

# Message from the Director-General

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## Good Development and Management of Infrastructure

KAZUSA Shuhei

Director General, National Institute for Land and Infrastructure Management

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(Key words) national land, civilized country, infrastructure, disaster prevention, strategic maintenance and control

### 1. Introduction

They say “All roads lead to Rome,” the Roman Empire had a good road network and sanitary accommodations seen in the existing aqueduct. In Changan, an ancient Chinese capital during the Tang Dynasty, elaborately designed city facilities based on city planning supported the prosperity of the city.

It is still fresh in our mind that American President Obama told “we determined that a modern economy requires railroads and highways to speed travel and commerce”<sup>1)</sup> in his inaugural speech on January 21. Without listing these examples, history has shown that civilizations which has constructed and maintained the good infrastructure prosper.

### 2. National land and Infrastructure

Compared to Europe and America, Japan is under severe land conditions. We take it for granted and live our lives without paying much attention to it. However, it is very important as the basic information to think about the role of the country, we who are engaged in the technological policy of domestic land, should speak up at every opportunity.

- ① Form of the land: the long and thin and arched land, 2,000km from north to south and 2,000km east and west, is divided into four islands. A big mountain range parts between the Pacific side area and the coast of the Japan sea side area, and therefore such as flats and basins, which makes it difficult both for humans and things to use the land and travel.
- ② Geological conditions and Ground: Geological

conditions of the mountain area which occupies 70% of the land is subdivided varyingly because of the strong crustal changes and is prone to sediment disaster. The alluvial plain on which most big cities exist has soft ground.

- ③ Earthquake-prone: This is connected to the geological conditions and ground, twenty percent of the big earthquakes with magnitude 6 or more in the whole world are said to occur in Japan. Therefore, the earthquakes are felt strongly in the cities in which population and assets are concentrated. Also big tsunami could strike at the coast.
- ④ Meteorological phenomena: Annual amount of rainfall range 1,400mm to 1,600mm, which is twice of the world average. In typhoon and rainy seasons, Japan is often hit by heavy rain. The Sea of Japan side is hit by heavy snow.

It is not easy to maintain and control the infrastructure under these severe land conditions. But once we fail to make efforts, the country would not be able to go on as a civilized country.

### 3. Disaster Prevention

We had two great disasters in Japan two years ago; The Great East Japan Earthquake in March and the great flood on the Kii peninsula in September. Last year, we had a tornado of F3 in Tsukuba in May and the heavy rain in north part of Kyushu in July. It is pointed out that the Japanese islands have entered a period of brisk seismic activity, and heavy rainfall characteristics which are seemingly caused by climate change associated with global warming

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that is happening frequently today. The most important subject is to strengthen the infrastructure for disaster prevention towards better resilience to these conditions.

After The Great East Japan Earthquake, the necessity to consider for every possibility by putting the latest scientific knowledge in force so that we would not repeat the so-called “over assumption.”

Especially against tsunami which inflict enormous amounts of damage, though occurrence frequency is very low, “the largest class of tsunami (level 2 tsunami)” which inflicts enormous amounts of damage was decided to be reviewed with thinking about every possibility, based on the latest scientific knowledge. Though “the biggest class of tsunami” in Nankai has just already been reviewed by the Cabinet Office and disclosed in public, there are areas where the height of tsunami exceeds 30 meters.

The facility improvements which purpose is to completely protect the urban area from the external source are not realistic. As for countermeasures against level 2 tsunami, there is a real need for the combination of hard measures, such as the improvement of resilient and adaptable facilities to protect the coast or multiple protection facilities for which road embankments are used and the soft measures, such as preparation of hazard maps, centered mainly on evacuation.

Resilient and adaptable facilities protect the coast are constructed to extend the time it takes for the facilities to be leveled as much as possible or to reduce the possibility to come down completely as much as possible even if the height of the tsunami exceeds that of past tsunami that form design basis of the facilities (tsunami which occur about once a century) and overflows the breakwater head. In the architecture field, new provisions about secondary design were established in 1981, when Order for Enforcement of the Building Standards Act was revised, based on the post-disaster situation of the

Miyagiken-oki earthquake in 1978, so that horizontal load bearing capacity as well as conventional stress allowance should be calculated to judge the quake resistance of buildings when considering the strength and toughness (deformation capacity and tenacity) of the buildings against force of the earthquakes.

Additionally, for the evaluation of seismic capacity of the bunk, the concept how the post-disaster bunk should be due to earthquakes was introduced after the Great Hanshin earthquake. However, facilities have only scarcely been built based on the premise of the destruction and collapse. Engineers who plan and design facilities should always have those images in mind of the functions brought out before construction to prevent disasters.

#### 4. Strategic maintenance and control

Last December, an accident occurred in the Sasago Tunnel on Chuo Highway, in which ceiling panels came crashing down and 9 people died. From the point of disaster prevention, safety and security, it is a pressing issue to go ahead with strategic maintenance and control not only in tunnels but also in all the other facilities because it is expected that the infrastructure in which we invested heavily during the high economic growth period would become older.

Needless to say the fundamental strategy of maintenance and control of infrastructure should be “preventative maintenance,” by which damage or defects are to be found early and appropriate countermeasures are to be taken before deteriorating causes a grave crisis, and not be “breakdown maintenance” after severe damages happen.

The main measure against this will be the extension of life-span of the existing facilities by occasional reinforcement or repair work. However, as the service standard required goes up with the change of society and function would become obsolete with the improvement of the surrounding technologies, we should consider the

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renewal and improvement of the facilities. It is also important to take into account of the life cycle of the facilities, such as planning, design, construction, maintenance, control and abolishment.

The process of “preventative maintenance” is as follows: 1)inspection and diagnosis of the targeted facility 2)evaluation of the degree of soundness, 3) prediction of damage and deterioration, 4) planning the reinforcement and repair or renewal by adding the functional improvement of the facility which would be demanded in the future and 5) implementation of measures.

To complete this process maintenance of the “database” (including the records of inspection and repair etc.) of existing facilities and planning of the technical standard and technological development that is required for each step.

Unfortunately, there have been some failures in the construction and application of the database. The important points of views are: “For what and how is the database used?” “How is the system continuously used?” “How the various kinds of database are connected organically?” In addition, these points of views should be shared among the involved parties, from the people who enter the inspection and repair records into the system to those who process the data and decide the measures of the investing planning.

As for the technical development, we are achieving some positive results by the on-going development of the technology to inspect the place where visual check is hard to conduct and to observe the wide variety and large quantity of constructions efficiently and without fail by utilizing the civil knowledge in the general technological development project “Development of inspect and observing technology for preventative management of the social capital” (2010 – 2012).

In the future, not only inspection and observation, we have to press forward with the development of technology, with sensitively meeting the needs at each step of design and

execution and bringing in the advanced technology of each field, such as ICT.

## 5. Conclusion

Measures against disasters and deteriorations are the most important area for the Japanese people, now. Now is the time to involve ourselves in intelligence for good development and management of the infrastructure.

## 【References】

- 1) “President Barack Obama’s 2013 inaugural address on January 21,” January 23, 2013, “Nihon Keizai Shimbun”
- 2) “ ‘Tsutaeru’ and ‘Sonaeru’ ” by Shuhei Kazusa, Civil engineering technology reference 55-1, p.4
- 3) “Nihonjin ha naze daisaigaiwo uketomerukotoga dekirunoka (Why Japanese can face the catastrophe) “ by Hisakazu Oishi, Kairyusha, Oct. 2011
- 4) “Shakaishihon-sutokkuno senryakuteki iijkanritoha nanika (What is the strategic management and control of the social capital stock” by Kazuhiro Nishikawa, TECHNICAL NOTE of National Institute for Land and Infrastructure Management, No.482 , pp.7-22
- 5) “Shakaishihonno sutokku-manejimentono suishin nimukete (Toward the promotion of stock management of social capital)by Hiroyuki Kishida, TECHNICAL NOTE of National Institute for Land and Infrastructure Management No.699 , pp.151-170

# Messages from Departments and Centers of NILIM

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## Perspective to advance the comprehensive technology policy research

KISHIDA Hiroyuki, Dr. Eng.

Executive Director for Research Affairs and Director of the Research Center for Land and Construction Management

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*(Keyword) Land Management, Stock management, Construction Management, Measurement*

### 1. Introduction

A severe natural characteristic of Japan brings a pure beautiful appearance and rich happiness. Population decline and declining birthrate and aging population are progressing rapidly, and energy problem has become socially apparent. Under such circumstances, the social capital is the most basic skeleton of the land to develop and manage as comfortable and safe and vibrant with looking down upon for the entire country while facing the disaster, which is the foundation that supports the life of the people, about the research in a large field of view and for smooth and efficient implementation of a concrete means, from the viewpoint of management of high-quality stock and securing and improving the quality of public works in the view of fine arrangements, it is important to promote comprehensive research and technology policy and research to think over the whole construction production system. In this paper, I want to discuss the specific point of view for advancing the following issues.

### 2. The first viewpoint – Land Management

In addition to weakening society due to the population decline, super-aging, and economic stagnation, and due to the frequent occurrence of large-scale natural disasters, environment surrounding our country is facing a change that we have never experienced before. Especially, for disasters devastating Tohoku Pacific Ocean Earthquake, we must hurry to reconstruction. In addition, including that Tokai, Tonankai and Nankai Earthquake are expected in the future, and the response to the direct Earthquake in capital city, therefore, construction of the strong land has become tenacious urgent issue.

On the other hand, as understanding the social capital stock is not necessarily sufficient, there have been a variety of problems. Among these problems, if we are not able to develop and manage appropriate social capital in the future, it is considered that we may not be able to image specifically how future life would change for the

people. Regarding these situations, we have two major approaches we can consider. On the one hand, we have macroeconomic perspective to know exactly the economic effects of public works to give the society as a whole. Moreover, it is necessary to transmit information for easy understanding including comparison with Western countries, to assess the social capital as stock. On the other hand, in the micro perspective, as people will continue to live as a sustainable national land, it is necessary for you to continue to actively implement initiatives such as the "measurement and transparency" for easy understanding in order for potential role and effects of social capital development and management have been brought to the various situations (Society, Economy and Life) for people.

In order to more effectively promote such efforts, it is expected to develop to collect various kinds of data. In particular, as the proportion of people among the national consciousness that they want to place the emphasis on the "richness of the heart" rather than "the richness of the object" as a border around the late 1970s (1), which celebrated period of stable growth is strong. Therefore I feel we need to show more concrete image of design and land management.

### 3. The second viewpoint – Stock management

In order to form a national land whose safety, the environment, and energy have a comprehensive harmony, it is necessary to promote to focus on the efficient high-quality social infrastructure that takes into account the characteristics of the region. In addition, support for update maintenance due to the aging of the social capital stock was concentrated investment in the period of rapid economic growth, which has become an urgent issue. While in harmony with the natural environment, particularly to prevent social and economic blow to the fatal injury in order to achieve the reduction of life cycle cost by a long life of social capital, inspection that takes into account the characteristics of each facility, planned



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maintenance and repair based on deterioration prediction are essential. For this purpose, the following issues become more important in the future. First, it is necessary to strengthen and expand efforts for preventive maintenance of the national land management. With the development of technology tools, such as a simple technique and new inspection and monitoring technology, is sharing and dissemination of technology in various fields. Then, there is a need for greater efficiency and sophistication of maintenance. We need the development of a platform for cross-sectoral to utilize the information and maintenance of infrastructure facilities, and the development of information storage and utilization techniques for managing and updating information more efficiently planning, design, and maintenance. Additionally, the efforts also need optimizing the maintenance of existing facilities. It is the development from planned maintenance of the stock, which is deployed to the efficient operation (Asset management of social capital). NILIM will continue to enrich the research and information exchange center in each Study Group "stock management" that is implemented. And the results obtained in the "Development of inspection and monitoring technology for proactively managing of social capital," the Ministry of Land, Infrastructure, Transport and Tourism Technology Development Projects were carried out in cooperation with each study unit. Because of the above reasons, I feel that it is also necessary to continue to disseminate such information more widely.

#### 4. The third viewpoint – Construction management

In the field of construction management, it is expected that it will be more effective in some of these perspective. For example, it is required to optimize the public procurement system to contribute to the maintenance of the social infrastructure stock infrastructure quality focus, and promote efficient.

As public procurement system for the social infrastructure of quality focused and efficient in response to the enforcement of Law of public works and goods (2005), procurement and construction management system (CM), such as an integrated system of comprehensive evaluation bid system construction and design has been underway for a variety of initiatives in order to improve and ensure the quality of public works. However, analysis of the challenges in business and reports directly to the Ministry of Land, Infrastructure, Transport and Tourism, through the necessary review based on it, improved adaptation is required toward a

bidding contract system to function as a mechanism to encourage such efforts for improving technical capabilities of bidders.

Also, learning actively which the best of rules contract order to include the method public infrastructure utilizing public-private partnerships such as PFI / PPP, has been brushing up sequentially through the application of the world until now, construction production in Japan. So it is also necessary that we change to a better system. In addition, it is necessary to respond to changes in the quality assurance method according to innovation construction stage. And we have to deal with the thing, such as the introduction of full-scale construction of CIM and the introduction of information technology to construction projects, but also to the advancement of construction management technology. And criteria for accurate and efficient supervision of public works, inspection and evaluation work performance, such as the review procedure, the reliably obtain high-quality results at the level of individual work. And it has become an important issue on which we will establish a system for corporate performance and efforts are appropriately reflected in the contractor selection process.

#### 5. Conclusion

For some perspectives that are considered important in order to advance the comprehensive technology policy research, I mentioned the issue with a mix of relevant research. It is closely related problem with these problems in other areas, and also closely related to each. Therefore it is necessary to continue the research comprehensively noted one solution not to bring the new problems. With the deep care and extremely fine enough about this perspective, I like to research further investigation.

#### 【References】

- 1) KISHIDA Hiroyuki : For the realization of a sustainable society : Issue of civil engineering materials, January 2013pp.6-7
- 2) KISHIDA Hiroyuki : Promotion of management of social capital stock, Proceedings of the National Institute for Land and Infrastructure Conference FY 2012, TECHNICAL NOTE of NILIM No. 699, pp.151-170  
(<http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0699pdf/ks069915.pdf>)
- 3) [http://www.nilim.go.jp/lab/pbg/theme/theme2/theme\\_soupro.htm](http://www.nilim.go.jp/lab/pbg/theme/theme2/theme_soupro.htm)

# Worldwide Check list toward the maintenance of the infrastructure

## -Asset Management International Standard ISO55000-

HORIE Nobuyuki, Director

Water Quality Control Department

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*(Key words) Asset Management, PC251, ISO55000, Overall optimization*

### 1. Introduction

“One of the typical cases is, whether or not there exists a framework that the Top can make an optimization decision anyhow when the budget was not sufficient due to financial reason though a large scale repair was required technically.” Specialists in various fields in various countries have announced his/her opinion one by one to the question raised by the Chairman.

First of all, what is the main task of the organization that manages large infrastructures? Operation of making the Asset Management International Standard ISO55000 is now coming to the last stage.

### 2. Task submitted to the infrastructure management in our country

Great east Japan earthquake disaster and gigantic Tsunami have asked us a question how it should be the social risk management including infrastructure and it has made clear again Japan’s weak point commencing with the energy.

While the financial situation goes down, veterans that have made a concept, created and managed it are retiring, staff number is reduced and the facility gets older, what goes on more and more is the situation necessitated to meet complicated social requirements, global address and speed-up.

### 2. Current of global infrastructure management

As for the infrastructure business in various fields, various management methods and management entities have been implemented in respective countries in the world as trial due to difficulty in finance and so on and there have been also implemented bold trials and errors in order to promote the service more effectively. In the 80s, USA have got to schematic maintenance management after having passed through the “devastated America,” England has practiced the Sucherism such as privatization and New Zealand and Australia have adopted the new public management NPM that has

introduced the civilian method and the like. By country and field, experiences of various entities have been collected and discussions have been made so as to make a common index on how to implement management. Some countries have further continued discussion by cross-fields to make a common index on the essential items to recognize what should be done by the infrastructure management organization first of all. Typical case is the PAS55 issued by the British Standards Institution (BSI), which is more and more applied globally.

On 2009, based on the above, England has made a proposition to establish a new international standard called “Asset Management (AM)” to the ISO. After having had the London preparative meeting on June 2010, draft making committee ISO/PC251 has started under approval of the ISO Board of Directors and first assembly was held in Melbourne on March 2011. Experts of various fields and titles have joined there from a dozen of countries and organizations in the world, and from Japan, as the Asset Management discussion had started already in another ISO committee (water and sewage field), three members such as the Professor SAWAI Katsunori of the Kyoto university, MIZUTANI Tetsuya of the Asset Management Strategy Department of Sendai city and I myself have joined. As the result of the big discussion in the first round five days, it was decided to make a draft of the International Standard ISO55000 series to be issued in three years to regulate what should be done aiming at whatever infrastructure management organization regardless of public or private. In the airplane of coming back, we three members have made a sigh “It’s awful, we can’t deal with at all!” emerged not knowing what to say.

Toward the fourth assembly in Prague on May 2005, some dozens of members continue integrated discussions by Working Group every time to deal with opinions submitted by respective countries. Through the Work Draft WD, Committee Draft CD, opinions from

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respective countries to the Draft of International Standard DIS are settled in the fifth assembly in Calgary from 29 April to 3 May, and through the definitive vote and preparation period in respective countries, it is scheduled to make effective the Standard in 2013 spring. To the present, roughly 50 experts in various fields in 20 countries have brought in their experiences, made discussions during twenty days only in the meetings, worked out, written the draft once, twice and erased every time. AS for the standard for the judge to certify it, DIS was fixed, after a big discussion, in the CASCO/WG39 first round Geneva assembly at the end of February. (Member of Japan: HORIE)

### 3. Outline of the Asset Management International Standard

“Asset” mentioned here means, commencing with the infrastructure resource, human resource, money, information, that is to say, various properties that the organization is able to have are included. Whole action of the organization to realize the value of the asset is called as the “Asset Management (AM),” through that the organization make a balance of the cost, risk and benefit fairly well. For that purpose, it is required to establish the AM target, policy and strategy plan along the organization target and needs of various related parties, then make a decision from both aspects of the technology and finance so as to practice this plan effectively and do monitoring in order to improve continuously on also controlling the related risk. And deciding factor is the leadership and office culture.

Combination of various factors in order to establish the policy, target and process is called as the “Management system (AMS)” by which the organization implements interactive operations. Not a simple information system, but a combination of the organization structure, function, responsibility, operation process, planning and management and so on.

The whole body is composed of three standards as described below; ISO55001 is the one that should be absolutely practiced at least to achieve effective AMS, and 02 is that description.

- 55000 “Outline, definition”: 1 Scope of application, 2 Rule, 3 Definition and reference
- 55001 “Requirements”: 1 Scope of application, 2 Reference standards, 3 Definition, 4 Organization status recognition (Needs of interested parties, AM system), 5 Leadership (Responsibility, policy, target), 6 Plan (Risk and occasion) 7 Execution support system (Various management resource,

information), 8 Business practice, 9. Results evaluation, 10 Continuous improvement and referential documents

- 55002 “Guideline for application” (Description)

Note that the risk management shall basically follow the ISO31000 Risk Management.

### 4. After having joined the draft making

I have so many things to make a sigh about from experiences to have engaged in the management and renovation in several official entities in Japan after having joined in the committees and WG making operation since the first round Melbourne assembly.

To meet various situations, whole states of its own facility and organization are correctly recognized everyday? Action and information in respective divisions are functioning all together? Is the plan backed up by the financial and technical strength? Is the top-down operation functioning to the task that needs swift decision and practice? (Doesn't it take too much time to continue discussion and do arrangement for everything?) Is the address policy determined to needs of every related party respectively?

Stock management can be achieved only when there was the management of the whole organization to realize it.

While various restrictions become much more harder in the drastic change of the circumstance, what is required for the leadership to swiftly make the overall optimization is that the role sharing that the responsibility is clear as well as the constant framework review based on the internal and external audit, evaluation and results are daily practiced.

Sendai city has first recognized the utility and significance of the asset management from the Australian survey to review the long-term investment several years ago, it has soon assembled a dedicated group by five members so as to begin introductive operation. It has taken a fresh look at the operation and constructed the information support system. At the time of the large earthquake disaster, it has displayed and shared various data of a channel made available by one mouse click on the GIS, which has brought an extraordinary effect on the disaster injury survey and emergency action on receiving the support team from foreign cities, together with the concept sharing through discussions with respective segments that were made for the introduction. I myself had, in the midst of dealing with the guerrilla heavy rain disaster, explosion disaster, road collapse and fare raise, an acute feeling for the necessity of making the

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management policy of the department that has made clear the risk management, information and publicity strategy and long-term finance plan from the way of thinking, not but stop and think every time. In such an aspect, I consider this time standard as just the essence of what should be done including the above and think that various discussions based on experiences in respective countries are a very hard study for me, always troubled with the English wall.

5. To finish

Sorrowful accident has triggered the practice of overall check on facilities by various management entities. And next, what is needed is the one step advanced objective check on the entire management method. Begin with a simple check first, and with the speedy improvement on whatever that can be realized earlier, toward the overall check.

And finally hoped for is a day that Japan presents various successful cases at the next generation PC251 and reflects them on the global standards.

(From 2011 - ISO/PC251 Japan Judge Member)

# Messages from Departments and Centers of NILIM

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## Shed light on the river channel design!

FUJITA Koichi (PhD, Engineering)

Director of the River Department

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*(Keyword) Foundation of study of technology policy, Disaster Prevention and Mitigation, Flood control, Rivers technology, Climate Change Adaptation*

1. Six Reasons to consider river channel design is very important

*It is a technology that integrates a plurality of objects.*

For the creation of the river channel, maintenance, conservation of nature, landscape formation, river channel use and easy flood control, completely different nature of several important goals are required for each purpose. Channel design is to aggregate at only one point of how the shape of the river after all. In this point, competence to proceed is asked that things are truly integrated.

*It is a technology that does not escape abstract theory, the theory of general*

River channel design cannot be supported under discussion "debate should be like this" or "indicative of the direction". In the end, we must decide on the form, so there is no room to replace the text representation. Under the pressure that we must decide concrete things, technical merits of the individual to be charged will be apparent. Therefore, the technique and technicians engaged with the technology are well trained.

*Logic is required* and people in charge will *be trained*

It is the technology of building social infrastructure is required logic in deciding. There is more than one purpose, and the theory of integrating and adjusting them is required to determine the shape. So, through the river channel design, logic of technology is exercised. The theory of negative effects of what it is trying to determine the things that have been documented only in 100% logically is the logic that has been trained proceeding to its destination and the turn will be coming for the first time. And to expose the negative effects in the front of the theory and technology, then it is probably more likely to become useless.

*It will be a serious match called into questions of the results*

In consideration of various measures, it should be fairly possible to develop the rivers relatively as soon as possible. Aspect of river disaster recovery is definitely important. If this is performed, then the result will appear in front as usual first appearance of the river, which is asked questions of the judgment of the quality; whether it is good to be true or not. Over the years, a variety of further quality can be seen. After 10 years to develop a river channel, the following things become specifically apparent; to find what organisms, to give effective flood control in response to the flood, and to fall within the expected maintenance effort. If there is a spirit that catches it, river channel design is a unique opportunity for hardball to improve technology.

*To be thought of the basics of the river technology*

The following inquiries of essential matters emerge: if one wants to determine the shape of the river, how the depth of the river? and how determined the width of the river in the first place? : What do you think you have to assume what the sediment supply? : How does it come to its present form? : If we continue in this state, what does the form become? etc.. Directly, it would be a discussion of the basic frame design of river channel. And it will lead to systematization of the river and technology.

*It is a technology that is open and connected to knowledge in various fields*

Even saying to determine the shape of the bite, utilization of knowledge is required in the following various fields; Hydrology and Hydraulic Engineering, Sediment hydraulics, of course, Geological terrain, Geotechnical Engineering, and Biology, and such as those involved in the ecosystem. And it is necessary to understand the relationship between the river and social and local conditions. The large number of elements involved the diversity of those characters is difficult to design river. However, those matters are also a proof of being a technology that has been

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connected to the open state of the river which is also a design community and the development of science and technology. You may also express it as "the junction of rivers technology".

2. Now, four reasons to consider why the river channel design is important

Standing position as a potential last resort of Disaster Prevention and Mitigation

Increase due to the impact of climate change flood flow has been an issue of concern. While a variety of measures to address the larger flood will be examined in one piece of hardware and software, we hit the spotlight inevitably also means that the excavation of the river channel in order to increase the flow-through capability (flood discharge flowing through the river safely). According to a simple calculation, River channel tract area (Cross-sectional area of a river channel) increases by few %, probability of flooding to occur outside the dike is reduced. For river channel excavation, there is the difficulty to a certain degree. However, it is a measure basically carried out only in river. So depending on the degree to which the practice of certainty would increase. In fact, many of the disaster recovery of the river channel excavation are mainly focused. Therefore, without falling into the river easy technique referred to as "you can simply dig" by excavation carried out through the appropriate consideration, we need to keep the pride of a persons involved in the rivers technology.

It is a technology that makes the system, and make a terrain

River channel design can be expressed the technology to create a system that is responsible for the formation or terrain. It is now commonly discussed that it should assume that the external force is increased in disaster prevention and mitigation by occurrence of the phenomenon in the long term, once hundreds of years or more. When we think of the difficulty of ensuring the sustainability of such a time scale in social infrastructure to develop, we remind of the importance of the workings of "creating a terrain that may be present in very long-term" again. Today it is also asked that putting in the river channel design technical content that matches the true meaning of "making the terrain" of things.

