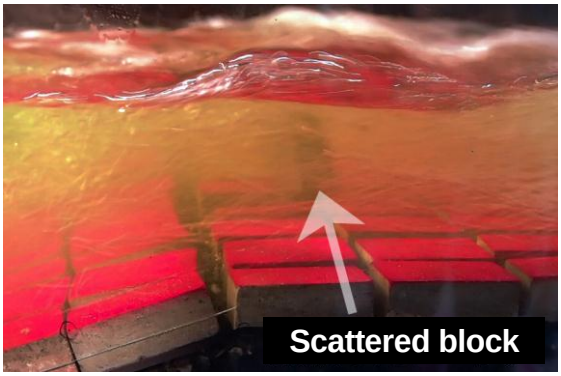

Photo 2: Test for Investigating Causes of Block Scattering

[Reference]

"Artificial Reef Design Guide" (revised version), 2004, supervised by Coast Division, River Bureau, MLIT and Coast Division, NILIM.

Topics

Disaster Investigation and Utilization of Results by the River Department

SUGIHARA Naoki, Research Coordinator for Integrated Water Disaster Management
River Department
HATTORI Atsushi, Head; FUKUSHIMA Masaki, Senior Researcher; MORI Hirotoshi, Senior Researcher; FUKUHARA Naoki, Researcher
River Division, River Department

Keyword: disaster investigation

1. Introduction

The River Department of NILIM conducts disaster investigations upon request for technical support from river administrators, and gives advice on emergency measures, restoration methods considering the cause of disaster, subsequent river channel design, and infrastructure design. This year, we dispatched personnel to the river areas listed in the table below where large-scale flooding or heavy rains caused damage to river management infrastructure.

2. New findings obtained from this year's investigations and countermeasures

In the Arakawa River of the Arakawa River System that flows through Metropolitan Tokyo and Saitama Prefecture, the cumulative rainfall reached a 10-year-high in early April during as a result of an hourly rainfall of approx. 25 mm/hr. As a result, slope slides occurred along river levees soon after completion and caused damage, including the outflow of sediment to the municipal road, buildings, etc. Also, in the Shonai River of the Shonai River System in Aichi Prefecture, a concentrated rainfall of approx. 89 mm/hr caused slope slides along the levee soon after completion and sediment outflowed to the municipal road.

The on-site investigation found that the main causes of damage were localized infiltration of rainwater into a steep slope where the topsoil was different from the levee body in terms of construction time and material, and a particularly weak slope since the river levee had recently been constructed.

In response to the findings above, we organized matters to consider in "design," "construction planning," "construction" and "after completion" into a method for preventing recurrence. This included considerations of a gentle slope, water drainage to avoid a concentration of rainwater and management of cover soil by compacting it similar to the levee body. This method was disseminated to the river administrators of the MLIT.

3. Utilization of investigation results

Investigation results and findings are organized as a report promptly after an investigation and are shared with river administrators of the MLIT via a database of damage information. In addition, findings are accumulated in the same database and used as a basis for updating technical criteria and guidelines, and are consequently utilized for preventing the recurrence of disaster, upgrading design, management, etc.

Table: Main Rivers in 2013 Disaster Investigations

Date of disaster	Date of investigation	Number of damaged locations	Municipalities	River system / River name	Damage form
Apr. 7	Apr. 8	3	Adachi-ku, Tokyo Kawaguchi-shi, Saitama Toda-shi, Saitama	Arakawa River System / Arakawa River	Slope slide in river levee
Jul. 8	Aug. 6	1	Yuzawa-shi, Akita	Omonogawa River System / Omono River	Cave-in of flood channel, subsidence of bed protection, etc.
Jul. 13	Jul. 31	3	Yurihonjo-shi, Akita	Koyoshi River System / Koyoshi River	Slope slide in river levee, sand boiling from foundation ground
Jul. 29	Aug. 12 Jan. 17	1	Komatsu-shi, Ishikawa	Kakehashi River System / Kakehashi River	Slope slide in river levee, sand boiling from foundation ground
Sep. 4	Sep. 10	1	Kanie-cho, Aichi	Shonai River System / Shonai River	Slope slide in river levee
Sep. 16	Sep. 24 Nov. 19	1	Fukuchiyama-shi, Kyoto	Yura River System / Yura River	Collapse of river levee, water leakage from foundation ground
Nov. 4	Nov. 20	1	Ichikawa-shi, Chiba	Tone River System / Edo River	Slope slide in river levee
Nov. 13		1			

* Red cells: Damage caused by rainfall

Topics

Support for Development of the Personnel of Regional Development Bureaus Who Engage in Advanced Measures for Sediment-related Disasters

UCHIDA Taro, Senior Researcher; KANBARA Junichi, Head; KAMIYAMA Joko, Researcher
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Keywords: sediment-related disasters, Sediment-related Disaster Prevention Law, emergency investigation

1. Start of a human resource development support program

In accordance with revisions to the Sediment-related Disaster Prevention Law, etc., the roles played in crisis management and early restoration of damaged areas in the case of a large-scale sediment-related disaster by the personnel of Regional Development Bureaus are increasing. NILIM, with the cooperation of the Public Works Research Institute, started in fiscal 2013 a human resource development support program with an advanced and practical menu for the personnel of Regional Development Bureaus who are familiar with their local circumstances. The purpose of this program is to have them acquire, through concurrent service for their Regional Development Bureau and NILIM, advanced skills in emergency investigation, etc. required by the Sediment-related Disaster Prevention Law in the case of sediment-related disaster, such as landslide dam formation or volcano eruption.

2. Contents and results of the program

During fiscal 2013, the program was held in July and November in the NILIM office for one week each time. The contents included (i) discussions about the points and considerations for advanced technical guidance to be provided to local governments, etc. in the case of a sediment-related disaster, (ii) exercises in the latest information and techniques concerning emergency investigation, emergency measures, etc., and (iii) analyses and discussions of issues and solutions for each Regional Development Bureau regarding emergency investigations / measures.

In addition, on-site exercise were conducted on August 28 and 29 from a site-oriented approach in areas that suffered serious sediment-related disasters including landslide dam formulation by the 2008 Iwate-Miyagi Nairiku Earthquake. The two days involved (i) inspections of the conditions after the collapse of a landslide dam, (ii) inspections of emergency measures execution, (iii) practical measurement training in irradiating lasers from a helicopter to an area of blocked river channel, and (iv) an exchange of opinions with the personnel of the Regional Development Bureau and local governments about the actions taken in the event of disaster, future issues, etc.

Furthermore, they joined actual technical support activities of damaged prefectures, including efforts for the sediment-related disaster caused by Typhoon No. 18 in Fukui, to acquire practical skills as a professional in sediment-related disasters (Photo 2).

In addition, the personnel of Regional Development Bureaus who participated in this program took the initiative to develop, as deliverables of the fiscal 2013 program, a (1) practical manual on laser measurement from a helicopter in emergency investigations, (2) landslide dam flood simulation manual for the personnel of Regional Development Bureaus, (3) method for setting conditions of natural dams in emergency investigation training, and (4) list of the construction methods selected as emergency measures to address river channel blockage.

Photo 1: Exercise with Flume Experiment concerning Landslide Dam Breach and Countermeasures

Photo 2: Disaster Investigation in Fukui

Addressing Flood Damage Reduction under the Global Climate Change Using Imagination and Organizing Technique to the Fullest Extent

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Keywords: global climate change, flood damage reduction measures, flood risk

1. Measures considering the global climate change are no-regret measures

When developing flood damage reduction measures to prepare for an increase in the scale and frequency of heavy rains that may be caused by global climate change, it is essential not only to prevent the occurrence of flood disasters but also to minimize damage to the extent possible. Systematic development of flood damage reduction measures requires avoidance of several potential pitfalls.

First, take steps to avoid over- or under-estimation of future flood possibilities. These estimates are based on the results of climate change simulations; both carelessness and optimism can skew the estimates.

Furthermore, when evaluating the effect of measures to compare multiple alternatives for countermeasures, attention should be paid to avoiding "insufficient consideration," e.g., failure to identify positive effects expected to mitigate disaster, and "insufficient caution," e.g., failure to identify serious risk without recognizing negative effects.

For example, imagine that we look back upon the aforementioned study of measures at a certain point of time in the future. We may regret it if we commit any of the aforementioned mistakes. We should use such imagination constantly and examine measures so that we can make the best efforts.

2. Organize and grasp various cases that could occur

As an effective approach to examine flood damage reduction measures, we are studying a flood risk analysis method that utilizes the relationship between the magnitude of flood damage and the scale of the flood, as shown in figure. In calculating the direct damage in the whole basin, as indicated on the vertical axis, the position and the number of points at which levee breach could occur is set based on the relationship between the flood water level and the height of the levee. The number of breach points is not limited to one, as all possible combinations of levee breach points are listed. The figure shows the maximum, minimum, and average values of damage in all these potential cases. In calculating the damage, the scale of flooding was set to range from a flood that just exceeds the present discharge capacity up to a large-scale flood with the annual probability of occurrence of 1/500.

When the results of such calculation are organized, as shown in the figure, it is possible to grasp the increasing tendency to damage according to the increase in flood scale (drastic increase in damage, reaching a limit, etc.). It is also possible to grasp the positive and negative effects of countermeasures from the changes in maximum, minimum, and average values.

3. Suggest proper measures depending on the flood damage change tendency

The figure also shows an example of an assumptive calculation for raising the levee height in the upstream, not considering the basic theory of flood control, i.e., raising the levee from the downstream. The negative effect is clearly visible, i.e., it brings mostly a decrease in the minimum value, brings an equivalent or an increase in the average value, and brings an increase in the maximum value.

Other indexes, such as death toll, could be examined on the vertical axis. It is also important to examine the increase or decrease in damage in each local area, as well as the whole basin. We are compiling a systematic approach to examine these “no-regrets measures.”

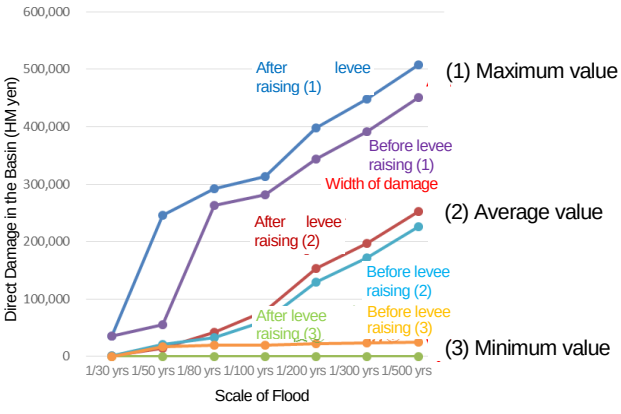

Figure: Example of Flood Risk Calculation

[Reference]

Climate Change Adaptation Research Group: Interim Report on Climate Change Adaptation Studies, Technical Note of NILIM, No.749, 2013.

Construction of a Sound Water Cycle in River Basins

-- Efforts for Proper Use and Conservation of Ground Water --

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Keywords: water cycle, ground water, ground water management, local government, flow analysis, field survey

1. Introduction

In view of the forecasted increase in draught risk due to climate change, the rise in water demand due to the global increase in population, and intensifying competition in the water business, attention is being paid to "sound water cycles" to keep in place the roles of water in human activities and environmental conservation.

Amongst the various factors that play into a water cycle, concern is being raised about uncontrolled development of ground water since it is characterized as private rights incidental to land and not well managed as river water. In addition, since ground water is a good and inexpensive water resource as seen in the recent increase in preference for mineral water, efforts are required to ensure proper use and conservation of ground water.

2. Ground water management

Ground water is generally characterized by good quality, little change in water temperature and no need for large storage, intake or supply facilities owing to intake from wells. Japan has many alluvial plains and fans where gravel layers containing much ground water have developed, so ground water has been widely used since ancient times and supported the life of people.

Meanwhile, there has not been great progress in the management of ground water because there are two opposing concepts, i.e., the "concept of water as a public resource," which would require that ground water be regulated by public law since it constitutes the foundation of the environmental function of land including surrounding areas, and the "concept of water as a private asset," by which ground water belongs to private property since the land owner may construct a well to use water for private purposes.

In recent years, however, in view of the necessity to prevent uncontrolled development of ground water and promote sustainable use of ground water, in the municipalities where ground water use is advanced, such as Kumamoto City (Kumamoto Pref.) and Ono City (Fukui Pref.), recognition of ground water as public property is being developed through continued environmental education and information dissemination. And, ground water management has been strengthened and/or upgraded.

3. Outline of the study

(1) Field survey on ground water management and systematic organization of advanced cases

Using questionnaire surveys for prefectures and municipalities, we want to grasp the status of ground water management in the country and identify issues, and examine measures for strengthening / upgrading ground water management for the areas where ground water management is advanced, such as Kumamoto City and Ono city. We intend to organize and summarize methods and concepts of ground water management systematically as reference for other local governments.

(2) Cross-sectional organization of the cases of ground water flow analysis

Ground water flow analysis is an important tool that visually clarifies, as shown in the table below, the ground water flow characteristics of the relevant region based on surface water and ground water flow models, and serves as basic information for the governance of ground water, including hydrologic processes such as rainfall and surface runoff, underground penetration, flow of ground water into rivers, leakage of river water into the underground, and pumping. However, the accuracy of the analysis is low due to insufficient data on the pumping discharge of ground water, nature of the soil, etc. It is, therefore, necessary to take into account such inaccuracies in order to properly handle analysis results. For these reasons, we intend to collect data on the cases of ground water flow analysis conducted by MLIT across the country and cross-sectionally organize the accuracy etc.

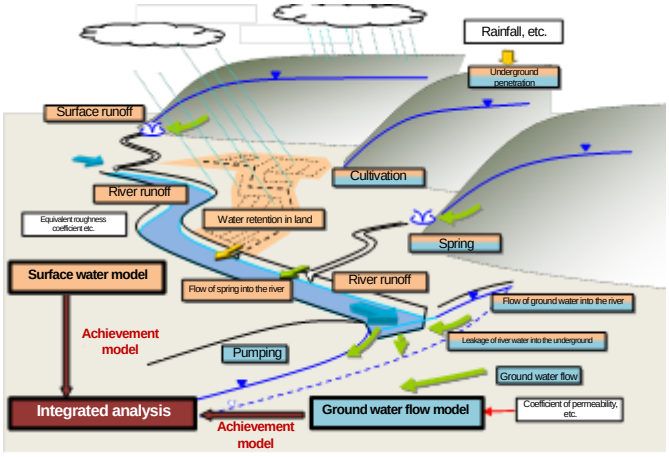

Figure: Conceptual Diagram of Ground Water Flow Analysis

Efficient Inundation Countermeasures According to Regional Characteristics

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Keywords: heavy rain, inundation countermeasure, regional characteristics

1. Introduction

In recent years, many regions of Japan have been hit frequently by heavy rain with an hourly precipitation of 50 mm or more, or by concentrated heavy rain in a short period of time such as 10 minutes. As the frequency of heavy rains is increasing, concern is also increasing over the decline in stormwater penetration due to the progress of urbanization, as well as the increase in inundation damage potential due to the development of underground space use. Cities need to advance urban stormwater management measures efficiently and effectively within their limited financial resources. In order to support inundation countermeasures according to regional characteristics, NILIM has organized various characteristics, including inundation damage and the development of storm sewers, according to the size of cities.

2. Damage by inner water inundation and development of storm sewers

An "inner water inundation" is a state wherein heavy stormwater that falls on an urban area or farmland cannot be drained into drainage facilities (sewerage, etc.) or public waters, and inundates buildings, land, and roads. From the inundation statistics [1)] of 2001 to 2009, we identified damage data for cases where no less than 50 structures were inundated by inner water inundations above or below the floor level ("inner water inundation damage"). We then organized the numbers of such cases according to the population of the municipalities in which they occurred. In addition, using the storm sewer development area (FY2010) survey conducted by the MLIT, we calculated the ratio of developed area to the total area where storm sewers are planned ("ratio of storm sewer development"). The results of the calculation are indicated in the figure. In small-and-medium-size cities (population of less than 300,000), the ratio of storm sewer development is smaller than that in big cities (population of not less than 300,000), but the number of cases of inner water inundation damage is small. In big cities where a decline in stormwater storage penetration is marked due to the progress of urbanization, area-wide development of storm sewers—including branch lines—is required. In small-and-medium-size cities where a certain level of stormwater storage penetration is expected, the development of branch lines is not necessarily required, therefore the selection and concentration of target areas should be ensured. As a result of analyzing the development of storm sewers from FY2008-2010, for which a detailed explanation is omitted, it was found that big cities are promoting area-wide development of main and branch lines, while small-and-medium-size cities are promoting development focused on main lines. The characteristics of storm sewer development in big cities and small-and-medium-size cities are summarized in the table below.

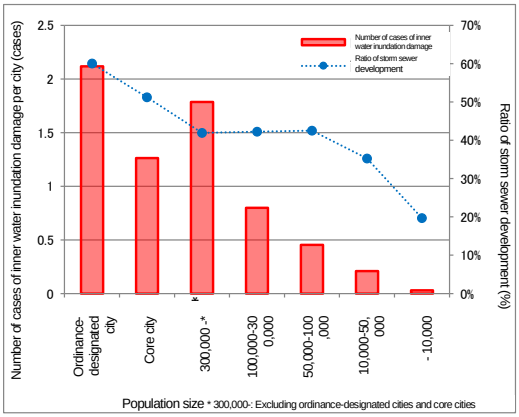

Figure: Number of Cases of Inner Water Inundation Damage and Ratio of Storm Sewer Development by Population Size

Table: Characteristics of Storm Sewer Development by Population Size

	Big city (Population of not less than 300,000)	Small-and-medium-size city (Population of less than 300,000)
Townscape	Many urbanized areas are formed in area.	Town is formed around the terminal station (heavily built-up areas are limited).
Trend of development	Development of main / branch lines in area	Concentrated on main lines (More selective / concentrated development than big cities)
Inner water inundation damage	Much	Little
Ratio of storm sewer development	High (51.1%)	Low (34.9%)
Necessity for structural measure development	Development including branch lines is necessary.	It is necessary to examine necessity for branch line development while advancing monitoring and non-structural measures (selection and concentration).

3. Inundation countermeasures in cooperation with other (non-sewerage) projects

In order to promote efficient inundation countermeasures in cooperation with non-sewerage projects, we are collecting and organizing examples of cases of such cooperation, including: effective use of stormwater reservoirs for inundation control in rivers; improvement of stormwater storage penetration using parks, schools, space under elevated roads, and farmland; support systems for development of stormwater storage penetration facilities in development activities; and others. In relation to this cooperation policy, we are going to evaluate their implementation methods and direct solutions alongside regional characteristics such as municipality population, urban area, suburban area, etc.

[Reference]

1) Inundation Statistics, 2001-2009, MLIT

Improving sustainable maintenance methods considering risk management

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Construction System Division, Research Center for Land and Construction Management

(Key words) Maintenance, risk management, sustainability

1. Introduction

Japan's public capital stock was created concentrated in the high-speed economic growth period, and it is predicted that the problem of deterioration will become serious in the medium to long term. Thus, in recent years, service-lifetime extension plans have been enacted in various fields of public capital. It is predicted that when service-lifetime extension plans have been executed as part of maintenance work in the future, a serious challenge will be whether the PDCA cycle of work will be effortlessly sustained without facing excessive risk. At the NILIM, we have responded to awareness of such problems by conducting "research on methods of improving sustainability of maintenance incorporating the perspective of risk management" for 2 years beginning in 2014. And in August 2013, the in-house Stock Management Research Committee (Chairman: Executive Director for Research Affairs, members are representatives of various research departments) began preparing for research to begin in the next fiscal year.

2. Outline of research scheduled to start in FY2014

Since FY2006, this Research Committee has clarified the degree to which methods of conducting maintenance in the fields of inspections, soundness evaluations, predicting progress of deterioration, countermeasures, data base construction, clarification of management goals, etc. have been physically provided in all fields of public capital. Research since 2014, has proposed evaluation methods for each management body to self-inspect effective ways of performing maintenance work in addition to the evaluation axis to answer the question: do these function effectively from the perspective of appropriate risk management or sustainability.

3. State of study by the Stock Management Research Committee

The Research Committee has had research departments in the NILIM report on the present state of maintenance in various public capital fields (sewage systems, river structures, road structures, dams and sediment control facilities, airports and ports, cities and housing, etc.) and has conducted discussions to abstract problems concerning the PDCA cycle of maintenance (sustainability and risk management). In this way, concerning present methods of inspecting or evaluating soundness for example, it is difficult to cover the entire fields managed, and fear that it could obstruct the PDCA cycle have appeared. And even regarding inspection and soundness evaluation methods, a disagreement has appeared concerning the point that concepts concerning improving efficiency or introducing new technologies should differ according to characteristics such as whether it is a facility to prevent disasters caused by abnormal weather or external force or is a facility that provides day-to-day services.

4. Future activities

In 2014, based on discussions by the Research Committee, work will begin in earnest. In this way, it will study differences in basic guidelines to maintenance that should essentially be part of each field while clarifying the degree of completeness of technologies applied—characteristics of the objects of management already explained, management body systems, inspections and countermeasures—or the degree of uncertainty. For example, questions such as whether to prioritize service life extension by inspections and repairs, to prioritize response through design such as providing easily-inspected structures, to prioritize restrictions on use or early reconstruction, or to prioritize corrective maintenance. The question of whether or not differences of this kind in basic policies are reflected in actual maintenance work will be verified by comparing fields through case studies and enacting an evaluation axis which should be newly adopted. We want to perform the verification with reference to case studies which include the private sector infrastructure field or the concepts of ISO5500X.

A Case of Utilizing Results

Creation of Visual Inspection Criteria for Deterioration of PVC Pipes

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Wastewater System Division, Water Quality Control Department

Keywords: sewer, maintenance guideline, PVC pipe, visual inspection criteria

1. Introduction

In recent years, road cave-ins and similar accidents have been frequently seen. To prevent such accidents, the deterioration in sewers should be accurately detected.

Deterioration in sewers is commonly determined in accordance with visual inspection criteria using TV cameras, but these inspection criteria were established mainly for rigid pipes such as reinforced concrete pipes.

It is, therefore, difficult to detect deterioration with the conventional criteria for PVC pipes, which are plastic flexible pipes and account for about 50% of the total length of pipe in the country.

Considering such circumstances, NILIM has established visual inspection criteria (draft) for detecting deterioration in PVC pipes.

2. Preparation of visual inspection criteria for PVC pipes

For sewerage, rigid pipes such as reinforced concrete pipes and earthenware pipes, and plastic flexible pipes such as PVC pipes are mainly used. These two types of piping are greatly different in structure and material, so their characteristics of deterioration are also different. For example, reinforced concrete pipes are very strong but are susceptible to changes in material properties, while PVC pipes are not susceptible to such property changes but are susceptible to changes in shape.

Accordingly, NILIM collected and analyzed TV camera survey data from local governments in order to identify the deterioration characteristics unique to PVC pipes and create visual inspection criteria for deterioration, and conducted TV camera surveys of PVC pipes laid more than 30 years ago, and load-proof performance tests and two-dimensional nonlinear static analyses (CAE) of deteriorated PVC pipes.

Consequently, as deterioration characteristics of PVC pipe, the presence of overall section change (Photo 1) and local section change (Photo 2), and the relationship between cracking and load bearing capacity were clarified. Based on these findings, we added the flatness and deformation of PVC pipes to visual inspection criteria, and clearly positioned the inspection criteria for cracks, etc. (Table).

Photo 1: Example of Flatness

Photo 2: Example of Deformation

3. Conclusion

The Japan Sewage Works Association is revising the Sewerage Maintenance Guideline, to which the visual inspection criteria for PVC pipes, created by NILIM, will be added.

Table: Visual Inspection Criteria (Extract)

	Rank		a	b	c
	Item	Operation			
Inspection for each pipe	Damage and axial crack to pipe	Reinforced concrete pipe	Lack Axial crack 5 mm or more in width	Axial crack 2 mm or more in width	Axial crack less than 2 mm in width
		Earthenware pipe	Lack Axial crack at least one-half of the pipe length	Axial crack less than one-half of the pipe length	-
		PVC pipe	Map crack Axial crack	-	-
	Flatness	PVC pipe	Flat with flexibility factor of 15% or more	Flat with flexibility factor of 5% or more	-
	Deformation (Projecting inward)	PVC pipe	Whitened or projecting inward less than 10% of the inner diameter of the pipe	Projecting inward less than 10% of the inner diameter of the pipe	-

Empirical Studies of B-DASH Project (Sewer Management System Technology)

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Keywords: B-DASH, sewer management system, screening survey

1. Introduction

In order to prevent road cave-ins and similar disasters resulting from damage to sewers, and to extend the life of sewers, efforts are being made to implement systematic inspections and surveys. However, it is difficult to deal with an enormous amount of sewer stock under the severe financial condition of local governments and the daily working volume in the current TV camera survey. It is, therefore, strongly required to develop an efficient survey method by combining various existing sewer inspection technologies.

2. Breakthrough by Dynamic Approach in Sewerage High Technology Project (B-DASH Project)

MLIT started the Dynamic Approach in Sewerage High Technology (B-DASH) Project in fiscal 2011. In fiscal 2013, in order to reduce maintenance costs and improve the ratio of inspections and surveys conducted, a research agreement on validating sewerage management technology was executed with 3 joint research organizations.

3. Outline of the sewer management system technology

(1) In-pipe camera inspection, wide-angle view camera survey, and profiling technology

This technology is for in-depth study using a wide-angle camera and path shape profiling system after screening sewers with major abnormality using an in-pipe camera and a conductance meter. (Kansei Kogyo Co., Ltd., Nissui Con and Hachioji City Joint Research Organization)

Figure 1: In-Pipe Camera

(2) Wide-angle camera survey and shock elastic wave inspection technology

This technology screens sewers with major abnormality using a wide-angle camera capable of detecting the in-pipe condition efficiently only with direct-view driving mode, and then examines the detected sewers to calculate the load bearing capacity of pipes by shock elastic wave inspection method and determine control measures. (Joint Research Organization of Sekisui Chemical Co., Ltd., Urban Infrastructure Technology Center Foundation, Kawachi-Nagano City and Osaka Sayama City)

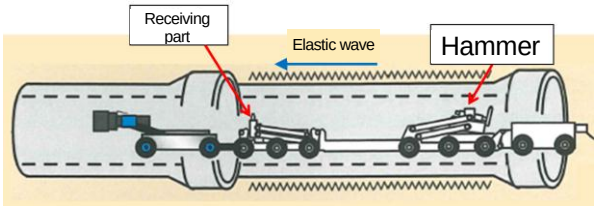

Figure 2: Image of Shock Elastic Wave Inspection Method

(3) Advanced image recognition technology

This technology contributes to labor-savings and efficiency improvement in surveys by using a power-loaded self-propelled TV camera capable of spherical imaging without stopping, learning-type automatic defect detection, and defect detection by laser projection. (Joint research organization of Japan Sewage Works Agency, NEC Corp., and Funabashi City)

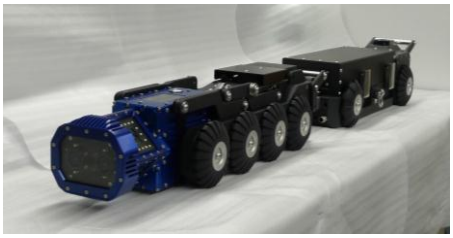

Figure 3: TV Camera with Advanced Image Recognition Technology

4. Utilization of findings from empirical studies

NILIM clarified the efficiency and required performance of surveys done with each of the aforementioned three technologies by comparing daily progress, survey costs, detectable defect items, accuracy, scope of application, applicable conditions, etc. with conventional survey methods. In the future, we plan to formulate guidelines (draft) for efficient surveying of sewers using these 3 technologies, which we hope will serve as a reference for local governments, survey companies, and equipment manufacturers.

[Reference]

http://www.nilim.go.jp/lab/ebg/index.htm

Upgrading Inspection and Management Methods for River Management Facilities

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Keywords: river levee, maintenance, inspection, patrol

1. Background

Of the 10,216 river management facilities (dams, water gates, sluices, sluice pipes, etc.) in the rivers administered by the country, as many as 3,765 facilities were constructed more than 40 years ago. The number of such old facilities is expected to continue to increase and deterioration is anticipated to accelerate in many of them.

The river administrators are monitoring the condition of river management facilities by conventionally conducting "inspections" (1 or 2 times a year), in-depth visual observations on foot, and "patrols" (comprehensive visual inspections 1 or 2 times a week, mainly from a car). They have maintained the functions of river management facilities and ensured flood control safety by detecting deformations as a sign of early damage and repairing facilities as required.

In the future, the number of deformations that will be detected is expected to increase in accordance with the increase in deteriorating river management facilities. Accordingly, efforts and time required for maintenance will also increase and, under the present maintenance system, functional maintenance of river management facilities may become difficult. Therefore, it is necessary to review the present inspection and patrol methods in the interest of upgrading the maintenance of river management facilities.

2. Technical perspectives

Conventionally, river administrators have conducted maintenance by monitoring the condition of facilities but on1y sporadically applied new technologies in order to rationalize their maintenance methods. They have not steadily studied enough to make continuous improvements based on actual condition using accumulated data on deformations and repairs.

In view of such circumstances, the MLIT started building a river maintenance database to record the places, types, scales, etc. of deformations found through inspections and patrols. With this database, the data that was previously managed separately by each river administrator will be collected and placed under integrated control. Taking this opportunity, maintenance of river management facilities should be streamlined by analyzing and evaluating this vast amount of data and incorporating results into site inspections and patrols.

For example, one possibility is to construct a PCDA cycle to streamline maintenance by first identifying locations susceptible to deformation from the deformation history and characteristics of river management facilities. Then, by strengthening the inspection and patrol and grasping the type and scale of deformation that is likely to degrade the flood control safety of river levees and so forth, it should be easier to determine whether repair is required or not.

3. State of study for upgrade

As part of the study for upgrading the maintenance of river management facilities, we are collecting data obtained from the inspection and patrol of river levees in five rivers to analyze and evaluate the status of those studies. As a result, so-far unknown characteristics of inspections and patrols have begun to become clear. For example, the number of deformations found by one administrator in one day is about 150 times those found in a patrol, although there are variations according to river.

Moreover, we have just begun to quantitatively evaluate as well the decrease in flood control safety of levees caused by deformation. It was found from this evaluation that once a crack occurs in a river levee, the safety factor for sliding decreases about 10 to 20% as compared with a case of no deformation, although it depends on the location of the crack and the nature of the soil of the levee.

Note that, to identify locations susceptible to deformation from the deformation history and characteristics of river management facilities, we are using a statistical processing method that has remarkably advanced in recent years, but we are still working on it.

We will continue to study and would like to upgrade maintenance by searching for desirable methods of inspections and patrols, in order to prepare against the accelerating deterioration of river management facilities.

Research Trends and Results

Upgrading Maintenance Technology to Support Dam's Long Life

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Keywords: support dam's long life, maintenance, comprehensive dam inspection, database

1. Introduction

Dams have the functions of flood control, water utilization, etc. and constitute important social capital. Many dams have been constructed to date in Japan. The MLIT controls about 120 dams at present, and started managing about 10% of them more than 50 years ago and about 50% more than 30 years ago. For the dams under the control of the MLIT, a "Comprehensive Dam Inspection Guidelines" [1] was established in 2013 in order to promote more effective and efficient maintenance on a long-term perspective. Based on this procedure, each dam is subject to comprehensive inspection at an interval of about 30 years and the support plan for dam's long life are being formulated.

Given the situation, it is desirable to upgrade maintenance technology in order to maintain the safety and functions of dams for a long time.

2. Efforts to upgrade dam maintenance technology

In order to maintain the required functions of dams under the direct control of the MLIT, daily inspections have been conducted by dam administrators and periodic surveillance have been conducted by professionals in principle every 3 years, in accordance with the inspection and maintenance requirements provided for in operating rules, etc. of each dam. Based on the results of these inspections, dams have been maintained in place with repairs as required. Information concerning maintenance including inspection, measurement, and repair histories has been accumulated by each dam administrator in the form of paper data or electronic information.

In order to upgrade dam maintenance technology, it is necessary to detect the age-related deterioration characteristics of dam structures and establish soundness evaluation methods. In order to study these issues, it is necessary to organize the accumulated management data on each dam into a database of unified format that would facilitate comparisons of the electronic data. Moreover, sharing the integrated database among dam administrators will enable the examination of facility repair and replacement from a broad perspective with reference to cases of other dams. (See figure.)

Therefore, the Large-scale Hydraulic Structure Division is working to create a dam maintenance database. Data on each dam will be registered in this database. We have built a prototype system in which collected dam data owned by MLIT have been registered. Registration items are as follows.

Registration data: (i) Basic information (specifications and basic drawing of the dam), (ii) Observation data (history of earthquakes, floods, etc.), (iii) Inspection data (daily inspections, extraordinary inspections, various measurement values, etc.), (iv) Surveillance results, (v) Repair / Replacement information, (vi) Maintenance plans.

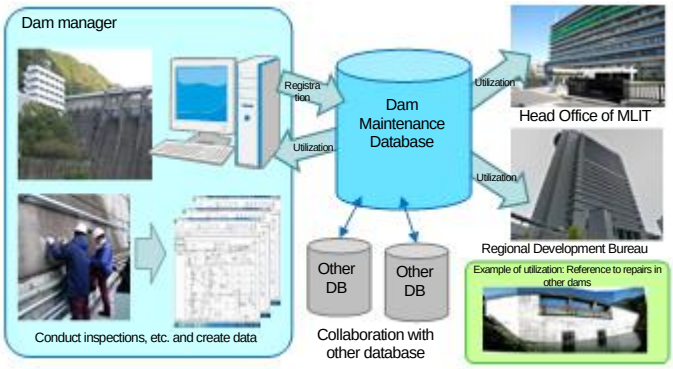

Figure: Image of Dam Maintenance Database Utilization

3. Future schedule

We will take the opinions of dam administrators about the database, and plan to improve the convenience of the database system. Furthermore, through comparative studies and trend analyses using various management data that we have registered in the database, we will continue to clarify the age-related deterioration characteristics and examine soundness evaluation methods for dam structures.

[Reference]

1) River Environment Division, Water and Disaster Management Bureau, MLIT: "Comprehensive Dam Inspection Guidelines / Commentary", October 2013

New Developments in Coastal Management
--- Introducing the Concept of Disaster Mitigation and Preventive Maintenance ---

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Keywords: coast, disaster mitigation, maintenance

1. Proposals released by Coastal Management Review Committee

From October 4 to December 16, 2013, the Coastal Management Review Committee, which consists of members from the Rural Development Bureau, the Fisheries Agency of the Ministry of Agriculture, Forestry and Fisheries, and the Water and Disaster Management Bureau and Ports and Harbors Bureau of the Ministry of Land, Infrastructure, Transport and Tourism, met 4 times and released proposals. The committee discussed coastal management for the future since various issues have arisen in coastal areas of Japan since the 1999 revisions to the Seacoast Law, including damage by tsunamis resulting from the 2011 earthquake off the Pacific coast of Tohoku and progressive deterioration in coastal protection infrastructure. In these meetings, the Coast Division supported the executive office in technical matters.

As particularly important subjects, the committee discussed the "clarification of disaster mitigation measures in coastal management" and "improvements to coastal maintenance." This former was a new subject since "disaster mitigation," which is an issue facing coastal protection infrastructure, has never been discussed. The latter subject aims to improve maintenance in coastal areas, which timely responds to the launch of "First year of social capital maintenance."

2. Clarification of disaster mitigation measures in coastal management

The concept of "disaster mitigation," which was newly introduced to coastal management, had been provided by the Central Disaster Prevention Council in view of the damage suffered from the Great East Japan Earthquake. "Coastal dikes of resilient structure" and "green embankments" (Figure) which integrates trees with a dike, were both raised by the Coast Division after the Great East Japan Earthquake and are expected to be effective towards reducing inland flood heights and ensuring evacuation time by delaying dike breaks even in the case of overtopping.

Introducing the concept of "disaster mitigation" requires consideration of land "area", in addition to the conventional concepts of coasts as a "line" and seas as "area." It will, therefore, greatly change the conventional concept of coastal management. In the future, it will be necessary to promote comprehensive measures for disaster prevention / mitigation in coastal areas inclusive of inland areas. This will require collaboration and coordination with municipal evacuations, land utilization planning and other disaster prevention and mitigation measures.

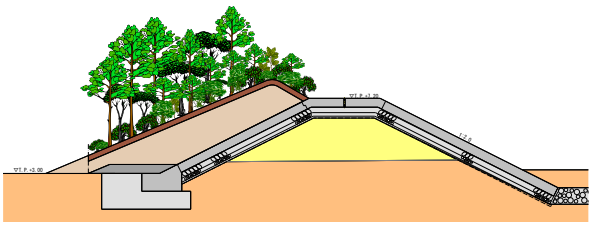

Figure: Trees Integrated with Coastal Dike of Resilient Structure

3. Improvement of coastal maintenance

Coastal protection infrastructure that was constructed more than 50 years ago and is still in use accounts for about 40% of the all infrastructure and rapid deterioration is a related concern. In addition, the inclusion of not only infrastructure but also erosion control measures for beaches will make coastal management complicated.

Since the committee discussed the necessity of preventive management, its importance was also recognized for coastal areas managed mainly by prefectures. However, since budgets and human resources are limited, the need to strengthen cooperation with private-sector organizations in developing activities in municipalities or coastal areas was also discussed. It was, therefore, made clear that the trend in coastal management is to include local residents without leaving everything to governments.