Needs to go beyond the "River channel-oriented Status"

Technology system to advance properly to increase

cross-sectional area of a river channel was an important place about the technology involved in the river channel improvement by laying the basis of age enhancement of flow-through capacity. On the other hand, now we also aware that there is a change in the river channel system of the formation and river channel respectively based on the understanding that it is important opinion arose. In other words, the importance of river channel plan was grounded in so-called understanding of the characteristics of the river channel. It was happened in the early Heisei period. In this regard, "Emphasis river channel current state" as a practical measure, in other words, the idea that change unnecessarily low-flow channel that is formed over the years has emerged. And this has become the starting point of river development even in the current study. This is (the author is seen as) a solution is a first-order approximation of river channel development that you understand the characteristics of the river channel. But wouldn't only emphasized "Status" or obsession have to walk alone? Would understanding river channel characteristics and efforts to river channel design that takes into account the understanding not have become blurred? Now I think we have been asked again river channel design which is advanced to status-oriented.

The need for a large scale of time and space to think

Related to the fact above, we are much likely to focus on each single event of interesting and important right in front of you in the excavation of technology and research issues related to the river channel and the setting process. Therefore, wouldn't the tendency to perceive how a dwarf compared to the scale of time and space to think little about the technology that meets the river channel have come out? With the above thing, bearing in mind the large changes in the entire river channel, and considering the nature of the river channel is neglected, are we likely to prone to fall into the pattern from the next to the next to consider the local symptomatic treatment? Or, research interdisciplinary is seemingly progressing, however, because of the above reason, it does not lead to the theory of technology to think the way the entire river channel, putting into a new field which is vertically integrated namely comprehensive and integrative. Consequently, would it become the ironic situation? If more concern has become a reality in any way, I think it is highly significant that the work from the front to the river channel design technology as a



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key to break it down.

### 3. The importance of making foundation for study of high-quality technology policy

Everyone says that leading to practical measures to integrate a variety of research and field information is required. If so, I want to emphasize that it is important to try and establish a concrete way one by one in order to decide how it should proceed. Comprehensive approach is an approach to achieve things, therefore, I would also confirm that it does not itself become a target. We should not be misled by the catchphrase that looks attractive. And we create a foundation and work together as forming the axial and specific technical issues and the goal which are surely important. You may think challenges for "channel design" sounds a bit old school. However from this point of view, don't you think it is not very important and modern field? I intend to take better care of high quality foundation of study of technology policy. Channel design is a representative, which is only one of them.

# Messages from Departments and Centers of NILIM

## For the maintenance and renewal of the aging road structures

MORI Nozomu

Director of the Road Department

(key word) Road structure, Aging, Maintenance, Renewal

### 1. Recent Movements

In January, 2013, the Social Capital Maintenance Strategy Subcommittee and the Social Capital Improvement Council made urgent proposals. They were based on that the painful accident of sudden ceiling collapse that occurred in the Chuo Expressway Sasago tunnel on December 2, 2012, and caught attention raising people's uneasiness that urgent maintenance is necessary for the aging social capital.

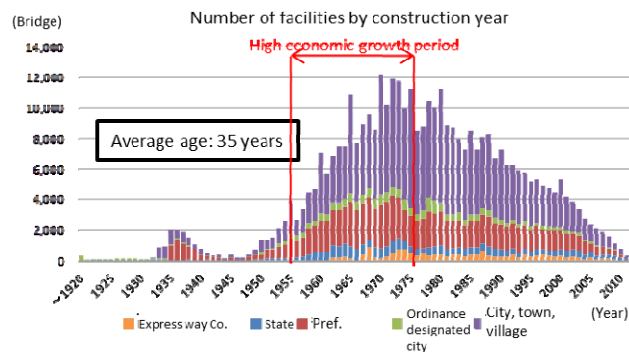
In the table, the plans/proposals regarding social capital which are made mentioned its maintenance and renewal are introduced. And as a new movement, "Road Maintenance Engineering Subcommittee" was set up under the Road Sectional Committee, the Social Capital Improvement Council on January, 2013 to examine the technological standards concerning road maintenance, general inspections of the operations, and ideal ways of standards for appropriate maintenance of the road structures. Maintenance necessity and importance of aging social capitals are pointed out beforehand, and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and related organizations, have worked on maintenance and inspection including research and development for them. However, reflecting various recent movements, not only for institutions under MLIT but also for local government are requested to take measures, and it is starting.

### 2. Aging road structures and current maintenance status

Road bridges (bridges with length of 2m or more), and a number of tunnels according to the administrators and construction years are shown in the figure. There are about 700,000 road bridges in its entirety, and the average age is 35 years (construction year is unclear on 300,000 bridges), about 20percent (140,000 bridges) are administrated by prefectures, and about 70 percent, 480,000 bridges, by cities, towns and villages. Among these, 1686 bridges are restricted for traffic, and 326 bridges are closed (as of April, 2012).<sup>5)</sup> There are about 10,000 tunnels in its entirety, and the average age is 33 years, and there is no big difference in aging with

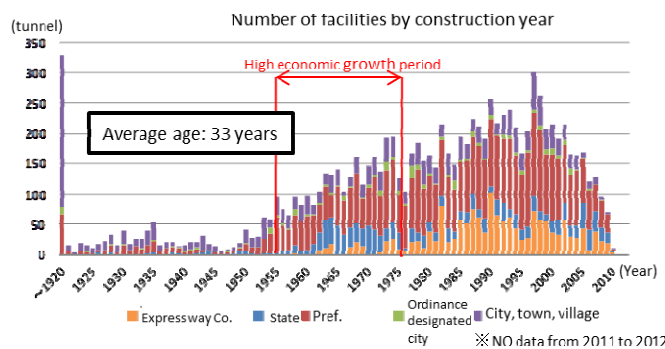
Table Recent main plans and proposals regarding maintenance renewal, etc.

Social capital improvement emphasis plan (August, 2012) <sup>1)</sup> Emphasis target 4 Conduct exact maintenance and renewal of social capital
Social capital maintenance strategy subcommittee emergency proposal (January, 2013) <sup>2)</sup> Comprehensive enhancement of infrastructure policy for real maintenance era - kick off "Maintenance policy first year" -
Ministry of Land, Infrastructure, Transport and Tourism technology basic plans (December, 2012) <sup>3)</sup> Emphasis project II Social capital maintenance and renewal project
Emergency economic package for Japanese economic recovery (cabinet decision in January, 2013) <sup>4)</sup> To conduct the social infrastructure overhaul promptly, and take measures for necessary urgent repairs etc. -(omission) To promote the scheming and strategic maintenance/renewal of social capital preparing for the aging in the future



Note) other than this, construction year unknown bridges are 301,000 due to old and no records

(a) Bridge



Note) other than this, construction year unknown tunnels are 250 due to old and no records

(b) Tunnel

Fig. Number of road facilities by admin and construction year<sup>5)</sup>



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bridges though there is a difference in that prefectures administrate about 50 percent. About 40 percent of the cities, towns and villages conducted the inspection of tunnels and 30 percent or less of them conducted it of the accessories to roads before the Sasago tunnel accident, and about 80 percent of cities, towns and villages did not use the specific procedures for tunnels and accessories.<sup>6)</sup>

### 3. Inspection Procedures

Some administrators did not inspect and some structures were not inspected, and so the Road Department of NILIM examined the general inspection procedures to be conducted in the whole country. Then we targeted bridges, tunnels, pavement, road accessories, side slopes, embankments, retaining walls, with the view point to prevent third party damage caused from structure corrosion and deterioration etc., discussing with Road Bureau of MLIT, related organizations and the specialists.

As for the periodic inspection, some administrators did not define procedures for structures, and are requested to define. We will summarize them cooperating with related organizations.

### 4. Towards forming strategic cycle of maintenance and repair

Effective and efficient maintenance is requested because the number of aging structures is increasing. For that, periodic inspection and diagnosis, formulate systematic preventive maintenance plan, maintenance cycle establishment, cycle effect to heighten preventive maintenance, and technical methods of each process are necessary to rationalize and upgrade, and we will work on emphatically cooperating with related organizations.

#### ① Diagnostic technique of deterioration and damage, and Performance evaluation techniques of structures

We work on the research for, technology for appropriate evaluation and diagnosis of deterioration and damage of structures, influence of them on structure performance, performance evaluation technique of current load bearing capacity considering the influence of repair and reinforcement.

#### ② Structure management method from the viewpoint of road network function

The health of road structures should be evaluated as a route when seen from road user's standpoint. And, when thinking of the large-scale earthquake etc. health should be considered based on multiple securities. Therefore, we work on the research technique to clarify the level that should be maintained as structure performance, and to evaluate the structure health by one idea from the function requesting each link in road networks of a

certain area.

#### ③ Techniques to make the entire road structure long-lived

The entire country must improve to make the entire social capital long-lived in addition to the view point of individual structures and maintenance of them forming road network. For this, it is important to grasp the deterioration tendency from macro viewpoint and to establish proper countermeasures. Therefore, we will construct the database to collect and accumulate the inspection and diagnostic results of road structures and maintenance information of the repair results etc. on a nationwide scale, cooperating with the administrations. Furthermore we will try to construct maintenance methods like analysis methods of current state of problems, technical corresponding methods to them.

#### ④ Administrator's support

For the maintenance of the structures, not only technological standards and manuals but also engineers who can diagnose the structure are necessary.

We try to share and to spread the technical findings and knowhow owned by NILIM, and contribute to the education of engineers on the maintenance site, by promoting the research and investigation such as correspondence to the technical problems and establishment of technical methods cooperating with the engineers of regional bureaus etc. And, technology consults on the road structures corresponded by the Road Department (including the training lecturers and committee members), were 134 (end of February, 2013), and there are technical problems in many organizations, therefore we will make an continuous effort for direct technical support to the administrators.

### 5. Conclusion

The Road Department of NILIM is working on the road structures, and on study about the road traffic, safety, environment, and landscape.

In the future also, based on the economic situation of domestic and foreign society, we will work on the study cooperating with administration, university, independent administrative organizations, academic society and association, private sectors, citizens and foreign organizations.

#### 【Reference】

- 1) <http://www.mlit.go.jp/common/000221986.pdf>
- 2) <http://www.mlit.go.jp/common/000986603.pdf>
- 3) <http://www.mlit.go.jp/common/000232351.pdf>
- 4) [http://www5.cao.go.jp/keizai1/keizaitaisaku/.../0111\\_01taisaku.pdf](http://www5.cao.go.jp/keizai1/keizaitaisaku/.../0111_01taisaku.pdf)
- 5) Road maintenance subcommittee 1st subcommittee data
- 6) Road maintenance subcommittee 2nd subcommittee data

## Agendas for addressing building Standards' maintenance

MUKAI Akiyoshi, Director of the Building Department

*(Keywords) The Great East Japan Earthquake, The Building Standards Act, Standard draft*

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### 1. Introduction

In architectural research department, the mission is to support administration for technical standards of architecture, fire protection and facilities / environment in Building Standards Act, Housing Quality Assurance Act and Energy Saving Act to achieve safety and security and comfortable living environment. Regarding agendas that has been addressed to create standard draft for earthquake disaster based on research estimates in research assignments that the architectural department has addressed and building standards' maintenance promotion business to maintenance standards, and these will be explained here. Situation and trend in each area are as follows;

Architecture area: Building certification / examination was tightened by the amendment of Building Standards Act in 2006 for prevention of recurrence of those cases such as the architecture accounting statement deception case. And after that, various measures have been implemented to promote the institution smoothly.

Fire protection area: Act for Promotion of Use of Wood in Public Buildings has been promulgated and implemented in 2010, but the possibility of easing of regulations in Building Standards Act by a research regarding fire resistance of wooden building has been considered.

Environment area: Various measures have been implemented for energy reduction during construction and operation.

Regarding The Great East Japan Earthquake, Tsunami, ceiling falling off, escalator dropping, soil liquefaction and long-period ground shaking have been considered to be necessary items that are needed to be addressed in technical standards.

### 2. Project research

There are 4 NILIM projects that the architectural research department has been addressing.

『Development of urban system for low-carbon and hydrogen energy system (hydrogen full pro) (2009-2012)』 Using hydrogen as an energy media, it is to develop construction technology to achieve minimization of hydrogen plumbing in safety with CO2 emission for a

formulation of urban energy system that does not depend on fossil fuel too much. It is to develop measures to assess fossil fuel dependence of city along with load curtailment of construction side, using high- efficiency equipments and renewable energy facility.

『Development of evaluation of seismic capacity technology for architectural structures which responds to upgrading of ground shaking information.(high earthquake resistant full pro) (2010-2012)』 It is possible to figure out the characteristic of ground shaking at a voluntary point with recent maintenance of seismic network and progress of seismology. In ground shaking that is observed or predicted, there is some ground shaking that exceeds designed earthquake load which is a supposition of current aseismic design. On the other hand, earthquake load that acts on architectural structures are known that has a possibility to be cut down if ground shaking on the ground level is deemed to enter directly to architectural structures. It is important to find out the relationship between 『ground shaking』 and 『earthquake load』 along with predicting ground shaking accurately to assess seismic capacity properly.

Therefore development of seismic capacity assessment technology for more reasonable architectural structures that respond to upgrading of ground shaking information has been addressed with collecting and analyzing of earthquake observed records of as many architectural structures as possible.

『Research regarding an adoption of new technology of architectural structures that focus on renewable energy.(2011-2013) 』 energy consumption of architectural structures has been increasing with improvement in living standards. With proceeding thermal structure of architectural structures and equipment efficiency, it is important to use natural energy (renewable energy) that exists on the premises of architectural structures, and a formulation of new standards that have renewable energy is needed.

『 Research regarding fire disaster security of three-story wooden schools(2011-2015) 』 Wood is effective to prevent global warming and low-carbon emissions during manufacturing compare to other

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materials, and it also eases humidity change of room and has merits to augment comfort. However it has been hard to construct with wood, because high fire resistance has been required for three-story wooden schools by the Building Standards Act. Regarding these regulations, it is supposed to review based on the results of the research about fire resistance of wood due to the enforcement of 『Act for Promotion of Use of Wood in Public Buildings 2010』. It has been considered to contribute to maintenance of technical standard that can ensure security during fire disaster by actual fire experiment of three-story wooden school along with research and examination of element experiment and simulation to find out possible conditions to ease by technical aspect.

Except those project researches, 『Research regarding assessment measure and standard of earthquake-proof safety of exterior material』, 『Research regarding technical standard of structural calculation program that contributes to smooth architecture affairs』, 『Research regarding calculation method of evacuation safe performance and expected standard during building on fire』, and these researched have been addressed

### 3. Consideration, creation and presentation of technical standard draft

In architectural research department, agendas have set that responds to research and development, and correspondence based on the damage of The Great East Japan Earthquake, and consideration, creation and presentation of technical standard draft has been addressed. Main agendas especially related to The Great East Japan Earthquake are; 『Standards regarding requirements of Tsunami evacuation building in structure』, 『Standards regarding ceiling falling provision』, 『Consideration of measures for long period ground shaking』. And the one that the architectural research department was related to research and development are 『Consideration of review of fire prevention standards regarding large-scale wooden building.

Regarding these, Building Construction Standards Committee, Architecture Fire Protection Standards Committee that have knowledgeable persons from academic society are established and operated in NILIM. The structure that reviews technical standards based on opinions from strategists has been maintained.

The Building Construction Standards Committee has especially been considering The Great East Japan Earthquake. The committee has done a field investigation in April, 2011, and it started considering provisions based on architectural structure damages, and

it took place 5 committee meetings by October, 2013. Based on these councils in the committee, it was reflected in Residence Chief Notice in November, 2011 『Review of guideline regarding requirements of Tsunami evacuation building in structure』, MLIT Announcement in December, 2011 『Technical Standard Announcement of designated evacuation facility based on Tsunami Disaster Prevention Regional Construction Act』 The committee had also invited opinions (Public opinion) regarding 『Technical Standards Draft for ceiling falling』 and 『Technical Standards Draft for escalator dropping prevention』 between July 31 and September 15, 2012.

Regarding these, it will be considered using Building Standards Maintenance Promotion Business. (Business that supports for the cost advertising for people who do collection and accumulation of basic data and technical knowledge from experimental trials about agendas that are set by the government for requirements to formulate and revise technical standards in Building Standards Act. Established in 2008, and research was implemented regarding 27 agendas in 2012.)

### 4. Challenges for the future

As challenges for the future related to the earthquake disaster, there are long period ground shaking provision, liquefaction of premises of residence measure.

Relate to long period ground shaking, it invite public opinions by presenting a long period ground shaking measure draft policy in December, 2010 before The Great East Japan Earthquake, and the draft policy will be reviewed by referring the consideration in Central Disaster Prevention Council and Headquarters of Earthquake Res. Promotion and observational data from The Great East Japan Earthquake. Regarding liquefaction of premises, simple liquefaction opinion measure that can apply to small - scale architectural structures by the Standard Maintenance Promotion Business has been considered.

The architectural research department has been doing administrative support with technical knowledge regarding technical draft formulation, and it also thinks that it is important to collect and accumulate knowledge by research including basic research and technical development, and the architectural research department works day after day.

### Reference

- 1) TECHNICAL NOTE of NILIM No.699 pp.43-54  
[http://www.nilim.go.jp/lab/bcg/siryounn/tnn0699pdf/ks06990\\_9.pdf](http://www.nilim.go.jp/lab/bcg/siryounn/tnn0699pdf/ks06990_9.pdf)

## Beginning of Full-scale Process for Housing Recovery

MIZUTANI Akio

Director of the Housing Department

*(Key words) The Great East Japan Earthquake, Rebuilding of houses, Livelihood support, Regional challenges*

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### 1. Introduction

It has been 2 years since The Great East Japan Earthquake. The damages caused to houses in the great earthquake were: about 150,000 houses were fully-destroyed, 270,000 houses were half destroyed, 730,000 houses were partially destroyed. As of December, 2012, 320,000 people are still forced to live in shelters or temporary housing, and prompt development of restoration is a great challenge. Each municipality has been setting up a line of rebuilding homes with reconstruction plans, but counting just Iwate and Miyagi prefectures 90,000 housing supplies as permanent housing are needed in the future, and 20,000 houses of these have been planned as disaster public housing. The number will be further increased when a portion of Fukushima prefecture is crystallized in the future. This portion has not been published yet due to the effect of the nuclear accident. The number of housing construction has been increasing in the disaster-stricken regions, but full-scale process of rebuilding homes will be desired with the development of reconstruction projects in each region.

### 2. Past efforts

Immediately after the disaster to now, efforts regarding securing housing and livelihood support for the victims that respond to each stage such as refuge life, securing of temporary housing, rebuilding homes and restoration have been continued, and NILIM has done related research for supporting such as giving advice to the municipality at each stage.

Especially, the disaster happened in areas where depopulation and the aged population have been growing, various challenges have actualized including livelihood support of elderly people, maintenance of the regional community, maintenance of the vitality of local society. Supports for these challenges are also in securing housing and housing planning has been required.

Exemplifications related to the housing field that NILIM has addressed are: Guidance and advice to municipalities regarding temporary housing construction, technical support for improvement of capacity of the

housing supply system in the region, and technical support for the establishment of supply plan and planning model projects towards public disaster housing construction promotion.

### 3. Future challenges

Challenges have become clear during the past efforts. The challenges of rebuilding homes that have shifted into full swing are: ① Establishment of a housing production system that responds to demands and speeds up of the rebuilding of homes. ② Housing supply that meets residency needs of the disaster-stricken inhabitants. ③ Continuation and vitalization of local society and regional community. ④ Maintenance of housing after a large amount of supply.

Towards these problems, NILIM continue to shape resolutions and address them by creating models of future development, creating institutions and structure, and establishing standards and assessment measures.

① For establishment of housing production system that responds to demands and speeding up of rebuilding houses

It can be said that speeding up supply and rebuilding homes to resolve refuge life in temporary housing as soon as possible are the most important task. Also, it is predicted that housing demands will increase rapidly with the development of reconstruction in the future. Establishment of housing production system is an agenda to supply a large volume in a short period, and efforts from various angles such as securing materials, transportation, and people will be needed.

Moreover, reconstruction has already become full-scale and the increase of cost of building materials has been concerned. Measures to greatly cut costs down for the liability relief of residents are needed.

② For housing supply that meets residency needs of

It is thought that support to municipalities is needed continuously for early materialization of housing supply plans based on the truth of disaster-stricken inhabitants. Regarding response to livelihood support of elderly people, vitalization of the regional community, housing

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supply that fits regional homes, and planning of housing design with care to regular vocation of inhabitants, consideration will continuously be needed. Inhabitant consciousness is high regarding regional disaster prevention in the devastated areas, and consideration is needed for housing planning.

Moreover, residence needs may change as time goes on, and responding flexibly by reviewing housing supply plans is also an agenda.

③ For continuation and vitalization of local society and regional community

Housing supply contributes to the continuation and vitalization of local society and regional community, and also the vitality of local society contributes to the improvement of residence quality. It is needed to proceed with “Renewal of regional potential” regarding the crystallization of housing planning.

Also, the issue of battered city center that many local cities have is an evident fact, and it is important to address with a standpoint to recover the vitality with the reconstruction.

④ Maintenance of housing after a large amount of supply

After the supply of housing and to maintain the function in a long period, proper operations for the administration and maintenance are needed. It is also needed to arrange the maintenance system with the supply system in advance. From the stock management standpoint, it is needed to consider the time to renew.

## 4. Conclusion

It is said that a disaster exposes challenges that regions have. The Great East Japan Earthquake is not exceptional. Aging, depopulation and regional communities, each of these is a challenge that has to be strongly addressed in other regions. Also, there are many regions that are required to respond to the challenges of facing disasters.

The process of reconstruction after the Great East Japan Earthquake will be a model of disaster prevention enhancement for other regions, and it also has to be a model in a standpoint that responds to various challenges that the regions have.

I was dispatched to China when The Great East Japan Earthquake occurred, and observed responses after the disaster from outside of Japan. The response to the disaster was seen with major concern also in China. It can be said that it gathered attention from not only China, but from all over the world.

The disaster, the process of reconstruction, challenges that have become clear, and the direction of resolution should be applied to not only Japan, but also foreign countries for development of a region and housing construction.

In addition, the majority of reconstruction process of the 2008 Sichuan Earthquake has been completed in 3 years. The reconstruction process was very quickly developed. The Sichuan Earthquake also wreaked enormous damage (I was dispatched to a project related to the reconstruction process.) where as many as 87,000 people died or were missing (Most of them were caused by collapsing residences and schools.), more than 5 million rooms collapsed. The processes of evacuation immediately after the disaster, temporary residence such as temporary housing, rebuilding and relocation of houses were same as Japan, but according to the report after 3 years, 2.2 million houses were rebuilt, and 4.4 million houses were repaired. It is said Chinese government also attached importance to quick reconstruction, and was aware that the process of reconstruction would be a ‘Model’ for the future.

Difference of the state of affairs in a country, especially segregation of duties of local government and central government, strong development of economic cooperation between regions, and reconstruction in a soaring economy, many parts are from a different background and context of our country, but the process (including: let it be a lesson to everyone) such as crystallization of quick planning, prompt business deployment, cooperation and support system, efforts to regional economic revitalization, records and storing should be referred.

## [Sources]

- 1) RESEARCH REPORT of NILIM No.52  
Emergency Responses and Engineering Contributions by NILIM for the Recovery from the 2011 Great East Japan Earthquake, Jan. 2013

<http://www.nilim.go.jp/lab/bcg/siryou/rpn/rpn0052.htm>

- 2) Reconstruction Agency Website “Actual status and effort of reconstruction”

<http://www.reconstruction.go.jp/topics/main-cat1/sub-cat1-1/>

- 3) The Japan International Cooperation Agency (JICA) Website

China Earthquake Resistant Architecture Human Resource Development Project

<http://www.jica.go.jp/project/china/006/index.html>

- 4) National Diet Library Reference 2011.9 “3 years from China Sichuan Major Earthquake - The sequence of reconstruction and challenges”



## Low Carbon Town Development With Multifaceted Support

SHIBATA Yoshiyuki

Director of Urban Planning Department

*(Keywords) Future image assessment, Land suitability, Area-wide energy usage, Urban heat island countermeasures*

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### 1. Introduction

“Promotion of Urban Low-carbonization Act” being implemented last December, Urban low carbonization is a part of the efforts to reduce CO<sub>2</sub> emissions, and also, the promotion contributing to development of healthy urban environment.

Therefore it is necessary for the central government to support comprehensive efforts by local governments, private companies and citizens for creating and implementing “Low Carbon Town Development Plan“ of the municipalities .

In our Urban Planning Department, we have been engaged in developing tools for years, supporting efforts of municipalities regarding low-carbon town development. The characteristic of the tools and the situation in which the tools can be used will be introduced here.

Related research achievements shall gradually be announced, but if anyone is interested in the practical use of the tools along with the studies, inquiries will be welcome and responded to individually.

### 2. Low Carbon Town Development as a target of urban research fields

The Urban Planning Department has carried out research that give importance to the following related challenges related to the goals stated in Low Carbon City Development Guidance established by the relevant minister.

① Reduction of energy consumption by consolidation of city functions and promotion of public transportation usage.

② Consolidation of necessary city functions for daily life to nearby neighborhood.

③ Reduction of financial costs by efficiency and prioritization of urban infrastructure maintenance and renewal.

④ Formulation of efficient energy system through such as cogeneration and sharing of heat systems in district and town level.

⑤ Moderation of heat-island phenomenon, by improvement of ground level green coverage, and securing of “ventilation paths”.