4. Other

In addition to the aforementioned two subjects, the committee discussed erosion control measures for beaches, conservation of Okinotorishima Island, and measures for adapting to global warming. In the near future, systems will be developed so that coastal management may be performed in accordance with the contents released by the committee.

[Reference]

Material on the Coastal Management Review Committee
http://www.mlit.go.jp/river/shinngikai_blog/kaigankanrinoarikata/index.html

A Case of Utilizing Results

Reference documents concerning periodic inspections of road bridges (2013 edition) —Bridge Damage Case Photo Collection—

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(Key words) Road bridge, maintenance, periodic inspections, damage case

1. Introduction

The percentage of Japan's huge stock of road bridge assets that has deteriorated is rapidly rising. We have to economically and rationally maintain these assets as we ensure safe and smooth traffic into the future. Therefore, it is important to appropriately clarify and evaluate the present state of bridges and implement systematic maintenance based on the results.

The Bridge Periodic Inspection Rules (Proposed) (March 2004) (below, "2004 Inspection Rules) have been enacted to cover road bridges operated by the national government, stipulating that periodic inspections formerly done at 10 year intervals be carried out every 5 years in the future, and that, in principle, all members be closely examined visually. At this time, in order to be able to evaluate and analyze characteristics of deterioration, in addition to the diagnosis of the soundness of members (deciding countermeasure categories), objective facts about the state of damage (evaluations of the degree of damage) are recorded. At the same time, the NILIM has published a technical report on the state of damage etc. which has been accumulated by past surveys (TECHNICAL NOTE of NILIM, No. 196, December 2004) to support technologists who perform inspections and diagnoses.

Since then, the NILIM has continued by analyzing the results of the 2004 Inspection Rules used nationwide, categorizing forms of damage, hypothesizing causes, and conducting survey research of design standards. And it has conducted studies concerning forms of damage and bridge erection environmental conditions by performing statistical analysis.

This fiscal year, based on knowledge obtained from survey research on deterioration conducted since 2004, technical consultations about defect cases, and technical support, a new collection of damage cases for management personnel to use as reference material has been prepared.

2. Configuration and outline of the Bridge Damage Case Photo Collection

This document organizes damage cases under items (I) to (V) shown in Table 2 for each inspection item in the Inspection Rules (26 types of damage shown in Table 1).

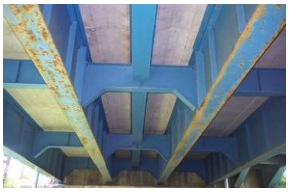
Damage to steel members	Damage to concrete members	Other damage	Common damage
[1] Corrosion [2] Cracking [3] Looseness, and falling [4] Breakage [5] Deterioration of corrosion protection function	[6] Cracks [7] Exfoliation and expose of rebars [8] Leakage or free lime [9] Falling [10] Damage to concrete reinforcing materials [11] Slab cracking [12] Flaking	[13] Abnormal opening [14] Irregularities on road surface [15] Defective paving [16] Obstruction of functions of bearings [17] Others	[18] Abnormal anchors [19] Discoloration and deterioration [20] Leakage and water retention [21] Abnormal noise or vibration [22] Abnormal deflection [23] Deformation or chipping [24] Soil plugging [25] Settlement, movement, leaning [26] Scouring

Table 1. Inspection Items (Types of Damage)

(I) General properties and characteristics of damage It shows photos of cases revealing general properties of damage and its characteristics
(II) Relationship with other damage It shows points which are closely correlated with other damage, and whose data must be carefully recorded.
(III) Evaluation of degree of damage It shows examples (Photo 1) of cases where degree of damage of the damage case was evaluated based on damage evaluation standards.
(IV) Deciding countermeasure category It shows characteristic damage cases and related information, so that it can be used as reference material to decide countermeasure categories
(V) Other reference information It shows information for use as references concerning past specific cases, precautionary items, causes of damage, and change of materials used.

Table 2. Characteristics of the damage cases classified

※Degree of damage is defined at 5 levels: a (no damage) and b, c, d, e (rising degree of damage)



(a) Evaluation of degree of damage [b]

(b) Evaluation of degree of damage [e]

Photo 1. Evaluation of Degrees of Damage (Example of Corrosion)

3. Summary

We are counting on the document being used effectively in the field and to contributing to appropriate diagnosis through inspections and to decision making concerning measures that managers take. In the future, we will continually accumulate and analyze inspection data, and develop comprehensive road bridge service-lifetime extension technologies including establishing, designing, and executing rational maintenance methods based on predictions of deterioration of road bridges.

[Source]

Web page of the Bridge and Structures Division (Entered in TECHNICAL NOTE of NILIM No. 748)

http://www.nilim.go.jp/lab/gcg/index.htm

Initiatives to provide airport pavement etc. inspection support system using smartphones etc.

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(Key words) Airport, pavement, inspection system, smartphone

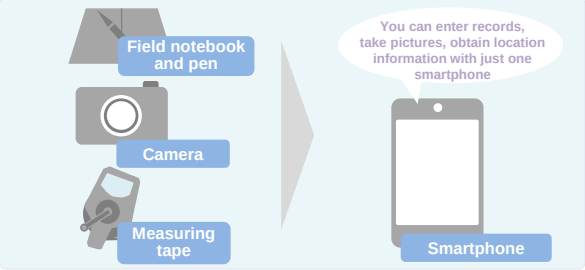
1. Introduction

Airport pavement and other facilities are inspected every day, visually on foot or while driving a vehicle. But preparing inspection records is labor-intensive because the facilities are wide and it is done at night, so it takes time to identify the locations of problems. For this reason, to increase the efficiency of inspections, we are studying the development of an airport pavement etc. inspection support system using smartphones, which have come into wide use in recent years.

2. Image of the airport pavement etc. inspection support system

To inspect facilities, inspectors now carry a field notebook and pen to keep records, a camera to take pictures, and measuring tape to identify locations. A smartphone etc. contains built-in functions to enter records, take pictures, and obtain location information, so an inspector can perform an inspection carrying one smartphone. (Fig. 1)

Figure 1. Equipment Carried for Inspections



This development can lower the costs of introduction because it uses smartphones available on the market. And using a free map data provision service can lower the development cost and maintenance cost.

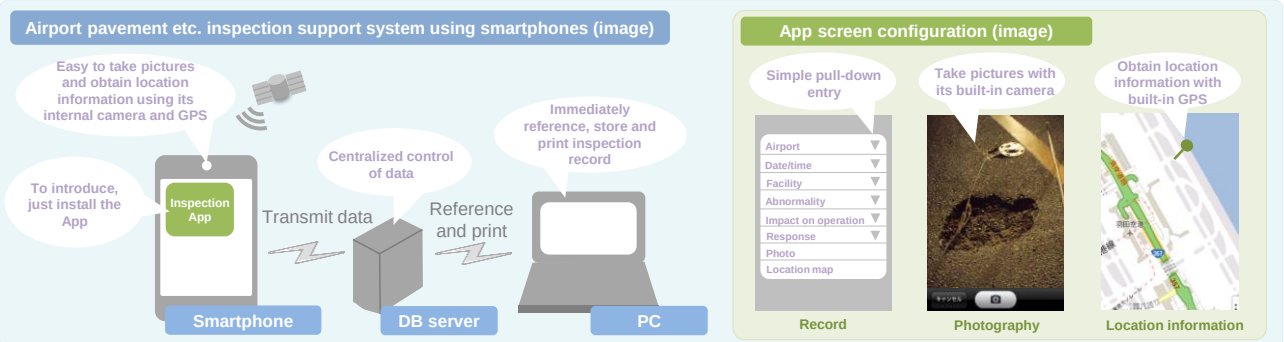
The system can be used by installing the newly developed App into smartphones etc.

At the scene, it must be done during the limited period at night, so to reduce the entry work, recording will be done with a pull-down menu, pictures taken using the built-in camera, and positioning done at the same time using the GPS function. And sending the recorded data to a database server (DB server) using its communication function, will permit the office to immediately clarify the status of an inspection and automatically prepare records in a time series. (Fig. 2) And by storing each airport's data centrally in a database server, users can count on being able to see all data and to perform strategic management using these data.

3. Future initiatives

In the future, we plan to [1] develop the application, [2] study and build the DB server environment, and [3] verify its feasibility by field testing.

Figure 2. Airport Pavement etc. Inspection Support System Using Smartphones (Image)



Topics

Efforts to Establish a JIS Standard for Sewer Pipe Renovation Method

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Keywords: sewer pipe renovation method, JIS standard, life extending measures

1. Introduction

This renovation method installs a new pipe inside an existing pipe in order to secure the load bearing capacity and discharge capacity of deteriorated sewers (Fig. 1). Since it enables renovation without replacing existing pipes, this method is essential for extending the life of pipes. The use of this method has been steadily increasing in recent years (Fig. 2) and similar methods have also been developed.

Since most other methods require that materials delivered to the site as semi-finished products be processed at the site and liner pipes be assembled at the site as finished products, construction should be managed at the site in accordance with specifications prepared for each project and in compliance with control procedures and values. From this viewpoint, the ISO has already established "ISO 11296s Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks." However, this standard is based on design concepts available in Europe and the USA, in which seismic performance and other construction conditions differ from those in Japan, so it is necessary to establish a national standard (JIS standard) based on the construction conditions in Japan.

2. Outline of JIS standard to be established

In establishing a JIS standard, it is necessary for the national government to coordinate between providers (manufacturers and constructors) and users (sewerage service provider) from a neutral position. Therefore, a JIS Standard Review Committee, in which the Wastewater System Division of NILIM serves as the executive office, was established to discuss sewer pipe renovation methods in fiscal 2011 and prepared a draft of a national standard (JIS standard) for renovation methods with consideration for ISO standards, seismic performance, etc. at the end of 2012. The draft provides the required performance and requirements for ensuring quality in the steps of manufacturing liner material and constructing liner pipes for each of the methods for close-fit pipes, cured-in-place pipes, spirally-wound pipes, and assembly pipes. The draft is characterized as an attempt to establish standards, before the ISO, for required performance of assembled pipes, design methods for the thickness of liner pipes, etc., which are not standardized by the ISO, based on the existing standards of organizations [1)] in Japan.

3. Future development

At present, the process to establish the new JIS standard under the joint control of the MLIT and the METI is ongoing, and discussions are being made from the viewpoint of whether the trade barriers stipulated by WTO/TBT are applicable. In fiscal 2014, the plan is to establish the draft as a standard. Establishment of this new JIS standard is expected to promote the efforts of manufacturers and constructors to ensure the quality of pipe renovation methods, as well as overseas development of domestic pipe manufacturers.

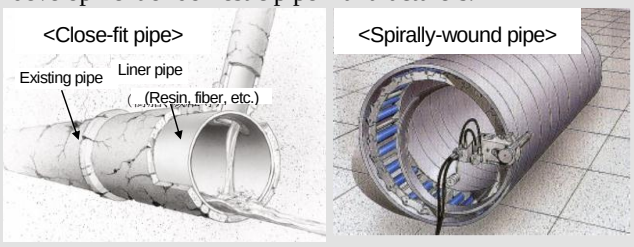

Figure 1: Example of Sewer Pipe Renovation Method

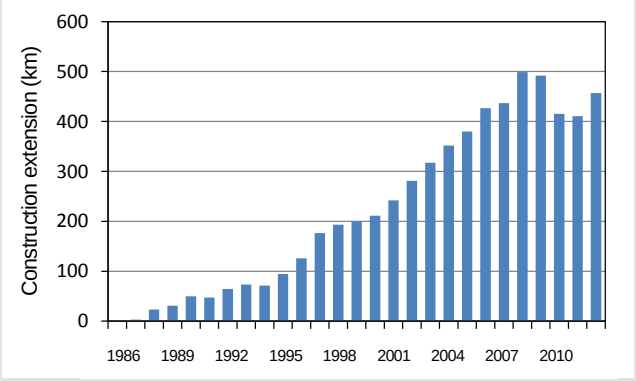

Figure 2: Construction results of Renovation Method by Year [2)]

[Reference]

1) Design and Construction Management Guideline in Sewer Pipe Renovation Method (Draft), Japan Sewage Works Association, Dec., 2011.
2) From material published by the Japan Pipe Rehabilitation Quality Assurance Association.

Topics

Technical Approach to support the Strategic Maintenance of River Structures

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Keywords: River Structure Management Research Task Force, strategic maintenance, collaboration between industry, academia, and government

1. River Structure Management Research Task Force

River management should be conducted according to the characteristics of infrastructure such as river channels, levees, dams, water gates and drainage pump stations. River channels and levees have different characteristics according to sections and locations, and are managed based on experience, while other infrastructure consists of civil engineering works with concrete structure, etc., machinery and equipment, telecommunication infrastructure, etc. and are subject to a series of management protocols, including inspections and repairs, according to the type of infrastructure. In addition, since the safety of individual pieces of infrastructure is correlated with river channels in similar sections, researchers in many fields are needed to study the management of river structures. In order to organize a group of researchers to follow structure management technology suitable for rivers, the River Structure Management Research Task Force (River Structure TF) was established in April 2012, consisting of researchers from the NILIM, the Public Works Research Institute (PWRI), etc.

The River Structure TF is conducting activities with a comprehensive objective, i.e., to further upgrade river maintenance in terms of both technology and management (development), and introduce and establish the most advanced technologies for effective and efficient river maintenance (introduction and establishment).

Figure: Sheet-Pile Revetment Deterioration Survey by River Structure TF

2. Activities in 2013

In order to achieve this objective, three points were established for 2013 as challenging issues for the present, i.e., (i) technical study of deterioration prediction, etc. for various structures, (ii) study of medium-to-long term management technologies for river structures, and (iii) advice for practical activities and administration.

For (i), the River Structure TF proceeded with a study to improve the efficiency of present visual inspections by grasping the status of levee maintenance and repair, and provided technical support to verification work in order to increase efficiency and labor-savings in inspection. This included reviewing inspection manuals and utilizing new technologies such as MMS. In addition, the PWRI undertook the development and study of nondestructive testing techniques for pinpointing cavities in levees near sluices or other structures, deterioration in concrete members and sheet-pile revetment, etc. For (ii), the River Structure TF took basic steps to review management methods, by collecting cases of social capital management overseas. For (iii), the River Structure TF posted a technical consultation form on their website to facilitate the process of accepting technical consultation requests from a wide range of sources including local governments, and received requests from 6 prefectures and cities in 2013. In March, the River Structure TF held a river structure management seminar to exchange advanced information on maintenance as a collaboration of industry, academia and government.

3. Future development

The River Structure TF will continue to conduct constructive activities to technically support the promotion of strategic maintenance for river structures in close collaboration with the MLIT and Regional Development Bureaus. This will include the promotion of R&D of new technologies, technical consultation for local governments, and providing opportunities for industry, academia and government to exchange a broad rage of information.

Topics

Large Vehicle Traveling Route Confirmation Using ITS Spots Public Experiment

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SUZUKI Shoichi, Senior Researcher
TSUKIJI Takahiro, Researcher
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(Key words) ITS Spot, probe information, traveling route confirmation public experiment

1. Introduction

As road structures in Japan deteriorate, there is a demand that existing infrastructure be effectively used longer than in the past, and it is important to monitor the routes traveled by large vehicles, which impose loads which have a relatively great effect on structures.

Our division uses ITS Spot services that permit two-way communication between road side devices (ITS Spots) and on-board equipment (ITS Spot compatible on-board equipment) as a technology which effectively clarifies the routes traveled by large vehicles, and is verifying this vehicle traveling route clarification technology on actual roads. (Shows a map of range in which data can be collected.)

Beginning in January 2014, a public experiment conducted by installing ITS Spot compatible on-board equipment in about 3,000 large vehicles to collect and confirm traveling route information will be conducted. This report introduces an outline of this public experiment.

2. Clarifying traveling route using ITS Spots

ITS Spot service, which started in 2011, can communicate large volumes of information in two directions, so it can not only provide road traffic etc. information to vehicles, but also collect probe information (traveling history and behavior history of vehicles).

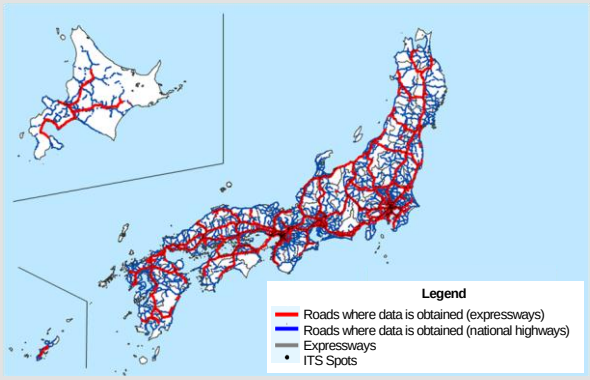
Using these types of probe information to clarify the traveling route of individual vehicles is not permitted in order to protect personnel information. But, it is possible to clarify the traveling routes of individual vehicles by especially adding information to identify each vehicle to the probe information for vehicles operated by companies which have exchanged permission to use traveling routes with the Ministry of Land, Infrastructure, Transport and Tourism.

3. Outline of the public experiment

ITS Spot compatible on-board equipment will be installed on about 3,000 large vehicles owned by logistics companies throughout Japan and probe information will be collected on a nation-wide scale. Running control records (daily reports) containing traveling routes will be recovered from some of the commercial operators and these will be compared with probe information collected by ITS Spots to verify the probability of the traveling route obtained from the probe information.

Specifically, based on vehicle stopped time and continuous traveling time etc. obtained from the probe information, it will be verified how accurately locations where they loaded or unloaded cargoes can be hypothesized and whether or not it is possible to abstract a single trip chain. And the precision of travel route information in double-deck sections and in dense urban districts will also be verified.

Figure. Range where Probe Information can be Collected
Data period: November 2011 to August 2012 (10 months)



Preparation of countermeasure proposal technology document based on past traffic safety countermeasures

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(Key words) Traffic safety countermeasures, countermeasure proposal, black spot, arterial road

1. Introduction

Although the numbers of fatalities and injuries caused by traffic accidents have tended to fall in recent years, every year, more than 800,000 people are killed or injured in traffic accidents, and this statistic continues to be high as an absolute value.

The fall of the number of traffic accidents is the result of the promotion of traffic safety education and the improvement of vehicle safety accompanied by diverse traffic safety countermeasures on the road side. At places where road managers take traffic safety countermeasures, each one has its unique road traffic environment and site conditions, and the causes of accidents also vary widely, so a problem faced by officials in charge of these locations is that they must rack their brains to propose countermeasures for each one.

So in order to support the proposal of traffic safety countermeasures appropriate to the causes of accidents in order to implement effective traffic safety countermeasures, a countermeasure proposal technology document has been prepared based on past countermeasure projects.

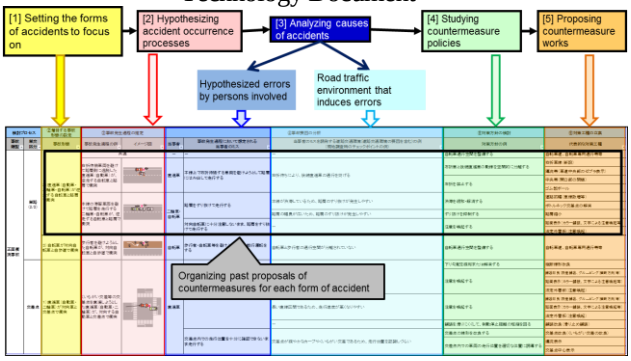
2. Preparing the countermeasure proposal technology document

To propose traffic safety countermeasures for arterial roads, generally, based on the results of the organization of accident data etc., studies are conducted—[1] to set the forms of accidents to focus on, [2] to hypothesize accident occurrence processes, [3] to analyze causes of accidents (hypothesizing errors by people involved and road traffic environments that induce errors), [4] to study countermeasure policies, and [5] to propose countermeasure works.

The countermeasure proposal technology document was prepared with the structure shown in the figure so that it can serve as reference material that road managers use when proposing countermeasures along with the study process.

To select the forms of accidents (location of each accident and combinations of people involved) to be entered in the countermeasure proposal technology document, statistical traffic accident data of the Institute for Traffic Accident Research and Data Analysis were used to aggregate forms of accidents for each accident category and to select about 50 cases as frequent forms of accidents. And from among accident occurrence processes, causes of accidents, countermeasure policies, and countermeasure work methods that are hypothesized for each form of accident, past proposals of countermeasures at about 8,000 locations accumulated in the Accident Countermeasure Database of the NILIM (locations defined as black spots in 2003 or in 2008, and where countermeasures were taken) were used to abstract appropriate combinations from the hypothesizing of accident occurrence process to the proposal of countermeasure works. And in addition, past countermeasure proposals for each form of accident were organized to simplify hypothesizing causes of accidents unique to each location. The table presents an example of the organization of right turn accidents at intersections.

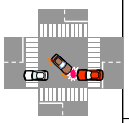
Figure. Structure of the Countermeasure Proposal Technology Document



3. Conclusion

This technology document will be completed and updated as necessary in response to the state of the execution of traffic safety countermeasures in the future.

Table. Example from the Countermeasure Proposal Technology Document Concerning Right Turn Accidents at Intersections

Study process		[1] Setting the forms of accidents to focus on	[2] Hypothesizing accident occurrence processes		[3] Analyzing causes of accidents			[4] Studying countermeasure policies	[5] Proposing countermeasure works
Form of accident	Type of location	Form of accident	Example of accident occurrence process	Image diagram	Person involved	Person's error hypothesized in the accident occurrence process	Example of a road traffic environment that induces error by a person	Example of countermeasure policy	Typical countermeasure works
Accident while turning right	Intersection	Vehicle right-turning collides with a vehicle coming straight from the opposite direction at an intersection	A right-turning vehicle turning right into the intersecting road between vehicles traveling in the opposing lanes collides in the intersection with a vehicle traveling in the opposite lane		Right-turning vehicle	Turns right while unable to adequately check the oncoming vehicle	Because of vehicle turning right from the opposite direction, it is difficult to check the opposite lane	Improve the visibility of vehicles approaching from the opposite direction when turning right	Right-turn lane (newly created or location improved)
							Because the right turn waiting location is not good, it is difficult to check the opposite lane	Guiding the traveling position of the right-turning vehicle to appropriate locations inside the intersection	Channel indicator (right turn)
									Intersection center indicator
					Oncoming vehicle	Traveling at a speed delaying avoidance of the accident even after noticing the right-turning vehicle	Because it is a descending slope, vehicles tend to travel too fast	Removing the descending slope or making it gentler	Improving longitudinal alignment
								Alerting the driver	Road surface indicators
									Illegal signboards

Studying the application of probe data to traffic safety measures

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(Key words) Traffic safety measure, probe data

1. Introduction

Traffic safety countermeasure projects are carried based on a PDCA cycle consisting of identifying black spots, analyzing causes of the accidents and planning countermeasures, implementing countermeasures, evaluating their effectiveness, and studying and taking supplementary countermeasures, in order to take more effective countermeasures. In the PDCA cycle, it is standard procedure to identify black spots and evaluate countermeasure effectiveness based on accident data. But because traffic accidents occur rarely, a long period of time is required to collect stable accident data.

So at the National Institute for Land and Infrastructure Management, the data properties of various kinds of probe data are organized in order to study methods of effectively identifying black spots.

2. Relationship of abrupt deceleration data with accidents

Figure 1 used abrupt deceleration data from probe data provided by Honda Motor Co., Ltd. to organize and prepare a distribution map of the relationship of the frequency of abrupt deceleration of 0.3G or higher with the number of accidents causing death or injury at every basic road link of DRM in a certain region (below, called "DRM link"). Figure 1 shows that the relationship of the frequency of abrupt deceleration with the number of accidents causing death or injury is greatly scattered and it is difficult to discover a fixed correlation.

So it was decided to narrow the focus to a specified route to compare the frequencies of abrupt deceleration and the numbers of accidents causing death or injury at each DRM link to confirm the correlation. In Figure 2, the relationships of the frequency of abrupt deceleration with the number of accidents causing death or injury at each DRM link are organized in parallel by focusing on a certain section of an arterial road. Overviewing the relationship of the two phenomena in Figure 2 shows that at locations where the number of accidents causing death or injury is higher than it is at other DRM links, abrupt decelerations tend to occur often, and at locations where accidents causing death or injury are rare, abrupt decelerations tend to occur rarely.

Examining each section in detail reveals that there are characteristic links where, even though accidents do not occur very often, at No. 17 in Figure 2 for example, the frequency of abrupt decelerations is far higher than it is at surrounding DRM links.

Figure 1. Relationship of Frequency of Abrupt Decelerations of 0.3G or more with Number of Accidents Causing Death or Injury

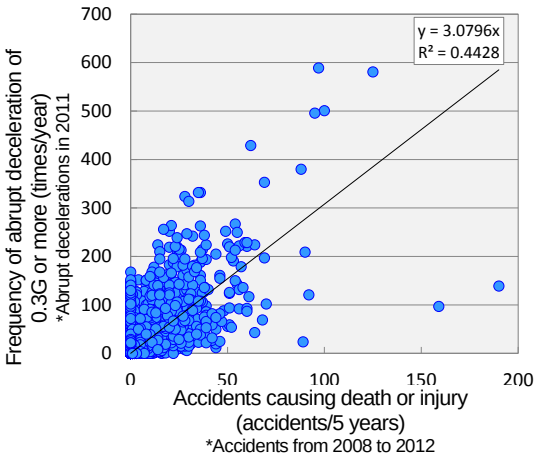
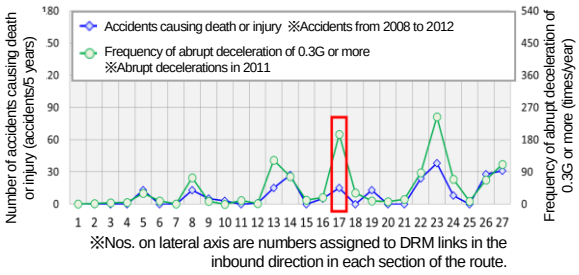


Figure 2. Number of Abrupt Emergency Decelerations and Number of Accidents Causing Death or Injury of Each Basic Road Link of DRM on Arterial Roads



3. Conclusions

In abrupt deceleration data, a correlation with accidents was seen in certain narrow sections. But even in sections which are narrow to a certain degree, there are many locations where the frequency of emergency deceleration occurrences in relation to accidents is much higher than at surrounding locations. It is assumed that the characteristics of occurrence of abrupt decelerations of this kind are also impacted by the road structure etc. In the future, factors such as road structures which impact the characteristics of the occurrence of abrupt decelerations of this kind will be clarified, and the analysis of its relationship with accidents and other studies of its application to the abstraction of accident hot spots will be carried out.

Evaluation of the effects of providing side strips on residential roads

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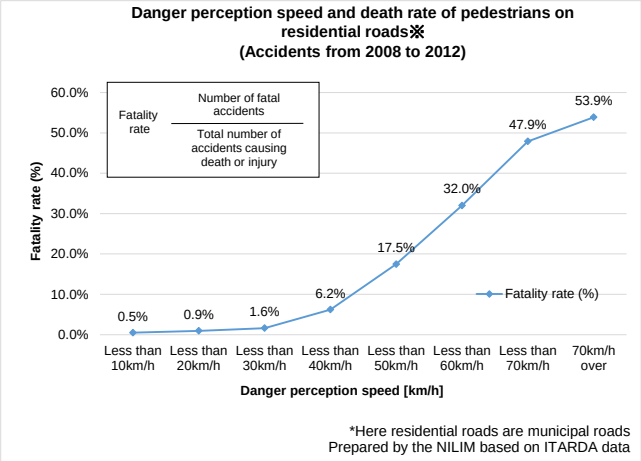
(Key words) Residential road, providing side strips, traffic safety

1. Introduction

The percentage of traffic accidents which cause death or injury that are four wheeled vehicle - bicycle or pedestrian accidents is about 25% on all roads, but higher at about 32% on residential roads.

And as the figure shows, the fatality rate of automobile – pedestrian accidents on residential roads rises from near the point where the danger perception speed exceeds 30km/h, and it is believed that restricting the traveling speed of vehicles to 30km/h or less will prevent serious accidents and reduce traffic accidents.

Figure. Danger Perception Speed and Fatality Rate



There are two traffic safety countermeasure methods: hard methods such as installing humps, chicanes, or narrowingss and other structures to restrict speed, and soft methods such as restricting traffic. The effectiveness of implementing many hard measures has been confirmed by past research, but the effectiveness of taking soft measures has not been verified as often as that of hard measures.

This research has focused on providing side strips, which is a soft method that gains local approval relatively easily, and which can be installed at lower cost than hard methods, to verify its effectiveness.

2. Analysis of the effectiveness of providing side strips

This research surveyed the state of travel on roads with similar roadside conditions etc. and analyzed the traveling speeds of vehicles, clarifying its effectiveness.

The analysis assessed the significance of differences between vehicle speeds on multiple similar routes where only one road structure element differs. The table shows the results.

Table. Significance of Speed Differences by Road Structure Element

Analysis items (road structure elements)		Overall assessment of significance*	
		Average speed	Maximum speed
Center line	Center line placed/not placed	○	○
Traffic restrictions	Traffic restriction enforced/not enforced	△	△
Road width	Road width (two-way traffic)	○	○
	Road width (one-way traffic)	△	△
Side strip	Roadside strip provided/not provided	△	△
	Width of roadside strip	○	×
Vehicle lanes	Width of vehicle lanes	△	△
Color	One side colored/not colored	×	△
	Both sides colored/not colored	△	△
	Comparison of one side and both sides	×	×
	Differences in color	×	×

*Case where significance of 5% is considered significant
○: Significant difference between all streets analyzed
△: Partial significant differences between all streets analyzed
×: No significant differences between all streets analyzed

Significant differences in speed were confirmed between roads with and without a center line and according to road widths (two-way streets), and it can be stated that these impact the reduction of traveling speed. There were partial significant differences according to traffic restrictions, road width (one-way

street), side strip width, and road width. And regarding coloring, which is counted on mainly to clarify side strips or regulate traffic, excluding one part, no significant differences in speed were confirmed.

3. Future directions

The comparison of routes did not clarify the effectiveness, although it did show a tendency for the speed to differ according to differences in road constituent elements. So now states of travel before and after countermeasure on the same route are being compared. And to clarify the effectiveness of measures other than speed restrictions, a questionnaire survey will be carried out to confirm the feelings of safety of users.

In the future, we want to organize these effects for each condition such as road width to clarify the most effective way to construct side strips.

Sharing knowledge for more effective and more efficient traffic safety measures

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(Key words) Traffic safety measures, human causes of accidents, speed reduction structures

1. Introduction

Traffic accidents, which are a serious road traffic safety problem, are caused by three elements—people, roads, and vehicles—and preventive measures are taken from the perspectives of people, roads, or vehicles. But, even when a traffic safety measure is taken to deal with a road related accident factor, if people do not use the road safely, the measure will not be fully effective. And if the road users do not even understand the purpose of the measure, it will be difficult to gain their approval of its implementation.

So in order to introduce traffic safety measures more effectively and more efficiently, we are conducting research to share knowledge about the purposes of traffic safety measure and methods of safely using roads with road users. This report introduces this effort.

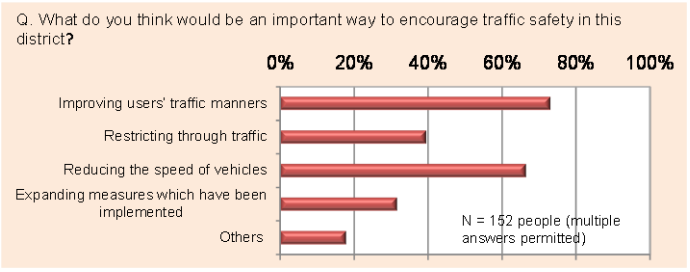
2. Traffic safety measure and road users' traffic manners

Traffic safety measures on wide roads such as arterial roads include measures such as building sidewalks or installing guard fences etc. to directly separate vehicles from pedestrians, but on residential roads for example, roads are narrow so measures that can be taken are limited. Therefore, reducing speed from the road side or improving road users' awareness are major elements of traffic safety. We conducted a questionnaire survey of the issue, "important ways to encourage traffic safety in this district" in one district in Tsukuba City where residential road traffic safety measures had been taken, resulting in many of the respondents pointing out "reducing the speed of vehicles" along with "improving users' traffic manners" (see Fig. (a)). And in answer to the question, "Do you think that demonstrating the purpose of measures will result in users driving more safely?", more than 90% answered either "Yes" or "Probably" (Fig. (b) top), while in response to the question "Do you think that the purposes and intentions of measures are shown to users?", only about 40% answered "Yes" or "They generally are" (Fig. (b) bottom), showing they believed that telling road users the purposes and intentions of measures will contribute to safer road use.

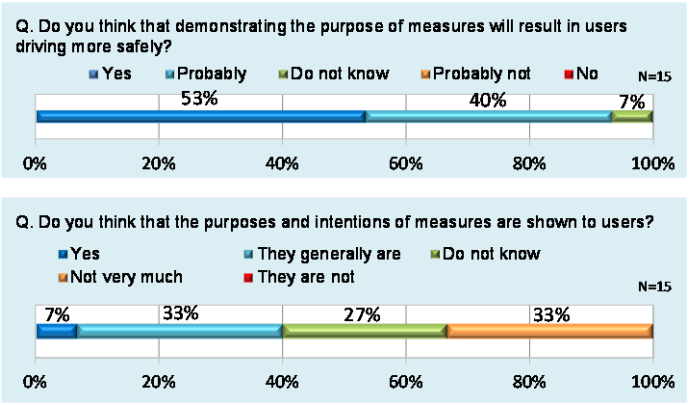
Based on the above findings, we will organize knowledge including the purposes of measures, primarily traffic safety measures taken on residential roads within the district etc., examples of dangerous situations and traffic accidents that result from road users' carelessness etc., and safe road use methods that will avoid these situations, and we will prepare documents to clearly communicate these kinds of knowledge to road users in easy to understand form.

In the future, we will clarify and verify the effectiveness of sharing this knowledge in districts where traffic safety measures have actually been taken, and at the same time propose this as one measure to reduce traffic accidents (methods and tools for communication with road users to avoid traffic accidents).

Figure. Results of Questionnaire Survey of Local Residents



(a) Important ways to encourage traffic safety



(b) Purposes of traffic safety measures

Topics

Social experiment on traffic safety on school routes

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(Key words) School routes, Traffic safety, Social experiment

1. Introduction

Traffic accidents involving children walking between their home and their school continue to occur , so traffic safety countermeasures for school routes are a pressing challenge.

The Ministry of Education, Culture, Sports, Science and Technology, Ministry of Land, Infrastructure, Transport and Tourism, and the National Police Agency prepared Emergency Joint Inspection Procedures for School Routes in May 2012 and have asked local government to implement this manual. In May 2013, the 2 ministries and 1 agency jointly announced a notification concerning future initiatives in response to the results of the emergency joint inspections, and in December, issued the notification, Promotion of Continuous and Effective Initiatives to Ensure Traffic Safety on School Routes, and are aggressively promoting its application.

The NILIM was already conducting research on traffic safety measures for residential roads, and as part of this research, from November to December 2013, in cooperation with Tsukuba City, which was studying specific traffic safety measures for school routes, it carried out a social experiment on public roads concerning traffic safety measures for school routes.

This report introduces an outline of this social experiment.

2. Outline of the social experiment

The social experiment was done by installing speed reduction structures etc. on school routes and verifying their effectiveness with the cooperation of the Tsukuba Central Police Station and Ninomiya Elementary School.

The route included a narrow section with width of about 4.0m and without walking space for children and a straight road section with 6.0m – 7.0m width where vehicles travel at relatively high speed. On this route, traffic from outside the district is particularly heavy in the mornings and evenings, and ensuring safety of children when commuting to and from school is a challenge.

3. Traffic safety measures tested

During the social experiment, the route was divided into 3 sections according to road conditions to study the traffic safety measures.

In the first section, a narrow road shared by automobiles and pedestrians, the roadside strips were widen and colored in order to ensure space where pedestrians can walk safely.

In the second section, which is a straight wide road, vehicles travel at high speed and pedestrians feel endangered, so humps and chicanes were installed to encourage drivers to reduce their speed. In light of the views expressed by some that this part was used as a short-cut of an arterial road, a bottleneck was installed at its entrance as a through traffic countermeasure.

To clarify the effectiveness of these measures, the speed of vehicles and locations they traveled were observed by video cameras. And to understand how safe and secure the users feel, a questionnaire survey of drivers, children commuting to school, and local residents was carried out.

4. Conclusions

The results will be announced as necessary, but the results of the questionnaire survey of the elementary school children show that about 80% of them answered that they felt safer than before the countermeasures were taken.

The NILIM will apply the results of the social experiment to research on traffic safety countermeasures for residential roads throughout Japan, and Tsukuba City will use them to implement

traffic safety countermeasure projects on school routes serving Ninomiya Elementary School.

[Sources]
NILIM web page: http://www.nilim.go.jp/lab/gdg/index.htm

Topics

Study of the introduction of roundabouts in Japan

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(Key words) Methods of controlling level intersections, roundabout

1. Introduction

Present level intersections include those which still face safety challenges such as the occurrence of collisions between vehicles crossing on intersecting streets and between a vehicle travelling straight through and a vehicle turning right on the same street. There are also signalized intersections where the traffic volume is low, resulting in the smooth flow of traffic being obstructed because drivers needlessly wait for a signal change when no vehicles are crossing the intersection. To counter these problems, America and the countries of Europe are aggressively introducing roundabout intersections. Interest in roundabouts as a type of level intersection where signal control is unnecessary during disasters has appeared in regions which suffered damage by the Great East Japan Earthquake. This report introduces the state of studies of the introduction of roundabouts in Japan.