### 3. Tools to support Low Carbon Town Development

#### (1) Urban and regional future image assessment tool

Regarding the future urban structure, several alternative proposals composed of planning measure packages such as, urban area expansion types, multicore concentration types and so on have been set, and reasonable selection is possible by assessing objectively and quantitatively QOL, environment and cost in a comparable fashion.

Improvement of practicality has now been addressed through case studies with public entities. It is expected to use when a big directional movement is considered regarding consolidation of urban function including visions about a set of area that is a base of city and cooperation with public transportation facility in the development phase of low carbon town development plan draft. Also, it is thought that alternative proposals such as placement of various citizen service functions and segregation of duties between bases are weighed if several base areas are set.

#### (2) Land suitability assessment technology towards strategic land management

Traditionally, various condition data that the land has is accumulated by city planning basic survey. Converting it to metrics in mesh unit, assessment point of land suitability is calculated by setting weighting of index by land items such as building use, agriculture and forestry use and so on. It is used as information for making a decision on land use and priority of maintenance. The research has been continued towards coordination of next fiscal year. In the planning process, for example, it is thought that it will be useful to consider challenges

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such as abstraction of inefficient area of urban infrastructure improvement and management due to the increase of vacant houses, various disaster hazards information and strengthening of collaboration with land use.

(3) Proper area consideration flow for the adaptation of heat energy face use

To proceed efficiently area-wide energy usage that contributes to the low carbon town development, process of derivation of development work such as proper area selection of area-wide energy usage in local public entities are organized. It is assumed to aggressively adopt area-wide energy usage by extracting high aptitude area of area-wide energy usage adaption such as an area that has high floor-area ratio or is close to unused energy sources, setting up action area, directing and supporting heat provider businesses in the areas. Also even if it is outside of the area, it is thought that to direct individual buildings by establishing requirements of public assistance and presenting support measure in advance regarding heat transferring among buildings or adaptation of DHC.

(4) Heat energy network system simple efficiency assessment program

A program was developed that could approximate the amount of heating necessary per square meter categorized by land use by entering the distance of heat flexibility plumbing and selection of heat system. Use of the program will give people a rough estimate and help to maximize the efficiency of heating systems in the area.

Also, after the project formulation, a planner can suggest using the assessment program to people related to business in the action area for heat transferring among buildings or other systems to get a higher energy saving effect.

(5) Assessment tool of CO<sub>2</sub> emissions reduction of urban heat-island countermeasures

A tool for the PC has been developed that can simply calculate thermal environment mitigation effect, air-conditioning load reduction effect and CO<sub>2</sub> reduction effect if individual or multiple countermeasures of urban heat island countermeasures are adopted. It is effective to consider target area of measure and combination of measure. Also, it can be used for numerical goal of

measure, establishment of assessment index (conversion to CO<sub>2</sub> reduction) regarding heat island countermeasures. After the plan formulation, negotiations will proceed to make high CO<sub>2</sub> reduction by using the assessment tools regarding development work in the target area of measure. In this case, it is possible to analyze impact to the environment in detail using an assessment tool (Detailed version) that is prepared separately.

(6) Standardization of the urban environment climatic chart

To methodically present as a guideline (draft) of procedure of measure that has “Current state map”, “Advice map”, “Effect map” as an urban heat-island countermeasure map to be able to try an efficient measure that fits area characteristic including use of “Kaze-no-Michi (Ventilation Path)”. Regarding the method of announcement, it is being coordinated. In the plan formulation phase, making “Current state map” and “Advice map” is important, and after the plan formulation, “Effect map” will be created based on minute consideration that responds to business plans, and by proceeding negotiations, the effect will ideally be high.

4. Future challenge

Except those tools that were introduced above,

- Smooth procedure of degeneracy of city that responds to progress of population decrease.
- Research, analysis, assessment measure of green in urban space that responds to upgrading of aviation laser measurement.
- Assessment measure of area and city facility by accessibility index.

Research that have been addressed.

Integrated measure development of consolidation of city function and promotion of public transportation facility, restructuring of daily living area around public transportation facility, analysis and assessment of measure effect regarding consolidation, smooth migration program for consolidation, cooperation with public welfare and agriculture measure, and these researches will be addressed regarding important challenge that local public entities face, and it will ideally support efforts to business solution.

## Direction of effort responds to environmental restoration of Tokyo Bay

SUZUKI Takeshi (Dr. Eng.)

Director of the Coastal, Marine and Disaster Prevention Department

(Keywords) Coastal area, environmental restoration, Tokyo Bay

### 1. Introduction

Since Japan's coastal area has large population and economic accumulation, large amounts of human sewage is finally discharged into the coastal sea. And the circulation of sea water is not enough in the enclosed sea. Consequently, red tides are chronically generated by eutrophication, and dysoxic water masses are formed by accumulated organic bottom sediment, having serious effects on aquatic fauna and flora, and other water environment issues.

“Environmental Restoration of the Sea“ has been established for the urban restoration project at the third decision in December, 2001 to remedy those coastal water environment issues. In response to this, Japan Coast Guard (JCG), Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Ministry of the Environment (MOE), Fisheries Agency and relevant local government formulated “Action Plan for Tokyo Bay Restoration“ in March, 2003. In March, 2013 it will have been 10 years since “Action Plan for Tokyo Bay Restoration“ was implemented.

Tokyo Bay is close to nature sea area that is located in the center of the Metropolitan area. The coastal area and watershed are population and industry intensive and the center of urban and industry that drive the Japanese economy. The size of the Metropolitan area (covering 4 prefectures) is 14,000km<sup>2</sup> which is only 4% of the total landmass, but its population is 3.5 million (28% of the total population), and the industry ships for more than 47 trillion yen (18% of the national revenue).

### 2. Past efforts of Tokyo Bay Restoration

The purpose of “Action plan for Tokyo Bay restoration” is to “Creation of “Tokyo Bay” that fits the Metropolitan area by retrieving amiable and beautiful “Sea“ that is diverse with wildlife and with comfortably water to play with”. 3 section committees: (1) Land area load reduction, (2) Environmental improvement in sea area, (3) Monitoring of Tokyo Bay, had been established

and has made progress towards the goal achievement. Effort items of each section committee are given in Table-1.

Table-1 Effort items of each section committee.

Section committee	Effort item
Land area load reduction	① Implementation of total amount reduction project and efficient business measures to reduce pollution from land. ② Construction and improvement of sewage facilities, and spread of advanced disposal processes. ③ Efflux load reduction in the rain. ④ Cleanup provision of river. ⑤ Reduction of pollution from ground surface. ⑥ Collection of floating debris.
Environment improvement in sea area	① Pollution reduction in sea area. ② Improvement of cleanup efforts of sea area.
Monitoring of Tokyo Bay	① Enhancement of monitoring ② Share and effective use of monitoring data ③ Civilian Monitoring activities

If you look at the efforts in the sea area, there is “Pollution reduction in sea area”, removal of mud including sedimentary organics in canals, improvement of bottom sediments, development of shallow bottom by using good sand, efficient collection of floating debris on the sea surface by cleanup vessels, collection of seabed debris by NPOs and fishermen, cleanup activities of the beach and tidal flats, and all of these have been conducted.

Regarding “Improvement of purification ability of sea area”, conservation of existing tidal flats and seaweed beds, rehabilitation / development of tidal flats, shallow bottom, beaches and rocky fishing spots, formation of biological network in a standpoint of a long period, construction of port structures that promote biofuels, reconstructing of mildly-sloped seawalls towards the creation of habitats for benthic organism, backfill of deep digging traces in the past that is an occurrence factor of blue tide, and these have been accomplished.

Regarding Monitoring of Tokyo Bay, enhancement of



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monitoring about bottom layer DO and benthic organisms, reinforcement of monitoring of tidal current and water quality by monitoring posts and marine vessels, development of website with relevant information, survey on beach litter and beach cleaning by local residents, reinforcement of cooperation with citizens and NPOs that do environmental conservation activities in Tokyo Bay, and all these have been accomplished.

### 3. Direction of Effort towards Tokyo Bay Restoration

Tokyo Bay restoration is not a goal that can be achieved by accomplishing entirely new efforts in a short period. Therefore based on previous improvement efforts, technology and knowledge, by making proper choices, improving, adding new efforts, and carrying on traditional efforts will be a realistic approach.

The effort towards Tokyo Bay restoration needs to set the overall goal. The goal should be attractive and hopeful that we can have hope towards the future.

It is impossible to set such a goal that is viable from every side such as the technical aspect, the economic aspect and the social aspect. Therefore when efforts are actually implemented, a goal cannot be set with only thinking of one accomplishment of the overall goal. Where it is implemented, it is possible to think specifically of contents, constraint conditions and other goals of the implementation. Thus collecting information by all possible means, firmly considering, setting goals that are realistic and viable despite the possibilities of certain uncertainties, and implementing are needed.

Today, the Japan economy is in a tough situation. Therefore financial constraints for the efforts of Tokyo Bay restoration has to be considered, and it is important to improve the environment efficiently through a low-budget. In this situation, multipurpose utilization of port facilities, use of dredged soil and recycled material, making improvement of the water quality efficient, and these kinds of efforts are important. The cooperation by various agents to advance those efforts will be needed, but to do that, approach that does not lose possibility by a formalism “Relaxed cooperation based on ability” should be emphasized.

### 4. Conclusion

The “Environmental Restoration of the Sea” project was started in December, 2001 as part of the urban restoration project, and during the past 10 years efforts

have been made towards achieving it.

Technology and information gathering in regards to the “Environmental Restoration of the Sea” have advanced, but it is a large goal that is not easily accomplished.

Turning Tokyo Bay that is located in the middle of the metropolitan area into an area that is considered valuable with comfortable nature and biological production can only be beneficial to Japanese economy and society.

It is an extremely difficult goal to have, but wrapping your head around it, increasing knowledge, advancing technology and not giving in to the challenges of the goal are necessary.

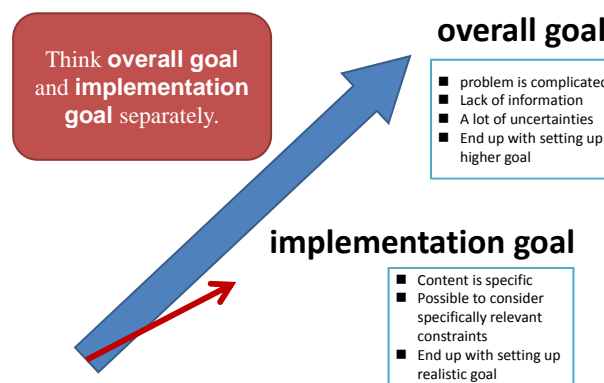


Figure-1 Two goals

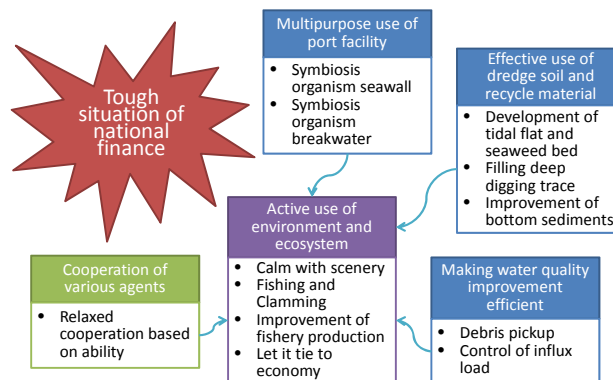


Figure-2 Direction of effort towards restoration of sea

# Performance Verification Act of Harbor Structure towards Further Streamlining

NAGAO Takashi

Director of the Port and Harbor Department

(Keywords ) Reliability, Action, Proof stress

## 1. Importance of Design Engineering View

Designing is an act to determine cross-section surface element that gives structure stability for assumed action. Margin is set with consideration such as various uncertain factors and variation to secure necessary safety. Indicators that indicate margin are various such as safety rate, proof stress action ratio, reliability indicator and fracture probability (for comparison, safety rate is not used for the harbor performance verification). In designing, it is needed to set margin along with assessment of action and assessment of response of structure for action. These assessments and setting all should reasonably be done.

Assessment of action and assessment of response of structure have been improved by a pile of engineering research. In port and harbor field, regarding input earthquake motion traditionally, the measure below has been adopted. level 1 earthquake motion is assessed as coefficient which is dived 5 block from all parts of the country, and level 2 earthquake motion, representative example is selected from past earthquake motion records, and acceleration is adjusted in response to assumed earthquake size. Today, based on the way of thinking of earthquake-resistant design guideline of civil structure of Society of Civil Engineers, time history crimp with consideration of amplification characteristic by source property, propagation path characteristic, deep layer ground in each port and harbor are set in both level 1 and level 2).

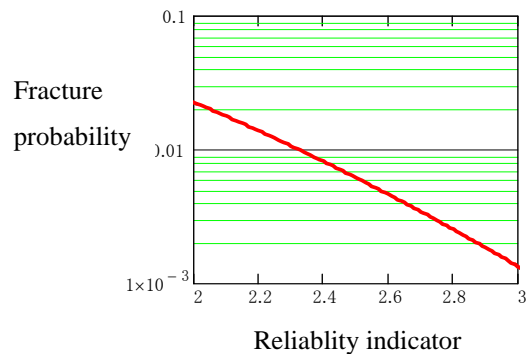
Research for response of structure has been improved. In earthquake-resistant design of quay, the following measure has adopted. For level 1, performance verification is done by setting intensity for verification that responds to deformation amount of quay 2). For level 2, effective stress analysis by 2D finite element procedure is normally used.

Research regarding action and response has been proceeded, but setting of margin ratio is the one that eventually determines reliability of structure, and setting of margin is needed to be done carefully in consideration of technical level of action and response in a standpoint of design engineering. Traditionally, it may have been a lack of view of the design engineering.

Chart-1 is a comparison of system reliability indicator for wave action of each breakwater 3). Reliability indicator is the indicator that indicates indirectly fracture probability of structure, and the relationship of them is indicated in graphic-1. Difference as reliability indicator between the lowest reliability indicator 2.04 and the highest reliability indicator is 30%. However actual stability of structure is assessed in fracture probability.

Fracture probability is 0.021 / 0.004 referring chart-1, and the difference is 5 times.

Structure format	Average of reliability indicator
Caisson type compound bank	2.11
Wave-dissipating block cleading bank	2.64
Superior slope bank	2.16
Upstand vanishing wave bank	2.04
Vanishing wave caisson bank	2.05



Graphic-1 Relationship between reliability and fracture probability

Required performance for breakwater is to maintain quiet in harbor, in this regard, there is no difference for required safety level for each structure format. However, there is actually a difference of safety level as above. The difference comes of the way of thinking of the proposer of wave power calculation formula for each structure. It occurred, because it was a different way of thinking, but it was used for the same performance verification calculation. Effort will be needed in the future to resolve such mismatch.

# Messages from Departments and Centers of NILIM

## 2. Further streamlining of action assessment

Regarding further streamlining of assessment of action and response, it will also be needed to proceed. Due to a space constraint, it's stated regarding action is as follows; The 2011 off the Pacific coast of Tohoku Earthquake occurred in 2011, a lot of damaged not only by tsunami, but also by the action of earthquake motion. Especially, situation of damage by district in the same harbor was very different, and it was the feature of the seismic damage. It is thought that because amplification characteristic in sedimentary layers from seismic basement to ground level is different in points that have almost same distance from seismic center.

For example, in Onahama harbor, a great damage occurred at No. 3 quay, but at Otsurugi quay, there was not damage (picture-1). Microtremor H/V spectrum (Ratio of horizontal component and vertical component of microtremor H/V spectrum amplitude) is indicated in graphic-2. Peak frequency of microtremor H/V spectrum responds to frequency that earthquake motion is amplified. Therefore if the frequency is less than 2Hz and has a great impact on deformation of quay, it is said that damage usually occurs during earthquake. The peak, at the quay no.3 less than 2Hz and at Otsurugi quay more than 2Hz, is approved, and it responds to the difference of damage. Based on the results, in Onahama harbor, zoning of input earthquake motion has been done, and it has reflected to designing. High assessment of accuracy of amplification characteristic of earthquake motion is very important to structure a strong country, and research will be needed to proceed in the future.

### Reference

1) NAGAO Takeshi and other: Probabilistic earthquake hazard analysis focused on fourier amplitude and group delay time. Japan Society of Civil Engineers collection of papers, No.801, I -73, pp.141-158, 2005

2)NAGAO Takeshi: Gravity formula for earthquake motion and setting measure of earthquake resistant performance verification intensity of sheet pile quay wall. TECHNICAL NOTE of NILIM No.310, 2006

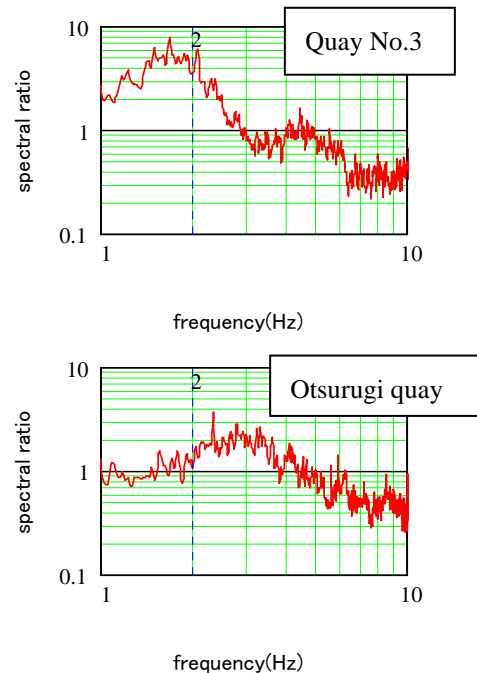
3)YOSHIOKA Ken, NAGAO Takeshi: Proposal of level 1 reliability designing method regarding externally stable of gravity formula breakwater. RESEARCH REPORT of NILIM No. 20, 2005



(a) Quay No.3



(b) Otsurugi quay



Graphic-2 Onahama harbor microtremor H/V spectrum

## Aviation policy in a new age and the foremost line of study on airports

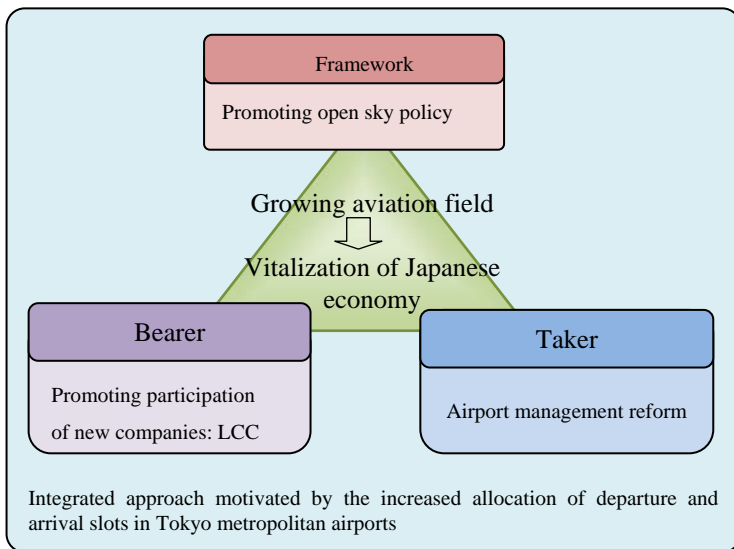
Kiyoshi Houji

Director of Airport Department

(Keywords) Aviation policy, Open sky(Airline deregulation policy), LCC, Airport management reform

### 1. Three aviation and airport policies in an integrated manner

Today, it is the biggest challenge in our aviation policy to pursue implementation of three combined policies ‘Open sky’, ‘Promotion of LCC entry’ and ‘Airport management reform’. By promotion and realization of these three policies mutually and in parallel, the aviation policy in an integrated manner shall aim at growth of aviation field and contribute to economic revitalization in Japan. The fact that airport capacity in Tokyo metropolitan area had long been a bottleneck of our aviation policy has largely expanded and accordingly it has become possible to shift a policy from regulation administration based on restricted capacity to open sky is behind the realized promotion of these policies.



### 2. Movement of airport capacity expansion in Tokyo Metropolitan area

At Haneda Airport, development projects such as construction of additional runways, extension of terminals offshore have been executed in stages and continuously, but, it was unable to meet the active demand for air transportation over-concentrated to Tokyo metropolitan area. As a result, while lessening flight frequencies, large aircrafts have been maintaining mass transportation between Haneda and other airports all over the country, and in this way,

domestic airline network unique to Japan has been developed. In addition, at local airports, runway extension projects have been executed one after another to make available services of large aircrafts with the aim of securing transportation capacity with Haneda Airport. While world aviation market has been downsizing and increasing flight frequencies, Japanese air network has been making a unique development due to the bottleneck at Haneda Airport. However, in October, 2010, the fourth runway (D runway) was offered for use marking the beginning of resolution of demand-supply bottleneck. Opening of D runway has realized capacity expansion of domestic airlines and departure and arrival slots were allocated to international airlines. As a result, regular international flights which have been suspended since opening of Narita Airport were to resume. Continuously, while airport control is planned to be oriented, capacity will increase in stages and finally, it is scheduled to increase capacity by 90,000 times/Y compared to the capacity before the use of D runway reaching to 447,000times/Y.

Expansion of annual arrival and departure slots in Tokyo metropolitan area airports (Haneda, Narita).

	Slots in Haneda (for international)	Slots in Narita	Total slots
Until Oct, 2010: (before use of D runway in Haneda)	303K	220K	523K
Current: (after Mar 25, 2012)	390K (60K)	250K	640K
Applicable from 2013 summer flight schedule: (after Mar 31, 2013)	410K (60K) 20K expansion for domestic flights	270K	680K
From then onward, implementation of open sky in Tokyo metropolitan area airports			
Final form: (Haneda: End fiscal 2013) (Narita: Within fiscal 2014)	447K (90K) 30K expansion for international flights	300K	747K

On the other hand, Narita Airport has long been operating with one runway because of the unfortunate history of struggle at the time of planning and construction. During this period, while Asian neighboring countries opened international gateway airports in succession, Narita Airport was compelled to operate extremely inferior facilities. Finally, second

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runway was extended to 2,500m in 2009, and based on local consent after that, separate operation of two runways has become possible and it is scheduled to expand capacity to a large extent.

As a result of concurrent progress of capacity expansion of these two airports, airport capacity in Tokyo metropolitan area has expanded to 747,000 times/Y and international standard airport capacity has been provided in Tokyo metropolitan area at last.

### 3. Development of Open sky (airline deregulation) policy

As there is hope for capacity expansion of Haneda and Narita, the conventional bottleneck of air transportation in Tokyo metropolitan area is to be swiftly broken and Open sky (airline deregulation) policy is to be implemented taking this opportunity. Although Open sky has been called for in the past, it has explanatory remarks to exclude Tokyo metropolitan area which has the most active demand and therefore it was unavoidable to be pointed out that open sky policy had little effectiveness.

Against a background of capacity expansion in Tokyo metropolitan area, open sky policy is to be realized in reality and in name. Airline companies have long been under strict capacity restriction, but now they have a chance to revitalize under a new open sky policy and to obtain benefits from active economic growth of foreign countries including Asian countries and it is expected to lead to sustained economic growth of our country.

### 4. Promotion of new entry of company such as LCC

Next, regarding airline companies as leaders of aviation policy, it is an issue to develop new entries such as Japanese LCC (Low Cost Carrier) that entered in 2012 in succession under a fair competitive environment. LCC is creating demand from segments of society who have never used air transportation using a new business model different from conventional airline companies and they are expected to become the engine of air transportation growth. Accordingly, to support them, the government takes aggressive policy to promote new entries of LCC by developing policies to review technical regulations and to prepare dedicated terminals. Currently, the share of LCC is about a mere 2%, but a policy target is to increase it to 20 ~ 30% in 2020.

### 5. Promotion of airport management reform

Furthermore, regarding airports as policy taker, airport management reform shall be promoted for effective airport operation. Landing fee revenues at 28 airports managed by the government is collectively managed, and it has been pointed out that the government lacks in local sense and management sense. Also, a lack of viewpoints of integrated management of airports caused by separate operating body, namely, runways, etc. (government) and airport

buildings (private), has been a problem.

Accordingly, it is planned to improve legal systems to enable to integrate management by private companies corresponding to the actual local situation and to promote airport management reform. By doing this, it will be possible to provide new options to airport management.

### 6. New aviation policy and measures to be taken by research institute

At the Airport Department, in consideration of the new trend of aviation policies mentioned above, we are conducting research issues conforming to needs of aviation administration.

For example, while using frequency of airports in Tokyo metropolitan area is increasing and physical restrictions of facility maintenance is becoming more strict, it is imperative to develop technologies to prevent worrying troubles such as peel-off of runways and to develop methods for efficient and effective maintenance and inspection in less time.

In addition, taking share expansion by LCC into consideration, we are conducting study regarding analysis of demand for air transportation and policy simulation and also examination on maintenance of airport facilities on the premise of LCC services.

Furthermore, taking it into consideration that privatization of airport will be making progress in the future, we believe that it is an important issue to construct a system to share know-how of airport facility maintenance system possessed by the government with airport administrators.



## Movement and outlook of dynamic traffic management by IT

Yukihiro Tsukada

Director of Research Center for Advanced Information Technology

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(Keywords) *ITS, Expressway, Traffic management, Fare policy, Smart IC, Information service*

### 1. Introduction

Expressways have been playing an important role of logistics and mass transportation between regions as foundation of social and economic activities. The proportion of expressway length represents a mere 0.6% against the total road length, but it increases to 9% on car/kilo basis and further to 44% in terms of transport volume of logistics. In addition, expressways fulfilled a function as an emergency transport route and risk management infrastructure at the time of the Great East Japan Earthquake.

However, by comparison with foreign expressways, our road length per head almost equals to  $\sqrt{\text{population}}$ <sup>1)</sup> and our expressway density is relatively low now.

The fatal and injury accident rate of expressways against general roads is 1/12 of total roads and also expressways demonstrate considerable decrease of CO<sub>2</sub> emission, but utilization rate of expressways is low in comparison with foreign countries. Although utilization rate of expressways in Europe and the United States is about 30%, our number is only 14% showing insufficient utilization. There are several reasons noted such as many missing links, high expressway toll and long distance between interchanges (IC) which is 10 km and about twice as long as the distance in foreign countries.

On the other hand, in order to solve traffic issues such as ease of traffic congestion, traffic safety and environment protection by seeking well-balanced utilization of expressways and general roads in each region, policies like reduced rate and installation of smart IC are being implemented.

### 2. Present situation of traffic management of expressways

Expressway management utilizing IT falls into the four general classifications, namely, information service, traffic control, fare policy and enhancement of network access. Movement at home and abroad concerning each policy shall be explained below.

#### (1) Traffic information service (VICS, route guidance)

VICS that distinguishes and delivers congestion degree from traffic counters and speed sensors, and displays traffic information on car navigation systems and mobile terminals is becoming widespread. In addition, a large scale and detailed dynamic route guidance using ITS spots set up on expressways has started. Furthermore, traffic information service by automakers and private

information companies is becoming a big trend together with spread of personal terminals like smart phones, etc.

Users make a shrewd choice of time and routes, etc. owing to such information service.

#### (2) Speed control (speed control and management)

Speed control is a policy that traffic controllers recommend or force to control speed in order to keep smooth traffic in case of congestion or an emergency (accident, abnormal climate, etc.). Active Traffic Management : ATM which is introduced in the U.K. and the United States is a representative sample. ATM controls speed in real time on the basis of traffic volume and speed data. Especially, in case of an accident, ordinary automobiles are allowed to run on breakdown lane in order to keep a lane for accident handling vehicles, thereby accident handling time has been actually reduced significantly. Lane guidance in a sag zone enabled by research and development of ITS and a cruising technology by ACC will be effective linkage with speed control.

#### (3) Fare policy (road pricing, reduced rate)

In our country, a reduced rate pilot program has been executed throughout the nation with the aim of problem-solving such as improvement of environment in area along a road and ease of traffic congestion through traffic conversion from general roads to expressways.

Councils involved in the pilot program around the country have contributed to improve receptivity of residents through program planning and execution, and also publicity and explanation of the outcome.

A nationwide analysis from both sides of effect of congestion ease and feasibility (degree of elasticity) showed the results that (i) reduced rate was effective in the morning and evening and late at night, especially late-night reduced rate made a remarkable switch of heavy vehicles from general roads to expressways, (ii) if an access to IC is good, degree of elasticity is high, etc. On the basis of the results of the pilot program, various and elastic reduced rates such as commuting reduced rate in the morning and evening using ETC and late-night reduced rate, etc. have been executed in earnest.

In Europe and the United States, policies to ease traffic congestion in cities and regions by application of road pricing to toll-free roads. For example, in major metropolitan regions in the United States, HOT lane which charges a part of lanes using IT is prepared as a traffic congestion mitigation program. Depending on a region, pricing and collecting method is different, a dynamic road pricing that fluctuates rates based on the

measured value in order to keep the speed above a certain level on a pay lane is recognized as the most effective method. Further, in Europe, congestion tax charged by ANPR in London and Stockholm and running distance rates for heavy vehicles charged by GPS and DSRC in EU countries such as Germany are becoming full-fledged. In Stockholm, the congestion tax was controversial at the time of introduction, however, as a result of its introduction following a pilot program and a referendum, inter-city traffic has been reduced by 24% three years after full-scale operation and favorable rating for congestion tax has risen to 74%. In this manner, these countries conducted pilot programs and flexibly introduced a fare policy utilizing IT, and finally gained support of residents through actual achievement to solve traffic issues.

#### **(4) Enhancement of network access (Smart IC)**

In our country, 63 smart ICs are installed and being operated across the country (as of April, 2013). As smart IC deals with ETC mounted vehicles only, it has merits such as simple tollgate installation, no collecting personnel and finally about a half of installation cost in comparison with traditional IC. In view of the present fact that ratio of ETC utilization has reached 88% at the end of 2012, further increase of utilization volume will be assured. It has been observed that the utilization volume of smart is affected by time crunch population and ETC penetration, etc. and also linked to various fare policies. For example, an exponential increase of utilization volume has been recognized in a trial free charge as well as adjacent IC. Utilization of smart IC has increased significantly because of functional advancement of IC such as full and 24hour operation, and handling of heavy vehicles. Furthermore, features of IC such as use for sightseeing and enhancement of access to emergency medical facilities are fully used.

### **3. Proposal of dynamic traffic management**

Along with preparation of expressway network, selection of plural routes has become possible and it is becoming important to execute policy to guide traffic by information service and fare policy. As mentioned in above 2, IT technology is good at assisting users to take actions wisely within a regional and limited time by providing in real time detailed information meticulously. In case of expressway management, it is possible to provide meticulous services such as (i) providing in real time information on congestion and fare, (ii) setting a proper level of fare, (iii) locating IC optimally, (iv) maintaining running environment for above a certain speed. Moreover, it is important to link policies of (i) through (iv) with each other. The author would like to propose traffic management which incorporates dynamic road pricing by IT composed of an integrated combination of information service, fare policy and access control, and also route guidance. Specifically, the proposed method provides in real time information on wide area congestion situation and a fare corresponding to this situation, then guide the nearest IC and show recommended route based on such information. It is

necessary to verify cost and effect, but I believe that it is highly probable from technical point of view.

### **4. Various fare policies by IT and running distance rates<sup>2)</sup>**

In Europe and the United States, pilot programs and review to introduce running distance rates by IT instead of fuel tax are carried out rapidly in view of securing revenues for social infrastructure corresponding to the rapid spread of EV and fuel-efficient car. It is a tough challenge to have this charge accepted by society considering a sense of burden of the charge, privacy and fairness, etc. but it is sure that discussion in those countries will become more lively because it is technically feasible. In consideration of running distance rates for heavy vehicles on main highways and actual introduction of congestion charges during peak hours and study progress of GPS usage on general roads for experimental running distance rates, it is highly possible for the time being that running distance charges will be introduced for limited type of cars within an area including expressways and main highway network. Although the time of introduction is unclear, I firmly believe that EV and micro-mini mobility are generalized and personal terminals play a great role.

#### **[References]**

- 1) Hitoshi IEDA: Vision – The Role of the Roads Responding to the Falling Population Environment: ‘Square root of Population×Area(national land coefficient) hypothesis’ and ‘Interaction opportunity hypothesis,’ *Dôro* (Roads) Magazine March issue 2005, pp4-5
- 2) See below for the recent developments of the running distance rates issues:

<http://www.gao.gov/products/GAO-13-77>

## A Step Towards Minimizing Damage from Natural Disasters

Kôji Gotô

Director of Research Center for Disaster Management

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(Keywords) *natural disasters, prevention/ control, national land surveillance, damage prediction/tracking*

### 1. Introduction

According to the IPCC Fourth Assessment Report, typhoons are growing in size and the amount of rainfall is rising, hence the increase of disasters caused by torrential rains has become a greater concern. Couple this with changes in meteorological and social conditions, such as the risk of epicentral earthquake generation in the metropolitan Tokyo area and/or Tokai, Tonankai and Nankai areas, plus increasing signs of volcanic activity, and further, depression of local area disaster prevention schemes due to the progression of low birth rates, increased longevity and consequent depopulation, the risk of natural disasters is increasing as never before. We must acknowledge that this tendency for increased risk will continue.

There are two central measures to prevent and control natural disasters: preliminary measures and response measures. Preliminary measures are for preventing and mitigating damages which could be caused by foreseeable disaster events, and response measures are for minimizing damages and preventing their outspread, and for achieving prompt rehabilitation and reconstruction activity in the disaster-stricken locations. Preliminary measures can also be classified as “preliminary disaster prevention and maintenance of disaster-prevention facilities” and “the establishment of prediction and precautionary systems.” Response measures can be classified as “rapid assessment of damages,” and “emergency and temporary response immediately following disasters,” and “rehabilitation and reconstruction measures.” Here, I would like to review the occurrence of natural disasters of recent years and introduce the survey studies by the Research Center for Disaster Management concerning preliminary and response measures.

### 2. Frequent occurrence of major disasters

When we consider the occurrence of natural disasters during the years 2011 and 2012, we find the frequent occurrence of serious and varied types of disasters. On January 26, 2011, Shin-moe-dake of the Kirishima mountains in Kyushu began its eruption activity after approximately three hundred years of silence. On March 11 of the same year, a 9.0 magnitude earthquake occurred off the Pacific coast of Tohoku and a large tsunami struck the Pacific coast of Tohoku and Kanto areas, seriously damaging both areas. Also in

September of the same year, Typhoon No. 12 hit Kii Peninsula and caused severe landslides in 72 locations with natural damming (from landslides) in 17 locations. An urgent survey was implemented, based on the Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas, in 5 locations of the natural damming sites that were assessed as “especially high-risk.” On March 7, 2012, a landslide caused by melting snow occurred in Itakuraku-kokugawa, Joetsu City, Niigata Pref. and it completely destroyed four houses where people were living. This landslide was very peculiar in that a sliding soil mass had traveled approximately 250 meters. On May 6 of the same year, an F3 Fujita scale tornado generated in Tsukuba City, Ibaraki Prefecture inflicted damage on many buildings. Further, beginning on July 11 of the same year, a prolonged rain front unleashed a downpour on northern Kyushu causing flooding and a sediment-related disaster that covered a widespread area. Around Mt. Aso, severe slope failures and flowing debris occurred. 23 people died or were missing due to sediment-related disasters caused by heavy rainfall. The occurrence of various disasters such as heavy rainfall, volcanic eruption, earthquakes, tsunamis, melting snow and tornados illustrate the reason our country is called “a country of natural disaster.”

### 3. Research Center for Disaster Management is making progress

Let me explain some of our efforts to prevent/mitigate damage from frequent occurrence of natural disasters.

#### (1) To prepare for natural disasters

In order to prevent/mitigate damage caused by natural disasters, it is necessary, on top of promoting disaster prevention measures such as maintenance of disaster-prevention facilities, to strengthen national land surveillance activity, more accurately predict the probabilities of disaster occurrences, provide sensitive information service to the municipalities and concerned residents, and support appropriate evacuation activities. Currently, in order to mitigate flooding/inundation damage caused by intense rainfall, we are conducting a study on “monitoring and forecasting systems for flood damage in integral river-basins, both inundation inside the levee and inundation by river water. In concrete terms, it is for prediction and surveillance of floodwater exposure in wide areas enabled by combining the installation of real-time surveillance equipment for



monitoring inundation depth, river water level, forecast generation utilizing a distributed rainfall-runoff model. It also provides rainfall surveillance via radar rain gauges. In the future, by utilizing existing fiber-optic networks, we plan to implement “wide area monitoring systems through fiber-optic networks” which will be able to report the status of conditions, such as the inundation level in urban areas, on a real-time basis.

The sediment-related disaster alerting information system was implemented on a nation-wide basis in March, 2008. In the event of an earthquake above level 5.0 on the Japanese scale, future issued criteria will be lowered temporarily. In light of the lessons learned from the 2011 Tohoku earthquake disaster, a study concerning the lowered ratio and a reasonable establishment method of the applicable period for quantitatively assessing the loosening of ground, is under way. There are natural disasters on a scale far outside the scope of our past experience or conventional assumptions, and multiple disasters in which earthquakes, tsunamis, flooding and/or sediment-related disasters occur at the same time. In order to cope with those disasters, studies have been made on damage and its influence on structures, formulation methods of disaster occurrence scenarios, and risk effect/assessment analysis of damage. We are currently conducting research for improvement of maintenance and control of disaster-prevention measures for infrastructure located in the midst of multiple natural disasters (with a focus on crisis management under excess external force).

#### **(2) A step towards rapid assessment of damage**

When a natural disaster of extreme severity arises, it is necessary to quickly assess its severity in order to minimize damage and prevent its outspread. However, there are times when smooth disaster-prevention support is difficult from lack of manpower or experience. Upon the request of the Regional Development Bureau and local governments, collaborative effort between the National Institute for Land and Infrastructure Management and the Public Works Research Institute will ensure experts are dispatched to disaster sites who can comprehend damage status, provide advice for the prevention of outspread damage or secondary damage, review safety of search activities conducted by the fire defense, maintain surveillance systems, and offer advice on emergency and/or tentative measures.

For massive earthquakes generated in wide areas, a study was conducted to support: quick initial response, an estimating method for seismic movement distribution based on strong motion seismograms (seismic intensity, acceleration, spectrum intensity, etc.), and from above seismic movement distribution, a method to estimate and judge the damage status of road and river facilities under our own control, and also to estimate and judge the degree of collapse-risk of slope faces. As an assessment method for determining passable roads after an earthquake, development of an evaluation method utilizing CCTV images and information from sensors installed on highway structures is underway.

A study of the method for acquiring damage

information by utilizing satellite and aircraft remote sensing technology during the outbreak of wide area disasters is also underway. It is primarily aimed at improving the method for acquiring information regarding large scale landslides and/or flooded areas, by utilizing synthetic aperture radar (SAR) images which are observable even at night or in bad weather. Furthermore, with a goal of quickly acquiring deformation information of post-disaster levees, research and development of mobile-mapping utilizing an in-car, high precision/high density laser scanner is underway.

#### **4. Conclusion**

In the Fukui Earthquake of 1948 and Typhoon Vera in 1958, a single earthquake and typhoon incident each took thousands of victims. Since those incidents, laws such as the Basic Act on Disaster Control Measures, improvements of fundamental disaster-prevention facilities, provisions of disaster-preventing information and consolidations of alerting and evacuation systems have been implemented. However, in the cases of the Southern Hyogo Prefecture Earthquake and The 2011 off the Pacific coast of Tohoku Earthquake the amount of damage was massive, with thousands to tens of thousands of victims.

For disaster-prone countries, disaster prevention and control measures must form the basis of all protective activity. With “Protecting people’s lives” as our mission, we must quickly and deliberately deal with the issues which will construct a strong national land infrastructure, strengthen national land surveillance functions, improve crisis management capability, enhance regional disaster-prevention power, and more. We would like to move ahead with research aimed at upgrading disaster prevention and control measures to minimize damage and prompt rehabilitation and construction of “a resilient society” which will reduce the negative impact of disaster on society as a whole.

#### **[Reference]**

- (1) White Paper on Disaster Management 2012: Cabinet Office, Government of Japan

# A trend of countermeasures for the long-period earthquake ground motion to architectural structures

MUKAI Akiyoshi, Director of the Building Department

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(Keywords) long-period earthquake ground motion, high-rise building, seismic isolated building

1. Actions after submitting the draft proposal for the long-period earthquake ground motion countermeasures

In the field of architecture, the long-period earthquake ground motion (i.e.: ground motion that includes long period of pitch and roll and has the characteristics of generating slow and long lasting tremor) is considered to give severe effect on high-rise buildings which have the long proper period of their own and also to affect seismic isolated buildings. On December 21, 2010 draft proposal for the countermeasures was issued from MILT and invitation of public opinions had been made until February 2011. (Ref. (1)) As a result, following opinions were received:

- The most agreed with the basic idea that something should be done to accommodate with long-period ground motion.
- It should cover Nankai earthquake and interrelated earthquakes.
- Not only the input, but the acceptable conditions for the building should also be shown.
- Retroaction of the new standard to existing buildings would be difficult, to which some easing steps and/or subsidy should be necessary.

On The 2011 off the Pacific coast of Tohoku Earthquake which occurred just after public opinions were invited, long-period ground motions were observed. (Ref. (2))

In the building standard development promotion project\* that started soon after, the following deliberations were made. (Ref. (3), (4) and (5))

\*It is the project, when the State lays down and/or revise technical criteria in the legislation such as the Building Standard Act, it will publicly seek for the collection and accumulation of the basic data and technical knowledge such as experimental data concerning the agenda which the State had set and subsidize the cost that had occurred (hereinafter called: "BDP").

2. The improvement method of preparation for the long-period earthquake ground motion (BDP Agenda No. 42)

Earthquake ground motion which was shown in the countermeasure draft proposal. Also, collected information regarding The 2011 off the Pacific coast of Tohoku Earthquake and prepared long-period earthquake ground motion wave profile for those earthquakes. Furthermore, in 2012 fiscal year, deliberations of improving flexibility and reliability of earthquake ground

motion preparation method for interrelated earthquakes.

3. Deliberation concerning architectural structure safety verification method (BDP Agenda No. 27-1, -2, -3)

Since 2010 fiscal year, with regard to reinforced concrete buildings, steel construction buildings and seismic isolated buildings, implementations of the structural testing for multiple cycle load, response evaluation of the buildings and earthquake observation of the buildings are in progress. Especially, in fiscal 2011, response analysis and investigation on high-rise buildings which were observed during The 2011 off the Pacific coast of Tohoku Earthquake were conducted. Also in fiscal 2012, shaking table tests for reinforced concrete building test structure, multiple cyclic load testing for the steel frame test structure, and multiple cyclic load testing for seismically isolated member of actual-size level were conducted and technical data concerning performance assessment of structural objects are being gathered.

4. Next step

It is anticipated that countermeasures for the long-period earthquake ground motion will be made up by not only focusing on the earthquake ground motion preparation method shown in above section 2 and documents for the performance assessment for structural objects shown in above section 3, but also taking in the accounts of the area of discussions made by the Central Disaster Prevention Council, Headquarters for Earthquake Research, the Building Construction Standard Committee in NILIM and the Working Group for the Long-Period Ground Motion set up in above committee.

#### 【References】

- (1) Draft proposal for the countermeasures on the long-period earthquake ground motion on high-rise buildings  
[http://www.mlit.go.jp/report/press/house05\\_hh\\_000218.html](http://www.mlit.go.jp/report/press/house05_hh_000218.html)
- (2) TECHNICAL NOTE of NILIM No.674, Damage investigation report of the 2011 Tohoku-Pacific Ocean Earthquake, Mar.2012  
[http://www.nilim.go.jp/lab/bcg/siryou/tnn/tn\\_nilim.htm](http://www.nilim.go.jp/lab/bcg/siryou/tnn/tn_nilim.htm)
- (3) Invite for implementing body: BDP fiscal 2011  
[http://www.mlit.go.jp/jutakukentiku/house/jutakukentiku\\_ho\\_use\\_fr\\_000037.html](http://www.mlit.go.jp/jutakukentiku/house/jutakukentiku_ho_use_fr_000037.html)
- (4) Invite for implementing body: BDP fiscal 2012  
[http://www.mlit.go.jp/report/press/house05\\_hh\\_000307.html](http://www.mlit.go.jp/report/press/house05_hh_000307.html)
- (5) Outlines of Results, listed: BDP fiscal 2011  
[http://www.mlit.go.jp/jutakukentiku/house/jutakukentiku\\_ho\\_use\\_fr\\_000047.html](http://www.mlit.go.jp/jutakukentiku/house/jutakukentiku_ho_use_fr_000047.html)

## Research Trends and Results

# Experiment on tsunami run-up in a river using the largest hydraulic model

HATTORI Atsushi(Ph.D., Engineering), Head

FUKUSHIMA Masaki (Ph.D., Engineering), Senior Researcher

MATSUURA Tatsuro, Researcher

River Division, River Department

(Keywords) tsunami run-up, tsunami in a river, water height, bank height

1. Basic information for the countermeasures against tsunami in a river

The tsunami occurred on the 2011 off the Pacific coast of Tohoku Earthquake overflow and washed out levees and inflicted immense damages. Accordingly, the assumed tsunami for the countermeasures against the tsunami in a river, two types of tsunami were set: as type 1, 'the maximum class of tsunami' of which generating frequency is extremely low but once generated it will bring an immense damages like the one experienced this time, and as type 2, 'tsunami for the cause of facilities planning' which are generated more frequently but tsunami height is relatively low<sup>1)</sup>. When drawing up the countermeasures for the tsunami in a river, it will be necessary to have, as basic information, to how upper stream does tsunami propagate and the maximum water levels at each distance from the river mouth.

2. The knowledge and issue regarding tsunami run-up in a river

It is generally possible to get information to draw up the countermeasures by making tsunami run-up calculation. The analytical method would be as follows:

"Guidance to analyze tsunami propagation in a river (draft)" shows the case example of the tsunami run-up in a river in the past<sup>2)</sup>. Maximum water level within the river channel of the tsunami this time was replicated in accordance with the guidance and that was compared with the actual observed value of high-watermark. However, there were some discrepancies in reproducibility depending on the rivers where further improvement of accuracy was desired. Because, it was the first time in Japan to experience the tsunami height exceeding the bank height, even a basic knowledge such as tsunami run-up phenomenon itself or its reflection on the analysis were not sufficient that we cannot get further into the fundamental improvement in a period. For instance, it is common that water height of tsunami in a river drops to a lower level as it propagates from the river-mouth towards upper stream, but those river channels, not like sea area, are shallow and together with the surrounding landform and land cover, they would presumably change the water height in a complicated manner, but those characteristics are yet to be comprehended sufficiently. It is also beyond one's understanding still of the knowledge concerning the difference of characteristics which may change

depending on the tsunami wave height and, like the tsunami this time, water height of the tsunami that flows over the bank, run-up distance or extent of the damage inflicting the bank.

3. Breakthrough on tsunami propagation in a river phenomenon by using hydraulic model experiment

To bring out such knowledge, deliberation was made by using various data observed at the site of the tsunami this time, but there was a limit, so it was decided to conduct experiments with large-size hydraulic model (Photo). The model fabricated this time was a replication of Shin-Kitakami River area covering from bay entrance to about 10 kilo-meters upper stream on the reduction scale of 1/330<sup>th</sup>. In this experiment, using the variables such as size of the tsunami, form of the river channel and state of the land cover, verifications and analyses are made on how water height and flow velocity are affected in the river channels and highlands area when tsunami propagates, and comprehend tsunami run-up phenomenon on the rivers. Furthermore, by making comparison between replication of tsunami run-up calculation and the actual experiment results for every experiment condition, the issues regarding the replicate calculation will be cleared up and improved, and consequently more accurate setting method regarding water height and flow velocity at the time of propagation will be worked out.

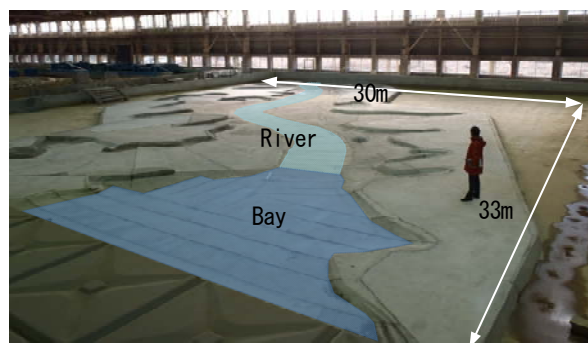


Photo: Experiment model

### 【References】

- (1) Countermeasures for the tsunami in a river investigative commission: An urgent proposal regarding the countermeasure against the tsunami run-up in a river, Aug, 2011
- (2) Japan Institute of Construction Engineering: Guidance to the analysis of tsunami run-up in a river (draft), May, 2007

# A Case of Utilizing Results

## Technical support to designating the assumptions of tsunami inundation by preparing guidelines

SUWA Yoshio, Head

KATO Fuminori, Senior Researcher

Coast Division, River Department

(Key words) *tsunami inundation estimates, the creation of communities resistant to tsunami disasters, the top class tsunami, tsunami inundation simulation*

### 1. Outline

To support prefectural governors to designate the assumptions of tsunami inundation along the tsunami prevention region development law, the Coast Division prepared the guidelines on designating the assumptions of tsunami inundation in February 2012, and gave prefectures technical advices, cooperatively with the Sea Coast Office of the Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism. The guidelines mainly introduce tsunami inundation simulations and methods to use the results of the simulations.

### 2. Guidelines on designating the assumptions of tsunami inundation estimates

The assumptions of tsunami inundation present the area and depth of inundation predicted by tsunami inundation simulations for the top class tsunami.

The following are the major items in the guidelines.

- Designating the assumptions of tsunami inundation are a series of setting the top class tsunami, setting calculation conditions, simulating tsunami inundation, and outputting the area and depth of inundation.

- The top class tsunami is set for each region's coastline to be the largest tsunami among the past tsunamis and the estimated tsunamis. Region's coastline is dividing a coastal region for shore protection basic plan into coherent coastlines assumed the height of the tsunami is the same considering natural conditions, past tsunami heights, and estimated tsunami heights.

- Fault models that give the initial tsunami profile can be set by referring reasonable models reviewed and published by public organizations such as the Central Disaster Management Council and the Headquarter for the Earthquake Research Promotion.

- In tsunami inundation simulations for designating the assumptions of tsunami inundation, facility damage induced by earthquakes and tsunamis should be considered that the top class tsunami may occur in adverse conditions and cause inundation from the viewpoint of protecting human life by all means, based on a lesson that there is no upper limit to the disaster.

- To understand inundation induced by tsunami run up to the land, the largest area and depth of inundation etc. to be designated in the assumptions of tsunami inundation are output as the results of tsunami inundation simulations.

To solve issues grasped through works for the assumptions of

tsunami inundation, the guidelines were revised three times (March, April, and October, 2012) to enrich explanations of facility conditions against earthquakes and tsunamis and others.