2. Outline of roundabouts

A roundabout is a type of circular intersection in which priority is given to one-way traffic flowing in a circle, and is a level crossing control method that does not interrupt the circular flow with signals or by requiring a temporary stop. They are being constructed in various regions as shown in Photo 1.

Photo 1. Example of construction (Hitachi City in Ibaraki Prefecture)

3. Past initiatives

The Road Bureau of the Ministry of Land, Infrastructure, Transport and Tourism has formed the Roundabout Study Committee[1)], which held its first meeting in September 2013. The purpose of this committee is to study characteristics of intersections suitable for the construction of a roundabout based on the characteristics of roads and state of traffic in Japan, and to hear expert opinions to study technical challenges to the introduction of roundabouts. In FY2012, in Karuizawa Town in Nagano Prefecture, six unsignalized intersections were converted to roundabout intersections with the support of a public experiment by the Road Bureau. And in FY2013, in Yaizu City in Shizuoka Prefecture and in Moriyama City in Shiga Prefecture, 4 unsignalized intersections were converted to roundabouts with the support of the same public experiment.

Linked to the above trend, the NILIM is conducting research to set suitable conditions and create design methods for roundabouts by, for example performing driving surveys on test roads (Photo 2) and by using traffic flow simulators, in order to prepare design standards.

Photo 2. View of Driving Survey on a Test Track

[Sources]
1)Roundabout Study Committee
http://www.mlit.go.jp/road/ir/ir-council/roundabout/index.html

Preparation of the Time Reliability Index Value Calculation Manual

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(Key words) Road traffic, time reliability, probe data

1. Introduction

According to the time a motorway opens for service, travel time on sections of parallel ordinary roads may shorten. And when this happens, not only average travel time, but the 95-percentile travel time (in a sense, travel time during congestion which occurs once every 20 days) for example, is also shortened (Fig. 1). In these cases, the confidence in travel time on the road felt by road users who set their departure time predicting the 95 percentile travel time will be increased, because they will be able to set a later departure time than the departure time before the new motorway opened for service.

The Traffic Engineering Division has studied a method of using probe travel time data to calculate index values which indicate such time reliability, and has summarized the findings in the Time Reliability Index Value Calculation Manual (below called "the manual"). We presume that regional development bureaus will use this manual to calculate time reliability index values in order to measure the effectiveness of a road project.

2. Calculation of the time reliability index value in the manual

Figure 2 is a flow chart of the time reliability index value calculation method presented in the manual. A characteristic of the manual is that it presents the methods: [4. Preparing OD section data], and 5. [Setting the reliability ranking of time reliability index values].

[4. Preparing OD section data] presents a method of preparing travel times for sections consisting of a number of connected DRM (Digital Road Map) sections (below called, "OD Sections") based on section unit probe travel time data of DRM. Compensation is done in cases where, during the processing of preparing OD section travel times, a DRM section for which probe travel time data was unavailable (below called, "missed measurement section") is found. Compensation for a missing measurement section is done using average travel time for the DRM section.

[5. Setting the reliability ranking of time reliability index values] presents a method of assessing reliability: a factor indicating the certainty of calculated index values. Reliability has been defined as probability that the difference between the index value calculated based on data for a number of days which can actually be obtained and the actual value (calculated value when there are no missed measurements, and data for all days could be obtained) is within ±5% of the actual value. Reliability is set as four ranks from A to D based on the number of days when data could be obtained, and is a yardstick indicating the probability of the calculated index value. And when the reliability rank does not satisfy the ranking which should be ensured, as necessary, the state of missed measurement sections can be checked to set sections within the OD sections whose index value is calculated.

3. Conclusions

The manual will be distributed to regional development bureaus, where it is counted on to be used not only to measure the effectiveness of road projects, but also to specify and prioritize sections where countermeasures are required.

Figure 1. Change of Required time on National Highway No. 1 (near Amanokawa Intersection: about 3km) after Opening of the Daini Keihan Expressway (2010)

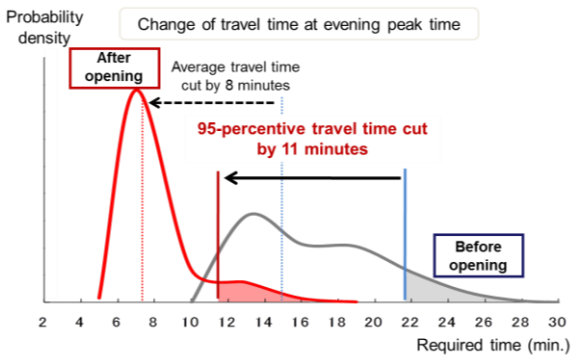
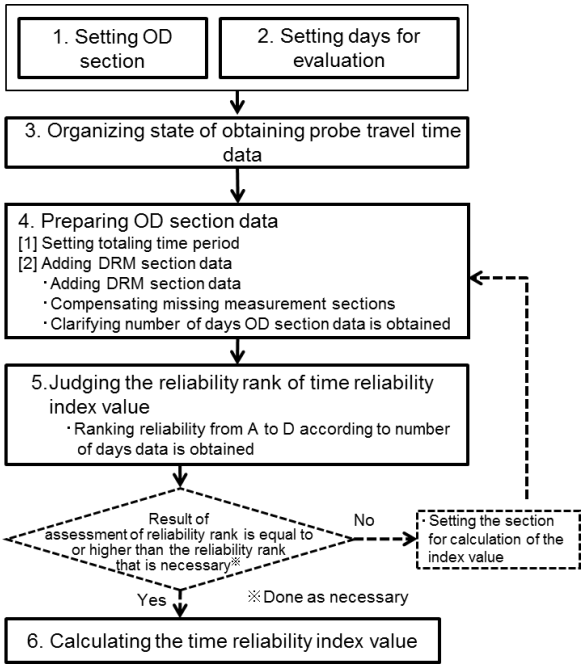


Figure 2. Time Reliability Index Value Calculation Flow Chart



Systems using probe information collected from ITS Spots

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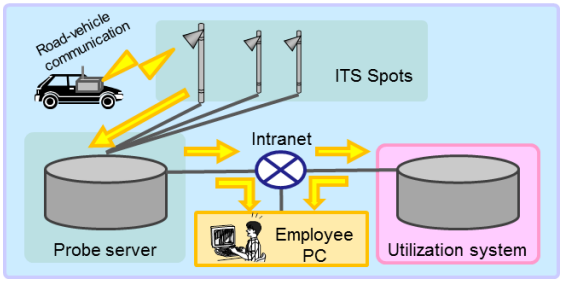
(Key words) ITS Spot, probe, road management

1. Introduction

The Ministry of Land, Infrastructure, Transport and Tourism has developed a system to collect probe information (traveling history, behavior history, etc.) from ITS Spots installed at about 1,600 places, mainly on expressways throughout Japan and began collecting this information in FY2011. The spread of ITS Spot compatible car navigation systems permits the collection of large volumes of probe information at low cost. This means that it is now possible to perform high frequency collection of section unit travel speed or information of use in wide-area road management to perform efficient and advanced road management work. This report introduces systems that use probe information which have been developed for use by road managers (Fig. 1).

Figure 1. Position of a Utilization System



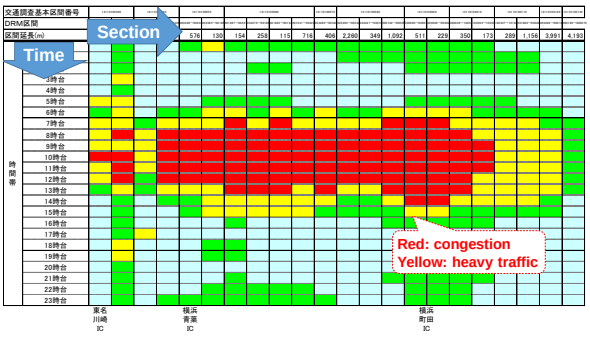
2. Outline of utilization systems

Utilization systems can aggregate and display based on travel speed or behavior histories in DRM link1) units prepared from probe information, and road managers can view and download the results (see Table and Figure 2 and Figure 3).

Table 1. Functions of utilization system

Feature name	Feature outline
Time–space diagram writer	Aggregation of each DRM link section or average speed by hour of selected route, shown on the sheet and illustrated on the map in different colors
Required travel time tabulator	Aggregations of required time to follow the shortest route or selected route by section or time, as shown on the graphs.
Sudden acceleration and braking area mapping tool	Mapping points of the selected areas on a map to indicate locations where sudden acceleration occurred.

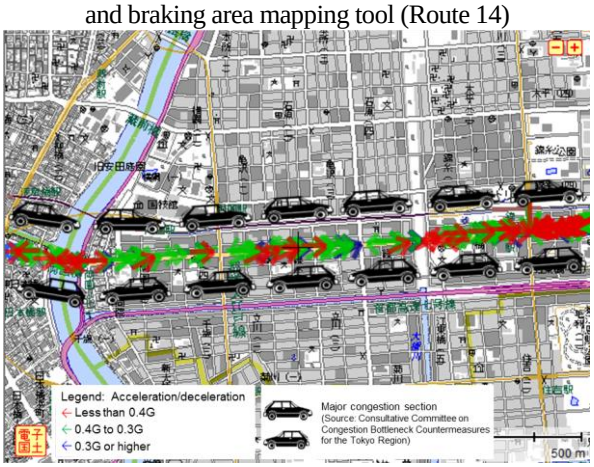
Figure 2. Example of Output Temporal-Spatial Speed Chart (Tomei Expressway)



[Legend]

	Ordinary road	Intra-city expressway	Inter-city expressway
	30km/h or higher	60km/h or higher	80km/h or higher
	20km/h or higher and below 30km/h	40km/h or higher and below 60km/h	60km/h or higher and below 80km/h
	10km/h or higher and below 20km/h	20km/h or higher and below 40km/h	40km/h or higher and below 60km/h
	Below 10km/h	Below 20km/h	Below 40km/h
	No data	No data	No data

Figure 3. Example output from the sudden acceleration and braking area mapping tool (Route 14)



3. Conclusions

In the future, this will contribute to more efficient road management by allowing road managers to aggressively use probe information to take congestion countermeasures, accident countermeasures, and disaster response measures, etc.

[Sources]
1) http://www.drm.jp/

2) Kanazawa, F. et al: Development of Probe data Utilization System to Facilitate Road Management, proc. of 20th ITS World Congress, CD-ROM, 2013

Empirical Studies for The B-DASH Project (Solid fuel forming, sewage heat utilization, nitrogen removal, phosphorus removal / recovery)

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Keywords: sewerage, energy-saving, resource-saving, cost reduction, greenhouse gas, innovative technology

1. Introduction

Sewerage infrastructure is social capital essential to public life and its potential uses, e.g., utilization of sewage sludge and sewage heat as energy, and utilization of phosphorus as resource are increasingly sought as a response to the issues of global warming and the tight supply of resources and energy, as well as measures for reducing greenhouse gases.

New technologies responding to such social and administration needs have begun to be developed but are less used in practice since many sewerage service providers are cautious about their introduction. For this reason, the Sewerage and Sewage Purification Department of the MLIT launched the "Breakthrough by Dynamic Approach in Sewage High Technology" (B-DASH) project in fiscal 2011, and the Water Quality Control Department of the NILIM serves as an executing agency of this empirical study. The objective of the B-DASH project is to reduce the costs of sewerage projects, create renewable energy through the verification and dissemination of innovative technologies and support the overseas development of the water business by Japanese enterprises.

2. Outline of the B-DASH Project

Under the B-DASH Project, the NILIM contracts out studies of innovative technologies to the public and conducts peer reviews of research organizations (contractor) that build full-scale sewage treatment plants in order to verify treatment stability, the applicability of technology, and the cost reductions, decreases in greenhouse gas emissions, and energy-saving effects resulting from introduction of the technology, etc. Based on the results of such verifications, the NILIM formulates guidelines for introducing the technologies. In formulating research findings and guidelines, the advice and evaluations of experts are obtained.

In fiscal 2011, two empirical studies of biogas utilization technology were conducted and the corresponding guidelines were formulated in July 2013.

In fiscal 2012, five empirical studies concerning technology for converting sewage sludge into solid fuel, technology for utilizing unprocessed sewage heat, and technology for removing and recovering nitrogen and phosphorus derived from sludge treatment were adopted. In fiscal 2013, these studies were continued to verify results and formulate guidelines.

In fiscal 2013, two empirical studies concerning power generation system technology using exhaust heat from combustion of sewage sludge were adopted, and the technology was put into practice.

Of these technologies, this paper gives an overview of the verification technologies adopted in fiscal 2012.

3. Outline of verification technologies adopted in fiscal 2012

(1) Technology for converting sewage sludge into solid fuel

(i) Empirical study on next-generation technology for converting sewage sludge into solid fuel without emitting greenhouse gas (Joint Research Organization of Nagasaki City, Nagasaki Institute of Applied Science, and Mitsubishi Nagasaki Machinery MFG Co., Ltd.)

This technology consists of the steps of hydrothermal reaction, high-rate digestion, dehydration, and drying processes. The plant hydrolyzes the degradable solid organic matter in sewage sludge by hydrothermal reaction, converts water-soluble organic matter into digester gas through high-rate digestion to utilize it as a heat energy source, and dehydrates and dries the residue in the remaining sludge to form solid fuel (**Photo 1**).

Figure 1: Appearance of Verification Facility (Nagasaki Eastern Sewage Treatment Facility)

(ii) Empirical study on the utilization of waste heat using low-cost technology for converting sewage sludge into solid fuel (JFE Engineering Corp.)

The technology uses the unutilized waste heat of an incinerator (about 300 °C) and surplus digester gas as a heat source for drying sludge in order to manufacture solid fuel with surface solidification drying equipment, and uses the solid fuel for the incinerator to reduce the use of supplemental fuel (**Figure 2**).

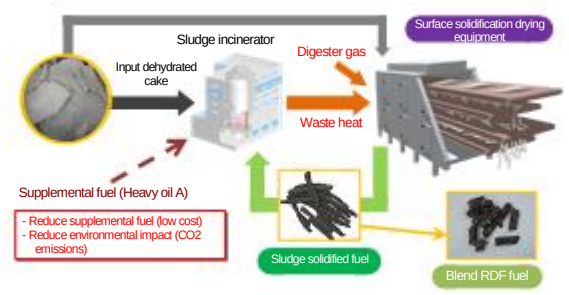

Figure 2: Processing Flow (Surface solidification drying technology)

(2) Technology for utilizing unprocessed sewage heat

○ Empirical study on sewage heat utilization using in-line heat-recovery technology (Joint research organization of Osaka City, Sekisui Chemical Co., Ltd., and Toa Grout Kogyo Co., Ltd.)

This technology installs a heat exchanger in a sewage pipeline when renovating deteriorated pipe, such as incurrent pipes and sewage mains at treatment facilities. Untreated sewage flows through the heat exchanger, and recovers sewage heat to utilize it for local air conditioning via a heat pump. The technology enhances the efficiency of the heat pump by utilizing the sewage temperature, which is higher than outside in winter and lower in summer (**Figure 3**).

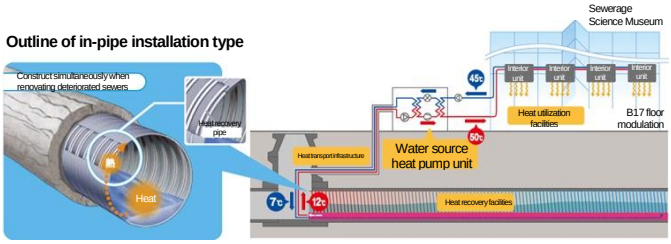

Figure 3: Flow in Verification Facility (In-pipe heat recovery technology)

(3) Technology for removing and recovering nitrogen and phosphorus derived from sludge treatment

(i) Technical empirical study on highly efficient nitrogen removal technology for fixed bed type Anammox process (Joint research organization of Kumamoto City, Japan Sewage Works Agency, and Takuma Co., Ltd.)

For removing nitrogen in the returned water derived from sludge treatment, this technology applies Anammox reaction technology and a fixed bed (function of Anammox bacteria converts ammonia and nitrite nitrogen into nitrogen gas under an anaerobic conditions) to reduce air demand, chemical costs, sludge generation, etc. (**Figure 4**).

Figure 4: Appearance of Verification Facility (Kumamotoshi Eastern Purification Center)

(ii) Empirical study on innovative technology for nutrient removal and resource recycling (Joint research organization of Swing Corporation, Kobe City, and Mitsubishi Shoji Agri-Service Corporation)

This technology aims to improve phosphorus yield as MAP (magnesium phosphate ammonium) suitable for fertilizer raw material by removing and recovering phosphorus directly from digestive fluid with a complete mixing crystallization reactor, and to control piping blockade with MAP (**Figure 5**).

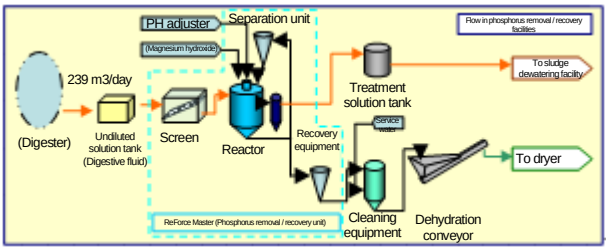

Figure 5: Flow in Verification Facility (Phosphorus removal / recovery technology)

4. Future development

The NILIM will continue to spearhead verification studies and in turn formulate guidelines on technology introduction based on study findings, and promote the dissemination of guidelines.

[Reference]

http://www.nilim.go.jp/lab/ebg/index.htm

Technology Introduction Guidelines for the B-DASH Project (Biogas utilization technology)

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Wastewater and Sludge Management Division, Water Quality Control Department

Keywords: Breakthrough by Dynamic Approach in Sewage High Technology Project, biogas, guidelines

1. Introduction

The MLIT launched the "Breakthrough by Dynamic Approach in Sewage High Technology" (B-DASH) project in fiscal 2011, and the Water Quality Control Department of the NILIM serves as an executing agency of this project.

We have, therefore, drafted guidelines for sewerage service providers to consider the introduction of innovative technology based on the results of our empirical studies and the evaluation by the B-DASH Project Evaluation Committee with regard to two technologies adopted in fiscal 2011 for water treatment (solid-liquid separation) and biogas recovery / refining / electricity generation in sewage treatment facilities.

2. Outline of biogas utilization technology

(1) Energy management system using intensive solid-liquid separation technology

This technology represents a technical system that generates electric power via a hybrid fuel cell by fully using biogas obtained from the digestion of raw sludge, of which collection is increased by upgrading solid-liquid separation using a carrier.

(2) Effective renewable energy production system utilizing biogas

This technology represents a technical system for using renewable energy for automotive fuel, etc. This is done through a series of processes for increasing the collection of biogas from local sources such as food, increasing the effective usage of the biogas by heating a sludge digestion tank made of steel, and purifying the biogas to high degree of quality with a packaged biogas upgrading system.

3. Outline of the technology introduction guidelines

The Table shows the content of the guidelines (draft). Chapters 1 and 2 describe the objectives and outline the technology. Chapter 3 estimates the effect of the technology when introduced in a treatment facility. Based on the results of estimations, the possibility of introduction is discussed. Chapter 4 examines basic planning, equipment design, etc. for introducing the technology. Chapter 5 describes check items and frequency that will be required when the technology is introduced.

Table: Content of Guidelines (Draft)

Chapter I General Provisions	Objective, scope of application, definitions of terms
Chapter 2 Outline of the Technology	Outline and characteristics of the technology
Chapter 3 examination for Introduction	Effect of introduction and examination method
Chapter 4 Planning and Design	Basic planning and design
Chapter 5 Maintenance	Check items, frequency, etc.
Reference Data	Verification results, case studies, etc.

4. Utilization of findings and future development

In order to introduce these guidelines to the concerned persons in local governments and businesses, a presentation was held at the Tokyo Big Sight on August 2, (Fri.) 2013.

By holding similar presentations, we will continue to constructively introduce these guidelines to concerned persons and to disseminate the technology.

Photo: Guidelines Presentation

[Reference]

1) TECHNICAL NOTE of NILIM No.736
Guidelines for introducing an energy management system using intensive solid-liquid separation technology
2) TECHNICAL NOTE of NILIM No.737
Guidelines for introducing an Innovative Biogas Production System
http://www.nilim.go.jp/lab/ecg/bdash/bdash.htm

Promotion of Climate Change Countermeasures using Sewerage

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Wastewater and Sludge Management Division, Water Quality Control Department

Keywords: climate change, biomass energy, dinitrogen oxide, resource circulation

1. Introduction

To promote climate change countermeasures, the Water Quality Control Department is proceeding with studies on the dissemination and promotion of technology for reducing GHG emissions by controlling the generation of dinitrogen oxide ("N_2O"), one of the greenhouse gases ("GHG") emitted from water treatment processes and utilizing the biomass resources and energy available from sewage.

2. Control of GHG emissions from water treatment processes

As for the N_2O generated by bio-reaction, since there are still many unclear factors including its development mechanism, sufficient measures are not taken to control the generation of N_2O from water treatment processes. This division, therefore, conducted a survey to grasp the status of N_2O generation at actual sewage treatment facilities, and found that the N_2O conversion rate was low and that generation was controlled at treatment facilities with a high nitrogen removal rate, particularly by MBR method (**Figure Fig. 1**). As the result of microorganism community analysis conducted to examine the development mechanismdeveloping factors, it was found that the MBR method successfully keeping kept high the abundance ratiopercentage of slow-growing nitrite-oxidizing bacteria high since nitrite-oxidizing bacteria are retained for a relatively held long period of time and the design allows for longer A-SRT (time during which active sludge is under aerobic conditions), which resulted in sufficient nitrification and control of N_2O generation. Therefore, the possibility was suggested that even a treatment facility that has not adopted the MBR method can control N_2O generation with an appropriate operating method, such as longer A-SRT. Since the survey so far shows a sudden increase in N_2O generation in the treatment facilities where no nitrogen is removed, measures for such phenomena should be sufficiently considered.

3. Climate change countermeasures by effective use of sewage sludge

In recent years, treatment facilities that introduce recycling / energy recovery technology (biogas power generation, solid fuel forming, etc.) using sewage resources have been increasing, mainly in large cities. However, since the rate of energy recovery from sewage sludge as of the end of fiscal 2010 is about 13%, further introduction of energy recovery technology is required in light of the potential of the country's sewage treatment facilities.

This division, therefore, formulated guidelines for considering the introduction of recycling / energy recovery technology for sewerage (**Fig. 2**), and calculation tools for estimating the effect of introduction into target treatment facilities, in order to support the dissemination of technologies that effectively use sewage sludge. These materials are expected to promote the dissemination of technologies that reduce GHG emissions in sewerage projects.

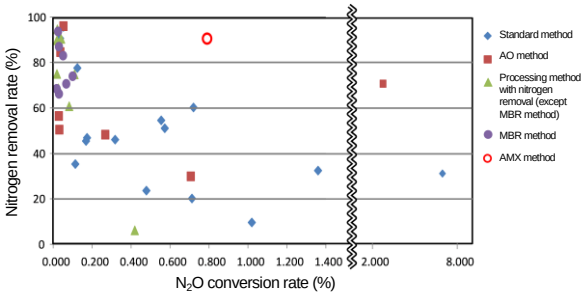

Figure 1: Relationship between Nitrogen Removal Rate and N2O Conversion Rate by Treatment Method

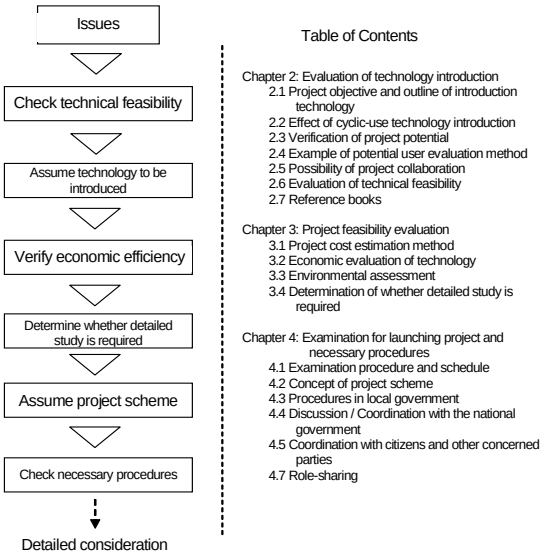

Figure 2: Guidelines for Considering the Introduction of Recycling / Energy Recovery Technology --- Table of Contents and Flow (Draft)

A Case of Utilizing Results

Identifying the Emission Factors of Dinitrogen Oxide in Sewage Treatment Processes and Reflecting Them in Greenhouse Gas Inventory

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Key words: Climate change, dinitrogen oxide, sewage treatment

1. Introduction

Of the greenhouse gas emissions from sewerage works, dinitrogen oxide (N_2O) accounts for about 10% [1] and, therefore, needs to be reduced. However, there are two main issues: one is that the N_2O emission factors of sewage treatment facilities used in the Cabinet Order for the Law for the Promotion of Measures to Deal with Climate Change and Greenhouse Gas Inventory are greatly uncertain due to the variation in measurement data used as the basis of factor calculation, and the other is that the factors are unified values and do not vary according to treatment methods, and, therefore, do not reflect the actual situation. Therefore, in order to promote climate change countermeasures, we conducted a survey to identify the generation of N_2O from sewage treatment processes and estimated more accurate emission factors from the study findings. Moreover, we present an outline of the Greenhouse Gas Inventory that we revised based on the findings of this study.

2. Survey on N_2O emissions and estimation of emission factors

We conducted 37 field surveys of 18 sewage treatment facilities in terms of main sewage treatment methods (conventional activated sludge process, circulating denitrification process, anaerobic-aerobic activated sludge process, pseudo-anaerobic-aerobic process, anaerobic-aerobic process, OD process, MBR process, etc.). As shown in the Figure, the measured values in most sewage treatment facilities were lower than the current N_2O emission factor of 160 mg-N_2O /m^3. The reason for this is that the current N_2O emission factor was calculated as an average for a limited number of data, i.e. 8 cases of data from 5 treatment facilities. Therefore, it may be overestimated given the extraordinarily high value (approx. 1,000 mg-N_2O /m3) affected the average. In this survey as well, a certain number of extraordinarily high values were measured in the processes without nitrogen removal, and the average value calculated, 137 mg-N_2O /m3, was close to the current N_2O emission factor. In contrast, in the treatment methods with nitrogen removal, there were no extraordinarily high values detected and the average was low at 9 mg-N_2O /m^3. Thus, the value of the N_2O emission factor differed greatly between treatment with and without nitrogen removal.

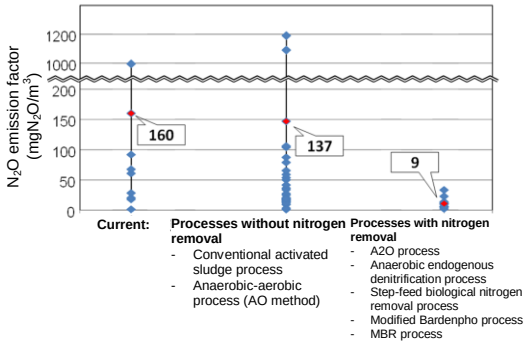

Figure: Current Values and Estimated Values from Survey Results

3. Reflection in Greenhouse Gas Inventory

Emission factors according to wastewater treatment methods were newly developed, as shown in the Table, using the data of this survey and other surveys. [2] In response to these values, the factors of "N_2O Emissions from Treatment of Household / Commercial Wastewater (Sewage Treatment Facilities)" in the Greenhouse Gas Inventory were revised [3] and incorporated into Japan's greenhouse gas emissions reports up to fiscal 2011. We will continue to work to promote climate change countermeasures.

Table: Revised N_2O Emission Factors in Sewage Treatment Facilities [2]

Conventional activated sludge process	Anaerobic-aerobic activated sludge process	Anaerobic-anoxic-oxic process Circulating denitrification process	Circulating nitrification denitrification type Membrane separation activated sludge process
142	29.2	11.7	0.5

(Unit: mgN_2O/m^3)

[Reference]

1) Miyamoto et al, "Collection of Presentations of Studies on Wastewater Systems," 2010, pp. 155-157.
2) Ministry of the Environment Task Force for Reviewing Greenhouse Gas Emissions Calculation Method, "Results of Review concerning Greenhouse Gas Emissions Calculation -- Improvement of the Calculation Method Used for the Waste Treatment, March 2013, p. 3.
3) National Greenhouse Gas Inventory Report of Japan, April 2013.

Air-conditioning Load Retrenching Effects for Buildings

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(Key words) Water retaining building materials, Evaporation, Heat/water simultaneous transfer

1. What is water-retentive material?

Water-retentive building materials are made of ceramics with fine pores of about 1 – 100 μm. When water accumulated by watering and precipitation vaporizes, it is deprived of vaporization heat, and an increase in the temperature of water retentive building material is curbed, which is expected to contribute to decreasing the cooling load.

2. Heat/moisture simultaneous analysis

The spread parameter of heat/moisture in high porosity materials widely varies according to the impact of temperature and the water content ratio. For this reason, we preliminarily investigated the characteristics of the parameters of water retentive building materials in an experimental laboratory and have developed a calculation method to predict the moment-to-moment surface temperatures and evaporation volumes by heat/moisture simultaneous analysis.

We also applied water to test samples in summer and observed the surface temperature (Figure 1). In order to corroborate the validity of analysis, the comparison between forecast calculations and observation results is illustrated in Figure 2. The surface temperature decreased to 40℃ from 70℃ by watering at noon on August 17, although it had been fine since the following day, showing the temperature increase being curbed.

3. Air-conditioning load reduction effects

In air-conditioning load calculations, water retentive building materials usually have not been dealt with. In this regard, we newly incorporated a heat/moisture simultaneous transfer model into air-conditioning load calculations for buildings and examined installation effects of water retentive building materials.

The annual air-conditioning load calculation result of a factory (floor area: 1,000m^2, roof insulation: 50mm) is indicated in Figure 3. This illustrates the fact that the cooling load and heating load have been reduced in each area of Tokyo, Osaka, and Naha owing to the construction of water retentive roofs. Since the water retentive building material decreases its surface temperature, it is effective for countermeasures against the heat island effect in the summer season and reduction in the cooling load. In addition, due to the function of the effect of heat resistance, it also is considered effective for reducing the heating load.

[Reference]

1) Ashie, et. al.: Japan Architectural Environmental Group Collection of Papers
2) Asie, et. al.: Collection of Academic Papers of the Convention of Society of Air-conditioning and Sanitary Engineers of Japan

Figure 1: Watering to experimental sample of water retentive building material

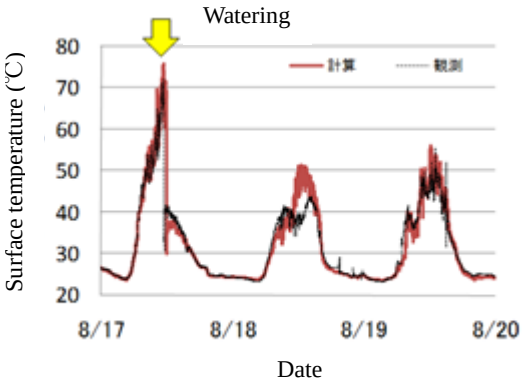

Chart 2: Comparison between calculation and

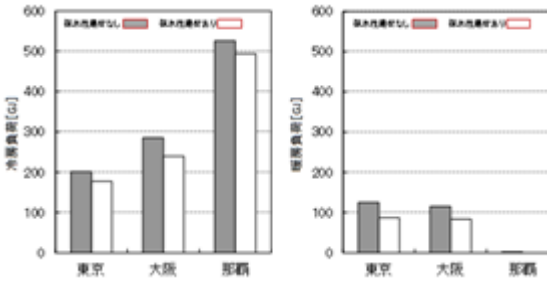

Chart 3: Air-conditioning load calculation results of factory

Watering

Development of Estimation Method for Energy Saving Technique of Residential Envelope Design

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(Key words) House, Energy Saving, Envelope Design, Estimation Method, Building Energy Standard

1. Revised Building Energy Standard

The Building Energy Standard for residential houses was revised in 2013, and the energy performance of a building changed to be represented by Design Primary Energy Consumption. In the standard prior to the revision, insulating performance and solar shading performance were only evaluated as the envelope performance. By this revision, envelope performance changed to be able to be evaluated based on heating and cooling loads (Figure 1). This change of the index gives a structure allowing flexible evaluation of the rise of the solar radiation heat acquisition rate, such as improvements of windows, the rise of heat storage performance such as utilization of concrete blocks and earthen walls, cross-ventilation performance in summer and the middle season, etc.

2. Revised Building Energy Standard

Since the standard prior to the revision mainly evaluated insulating performance and solar shading performance, the evaluation of insulating and solar shading techniques can be said to be sufficient, such as insulating reinforcement for heat bridges, utilization of eaves and characteristics of solar shading of various types of glass, i.e. low-e glass. However, the techniques to improve solar radiation heat acquisition performance and thermal storage performance are still not evaluated sufficiently in the revised standard. Therefore, NILIM started a research project named Research on Evaluation Method of Energy Saving Techniques corresponding to Local Home Building Techniques, of which the research period is from 2013 to 2015. In this project, the estimation methods for envelope energy saving techniques which have not hitherto been evaluated sufficiently will be developed. From the techniques discussed in the project, the examples about the solar control techniques are shown in Figure 2.

3. Development of Simple Evaluation Methods

The solar radiation heat acquisition rate (η value) as the index for the performance of openings changes hour to hour depending on the sun's position. This η value can be calculated theoretically taking into account the type of the attached materials such as blinds, the direction of the window and its construction location and so on, but it is not realistic that designers calculate this index because this calculation is too complex. Therefore, we are developing simplified evaluation methods for η values and other indices.

4. Utilization of Research Results in the Standard

This report introduced the research implemented by NILIM relating to the development of evaluation methods for envelope performance of residential houses. The research results will be utilized in the documents and online programs[1,2] as the calculation methods for the designed primary energy consumption.

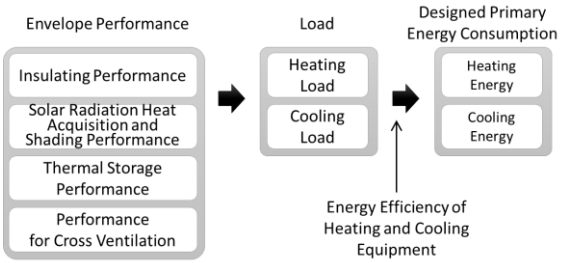

Figure 1 Structure of Evaluation for Envelope Performance in Revised Building Energy Standard

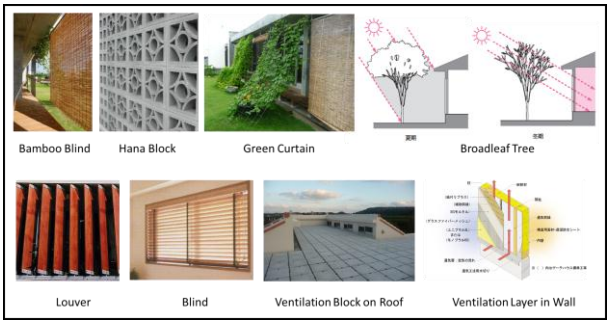

Figure 2 Example of Energy Saving Techniques *(Evaluation Methods Developed in NILIM Project)*

[References]

1) Technical Note of NILIM No.701 Relevant Materials for Certification Standards of Low-Carbon Buildings (Promulgated in Dec. 2012) – Manual of Program for Primary Energy Consumption in Houses –
2) Technical Information of Building Energy Standards and Certification Standards of Low-Carbon Buildings (Building Research Institute (Cooperated by NILIM)) http://www.kenken.go.jp/becc/house.html
3) Ministry of Land, Infrastructure, Transport and Tourism, Information about Revised Building Energy Saving Standards http://www.mlit.go.jp/jutakukentiku/build/jutakukentiku_house_tk4_000005.html

Wireless Power Supply Technology for Running Vehicles: Experiment Using a Model Vehicle

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TANIGUCHI Hisatoshi, Researcher, (Ph.D. Information
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(keyword) electric vehicle, non-contact power supply, electricity supply in running state

1. Studies on wireless power supply

The NILIM has been working, in partnership with Tokyo University, on developing and testing a technology that realizes power supply and battery charging for running electric vehicles. Until last year, our focus was to conduct some basic testing, such as electricity transfer over a big gap, and supplying electricity in a large area with an asymmetrical power transmission and reception unit, to identify the essential elements to achieve this goal. Using a power transmission and reception unit, 35cm in diameter, we have successfully transferred electricity over an approximately 80cm gap, which simulates the distance when transferring the power on an actual road. Another test using a model vehicle with a bulb attached has also proved it possible to supply power continuously, over 3m in distance, by employing transmission and reception units with different sizes and shapes. (See Photo 1)

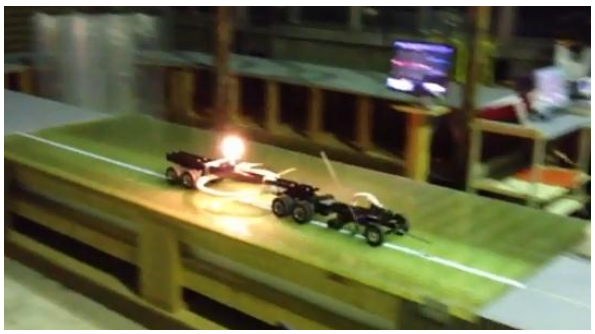

Photo 1 Experiment using a model vehicle

This year, we built a system where a model vehicle can run continuously using transferred electricity, and, by doing so, we identified a set of essential factors for wirelessly supplying power for a running vehicle. At ITS World Congress Tokyo 2013, we presented our experiment as well as its result.