### 3. Utilizing the guidelines

Together with preparing the guidelines, contact point for technical consultation on tsunami inundation simulations was set up in the Coast Division, and explanatory meetings with prefectural officials and construction consultants were held in February and March 2012. Besides these, to solve technical problems in designating the assumptions of tsunami inundation, the Sea Coast Office of the headquarter and the Coast Division held opinion exchange meetings with officials in prefectures and regional development bureaus in ten regional blocks after April 2012, and responded to the consultation of each prefecture. As of January 2013, Ibaraki, Aomori (only a part of coastlines), Tokushima, and Kochi Prefectures have already designated the assumptions of tsunami inundation, and the other prefectures are supposed to proceed in works.

[Sources]

1) Guidelines on designating the assumptions of tsunami inundation

[http://www.mlit.go.jp/river/shishin\\_guideline/bousai/saigai/tsunami/shinsui\\_settei.pdf](http://www.mlit.go.jp/river/shishin_guideline/bousai/saigai/tsunami/shinsui_settei.pdf)

2) The assumptions of tsunami inundation in Ibaraki Prefecture

<http://www.pref.ibaraki.jp/bukyoku/doboku/01class/class06/kaigan/tsunamisinsui/2shinsui.html>

3) The assumptions of tsunami inundation in Aomori Prefecture

<http://www.pref.aomori.lg.jp/kotsu/build/tunami-sinsuisout/ei.html>

4) The assumptions of tsunami inundation in Tokushima Prefecture

<http://anshin.pref.tokushima.jp/docs/2012121000010/>

5) The assumptions of tsunami inundation in Kochi Prefecture

<http://www.pref.kochi.lg.jp/soshiki/170201/tsunamimap.html>



# A Case of Utilizing Results

## Technical support in relation to resilient structures of coastal dikes

SUWA Yoshio, Head

KATO Fuminori, Senior Researcher

HATOGAI Satoshi, Researcher

Coast Division, River Department

(keywords) resilient structures, tsunami, overflow, scour

### 1. Introduction

In a 'Basic concept in relation to restoration of coastal dikes, etc. suffered from the 2011 off the Pacific coast of Tohoku Earthquake and tsunami,'<sup>(2)</sup> which was compiled based on a view of 'Structures which can produce resilient effect of facilities even in case of exceeding the designed height of tsunami' presented in a report of Expert Examination Committee of Central Disaster Prevention Council<sup>(1)</sup>, prevention of scour by back bottom slope protection works and prevention of washout by securing member thickness of back slope covering works, etc. were pointed out as structural devices of coastal dikes, etc. In order to reflect such structural devices in restoration after disaster, etc., River Department of NILIM conducted a technological study in cooperation with Coast Division of Water and Disaster Management Bureau and Tohoku Regional Bureau.

### 2. Scope of the study

Focusing on the scour of back bottom slope of coastal dikes with a general form of trapezoid cross section and the stability of back slope protection works, devices for improvements of scour resistance and stability were examined by hydraulic model experiments, etc.

### 3. An example of resilient structures

Main points to note among the devices confirmed by the hydraulic model experiments are shown in the table.

Table: Main points to note about structural devices

It is important to completely change the flow direction of overflow flowing down the back slope not to run into the foundation (securing the flat ground of back bottom slope) in order to keep the scour of back bottom slope away from the main body of the dike. → To lay down the soil stabilization as well as the foundation work and secure the flat ground of back bottom slope as shown in the Table.
--

It is important to avoid unevenness because the unevenness increases the active surface of hydrodynamic force and the degree of destabilization if unevenness occurs in back slope covering works. → To form a structure difficult to produce unevenness against water flow by fitting together cutout blocks.
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It is important to form a structure in consideration of negative pressure produced at back slopes. → To integrate slope blocks and armoring work on crown so that one unit of block does not cover the negative pressure range.
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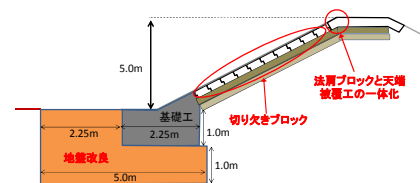


Figure: An example of resilient structures (dimensions are local equivalent value)

### 4. Conclusion

The results of this study were published in NILIM Technical Flash<sup>(3)</sup> in May and August, 2012 and they were reflected in the disaster restoration works in South coast of Sendai Bay (partial completion scheduled at the end of March, 2013)



Photo: Laying works of cutout blocks

### References

- (1) Expert Examination Committee of Central Disaster Prevention Council on countermeasures against earthquakes and tsunami learning lessons from The 2011 off the Pacific coast of Tohoku Earthquake: Expert Examination Committee report on countermeasures against earthquakes and tsunami learning lessons from The 2011 off the Pacific coast of Tohoku Earthquake, <http://www.bousai.go.jp/jishin/chubou/higashinon/hokoku.pdf>
- (2) Committee on tsunami protection measures at coastal areas: Basic concept about restoration of coastal dikes, etc. suffered from the 2011 Tohoku-Pacific Ocean Earthquake and tsunami, [http://www.mlit.go.jp/river/shinngikai\\_blog/kaigantsunamitaisaku/kangaekata/kangaekata111116.pdf](http://www.mlit.go.jp/river/shinngikai_blog/kaigantsunamitaisaku/kangaekata/kangaekata111116.pdf)
- (3) Ministry of Land, Infrastructure, Transport and Tourism, Research Center for Land and Construction Management: Study on the structure of coastal dikes which can produce resilient effect, NILIM Technical Flash, 2012, <http://www.nilim.go.jp/lab/bcg/sokuhou/index.html>

# Research on assessing the risk of landslide in storms following major seismic disturbances

NOMURA Yasuhiro, Researcher

OKAMOTO Atsushi, Head

OKUYAMA Yuki, Researcher

Research Center for Disaster Management, Erosion and Sediment Control Division

(Key words) Earthquake, Landslide, Risk assessment, Sediment disaster warning information

## 1. Introduction

It is said that once a large magnitude earthquake occurs, it loosens portions in slopes such as a crack, which makes it more likely to cause landslides compared to before the earthquake (Photo 1). The sediment disaster warning information issued by the prefectural governments and local meteorological observatories in collaboration is made public when the 60 minutes cumulative rainfall and soil-water index exceeds a certain criterion, but after the large magnitude earthquake, an interim criterion that is 50 to 80 percent of normal is actually applied to issue the information. (Fig. 1 generally only the soil-water index is lowered.) Here, we would like to introduce the results of the research on the adequacy of this interim criterion.

## 2. Evaluation of the interim criterion of the Sediment disaster warning information after earthquakes

We have calculated the disaster capture rate which is the percentage of the numbers of the issued warning information before sediment disaster occurrence based on the rainfall data and sediment disaster occurrence data in a half year in the Tohoku and Kanto region that have observed earthquakes of the intensity 5 or more due to the Great East Japan Earthquake, 2011 and applied the interim criterion. At that occasion, we have classified three areas such as (1) Disaster capture area by the normal criterion, (2) Capture area by the interim criterion and (3) No capture area (Fig. 1) and classified the numbers of disasters in the respective area and largest earthquake intensity in the Table 1 and Fig. 2. By that result, we have found that introduction of the interim criterion has successfully raised the capture rate by 18.8%, which was 68.8% by the normal criterion just going under the nationwide average value of 75% at normal time, so it can be called an improvement. Therefore the interim criterion was somewhat effective. Further, we have reviewed the required minimum lowering rate based on the consideration that lowering the criterion might increase the warning information issuance frequency and increase the air shot, and obtained the result that there was no change in the capture rate between 70 to 80% and 50 to 80% of the criterion value.

## 3. To finish

From now, we are to implement a further review through the slope stability analysis to have a quantitative evaluation on loosened ground due to earthquakes.



Photo 1 Example of the slope that has collapsed by the rainfall after to the Great East Japan Earthquake, 2011(provided by Tochigi Pref.)

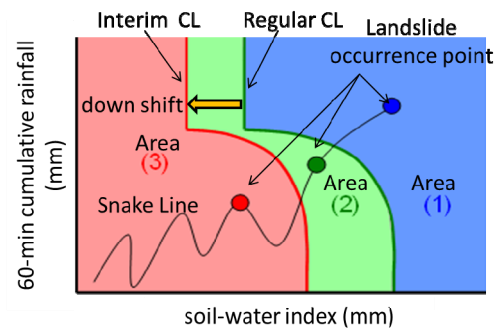


Fig. 1 Provisional reference and disaster capture image after large magnitude earthquake

Table 1 Relation between the disaster capture state and largest earthquake intensity

Area	Number of landslide occurrence				Total	Share
	Level5+	Level6-	Level6+	Level7		
(1)	5	8	9	0	22	68.8%
(2)	1	0	5	0	6	18.8%
(3)	0	0	4	0	4	12.5%
Total	6	8	18	0	32	-

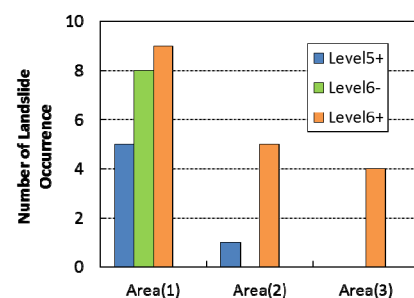


Fig. 2 Relation between the disaster occurrence state and largest earthquake intensity

# Estimate of volume of debris on the road after earthquake

MABUCHI Toshiaki, Senior Researcher

KANEKO Masahiro, Researcher

Earthquake Disaster Prevention Division, Research Center for Disaster Management

(keywords) earthquake debris, road emergency, estimation method

## 1. Introduction

For earthquakes which occur in urban areas such as earthquakes that directly hits Tokyo area and earthquake that directly hits Chubu area • Kinki area, it is extremely important to immediately eliminate road obstacles for emergency routes, etc. in view of the magnitude of the impacts on society, etc. following the earthquake. In this research, as basic data necessary for planning in relation to actions of road administrators after earthquake such as elimination of road obstacles and with the object of earthquakes which occur in urban areas, obstacles (earthquake debris and neglected vehicles) which cause decreased function of road transportation system on emergency routes, etc. and the extent of decreased function were clarified and its estimation method was studied.

## 2. Organizing actual conditions of earthquake debris occurred on main roads

Actual conditions of earthquake debris occurred on the main roads by the collapsing of buildings, etc. by the road side were organized by deciphering aerial photographs taken of the 1995 Hyogo-ken Nanbu Earthquake. Information on width and length, etc. of protruded earthquake debris on the road and the properties of collapsed buildings (wooden • non-wooden, low-rise • high rise), etc. were summed up as follows.

(1) Frequency of occurrence of earthquake debris on main roads per length of road 4 (items / km) at most and comparatively lower than narrow streets<sup>(1)</sup>.

(2) There was not much difference in length of protrusion between wooden and non-wooden.

## 3. Formulation of estimate equation of volume of earthquake debris on main roads

‘Building-to-land ratio’, ‘floor area ratio’ and ‘use district’, etc. which data were relatively easily available from city planning summary drawings, etc. used as variables in order to estimate volume of debris. In estimating the width of earthquake debris (a), a coefficient of each variable was calculated by regression analysis and (Formula-1) was set up.

$$a = -3.479 + 0.621 \cdot X1 + 7.509 \cdot X2/100 + 0.607 \cdot X3/100 + X4 \dots \text{(Formula-1)}$$

X1: number of building stories X2: building-to-land ratio (%) X3: floor area ratio (%)

X4: use district: residential district: 0.585, neighborhood business district: -0.311, business district: -2.585, semi-industrial district: 1.155, industrial district: 2.857

Height of debris (h(m)) and length of debris (L(m))

were used as a function of width of debris (a(m)) and following (Formula-2 and 3) were set up by regression analysis using the measured values. In addition, assuming that debris are triangular prisms, volume (V (m<sup>3</sup>)) can be obtained as (Formula-4) using width of debris (a), height of debris (h) and length of debris (L).

$$h = 0.32 \cdot a + 0.853 \dots \text{(Formula-2)}$$

$$L = 1.089 \cdot a + 7.487 \dots \text{(Formula-3)}$$

$$V = a \cdot h \cdot L / 2 \dots \text{(Formula-4)}$$

## 4. Forecasting method of neglected vehicle quantity

In order to forecast quantity of neglected vehicles in time of earthquake disasters, the generation status was investigated utilizing aerial photographs at the time of Hyogo-ken Nanbu Earthquake. Comparing the photographs taken in the afternoon of January 17, the day of Hyogo-ken Nanbu Earthquake with the photographs taken in the morning of next day 18th, if there were vehicles on the same place, they were regarded as neglected vehicles and the result of discriminated quantity of neglected vehicles was listed in the Table. Since the earthquake occurred early in the morning, the number of neglected vehicles was not so many.

Table: Generation status of neglected vehicles by aerial photograph discrimination

Routes	Block length	Number	Number/length
National Route 2 (Direct control national route)	19.2 km	52	2.7 / km
Yamate-kansen Route (main local roads)	12.5 km	78	6.2 / km

## 5. Conclusion

By discriminating aerial photographs at the time of Hyogo-ken Nanbu Earthquake, the generation status of earthquake debris on the main roads, etc. caused by collapsed buildings, etc. by the road side was organized and the estimate equation was formulated. In addition, it generated the quantity of organized neglected vehicles. It is hoped that the above will enable to forecast volume of debris, etc. on roads post-earthquake to some extent will contribute to advance preparation of equipment, etc. necessary for elimination of debris, etc.

[Reference] (1) Functional disorder of street network and its influence focusing on ‘street blockades phenomenon’ in Hanshin Awaji Earthquake, Japan Society Civil Engineering Journal, October, 1997 Hitoshi IEDA et.al

# Research Trends and Results

## Dam Flood Control based on Ensemble Rainfall Forecasting

River Department, Water Management and Dam Division

KAWASAKI Masaki, Head

INOMATA Hironori, Researcher

(Key Words) dam flood control, ensemble rainfall forecasting

### 1. Introduction

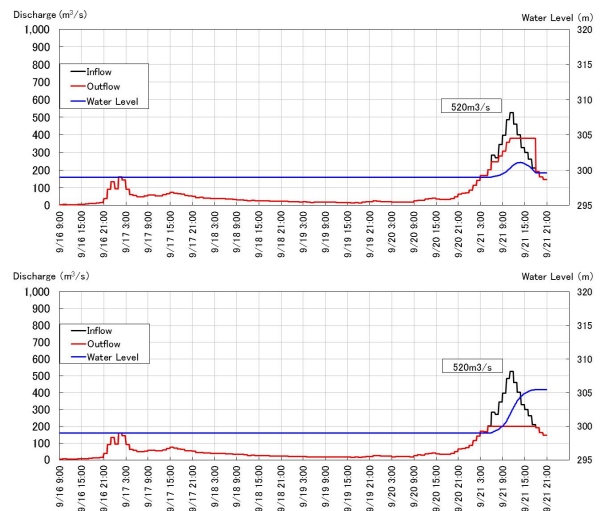
Utilization of rainfall forecasting is one strategy to enhance flood control functions of existing dams. It is true that the accuracy of rainfall forecasting improves day by day but the error has still not been zero. Accordingly, utilization of rainfall forecasting in dam flood control is still very limited. Because it seems very difficult for the error to be zero soon, it is important for us to recognize that the error is never zero and propose methodologies to utilize rainfall forecasting data which has not only error but also potential to enhance flood control functions of existing dams.

The Water Management and Dam Division has proposed the methodology which estimates the outflow discharge considering the probabilistic distribution of error in rainfall forecasting. One problem of that methodology is how to set the probability distribution. Then, we applied the ensemble rainfall forecasting (ERF) data for dam flood control operation. ERF data estimates the range of forecasting with taking into consideration meteorological conditions at that time. In addition to that, ensemble rainfall forecasting does not need accumulation of historical forecasting and observation data to determine the statistical relation between them.

### 2. Dam flood control based on ensemble rainfall forecasting

The figure shows the simulation result of dam flood control operation of the Hachisu Dam for Typhoon Roke in 2011. Every time the boundary condition is updated, ERF is calculated and the outflow discharge which minimizes the expected peak discharge in downstream is

estimated. That outflow discharge is released until the next update of the boundary condition. As a result, the outflow discharge based on ERF was stationary in the outflow discharge which starts flood control operation. Accordingly, the flood control based on ERF decreases the peak discharge in downstream by around 10% compared with the flood control by the regular rule.



Flood control simulation of the Hachisu Dam for Typhoon Roke (Upper: the regular rule, Bottom: Operation based on ensemble rainfall forecasting)

### 3. Other problems

The complementary operation rule has to be proposed to avoid increasing peak discharge in the downstream for low accuracy of ERF.

#### 【Reference】

- 1) Mitsuishi et al.: Research on Risk Management of Dam Flood Control by Utilizing Rainfall Prediction, Journal of Japan Society of Dam Engineers, Vol.21, No.4, pp242-250, 2011



## A Case of Utilizing Results

# Technical matters for introduction of X-band MP Radar observation

KAWASAKI Masao(Ph.D., Engineering), Head

TSUCHIYA Shuichi, Researcher

Water Management and Dam Division, River Department

(keywords) XRAIN, X-band MP Radar, heavy rain observation, technical data

### 1. Introduction

In recent years, scattered heavy rain and localized heavy rain frequently occur all over Japan and they generated flood damages and water accidents. It is important to understand the heavy rain situation accurately for disaster control measures and weather radars which can receive real time precipitation information in the whole area are highly effective.

Water and Disaster Management Bureau of Ministry of Land, Infrastructure, Transport and Tourism have deployed X-band MP (multi parameter) Radars, the recent model weather radars, and have built a radar observation network called XRAIN intending to enhance image resolution of radar precipitation information and to improve real time processing, thereby enhancing heavy rain observation system and high precision of flood forecasting are underway. XRAIN started its trial operations in 2010 with a network of 11 radars and additional radars were deployed every year thereafter. As of now (2012) a network of 27 radars is implementing trial operations.

### 2. Establishment of technical matters to introduce X-band MP Radar observation

Radars are the equipment to transmit radio waves and receive the radio waves reflected from precipitation particles group and they do not directly measure the precipitation. The data directly obtained from radars are the strength of radio waves propagated through and reflected from the precipitation particles group and the phase information. Rainfall observation by radars utilizes the characteristics that such information is relevant to the intensity of rainfalls of precipitation particles group. In order to observe precipitation with high precision by radars, it is required to study scan mode such as the elevation angle of antennas and the rotation speed and to conduct the identification operation of calculation parameters of the precipitation and so forth. Manufacture and installation of radars only never achieves precipitation observation with high precision.

There is no precedent in the world to put X-band MP Radars to practical use. Therefore, NILIM, in introducing them, in cooperation with experts of radar

observation, have been conducting studies on design of radar network, building of data processing and delivery system, scan mode and parameter tuning, etc. and also, enhancement of decay compensation and synthesis method. Thus we have been contributing to securement of the specified accuracy of X-band MP Radar observation, to improvement of the accuracy and to establishment of technical matters.

### 3. Preparation of technical data

Three years have passed since the construction of XRAIN and it is scheduled to proceed to an official operation from the trial operations. Accordingly, the technical data which summarized technical knowledge obtained through the trial operations and assembled the information about observation system by X-band MP Radar, calculation method of precipitation and various study methods were prepared this time.

The first half of the technical data describes the principle specifications of radars, transmission method, signal processing, system structure of XRAIN and calculation method of rainfall intensity as matters related to hardware and software composing XRAIN. The latter half describes selection of radar installation locations, ideas about observation configuration, initial adjustments, various verifications and study methods as matters related to introduction of X-band MP Radars and initial adjustments and verifications.

The technical data are scheduled to be published as NILIM papers. It is expected that the data will be of some help toward technical development concerning future introduction of radars by Regional Development Bureaus and local governments, radar observation and utilization of radar precipitation information.

Moreover, in the future, depending on the progress of research and development of technology, specifications of equipment to be employed by XRAIN and precipitation calculation methods, etc. will possibly be amended and improved and on this occasion, the technical data will be revised accordingly.

# Investigation of flooding streams caused by heavy rain disaster in the Northern Kyusyu

ONAMI Hiroyuki, Researcher

ITO Hiroyuki, Head of Flood Disaster Prevention Division

Research Center for Disaster Management

(Keywords) Heavy rain disaster in the Northern Kyusyu, flooding stream, field survey

## 1. Introduction

In July 2011, torrential rain disasters occurred in the Northern Kyusyu area of Japan, hitting the wide area from Fukuoka Prefecture to Kumamoto Prefecture. In this disaster, the highest water levels ever observed were recorded in some rivers, causing overtopping and flooding in many places. Although investigations on flood marks of the past inundations that occurred in the areas protected by levees were conducted so far, behaviors of flooding streams had been never investigated. However, it has been pointed out that taking appropriate actions corresponding to the behaviors of flooding stream is important in a flood disaster. Therefore, it is important to grasp the actual behaviors of flooding stream in conjunction with improving inundation analysis techniques. In this study, observations and inquiring surveys were conducted after the flood disaster, and to grasp the behaviors of flooding stream qualitatively.

## 2. Flooding courses at basins of Kagetsu-gawa River and Yamakuni-gawa River

Heavy rains and flooding hit Hita City of Oita Prefecture where the Kagetsu-gawa River stretch of the Chikugo-gawa River system flows and Nakatsu City of Oita where the Yamakuni-gawa River flows twice on Jul 3rd and 14th. The following shows the results of the situation of flooding that occurred on July 3rd.

### 2.1 Kagetsu-gawa River (Miyuki-bashi Bridge ~ Kagetsu-gawa Bridge downstream)

This area is a district widely damaged by inundation. According to the inquiring surveys, we have heard residents in this area saying “overflowing water poured into the residential street from the street along embankments and the waterways inside the levees”. Based on which, it is suggested that not only configuration of the ground but also arrangement of spaces or roads and waterways will greatly impact on flooding streams (Figure-1). What is more, concrete block walls of Showa Gakuen High School were collapsed on a large scale by driftwood (Photo 1). This was an extremely large damage compared to other facilities around the area, leading to the assumption that fluid dynamic force increased substantially by flotsam. At the same time, there were a large number of lumber mills in the upper river and dam-up and facilities damage caused by drifting woods were seen in many places.

### 2.2 Yamakuni-gawa River

Although the Yamakuni-gawa River is an entrenched channel, overflow on levees were found here and there

due to dam-up caused by rubbles adhering to bridges. Figure-2 shows the situation of inundation in the Hida district. Controlled bridges of the Yabakei Bridge and the Arase dam were blocked by driftwood and there was overflowing in the scarp. Additionally, flooding water passed through the road in a community as its main course and the water level inundating houses at the mountain side was higher than that at the river side.



Figure-1 Study results of flooding stream of Kagetsu-gawa River

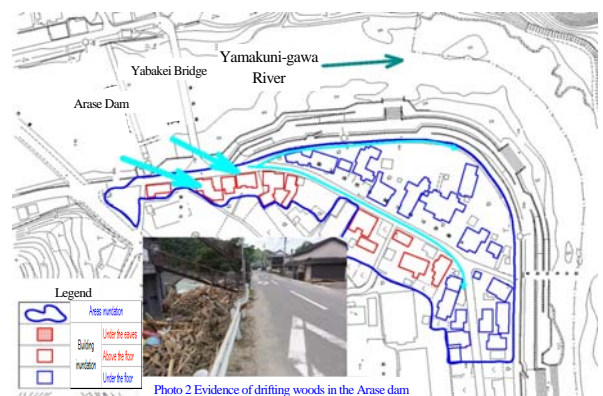


Figure-2 Study results of flooding stream of Yamakuni-gawa River

## 3. Conclusion

We showed one example of investigating results of behavior of flooding stream causing flood disasters. In the future, we will conduct a swift field-survey after occurring flood disaster and accumulate obtained data systematically for the purpose of contributing to consideration of risk-management measures and verification of inundation calculation accuracy based on the characteristics of flooding stream.

## Research Trends and Results

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# Development of the technology to measure sediment transportation on mountainous river

HAYASHI Shin-Ichiro, Researcher

UCHIDA Taro, Senior Researcher (Ph. D of Agriculture)

OKAMOTO Atsushi, Head

Research Center for Disaster Management , SABO (Erosion and Sediment Control) Division

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*(Key words) hydrologic and sediment measurements, suspended load, bedload*

### 1. Introduction

As the mountainous rivers have remarkable fluctuation regarding the flow rate and river bed spatiotemporally, implementation of continuous hydrologic and sediment measurements (water level, suspended load and bedload etc.) have been tentative in limited area due to various difficulties such as damage and loss of the observation instruments. SABO Division has been conducting the technological development on the hydrologic and sediment measurements. Moreover nationwide MLIT SABO offices implement the hydrologic and sediment measurements in recent years. In the revised part for investigation of Technical Criteria for River Works, the hydrologic and sediment measurements are stipulated to implement and edit the results as chronological table.

### 2. Manual on hydrologic and sediment measurements on the mountainous river

SABO Division has released the Technical note of NILIM No.686 “Manual on hydrologic and sediment measurements on mountainous river”. It describes the purpose, concept and standard methods of hydrologic and sediment measurements based on the research results such as the Project research “Research on the method for general sediment management for national land conservation” (fiscal year 2008 to 2010) and the measurements of MLIT SABO offices. Four significant purposes of hydrologic and sediment measurements are shown in the manual as follows.

#### (1) Monitoring sediment transportation

Establish the future monitoring method to detect the occurrence of the sediment production and urgency of the sediment disaster by using real time monitoring data

#### (2) Establishing SABO master plan and evaluation of SABO works

Establishing SABO master plan and setting parameters of runoff analysis and numerical simulation for river bed deformation based on the monitoring data

#### (3) Disaster management for landslide dams

Setting parameters of runoff analysis to predict the timing

of overflow at landslide dam

#### (4) Establishing the general sediment management plan

Estimation for sediment volume and particle size from mountainous area to downstream

Moreover the manual shows the standard methods of the hydrologic and sediment measurements as follows.

(1) Hydrologic measurements: precipitation, flow rate (by measuring water level and flow velocity)

(2) Suspended load observation: Turbidity meter, extraction of suspended load from flow directly

(3) Bedload observation: Acoustic bed load meter

### 3. The example of analyzing the data of hydrologic and sediment measurements

Figure shows the analysis example of the comparison between the bedload volume obtained by the acoustic bedload meter, per catchment area and total periodical precipitation and the volume of sediment discharge estimated by the survey data of sedimentation in check dam which has almost same catchment area of former measurement, per catchment area and total periodical precipitation. Both volumes are approximately same. This result suggests the capability of the acoustic bedload meter which is able to estimate the bed load volume favorably.

# Research Trends and Results

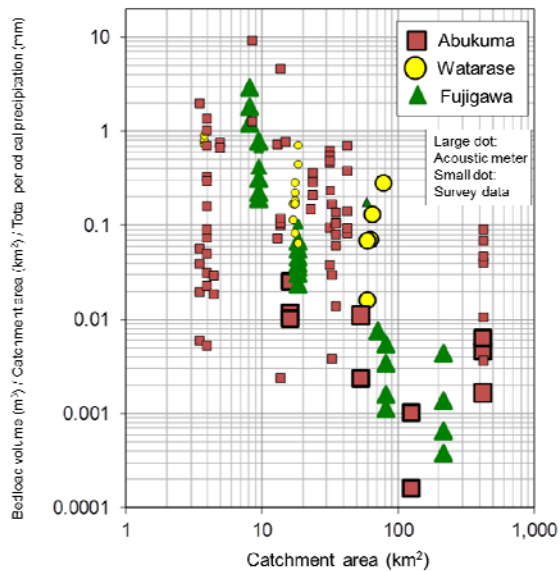


Fig. The analysis example of the relation between the volume obtained by the acoustic bedload meter and the volume estimated by the survey data of sedimentation in check dam

## 4. Future plan

We continue to gather and analyze the data of hydrologic and sediment measurements to clarify the factors which control sediment transportation that varies depending on the place and flood. Then we conduct the study to clarify to the conditions (e.g. topography, sediment production in upstream) which control the factors.

### [Reference]

The Technical note of NILIM No.686 “Manual on hydrologic and sediment measurements on mountainous river”

<http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0686.htm>



## Research Trends and Results

# Protect the sand dune (regarded as a natural dike) using the “Sand pack” -Beach scarp recession preventive works-

SUWA Yoshio, Head

NOGUCHI Kenji, Senior researcher

WATANABE Kunihiro (Ph. D. Agriculture), Researcher

Coast Division, River Department

(Key words) Sand pack, Beach scarp recession preventive works, GeoTextile, Beach nourishment

### 1. What is the “Sand pack”?

“Sand pack” is a large GeoTextile bag filled with beach material collected on site or shared with the beach nourishment. Although it is applied in foreign countries, problem has been whether it is applicable or not to the Japanese beach composed of coarse-sand-containing beach material formed by hard waves grown by the steeply sloped sea floor. If the sand pack was proved applicable, it is expected to see earlier accomplishments of the beach prevention effect taking advantage of its merit of short period construction work and economic efficiency.

### 2. Collaborative research and editing of the “Guide line to the Beach scarp recession preventive works (draft)”

Coast Division has performed the collaborative research called “Research on the performance evaluation technology of the sand back fill work in the beach conservation” from the fiscal year 2010 to 2012. In that research, we have carried out the hydraulic model test of the sand bag, durability test for sand bag material, construction experiments on site, follow-up monitoring, and so on and organized performance evaluation methods.

As a result, it was proved that the lifetime of the bag material becomes shorter near the shore line on the sand eroding beach, since those beaches are always attacked by tireless waves propagating over steep topography. On the other hand, we also found that the abrasion external force is smaller if there was wide sand beach on the front even in the coast facing the outer sea, which performed the bag lifetime longer to approximately ten years or more. Accordingly we have decided to make a proposition of the practical use of the sand pack to the Beach bank scarp retreat recession preventive construction works of the sand dune as its application based on such characteristics. As we have carried out the site test on Sumiyoshi area of Miyazaki coast shown in photo 1, we have made a summary of the result of that collaborative research as the Guideline to the Beach bank retreat preventive construction work (draft).



Photo 1 Preventive effects to the earth fill on the back

### 3. Beach scarp recession preventive works

Fig. 1 shows the cross section of the Beach scarp recession preventive works. The construction work consists of the standalone sand pack laminated body and beach nourishment earth fill located on the front of the beach fill, in which sand covering beach nourishment is implemented on the laminated sand pack if necessary. The laminated sand pack and beach nourishment fill on the back have the function to decrease the denudation of the lower part of the beach due to waves and prevent the beach bank from retreating. The Guideline (draft) shows how to set the cross section of the Beach scarp recession preventive works, the sand pack weight assessment method, evaluation method of the tension reacting on the bag material, how to set the abrasion external force and climatic aging deterioration external force, calculation method of the required force for the bag material, performance evaluation test method and so on.

In the proximity of Oidanohama, Miyazaki coast shown in photo 2, it was decided to adopt the Beach scarp recession preventive works taking advantage of the experience of the site test on the Sumiyoshi proximity and concept of the Guideline (draft)

#### 【Reference】

- 1) Coast Division HP <http://www.nilim.go.jp/lab/fcg/>

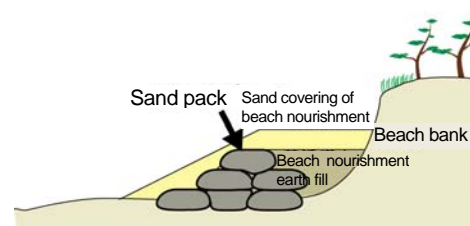


Fig. 1 Cross-section of the Beach scarp recession preventive works



Photo 2 Proximity of Oidanohama that the first Sand pack project is being carried out

## Research Trends and Results

# Estimation of tsunami wave force by damage simulation of a highway bridge

KATAOKA Shojiro (Ph.D.), Senior Researcher

KANEKO Masahiro, Head

Earthquake Disaster Prevention Division, Research Center for Disaster Management

(Key words) Earthquake-tsunami damage simulation, Highway bridge, Tsunami action, Great East Japan Earthquake

### 1. Introduction

Damage to a large number of bridges by the 2011 Tohoku tsunami, especially flow out of superstructures, caused harmful effects on the disaster area. Japanese design specifications for highway bridges were revised on February 2012 and structural planning taking account of tsunami effects was newly prescribed. Design tsunami load, however, was not described although it is required for bridge design when the tsunami effects are inevitable.

As a part of the research project towards formulation of design tsunami load for highway bridges, tsunami wave force acted on Koizumi Ohashi Bridge, of which superstructure and a pier (P3) were washed out, was estimated by a continuous earthquake-tsunami damage simulation<sup>1)</sup> as shown in Figure 1.

### 2. Earthquake –tsunami damage simulation

Since the mainshock motion had not been obtained at the site, aftershock observation was conducted from November 2011 to March 2012. The mainshock motion was estimated using an aftershock record with the site response characteristics and then applied to an earthquake response analysis. Seismic force acted on the bearings was found to exceed their yield strength while no pier was seriously damaged by the seismic action.

Time histories of tsunami height and flow velocity at the site were calculated by tsunami propagation and run-up simulation. Horizontal and vertical forces acted on the superstructure due to the simulated tsunami were analyzed by the numerical wave tank as shown in Figure 2. Finally, the analytical wave forces were applied to a tsunami response analysis assuming the seismic damage

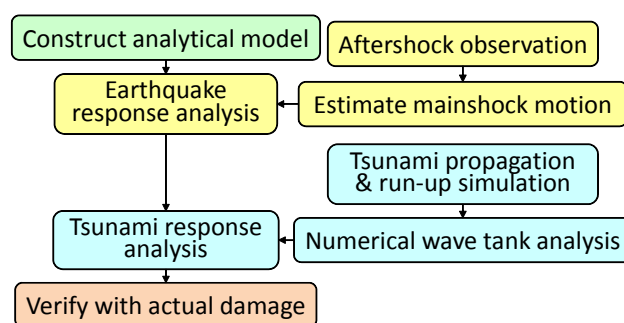


Figure 1 Flow of the earthquake-tsunami damage simulation

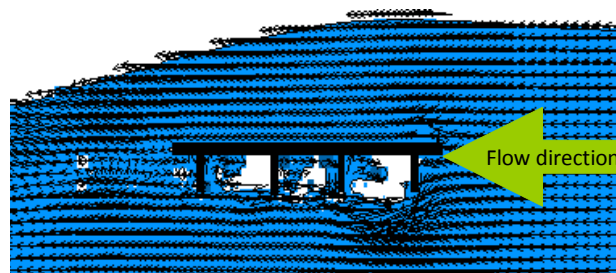


Figure 2 Example of numerical wave tank analysis

remained. The tsunami action was found not only surpass the strength of bearings but shear strength of P3; the result coincides with the actual damage to the bridge.

The peak horizontal wave force acted on the 90.9m-long superstructure was about 6MN, which is smaller than half of the wave force estimated by an existing formula.

### 3. Ongoing and future actions

Further research has been conducted towards reliable formulation of tsunami load for design practice based on the fact experienced during the Tohoku tsunami.

[Sources]

1) Earthquake-tsunami damage simulation of a highway bridge of which superstructure and a pier were washed out, Proc. JSCE A1, Vol. 69, No. 4, 2013(in press).



# A Case of Utilizing Results

## Revision of design earthquake motion for interplate earthquakes

KATAOKA Shojiro (Ph.D.), Senior Researcher

Earthquake Disaster Prevention Division, Research Center for Disaster Management

(Key words) Level 2 earthquake motion, Standard acceleration response spectrum, Zone factor, Acceleration waveform

### 1. Introduction

Japanese design specifications for highway bridges, which is revised in February 2012, require seismic design using two types of Level 2 earthquake motion, i.e. Type I and Type II earthquake motions. Type I represents ground motion from large-scale interplate earthquakes, while Type II from inland shallow earthquakes. Level 2, Type I earthquake motion was revised<sup>1)</sup> taking account of giant earthquakes along Nankai Trough etc. based on recent research achievement.

### 2. Revision of Level 2, Type I earthquake motion

Design earthquake motions for highway bridges are set by multiplying zone factor to standard acceleration response spectra. The standard acceleration response spectra for Level 2, Type I earthquake motion were revised as shown in Figure 1 based on the ground motion in Tokyo area during the 1923 Kanto earthquake estimated by new attenuation relationships developed by NILIM.

Zone factors applied to Level 2, Type I earthquake motions were also revised taking account of giant earthquakes along Japan Trench and Nankai Trough. The zone factor was set to 1.2 in the area where ground motion intensity was estimated larger than that in Tokyo area during the 1923 Kanto earthquake (Figure 2).

Furthermore, acceleration waveforms were produced by spectral fitting using strong motion records from the 2003 off Tokachi and the 2011 off Tohoku earthquakes as original waveforms for seismic design using time history response analyses.

### 3. Ongoing action

Successive research has been conducted towards

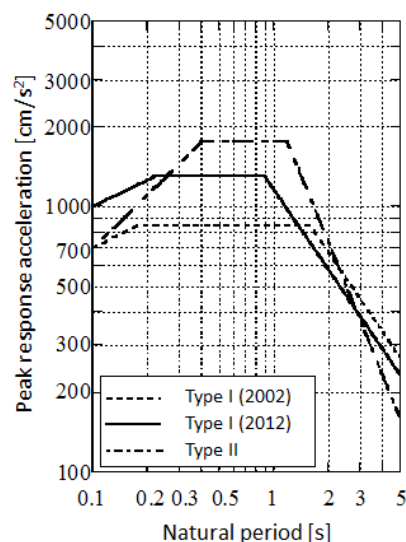


Figure 1 Comparison of standard acceleration response spectra for Level 2 earthquake motion (Soil type II)

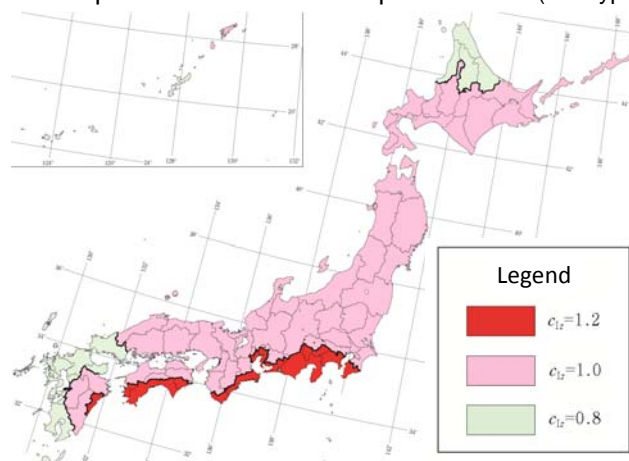


Figure 2 Zone factors (Level 2, Type I earthquake motion)

further improvement of the design earthquake motions following the latest knowledge of giant earthquakes that occur on plate boundaries as well as long active faults.

[Sources]

1) Kataoka, S. (2012), "Revised design earthquake motion and the effects on seismic design of highway bridges," *Proceedings of the 28th U.S.-Japan Bridge Engineering Workshop*, Portland, Oregon, USA.

## Research Trends and Results

# Countermeasures against large-scale earthquake in sewage system based on the damage of Great East Japan Earthquake

YOKOTA Toshihiro, Head

FUKATANI Wataru, Senior researcher

MATSUHASHI Manabu, Researcher

Water Quality Control Department, Wastewater System Division

*(Key words) Sewage system, Countermeasure of earthquake, Countermeasure of tsunami*

### 1. Study committee for earthquake and tsunami countermeasure techniques in sewage systems.

Tsunami and liquefaction in the Great east Japan earthquake had brought critical damages to wastewater treatment plants, pump stations in coastal areas as well as sewer pipes including the inland areas throughout the Tohoku and Kanto regions.

MLIT organized “Study committee for earthquake and tsunami countermeasure techniques in sewage system” consisting of academic experts immediately after the disaster. Then, they submitted four proposals and made a summary of committee as the last report on March 2012. In this report, NILIM investigated the protection of repeated damage and future tsunami-resistant countermeasures in sewage system facilities. In addition, we verified the efficiency of the earthquake-resistant countermeasures adopted after the Niigata-Chuetsu earthquake.

### 2. Checking the liquefaction countermeasure effect in sewer pipes

Earthquake preventive countermeasure guideline in sewage systems describes three backfill methods (such as compaction of the backfilling soil, backfilling by crushed stone, and solidification of the backfilling soil) as the earthquake countermeasures of the sewage pipe. Among those methods we checked the countermeasure effect of the “backfilling by crushed stone” and “solidification of the backfilling soil”. As a result, no traffic trouble of road and no functional disorder of sewer flow were observed in any places that have executed such countermeasures (Photo 1). There found, however, a problem in terms of construction management as the materials or strength of some sewer pipes has not fulfilled the given standard.



(A) (B) (C)

Photo 1. Situation of roads in the disaster area. The road which had not provided earthquake-resistant countermeasure (A). The road which had provided earthquake-resistant countermeasure of backfilling by crushed stone (B). The road which had provided earthquake-resistant countermeasure of solidification of the backfilled soil (C).

### 3. The view of the sewage system design in consideration of tsunami protection measures.

We analyzed the characteristics of damage with the Great east Japan earthquake and made a summary of the view of the sewage system design for tsunami-resistant countermeasures. Assuming the tsunami of the worst-case scenario defined by the prefecture and city government, we summarized the functions to be maintained on a priority basis on the tsunami hit by three sections such as sewer pipes, pump stations and wastewater treatment plants as shown in Table 1. We determined that the pumping for sewer evacuation and the sterilization must be maintained even in the time of disaster. Functions to recover overall function were divided into “Recover swiftly” and “Recover earlier” based on the concept of the risk management.

# Research Trends and Results

Table 1. Functions to be maintained at the time of tsunami

Type of facility	Sewer system	Pump station	Wastewater treatment plant		
Functional category	Essential functions		Other functions		
	Backflow prevention	Pumping	Pumping Sterilization	Sedimentation Dewatering	Other than shown on left
Tsunami resistance	"Must be maintained" even in a disaster situation		Although functional suspension is accepted temporary, it "should be recovered swiftly"	Although temporary suspension is acceptable, it "should be recovered earlier"	
Type of protection	Risk avoidance		Risk reduction	Risk retention	

#### 4. Practical use of this research and future development

This study was summarized as four proposals as well as the last report proposed by Study committee for earthquake and tsunami countermeasure techniques in sewage systems, and effectively-utilized to recover sewage system facilities in damaged areas. Moreover, this study will benefit the revision of the Earthquake preventive countermeasure guideline in sewage system and the manual of earthquake-resistant countermeasure in sewage systems.

#### 【Reference】

1) Report of Study committee for earthquake and tsunami countermeasure techniques in sewage systems

[http://www.mlit.go.jp/mizukokudo/sewage/crd\\_sewage tk 000170-1.html](http://www.mlit.go.jp/mizukokudo/sewage/crd_sewage tk 000170-1.html)

# A guide to the discharge and treatment of wastewater during a disaster

HARADA Ichiro, Head

YAMASHITA Hiromasa, Senior researcher

HAMADA Tomoyuki, Researcher

Wastewater and Sludge Management Division, Water Quality Control Department

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*(Key words) Wastewater discharge, Treatment function, Emergency measures, Staged emergency restoration works*

### 1. Introduction

The Great East Japan Earthquake of March 11, 2011 damaged sewerage treatment plants at 120 locations, and the tsunami inflicted disastrous damage so severe it caused the failure of all functions at many sewerage treatment plants and pumping stations along the coastlines of the stricken prefectures. Basic concepts for emergency measures and staged emergency restoration concerning sewerage system functions which must be ensured during a disaster have been presented in the Report by the Sewerage Treatment System Earthquake / Tsunami Countermeasure Technology Study Committee established in response to the Great East Japan Earthquake (hereafter “Committee report), and local governments where the earthquake caused damage have been carrying out staged emergency restoration based on this report.

On the other hand, more large earthquakes are predicted, so there is a growing need to prepare for disasters that will cause the loss of sewerage discharge and treatment functions.

### 2. Investigation on damaged local governments

MLIT and NILIM are taking advantage of knowledge gained responding to the Great East Japan Earthquake by surveying the impacts on treatment functions of sewerage treatment plants and on the waters receiving discharged treated wastewater, at the emergency restoration stage and are studying methods of appropriately managing sewerage during disasters, in order to clarify concrete measures to ensure sewerage system functions during disasters. And they have also surveyed and analyzed cases of emergency measures and emergency restoration of sewerage systems operated by local governments in the disaster region.

### 3. Publication of “A Guide to the Discharge and Treatment of Wastewater during a Disaster (Draft)”.

Based on knowledge gained from the results of these studies, and considering the results of investigations by the Committee to Study Appropriate Management of Sewerage Treatment at the Restoration Stage following a Disaster, we have prepared “A Guide to the Discharge and Treatment of Wastewater during a Disaster (Draft)” and announced it. This guide is to show the idea of securing the wastewater discharge and treatment function required at the time of disaster by the “Emergency measures” pursuant to the site situation and improving those functions through gradual “Staged emergency restoration works.”

“Emergency measures” are to grasp overall damage status of the facilities immediately after the disaster and summarize those items which is restricting the implementation of emergency measures and then swiftly discharge the wastewater from living space of disaster stricken people so as to prevent waterborne disease from prevailing. This Guide explains the key points of the Committee report such as necessary investigations, actions and publicity activities at the time of disaster. In addition, this guide explains cases of measures under this disaster.

“Staged emergency restoration works” are to select and implement temporary treatment to keep sanitary environment in the city and conserve the water quality in receiving water body in the course of proceeding on the full recovery of the treatment function when it is expected to take time until completing the full recovery. Based on the Committee report, we have summarized countermeasure method and effect from the case of the “Staged emergency restoration works” in this disaster in this guide.

## Research Trends and Results

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In addition, this guide explains the concept on the design and maintenance of each treatment method and disinfection method.

We anticipate that this guide will be applied to prepare sewage works by administrator for future disasters and to respond to disasters.



Photo Example of emergency restoration works (Temporary sedimentation tank constructed by rough digging)

## Arrangement and assessment towards earthquake observation and earthquake motion of architectural structure

AZUHATA Tatsuya (Dr. (Science)), Head  
 ARAI Hiroshi (Dr. (Engineering)), Senior Researcher  
 Building Department Structural Standards Division

INOUE Namihiko, Senior Researcher  
 IWATA Yoshihiro (Dr. (Engineering)), Senior Researcher  
 Standards and Accreditation System Division

(Keywords) Earthquake observation, Earthquake motion assessment, dynamic interaction, seismic design

### 1. Introduction

To ensure safety of architectural structure for a great ocean trench earthquake, it is important to assess earthquake motion that impinges on architectural structure. Therefore, as part of MILIT general technology development, earthquake observation has been done for earthquake motion assessment regarding various architectural structure from low rise to super high rise. Arrangement of record / analysis result of 5-story box frame type reinforced concrete construction is indicated here as an example.

### 2. An example of arrangement of record and analysis result

Figure 1 is an outline of installation of seismograph. In this research, the seismograph is installed outside of architectural structure to demonstrate the relationship between 『earthquake motion』 of the ground level and 『earthquake load』 that impinges on architectural structure.

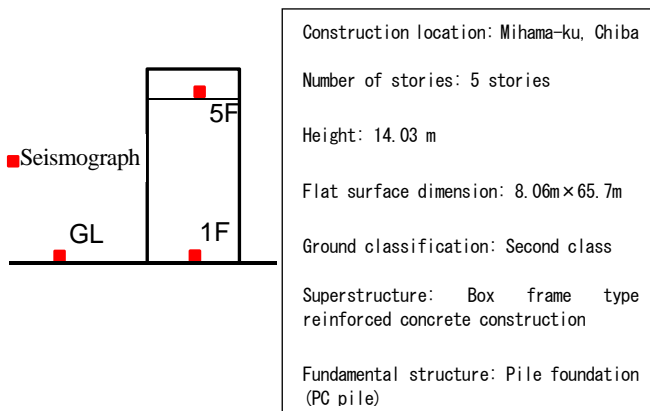


Figure 1 Outline of target architectural

Figure 2 is a Fourier spectrum ratio from earthquake record of The 2011 off the Pacific coast of Tohoku Earthquake

(main shock), and Figure 3 a comparison of maximum acceleration observed at first floor and 5th floor during main shock and aftershock. The following will be understood by Figure 1 and 2.

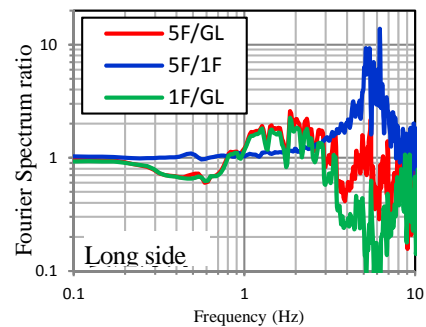


Figure 2 fourier spectrum ratio (The 2011 off the Pacific

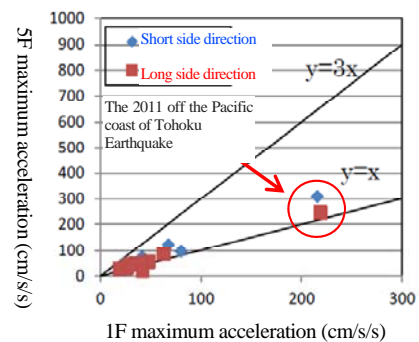


Figure 3 Maximum acceleration at the 1st floor and 5th floor (main shock and aftershock)

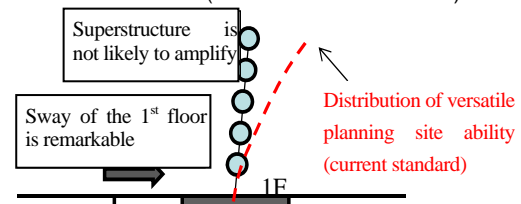


Figure 4 Assumed behavior during earthquake from the record and Earthquake assessment



# Research Trends and Results

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(1) Fourier spectrum ratio 5F/GL (red) and 1F/GL (green) are almost conformable with neighborhood of predominant frequency (approx. 2Hz) (Figure 2).

(2) Maximum acceleration of the 1st floor and 5th floor is also almost conformable (Figure 3).

(3) From (1) and (2), this architectural structure is assumed that it presented the behavior as it's indicated in Figure 4, and earthquake load in superstructure, it is thought that it is less likely to amplify than assessing on the assumption that it is foundation fixing.

### 3. Conclusion

Today, earthquake record of architectural structure has been arranged and assessed by type of ground, story and structure. It helps streamlining of earthquake resistant design of structure by being able to accurately assess the relationship between earthquake motion on the ground and earthquake load that impinges on architectural structure.

## Research Trends and Results

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# Full-scale fire experiment of three-story wooden school building (preparatory experiment)

NARUSE Tomohiro(Ph.D., Engineering), Head

NII Daisaku(Ph.D., Engineering), Senior Researcher

Fire Standards Division, Building Department

FUKAI Atsuo, Head

YOKOTA Yoshihiro, Researcher

Standards and Accreditation System Division

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(keywords) *three-story wooden school building, full-scale fire experiment, fire safety*

### 1. Introduction

The act concerning promotion of wood utilization in public buildings, etc. was enforced in October, 2010. Therefore, NILIM started to prepare a basic draft by collecting necessary data to review provisions related to fire protection of Building Standards Law regarding three-story wooden schools.