2. The Challenges: from bulb to motor

Transferring electricity to a bulb, as seen in our experiments last year, is a favourable condition for wireless power supply using magnetic field resonance. With light bulbs, load is consistent, and the most of the energy is turned into heat and light, not returning to the power source. On the other hand, with electric vehicles, the load varies depending on conditions like the driver's control and the amount of power stored in the battery. This is a critical issue in achieving wireless power transfer with a magnetic field resonance system, resulting in situations like not being able to transfer electricity at all, or unexpected voltages applied to the storage battery.

Many of the wireless power supply devices currently in development for commercial use are for parked vehicles, and maintain optimal charging conditions by passing load status information from the vehicle to the power transmission unit. However, this method is not valid when the vehicles are running. We at The NILIM have achieved wireless electricity supply for a running model vehicle, by implementing a control circuit where both the power source and the receiver automatically maintain optimal conditions. (See Photo 2)

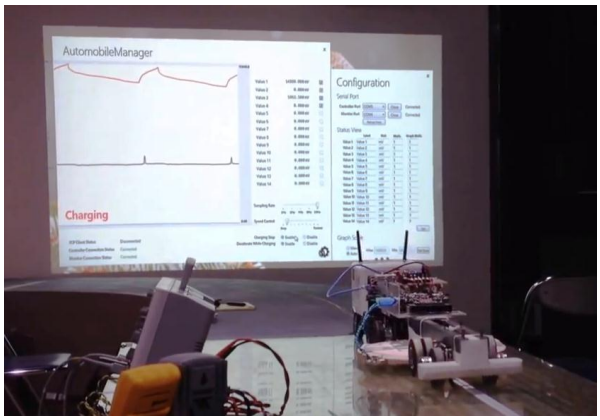

Photo 2 Experiment on power supply for a running vehicle

In Photo 2, you can see that the red graph, representing charging status, increases at the power supply point (where the car is, in the photograph), indicating that the battery is successfully charged while the model vehicle is running.

3. Supplying electricity for running vehicles

The test with the model confirms which technologies are required in order to supply electricity for running vehicles. However, it is still essential to test at higher levels of electrical power, in order to apply these results to real electric vehicles. Thus, our next step is to progress further with technical verification, aiming for a life-sized experiment and testing with greater power.

Using the energy of plant waste from cities

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SONE Naoyuki, Researcher
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(Key words) Biomass, plant waste, energy use, storage

1. Introduction

One low carbon city creation policy is the use of pruned branches and mowed grass etc. from green parks and roadside trees, etc. (below called, "plant waste from cities") as sources of energy. However, while plant waste from cities has been chipped for use as fertilizer or materials as part of green recycling, it has rarely been used to supply energy. In response to these background circumstances, the Landscape and Ecology Division has been conducting "research on the use of local production for local consumption type reusable energy in cities" since FY2012. This report introduces the potentiality of the use of plant waste from cities as an energy source based on the results of these researches.

2. Plant waste from cities

According to "Concerning the Present State and Roadmap for Biomass Utilization Technology" in the "Biomass Commercialization Strategy" prepared in September 2012 by the Biomass Utilization Promotion Committee concerning the use of this energy, its practical use is possible now (2012) and in about 5 years (about 2017), and that source materials will include woody material and grassy plants.

Standards for the use of woody biomass as fuel include the Proposed Guideline to Fuel Use Chip Quality Standards of Iwate Prefecture, which is a local government that makes advanced use of woody biomass, Wooden Chip Quality Standards of the National Wood Chip Industry Federation, and the wood pellet quality standards enacted by the Japan Wood Pellet Association in harmony with the EN Standards for Non-industrial Use Wooden Pellets enacted jointly by 28 countries of Europe in 2010.

Comparing the characteristics of plant waste from cities as a fuel with these standards shows that immediately after pruning and mowing, the moisture content of the pruned branches and mowed grass is high. And measurements of the ash content of the leaves of the pruned trees and of the mowed grass show that it is higher than the standard levels, and that the contents of sulfur (*S*), nitrogen (*N*), and chlorine (*Cl*) are also higher than the standard values.

3. Future development and use of the results

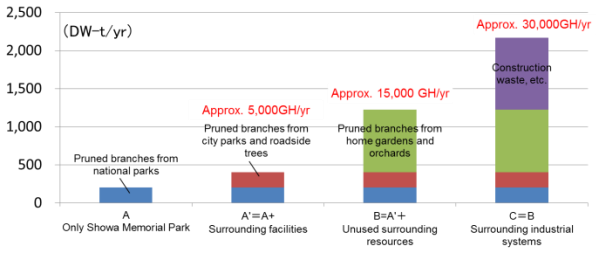
Presumably pruned branches without leaves contain a lot of tree bark, but it is believed that it will be possible to use energy just like normal wood. So a study is being made of a process in which immediately after branches are pruned, their moisture content is lowered to prevent decay or fermentation, then they are stored and later used as energy.

And trial calculations of the quantity produced in two districts in Japan are being done, including, not only plant waste produced in cities by the maintenance of public works such as rivers, roads, parks, etc., but also other woody biomass such as construction waste, and surplus forest material. (See the figure).

And present technology studies concerning the possibility of using energy of small-scale parks etc. dispersed plant waste from cities, and including the results of the above study, will be summarized in the document, Technology Document Concerning Methods of Using Energy of Plant Waste from Cities that will be released as a TECHNICAL NOTE of NILIM.

Photo. Use of Branches Pruned from Park Trees to Heat Park Facilities
(Oi Pier Central Seashore Park: Tokyo)
(Left: Chip dryer using solar heat, right: boiler)

Figure Quantity of Usable Wooden Biomass around Showa Memorial Park (Trial Calculation)



Calculating quantity of CO_2 fixation by urban trees applying 3-dimensional measurements

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(Key words) Urban trees, CO_2, 3-dimensional measurement

1. Introduction

According to the IPCC, there is no room to doubt global warming, the major cause is the rise of the CO_2 density in the atmosphere, and there is an almost proportional relationship between the cumulative quantity of CO_2 emitted and the rise of the average air temperature.

Combining measures to reduce or restrict emissions to curtail CO_2 is an absorption source measure. Trees grow by fixing CO_2, so the Kyoto Protocol includes a mechanism which can withdraw the quantity of CO_2 absorbed from the quantity emitted by forests and green belts which satisfy specified standards, and the Ministry of Land, Infrastructure, Transport and Tourism coordinates the quantity of CO_2 fixed by the restoration of vegetation such as urban greenery. Japan is not participating in the second commitment period of the Kyoto Protocol, but must continue to reduce quantities in order to establish a new international framework.

2. Purpose of the research

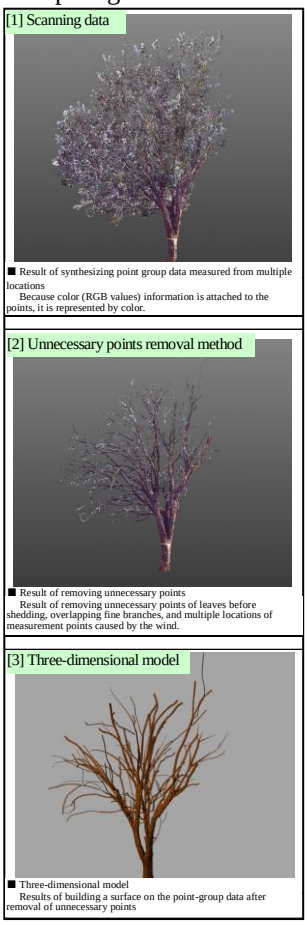
It is known that the carbon (C) content of trees is about 50% of dry weight of the woody part regardless of the species, so it is possible to estimate the quantity of CO_2 that a tree fixes based on the dry weight of the woody part. The speed of growth and density of trees vary between species, so it is possible to calculate the CO_2 fixation of any tree species by investigating the dry weights of various species at various ages. Until now, the NILIM has cut down trees and measured their volume and weight to calculate the CO_2 fixation quantities of camphor tree (*Cinnamomum camphora)*, bamboo-leak oak (*Quercus myrsinaefolia*), Japanese zelkova (*Zelkova serrata*), and gingko (*gingko biloba*), and others. But, because this loses valuable tree resources and the cutting etc. is time-consuming and costly, this research was intended to establish a CO_2 fixation quantity calculation formula for many species of trees by non-destructively and efficiently estimating the dry weight of trees without cutting them down.

3. Three-dimensional measurement of tree shapes

A three-dimensional laser scanner, which is an instrument which performs non-contact 3D geotagging of the surface shape of an object, is used to measure disaster sites or complex civil engineering structures, traces, etc. This method is used to estimate the volume of a tree to calculate its dry weight by finding the product of the volume and air-dried specific gravity of a sample.

Figure 1. Measurement of Tree Shape

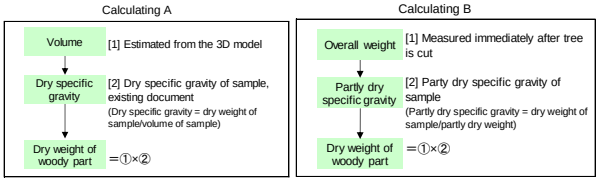
Figure 2. Processing of Preparing the 3D Model



To verify this method, dry weight A calculated by weighing and the dry weight B found by cutting a tree, removing its leaves, then measuring it were compared.

In the future, the number of tree species will be

Figure 3. Dry Weight Calculation Methods



increased and the precision verified, to calculate the quantity of CO_2 fixed within an error of 10%.

[Sources]
Landscape and Ecology Division web page: Calculation of quantity of CO_2 fixed by urban trees
http://www.nilim.go.jp/lab/ddg/naiyo/co2/co2.html

Improving methods of predicting change of emissions of carbon dioxide from automobiles as roads open for service

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(Key words) Road, carbon dioxide, technical method of evaluating road environment impact

1. Introduction

The development of methods of predicting change of greenhouse effect gas emissions accompanying road projects has, until now, been done by various administrative bodies and research institutes inside and outside of Japan, but, a standard method which a road builder can practically apply at the road plan study stage has not been established.

So studies have been carried out to complete knowledge concerning the range of the impact of changes of traffic flow and of the emissions of carbon dioxide (below, "CO_2") when a new road opens to traffic, and to overcome challenges to improving methods of predicting the range of such impacts.

2. Study method

Fifteen actual road plans (5 cases each of bypass, expressway, and ring road projects) were used to trial calculate change of traffic volume, traveling speed, and CO_2 emissions caused by the opening of a new road to service and to analyze the state of these changes, based on the CO_2 emission coefficient by estimated traffic volume and by travel speed.

Figure 1. Distribution of Change of CO_2 on the New Road and Surrounding Roads (Example of a bypass road, yellow shows the project location)

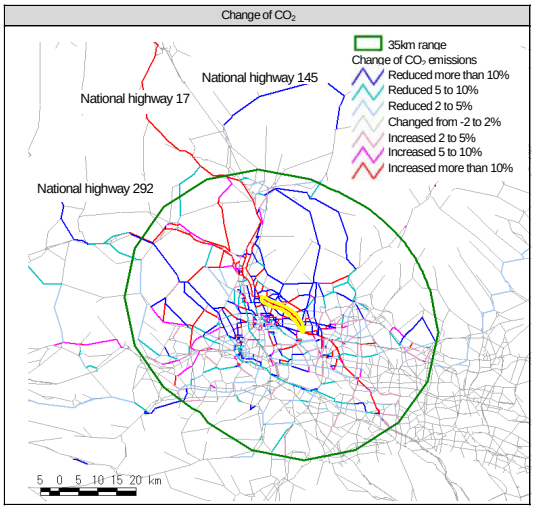
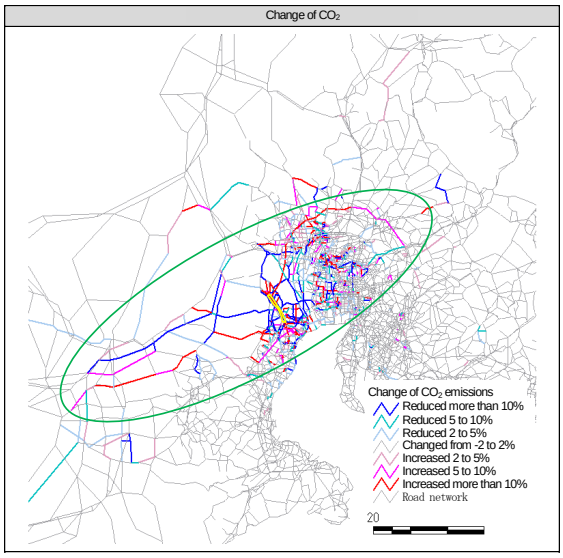


Figure 2. Distribution of Change of CO_2 on the New Road and Surrounding Roads (Example of a ring road, yellow shows the project location)



3. Results of the study

Figure 1 and Figure 2 show examples of the change of CO_2 emissions accompanying the change of traffic volume on the new road and on surrounding roads.

They show that while the traffic volume increases on the new road and sections at each end, on multiple roads parallel to the new road, the traffic volume falls accompanied by a decline of CO_2 emissions. As a result of analyzing such changes in traffic volume and CO_2 emission in detail, the following were obtained as criteria for the range of the evaluation of the new roads.

Bypass:	for 10km of improved road, areal range of about 30 to 40km
Expressway:	areal range on the inside of a distance of 50km or more. It is also effective to narrow the focus to expressways and national highways.
Ring road:	wide areal area such as an entire regional block.

But in the future, the criteria must be verified by comparison with actual changes caused by the opening of a new road.

4. Summary

The successful results and knowledge provided by the study will be further verified in the future, and will contribute to the building of a method of predicting CO_2 emissions of road projects.

Clarifying the future roadside environmental load reduction effects of the penetration of next-generation vehicles

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(Key words) Next-generation vehicles, carbon dioxide, roadside environmental load

1. Introduction

Cargo vehicles produce 34% of all CO_2 emissions from the transport sector[1)], and it is important to introduce cargo vehicle environmental load countermeasures. This research trial calculated the future roadside environmental load reduction effects of the penetration of next-generation vehicles.

2. Trial calculation conditions

The table presents an outline of the trial calculation conditions. In addition, traffic volume, traveling speed, next-generation vehicle penetration rate and CO_2 emission factor were set with reference to source documents[2)3)4)5)6)7)].

3. Trial calculation results

As a result of the trial calculation of CO_2 emissions by the procedure shown in Figure 1, the CO_2 emissions in 2050 were calculated as 45% lower than in 2010. At this time, CO_2 emissions by small-sized vehicles and heavy vehicles are almost equal, but because the penetration rate of large next-generation vehicles will be lower than that of small-sized next-generation vehicles, the trial calculation revealed that in 2050, heavy vehicles will emit between 60% and 70% of all CO_2 (Fig. 2).

4. Summary

The trial calculation clearly shows that even among cargo vehicles, it is important to promote measures to spread the use of next generation vehicles as heavy vehicles in particular.

Table. Outline of Trial Calculation Conditions

Items	Settings
Object of calculation	Carbon dioxide (CO_2)
Calculation period	2010, 2020, 2030, 2040, 2050
Calculation range	Sections where normal traffic volumes are surveyed during the road traffic census
Next-generation vehicles considered	Hybrid vehicles, plug-in hybrid vehicles, electric vehicles, fuel cell vehicles, clean diesel vehicles, gasoline vehicles
Level of penetration of next-generation vehicles	Zero: (penetration rate same as in 2010) Low: (case where penetration rate is estimated as low) Medium: (average penetration rate) High: (case where penetration rate is estimated as high)

Figure 1. Trial Calculation Procedure

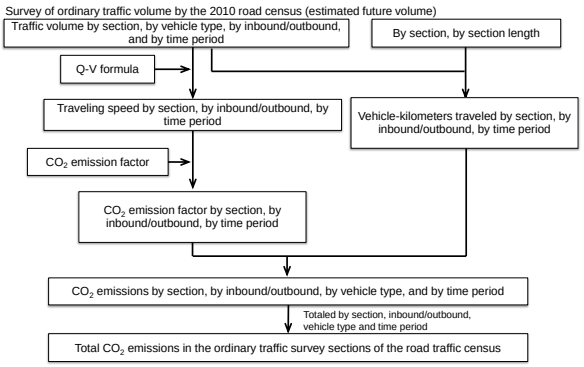
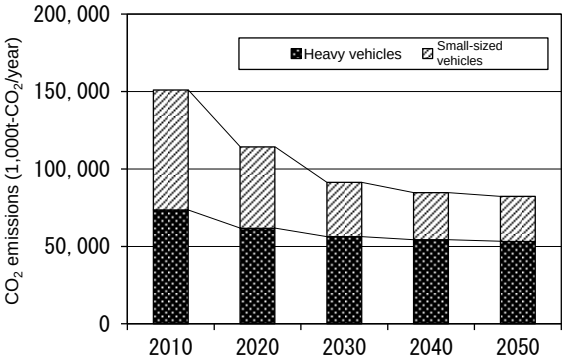


Figure 2. Trial Calculation of CO_2 Emissions (Penetration level: high)



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1) Ministry of Land, Infrastructure, Transport and Tourism web site: Carbon dioxide emissions by the transport sector, http://www.mlit.go.jp/
2) Ministry of Land, Infrastructure, Transport and Tourism, Study Committee on Future Traffic Demand Estimation on Roads: Estimation of future traffic demand, 2008
3) Central Environment Council: Report on countermeasures and policies beginning in 2013, 2012
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6) Next-generation Vehicle Penetration Strategy Committee: Next-generation vehicle penetration strategy, 2009
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Proposal for Enhancing River Environment Management

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Keywords: river environment, management, Ecological niche model

1. Maximizing the information on river environment

In realizing the conservation and restoration of a beautiful and natural river environment, basic river environment information is mainly obtained from the biological surveys, called the National Census of the River Environment ("Census"), which is conducted every 5 years. A river environment information map is created by summarizing the Census data in a map. Such information has become available this decade and accordingly basic knowledge of the conditions of river environments in Japan has been increased. Therefore, efforts should be made to utilize such information and knowledge in the practical river management, with the aim of enhancing the effectiveness of management.

2. Issues in practicing environmental management and solutions

Generally, management consists of four items: monitoring and evaluating conditions, improvement measures, and target setting. As a result of applying this to the management of a river environment, issues and solutions in each item are considered as follows.

○ Issue 1 <Monitoring the conditions> Measuring the distribution / amount of habitat

In river environment management, not only living things but their habitats are generally taken into consideration. Particularly, for what regards river channel topography and vegetation, a good balance of flood control conditions, such as discharge capacity, and environmental conditions, such as good habitats, is needed, and is one of the targets in practical management.

For what regards physical habitats, neither a mechanism nor a survey method for periodically collecting data has been established, as in the Census, e.g., distribution or amount (e.g. area) of rapids and pools essential for fishes. For this reason, it is necessary to establish a mechanism for obtaining habitat data periodically.

○ Issue 2 <Evaluating of the conditions> Evaluating habitat quality

The quality of a habitat is evaluated by checking the inhabitation of living things under the Census against the condition of the habitat. Since the Census is conducted in typical areas, a method is required to evaluate the condition of habitats in other areas.

○ Issue 3 <Improvement measures> Providing technical information on improvements / management

For the river segments under the control of the national government, technical information as to what approach is appropriate or should be avoided for eco-friendly river improvement / management is lacking. It may require steady efforts, but it is necessary to focus on collecting existing data for the locations improved as part of activities in Issue 1, and provide the obtained information.

○ Issue 4 <Target setting> Need further discussion

Many discussions have been made on setting targets but not yet reached a conclusion. Therefore, practical measures should be continued in order to maintain or improve the present situation for the time being.

3. Development of habitat evaluation methods

The NILIM, in collaboration with the MLIT, Regional Development Bureaus, and Public Works Research Institute, has been studying the aforementioned issues since last fiscal year. To represent our study, the following describes Issue 2. For Issue 2, studies are underway on the application of an approach (ecological niche model) for evaluating, based on habitat information, the appropriateness of a habitat as probable habitat for a certain type of organism (indicator species). This issue was studied using Census data on fishes and physical environment data on 1 km sections plotted in 2006 for the rivers under the direct control of the national government (Figure).

In the future, we will also study practical measures for Issue 2, using this kind of models.

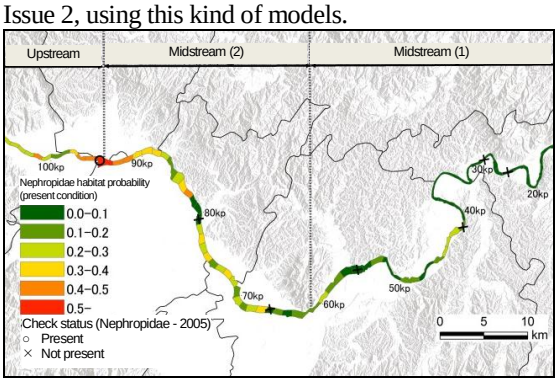

Figure: Example of Habitat Potential Evaluation with Ecological Niche Model

Study on Maintenance Flow Rate Setting Procedure for Rivers in Mountainous Area

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Keywords: renewable energy, small scale hydropower, rivers in mountainous area, river maintenance flow rate

1. Background of study

The development of renewable energy is attracting attention after the power supply shortage that followed the Great East Japan Earthquake. Since a fixed price purchasing system for renewable energy started in 2012, the purchase price of renewable energy has been rising. For small scale hydropower, one of the renewable energies, revisions to the River Law in 2013 allow providers to register instead of requiring permission for subordinate power generation using the existing water utilization system since it is not expected to have new impacts on river environments, etc. As a result, application documents and procedures were simplified and the period required to obtain water rights was significantly shortened.[1)]

In the case of new water intake, it is still required to determine the river maintenance flow rate in consideration of the impact on the river environment, etc. However, for rivers in mountainous areas where small scale hydropower is likely to be introduced, it would require much time and effort to set the river maintenance flow rate in the conventional manner since there is little data or knowledge necessary for setting the rate. Therefore, this study aims to facilitate water utilization procedures for small scale hydropower by establishing a suitable and simple approach for setting river maintenance flow rate for rives in mountainous areas.

2. Study method

This study is surveying, as model rivers, 4 rivers where small scale hydropower systems have been introduced. The study items have been limited to two considering the characteristics of rivers in mountainous area, i.e. impact of water intake on the habitats of living things and impact on landscape.

(1) Impact of water intake on habitats

By classifying the components of river channels in mountainous areas into step pool channels, cascade channels, and riffle-pool channels, and defining each of them, the effect of flow rate decrease on habitats was examined for each component of the targeted river channels. Considering that maintaining the habitats is important to reducing the impact of water intake on living things and that no significant changes in physical quantity including depth, velocity, water surface area, and water temperature is important for maintenance, we did an hydrologic accounting by modeling each component of the river channel and estimated what changes the decrease in flow rate could cause to such physical quantities (Figure).

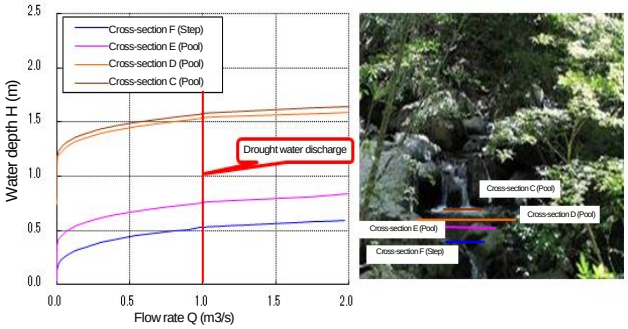

Figure: Example of Site and Hydrologic Accounting

(2) Changes in the landscape of rivers in mountainous area due to water intake

From past studies, it was found that people perceive a greater "amount of water" in areas whitened by ruffled waves caused by a drop or otherwise in the stream. Therefore, we conducted an experiment on landscape preferences to study how people perceive the "amount of water" with photos taken of an actual river with the flow rate reduced in stages using a pump, and analyzed correlations between the "perceived amount of water," scale of ruffled waves, and various quantities of river.

3. Future plan

Based on the results of this study, we plan to propose a reasonable method for setting flow rate for river maintenance in mountainous area, and verify the applicability thereof through case studies.

[Reference]

1) MLIT website
http://www.mlit.go.jp/river/riyou/syosuiryoku/index.html

Maintenance of Good Water Environments by Wastewater Treatment and Evaluation of Sustainable Wastewater Treatment Methods

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Keywords: coliform count, coliform group count, energy consumption, nitrogen removal, reclaimed wastewater

1. Introduction

Sewage systems greatly contribute to the maintenance of a good water environment, and for that purpose, the removal of harmful microorganisms, organic matter and nutrient salts in sewage is important. Moreover, efforts to reduce energy consumption related to wastewater treatment are important for achieving a sustainable environment. This division is conducting research and studies from various viewpoints into the maintenance of a good water environment by wastewater treatment.

2. Study on introducing new hygienic indexes to wastewater treatment facilities

"Coliform group count" has been used as an environmental standard for water quality and as a hygienic index for final effluent from wastewater treatment facilities since it allows for easy and cost-saving measurement. However, its validity as an index of fecal contamination is pointed out to be low mainly because of contained bacteria of soil origin. At present, surveys and studies on reference values are proceeding in order to change the index used in the environmental standard for water quality from a rough coliform count to measurable E.coli count." Therefore, the need is growing for studies into changing the index to E.coli count also for effluent

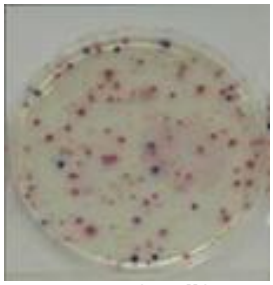

Photo: Appearance of Coliform Colonies (Blue: E.coli count, Red: Coliform group count (except E.coli))

The NILIM is conducting a survey to grasp the E.coli count in effluent, variations thereof by season and time of day, the effect on measurement values due to the difference among multiple measurement methods, etc. The survey has so far revealed variations in the measured E.coli count according to the measuring method used for final effluent. Variations according to seasons or time of day were not clearly seen. These results are to be utilized to study the methods for measuring E.coli count.

3. Study on reduction of energy consumption related to nitrogen removal

Since energy efficiency in nitrogen removal is low in small-scale wastewater treatment facilities, we studied whether energy consumption could be reduced in the whole drainage basin by integrating the pollution load removal and associated energy consumption of multiple wastewater treatment facilities in the same basin into a large-scale wastewater treatment facilities. Using the Sewage Statistics in Japan (note), we organized the relationship between energy consumption (kL/day), obtained by converting into quantity of heavy oil from electric power used in wastewater treatment facilities for water treatment, and the nitrogen removal load (tN/day). And we developed formula showing the relationship between the nitrogen removal load (tN/day) and the energy consumption (kL/tN) per unit removal amount, since energy efficiency changes according to the scale of the facilities. With this formula, we calculated energy consumption in five small and large treatment facilities in the model drainage basin, and studied whether it is possible to reduce energy consumption while ensuring the amount of removal by concentrating nitrogen treatment in a large facility. As the result, it was estimated possible to reduce 16% of the energy consumption required for water treatment in the whole drainage basin.

4. Evaluation of energy consumption related to reclaimed wastewater supply

Reclaimed wastewater from sewage is a valuable water resource available even in times of drought. Since the utilization of reclaimed wastewater needs to consider energy consumption, we are studying reclaimed wastewater processes that minimize energy consumption. So far, we have found that, when a large amount of energy is consumed to convey reclaimed wastewater, there is room to reduce consumption by screening supply areas. We are proceeding to evaluate energy consumption and life cycle CO_2 assessment related to reclaimed wastewater supply.

[Reference]

"2009 Sewage Statistics in Japan", Japan Sewage Works Association, June 2011

Possibility of restoring eelgrass (*Zostera marina*) beds in Miyako Bay damaged by the Great East Japan Earthquake

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(Key words) Great East Japan Earthquake, tsunami, zostera marina, sediment, particle-size distribution, Miyako Bay

1. Introduction

The tsunami triggered by the Great East Japan Earthquake of March 11, 2011 destroyed a lot of eelgrass (*Zostera marina*) (Photo) growing in sand. Eelgrass beds, which are called the cradles of the sea, are one of the foundations of coastal ecosystems, as they function as spawning grounds for fish and habitats for fry, and their destruction severely impacts coastal ecosystems. This research was conducted in the head of Miyako Bay, where eelgrass beds had formed before the earthquake, to clarify the state of eelgrass and sediments, and to learn if it will be possible to restore the eelgrass beds in the future.

2. Method

A survey was done focusing on grain size, which is a condition for the breeding and growth of eelgrass that can be greatly changed by a tsunami. In October 2012, the state of distribution of eelgrass was clarified and sediments were sampled at 120 points in the head of Miyako Bay. And to learn the transport routes of eelgrass seedlings, a three-dimensional model was used to calculate the currents inside the bay.

3. Results

There were places behind the breakwater at Takahama and at the inlet behind the peninsula on the east side where eelgrass was found in dense or open communities (see Figure). This is assumed to be a result of the shadow of port structures or the peninsula preventing their destruction by the tsunami.

The sediment at these locations was evaluated for its suitability as the habitat of eelgrass based on its particle-size distribution. The sediment between Kobori, and Horiuchi, at Takahama, at Kamagasawa, and Akamae, where either dense or open communities of eelgrass was confirmed, had particle-size distribution suitable for the breeding and growth of eelgrass.

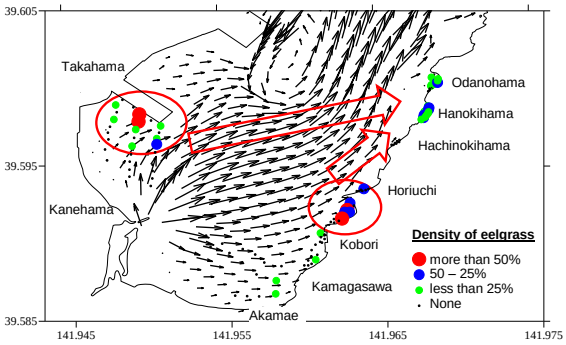
And the figure is an example of a map prepared by superimposing the distribution of eelgrass which survives on the results of calculating the tidal residual current of the surface layer in the head of the bay in the autumn. The eelgrass in Takahama and Kobori are upstream of the flow, which means that seeds can be counted on to move to Hachinokihama, Hanokihama, and Odanohama from Takahama, and Kobori. The direction of the flow is the same in every season, so similar advection currents can be counted on to occur in every season.

4. Perspectives of future monitoring

This survey reveals that many places with sediment conditions suitable for use as habitats by eelgrass remain. We wish to continue monitoring in anticipation of the small scale eelgrass beds which remain steadily expanding a little at a time into their surroundings and the eelgrass beds confirmed to be dense communities acting as supply sources restoring eelgrass beds over a wide area.

Photo. Eeelgrass in Miyako Bay

Figure. Residual Current (Autumn) and Eelgrass Distribution



[Sources]

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Study to achieve more prioritized and efficient environmental conservation measures for plants and animals in road projects

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(Key words) Environmental conservation measure, road project, raptors, environmental impact assessment

1. Introduction

During road projects, a variety of environmental conservation measures are taken to avoid, mitigate, or compensate for the project's impacts on rare plants and animals. These include the following measures of unconfirmed effectiveness which are taken by road projects while hearing the opinions of local experts.

- Showing concern for raptors during works
- Transplanting vegetation
- Relocating amphibian species

The Environmental Impact Assessment Law obligates surveys (post-project surveys) when implementing environmental conservation measures of uncertain effectiveness (below called, "uncertain measures"). And the preparation and release of the report will, under the revision of the Environmental Impact Assessment Law, be obligated beginning with project submitting an environmental impact statement in April 2013.

This paper discusses present conditions focused particularly on showing concern for raptors during works, and introduces the state of studies conducted to achieve prioritized and efficient environmental conservation measures.

2. Present state of consideration for raptors during work

Protection of raptors is presented in Methods of Protecting Raptors (Enacted in August 1996, revised December 2012) from the Ministry of the Environment. And the Supplement (TECHNICAL NOTE of NILIM No. 721) to the Environment Impact Assessent Technique for Road Project(ditto No. 714), explains the method of assessing the environmental impact on raptors and countermeasure examples. As part of every road project, based on these documents, nesting locations and the state of propagation are surveyed at the same time as a variety of countermeasures are studied and executed.

Around nesting locations, work is often done so as to avoid the nesting period (generally spring to early summer) but, when for example, the nesting location is visually monitored and anything abnormal is observed while the work is executed, actions are taken in response, including studying the temporary suspension of the work.

Almost all of the above initiatives are taken to avoid impacting the propagation of raptors during the execution of the project (Table). But these surveys and countermeasures incur annual costs per project in the order of several tens of millions of yen (trial calculated as several billions of yen per year for government executed road projects nationwide).

Table. Results of Verification of Impacts of Road Projects on Raptors (under close examination)

There is impact	Slight impact		Unclear
		Propagation failure by non-project causes	
0	463	17	5

Note) Number of cases are total number of nests/year (nationwide: 2009 to 2012)

3. Study to achieve prioritization and efficiency

The state of nesting and propagation of raptors are surveyed and countermeasures taken during works throughout Japan to prevent impacts on their propagation, but the effectiveness of these countermeasure is still considered to be uncertain, and it is difficult to achieve greater prioritization and efficiency. This is assumed to be a result of the fact that for the following reasons, the results of surveys of each project are limited to knowledge within each site (or work office).

- Propagation of raptors is linked to various factors such as natural conditions, type of works, differences between species of raptors or individual raptors, so decisions must be made independently for each site. (diversity is high.)
- It is impossible to publicize information including locations of nests in particular to prevent poaching.

For this reason, the NILIM, by collecting and analyzing survey reports on uncertain measures on government executed road projects throughout Japan, intends to clarify the causal relationships between the actions of raptors, the success or failure of their propagation and the operation of construction machinery during works in order to prioritize truly necessary countermeasures etc.

And for the same reasons, it is also difficult to prioritize the transplantation of vegetation or the relocation of amphibians.

The NILIM aims to achieve so-called formalization of knowledge and further prioritize or increase the efficiency of effective countermeasures by each project so that it will be possible to share knowledge obtained at each site concerning these uncertain measures.

4. Use of the successful results

Based on future successful results, the Environment Impact Assessment Technique for Road Project will be revised. And by submitting manuscripts, the NILIM will provide information concerning the conservation of wild animals such as Methods of Protecting Raptors.

Qualitative repletion of the public infrastructure combining reconstruction and redevelopment of public facilities

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(Key words) Redevelopment of road space, landscape formation, spatial planning, downtown and suburbs, linkages

1. Introduction

The increase in the number of deteriorated public facilities has been accompanied by a need for strategic maintenance and qualitative repletion of public infrastructure. This means there is a growing need for the creation of high quality spaces in order to form good landscapes and living environments as part of the process of renewal and redevelopment of public facilities.

When redeveloping road space in particular, it is necessary to create public space linked to roadside facilities in order to form integrated landscapes and stimulate tourism, etc. And as shown by the Scenic Byway Japan movement, diverse regional activities are being undertaken nationwide centered on roads from the perspective of their use. But linking multiple projects that include roads and other facilities and span the downtown and suburban parts of cities, and the frame work of road projects which effectively link local activities to the formation of landscapes have not been fully proven, and methods of enforcing the Landscape Act and other policies to develop the formation of good quality space have not been clarified.

This research will clarify project and system operating methods and their effectiveness based on innovations in project organizations and design, and maintenance and utilization methods applied after redevelopment in order to verify planning methods which link road projects with related projects, and the activities of concerned parties in city centers and in suburbs by looking at cases in which road space was redeveloped.

2. Analyzing the road redevelopment cases and organizing related system operations

For the survey, road and street redevelopment project cases are collected for about 100 locations nationwide in order to organize information and clarify actual state of redevelopment of road space. And in order to stress clarification of recent trends in redevelopment and improvement points etc. we broadly consider scales and the process of landscape formation (Table, Photo). These are systematically classified in parallel with the study of specific standards that can be applied to clarify the degree of qualitative improvement.

And present systems related to regional activities are organized. Focusing on the use of preservation districts for groups of traditional buildings, civil engineering legacies etc. through initiatives such as Scenic Byway Japan movement, challenges are organized and methods which can link local people over a wide range are studied.

3. Future development

Following the study conducted by collecting and systematically classifying the above cases, based on the detailed study of specified cases, methods of carrying out public works projects through linking road projects with other projects, analysis of the urban ripple effects, and formation of landscape in city centers and suburbs by enforcing the Landscape Act and other systems will be studied. And cases in overseas cities will also be comparatively analyzed. And as the final result, we want to support regional development focused on roads by constructing a data base and handbook which can be used to clarify characteristics of each case.

Table. Systematic Classification of Road/Street Redevelopment Cases and Sample Cases

[1] Pedestrian-centered roads that are the faces of tourist regions	Shinmondori Street in front of Izumotaisha Shrine
[2] Station plaza roads that form the skeleton of a city	Otemaedori Street in front of Himeji Station
[3] Commercial and shopping streets used mainly by pedestrians	Marugame-machi shopping street
[4] Creating open spaces	Soseigawa Park (Sosei Tunnel)
[5] Improved use by constructing buildings above and below roads	Ohashi Jct. on the Metropolitan Expressway
[6] Integrated redevelopment by revising route designations	Streets around the main building of the Dogo Hot Spring
[7] Road development linked to residential district development	Relocating on hills as part of earthquake disaster restoration
[8] Improving section configuration by changing the number of lanes etc.	Bicycle paths and on-road parking areas

Photo. Creation of Green Shady Space by Widening Roads (Kobe: former foreign settlement district. Corresponds to [3], [4], and [8] in the above classification)

A Case of Utilizing Results

Preparation of "Manual for Evaluating the Invasiveness of Plants Introduced to Rivers" (Draft, tentative title)

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Keywords: alien plant, invasive risk assessment, river management

1. Background "Manual (draft)" preparation

In the "National Strategy for the Conservation and Sustainable Use of Biological Diversity 2012-2020" (Sep. 2012), as one of the national targets of Japan to achieve the Aichi Target, it is required to develop an "Invasive Species List" and "Invasive Alien Species Control Action Plan (tentative)" by 2014, so discussions are underway accordingly.

In riverbeds, many plants including alien plants are used for levee armoring, planting in river parks, etc. (Figure). Some alien species are invasive and escape from the originally seeded / grown area, whereby affecting native species and ecosystems. Therefore, when using an alien species as a garden plant (Photo) in a riverbed or afforestation project, it is necessary to grasp in advance its escape and settlement risks.

Therefor, as reference material for selecting plants that do not impact the natural environment or river management, we developed a "Manual for Evaluating the Invasiveness of Plants Introduced to Rivers" (draft, tentative title). It organizes the concept of prior assessment in introducing new species, points of attention in introduction and management, etc.

2. Outline of "Manual (draft)"

The "Manual (draft)" first organizes the concepts of invasiveness including the necessity for considering it, and then introduces how to assess invasive risk including assessment methods in other countries. Furthermore, the Manual describes the species that warrant attention based on the results of the Census of Rivers and Riparian Areas, and points of attention in using garden plants and afforestation plants.

Ten percent of the introduced plants are said to escape to outer fields, and 10% of those species are said to settle and a further 10% of them are said to become invasive. Therefore, many of the alien plants used may not be invasive. However, even if the quantity of alien plants is very small at first, they are likely to increase enormously as time elapses. In such case, they are regarded as "invasive alien species," which escape and settle in the natural environment and adversely affect ecosystems and human activities. It will become very difficult to eradicate them if they expand across a wide area. It is, therefore, important not to use alien plants with high risk of escape and settlement from the beginning.

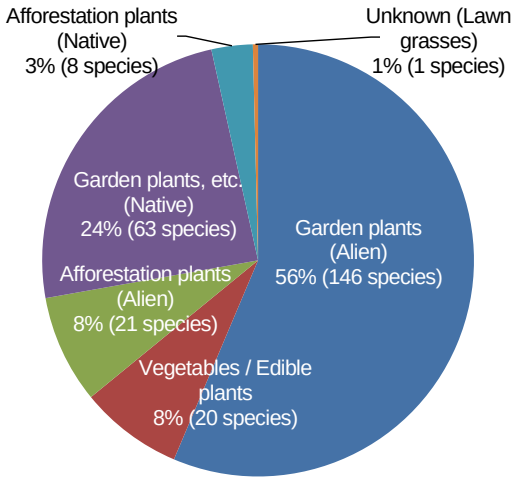

Figure: Number of Species of Herbaceous Plants Seeded / Grown in Japanese Rivers from 2005 to 2010

3. Publication of findings

The "Manual (draft)" will be released to the public as an NILIM document.
(http://www.nilim.go.jp/lab/ddg/seika/)
We hope that this material will contribute to alien species control measures at actual sites.

Photo: Example of Garden Plants Growing in Riverbed
(Left: Verbena hybrida, Right: Forget-me-not)

Topics

Towards rapid support activities by regional construction contractors when a giant earthquake has occurred

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(Key words) Great East Japan Earthquake, regional construction contractors, disaster response management

1. Introduction

Immediately after the Great East Japan Earthquake occurred, regional construction contractors quickly began activities to support the restoration of infrastructure functions, which was linked to large-scale rescue and live-saving activities. The NILIM conducted a questionnaire survey concerning the actual state of support activities by regional construction contractors in cooperation with Tohoku Regional Development Bureau and Tohoku Federation of Construction Contractors Associations, receiving responses from 806 companies. From the survey results, many facts about future disaster management were learned. This report introduces the results of an analysis of factors behind the rapid support activities.

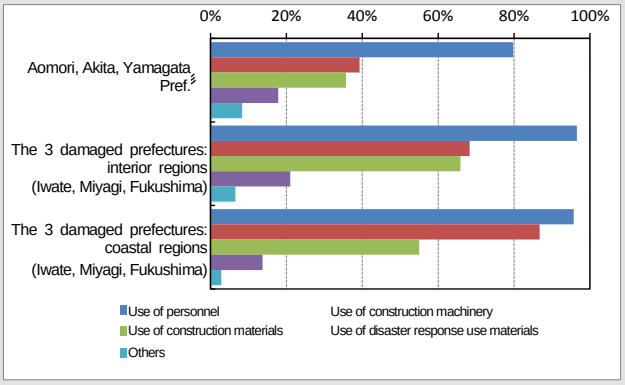
2. Resources contributing to the support activities

The Figure shows the results of aggregating resources used for rapid support activities by Aomori, Akita and Yamagata Prefectures where the damage was relatively light and by the interior regions and coastal regions of the three prefectures where the damage was large (Iwate, Miyagi and Fukushima Prefectures). In all regions, "Personnel" showed a high percentage. In the coastal regions of the three damaged prefectures, "Construction machinery" showed over 80% . In the interiors of the three damaged prefectures, "Construction materials" showed a relatively high percentage. It can be concluded that in order to conduct rapid support activities immediately after an earthquake, it is necessary to provide construction machinery and construction materials in addition to personnel.

3. Methods of securing resources

An analysis was done to clarify how to secure the personnel, construction machinery and construction materials required for rapid support activities, by Aomori, Akita, and Yamagata Prefectures and by the interior regions and coastline regions of the three damaged prefectures. The results for personnel (operators) are introduced below.

Figure. Resources Used for Rapid Support Activities



In all regions, to obtain sufficient operators, they secured most from among their own employees followed by employees from cooperating companies inside the prefecture. In addition, on the coastlines of the three damaged prefectures, many operators were contributed by cooperating companies outside the prefecture. This was conspicuous on the coastlines of Iwate Prefecture and Miyagi Prefectures in particular.

Similar results were obtained concerning resources other than operators. In severely damaged regions, where insufficient resources were secured by cooperating companies inside and outside the prefecture, permitting rapid support activities.

4. Conclusions

We wish to carry out research to find out how to smoothly secure resources needed for support activities from cooperating companies and leasing companies etc and in which regions to make priority investments in order to prepare for great earthquakes.

[Sources]
TECHNICAL NOTE of NILIM No. 729
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0729.htm

Topics

Use of 3D Archives of Local Dwelling Space

-Visualizing History of Settlements beyond Disasters and Development-

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(Key words) *3D Archives*、*Settlements*、*History*

1. Introduction: Historical Documents in 3D

Methods for preserving data even after their formats became obsolete were developed in the previous study[1]. This study applied the developed methods to the data recording actual settlements, which integrate fragments of maps, photos that record historical parts of a settlement. Also ways to access to the source records from the 3D objects, to visualize them on the site, to convert them in any desired format were tried out, in order to extend the possibilities for future use.

2. Okushiri Island: experiencing Disaster

Coastal settlements of the island were destroyed by tsunami and fire after quake on July 12, 1993. However, they were quickly reconstructed through effective support provided by the Hokkaido prefectural government and the research institute for housing and urban planning[2].

In this study, the settlements were reconstructed through analysis of old analog photos and maps.

Figure Reconstructed Cape Area in Aonae Village

The area was totally destroyed in 1993, and become a memorial park after reconstruction. Houses were reconstructed through analysis of old photos. The settlement can be seen from any viewpoint. Each house can also be selected to access the old photos that record it.

The history prior to 1993 included a big fire in 1963 when the population was at its peak. Efforts for reducing the density, including land readjustment, extension of the width of roads, and the development of new towns on the hill were undertaken. A previous tsunami due to the Central Japan Sea Earthquake in 1983 caused damage smaller to those of 1993. Footpaths for evacuation to the new town on the hill were added. These components for disaster mitigation are common to those that were chosen after 1993, and the shared experience obviously provided conditions for rapid consensus on the reconstruction plan after the far larger disaster in 1993.

3. Tsukuba: experiencing Large Scale Development

The Japanese government decided to relocate several functions of the capital Tokyo to Tsukuba region in 1963. The development process of the region can be traced through official urban planning drawings, systematically taken air photos, design drawings of public buildings and photos after completion from the 45 organizations (mostly research institutes) involved in the relocation project, which comprised totally 2,700 hectares.

Seeking for a wider scope, the previous space of a research institute before the relocation was also surveyed in this study, and compared with the new campus.

The change of land use before 1963 was also surveyed.

The comparison revealed that the last large scale development after 1963 was one component of chain of changes of one site among forest, military airport, space for resettlements of the refugee from colonies after the war and current research institutes.

Also, histories of organizations show the chain of relocations within the metropolitan region, through which knowledge was continuously accumulated and overlaid.

4. Conclusion: toward a Stock of Empirical Wisdom

In order to achieve the legacy-free usage, the archived data file is attached with a metafile describing the procedure to read. A special common format/grammar of this metafile is defined for the developed Virtual Converter, which compiles the metafile to create executive operations that utilize the data.

This Virtual Converter is integrated in an Android based application (VC-3M) for tablets, that present the recorded data on site from the viewpoints and camera angles obtained from GPS, gravity and magnetic sensors.

The same source code of the Virtual Converter is also applied to a Windows-based web server application which can deliver the preserved data in any format defined by the attached metafile (VC-4D).

Hopefully, the rapidly changing ICT technologies will not accelerate the legacy process of recorded data and forgetting them, but contribute to the lasting succession of valuable empirical wisdom of each local settlement.

[Sources]
1) Basic Research on the Technologies for Permanent Diachronic Memory of 3D Housing Information. http://sim.nilim.go.jp/MCS/phi/(in Japanese)
2) Hokkaido Prefectural Cold Region Housing and Urban Research Institute (Hokkaido Northern Regional Building Research Institute, today)
3) http://sim.nilim.go.jp/Okushiri (in Japanese)
4) http://sim.nilim.go.jp/Tsukuba(in Japanese)

Configuration of Draft Scenario for Systematic Urban Shrinkage of Urban Areas in Depopulating Cities

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(Key words) Depopulation, Urban Area Restructuring, Systematic Shrinking

1. Introduction

Taking into account the predicted population decrease in local cities and rigorous fiscal and environmental restrictions in the future, introduction of "systematic shrinkage of urban areas" seems inevitable in restructuring urban areas and realizing a "compact city type urban structure". Thus the Urban Planning Department has been deliberating expected urban feature, enforcement requirements, effective steps to carry out and so forth, when implementing such measures. Based on deliberations, of last fiscal year, for examples of relocations of residents, we examined its implementing scenarios.

2. Implementing Process and Elements of Systematic Urban Shrinkage of Urban Areas

First of all, by reference to the process of relocation of depopulated settlements and implementation of urban planning projects, we compiled practical procedures of systematic shrinkage centering on the relocation of residents and arranged them in the following four phases (see Figure).

(1) Consensus formation: Discriminate the urban area into consolidated and shrinking zones in upper level planning process etc. and obtain an agreement in the latter.
(2) Preparation of relocation base: While the preparation of relocation to accept residents is carried out in the consolidated zone, new public investment is cancelled in shrinking zones.
(3) Relocation: After the completion of the relocation base, relocation of residents from the shrinking zone progresses, and in parallel, maintenance management of infrastructure in the degenerating zone is cancelled serially.
(4) Disposition of vacant lots: Along with finishing relocation from the shrinking zone, initiate improvement as a vacant lot and

Phase	Deliberation method/procedure of urban district degeneracy
①Consent formation	a. Deliberation/positioning in basic concept/comprehensive projects b. Deliberation/positioning in urban planning master plan c. Preparation/positioning for random plan in livelihood formation project
②Accepting destination improvement	a. Make existent urban district an accepting destination. b. Newly improve an accepting destination by urban district development project and development action
③Transfer	Calculate compensation cost/transfer cost according to the following methods a. One case examination (method to calculate compensation amount or the like individually) b. Maximum limit of aid or the like are prescribed by law
④Vacant lot disposition	a. Rights of land/building remain owned by the right holder concerned. b. Return the land to being a vacant lot and restrict land use for housing. c. New land utilization (farm land, park/green space, mega-solar, etc.)

Figure: Implementing process for systematic shrinkage of urban district degeneration

utilization of the site.

Furthermore, on the premise of the above process, we have arranged composition elements necessary for the formation of the scenario's draft in the following four items.

a) Residents' relocation method and their destinations: The two cases of relocation accompanied by coercive force and voluntary relocation incentives by inhabitants and provision of housing to be an accepting destination by government and securement of destinations by their own exertions are considered. It can be presumed that initially inducing voluntary relocation, and subsequently, transfer to a method to be accompanied by coercive force or the like to a phased combination.

b) Program for phased abolition of facilities and so on: Based on the concept of strategic infrastructure improvement and management, on the premise of differentiation and concentration for service levels on a zone –by-zone basis, from the dual viewpoints of renewal/reduction and repletion/maintenance/abolition, consideration can be carried out on four types: renewal/repletion, renewal/maintenance, reduction/maintenance and reduction/abolition.

c) Program for phased abolition or the like of administrative services: In the process of degeneration, it is difficult to abolish administrative services for elderly people with low incomes, so a decrease in provision levels and substitution of services with more inexpensive costs becomes the premise. In addition, livelihood assistance services for the elderly in the consolidated zone can be presumed.

d) Content of improvement for transferred vacant lots: Other than the utilization morphology of an open space utilization type, a case to make it a green space also is presumed unless it can be positively utilized.

3. Deliberations based on a scenario draft for systematic shrinkage

The specification of abovementioned processes and the composition elements had been considered in the case study districts and we have established draft scenarios. In the future, based on this draft scenario, the effects of systematic shrinkage of urban areas are scheduled to be calculated and arranged from both aspects of quantitative and qualitative analyses.

[Reference]

1) NILIM Report 2013 "Research on how the systematic shrinking of urban areas in depopulating cities should be" http://www.nilim.go.jp/english/annual/annual2013/44.pdf

Survey Results on Area Management in Densely Built-up Areas

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(Key words) Area management, Densely Built-up Areas, Physical improvement, Enhancement of fascination and vitality

1. Foreword

In order to improve the disaster prevention performance in densely built-up areas, it is crucial to carry out improvements in view of hardware aiming for non-combustibility and flame resistance, such as rebuilding of decrepit houses, improvement of road networks and of parks and open spaces. It is also important to enhance the vitality of local inhabitants and communities (regional vitality) in view of the promotion for the consensus formation toward improvement to make this possible and ensuring initial firefighting at the time a disaster occurs. For this purpose, it is necessary to make living space attractive by improving a receptive environment (child rearing environment) for the young child-rearing generation of which the influx shall be accelerated and the living environment for the increasing numbers of the elderly. Meanwhile, under the situations of local governments with fiscal predicaments in recent years, the town development for disaster prevention and the improvement/management for living spaces/facilities shall not be carried out by governments unilaterally, but the introduction of "area management," in which local inhabitants, business operators, landowners and lease holders or the like independently will perform their parts, is considered to boost its significance.

In this regard, NILIM carried out a detailed survey for actual states of operations relevant to management examples/methods, in which local inhabitants, business operators, landowners and lease holders or the like independently carry out improvement/management for living spaces/facilities, aiming at the enhancement of local fascination/vitality along with physical improvements (disaster prevention performance and living environments), implemented arrangements with respect to the points for applications in densely built-up areas from the aspects of organization management and improvements/maintenance/management/utilizations of facilities. This paper reports part of the survey results.

2. Actual condition survey for advanced examples of area management along with physical improvement

Concerning advanced examples of area management which enhances local fascination and vitality along with physical improvements (disaster prevention performance and living environments), we have surveyed actual operational states centering on the momentum and process of introduction and profitability of development and business in detail by hearing surveys and data collections or the like and prepared a collection of cases. As measures to be aimed for, we selected improvements for parks/open spaces, community roads/evacuation routes, inhabitants' interaction/living supporting facilities, disaster prevention facilities such as rain water preserving tanks and rebuilding/relocation mediation.

Characteristic examples are those cases in which local inhabitants conclude an agreement with the government to carry out maintenance/management/utilization for open spaces and vegetable gardens for which the government receives a lease and donation to improve them (in Setagaya Ward, Sumida Ward, Kobe City, Nagasaki City etc.: Photo 1); land owners and lease holders at the back of blind roads and the government contract an agreement to secure urgent evacuation routes (in Itabashi Ward etc.); local inhabitants with 3 neighborhood as minimum unit and the government contract an agreement to promote landscape creation (in Toda City: Photo 2); a private consultant established in a community café in the densely built-up areas (in Kobe City: Photo 2); the government is operating a subsidy program by which inhabitants propose and carry out hardware improvement independently for the sake of their familiar town (in Yokohama City).

3. Conclusion

The report[1)] of this survey has been made public by NILIM, with much information on measures in reference to local governments, NPO, town development consultants, neighborhood community associations and the like. We invite you to make use of this information for your reference.

[Reference]
1) NILIM (2013) “Survey report on area management methods in densely built-up areas” http://www.nilim.go.jp/lab/jeg/erimane_20130927.pdf (in Urban Development Division)

Photo 1: Open space and vegetable garden by disaster prevention open space development project (in Kobe City)

Photo 2: Improvement of landscape by planting based on Sangen (3 neighborhood) Agreement (in Toda City)

Greenbelt planning technologies to respond to population decline and degeneration etc. of cities

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(Key words) Population decline, degeneration of cities, compact city, greenbelt planning, basic plan for greenery

1. Outline of the research

Greenery in cities serves as an infrastructure with functions indispensable for safe and pleasant city life, by providing nearby places for rest and recreation, mitigating the heat island phenomenon through evapotranspiration of vegetation, and preventing the spread of urban fires. Past administration of parks and greenbelts has, with top priority on "finding ways to conserve and create greenery as cities continued to expand", promoted the systematic provision of parks, conservation of greenbelts and greening of cities with a basic plan for greenery (Article 4 of the Urban Green Space Conservation Act) as the master plan. But, against the background of population decline and degeneration of cities, the future will see a demand for a switchover to the concepts of park and green space administration from a broad perspective and to the enactment of greenery plans with this as its guideline, in order to "realize happy lives for people by urban development through greenery, even in a society not premised on growth".

The Landscape and Ecology Division is, based on such problem consciousness, researching basic planning technologies for greenery in response to population decline and degeneration of cities" (research period: 2013 to 2015). In FY2013, the division organized existing knowledge from the perspective of responding to new social needs predicted to intensify in the future and to the functions of greenery, and at the same time, collected advanced cases of greenery plans in foreign countries.

2. Organizing the functions of greenery in response to new social needs

The Urban Reconstruction Strategy Study Committee[1)] has, concerning the future of regional cities, pointed out the appearance of scattered unused land, more elderly people living alone, and as results, decline of urban functions, weakening of regional economic vigor, susceptibility to disasters, etc. In response to such prospects, based on past research (149 documents), it organized functions of greenery to respond to hypothetical problems such as, "creating conditions making life worth living by exploiting unused land for agriculture" and "promoting longer healthy lives through the use of parks". A future challenge is to organize points in planning and design to display various functions.

3. Clarifying green planning initiatives outside Japan

We collected administrative documents from foreign cities which have already faced serious population decline and degeneration of cities and have taken initiatives to resolve these problems, and organized the contents of plans for the use and treatment of greenery and open spaces (see the table). To obtain hints for cities in Japan, it will be necessary to perform analysis based on background conditions such as laws and social conditions etc. in each country.

Table. Outline of Cases of Greenbelt Plans in Foreign Countries

City (country)	Plan/Countermeasure	Outline
Cleveland (U.S.)	Re-imaging a more Sustainable Cleveland(2008)	New plan for strategic unused land to improve sustainability of cities
Philadelphia (U.S.)	Green Stormwater Infrastructure (2011)	Greenery conservation/creation plan aiming to control rainwater runoff as a climate change adaptation measure
Detroit (U.S.)	Detroit future City (2012)	Plan for the use of unused land to create greenbelts as an urban infrastructure
Liverpool (U.K.)	Green Infrastructure Strategy (2009)	Greenery conservation and creation plan focused on economic values and health and welfare
Berlin etc. (Germany)	Studtumbau Redevelopment) (2002)	Reflecting concentration of cities by reducing building floor space in greenery planning

4. Future schedule

It is impossible to consider the functions of greenery in isolation from desirable cities and society. In the future, we wish to conduct research focused on the future images of cities, linked with research institutes in a wide range of research fields and with local governments close to the scene.

[Sources]

Interim Report of the Urban Reconstruction Strategy Study Committee

http://www.mlit.go.jp/report/press/toshi01_hh_000013.html

Development of Material/Framing Knowledge Base Regarding Design Specifications of Existing Detached Timber Housing

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(Key words) Existing housing, Detached timber housing, Material framing method

1. Foreword

The Ministry of land, Infrastructure, Transport and Tourism has been carrying out existing long term quality housing promotion projects or the like slated for a series of policies for existing housing distribution promotion/stock renewal. With respect to existing housing, NILIM has been carrying out the development for technology to readily comprehend its materials and framing and so forth and evaluate its performance efficiently; even in a case where there is no data such as drawings or the like. This paper reports the development of a material/framing database in regard to designing specifications of existing detached timber housing.

2. Acquisition/accumulation of material/framing data

Over about 30 years we have carried out research for design survey specifications, targeting existing housing for which housing construction operators with supply results of public financial loan housing capable of acquiring data such as drawings. In the method of research, researchers browsed the stored drawings, extracted descriptions indicating materials and framing methods and recorded data related to employ actual conditions of framing method or the like according to age brackets. In three years of research from 2011 to 2013, we have obtained actual data in regard to 1,247 cases of housing by 55 operators in total, from Hokkaido, Tohoku, Kanto, Chubu, Chugoku and Kyushu.

3. Improvement of materials/framing database

Acquired data was arranged according to hierarchical definitions, looking into layer composition of foundation and exterior walls, roofs, openings or the like on a regional basis, from the surface (visible part) to interior (invisible part). Although to make descriptions of drawings or the like in data for housing was intended according to changes in a chronological order, it was presumed from the beginning that information not described in drawings would be plentiful as it was customary to refer to common specifications in building design. Accordingly, for the documents of specifications of the former Public Loan cooperation which had also been referred to in designs for timber housing, we analyzed them in descriptions in respect to specifications for each year in the targeted period of design specification research and carried out a similar arrangement. Moreover, with reference to operators for whom cooperation was not obtained, we carried out interviews for items incapable of corroboration by descriptions on drawings or the like. s.

According to these operations, we integrated the data obtained by research in three years, making districts where housing was located, years of construction or the like searching conditions, assuming a combination of materials/framing method, and have experimentally produced a material/framing method which assumes/indicates a combination of material/framing methods considered to have been general in each district/generation.

4. Deliberation issues in the future

Deliberating indication method for information and operation methods to readily be utilized in practical businesses in actual research for existing housing and operating method for database systems, we are prepared to establish this method.

[Reference]

1) Comprehensive technology development project
Development of capability evaluation technology for existing housing or the like slated for existing housing distribution promotion/stock renewal (2011 – 2014)
http://www.mlit.go.jp/tec/gijitu/kaihatu/pdf/soupro011.pdf

2) Research on grasp method for material/framing method of existing timber housing (-1) (-2), Architectural Institute of Japan Convention for fiscal 2013 (Hokkaido) Academic Speech synopses collection 5487 – 88, pp997 – 1000. 2013. 8

Research on Diagnostic Costs for Exterior Walls of Buildings

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(Key words) Exterior wall diagnosis, Diagnostic costs, Periodical report system

1. Introduction

Inasmuch as professional knowledge and technology are required for research/diagnosis for mortar finished exterior walls, although it is generally asked of building diagnosis operators, with reference to the diagnostic cost proposed from the operators, a great many have commented on the inability to judge whether or not it is a fair price. Information on research costs is scarcely publicized and information as serving as materials for these judgments has yet to be improved.

Based on this situation, in order to comprehend prices and price compositions or the like in the research diagnosis for exterior walls, we carried out a questionnaire survey targeting building diagnostic operators.

2. Research method

In the survey, we configured two categories of RC condominiums (5 story/gross floor area 1,814m^2: Building A and 11 story building/5,887m^2: building B) as model buildings, and collected information on exterior wall diagnosis costs by percussion diagnosis and infra-red rays, operation items and those compositions in the estimate, and the standard unit prices of each operation.

In calculating the costs, on the presumption of a case when required for "diagnosis only" exists in multiple classes in ordinary diagnostic operations, we asked for submission of data capable of examining each cost.

In consideration of regional characteristics and firm size for these surveys, we divided the whole nation into six areas and collected data from research diagnostic operators.

3. Outline of survey results

1) Diagnostic costs by percussion method

In regard to the estimated amount of the percussion method, the variability of the total costs (direct cost, temporary stage + miscellaneous expenses) was great and the maximum/minimum reached to about 30 times in two model cases. In this survey, due to the condition of the temporary stage to be configured by the operators' side, the costs of temporary stages between the one by strut scaffolding and the place employing gondolas or high-elevation operating vehicles spread to 50 times in the cost of temporary stage cost only (Figure 1). In the cost examination, it was reconfirmed that the confirmation of conditions for temporary stages became one point.

2) Diagnostic costs by infrared ray method

Although the variability of total costs is smaller than the case of the percussion method, nonetheless, the maximum/minimum spread to about nine times. In the case of infrared ray survey, the ratio occupied by onsite photographing and analysis operations in direct costs is large, having a spread of more or less ten times (Figure 2). In respect to this point, since there were few operators using high-elevation operating vehicles, it is considered the cost difference occurred due to this.

In general, the survey on the north surface is difficult by the infrared method. In the survey this time, inasmuch as there were operators to have examined cost calculations based on the possibilities of such diagnosis, knowledge in reference to materials to the judge appropriate technical strength was gained.

4. Conclusion

Concerning these survey results, we are prepared to publicize as the data for building

owners and so forth to utilize in examining survey and diagnostic costs.

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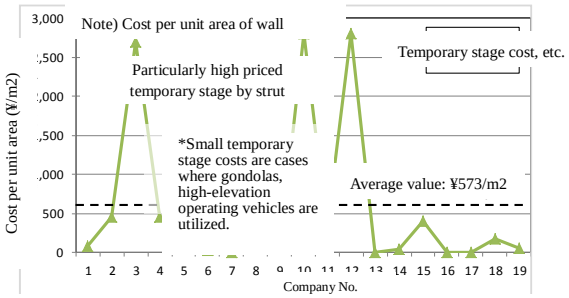

Figure 1: Estimate costs distribution (temporary stage cost, etc.

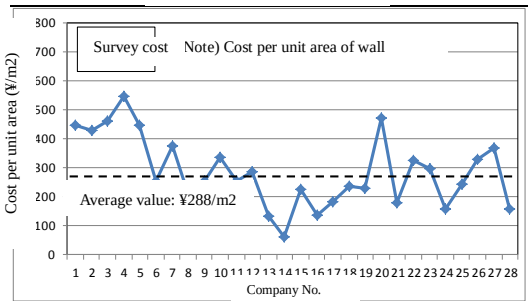

Figure 2: Estimate costs distribution (Direct survey cost in case

Determination of Degradation Conditions based on Actual Survey for Demolished Buildings

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(Key words) Timber housing, Demolition survey, Ant harm, Decay

1. Introduction

This research determines the situation of degradation/damage and defects or the like of existing detached timber housing according to actual surveys targeting demolition cases, attributes of building (date of construction, location environment, formulation of each part or the like) and arranges relationships between emergence trends and locations of degradation, damage or the like, and on that basis, aims to develop a simple inspection method for their current state contributing to rational comprehension of the current state of existing housing.

This paper introduces knowledge, analyses and so on obtained through surveys for demolition/reform objects of detached timber housing implemented up until now.

2. Content of research

(1) Improvement of actual example data in respect to degradation and damage of existing detached timber housing

According to a survey for demolished buildings or the like, with the emergence of sites of degradation phenomenon in detached timber housing, we consolidate actual example data with reference to conditions of decay/damage or the like to members inside the structure. By conducting actual condition surveys for existing detached timber housing and so forth built in each district throughout the nation, we will take into account not only effects on degradation by difference in climate conditions , but also the location of housing and methods of use, to consolidate data with respect to degradation and damage occurring to detached timber housing.

(2) Guideline of current condition inspection method for existing detached timber housing

Based on the actual example data obtained in (1), by focusing attention on degradation phenomenon affecting housing performance, we shall establish a current condition inspection method to efficiently and rationally grasp the conditions of gradation/damage. Specifically, a guideline for the actual state inspection method from variations of appearance to be confirmed by visual inspection, occurrence of degradation/damage or the like in parts difficult to visually look into such as the interior of walling bodies shall be configured based on actual example data to give estimates with a certain level of accuracy. In addition, in regard to parts with high occurrence risks, a guideline of the actual state inspection method capable of being induced so as to confirm the occurrence of degradation/damage or the like by concentrated current state inspections and detailed inspections and so on shall be configured.

3. Survey results

Prior to initiation of demolition work, by carrying out current state visual inspection for variations such as cracks and rain infiltration, discoloring or the like, and on that basis, carrying out investigation on the degradation of interior members such as decay, damage, harm caused by termites or the like after the demolition of the finished materials. In accordance with this, we tried to comprehend variations in parts capable of visual inspection and the actual state of interior degradation/damage and their relationship. As a result, we were able to detect degradation phenomena not previously assessable in the current state surveys such as in in water areas like the bathroom, toilet and so forth. Through these results, the current state survey incorporates a method to determine the general current state in assumption/consideration and through a trial of survey methods combined with degradation surveys, which carry out actual determination of degradation/damage or the like. Through this, we have consolidated the guideline of the current state inspection method, and deliberated on this so that the surveys in the future can be smoothly carried out and the survey results efficiently collected.

Photo 1: Implemented situation of current state survey

Photo 2: Implemented situation of degradation survey

Table: Type of relationship between changes and degradation

	Current state survey	Degradation survey	Assumed case
1	With changes	With degradation	・A case of emerging deformation (inclination, etc.) due to structural materials with considerable degradation ・A case where degradation was assumed to emerge affected by degradation factors (moisture, termites, etc.), due to occurrence of cracks or the like.
2	Without changes	With degradation	・A case where detection cannot be made by inspection due to an unchanged appearance, even though degradation of structural materials has advanced
3	With changes	Without degradation	・A case where structural materials have not been degraded, even though changes are detected in the appearance.

Development of an efficient bicycle traffic survey method

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(Key words) Bicycle network planning, bicycle traffic survey, smartphone

1. Introduction

In November 2012, the Guideline to the Creation of Safe and Comfortable Bicycle Utilization Environments[1)] was published. It indicated the importance of clarifying the characteristics of local bicycle use and preparing a bicycle network plan in order to improve bicycle use environments.

This research was undertaken in an attempt to develop a method of efficiently surveying bicycle traffic in order to support the preparation of bicycle network plans.

2. Outline of the bicycle traffic survey method

We developed a survey use application(Bicycle Planner) to clarify bicycle traffic routes etc. using GPS positioning data obtainable using a smartphone. The application is easy to use, because the test subject simply taps the screen of the smartphone when starting to travel, when changing traveling method, and when reaching the destination and so on, permitting surveying with a small burden on the test subjects (see Fig. 1). It is also a low cost survey method, because the survey devices used are smartphones owned by the test subjects. It can analyze the characteristics of local bicycle use by clarifying purpose of use of the bicycles, and the sex and age group of each bicycle user (see Fig. 2).

3. Uses of the survey results

This survey can clarify the routes traveled by the test subjects, number of cyclists using each route (see Fig. 3), the average traveling speed of the bicycles, trip length, and so on. These data can be used for a variety of purposes: to study using routes with heavy bicycle traffic as routes forming part of the bicycle network plan, verifying the effectiveness of creating a new bicycle traffic route by comparing the traffic routes before and after its creation, and using the traveling speed, trip length etc. as planning goal indices when planning the bicycle network.

4. Conclusions

In the future, we will propose and support the use of this survey method by local governments that are studying the preparation of a bicycle network plan.

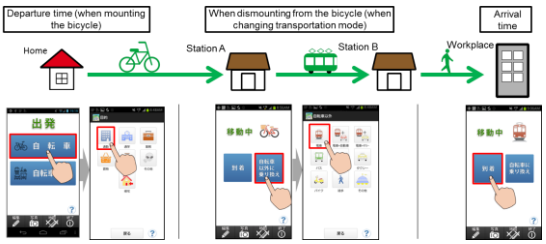

Figure 1. Image of Operation of the Application

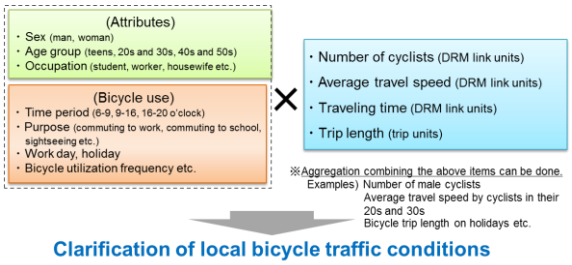

Figure 2. State of Bicycle Traffic can be Clarified with Major Survey Items

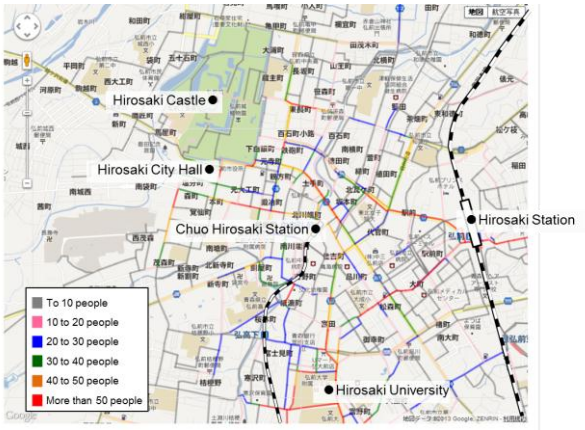

Figure 3. Example of Display of Total Bicycle Traffic

[Sources]
Ministry of Land, Infrastructure, Transport and Tourism, Road Bureau web page
http://www.mlit.go.jp/road/road/bicycle/pdf/guideline.pdf

Bicycle traveling space mixing bicycles and automobiles

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(Key words) Bicycle traveling space, mixed traffic lane, design

1. Introduction

Since November 2012, when the Ministry of Land, Infrastructure, Transport and Tourism and the National Police Agency released the Guideline to the Creation of Safe and Pleasant Bicycle Utilization Environments[1)] (below called, "the Guideline"), the creation of bicycle traveling spaces has been beginning in earnest in throughout Japan.

Under these circumstances, the NILIM has analyzed the effectiveness and problems revealed by fact-finding surveys of the use of bicycle traveling space which has actually been created, and this report introduces part of these findings: research on mixed vehicle lanes (a form in which bicycles and automobiles share a traffic lane), which is one form of bicycle traveling space.

2. Bicycle traveling space called a mixed vehicle lane

Past provision of bicycle traveling space has often been carried out by installing bicycle paths, which physically separate bicycles and automobiles, or bicycle lanes, which are separated visually, on roads with relatively wide extra space. But looking at overall roads shows that on many roads, heavy bicycle traffic requires the provision of bicycle traveling space where there is no extra road width. Regarding such roads, the Guideline recommends that because of automobile traveling speed and automobile traffic volume etc., even on a road where structural or visual separation is desirable, if restrictions on width makes the provision of such separations difficult, a mixed vehicle lane can be studied as a temporary form. But, few mixed vehicle lanes have been established, and it cannot be said that our knowledge about the traffic behavior of bicycles and automobiles is adequate. And methods of placing road surface indicators showing the locations of mixed vehicle lanes for use by bicycles have not yet been specifically established.

3. Description of the research

The NILIM is now conducting the following studies at actual locations of mixed vehicle lanes in order to clarify the traffic behavior, safety, and comfort in mixed vehicle lane type bicycle traveling space.

Photo. Example of a Mixed Traffic Lane

(1) Analysis of bicycle/automobile traffic behavior

Change of bicycle traveling line (bicycle pedestrian paths or traffic lanes) after provision, behavior of bicycles and automobiles when close together or when an automobile passes a bicycle, and whether or not conflict occurs were surveyed and traffic behavior was organized to analyze safety.

(2) Study based on a traffic micro-simulation

Based on the traffic behavior so obtained, a traffic micro-simulation capable of reproducing behavior of an individual bicycle or automobile was done reproducing the state of traffic on a mixed vehicle lane, and at the same time, sensitivity analysis was performed based on the change of bicycle and automobile traffic volumes to clarify problems which could occur according to traffic conditions.

(3) Survey of consciousness of users

A questionnaire survey of users was performed to examine mutual consciousness of bicycle and automobile users regarding travel on mixed vehicle lanes, and the visibility and comprehensibility of road surface indicators, to analyze the effectiveness of providing mixed vehicle lanes and problems they cause.