### 2. Purpose of preparatory experiment

Full-scale fire experiment of three-story wooden school building (preliminary experiment) was conducted in the premises of NILIM on February 22, 2012 and as a result, the following issues emerged.

- Early spread of fire to upper floors from the room on the first floor where a fire occurred through the external openings (about four minutes after setting fire to the second floor and about six minutes after setting fire to the third floor)
- Early spread of fire through fire walls (about 18 minutes after setting fire on the first floor)
- Fire walls collapsed without freestanding (96 minutes after setting fire)

In order to address these issues,

- to make interiors of the building except pillars, beams and floors resistant to fire,
- to place balconies and eaves to upper part of openings of outer wall and
- to separate fire walls structurally and change fire-proof doors and so forth

were worked out as countermeasures.

And it was intended to confirm their effectiveness and to gather data for evaluation of fire spread routes, impacts on surroundings of the building and impacts on main construction frames of the test body in case of long continuing fire, etc. and accordingly full-scale fire experiment (preparatory experiment) was conducted in Gero City, Gifu Prefecture on November 25, 2012. The constructed test building was a quasi-fire resistive construction for one hour duration with the building area of about 310m<sup>2</sup> and the total area of about 850m<sup>2</sup>.

### 3. Outline of the result of preparatory experiment

In the fire starting room, the fire source grew to limited part and did not spread in the whole room and as a result, combustibles stored in the fire starting room were reignited 50 minutes after setting fire. After that, the fire source gradually grew and the fire spread to the whole room about 89 minutes after setting fire and flames spouted from external openings.

The spread of fire from the fire starting floor (the first floor) to the second floor occurred about 129 minutes after setting fire through the floor of the second floor and the spread of fire to the third floor occurred about 139 minutes after setting fire through external openings. After confirmation of the spread of fire to the third floor, fire extinguishing started at the moment 142 minutes after setting fire.

The results indicate the following: firstly, the spread of fire from the fire starting room to staircase and the spread of fire through fire walls did not occur because early

# Research Trends and Results

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spread of fire to upper floors through external openings was prevented, and secondly, although pillars of the fire starting room carbonized 5~6 cm in-depth from the surface after completion of the experiment, both of the test body and fire walls did not collapse. Thereby, effects of the countermeasures against the issues of the preparatory experiment were confirmed and various data were gathered.

## 4. Conclusion

Based on the preliminary experiment and this preparatory experiment, after adjusting specifications and test methods, it is scheduled to conduct again full-scale fire experiment with building configuration which is supposed to be standardized and to prepare a basic draft in 2013.

[ Reference ]

As for the results of preliminary experiment and preparatory experiment and outline of video image, refer to the following URL.

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



Photo: The spread of fire to the second floor at the time of 137 minutes after setting fire

# A Case of Utilizing Results

## Technical datum original plan concerned ceiling fall and escalator fall

Building Department, Standards and Accreditation System Division

FUKAI Atsuo, Head

IWATA Yoshihiro, Senior Researcher

Environment and Equipment Standards Division

KUBOTA Yuji, Senior Researcher

Research Center for Land and Construction Management Evaluation System Division

WAKIYAMA Yoshio (Doctor, Engineering), Senior Researcher

(Key word) Building datum for ceiling and escalator

### 1. Damages in The Great East Japan Earthquake

In The Great East Japan Earthquake, the ceiling fell out in many buildings, such as a gymnasium and a music hall, and damage arose on a scale of there being nothing once. Moreover, two or more damage in which the escalators that are installed in the shopping center fell occurred. About these measures, it is not clearly shown as a technical standard based on the Building Standard Law now.

Based on the Technical Original Plan concerning the anti-ceiling falling off measure and Technical Datum Original Plan concerning anti-escalator fall measure, National Institute for Land and Infrastructure Management prepared the Technical Datum Original Plan. That was published as a public comment 1) and 2) from July 31, 2012.



Photo: An example of the ceiling falling off damage in a gymnasium

### 2. Technical Datum Original Plan

(1) Technical Datum Original Plan concerning an anti-ceiling falling off measure

Making a suspended ceiling for the target, we set a ceiling of larger than 200m<sup>2</sup> located at higher than 6m. We presented the datum that consists of the specifications' datum that setting concrete specifications, datum according to a calculation by spectrum method, and case that performed high structure calculation along with a structural skeleton.

(2) Anti-escalator fall measure

In order to establish enough "bearing width" we presented datum that require the "Bearing width" must more than 1/40 of hoisting height (lift)

### 3. Future plan

Proceeding an opinion recruiting until September 15, the Building Structure Datum Committee (Chairperson - Tetsuo Kubo, Honorary professor in Tokyo University) which established in National Institute for Land and Infrastructure Management is going to deliberate because of the submitted opinion.

In future, we will establish a Technical Datum based on Building Standard Act on the basis of the technical datum original plan that contains information gathered after going over the required legal process.

	Current state	Example by Technical Datum Original Plan
Junction hardware such as a clip, a hanger	Hook type that has risk of slip or come off at earthquake.	Junction by screws, etc.
Placement of hang bolts, braces	Various by design	Tightly arrange Hang bolt / m <sup>2</sup> ~2 Reinforced brace 1 pair / 15 m <sup>2</sup>
Earthquake force for design(Horizontal direction)	1G approx. in reality	Maximum 2.2G

Figure: Comparison of Technical Datum Original Plan and current state concerning anti-ceiling falling off measure

### Reference

- 1) Opinion recruiting about "Tentative plan of anti-ceiling falling off measure in a building"
- 2) Opinion recruiting about ""Tentative plan of anti--prevention of falls measure of an escalator"  
[http://www.nilim.go.jp/lab/bcg/kisya/journal/kisya20120731\\_1.pdf](http://www.nilim.go.jp/lab/bcg/kisya/journal/kisya20120731_1.pdf)

## Research Trends and Results

# Consideration regarding seismic performance of panel structure by Cross Laminated Timber

Tsuchimoto Takahiro (Dr. agriculture), Head

Evaluation System Division, Research Center for Land and Construction Management

*(Keywords) Wooden building, Public architecture, Cedar, Domestic timber, Region*

### 1. Introduction

As a general rule, it is constructed by wooden construction regarding low rise architectural structure due to the Act for Promotion of Use of Wood in Public Buildings. However structure method of large scale wooden architectural structure is needed to be generalized to make public building wooden. As a structure method to do large scale wooden architectural structure possible, there is a box-frame construction using panel of Cross-Laminated-Timber (Cross-Laminated-Timber : CLT), and it is required to be generalized from home and abroad. CLT construction method uses thick panel of lamina that is orthogonalized and done lamination glueing (Picture 1). The structure method comes from Europe. Therefore the consideration regarding earthquake protection securement has just begun.

This experiment is implemented as a first step for a final purpose that is a formulation of earthquake-resistant design measure of the CLT structure method.



Picture 1 Cross Laminated Timber (CLT) Panel

### 2. Specimen and experimental method

CLT panel that is originated and produced in Europe, it is possible to produce width about up to 3 m and length about up to 20 m, and its aperture is normally formed by cutting from rectangle panel. But this time, 1 m wide panel was used as wall panel, cross member panel and floor panel, and a structure method that constructs the building frame by jointing each panel with bolts was adopted. The specimen

(picture 2 4 m×8 m×9.5 m) was assumed as a 5 story building and put weights on the top of structure of the third story, and the weights were about 400 kN that correspond to fixed load of 2 story. In response to that, using large scale earthquake resistant experiment facility of National Research Institute for Earth Science and Disaster Prevention, artificial seismic wave that corresponds to earthquake that rarely and / or very rarely occurs which is required by the Building Standards Act and observed wave from the South-Hyogo Earthquake in 1995 (JMA Kobe) were entered in long axis direction.



Picture 2 Appearance of specimen

### 3. Experimental result

As a result of the shaking test, the maximum interlaminar deformation was developed at the second story (picture 1), but for the artificial seismic wave that corresponds to earthquake that very rarely occurs which is required by acts related to the Building Standards Act, it was about 1/166 rad, and for the JMA Kobe, it was about 1/61 rad, and the both went no further than that. It is corresponded to quite small deformation than the result of numerical analysis that was done previously based on the result of shear test of joint part 1) and horizontal shear test of plane frame elements 2).



# Research Trends and Results

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Because there was no big damage observed for both of them, and damage boundary of CLT panel structure of this structure method was taken as damage boundary deformation of wooden building 1/120 rad, and it indicated a good possibility.

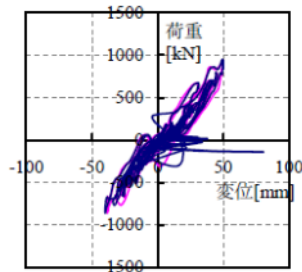


Chart1 Load deformation relationship

The details of the experimental result should be referred to literature 3). This research was implemented as part of a collaborative research by three that were NILIM, NIED (National Research Institute for Earth Science and Disaster Prevention) and Nihon System Sekkei, Inc.

(Sources)

1) SUZUKI Kei, GOTO Takahiro and other: Strength test of CLT Joint, WOOD STRUCTURE PROM INC. , Unpublished information.

2)TSUCHIMOTO Takahiro, TSUDA Chihiro and other 4 people: The 62nd The Japan Wood Research Society Research Publication Synopsis, CD, 2012

3)TSUCHIMOTO Takahiro, KAWAI Naoto, YASUMURA Motoi and other: The Architectural Institute of Japan Academic Lecture Synopsis, C-1, 305-326, 2012.

# The design examples of wooden building to be constructed in the region where tsunami attack may occur

TSUCHIMOTO, Takahiro (DAg): Head

Evaluation System Division, Research Center for Land and Construction Management

(Keywords): depth of water coefficient, tsunami refuge building, inundation height, wave pressure distribution, tsunami prevention regional construction, displacement, buoyancy, topple down

## 1. Background of deliberation

Great many wooden buildings suffered damage by the tsunami triggered by the 2011 Great East Japan Earthquakes. The results of comparison made with its actual damage situation<sup>(1)</sup> and external force and proof stress of wooden buildings which were worked out from the tsunami refuge building guideline does not agree each other<sup>(2)</sup>. So an appropriate depth of water coefficient meeting the damage situation was calculated which suggested the possibility to set in between 1.0 and 1.5<sup>(3)</sup>.

On the other hand, in the regions where they have suffered devastating damages by the tsunami, majorities are drawing up their reconstruction plan to move houses to the high ground, but there still is a large number of people who would prefer to live in a place where they can view the seashore. Meanwhile, for the regions where they are likely to be hit by the tsunami triggered by the predicted Tokai-Tonankai earthquake, the proactive program would become necessary.

And so, the deliberation of drawing design methods regarding the wooden buildings and wooden tsunami refuge buildings to be constructed within the regions of possible tsunami attack.

## 2. Calculation of the external force

Wave pressure and wave power of tsunami was calculated based on the wave pressure distribution which is the product of depth of water coefficient and hydrostatic pressure set in the tsunami refuge building guideline<sup>(4)</sup>. For the depth of water coefficient, figure 1.5 was used which was drawn from the Notification of the Ministry of Land, Infrastructure, Transport and Tourism 2011, No. 1318, based on the Act regarding tsunami prevention regional construction, in which it is applied to the locations where reduction of wave pressure blocked by other facilities is expected and at the same time more than 500 meters away from the seashore and rivers.

Openings of the building are presumed be damaged, and buoyancy resulting from dead air space between the

ceiling height of the floor lower than inundation height and inundation height whichever is lower and the bottom end of the partition wall was also considered. The fixed load of the building is reduced by specific gravity of water and the movable load was not included in the weight of the building because they would be washed away. Other issues like consideration of pressure-resistant materials and floating wreckage, were made in accordance with the tsunami refuge building guideline<sup>(5)</sup>.

## 3. Verification of wooden building proof stress

With regard to the horizontal load which affects to the parts of the wooden building, shear proof stress of the building frame, tension proof stress of joint parts and shear proof stress of anchor bolts were verified.

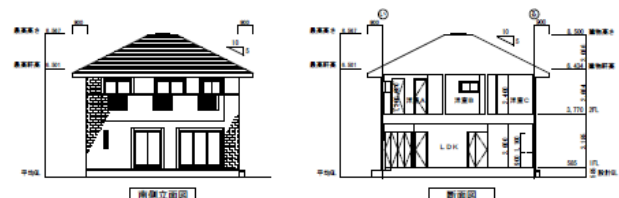
The ultimate shear proof stress of the wooden building was calculated using the figure 1.5 times of allowable proof stress.

Also toppling down and sliding of the whole building against horizontal load were verified. Furthermore, tension proof stress of joint parts and anchor bolts against buoyancy were verified. See document (5) for more detail.

## 4. Design examples

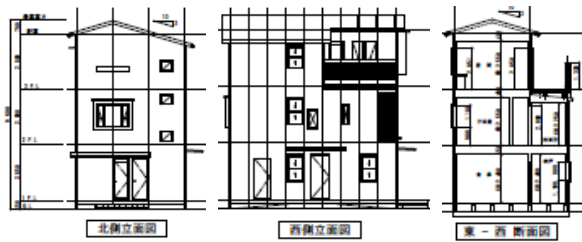
Followings illustrate the outlines of design examples.

4.1 Two-story wooden house (inundation height: 2 meters, depth of water coefficient: 1.5)

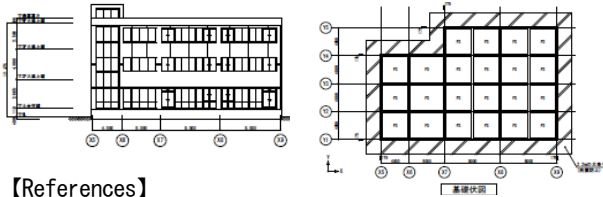


4.2 Two-story wooden house (inundation height: 3 meters, depth of water coefficient: 1.5)

## Research Trends and Results



4.3 Wooden tsunami refuge building (inundation height: 4 meters, depth of water coefficient: 1.5, refuge floor: roof terrace (4<sup>th</sup> floor))



### 【References】

- (1) National Institute for Land and Infrastructure Management document No. 636, Building Department document No. 132, The 2011 earthquake off the Pacific coast of Tōhoku, (flash) (the Great East Japan Earthquake)  
<http://www.nilim.go.jp/lab/bcg/siryoutnn/tnn0636.htm> ,  
<http://www.kenken.go.jp/japanese/contents/topics/20110311/0311quickreport.html>, 2011.
- (2) TSUCHIMOTO Takahiro, NAKAGAWA Takafumi, ARAKI Yasuhiro, TSUDA Chihiro: "Damage to Wood Buildings during The Great Tohoku Earthquake Part 3- Damage due to tsunami", 11<sup>th</sup> Proceedings of World Conference on Timber Engineering, 2012.
- (3) TSUCHIMOTO Takahiro, NAKAGAWA Takafumi, ARAKI Yasuhiro, KAWAI Naoto: "Damage Due to Tsunami and Tsunami Resistance Performance of Wood Houses during The Great Tohoku Earthquake", Proceedings of 15<sup>th</sup> World Conference on Earthquake Engineering, 2012
- (4) Cabinet Office: The guideline regarding tsunami refuge building  
[http://www.bousai.go.jp/oshirase/h17/tsunami\\_hinan.html](http://www.bousai.go.jp/oshirase/h17/tsunami_hinan.html), 2005.6
- (5) The Japan Building Disaster Association: Commentaries regarding the structural requirements for the tsunami refuge building, 2012  
[http://www.kenchiku-bosai.or.jp/seismic/tsunami\\_text.html](http://www.kenchiku-bosai.or.jp/seismic/tsunami_text.html)

## Research Trends and Results

# NILIM Supports Local Governments on Anti Liquefaction of Housing Areas for Recovery from the Great East Japan Earthquake Disaster

AKASHI Tatsuo (Ph.D.), Head

OHASHI Masamiki, Senior Researcher

Urban Planning Division, Urban Planning Department

ARAI Hiroshi (Ph.D.), Senior Researcher

Structural Standards Division, Building Department

(Key words) Land Liquefaction, Disaster Prevention on Housing Area, Great East Japan Earthquake

### 1. Anti-liquefaction Method implementable to Housing Areas

The Great East Japan Earthquake caused not only tsunami disaster but also caused very extensive land liquefaction including in housing areas. Method of anti-liquefaction which should be implemented to areas with roads and houses has been a big problem on the process of recovery because there are very seldom precedent cases other than in plain ground with no building. Another big problem is construction costs which should be affordable for ordinary house owners. Established methodology has yet to be conceived.

In order to support the local government as well as residents in the struck areas, the City Bureau of MLIT introduced new financial subsidy to the local governments in order to implement district wide treatment with both roads and housing lots integrally, which will be expected to reduce allotted payment for housing owners indirectly. Then, NILIM has taken charge of technical support to the local governments mainly for adequate selection of unprecedented method. One example will now be introduced.

### 2. Development of the Simple Calculation Software for Lowering Groundwater Levels Method

Firstly, we focused on Lowering Groundwater Levels Method. An advantage of this method is that construction is needed only within the area of roads but its effect will reach into the surrounding housing lots. Running cost can be reduced if the depth of groundwater lowered is less than 3 meters from the surface. However, there are a negative sub effect of potential land subsidence which caused by compaction of deeper clay layers. These positive and negative effects can be estimated but only through complicated formula. It was a kind of a bottleneck of investigation making consensus building and decision making difficult.

In order to break the bottleneck, a simple software tool based on Microsoft Excel sheets was urgently developed. As figure shows, what depth zone has liquefaction risk by FL value graph as well as easily calculate potential ground sinkage both by liquefaction and clay layer

compaction can easily be seen. The output is frequently updated according to the input on scale of earthquakes and groundwater levels.

NILIM offered the calculation software for free through its homepage, which has been contributed to local decision making in the struck areas.

### 3. Development of Second Software for Grillwork Underground Walls Method

Next, NILIM developed second simple calculation software on Grillwork Underground Walls Method which is an alternative for the ground where unsuited for downing groundwater level. It also use Excel sheets, but its output is calculated by high speed computer in advance with approximately 18,000 ways of equivalent linearization analysis, which is hard to do for local governments by themselves. This is also able to download free from NILIM homepage.

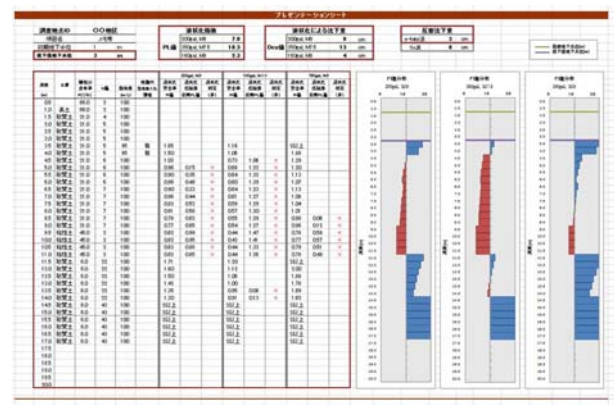


Figure: Image of Calculation Software for Anti Liquefaction Effect (NILIM Liquefaction Sheets)

[Sources]

1) NILIM homepage

<http://www.nilim.go.jp/lab/jbg/takuti/takuti.html>

## Research Trends and Results

# Undertaking the housing recovery and reconstruction by local builders in the Great East Japan Earthquake

SUMIKURA Hideaki, Researcher (Ph. D., Engineering)

Housing Department, Housing Production Division

MORI Masashi, Head

Housing Planning Division

(Key words) The Great East Japan Earthquake, Local builder, Housing, Repair, Reconstruction

### 1. Introduction

By The Great East Japan Earthquake occurred on March 11, 2011, Tohoku region has suffered from significant damage brought by the earthquake and further by the Tsunami in the maritime areas. MILIM has been, remarking the housing recovery and reconstruction undertaken afterward by local builders located in damaged areas, continuously implementing the actual investigation in damaged areas from immediately after the disaster so as to study actual state of the housing production system that contributes to raise up the local potential for recovery at the time of emergency such as disaster. This report is to introduce such reaction for the repair and renovation of housing implemented by local builders and the like immediately after the disaster.

### 2. Reaction of local builders immediately after the disaster

The Great East Japan Earthquake has broken full or half of approximately two hundred thousands housings at the time of December 2011 (including those housings flown out by the Tsunami). The I corporation, having its main office in Morioka, Iwate prefecture, has stopped the construction work immediately after the disaster but started actions to the extent it could do although complaining the gasoline shortage as it has received requirements for repair from the day after the telephone was recovered. The S corporation in Rikuzentakada has sent out its staff earlier to visit the clients homes when the road became available that has been broken around five days by the wreckage brought by the Tsunami, in order to check damaged situation of the housing and acknowledge emergency action as well as requirements for the reconstruction and repair of the housing. The H and other corporations in the same city have taken away the wreckage using their own heavy equipment for construction. Thus, we have found that local builders have started actions for the recovery and reconstruction immediately after the disaster although they themselves have been damaged.

### 3. Repair and renovation of damaged housing by local builders

The above-mentioned S corporation has, to those housings that become available by the repair or renovation, acknowledged the state of the damage and confirmed the owner's intent to live there, then executed the repair or renovation work soon after the disaster. Shown in the figure is that process. There were a lot of shortage in the material and parts to use

for the housing work, such as plyboard for framework, heat insulation material, roof tile and so on as the material factories have been damaged. By that reason, full-scale construction work has just started at the beginning of the April 2011. Another reason was that damaged people could just draw the scenario of the budget encouraged by the public donation also around that period.

### 4. Movement and current situation for the reconstruction of the housing

Coming from now is the areal full-scale recovery stage realized by reconstruction of the housing and so on. As the target of using the productive potentiality of local builders in that period, approximately 360 groups of areal recovery housing builders were organized in Iwate, Miyagi and Fukushima prefectures. At the time of this report (February 2013), there found a few cases of housing reconstruction realized by such a group due to the delay in housing land development except that partial cases are seen undertaken by major housing makers. On the other hand, as examples of model house construction by the same group have appeared one by one, with the progress of the high land development, the group in question is expected to become a powerful resource to undertake the housing reconstruction in damaged area.

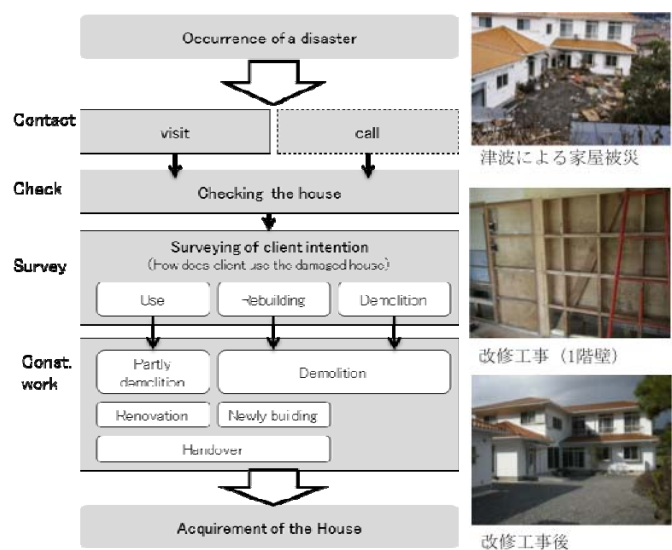


Figure Flow of the repair/renovation of damaged housings



# Research Trends and Results

## Post Great East Japan Earthquake activities by the construction industry

Research Center for Land and Construction Management  
KOHASHI Hidetoshi, Research coordinator construction management

Construction System Division  
WATANABE Kenichi, Construction management technology chief official  
YOKOI Hiroyuki, Guest research engineer

(Keywords) Great East Japan Earthquake, Disaster response, Disaster response management

### 1. Forwards

Right after the outbreak of The Great East Japan Earthquake, we saw various activities carried out by the construction industry such as recovery of social capitals, victims support etc. This report aims to record widely on those activities by the construction industry and (some of) its member companies to identify the role of the construction industry during a disaster outbreak.

This report consists of questionnaires concerning preparedness during normal time, status of support activities, as well as their self-evaluations, and responses were received from the construction industry groups (32) and its member companies (8 groups/137 companies).

### 2. Overview on the study result

27 groups in the construction industry have already concluded in total 93 disaster agreements with the administrative organs, which conducted support activities after the earthquake by 58 agreements upon requests, and by 18 agreements on their own decision without any request. 17 groups that concluded the disaster agreements evaluated that the agreements were useful in their quick responses to the activities, hence we believe the role played by the disaster agreements were quite substantial.

Amongst the contents of activities conducted by the construction industry (fig.), the highest number was that of checking the social capitals, as well we there were many cases of provision/ transport of construction equipment or provision of equipment/works for temporary housings. Also, there were supports provided

on other areas than construction which is not stipulated in the disaster agreements, such as provision and transport of medical supplies, foods, fuels etc., These supports were not limited to construction but included medical treatment and rescuing the lives of victims. Thus, as well as supports activities using the technical expertise of the construction industry, materials and goods were procured and provided to the disaster areas using the wide organization network of the construction industry.