4. Future activities

Results of research on mixed vehicle lanes will be regularly released by announcing reports of these results. And we will continue to accumulate and organize knowledge about the provision of bicycle traveling space, and publish this information as technical documents to be used to support the provision of bicycle traveling space now underway in various parts of Japan

Basic Analysis of Energy-saving Domestic Marine Unit Load Transportation

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(Key words) domestic marine unit load transportation, fuel consumption, energy saving

1. Introduction

Response to global warming has become an important issue, and the need for unit load transportation using containers, chassis, etc. are also great.

In order to contribute to the design of policies for future freight transportation, we conducted a questionnaire survey of shipping companies which operate ferries, RORO ships and container ships used for domestic marine unit load transportation. We also introduce the results of analysis conducted to grasp the state of actual transportation by every ship type and the state of measures taken by shipping companies to reduce energy consumed by transportation.

2. The outline of the questionnaire survey

The questionnaire form related to energy-saving transportation was created separately for ferries, RORO ships, and container ships, and it was mailed to shipping companies in July, 2012.

The recovery results are shown in the table.

Table. Questionnaire vote recovery result

	Total of all ship types	Ferry	RORO ship	Container ship
Number of shipping companies (Recovery rate)	29 (94%)	11 (100%)	10 (91%)	12 (86%)
Number of ships (Recovery rate)	55 (90%)	22 (100%)	17 (89%)	16 (80%)

Note: Because the questionnaire survey of more than one type of ship may have been conducted in the same shipping company, the sum of the number of shipping companies of all ship types and the number of shipping companies of each ship type do not match.

3. Analysis of the questionnaire survey result

(1) Actual state of domestic marine unit load transportation

Based on the questionnaire, the results of analysis of operation speed for every route section, and fuel consumption per distance and per ton-kilometer are shown in figure 1.

Operation speed is shown in the upper row of figure 1. The average value of the operation speed for every route section of ferries was the largest, revealing a characteristic of passenger ferries.

Moreover, all types of ships sailed an average of between 80% and 90% of their service speeds.

Fuel consumption is shown in the lower row of Figure-1. The average actual fuel consumption per distance differed between ship types, with that of ferries the largest. However the average value of actual fuel consumption per ton-kilometer differed little between ship types.

This is because the load factor of container ships was low and that of ferries was high. So fuel consumption per ton-kilometer of container ships was high.

When the average value of estimated fuel consumption per ton-kilometers when fully loaded was compared with the actual average value, it turned out that the average value of fuel consumption per ton-kilometers of ferries decreases about twenty percent, RORO ships decreases about 60 percent, and container ships decreases about 70 percent.

Operation speed and fuel consumption analysis results

Figure 1. Results of analysis of operation speed and fuel consumption

Ship type (Actual value)		Ferry (Average 5,083t)	RORO ship (Average 5,367t)	Container ship (Average 2,357t)
Operation speed (Actual value)		Average 37.1 [km/h]	Average 34.6 [km/h]	Average 19.8 [km/h]
Cruising rate/speed (Actual value)		Average 86.3%	Average 88.5%	Average 85.3%
Fuel consumption (Actual value)	Per unit distance	Average 67 [kg/km]	Average 44 [kg/km]	Average 15 [km/km]
	Per ton-kilometer	(Average load factor 76%)	(Average load factor 66%)	(Average load factor 45%)
		Average 0.026 (kg/t/km)	Average 0.023 [kg/t/km]	Average 0.023 [kg/t/km]
		Approx. 20% reduction	Approx. 60% reduction	Approx. 70% reduction
When fully loaded Fuel consumption (Estimated value)		Average 0.020 [kg/t/km]	Average 0.009 [kg/t/km]	Average 0.007 [kg/t/km]

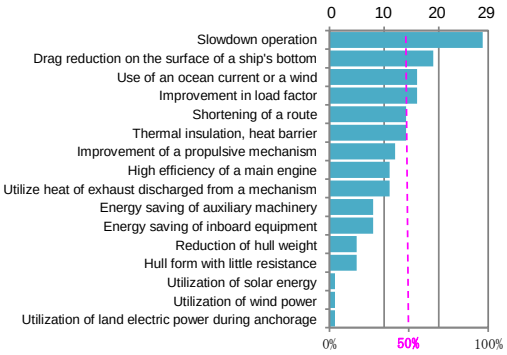
(2) State of measures to save energy in transportation

The questionnaire results are shown in figure-2.

Most shipping companies carried out slowdown operation (97%). Many shipping companies carried out energy-saving transportation measures which do not require much investment in plant and equipment.

The number of shipping companies which carried out each energy-saving transportation measure

Figure 2. Number of shipping companies which took each energy-saving transportation measure



4. Conclusion

I would like to utilize the analysis results as data to analyze the influence which environment and modal shift policies have had on the cost of transport and operation speed of domestic marine ships, etc.

[Source]
TECHNICAL NOTE of NILIM NO. 716
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0716.htm

Study of International Air-Passenger Traffic in East and Southeast Asia

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(Key words) International Air-Passenger Traffic, Low-Cost Carrier

1. Introduction

The capability of Japanese airports, including those in the Tokyo Metropolitan Area, must be enhanced because one of their most important purposes is to enhance international competitiveness by facilitating international air traffic according to the New Growth Strategy "Japan Revitalization Strategy" (cabinet decision on June 14, 2013). Because air-traffic demand forecasting will be essential to formulate aviation policy, several studies related to traffic demand forecasting have been conducted in the Airport Planning Division. The current method does not take into account traffic induced by the impact of the entry of LCCs entry. An analysis of the aviation market in East and Southeast Asia, where many LCCs started business, would play an important role in improving forecasting. So we analyzed recent international air-passenger traffic in East and Southeast Asia during 2005-2012.

There are no statistics which directly capture international air-passenger traffic. Instead, we used Capstats statistics (statistics of seat capacity provided by RDC Aviation) which accurately represent the current state of the aviation market in East and Southeast Asia.

2. Major Findings

The increase in traffic demand in East and Southeast Asia is remarkable and this trend is particularly strong in the ASEAN sphere. The increase in supply by LCCs is also remarkable. The following are major findings of this study.

① Total seat capacity inside all East and Southeast Asia in 2012 is 250 million. Since 2005, it has increased by 42.9% (the annual rate was 5.2%). In 2011-2012, it increased by 10.1%.

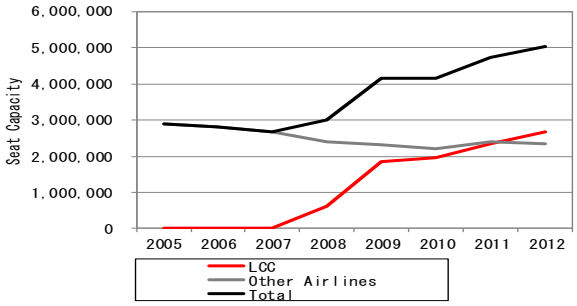
② The growth rate of seat capacity on the routes between Japan, Korea and China is lower than that of total seat capacities among East and Southeast Asian countries.

③ China has had the highest seat capacity in East and Southeast Asia since 2007. Seat capacity from/to China in 2012 has increased by 54.2%.

④ Regarding the growth rate of the seat capacity from/to respective airports inside East and Southeast Asia during 2005-2012, the annual growth rates in Hong Kong, Bangkok, Tokyo and Macau were less than 3.0%, which was less than the average of all East and Southeast Asia. On the other hand, the annual growth rates in Singapore, Seoul, Kuala Lumpur, Manila and Jakarta were more than 5.8%.

⑤ The route between Hong Kong and Singapore has the largest seating capacity of respective air-routes in the year 2005-2012. On the Jakarta-Singapore and Kuala Lumpur-Singapore routes, LCCs' seating capacity has significantly increased since 2009, and total seating capacity has also been boosted significantly (Figure).

Figure Seat Capacity between Kuala Lumpur and Singapore



3. Concluding Remarks

We could analyze and catch the trend of single track routes and LCC's routes which could never be analyzed thoroughly in previous studies. We are planning to conduct a similar study when other trends emerge in the near future.

[Sources]
TECHNICAL NOTE of NILIM No.744
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0744.htm

An Analysis of the Entry/Withdrawal of Low-cost Carriers(LCCs) in International flights in the Asian Civil Aviation Market

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(Key words) *Low-cost Carriers(LCC), OAG Flight Guide Worldwide, Airport Planning*

1.Introduction

Based on Official Airline Guides (hereinafter referred as "OAG") and so on, we created a database of indicators which represent features of the Asian civil aviation market. Consequently, this paper reports on an analysis of the Low-cost Carriers(LCCs)' entry/withdrawal into/from international flights in the Asian civil aviation market. There is no similar analysis dealing with the Asian civil aviation market.

2.Method

Our analysis is based on the OAG. First, we selected 15 airlines which operate international passenger flights from/to East and Southeast Asian airports. Such airlines include both full service carriers (FSCs) and LCCs. Secondly, we created a database consisting of the number of seats and flights, the flight distance, the number of airlines serving the routes and other characteristics including the Gross Regional Product (GRP) and the populations of cities in which departure/arrival airports are located. Lastly, we conducted a detailed analysis of the impact of LCC's entry into the market. The effects of airport expansion projects and multilateral Air Transportation Agreements(ATAs) among ASEAN countries are incorporated into the analysis. Our analysis targets year-over-year for 2004-2012.

3.Major Findings

(1) Average Flight Distance

In most cases, average flight distances of LCCs are in the range of 1,000-2,000 kilometers while those of FSCs are in the range of 2,000-6,000 kilometers.

(2) Average Number of Flights

The average number of flights for LCCs significantly fluctuates year to year. Also, in most cases, average number of flights for LCCs are in the range of 15-25 a week for two-ways while those of FSCs are at most 14 a week for two ways.

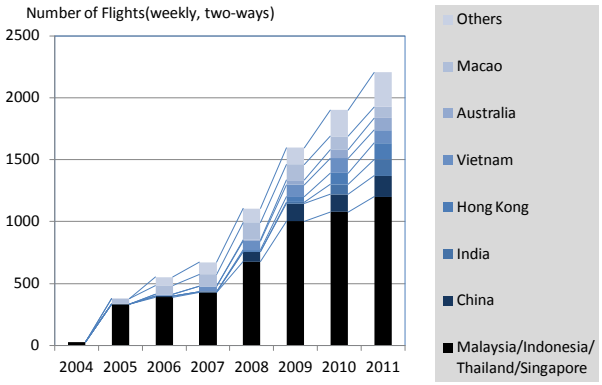
(3)Trend of Air Asia Entry/Withdrawal

About 55% of all Air Asia international flights connect the following four countries: Malaysia, Indonesia, Thailand and Singapore. Furthermore, on such routes, the number of flights is larger than those serving other routes.

(4) Trend of Jetstar Asia Entry/Withdrawal

Most routes operated by Jetstar have the following three features. First, other airlines including both FSCs and LCCs also operate large number of flights on such routes. Second, both origin and destination are located intra Southeast countries. Third, neither Qantas nor Valuair both of which are intercompanies of the same group, operate on such routes. Also, about 60 percent of all the Jetstar Asia international flights are ones connecting Singapore and Kuala Lumpur/Hong Kong/Bangkok/Ho Chi Minh/Manila/Taipei in 2012.

Figure Number of AirAsia Flights



(5) Trend of Tiger Airways Entry/Withdrawal

Tiger Airways has already halted its services on one-third of the routes on which it had begun operating. The duration between entry and withdrawal is at most three years. Tiger Airways avoids competition with Jetstar: the number of routes which are operated by both airlines is low. It is assumed that Tiger Airways avoids service cannibalization.

4.Concluding Remarks

We are planning to conduct a further detailed analysis using the database which we have already created. Specifically, such analysis is focused on the impact by progress of further ASEAN ATAs and projects for airport capability enhancement.

[Sources]

TECHNICAL NOTE of NILIM No.757
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0757.htm

A Case of Utilizing Results

Support of Aviation Policy Formulation by the Enhancement of the Aviation Demand Forecasting Method

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(Key words) *Aviation Demand Forecasting, Low Cost Carrier(LCC)*

1.Introduction

In Order to provide a basis for a technical review aimed at further enhancement of the capability of airports in the Tokyo metropolitan area, the Civil Aviation Bureau announced demand predictions at a Transportation Policy Council meeting on September 26, 2013. The predictive model was developed and improved by the NILIM Airport Planning Division. In addition, we gave technical advice to the Ministry regarding the application of the model.

This paper summarizes the predictions including a summary of the results and future prospects for the research design.

2.Summary of the Predictions

(1)Summary of the Results

Predictions were made for FY2017, FY2022, FY2026 and FY2032. The predictive model was developed based on the *Four Step Model* which is often applied to various kinds of transportation project planning. Since the prediction results are significantly affected by the GDP, we made predictions for the following three cases: Low-growth/Middle-growth/High-growth. The Middle Growth scenario is based on the Japan Revitalization Strategy formulated by the Cabinet on June 14th, 2013.

It is predicted that total aviation demand for airports in the Tokyo metropolitan area will be 110-130 million in passenger traffic and we will need 690-760 thousand landing/departure slots in FY 2022(Middle-growth Case). We also predict that such aviation demand will exceed capacity of the airports in the same year.

(2)Improvement of the Predictive Model

The impact of low-cost-carrier(LCC) entry into the domestic/international aviation markets is taken into consideration by the scenario in which the increase in the share of LCCs will cause a decrease in flight fares and an increase in passengers. Furthermore, the effect of Tourism Policy including the visa-waiver-program for tourists and so on is also taken into account.

3.Future Prospects of the Research Design

(1)Domestic Aviation Demand Forecasting

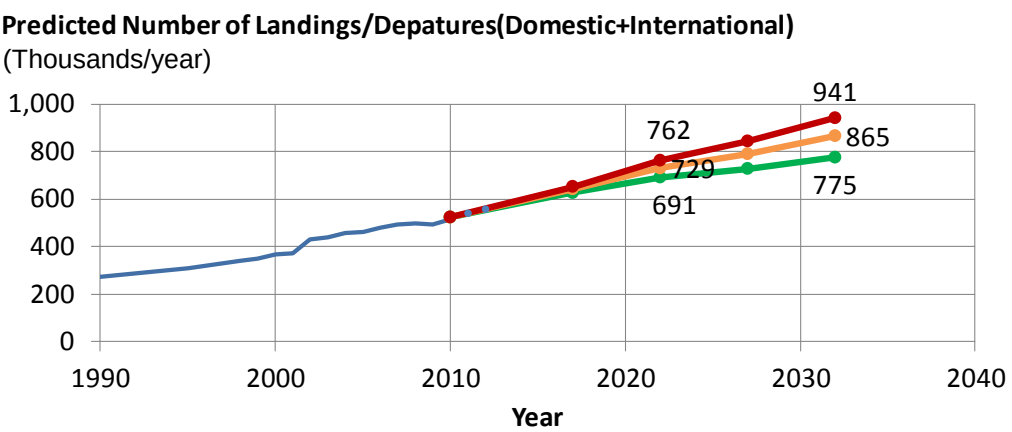
Using a stated-choice survey, we are examining air transport demand changes when low cost carriers(LCCs) enter domestic aviation services between Tokyo Int'l Airport and Kansai Int'l Airport and the Linear Chuo Shinkansen(high-speed railway) begins operation. In order to conduct the examination, we are collecting data from the stated-choice survey and developing a prototype for the mode choice model which could treat LCCs as an independent transport mode.

(2)International Aviation Demand Forecasting

Now we are conducting a detailed analysis of the LCCs entry/withdrawal into/from international flights in the Asian civil aviation market. Such research findings will be incorporated into the current international aviation demand forecasting model.

[Sources]
Transportation Policy Council on September 26, 2013
http://www.mlit.go.jp/common/001018977.pdf

Figure. Prediction of Aviation Demand in the Tokyo metropolitan area



Measures for more efficient and secure logistics

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(Key words) International logistics, security inspections, logistics information

1. Introduction

In response to the 9/11 terrorist attacks of September 11, 2001, in 2004 the revised SOLAS Convention came into force and the Act on the Assurance of Security of International Ships and Port Facilities took effect.

And the United States began to demand that exporting countries perform 100% cargo security inspections, resulting in fear that meeting the requirements of such strengthened security could slow down logistics.

As a result of the internationalization of industry on the other hand, the impacts of any interruption or slow-down of economic activities by terrorism or a large-scale disaster will have wide repercussions, and there is now a demand that economic activities in disaster regions be quickly restored.

So our division has conducted research to clarify trends and characteristics of new security technologies capable of responding to the increasingly strict security requirements, to develop methods of predicting the slow-down of logistics by strengthening inspections and of evaluating countermeasures, and to create logistics information systems, which will be one tool for speeding up action to restore economies after disasters.

2. Trends and characteristics of security measure technologies

We collected information about overseas emergency response programs, and at the same time, clarified new X-ray inspection technologies capable of discovering hazardous substances including non-metals hidden in containers as container cargo inspection technologies, and identification technologies to deter suspicious people.

3. Development of logistics slow-down prediction and countermeasure evaluation methods

It is feared that strengthening logistics security inspections will increase gate waiting time, causing congestion of trailers.

So we conducted a field survey to clarify the actual situation and performed numerical simulations that can represent and evaluate the situation. The change of waiting time caused by longer inspections was also numerically simulated, showing that if inspection time increases, it will be impossible to deliver all cargoes to piers. A numerical simulation confirmed that it would be possible to handle the cargoes by changing present specialized lanes into multi-purpose lanes as a countermeasure.

Photo. View of vehicles waiting for a gate to open
Approximately 300 vehicles are waiting

4. Internationalization of logistics information systems

It is necessary to clarify the state of logistics at normal times in order to promptly take countermeasures when an international logistics network has been disrupted by a disaster or by terrorism.

Logistics information systems are now being built around the world, but it would be beneficial to build an information network linking nations and able to deal with international supply chains. So we are cooperating with administrative bodies in the construction of container logistics information networks linking countries.

5. Conclusions

At this time, the internationalization of manufacturing etc. has given international logistics networks an important role in the international economy, and any slow-down of logistics could slow down international economic activities.

So technologies that can be used to smooth logistics are becoming increasingly important, and we will conduct research to create more efficient security

countermeasures and logistics.

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tm

Collaborative research with the U.S. and Europe on ITS

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(Key words) Probe data, application, evaluation tools and methods

1. Introduction

The Intelligent Transport System Division is performing collaborative research in the ITS field with the U.S. and Europe under a Memorandum of Cooperation in the field of ITS (Intelligent Transport Systems) signed between the governments of Japan and the U.S. and the governments of Japan and the European Commission. This paper reports on the results of research conducted between Japan and the U.S. concerning probe data and evaluation tools and methods, which are two prioritized research areas identified with the U.S. and with Europe, and on the directions of future trilateral collaborative research between Japan, the U.S. and Europe.

2. Collaborative research on probe data

Japan and the U.S. have exchanged information about research on ITS at annual bilateral meetings since 1993 and at task force meetings held several times since 2009, and collaborative research on probe data was started in 2010 to promote research and development in the two countries. In the collaborative research, probe data was jointly defined, then probe data and probe data systems in Japan and the U.S. were compared, to specify 19 probe data enabled applications. Of these, seven high priority application bundles considering their feasibility, public sector application, usability on expressways, and international standards harmonization were developed, and from among these, three applications were jointly selected for further collaborative research (see the Table). The contents up to this time were summarized in the assessment report in November 2013. In the future, with the participation of Europe, trilateral collaborative research will be undertaken concerning technological research on each application and cross-cutting issues including security, standardization, privacy, and data ownership.

Table. Three Selected Applications

	Application	Outline
[1]	Application to clarify road traffic management indices (travel time, speed, etc.)	It will collect time, location, speed and other probe data to clarify times and sections congested for use in enacting road plans etc.
[2]	Application to harmonize vehicle traveling speeds	It will collect time, location, speed and other probe data to clarify the state of traffic, aiming to maximize traffic volume and reduce accidents by supplying information such as recommended speed.
[3]	Application to provide road management work support using weather information	In addition to time, location, speed, and acceleration, it will collect the state of operation of wipers, back lamps, head lamps, ABS and other aspects of state of operation obtainable from CAN data, and car mounted camera images as probe data for use in road maintenance work.

3. Collaborative research on evaluation tools and methods

In order to promote research and development and the deployment of ITS, evaluation tools and methods to verify the effectiveness and benefits of ITS are needed. Although Japan and the U.S. have already developed their own methods of evaluating the effectiveness of ITS, no common methodology is applied consistently across evaluation efforts within Japan and within the U.S. Thus, Japan and the U.S. are conducting collaborative research on evaluation tools and methods in order to develop a consistent methodology to evaluate the performance and cost-benefits of ITS. The collaborative research has organized performance indicators and evaluation tools and methods which are used in Japan and the U.S., and in November 2013, prepared an interim report of the contents of the research completed up till that time. In the future, a common glossary of terms used in Japan and the U.S. will be developed, evaluation tools and methods used in the U.S. and in Japan respectively will be comparatively analyzed, and categorization and organization of evaluation methods will be developed.

4. Conclusions

In the future, Europe will join this activity to expand probe data collaboration from a bilateral to a trilateral effort, and a report on probe data will be prepared with October 2015 as the target. A report on evaluation tools and methods will be prepared by Japan and the U.S. with September 2014 as the target.

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Bidding trends in the field of civil engineering consulting

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(Key words) consultant engineering, bidding method, Quality and Cost Based Selection (QCBS)

1. Introduction

Since the FY2007 introduction of the Quality and Cost Based Selection (QCBS), method of deciding the successful bidder by comprehensively evaluating price and technology, for civil engineering consulting ordered by the Ministry of Land, Infrastructure, Transport and Tourism , the number of orders has steadily increased until it reached about 47% of all orders for civil engineering consulting in FY2012. And during this period, various low bid prevention measures such as the Assessment System for Certain Accomplishments (multiply the number from 0.0 to 1.0 by engineering points of the bidder whose bidding price is lower than Threshold Price for Low Price Inquiry) were introduced to QCBS, lowering the low successful bid rate to 0.2%.

On the other hand, the tendency for bidding prices to be concentrated near the threshold price for low price inquiry has strengthened, and bidding is being conducted under strong consciousness of price competition as in the past.

2. State of bid value with QCBS

The ratio of each bid value to Threshold Price for Low Price Inquiry is defined as the "Threshold Price Ratio", and the table shows the frequency of the appearance of Threshold Price Ratios from 1.0 to 1.05 in bidding for works executed by regional development bureaus etc. It shows that all bidders which include a successful bidder who bid directly above the Threshold Price for Low Price Inquiry are increasing every year. We interviewed contractors about this tendency, and they pointed out that in cases where, even through their technological capacity is superior, the difference in technology scores between them and others are small or unclear, it is difficult to shift their technological capacity to price, and ultimately, the competition becomes a simple price competition[2].

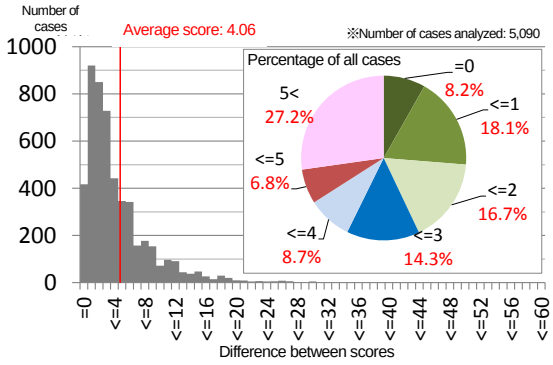
Table. Frequency of Threshold Price Ratios from 1.0 to 1.05

	FY2009	FY2010	FY2011	FY2012
Successful bids	0.211	0.359	0.553	0.635
All bids	0.231	0.420	0.600	0.657

3. Technology evaluations in QCBS

In response to the information pointed out above, the distribution of first or second technology scores for various works to which QCBS was applied in FY2012 when QCBS was applied, were organized in the chart. Although the difference in scores exceeded 5 points in about 27% of the work cases, the technology score difference was extremely small at 1 point or less in about 26% of the work cases.

Figure. Distribution of Differences Between Scores of First and Second Technology Score



4. Future research

We are worried that excessive price competition lowers not only quality, but also technology capability of the entire construction industry. In order to appropriately evaluate technology capability, we wish to study revising the technology evaluation procedure in QCBS, and also to study the best way to apply ordering methods including Quality Based Selection and competitive price selection .

And as a result of decline in the quantity of orders in recent years, competition between regional companies and major consultant companies which active over wide areas of Japan has been seen in some field of works[3]. In order to study ways to carry out nurturing of regional companies to handle the response to disasters, we wish to spotlight bidding trends by company category in the future.

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Study of introducing the negotiated bidding method into bidding and contracting of public works

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(Key words) Public works, bidding and contracting, Quality and Cost Based Selection , negotiated bidding method

1. Introduction

Almost 100% of works under the Ministry of Land, Infrastructure, Transport and Tourism are handled uniformly by Japanese bidding and contracting methods such as the open competitive bidding and Quality and Cost Based Selection, etc., and it is difficult to use diverse bidding and contracting methods to adapt to the needs of the times or to characteristics of projects. Therefore, the *Central* Council for Construction Contracting Business has announced that it intends to revise the system by, for example, systematically positioning diverse bidding and contracting methods or introducing the negotiated bidding method: selecting the company with the highest level of technology through a public subscription and then signing a contract based on negotiations concerning price and construction methods.

2. Diverse bidding and contracting methods (negotiation bidding method)

The negotiated bidding method is already used overseas under the EU Public Procurement Directive or the U.S. Army Corps of Engineer's ECI (Early Contractor Involvement) procurements, and in Japan, a similar method is applied under the construction consultants' proposal method. For public works projects in Japan, the Quality and Cost Based Selection (technical proposal evaluation type (type A), which uses the superior technical capacity of private companies based on technical proposals, for works for which the orderer cannot prepare standard specifications for example, is applied, but as shown in the table, it is difficult to use private sector knowhow etc. without specifying the company that has made the best technical proposal.

Table. Table of Advanced Technical Proposal Type in FY2012

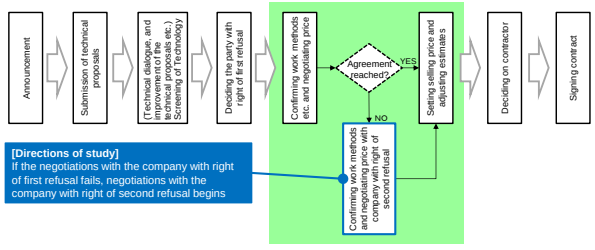
Work name	Rank of winning bidder	
	Technology evaluation score	Bid price
○○district box culvert work	3rd	2nd
□□bridge damage restoration and restoration of a collapsed bridge	1st	1st
△△district multi-purpose utility tunnel work	2nd	1st
●●Dam redevelopment and construction of tunnel outlet works gate room system	3rd	1st
×××Dam redevelopment, construction of tunnel outlet works system of inlet	3rd	1st
◆◆Viaduct superstructure work	6th	1st
◇△Bridge superstructure work	2nd	1st

State where the company which made the best technology proposal cannot be specified
Company with the lowest technical evaluation score (6th) won the bid with the lowest price etc.

3. Studying the negotiated bidding method

Under the negotiated method which is now being studied based on the state of the technical proposal evaluation type (type A) of this kind, the contract is signed after the company which has made the best technical proposal has been designated as the company with first refusal rights, negotiations are conducted with that company to confirm the execution methods based on the technical proposal, and set the price (unit price or rate), and the negotiations have reached an agreement. (If these negotiations fail, the orderer negotiates with the party with second rights of refusal.)

Figure. Flow Chart of Negotiated Bidding Method



This method is described with reference to a method given a trial in the selection of a CM contractor by the Urban Renaissance Agency.

4. Future schedule

The negotiated bidding method is being studied by applying it to a case where it is difficult to set specifications because of characteristics of the work (case where it is necessary to use this method considering the past ordering by the orderer), but in the future, we will study details of procedures for its operation while hearing the views of the Advisory Board on Future Construction Production And Control Systems to Fulfill Orderers' Responsibilities, which was established in 2013, including possibility of applying it to works where local conditions and other execution conditions are complex and highly unique, so it is difficult to specify specifications in advance.

Comprehensive public works procurement methods in the U.S. and the U.K.

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(Key words) Indefinite quantity contract, ID/IQ, framework agreement

1. Introduction

Procurement of works by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is now almost always done by open tendering and the overall evaluation system, while the procurement method is the uniform tendering and contracting system. In America and Europe on the other hand, diverse procurement methods are used.

The NILIM is surveying overseas procurement methods of this kind in order to contribute to improvement of public procurement in Japan, and this paper reports on comprehensive procurement methods.

2. ID/IQ in the U.S.

Under Federal Acquisition Regulation (FAR), Indefinite-Quality Contracts are stipulated as one type of Indefinite-Delivery Contracts. Indefinite-Quantity Contracts, which are generally called ID/IQ, are signed as comprehensive contracts in which both the procurement period and quantity are unspecified, and are used by the US Army Corps of Engineers (flood control structures etc.) and by the Federal Highway Administration.

An ID/IQ contract includes a basic contract and individual orders based on the basic contract called task orders (below, "TO").

The figure shows the basic contract and TO procedure. The request for a basic contract indicates the maximum and minimum quantities of both the basic contract and the TO (total quantity). The award criteria is trade-off with the best value (total evaluation of price and technical factors) for the basic contract, while for a TO, it is often the lowest price. The basic contract request, in many cases, presents the initial TO and specifies the awardee of the first TO at the same time as it specifies awardees of the basic contract.

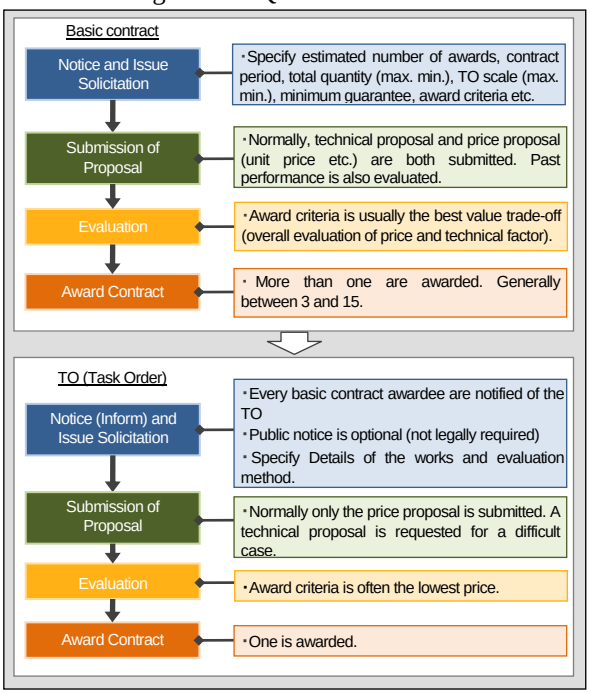
The contract period is often a maximum of five years, and the initial basic contract is considered one year + option year(s), and renewal agreements are often signed.

3. Framework agreement in the U.K.

A framework agreement (below, "FA") is stipulated by the Directive 2004/18/EC. A FA is defined an agreement between one or more contracting authorities and one or more economic operators, the purpose of which is to establish the terms governing contracts to be awarded during a given period, in particular with regard to price and, where appropriate, the quantity envisaged. The term of the FA may not exceed four years. Where a FA is concluded with several economic operators, the latter must be at least three in number. The U.K. stipulates regulations similar to those of the directive in The Public Contract Regulations.

The award criteria of a FA in the U.K. is done in the same way as procurement of normal independent contracts, contracting authorities use 'the most economically advantageous' (not the lowest price). There is no legal obligation to issue a public notice of an individual contract based on the FA (called a "Call-off"), that may be directly awarded by application of the terms laid down in the FA, or be awarded by mini-competition.

Figure. ID/IQ Flow in the U.S.



4. Conclusions

The comprehensive procurement method is used for construction and for maintenance in both the U.S. and

the U.K. At this time, MLIT uses the comprehensive method exceptionally under a cooperative agreement on disaster response, but we think that it may be possible to apply comprehensive methods much more widely.

Integrated control of maintenance information for bridges using three-dimensional models

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(Key words) CALS/EC, bridge, three-dimensional data, maintenance

1. Introduction

The NILIM is conducting research on three-dimensional data standardization technology and visualization technologies to be used for computerized execution or at the maintenance stage in order to advance and increase the efficiency of public works.

This research is the study of methods of performing integrated control of bridge maintenance information, as part of the construction of an infrastructure for the smooth distribution and utilization of three-dimensional data in public works.

2. Prototype of the system

Bridge maintenance accumulates records of inspections and repairs at the maintenance stage in addition to various kinds of information generated at the design and construction stages. The system that is proposed here will, with a three-dimensional model prepared at the design stage as its platform, centrally control information useful for maintenance by entering and linking this information. The use of the three-dimensional model will simplify the clarification of the spatial positions of each structural body and member of the entire bridge, permitting information control with superior traceability and searchability. The figure shows a prototype of the proposed system.

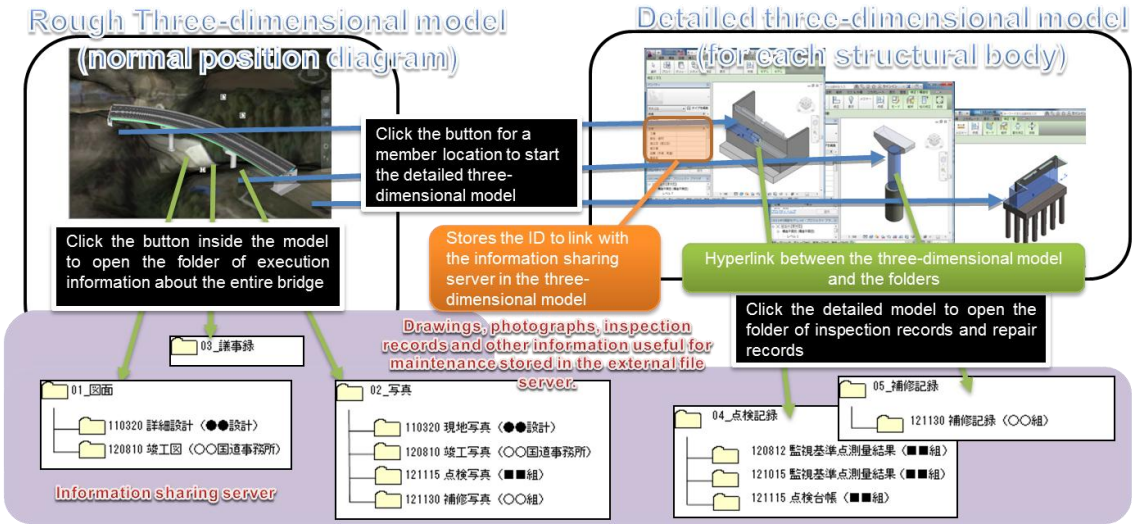
The system consists of a rough three-dimensional model to confirm the surrounding topography and the bridge shape, detailed three-dimensional models of each member and structural body, and an external file server to store information of various kinds. The external file server can, in order to simplify its introduction and operation, be prepared using market software and hardware not used by specialized systems, and various kinds of information inside each three-dimensional model and the external file service are controlled by linking with hyper-links.

The system has the ability to centrally control the history of information by clarifying data renewal sequence based on the folder structure inside the external file server and on naming rules, in order to insure traceability of the various kinds of information used at the maintenance stage.

3. Conclusions

In the future, we will study integrated control of information with, as the platforms, two-dimensional screens or simple three-dimensional models considering links with existing related databases and use for maintenance of existing bridges.

Figure. Prototype of the Maintenance Information Control System Using a Bridge Three-dimensional Model



Evaluation of traffic related public works projects in foreign countries —Present situation in England—

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(Key words) Public works project, project evaluation, traffic related public works project, road project, England

1. Introduction

The NILIM has been conducting survey research to advance and improve public works project evaluation methods, but many past surveys prioritized parameter setting and other detailed features of evaluation methods, so beginning in FY2013, it will focus its survey on the interrelationships of public works project planning systems, decision-making methods, and project evaluations. In FY2013, it surveyed traffic related public works project evaluations in England, the United States, and Germany, but this report will introduce the present situation in England divided into four levels for simplified comparison with Japan.

2. Policy level

At the level—Aiming in the overall direction which the government has proposed, inducing the government's series of linked decision making (Plan, Program, Project decisions)—it is a level corresponding to "forming a network permitting use from throughout the country in about 1 hour", which is a basic concept of the High Standard Arterial Road Network Plan in Japan's Fourth Comprehensive Development Plan (1987). In England, after the establishment of the Cameron government in 2010, the Public Services Transparency Framework was adopted as a new framework for policy evaluations, and every ministry has prepared a Business Plan that includes a vision, allied priority matters, structural reform plan, ministry expenditures, and transparency. The Department for Transport complied with this in 2010 by preparing the Business Plan 2011-2015, which is a concrete mid-term plan that includes road and railway investment program, expenditures plan etc.

3. Plan (basic planning) level

The level—Strategies and concrete plans enacted to define the policy in detail and move to its implementation—is a level corresponding to Japan's High Standard Arterial Road Network Plan (14,000k). In England, the Department for Transport announced Investment in Highway Transport Schemes in 2010 concerning large-scale road projects, and while it is not as long term a plan as Japan's, it corresponds to the Plan level. The Schemes present plans for implementation of large-scale road projects in detail from the medium to long term, and specifically presents plans for projects which should be started in the period (2010 to 2015), projects which should be started after 2015, projects whose implementation will be studied, and projects whose start-up is postponed. The priority of large-scale road projects is set from four perspectives: public's value for money, strategic value, feasibility, and effects incalculable in monetary terms.

4. Program level

At the level—Schedule with coherence: plan is detailed and consists of promises, methods, and actions that advance it to implementation—it corresponds to Japan's Priority Plan for Social Infrastructure. In England, the Business Plan 2011-2015 mentioned above corresponds to this level. The expenditure plan in the Business Plan is based on Departmental Expenditure Limits, decided through negotiations with HM Treasury.

5. Project level

This is the level which corresponds to Japan's new project adoption stage. In England, the Department for Transport's project adoption process is stipulated in detail by the Project Control Framework Handbook. This process consists of 7 steps from the policy option formation to project completion, and at times important for the construction decision, the Minister of Transport and the HM Treasury must approve it. The results of project evaluations are organized in the Appraisal Summary Table, that includes a variety of quantitative and qualitative items other than B/C, and it reflects public comments or opinions voiced at public hearings. Reports summarized in it are used by the Minister of Transport for decision-making.

Collection and analysis of people and vehicle movement data using a smart-phone application

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(Key words) Smartphone, probe-person survey, big data

1. Introduction

At the basic policy meeting of the Road Subcommittee of the Panel on Infrastructure Development held February 6, 2013, the importance of clarifying the movement of people using ICT was suggested, and the NILIM is conducting research on methods of collecting and analyzing people and vehicle movement data. This report introduces an outline of a method of collecting people and vehicle movement data using a smart phone application (below, "the App") developed by the NILIM.

2. Outline of a survey using the App

The survey was done by having test subjects download the App, which they then used to enter information to be collected by the survey (purpose of movement, movement method, departure location/destination, and location information obtained by the smartphone's GPS function, and so on.) Figure 1 shows operating screens of the App.

3. Survey in Tsukuba City

For one month in November 2013, a survey of people who lived or worked in Tsukuba City and was carried out using the App (Fig. 2). This survey was done by the Tsukuba Mobility Traffic Research Committee[1)] in cooperation with Tsukuba City.

As a result of the study, 138 people participated. Almost half of these people were aged from their forties to sixties, and a people in a wide range of ages took part (Fig.3). The typical movement method percentages were about 60% by car, followed by bicycles and train (Fig. 4). The average number of trips was about 2.7 per day (trip/persons), and collected data was similar to the nationwide FY2010 PT (weekdays: 2.84 (trips/persons), holidays: 2.91 (trip/persons)).

4. Conclusions

The survey done using the App is characterized by its ability to collect actual movement trends of the test subjects in detail, unlike a questionnaire survey. The survey in Tsukuba City attracted a wide range of participants, but to establish a data survey method, ensuring test subjects and unbalanced attributes are problems. In the future, we will continue to study people and vehicle movement data study methods, as we research data analysis technologies based on the data which was collected.

Figure 1. Smart Phone Application Operating Screen

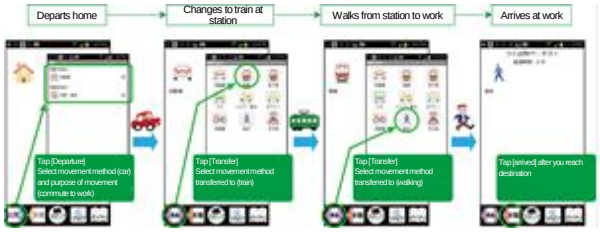


Figure 2. Movement History Collected by the Study (Example of NILIM employee)

Figure 3. Attributes of Study Participants

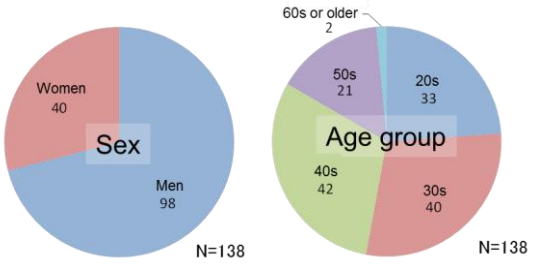
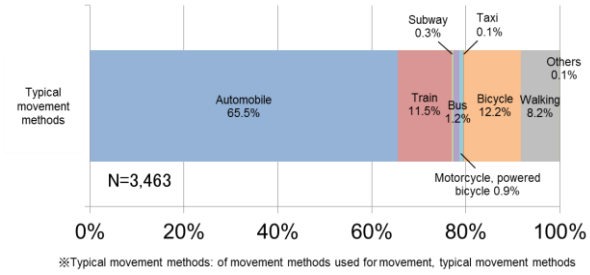


Figure 4. Typical movement Method Percentages



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Movement of people, development of a platform, and working on the application of transportation planning

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(Key words) Movement of people, Trail data

1. Introduction

Information that can clarify the actual way people move collected 24 hours/day for 365 days/year on a nationwide scale from smartphones, car navigation systems, transportation smart card systems etc. (below, "movements of people") is counted on to be used in a variety of fields.

The NILIM is researching the possibility of applying diverse movements of people to transportation planning by developin a platform capable of collecting and analyzing such information [1)]. This paper reports on the results of a verification of the possibility of applying diverse movement of people to transportation planning through combinational analysis of this information and future prospects.

2. Trial of combinational analysis

This research performed features analysis of diverse movement of people and abstraction of usage scenes in the transportation field, verifying that it is possible to apply diverse movements of people to each usage scene based on a case study of combinational analysis[2)]. The following introduces examples of the results of a case study of combinational analysis that clarifies the actual state of public transportation services.

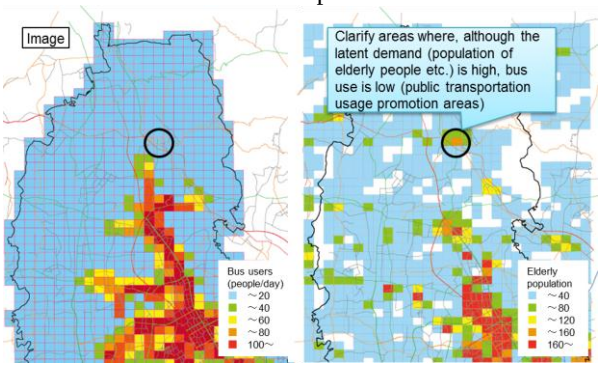
In order to promote the use of public transportation by making it more convenient, it is important to provide public transportation adapted to the residents' needs. The figure shows an image of the abstraction of latent demand for public transportation. As one application of this combinational analysis, superimposing the flow of people in mesh form obtained from cell phones and actual bus usage by route, by bus-stop, and by time period obtained from transportation system IC cards etc., we succeeded in clarifying the actual movement before and after boarding/alighting from busses at bus-stops in addition to the state of boarding/alighting at each bus-stop (figure on left). By comparing this with population distribution by mesh based on the national census and the Basic Residents Register, it was possible to clarify areas where, although the latent demand (population of elderly people etc.) is high, bus use is low (public transportation usage promotion areas). (Fig. on right)

It can be said, that in this way, combinational analysis of multiple movements of people can analyze or visualize the state of transportation, which is difficult to do with only a single movement of people, so that it can be applied to transportation planning.

3. Future prospects

The results of the research were obtained through activities of the Tsukuba Mobility Traffic Research Committee[3)]. In the future, we will verify the combinational analysis of diverse movement sof people in the field and clarify the possibility of applying it to transportation planning.

Figure. Image of Abstraction of Latent Demand for Public Transportation



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Development of a road management support system using road infrastructure map information

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(Key words) Road infrastructure map information, road management support system

1. Introduction

Road management spans many categories of work, including administrative counseling, road inspections, and pavement management. Various kinds of information are handled to perform each category of work, but much of this information is related to maps. Road infrastructure map information consists of large scale (1/1,000 or higher) road maps that represent 30 road structures such as traffic lanes with graphics, and they are prepared using road work completion diagrams. If there were mechanisms able to link various kinds of information used for road management and perform superimposition display on road infrastructure map information, it would permit spatial searching, statistical processing, analysis etc. and would be counted on to contribute to more efficient and more advanced work.

The NILIM has developed a prototype of a road management support system using road infrastructure map information (called “Road Web Map”) which has been trial operated by a road manager.

2. Outline of the Road Web Map

A characteristic of the Road Web Map is that it shares various categories of information about road management using road infrastructure map information as a sharing infrastructure (see Fig. 1).

Figure 2 is an image of the functions of the Road Web Map. The infrastructure for each type of work includes map searching and other sharing functions and a user’s management function. Individual functions specialized for each work type are added to this infrastructure.

3. State of development

In the past fiscal year, through repeated discussions with road managers, the functions which the road infrastructure web map must provide were abstracted, and the required function conditions were defined. We asked private companies that develop and build systems related to GIS applications or road management work for their opinions concerning required function conditions and summarized the results in the Required Function Conditions Definitions[1)].

This fiscal year, the prototype of the common functions and the individual function, administrative counseling function were developed based on the Required Function Conditions Definitions. And the Chiba National Highway Office of the Kanto Regional Development Bureau performed a trial of the prototype, and organized the operability of the Road Web Map and the effectiveness and usefulness of and problems with each function.

4. Conclusion

In the future, we are eager to improve the Road Web Map based on challenges clarified by the trial operation, and at the same time, add other individual functions and perform development to begin actual operation at the National Road Offices.

Figure 1. Overall Image of the Road Web Map

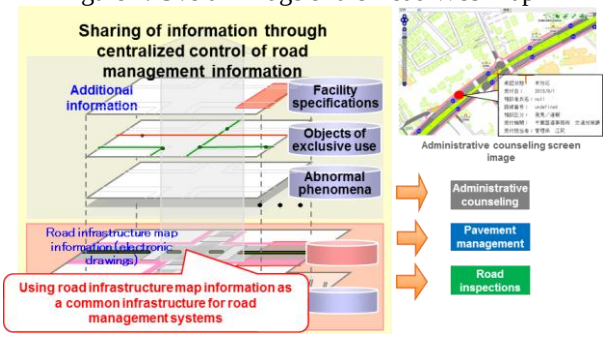
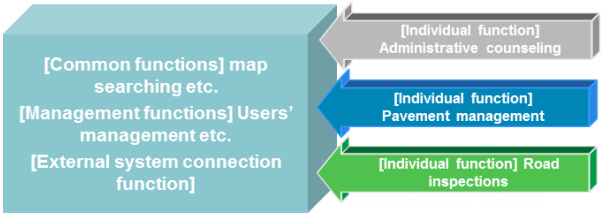


Figure 2. Image of Functions of a Road Web Map



[Sources]
1) R. Imai, Y. Sasaki: Initiatives for more efficient road management using large scale road maps, Civil Engineering Journal, No. 54-3, pp. 45-46, 2012

Efforts of Preparation for the Draft of Building Related Technical Standards

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(Key words) *Buildings, Technical standards*

1. Background

Although technical standards for the security of safety have been stipulated in the building standards law or the like, in regard to technical standards, it is necessary to appropriately reevaluate them based on the progress of investigative research and technological development and the lessons of disasters.

For this reason, as a system to carry out standardization based on the result of studies in NILIM and the building standards promotion projects (the subsidiary projects by the Ministry of Land, Infrastructure, Transport and Tourism: the Nation configures research subjects relevant to the improvement of building standards to subsidize research expenses for operation entities selected by open recruitment), the Building Structural Standards Committee (Chairperson: Tetsuo Kubo, Professor emeritus at the University of Tokyo, from fiscal 2013) will be established and the Building Fire Prevention Standards Committee (Chairperson: Makoto Tsujimoto, professor at the Tokyo University of Science, from fiscal 2012) in NILIM, the system to prepare drafts of technical standards has been established based on external experts' opinions. Furthermore, aiming to upgrade/streamline for technical standards, we will establish "Contact Point" to widely deal with proposals for improvements/reevaluations from private sectors or the like.

2. Building Fire Prevention Standards Committee

For timber buildings whose gross area exceeds 3,000m2, due to concern to affect tremendous risks to peripheries in the case of fire of the building concerned, in accordance with the Building Standards Law, Article 21, Paragraph 2, it is now compulsory that major structures shall be made fire-resistive construction. Furthermore, structures which a multitude of persons utilize and those to be used for sleeping, in order for staying persons to ensure evacuation/rescue, to make it fire-resistive building or quasi-fire-resistive building according to the number of stories or areas is made compulsory and a three story school shall be a fire-resistive building.

In the Building Fire Prevention Standards Committee, based on the results of fire experiments by actual scale models for timber structure schools which had been implemented from fiscal 2011 to 2013, deliberations were carried out in reference to reevaluations for the provisions or the like concerned in regard to timber structure three story schools (held five times in fiscal 2013 by December).

3. Contact Point

The Contact Point* is where we receive proposals from private operators with respect to reevaluations for technical standards and the improvement for new standards based on the Building Standards Law or the like, and with regard to proposals received, deliberations are carried out in cooperation with the Building Research Institute, in NILIM in view of technical aspects. For FY 2013, four cases of proposals have newly been received (as of December), and we have been carrying out deliberations in tandem with proposals received in the past.

*Inaugurated on the homepage on the Information Center for Building Administration

4. Schedule in the future

Based on the trend of deliberation in the Council for Social Infrastructure, we are continuing to carry out deliberations on reevaluations for technical standards in compliance with the development for investigation research and progress and so on.

Development of Accessibility Indicators Evaluating the Livelihood Convenience of Cities

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(Key words) *Intensive type Urban Structure, Public Transport Oriented type, Accessibility Indicator, PDCA*

1. The characteristics of accessibility indicators

The Ministry of Land, Infrastructure, Transport and Tourism aims to realize urban structures of an intensive type. For this reason, in order to correct the excessive car dependency trend in which low residential density is thinly spread, the Urban Planning Department has developed an accessibility indicator to comprehend the current status and evaluate a policy draft. This indicator illustrates easiness of a means of transportation other than cars (public transport, bicycles, or walking) to reach from residential areas to the spot where urban service facilities are located.

The purpose of this research is to assist for staff of local public authorities in charge of urban planning/urban transport planning to evaluate and improve the current state of the urban structures for themselves when implementing periodical review for planning (PDCA). Therefore, we defined the indicator based on the time required (unit: minutes) so as to readily be understood intuitively. We will describe the outline of two categories of accessibility indicators in the following.

2. Accessibility indicator for public transportation

This indicator evaluates easiness in utilizing public transport at each point in the urban areas (mesh) as being higher if users can reach the boarding zones (railroad stations or bus stops) in less time and the frequency of transport service is high, and the indicator is boosted to be higher proportionately. The indicator value is a sum of the transfer time required for reaching to the boarding zones of public transportations by road and the waiting time to board the bus or train. In addition to the distance from each spot to the boarding zones, there is a characteristic in a point deemed as a time required by transforming the number of routes and operating frequencies utilizable from there to the expectation value synthesized averaged waiting times according to directions/routes.

3. Accessibility indicator for urbanized services

This indicator evaluates according to the amount of time required (minutes) for reaching sites with facilities offering urbanized services (central parts of town and central stations, nearest hospital complex or the like) by road and using public transportation during the time zone of daytime on weekdays.

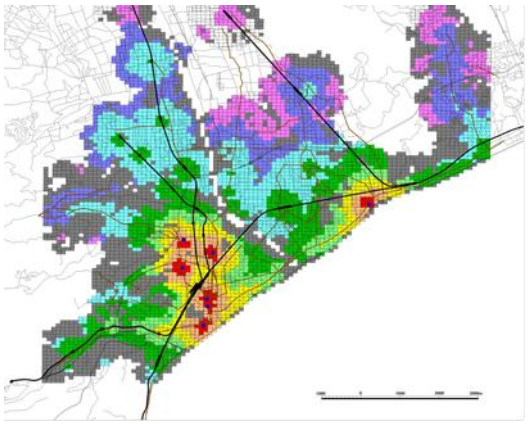

figure1: Trial calculation example of Accessibility indicator (hospital)

4. Publication schedule for outcomes

Using the indicator developed here, regarding a) location of residential areas, b) location of facilities offering urbanized services, c) location and service frequency for public transport to connect both sides, the changes in accessibilities before and after the enforcement of policies can be forecast and evaluated for these three multiple policy drafts. An interpretation for utilization method including examples of policy evaluations using the indicator is slated for its publication from the homepage of the Urban Planning Department as a Guide for Accessibility Indicator Utilization (draft).

[Reference data]

The two indicators introduced have been posted as (analysis item A0601) Accessibility indicator to public transport, (analysis item A0602) Accessibility indicator to major facilities in the Land, Infrastructure, Transport and Tourism Ministry, City Bureau, Urban Planning Survey Division Homepage Urban Planning Basic Survey Data Analysis Examples (Draft) (2013.7).

Research on appropriate public capital facility management levels considering change over time of actions and performance —Towards building strategic maintenance methods for breakwaters—

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(Key words) Breakwater, maintenance, life cycle cost

1. Outline of the research

The purpose of the research is to develop a method that can calculate anticipated values and scattering of life cycle costs during the period of use of breakwaters, to study appropriate maintenance and management levels (safety level) of breakwaters. Life cycle cost has been defined as the cumulative total during the period of use of [1] initial cost of construction of the breakwater, [2] cost of repair of the breakwater when it is deformed and cost of restoration when it is severely damaged (value of direct damage), and [3] logistics rerouting cost incurred in a port if a breakwater protecting the port is damaged (value of indirect damage).

2. Outline of results of the research

The following are results of a trial calculation of appropriate block settlement management of a caisson type breakwater covered with wave dissipating blocks.

As shown in Figure 1, wave dissipating blocks on a wave dissipating block covered breakwater often gradually settle over time because of scattering produced by high waves during typhoons. If this settlement is ignored, wave force acts directly on the caisson body, and according to circumstances, the waves may break so the impact wave force acts on the caisson, resulting in the high probability of even more severe damage, such as the caisson sliding off the rubble mound. But generally, even if a wave dissipating block settles, it is often ignored, because at normal times, breakwaters remain adequately stable under the normal waves, ensuring a degree of calmness behind the breakwater, so its repair is judged to be of low urgency.

So we used a newly developed tool to perform a trial calculation to determine what degree of settlement of a wave dissipating block requires repair work (settlement repair start criterion) in order to be able to minimize the life cycle cost. Figure 2 shows the results of a trial calculation of an actual breakwater section, with the lateral axis showing the settlement repair start criterion of wave dissipating blocks, and the vertical axis plotting the anticipated value and standard deviation of the total value of parts [2] and [3] of the life cycle cost explained above.

The figure shows that repairing the block immediately after the settlement of the block becomes equal to the height of about 1 wave dissipating, it will be possible to minimize the anticipated value of the life cycle cost, and at the same time, limit the

Figure 1. Image of Progression of Damage to a Caisson Type Breakwater Covered with Wave Dissipating Blocks

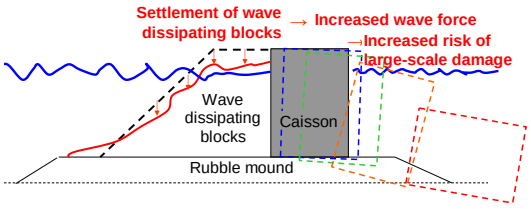
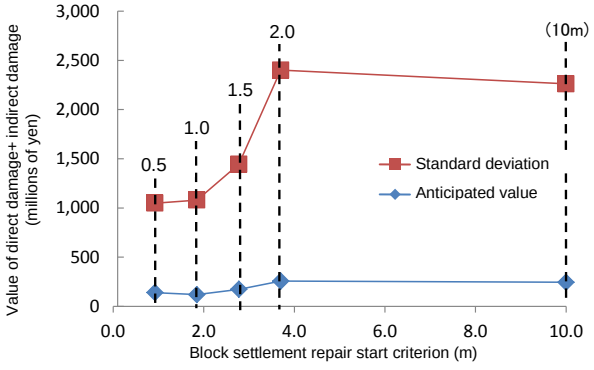


Figure 2. Relationship of Settlement Repair Start Criterion and Live Cycle Cost of a Caisson Type Breakwater Covered with Wave Dissipating Blocks



possibility of severe damage when a disaster occurs. These are limited study results, but they clearly show that at a wave dissipating block covered breakwater, diligently repairing settlement of blocks is a rational choice from the perspective of reducing total cost.

3. Conclusion

In the future, we will verify this model and improve it so it can used for practical work.

[Sources]
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2) T. Nagao et al.: Study of target wave stability level of breakwaters, Journal of the Japan Society of Civil Engineering, B2 (Coastal Engineering) Vol. 67, No. 2, pp. 781-785, 2011.

Research on the application of super high tension bolts to highway bridges

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(Key words) highway bridges, super high tension bolt, high strength bolted friction joint, slip test, slip coefficient

1. Introduction

Connecting members to erect a steel bridge is usually done by welding, or using high strength bolted friction joints (Photo 1). The higher the strength of the bolts used, the smaller the joints and the less work required to construct the connections, contributing to the reduction of costs of construction, repair, and retrofitting of highway bridges. Although bolts (F13T, F11T) stronger than the usual bolts (S10T, F10T) since 1964 were adopted, the phenomenon—brittle failure (delayed failure) suddenly occurred in F13T, then later the same damage occurred in F11T beginning in 1975, so its adoption was stopped from the 1980 design standards. Since 1991, under an administration circular from the Road Bureau of the former Ministry of Construction, bolts in danger of delayed failure have sequentially been replaced fall prevention measures have been taken. As this shows, there was concern about the long-term durability of higher strength bolts, so since then, no research on the applicability of higher strength bolts to steel highway bridges was carried out. But in recent years, super high tension bolts (S14T) created by improving delayed failure resistance performance were developed, and they have been adopted in the building construction field. Now the NILIM is studying the application of super high tension bolts (S14T) to highway bridges.

When applying these to highway bridges, because the harshness of the environment when used mainly outdoors (influence on delayed failure in particular), execution methods, number of rows of bolts etc. differ from those in the building construction field, joint research by industry, academia, and the government is being carried out to set required standards for quality of long-term durability and execution methods, including delayed failure. The NILIM is performing standard slip tests (Fig. 1), bending tests of connections of a girder (Fig. 2), and numerical analyses.

2. Past results

Durability is tested by measuring the hydrogen content of bolt materials, which is a factor related to delayed failure, accelerated corrosion testing (photo 2) and surveys of corrosion of high strength bolts in existing bridges.

Regarding execution methods, precautions to be followed in design and execution, which can ensure quality, are organized.

Standard slip tests were done within a range where high strength bolted friction joints have been used in existing bridges, and with connection surface treatment, base material plate thickness, base material quality, hole diameter, number of rows of bolts, and reassembly etc. as parameters, obtaining a slip coefficient of 0.45 or higher used to evaluate slip strength of high strength bolted friction joints stipulated by the present design standards, except in cases where organic zinc rich paint is used as to coat the surface. The girder bending test performed under different main girder flange thickness and bolt layout conditions, similarly, obtained a slip coefficient value equal or higher than the stipulated 0.45, too.

3. Future challenges

Based on past results, test data and numerical analyses results will be completed and testing done to reflect these in design and execution standards.

Photo 1. Example of a steel bridge high strength bolted friction joint

Photo 2. Accelerated corrosion test

Figure 1. Standard Slip Test

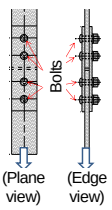
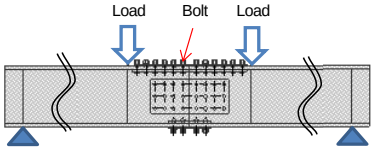


Figure 2 Girder Bending Test



[Sources]
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2) Tamakoshi et al.: Impact of causal factors on the application of super high strength bolts to the bridge field, Civil Engineering Journal, Vol. 55, No. 8, pp 18 – 21, May 2013

Features of tsunami action on highway bridges by the Great East Japan Earthquake

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(Key words) *the Great East Japan Earthquake*、*tsunami action*、*highway bridge*

1.Introduction

Damage to many bridges by the 2011 Tohoku tsunami, especially the flow out of superstructures, caused harmful effects in the disaster area. As a part of a research project to formulate design tsunami action for highway bridges, a tsunami numerical simulation was performed to investigate features of tsunami action on highway bridges. The simulation result is examined by comparing estimated wave force acting on superstructures and their loading capacities[1].

2. Features of tsunami acting on highway bridges

Propagation and run-up of the 2011 Tohoku tsunami were simulated using 2-D FDM, based on the nonlinear long wave theory, in order to evaluate time histories of wave height and flow velocity at 10 bridge sites. Horizontal and uplift forces acting on the superstructures due to the simulated tsunami were then analyzed using the numerical wave flume[1], i.e. a numerical analysis model used to conduct hydraulic model experiments by numerical simulations.

Figure 1 shows the ratios of horizontal force to horizontal capacity and vertical force to vertical capacity of superstructures of highway bridges. The capacities were estimated from the ultimate capacity of bearings and weight of superstructures. We can see that at least one of the horizontal and vertical wave force-capacity ratios of the superstructures that were washed out are larger than 1, except for the Koizumi-ohashi Bridge, while both the horizontal and vertical ratios of the superstructures that survived are smaller than 1. As for the Koizumi-ohashi Bridge, the process of its superstructure washout was reproduced by a detailed earthquake-tsunami damage simulation, taking account of effects of strong motion and rupturing sequence of its bearings.

Since the wave force-capacity ratios account for the damage status as described above, the simulated tsunami at the bridge sites are considered to be reliable. Figure 2 shows time histories of tsunami inundation height at the bridge sites. The speed the water surface rose is around 1 to 5 m a minute at these sites; the tsunami is not likely to be a bore-type one but one that gradual raises the water surface.

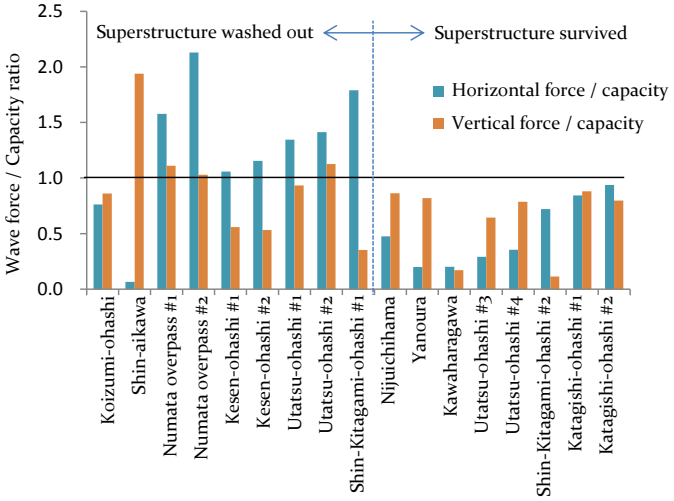

Figure 1 Wave force/capacity ratio of superstructures

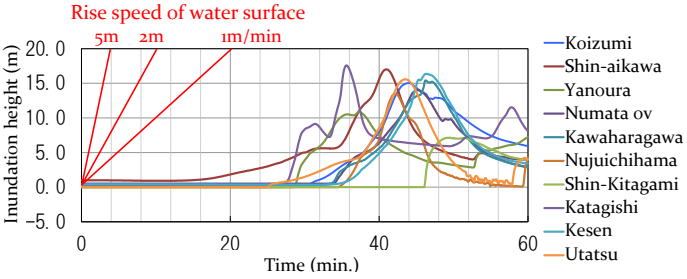

Figure 2 Time histories of inundation height at bridge sites

Peak flow velocity of the simulated tsunami is around 6 to 8 m/s, which coincides with the average subaerial flow velocity, about 6m/s, estimated from debris movement recorded in video shots.

3.Ongoing and future actions

Further research has been conducted to reliably formulate tsunami action for design practice based on the features of the tsunami from the Tohoku event as well as anticipated future giant earthquakes.

[Sources]
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Next-generation cooperative services linking ITS Spots with cell phone networks

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(Key words) Cooperative ITS, road – vehicle communication, vehicle – vehicle communication, smartphone

1. Introduction

The NILIM has been conducting "Joint Research on Development of Next Generation Cooperative ITS", which is joint public-private research on next-generation cooperative ITS with 15 private sector manufacturers since 2012.

Through the joint research, a system architecture consisting of a theoretical model and a material model has been created in order to define service contents and model the system functions and information flow, in order to clarify the overall image of cooperative ITS services. Specifically, it classifies 7 major matters—support for safe driving, smoothing traffic flow, improving the environment, improving comfort, emergency response, support for administrative activities, and support for economic activities—and lists 196 proposed services.

It also studies a road map to the development of cooperative ITS and its spread inside and outside of Japan.

This paper reports on the contents of the joint research concerning services linking ITS Spots with cell phone networks using cooperative ITS technology.

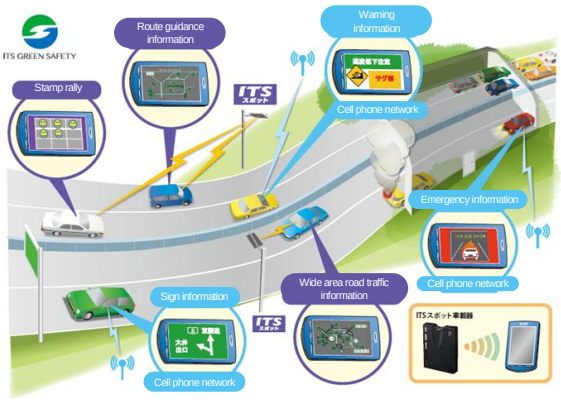
2. Outline of services linking ITS Spots with cell phone networks

"Services linking cell phone networks with ITS Spots" were jointly developed with 14 private sector companies including the expressway operators. At ITS World Congress Tokyo 2013, the showcase, "Cooperative Services of Mobile Communications and ITS Spots (12V)" was carried out, and the effectiveness of the services was surveyed.

As the showcase, participants drove from Odaiba to Umihotaru on the expressway while using smart phones to experience various services established by linking cell phone networks to ITS Spots. The following five services were newly studied.

[1] Technologies to link and complement ITS Spots or other existing infrastructure with cell phone networks were applied to continuously supply sign information, landmark information etc. for display on smartphone screens along with road traffic information from ITS Spots.

Figure. Image of Services Linking ITS Spots with Cell Phone Networks



[2] In the Aqua Tunnel where GPS is blocked, using information from ITS Spots installed in the tunnel in addition to sensor information, obtainable by smart phones and base station information about cell phone networks, clarified position information about traveling location more accurately.

[3] Real-time information provision in four languages (Japanese, English, Chinese, and Korean) using a function which supplies information to smartphones from the cell phone network was demonstrated.

[4] When starting to drive, the driver's smartphone and the smartphones of the passengers were grouped so that while driving, information the driver received from the cell phone network and from ITS Spots was also displayed on the passengers' smartphones to share the state of traffic surrounding the automobile.

[5] Recording the automobile passing each ITS Spot installed on the way to the destination to confirm the automobile is traveling on the predetermined route was demonstrated.

The results of a survey of the effectiveness of the services show that concerning the early practical introduction of the services, 30% of the respondents answered "strongly desirable" and 60% answered "desirable if possible". And concerning their intention to use the services, about 90% of them answered, "I want to use them", so it can be concluded that desire to use the services is strong.

3. Conclusions

In the future, we will continue studies based on knowledge obtained from the results of the showcase, to effectively operate services to begin their actual operation.

[Sources]

Twentieth ITS World Congress Tokyo 2013, Showcase GS: Mobile Communications – ITS Spots Cooperative Services (12V) Pamphlet

Congestion countermeasures by road-vehicle cooperation using automobile technology

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(Key words) Expressway, sag, congestion countermeasure, ACC

1. Introduction

Approximately 60% of congestion on inter-city expressways in Japan occurs in sections called sags where the road gradient is gradually changing to a rising gradient, a problem demanding urgent measures. This division is cooperating with auto makers on research and development of expressway congestion countermeasures based on road-vehicle and vehicle-vehicle cooperation of the road infrastructure and automobiles. This report introduces initiatives concerning research and developments of these congestion countermeasure services.

2. Outline of the service and its expected congestion mitigation effectiveness

This service provides information from the road side about traveling methods which effectively mitigate congestion according to traffic conditions in order to maintain smoother and more stable traffic flows by having drivers operate their automobiles based on this information, using a system that consists of roadside information provision antennae called ITS Spots, which are already installed at more than 1,600 locations on expressways as part of the road infrastructure, and an automatic control system that controls following distance between vehicles and vehicle speeds at fixed levels called ACC (Adaptive Cruise Control) and which has spread in recent years as automobile technology (Fig. 1).

To confirm the effectiveness of these congestion countermeasure services, based on the results of various test drives conducted on test courses, vehicle behavior models were built and simulation calculations performed on computers to trial calculate effectiveness. Hypothesizing a case of relatively small-scale congestion (congestion of about 15km/h) with occurrence frequency accounting for about 70% of all congestion on the Yamato Sag on the outbound Tomei Expressway, the rate of decrease of congestion loss time was trial calculated according to the mixing rate of vehicles receiving the service and cooperating with any one of the driving operations in [1] to [3] in Figure 1 (smooth traveling vehicles) (Fig. 2). The results indicated that at a mixing rate of smoothed traveling vehicles of about 20%, the congestion loss time can be cut by about 24%.

Figure 1. Image of the Congestion Countermeasure Service based on Road-Vehicle Cooperation

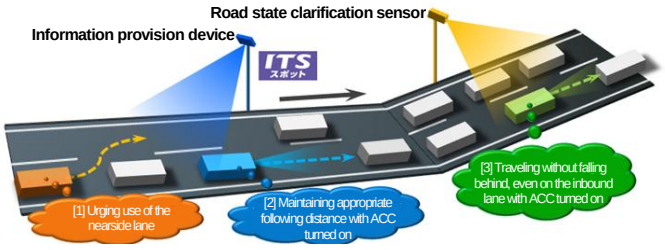
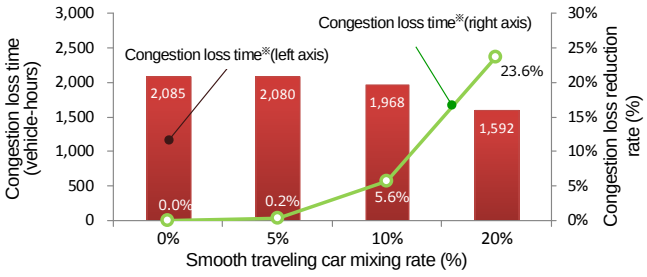


Figure 2. Congestion Loss Time According to the Smooth Traveling Vehicles Mixing Rate



※Congestion loss time means the time obtained by subtracting the actual traveling time from the standard traveling time (assuming speed of 70km/h) required when traveling in a certain section. It was assumed that the average following distance of a smooth traveling vehicle was about 1.75 seconds before the sag and about 1.5 seconds on the rising slope, and that on the rising slope, it follows the leading car alertly so it does not fall beyond it.

Figure 3. Showcase at the ITS World Congress Tokyo 2013

↗ View of preliminary explanation at the booth before the participants get in the car

↗ View inside the car during the demonstration drive (lower right is a table terminal screen displaying vehicle information)

3. Application of the results and future development

Based on this research, in the showcase event of the ITS World Congress held in Tokyo in October 2013, in cooperation with five domestic auto makers, the world's first demonstration drive providing experience of the service was held, showing off Japan's advanced initiatives in this field (Fig. 3).

In the future, we will study advertising and public awareness-raising methods to increase the social acceptability of these services and methods of providing drivers with easy to understand information by carrying out questionnaire surveys and performing testing using test subjects, and at the same time, perform simulations to clarify the road-vehicle cooperation system development goals and the congestion mitigation effectiveness at the nation-wide level.

A study of methods of creating and updating large scale road maps by government-private sector joint research

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(Key words) fundamental geospatial data of road, map creation method, cruise assist system

1. Introduction

Large-scale (1/1,000 or higher) road maps are counted on to used for various purposes in private, academia, and government; to advance road administration and cruise assist systems for example. The Ministry of Land, Infrastructure, Transport and Tourism began to apply road works completion drawings etc. preparation instructions to paving works etc. to provide the fundamental geospatial data of road as large-scale road maps in FY2006. A strong point of this provision method is that immediately after the work is completed, a renewal cycle which creates road maps is established. But because it is time-consuming to construct all lines, maps are now provided for about 30% of government managed roads. Expanding this to a variety of usage situations requires early realization of the construction of the road network.

So the NILIM began to perform two years of private, academia, and government joint research intended to establish methods of providing and updating large scale road maps using existing resources such as electronic maps, point group coordinates data, aerial photographs etc. owned by the government and private sector. This paper reports on part of the contents and progress of the joint research[1)].

2. Contents of research on large-scale road map provision and updating methods

The joint research set the following two research themes based on users' needs for large-scale road maps[2)].

- Theme 1: establishing methods of providing and updating the fundamental geospatial data of road using existing resources (Fig. 1)
- Theme 2: Establishing methods of using the fundamental geospatial data of road and existing resources to provide and update large scale road maps necessary to provide cruise assist services (Fig. 2).

3. State of initiatives in this fiscal year

As Theme 1, special features of each existing resource were analyzed to actually use existing resources to summarize provision methods which can realistically be executed by making a prototype of natural features in the fundamental geospatial data of road.

As Theme 2, essential conditions and necessary natural features of large scale road maps and their precision required for cruise assist services were defined, and provision methods completed by trial production of each natural feature.

4. Conclusions

In the future, we will consider large scale road map updating methods to verify their usefulness by making maps in conformity with provision and updating methods. And Large Scale Road Map Provision and Updating Rules (Proposed) for each theme will be compiled.

Figure 1. Image of Provision and Updating of the Fundamental Geospatial Data of Road Using Existing Resources

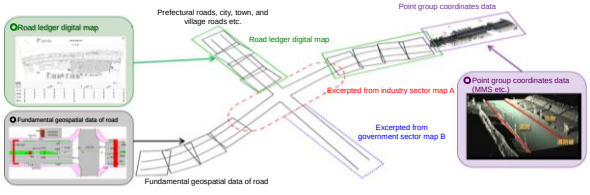
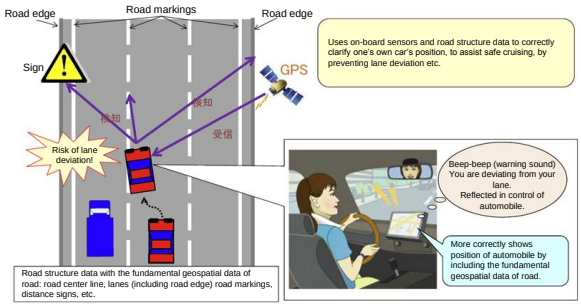


Figure 2. Image of Cruise Assist Services Using Large Scale Road Map



[Sources]
1) Imai, R., Fukada, M., Shigetaka, K.: A study of a method of creating and updating large scale road maps by public private partnerships, *the GIS Association of Japan*, Vol. 22, 2013
2) Imai, R., Matsui, S., Shigetaka, K., Sasaki, Y.: Experimental release of the fundamental geospatial data of road: Needs concerning large scale road maps of industry and academia, *the GIS Association of Japan*, Vol. 22, 2013

Topics

Release of CommonMP Ver. 1.3

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River Department

Keywords: platform, hydraulic / hydrologic analysis, element model

1. Introduction

Since April 2007, the River Department has been developing a platform of a PC analysis model that simulates complicated hydraulic and hydrologic phenomena in river basins by connecting multiple hydraulic and hydrologic analysis models (river channel models, outflow models, etc., collectively "element models"). We released this platform (CommonMP: Common Modeling Platform for water-material circulation analysis) on the website [1] in March 2010, revising the version every year. This paper reports on Ver. 1.3, released in November 2013.

2. New functions of CommonMP Ver. 1.3

CommonMP Ver. 1.0 was capable of implementing a single simulation project (a set of conditions for simulation data, connection of element models to be used, etc.) and displaying analysis results as simple graphs. In Ver. 1.1, a function for distributing simulation projects to different computers was added. In Ver. 1.2, support for implementing multiple simulation projects concurrently was added, which enabled calculations for real-time flood prediction by the joint use of a tool for obtaining real-time hydrologic data.

Ver. 1.3 adds a river channel combination model that combines river channels and adjusts branch flow rate, etc., and a levee break / overtopping model (Figure) that adjusts water passing between a river channel and protected lowland by combining the river channel model and the flood model. Consequently, simulation that integrates branch river channels or a river channel and flooding has become available.

In addition, Ver. 1.3 disclosed the development specifications of the software (extension tool) that mainly displays analysis results on CommonMP, and set forth a procedure for installing the extension tool in CommonMP and a sharing it so that persons other than CommonMP developers may develop and distribute the extension tool as well as element models.

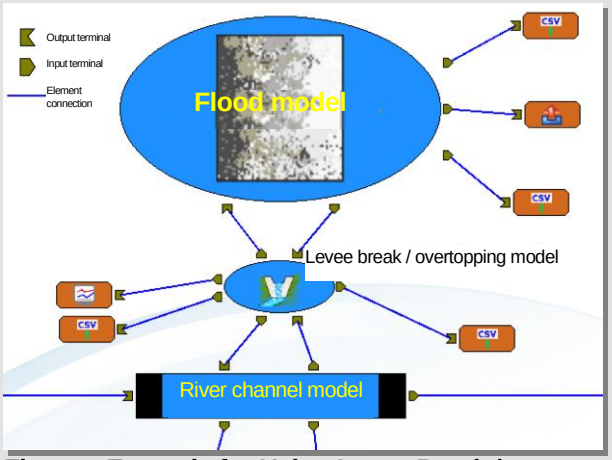

Figure: Example for Using Levee Break / Overtopping Model that Combines Flood Model and River Channel Model in CommonMP

3. Future activities

With the release of Ver. 1.3, hydraulic and hydrologic analyses including branch channel and flood analyses have become available in CommonMP. In the future, we plan to develop a practical flood analysis model, and extension tools that support the export of analysis results from CommonMP to reports, etc. in order to build an environment for using CommonMP in daily operations.

Extension tools will be included in a library on the CommonMP website in the same way as the Element Model Library [2], released in March 2012, so that any user may use them.

[Reference]

1) CommonMP website: http://framework.nilim.go.jp
2) Element model library:
http://framework.nilim.go.jp/lib-model/index.html

Dispatching of experts and technical assistance activities in the event of a disaster

1. Introduction

The NILIM, which researches various fields related to housing and public capital provision, responds to an accident or disaster by dispatching experts to survey the state of the damage and to provide technical assistance with recovery and restoration. And it responds in various other ways: NILIM TEC-FORCE deployment, conducting surveys in response to requests from the regional development bureaus or local governments and as required by law, and carrying out its own independent surveys as part of research to contribute to disaster prevention and disaster damage mitigation.

2. NILIM TEC-FORCE

After a particularly large-scale disaster occurs and when ordered to do so by the Director of the Government Headquarters for Disaster Countermeasures of the Ministry of Land, Infrastructure, Transport and Tourism, the NILIM dispatches experts in various fields as the Advanced Technology Guidance Team of the Technical Emergency Control Force (TEC-FORCE) to the scene, where it surveys the state of the damage, evaluates the safety of facilities, and provides technology assistance to prevent secondary disasters.

In FY2013, experts were dispatched to the sites of disasters immediately after they occurred to provide technological assistance: the earthquake with its hypocenter near Awaji Island and an accident at the Kyoto Jukan Expressway extension work site (road field) in April, the Chugoku region torrential rain disaster (sewage systems field) in August, and to the sediment disaster (sediment control field) on Izu Oshima caused by typhoon 26 in October.

3. Other technological assistance

In the event of an accident or disaster, experts with advanced technology expertise in many fields are dispatched to the scene in various roles, to conduct surveys in response to requests from regional development bureaus or local governments in the disaster region, or in compliance with the Sediment Disasters Prevention Act or a directive from the Director of the River Improvement and Management Division. The experts who are dispatched carry out field surveys according to the state of occurrence of the disaster and at the same time, provide required technological assistance to officials on the scene and to ministry headquarters in preparation for emergency and permanent restoration. And they accumulate high precision data and other information immediately after the disaster and conduct research in order to propose future revisions to technology standards and new policies for disaster prevention.

In FY2013, torrential rainfall and sediment disasters struck throughout the archipelago—Niigata in July, Akita and Iwate in August, Fukui, Kyoto and elsewhere in September—then again in September, disastrous tornadoes struck the Kanto Region. After each event, the NILIM dispatched experts in sediment control, building construction, rivers and so on.

And when a storm surge disaster caused by Typhoon 30 struck the Philippines, the NILIM sent an expert as part of an international emergency rescue team and expert team (early recovery). It also sent JICA experts in response to a disastrous earthquake, also in the Philippines. They gave technological advice to Philippine government bodies to assist with the clarification of the damage mechanisms and support recovery and reconstruction.

Table. Dispatch of Experts in 2013 (December 2013)

Disaster	Day dispatched	Place dispatched	Reason	Personnel dispatched
Hurricane Sandy	Feb 24 to March 2	U.S. *	the Hurricane Sandy Survey Team	Director-General: KAZUSA Shuhei Research Center for Disaster Management Research Coordinator for Earthquake Disaster Prevention: UNJOH Shigeki River Department, Coast Division Head: SUWA Yoshio Research Center for Disaster Management, Flood Disaster Prevention Division Head: ITO Hiroyuki Earthquake Disaster Prevention Division: Senior Researcher: MABUCHI Toshiaki

Disaster	Day dispatched	Place dispatched	Reason	Personnel dispatched
Heavy rain caused by low pressure from April 6	April 8	Tokyo Adachi Ward Kawaguchi and Toda Cities in Saitama Pref. (Arakawa River in Arakawa River System)	Survey under directive from the Director of the River Improvement and Management Division	River Department, River Division Head: HATTORI Atsushi Senior Researcher: MORI Hirotosh
Strong wind on April 7	April 11	Tsu and Iga cities in Mie Pref. (damaged wind power facility)	Request from the Building Guidance Division of the Housing Bureau	Research Center for Disaster Management Research Coordinator for Disaster Mitigation of Building: OKUDA Yasuo
Earthquake with hypocenter near Awajishima Island (April 13)	April 16	Sumoto City in Hyogo Pref. (Sumoto Bridge) *	TEC-FORCE	Road Department, Bridge and Structures Division Head: TAMAKOSHI Takashi Senior Researcher: SHIRATO Masahiro Researcher: MIYAHARA Fumi
	April 16 to 17	Sumoto City etc. in Hyogo Pref.	Independent survey	Housing Department, Housing Production Division Senior Researcher: NAKAGAWA Takafumi
Kyoto Jukan Expressway extension work site accident	April 24	Kyotango City, Kyoto Pref.	TEC-FORCE	Road Department Research Coordinator for Road Structures: MIZUTANI Kazuhiko
Heavy rain starting July 17	Aug. 1 to 2	Nagaoka City in Niigata Prefecture (Moriage, Teradamari)	Request from Niigata Prefecture	Research Center for Disaster Management, Erosion and Sediment Control Division Researcher: HAYASHI Shinichiro
	Aug. 5 to 6	Hagi City, Yamaguchi Pref. (Susa Purification Center) *	TEC-FORCE	Water Quality Control Department Research Coordinator for Wastewater System Restoration; OZAKI Masaaki
	Aug. 5 to 6	Hagi City and Yamaguchi City in Yamaguchi Pref. (Susa, Atohtokusa)	Independent survey	Research Center for Disaster Management, Flood Disaster Prevention Division Senior Researcher: YAMAMOTO Akira Researcher: ONAMI Hiroyuki
Heavy rainfall from Aug. 8	Aug. 10	Senboku City Akita Pref. (Kuyobutsu District) Iwate Pref. (National highway 46) *	Request from Akita Pref. Request from Tohoku Regional Development Bureau	Research Center for Disaster Management, Erosion and Sediment Control Division Head: KANBARA Junichi
Tornado on Sept. 2	Sept. 2 to 3	Koshigaya City, Matsubushi Town, Saitama Pref Noda City, Chiba Pref. *	Request from the Building Guidance Division of the Housing Bureau	Building Department, Standards and Accreditation System Division Head: ANDO Koji Researcher: KABEYASAWA Toshikazu Housing Department, Housing Production Division Senior Researcher: NAKAGAWA Takafumi
Heavy rain by a front on Sept. 4	Sept. 10	Nagoya City, Aichi Pref. (Shonai River on the Shonai River System)	Survey under directive from the Director of the River Improvement and Management Division	River Department, River Division Head: HATTORI Atsushi Senior Researcher: MORI Hirotoshi
Typhoon 18	Sept. 18 to 19	Obama City, Wakasa Town, Mihama Town in Fikui Pref.	Request by Fukui Pref.	Research Center for Disaster Management, Erosion and Sediment Control Division Head: KANBARA Junichi
	Sept. 18 to 19	Kyoto City and Fukuchiyama City in Kyoto Pref. Takashima City in Shiga Pref.	Independent survey	Research Center for Disaster Management, Flood Disaster Prevention Division Senior Researcher: YAMAMOTO Akira Researcher: ONAMI Hiroyuki

TEC-FORCE

Disaster	Day dispatched	Place dispatched	Reason	Personnel dispatched
	Sept. 20	Ritto City in Shiga Pref. (Anyoji)	Request by Shiga Pref.	Research Center for Disaster Management, Erosion and Sediment Control Division Senior Researcher: MIZUNO Masaki
	Sept. 24	Fukuchiyama City and Maizuru City in Kyoto Pref.	Request by the River Improvement and Management Division of the Water and Disaster Management Bureau	River Department, River Division Head: HATTORI Atsushi Senior Researcher: MORI Hirotoshi
	Sept. 27	Kyoto City in Kyoto Pref.	Independent survey	River Department, Coast Division Head: SUWA Yoshio Research Center for Disaster Management, Flood Disaster Prevention Division Head: ITO Hiroyuki Earthquake Disaster Prevention Division: Senior Researcher: MABUCHI Toshiaki (All the Hurricane Sandy Survey Team)
Typhoon 26	Oct. 16 to Nov. 2 (rotation system)	Oshima Town, Tokyo Pref. *	TEC-FORCE	Research Center for Disaster Management Research Coordinator for Sediment-related Disaster Prevention: WATANABE Fumito Erosion and Sediment Control Division Head: KANBARA Junichi Senior Researcher: UCHIDA Taro Researcher: HAYASHI Shinichiro Researcher: OKUYAMA Yuki
Earthquake with hypocenter near the Philippines (Oct. 15)	Nov. 18 to 22	Philippines*	JICA experts	Research Center for Disaster Management, Earthquake Disaster Prevention Division: Senior Researcher: MABUCHI Toshiaki
Typhoon 30	Dec. 2 to 15	Philippines	International emergency rescue team and expert team (early recovery)	River Department Research Coordinator for Water Environment: FUKUHAMA Masaya Research Center for Disaster Management Research Coordinator for Earthquake Disaster Prevention: KUSAKABE Takaaki

※ This table presents only emergency responses immediately following a disaster: it does not include technology support for emergency restoration and final restoration undertaken continuously after the emergency response.

※ Persons dispatched include only staff of the NILIM (Post and rank at time of dispatch)

※ For dispatch cases marked with [*], see related articles in the report.

Debris Flow Disasters Caused by Typhoon Wipha (T1326) on Izu-Oshima Island and Technical Support of NILIM TEC-FORCE

NISHI Masato , Director of Research Center for Disaster Management
WATANABE Fumito , Research Coordinator for Sediment-related Disaster Prevention
KANBARA Jun'ichi , Head, SABO (Erosion and Sediment Control) Division
UCHIDA Taro (Ph.D.), Senior Researcher
HAYASHI Shin-ichiro , OKUYAMA Yuki , Researchers
EKAWA Masafumi , HATA Masayuki , NIWA Satoshi , Guest Research Engineers

(Key words) *Izu-oshima Island*、*Debris flow*、*TEC-FORCE*、*Technical support*

1. Introduction

On October 16, 2013, Typhoon Wipha brought precipitation exceeding 800 mm over a 24-hour period to Izu-Oshima Island, Tokyo. As a result, simultaneous debris flows occurred on hillsides of the volcano, Mt. Mihara, resulting in 36 deaths and 3 missing (as of Jan. 15, 2014; Photo 1). The SABO (Erosion and Sediment Control) Division of the Research Center for Disaster Management at the National Institute for Land and Infrastructure Management (NILIM) and the Erosion and Sediment Control Research Group of the Public Works Research Institute (PWRI) implemented technical support for the Tokyo Metropolitan Government and Oshima Town Office from the moments immediately after the debris flow disasters to early in November to prevent secondary disasters and to implement emergency recovery.

Photo 1 Debris flows on hillsides of volcano Mt. Mihara

2. Characteristics of debris flow disasters on Izu-Oshima Island

The disaster was characterized by multiple shallow landslides of volcanic ash layer deposited on the hillsides. The ash was approximately 1 m deep and transformed into downhill debris flows. In addition, a huge number of trees, toppled by shallow landslides and debris flows, were carried downhill by the debris flows. The Motomachi-Kandachi district suffered serious loss of life and property damage from the direct impact of the debris flows. Downhill from the Motomachi-Kandachi district, blockage caused by driftwoods at bridges caused floods, resulting in more loss of life and property damage (Photo 2).

Photo 2 Blockage of driftwoods at Motomachi Bridge

On the contrary, the Motomachi district has sediment-related disaster prevention facilities (i.e. check dam) and these facilities protected residents or reduced damage by capturing debris flows and driftwoods (Photo 3).

Photo 3 Capture of debris flows and driftwoods by a sediment-related disaster prevention facility along Okanesawa River

3. Implementation of technical support

After the debris flows, weather forecasts predicted that Typhoon Francisco (T1327) would arrive in 10 days, creating the risk of secondary disasters in the stricken area.

The SABO (Erosion and Sediment Control) Division of the Research Center for Disaster Management at the NILIM and the Erosion and Sediment Control Research Group of the PWRI implemented technical support for the Tokyo Metropolitan Government and Oshima Town Office after the debris flow disasters, to prevent secondary disasters and to implement emergency recovery activities as the TEC-FORCE (Technical Emergency Control Force) over an 18-day period from October 16 to November 2, by dispatching personnel equal to 48 man-days in total.

The type of technical support NILIM provided was as follows.

- Emergency ground surveys to identify damage and prevent secondary disasters (Photo 4)
- Providing technical advice to the Tokyo Metropolitan Government on preventing secondary disasters and implementing emergency recovery activities
- Providing technical advice on selecting target areas and precipitation criteria for issuing evacuation advisories, orders and cancelation by the Mayor of Oshima
-Providing technical instruction to ensure safety during rescue activities

Moreover, NILIM provided advice on organizing results of emergency inspections of locations at risk of sediment disasters performed by the MLIT Regional Office TEC-FORCE immediately after the disaster (Photo 5).

Photo 4 Emergency ground survey

Photo 5 Providing advices to the MLIT Regional Office TEC-FORCE

4. Continuing technical support for Izu-oshima Island's recovery and future research plans

The Director of the Research Center for Disaster Management participated as an administrative member in the Izu-Oshima sediment-related disaster countermeasure planning committee that was tasked by the Tokyo Metropolitan Government with establishing a master countermeasure plan. The NILIM is continuing to provide technical support for Izu-Oshima Island's recovery.

NILIM has plans to implement research activities to analyze the mechanisms of the shallow landslides and debris flows of this disaster and to establish technologies for structural and non-structural measures against sediment-related disasters in volcanic regions.

[Sources]

Research Center for Disaster Management, NILIM & Erosion and Sediment Control Research Group, PWRI: Sediment-related Disasters Caused by Typhoon Wipha (T1326) on Izu-oshima Island, 2013, Civil Engineer Journal, Vol. 55, No. 12, p.4-7, 2013 (in Japanese).

Damage Investigation of Buildings or the like by Tornadoes Occurring on September 2, 2013

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ANDO Koji (Dr. Eng.), Head
KABEYASAWA Toshikazu (Dr. Eng.), Researcher
Standards and Accreditation System Division, Building Department
NAKAGAWA Takafumi (Dr. Eng.), Senior Researcher
Housing Production Division, Housing Department

(Key words) Tornado, Gale devastation rank, Gymnasium roof, timber houses

1. Outline of investigation

On September 2, 2013, a tornado ranked 2 on the Fujita scale occurred and caused damage to buildings or the like, centering on Koshigaya City, Matsubushi-machi, Saitama Prefecture and Noda City, Chiba Prefecture. NILIM carried out onsite investigations on September 2, 3 and 5 in order to comprehend the outline of the damage in regard to buildings and so forth in collaboration with the Building Research Institute.

2. Damage distribution

We carried out appearance inspections for 593 buildings in total, targeting areas which seemed to have especially momentous damage within the scope of investigations and judged the damage degree in view of damage of structural frames/roofs/exterior members or the like based on the gale damaged degree ranking (see chart). In this investigation, collapsed damage of 17 buildings (Rank 5) was confirmed in total. In addition, we have found that damage by tornados were more or less distributed in a linear fashion.

Figure Distribution of gale damage degree rank

3. Damage to educational facilities

The damaged gymnasium of an educational facility has a flat surface size of 20m x 30m and height of about 10m, and the roof is a cubic truss with a reform construction implemented in 2005 (Photo1). For fixing the roofage to the main building, screws were used. The metal roof is partially twisted up due to breakup at connecting part between the main building and roofage and the broken part was about 25% of the total area. Moreover, part of the roof was bent upward. Furthermore, the fall of slope roof is confirmed in addition to the destruction of steel sheet roofage and the main building.

Photo 1: Damage in educational facility A Gymnasium

4. Damage to timber housing

The timber house illustrated in Photo 2 shows the possibility of destruction due to the upper structure of a building blown from the neighboring area. As an example of the collapse of a whole structure, we corroborated a two-story house had its ground floor collapse and upper structure blown away leaving its foundation. Other than these, (1) damage to the roof truss, (2) damage to openings/exterior finishes and (3) damage by incoming articles have been corroborated.

Photo 2: Collapse of upper structure in timber housing

(Reference)

NILIM disaster investigation report (home):

Damages by tornadoes occurring on September 2, 2013 in Koshigaya City, Saitama Prefecture and Noda City, Chiba Prefecture (flash report)

http://www.nilim.go.jp/lab/bbg/saigai/h25koshigaya/130904tatsumaki.pdf

Survey of Damage and Relief Actions in New York after Hurricane Sandy

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Keywords: Hurricane Sandy, storm surge, city damage, crisis management actions

1. About Hurricane Sandy

Hurricane Sandy formed in the Caribbean Sea on October 22, 2012 and landed in New Jersey around 8:00 p.m. on October 29. Upon landing, it was a huge storm with an average wind speed per minute of approx. 36 m/s and scope of 1400 km. From October 28 to November 1, the strong winds and storm surge (record-high sea level of 13.88 ft in Manhattan) caused damage mainly in the states of New York and New Jersey. Since this is an important case where a modern city was hit by flooding, we conducted an on-site survey jointly with societies related to disaster prevention, from the viewpoints of grasping the aspects of damage to city services and disaster response.

2. Damage by Hurricane Sandy

In New York and New Jersey, coastal areas were flooded by storm surge (Figure). Main aspects of the damage are as follows.

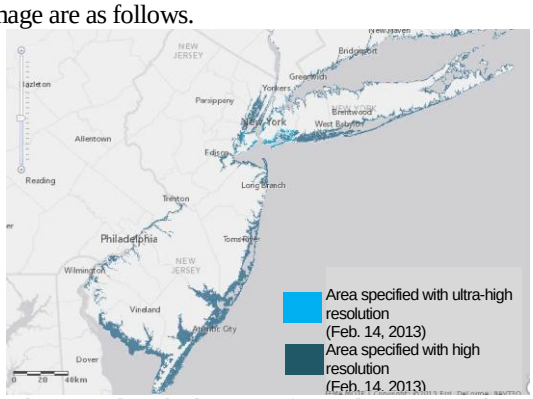


Figure: Flooded Area of Hurricane Sandy (Source: Federal Emergency Management Agency)

(i) Human damage: Hurricane Sandy reportedly killed a total of 132 persons in the U.S. and Canada as of November 16, 2012. The main causes of death were "drowning", "fallen trees," "external injuries," and "carbon monoxide poisoning."
(ii) Damage to transportation facilities: Subway tunnels and stations, street tunnels, etc. were flooded (Photo).
(iii) Damage to electric power facilities: A substation flooded and exploded in the City of New York and power supply stopped. A total of 8 million households in 17 States were affected by the blackout.
(iv) Suspension of business in stock exchanges: Stock exchanges were closed on October 29 and 30 to ensure the safety of employees.

Photo: Flooded Subway Station (Source: Metropolitan Transportation Authority)

3. Response to disaster by government, etc.

The following findings were obtained concerning disaster response.
(1) Preparation and implementation of a timeline of disaster-response actions

Measures for a big hurricane as well as a time schedule (time line) for implementing those measures are prepared during ordinary times, and based on these, drastic measures, including evacuation orders involving hundreds of thousands of people and the suspension of public transportation, were carried out by the day prior to the arrival of hurricane.
(2) Establishment of the joint local task force by the Federal and local governments, etc.

A joint local task force was established by the Federal, State, and municipal governments, and each organization acted efficiently by sharing roles and in close cooperation with each other.
(3) Communication by the heads of administration

Governors, mayors, etc. actively appeared on mass-media to call for evacuation and responsive actions, etc.
(4) Verification of implemented disaster response

PDCA was establishment to verify the actions made in response to the disaster and utilize results for future responses.

[Reference]

On-site Survey on the U.S. Hurricane Sandy
http://www.mlit.go.jp/river/kokusai/disaster/america/index.html

Survey of Damage to Road Bridges by the Bohol Island Earthquake in the Philippines

MABUCHI Toshiaki, Senior Researcher

Earthquake Disaster Prevention Division, Research Center for Disaster Management

Keywords: Bohol Island Earthquake, road bridge, damage survey

1. Introduction

An earthquake of M7.2 occurred on Bohol Island, Philippines, on October 15, 2013 It caused serious damage and resulted in 222 deaths, 8 missing persons, and 796 injured (as of the end of October). Since road bridges also suffered serious damage including collapse from this earthquake, the Department of Public Works and Highways of the Philippines Government requested technical assistance for road bridge restoration to the Japan International Cooperation Agency ("JICA") hereafter). As requested by JICA, I was dispatched to the Philippines as a short-term expert to survey the damage to road bridges from November 18 to 22, together with Junichi Hoshikuma, senior researcher of the Center for Advanced Engineering Structural Assessment and Research (CAESAR), Public Works Research Institute, and Toru Tsuchihashi of the Planning / Coordination Division, Economic Infrastructure Development Department, JICA.

Note that, on November 4 to 11, 20 days after this earthquake, Typhoon No. 30 ("Haiyan") passed through an area about 140 km north of Bohol Island and caused enormous damage to Leyte and Samal Islands, but no further serious damage to the road bridges on Bohol Island, which was just a short distance away.

2. Outline of the Philippines Bohol Island Earthquake

The earthquake struck at 8:15 a.m (local time). on October 15 (Wed.), 2013 with an epicenter in Sagbayan Town (north latitude 9.86°, east longitude 124.07º). It had a magnitude of 7.2 and focal depth of 12 km, according to the announcements of the Philippine Institute of Volcanology and Seismology.

On the Island, a reverse fault, which is a concealed fault different from the existing fault (Bohol Fault), was found and named the "Northern Bohol Fault."

The maximum seismic intensity was 7 on the 12-stage seismic intensity scale of the Philippine, which is equivalent to about an upper 5 on the Japanese intensity scale.

3. Damage to road bridges

Damage to road bridges occurred on the west side of the roads running around Bohol Island. We investigated 16 bridges during the survey period. The photo shows the collapsed Moalong Bridge. The deformation in the surrounding ground caused the abutment and intermediate abutment to tilt. The bridge girder then collapsed because of the shortened girder seating. In many other affected bridges, damage resulting from the movement of the abutment due to the subsidence of surrounding ground was seen.

Such form of damage was also seen in the 1990 Luzon Earthquake [1]. It is, therefore, necessary to take seismic improvement measures including the seismic design of substructure, and bridge collapse prevention measures, according to ground conditions.

4. Conclusions

We promptly reported the survey results to the Department of Public Works and Highways of the Philippines Government, and introduced the seismic measures in Japan in consideration of the type of damage to the road bridges in the Philippines. The geographical environment of the Philippines is similar to Japan and likely to suffer disasters from earthquakes and typhoons. We hope that this survey will contribute to the development of disaster-resistant roads in the Philippines.

[Reference]

"Report on the 1990 Philippines Luzon Earthquake Damage Survey," edited by the Japan Society of Civil Engineers (Earthquake Damage Survey Series 1)

Photo: Damage to Moalong Bridge (Built in 1982)

Major Disaster Surveys

1 On-site guidance for sewerage facilities concerning damage by heavy rain in the Chugoku District

Because of heavy rain in the northern and central parts of Yamaguchi Prefecture in July 2013, extensive damage occurred within the Hagi Environmental Protection Sewerage System (Susa Treatment Area),. More specifically, slopes of an adjoining national highway collapsed and the sediment flowed into the wastewater treatment plant whereby causing a shutdown.

To maintain sewerage services, vacuum trucks from Hagi City joined with vacuum trucks from three other cities in the prefecture in support. The trucks pumped the sewage and prevented wastewater flooding in the community. However, it was difficult to continue in the long-term transport of wastewater, therefore Hagi City had to recover the treatment facilities as soon as possible. In this regards, the National Institute for Land and Infrastructure Management (NILIM) gave guidance on the relevant organizations to consult and step-by-step procedures for recovering wastewater treatment.

OZAKI Masaaki, Research Coordinator of Water Quality Control
Water Quality Control Department

2 On-the-spot survey of a bridge damaged by the April 13 earthquake near Awajishima Island

An earthquake with its hypocenter near Awajishima Island at 5:33 a.m. on April 13, 2013 (M6.3, max. seismic intensity: weak 6) caused large cracks on a bridge abutment of a cable-stayed bridge (Suhama Bridge, administrated by Sumoto City, Hyogo Prefecture, bridge length: 149m) on Awajishima Island. Responding to a request from the Kinki Regional Development Bureau, the Bridge and Structures Division conducted an on-the-spot survey as TEC-FORCE, with the Public Works Research Institute. They provided technological guidance concerning safety evaluations and restoration measures.

TAMAKOSHI Takashi, Head
MIYAHARA Fumi, Researcher
Bridge and Structures Division, Road Department

3 On-site guidance for sediment-related disasters in Senboku, Akita

The debris flow in the Kuyobutsu District of Senboku, City, Akita Pref., which occurred due to a slope failure induced by heavy rain that began at dawn on August 9, 2013, caused serious damage -- 6 deaths, 2 injured, 16 houses damaged (including 10 vacant houses). In response to the request of Akita Prefecture for the dispatch of disaster survey personnel, the Erosion and Sediment Control Division conducted an on-site survey on August 10 and gave technical advice to Akita Prefecture and Senboku City on a future warning and evacuation system. For this study, Akita Prefecture formed a "Warning / Evacuation Review Committee for Senboku Kuyobutsu Debris Flow," to which we are continuously giving technical advice.

KANBARA Jun'ichi, Head
NIWA Satoshi, Guest Research Engineer
Erosion and Sediment Control Division, Research Center for Disaster Management

International Research Activities

1. Mission of international research activities

1.1. Three missions

The NILIM is the country's only research body in the housing and public capital fields. As an organization of the Ministry of Land, Infrastructure, Transport and Tourism, its mission is to provide technical support necessary to more accurately and rapidly plan, propose, and implement policies of the Ministry of Land, Infrastructure, Transport and Tourism. Based on this, the NILIM resolutely works to fulfill the following missions related to international research activities.

[1] Improving the quality of policies

[2] International harmonization of technical standards etc.

[3] Extending technical assistance

Concrete examples of its initiatives are described below.

[1] Improving the quality of policies: Field survey of Hurricane Sandy in the U.S.

In February 2013, with the NILIM Director General as its leader, a survey team including the members of the JSCE was formed. The team surveyed damage caused by Hurricane Sandy in the U.S., the response to it, and reported its findings to the Minister of Land, Infrastructure, Transport and Tourism. It has presented the results of the survey at several meetings held in Japan.

[2] International harmonization of technical standards etc.: Participation in international conferences concerning international standards

At the same time as the NILIM works to inform the world of Japan's approach to technical standards etc. it strives to harmonize Japan's technical standards with international standards. By participating in many international conferences such as ISO meetings, we have made proposals from Japan's standpoint, collected information about international trends, and adjusted these with concerned parties inside Japan.

[3] Extending technical assistance: Dispatching experts and study and training by the JICA, bilateral research links

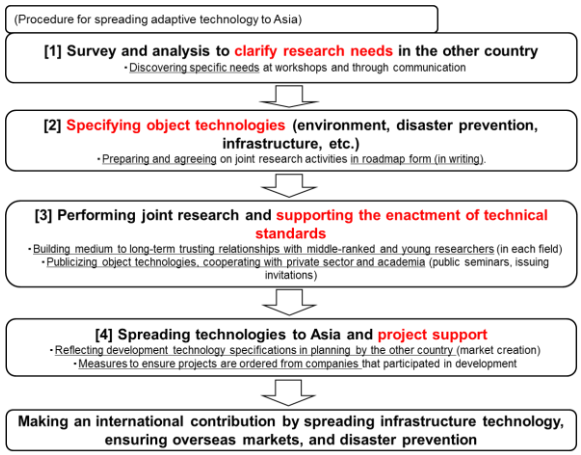
Wide experience and know-how in technical guidance the NILIM has accumulated through domestic dispatch of experts and on-the-job training is also applied outside of Japan. It provides technical assistance through the dispatch of experts and on-the-job training by the JICA in response to requests from overseas.

And with priority on the countries of Asia, we conduct bilateral research connections emphasizing the medium to long term. At this time, we have signed research connection memoranda concerning infrastructure provision with India, Indonesia, and Vietnam, to provide these countries with technical assistance. We are now making preparations focused on the possibility of research connections with Myanmar.

1.2 Exporting technology in conjunction with research connections

Of the three initiatives of the NILIM discussed above, it appears that fewer efforts to promote [3] Extending technical assistance were made compared with the other two until we formed priority bilateral research links. Therefore, to extend technical assistance effectively and efficiently, joint research from the medium and long term perspectives will be conducted in the 4 Asian countries mentioned above in line with the procedure shown in the figure.

Figure. Procedure for spreading adaptive technologies in Asia



Bilateral medium to long term research connections and technical assistance are accompanied by a steadily growing need to provide the outside world with technical theories related to the provision of infrastructure in Japan and written technical standards based on these technical theories. Technology assistance, or in other words exporting technologies, equals exporting concepts and theories of these technologies. Providing technical standards that have systemized technical theories can be called part of technology assistance. The increasing need to provide these to foreign countries is a result of impetus from both inside and outside of Japan: requests for Japanese technology from overseas along with pressure inside Japan to export infrastructure overseas.

Providing technical theories or technology standards to foreign countries naturally makes an international contribution by spreading infrastructure technologies and preventing disasters, and it also introduces foreign countries to technical theories and technology standards familiar to Japanese companies,

establishing the infrastructure simplifying Japanese companies advance into these countries, or in other words, ensuring overseas markets.

Below specific examples in the road field are cited following the procedure in the figure.

2. Survey analysis (preparation) to clarify research needs of other countries

We are now making preparations to support technical standards and form research connections with Myanmar.

In 2013, the Minister of Land, Infrastructure, Transport and Tourism and the Minister of Construction of the Republic of the Union of Myanmar signed a memorandum of cooperation in the road field. In response, the NILIM and Public Works Research Institute studied the support system, and exchanged information with JICA experts.

In the future, we will visit and tour the region to specify the object technologies and study performing a survey to clarify technology assistance and research needs.

Photo 1. View of a road in Myanmar
Because water gathers on roads when rain falls, neighboring farmers who received commissions from the government are digging ditches beside the road to drain the water.

3. Specifying the object technologies

In June 2012, road interim report workshops were held in three countries, Japan, Indonesia, and Vietnam.

And research connections operate in six fields with both Indonesia and Vietnam. And as candidates for JICA project cases in particular, surveys and research have been conducted in the paving field (natural asphalt material (AsButon)) with Indonesia, and in the paving, bridge (restoring the paving on the Thang Long Bridge) and tunnel fields (Hai Van Tunnel maintenance) with Vietnam.

Workshops were held, specifying technology to be the topic of joint research in various research linked fields.

4. Performing joint research and supporting the enactment of technical standards

Based on bilateral research links with Indonesia, a guideline to traffic volume measurement methods in Indonesia was prepared last year (FY2012). This earned an award at the REAAA in March 2013.

In addition, in cooperation with the PWRI, the NILIM formed research connections to develop practical pavements made of new materials (natural asphalt material (AsButon) in Indonesia), and conducted joint research to propose utilization methods and to enact technology standards.

5. Spreading technologies to Asia and project assistance

We are now responding to a request from the Government of Vietnam by giving consultation services on the repair of the paving on the Thang Long Bridge, which is a key point linking Noi Bai Airport with downtown Hanoi in Vietnam, and under a memorandum signed with the Institute of Transport, Science, and Technology of the Ministry of Transport of Vietnam, we are establishing research connections in cooperation with the PWRI.

In October 2012, we discussed the Thang Long Bridge pavement repair project, visited the site, and provided technical advice.

And we gave overall cooperation and assistance with technological aspects of the project to the local JICA office and embassy.

In the future, we will support this project to establish it as a JICA loan assistance case and at the same time study giving technical assistance to encourage Japanese owned companies to advance into overseas markets, and provide information about road environment technology standards.

Photo 2. Technicians from the NILIM and PWRI etc. Inspecting Pavement at the Thang Long Bridge in Vietnam
In response to a request from the Government of Vietnam, Japanese technicians are examining the pavement and looking for the causes of damage to it in order to repair the paving on the Thang Long Bridge, which is a key point linking Noi Bai Airport with downtown Hanoi in Vietnam

6. Conclusions

Although brief, the above describes our international research activities. We wish to continue to provide research assistance in the future while hearing the views of concerned scholars etc. concerning how we ought to conduct international research activities.

Major International Conferences

1. Seventeenth MLIT/FHWA Intergovernmental Conference and Twenty-ninth U.S.-Japan Bridge Workshop (Japan: November 11 to 13, 2013)

At the MLIT/FHWA Intergovernmental Conference, which is a conference with the U.S. Department of Transportation under the Japan-U.S. Agreement on Cooperation in Research and Development of Science and Technology (traffic science technology field), the participants exchanged information concerning the latest policy trends in the formation and management of bridges and other structural assets related to bridges and other structures, which is the cooperation theme in the road science technology field. This year, they exchanged and debated the most advanced information concerning road bridges, tunnels, and pavement inspection systems, risk management, and seismic retrofitting of bridges.

The U.S.-Japan Bridge Workshop is held on alternate years in Japan and the U.S. as an activity of the Wind and Seismic Effects Panel, working group G (traffic systems) of the Japan-U.S. Conference on the development and use of natural resources (UJNR). This year it was held in Japan, where the participants announced papers, conducted discussions, and exchanged information concerning maintenance of viaducts, inspection and survey methods, tsunami, earthquake resistance evaluations and so on.

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