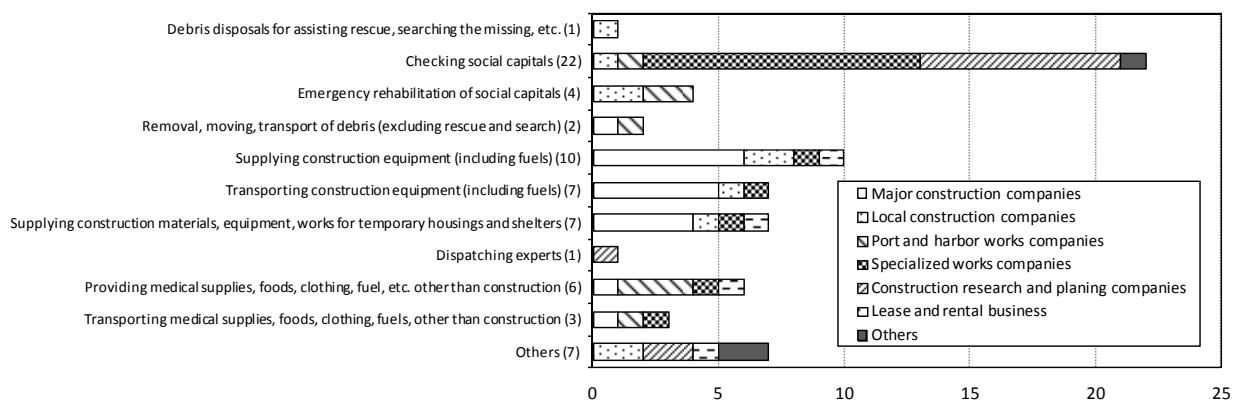
On the other hand, there were issues observed such as prolonged time in securing and transporting the equipment and fuels for such activities, which raised the need for coordination with lease & rental, fuel and transport industries.

### 3. Conclusion

The result of this survey will be published in “Post Great East Japan Earthquake Disaster response management (by Disaster Response Management Special Theme Committee in Japan Society of Civil Engineers)” and will be summarized as research material by the National Institute for Land and Infrastructure Management.

### 【Reference】

- 1) The Great East Japan Earthquake disaster response management (Japan Society of Civil Engineers) <http://committees.jsce.or.jp/2011quake/node/143>



Graph Support by the construction industry

No. of support activities

# Research Trends and Results

## Role of Regional Construction Contractors in The Great East Japan Earthquake

OHASHI Sachiko, Senior researcher  
 TAKEYA Shuichi, Head (Dr.Eng.)  
 Research Center for Land and Construction Management  
 Construction Economics Division

(Keywords) Great East Japan Earthquake, Regional construction contractors, Disaster response management

### 1. Forward

Right after the outbreak of Great East Japan Earthquake, regional construction contractors started support activities for recovery of the infrastructure functions, which lead to large-scale rescue/relief efforts to disaster stricken areas. With this in mind, National Institute for Land and Infrastructure Management, Tohoku Regional Bureau and Tohoku Construction Association Federation, with the cooperation of Tohoku Univ. conducted a survey on activities by the regional construction contractors, and recorded and documented its role, to serve as an information for future disaster management.

### 2. Contents of this survey

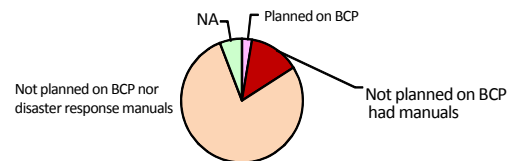
The survey was conducted in the form of questionnaires to 1,730 member companies in Tohoku Construction Association Federation on the activities between Mar.11 to 18. The questionnaire was distributed from Sep.to Oct. 2011, and 806 companies responded.

The contents of the survey are shown in Table 1. The survey was conducted principally on the support activities for the recovery of the infrastructure functions, including rescue and relief activities. Here, we are presenting part of the results on the effects and issues of business continuity plan (BCP) and disaster prevention drills.

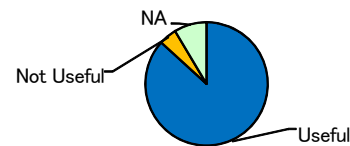
As for BCP and disaster response manual, 20% of the companies have laid out their plans before the Great Earthquake, of which 90% responded there were useful items (Graph 2) . As for its contents, many cited “plans concerning organization framework and chain of command”, are found to be effective. As a future improvement, it would be effective to make an assumption when telephone line is dead.

Table 1 Survey contents

Contents	Questions
Attribute	Basic info of the company, whether affected and if so, its level
Activity contents	Start to completion of activities and their details
	How to secure human resource, construction equipment, communication methods, fuel, goods for activities
	Reminders, difficulties faced and factors for breakthrough to enable swift activities,
Preparedness	Relationship between disaster agreements and support activities, planning on BCP/disaster response manual, conducting disaster prevention drills.



Graph1 Planning of BCP/disaster response manual



Graph2 Effect of BCP/disaster response manual

Slightly less than 20% conducted any disaster prevention drill one year prior to the Great Earthquake, of which more than 90% responded that it was useful in some way.

Also, another consideration is that joint drill with the administrative organization or other company will have different effect and both should be conducted in the future.

### 3. Conclusion

Other than what's been presented here, analysis is conducted on quick initial response, decision-making procedures on the support activities and disaster agreements, etc. results of which is due to be published. Also, National Institute for Land and Infrastructure Management has in the past surveyed the regional construction contractor's activities after The Iwate-Miyagi Nairiku Earthquake in 2008 and The Niigataken Chuetsu-oki Earthquake in 2007, results of which are to be analyzed.

#### 【Reference】

- 1) Ohashi, Takeya, Mori : The 30<sup>th</sup> research presentation and discussion on construction management issues/ Effect of BCP, disaster response manual by regional construction industry in Great East Japan Earthquake, Dec.2012.
- 2) Ohashi, Takeya, Mori : Effect of disaster prevention drill by regional construction industry in Great East Japan Earthquake, ditto

## Reports on Damage to Buildings, etc. brought about by the Tornado which hit Tsukuba, Ibaraki on May 6, 2012

OKUDA Yasuo, Research Coordinator for Disaster Mitigation of Buildings (Dr., Engineering)  
Research Center for Disaster Management

FUKAI Atsuo, Head

KABEYASAWA Toshikazu, Researcher(Dr., Engineering)  
Building Department, Standards and Accreditation System Division

TSUCHIMOTO Takahiro, Head ( Dr., Engineering)  
Research Center for Land and Construction Management, Evaluation System Division

(Key words) Tornado, F3, Ranking of Wind Damage, Falling

### 1. Introduction

Damage to buildings and other facilities cause by the tornado that occurred in Joso city of Ibaraki prefecture at around 12:35 on 6th May 2012, were brought about mainly in such area as Hojo, Osuna and North industrial Park in Tsukuba city of Ibaraki prefecture. According to the Metrological Agency, a gust of wind was caused by the tornado, and its damage ranged approximately 17km long and 500 meters wide spreading from Joso city to Tsukuba city at the estimated Fujita scale 3 judging from the damage.

NILIM and Building Research Institute(BRI) surveyed immediately after the occurrence of the tornado in order to grasp the damage to the buildings, etc. in Tsukuba city and made an on-spot summary report.<sup>1),2)</sup>

### 2. Damage Report

The Tsukuba city office has reported the damage, 1casualty, 37 injured, 210 totally collapsed buildings, 47 mostly collapsed, 197 half collapsed and 639 were partially damaged. Both NILIM and BRI have classified those buildings as damaged by the gusty wind focusing on the Hojo area of Tsukuba city and made the Damage Distribution map Fig. (1).

Among the buildings made of wood, there were various degrees of damage such as completely overturned buildings, removed superstructures, collapse, inclination, blown roof framework, blown roofing materials, broken windows and aluminum sash. Particularly the case of whole wooden houses ripped from their foundation and overturned (Photo-1) was unprecedented in our country. The mechanism that caused the damage was studied and the wind velocity at the outset of the damage was estimated.

Although there were no reports on direct damage to building complexes made of reinforced concrete hit by the tornado, damage to balcony rails, windows and sash was caused by the objects brought by the tornado (Photo-2).



Damage distribution map Fig. 1.



Overturned building (Photo-1) Wind pressure of the tornado and hit by flown objects (Photo-2).

### 3. Summary

We have surveyed the disasters by the Tornado occurred in Tsukubacity on May 6, 2012 and summarized the findings as above.

### Reference

1) TECHNICAL NOTE of NILIM No. 703 Damage investigation report on buildings brought about by the Tornado occurred in Tsukuba city of Ibaraki prefecture on 6th May 2012 (Heisei 24), as of January 2013.

<http://www.nilim.go.jp/lab/bcg/siryou/tmn/tnn0703.htm>

2)

Quick Report on Damage to Buildings by the Tornado on May 6, 2012 in Tsukuba City, Ibaraki Prefecture, JAPAN

<http://www.nilim.go.jp/lab/bbg/saigai/index.html>



# Technical Assistance for Sediment Disasters Caused by Heavy Rainstorms in the Northern Kyushu District

OKAMOTO Atsushi, Head  
 MIZUNO Masaki, Senior Researcher  
 NOMURA Yasuhiro, Researcher  
 SATO Takumi, Guest Research Engineer  
 NIWA Satoshi, Guest Research Engineer  
 Research Center for Disaster Management, Erosion and Sediment Control Division

(Key words) Northern Kyushu District Heavy Rainstorm, debris flow, slope failure, occurring all-at-once

## 1. Introduction

From July 11<sup>th</sup> to 14<sup>th</sup>, 2012, an active seasonal storm front delivered a record rainfall in the Northern Kyushu district. A total of 268 sediment disasters resulted in 23 dead (or missing) persons and the full or partial destruction of 152 houses in Fukuoka, Oita and Kumamoto prefectures, according to Sabo Department, Ministry of Land, Infrastructure, Transport and Tourism on December 31. By request of Kyushu Regional Development Bureau and Kumamoto prefecture, etc., Erosion and Sediment Control Division, NILIM, along with Erosion and Sediment Control Research Group, PWRI, investigated the Aso District and Kawabe River Basin in Kumamoto prefecture and provided technical guidance on warning and evacuation, restoration measures, and direction for investigations to be made.

The Japan Self-Defense Forces and Fire Departments in charge of searching for missing persons in the Aso District sought advice for secondary disaster prevention. The researchers explained that considerations should be made during searches, amid occasional heavy rains immediately after the occurrence of the disasters.



Photo 1 Technical assistance for missing person searches by the Japan Self-Defense Forces (Shinsho Area in Minami Aso Village on July 13<sup>th</sup>)

## 2. Summary of investigation / technical assistance

### 2. 1 Aso District

Debris flow and slope failure occurred simultaneously in the Aso District mainly at the caldera walls of the somma of Mt. Aso. Since the number of the sediment disasters that caused human and house damage was extensive, NILIM

and PWRI organized 3 groups (a total of 9 members) and performed investigations. At the locations where missing person searches were being conducted, the groups explained to the Japan Self-Defense Forces about observation points such as sediment movements in the streams, rock falls at the head of the failed slopes, and the tilts of the trees, etc., about directions to evacuate such as higher areas in the cross directions instead of downstream areas, and about the speed of debris flow and window time to evacuation, etc. The site manager of the Japan Self-Defense Forces said, "We were concerned about the secondary disasters looking at the debris such as boulders, but now we can make decisions calmly with their advice."

One of the characteristics of sediment disasters in the Aso District is that many surface failures occurred on the caldera walls at the relative height difference of a few hundred meters, and they transform into debris flow, dragging driftwoods into the flow. They include those occurring in the zero-order basins, which do not represent distinct geographical features of valleys. There are cases where collapsed sediment reached areas 50m or more off the toes of the slopes due to fine volcanic soil saturated by a large amount of rainfall and ground water, or other factors. Moreover, there were reoccurrence of slope failure and debris flow in the same torrents as the Aso disaster in 1990; however, there were many cases that the sediment-control dams and other structures prepared by the prefectural government after the earlier disaster prevented or reduced the damage.

### 2. 2 Kawabe River Basin

Many debris flow and slope failure occurred in Itsuki Village under the jurisdiction of Kawabe River Dam Sabo Office. Though there was no reported human or house damage, unstable sediment remained in the torrents and on the slopes upstream the roads, so the groups provided technical guidance to the office and the village government for the future monitoring systems.

## 3. Conclusions

The Aso disaster taught us a number of lessons. In the future, we are going to conduct investigations and research into the mechanisms of slope failure and debris flow, effects of sediment control facilities, and warning and evacuation, etc.

【Reference】

NILIM HP: <http://www.nilim.go.jp/lab/rbg/index.htm>

# Description on the actual damages to the peoples' lives by The Tohoku Pacific Ocean Earthquake And Tsunami

KUBOTA Keijiro, Senior researcher

ONAMI Hiroyuki, Researcher

ITO Hiroyuki, Head of Flood Disaster Prevention Division,  
Research Center for Disaster Management

*(Key words) Tsunami, Actual damage to the peoples' lives, Direct conversation inquiry*

## 1. Introduction

Tsunami has brought not only the damage on the property such like collapsed and wrecked houses but also damages to the peoples' lives that the victims have been forced to live up for a long period of time under inconvenient conditions under shortage of daily household goods, no utilities supply, destructed community functions. By those reasons mentioned above, we visited victims' houses in the Tsunami disaster area directly so as to grasp the actual circumstances of damages to the lives of such peoples.

## 2. Inquiry method

Actual inquiry was implemented from February to June 2012 with the collaboration of total 223 victims in seven cities (Iwate pref.:Kamaishi,Miyako, Miyagi pref.:Ishinomaki, Shiogama, Tagajo, Iwanuma, Fukushima pref.: Soma). We have visited homes of such victims respectively and sounded their life after disaster through direct conversation inquiry about one hour each.

## 3. Damages to the life

We came to have grasped actual circumstances that the victims are obliged to bear inconvenient life long time as shown below.

- It became difficult to obtain food and daily household

goods as almost all of the retail shops have got damage.

- Using the bicycle as a substitute for the damaged automobile until new one becomes available, but obliged to move long distance for going and coming between the safe shelter and home as well as purchase of daily households goods.
- Life in shelter becomes long not knowing when and how to recover the proper housing as there is no target that the area is recovered without concrete land development schedule.

Further, following examples were shown on deteriorated physical condition and mental illness due to long period of inconvenient life.

- A person lost its physical conditions and was under medical treatment at home following a distress caused from staying long in a shelter. As a result the person fell suddenly one day and cannot stand up any more.



Photo-1 Area destroyed by the Tsunami





Photo-2 Longer-term shelter life

Family members are suffering from unstable mental condition caused by the fear of Tsunami and cannot determine to return home adjacent to the beach.

- A person who could not approach his/her house as only pillars were left on the ground floor, lost all memory articles such as children's photos in early childhood that were left on the second floor when his /her house was torn down.

#### 4. Conclusion

In the inquiry process, we have made great efforts to make the query sheet flexible in order to explain and ask questions pursuant to understanding of victims since inquiry items are complicated and diversified.

In the catastrophes, victims tend to suffer from the inconvenient life for long period that does not appear on the statistical figures. Hence the challenge is how to reflect such circumstances in the business evaluation and so on.

We would like to express our sincere appreciation to those victims who cooperated with us in this time inquiry.

# Prioritization of the Tsunami Countermeasure among air ports

NAKAJIMA Yuki, Research Coordinator for Advanced Airport Technology  
Airport Department

(Key words) Tsunami, Alternative airport, Priority, Qualitative evaluation

## 1. Alternative airport in the Great East Japan disaster

During the earlier stage of the Great East Japan disaster (approximately 72 hours) while more than 20 thousand people were isolated (in more than 75 places), we saw rescues were implemented through lifting in the air and takeoff/setdown on the roof by the Rotary-wing aircraft. Sendai airport has got damage in Miyagi prefecture, but it performed emergency recovery after four days of serious efforts by the staff. While that time, nearby Camp Kasuminome of the Japan Ground Self-Defense Force has supported such aircrafts as an alternative airport. Also in the public airport in neighbor prefecture, there implemented the broad area medical transportation by the DMAT (Disaster Medical Assistance Team) by means of the Fixed-wing aircraft as well as the Rotary-wing aircraft. In that disaster, it was revealed the actual state of the aerial action of the search and rescue supported by alternative airports in the earlier stage.

## 2. Trial of the prioritization of airports

As there are abundant cases of the Risk qualitative evaluation in the aviation field for the accident countermeasure, we are to adopt a simple qualitative evaluation as a review method to prioritize the Tsunami countermeasure of airports. At that time, we have made a focus onto secure the search, rescue and life saving action in the earlier stage of the Tsunami and made a review based on the possibility of securing the alternative airport since the height of the Tsunami as a cause of the damage is remarkably significant and hard to estimate.

Since the risk is a combination of the occurrence frequency and result significance, we can raise the prevention (level raising), avoidance (alternate), imputation (insurance) and the like as that examples.

About the occurrence frequency, we have made the ranking based on the magnitude of urgency from the Nankai trough earthquake from the description on the “Airport Tsunami countermeasure review committee report (2011)” of the Aviation Division and the allowance height from the estimated Tsunami height of the airport ground level. Also on the result significance, we have determined to do the ranking based on the concept of securing the Rotary-wing aircraft imperative to implement the research and rescue first and securing the Fixed-wing aircraft imperative to implement the broad area medical transportation second, taking into consideration whether there is an alternative airport nearby that can undertake such a task. (Fig. 1)

発生 頻度	南海トラフ 切迫性大	大		結果重大性		指標例	
		余裕高+0m	余裕高+2m	致命的	回転翼機不可 人命救助の機会損失大	50キロ圏内に 代替空港なし	
	南海トラフ 切迫性大	余裕高+2m	↑	重大	6時間以内、固定翼機 人命救助の機会損失中等	100キロ圏内に 代替空港なし等	
		余裕高+4m					
	南海トラフ 切迫性小	余裕高+0m		↓	軽微	6時間以内、固定翼機 によるDMAT活動が可能	2時間以内に 点検・運用
		余裕高+2m					
	余裕高+4m						

Fig. 1 Ranking of the Occurrence frequency and result significance

## 3. Result of the trial

When we have made a trial of the qualitative

evaluation of existing airports based on the above, we could have a classification of three groups of the airport that the rank is given from the top right to the bottom left as shown in the Fig. 2.

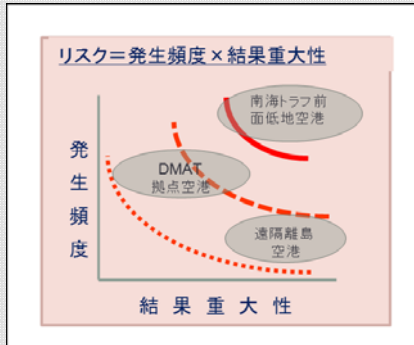


Fig. 2 Example of the qualitative evaluation trial

“Nankai trough front low ground airport” is the one that has a great urgency and little allowance in the ground level, and further there is no alternative airport nearby, therefore ongoing now is the training that uses the Helicopter mounted Self-Defense ship as the alternative airport. It is scheduled to call the DMAT and receive the medical transportation in the “DMAT base airport” and also in airports in the maritime area partially. “Long distance isolated island airport” has a low occurrence frequency, but having no land route, it is imperative to keep collaboration with the main land and neighbor islands as it is anticipated to see a serious damage once the disaster occurred. From now on, we are to proceed on reviewing the research such as on the alternative broad area trunk line traffic, introduction of the qualitative evaluation and so on.



# Analysis of the Effects of the Measures for Technical Note of Traffic Safety Measures and Planning

TAKEMOTO Azuma Researcher

OZAKI Yuta Researcher

YAMAGUCHI Kimihiro Guest Research Engineer

YABU Masayuki Head

Road Department, Advanced Road Design and Safety Division

(Key words) traffic safety measures, analysis of the measure effects, accident black spots, arterial road

## 1. Introduction

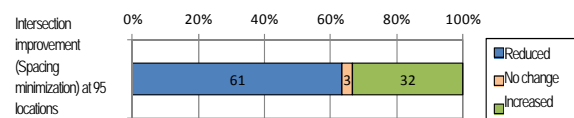
Ministry of Land, Infrastructure, Transport and Tourism, joined with National Police Agency, designated as “accident black spots” of those intersections and basic road sections which has the high rate and/or are of frequent occurrence of fatal and injury accident, and Prefectural Public Safety Commission and the responsible road administration offices implement cooperated measures. This project lowers fatal and injury accidents overall at the locations which were completed the measures, however, investigated by each location, it found points to be improved that the measure effects vary and there increased other types of accidents which were not targeted to reduce by the implementation of the measures, etc. Therefore, the researchers analyzed the effects of traffic safety measures that were implemented up to the present and they clarified consideration points such as the effects of each construction measure type and its factors that cause a dispersion, and effects on traffic behaviors, in order to write technical notes that will contribute planning and implementation of the more effective safety measures.

## 2. Analysis of the effects of traffic safety measures

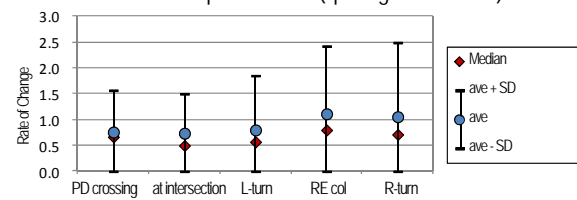
An analysis was conducted of the effects by construction measure type on 106 construction measure types that were implemented at 10 locations for the implemented traffic safety measures on accident black spots. The rate of change in the number of fatal and injury accidents before and after measure implementation (= the average number of the accidents after measure implementation / (divided by) the average number of the accidents before measure implementation) showed the result that there were 89 construction measure types with the rate of change as 1.0 or lower and the number of accidents were reduced by the implementation of the measures in general.

Then, the authors focused on the dispersion of the effects by each construction measure type. The following indicates a couple of examples of the analysis results of the spacing minimization measures of intersection improvements. The purposes of spacing minimization are: (1) the speed control of left-turn vehicles by “smaller minimum corner radius” (2) an improvement of visibility for pedestrians through turning traffics by “reallocation of a pedestrian crossing closer to the intersection”, (3) the reduction of dilemma zone followed by shorter stop line distance by “forwarding the stop line marking”.

Among 96 locations where implemented spacing minimization, the rate of change of the number of total fatal and injury accidents before and after measure implementation resulted that the number of accidents was reduced at 61 locations (64%) and was increased at 32 locations (33%)(Graph 1). Next, it was focused on the rate of change of the number of fatal and injury accidents by accident type, among the accidents at pedestrian crossing, at an intersection corner, and on right-turn traffic which was targeted to reduce by spacing minimization, both the median and the average of the rate of change



Graph 1 The change of the number of total fatal and injury accidents after measure implementation (spacing minimization)



\* The rate of change = the average number of the accidents after measure implementation / the average number of the accidents before measure implementation

Graph 2 The rate of change of fatal and injury accidents by accident type (spacing minimization)

were less than 1.0 and that there were many locations that were reduced the number of accidents (Graph 2). On the other hand, the median of the rate of change was less than 1.0 on rear-end collisions and at right turn and the number of accidents were reduced at half or more locations, however, the average was larger than 1.0 and there were locations that increased the number of accidents.

To recognize the factors of increased accidents, the researchers investigated the effects on traffic behaviors by implementation of the measures. It was found that there was following vehicle's sudden breaking after rapid deceleration of the left-turn vehicle at locations that implemented “smaller minimum corner radius”. It may be considered effective to implement a speed control measure for left-turn vehicles before the intersection and/or other measures as multiple measures for the applicable locations.

## 3. Summary and the points to improve

From the above results, it was confirmed that it was shown effective for the accident types that were targeted to reduce by the implementations of the measures while it is possible to increase the number of accidents among other accident types depending on the location. In order to implement traffic safety measure more effectively, it is important to select the construction measure type with thorough estimation of traffic condition changes after measure, and it is necessary to make investigations suitable for the site location such as implementing multiple measures based on the necessity.

In the future, it will be further summarized the results of the analysis of the effects on traffic safety measures, consideration points at measure implementation, etc. by accident type and by construction measure type, and is planned to write technical notes which will support planning and implementation of the more effective traffic safety measures.

## Research Trends and Results

# What is the road that makes a feel of human priority?

HONDA Hajime, Senior researcher

OKIMOTO Hiroto, Outside researcher

YABU Masayuki, Head

Road Department, Advanced Road Design and Safety Division

(Key words) Community road, Road cross-section composition, Side strip, Driving simulation

### 1. Introduction

On 2012, there arose a series of traffic accidents that involved children and students going to or coming back from school, thus raised the urgent task of making the traffic security countermeasure of the school road.

At present, as the traffic security countermeasure for the community road including the school road, MLIT and National Police Agency have designated total 1,300 areas as "Relief walking area" since 2003 and significantly proceeded on upgrading the footway, enlarging the side strip, introducing the road structure able to control the driving speed such as Hump, the limit speed control and ?, but it is imperative to continuously practice such countermeasures.

However, though pedestrians and bicycles mainly use the community roads, almost all of them have narrow road width, then it is difficult to secure their space separately from the motorway. Furthermore, it is required to adopt such a countermeasure that is low cost and easier to prevail as the community roads are long and widely spread.

Accordingly, in this research we focused on the road cross-road composition to research the relation of such cross-road and walking speed in order to understand what is the road to make a feel of human priority.

### 2. Driving speed subject to the composition of the road cross-road

The research was carried out by human subjects who run through the computer graphic (hereafter CG) image space under integrated areas along the road using the Driving simulator (hereafter DS), in which driving speed and driving route are recorded on respective image space and impressions (s)he felt on running through was grasped through query. The CG roads are classified by total 23 types having three width such as 4m, 6m and 8m with or without road strip, different width and color, with or without center line and so on. There was no consideration on the oncoming vehicle and foot passenger.

As a result, lower driving speed was obtained in the 6m width road with chicane road strip and full color CG image without chicane road strip.

On the other hand, although we could not have a distinct result on the restrictive effect on the driving speed by enlarged road strip and colorized road, we have received a number of responses that raised the colored road strip as one of the factors that have made them

restrict the driving speed.

Furthermore, in an example that we have made one cross-section of the CG image a still and showed several stills to the same human subject and asked which was the one made him a feel of human priority, most preferred one was the motorway of 2m with road strips 2m X 2 for the case of 6m road (Left bottom of the Fig. 1).

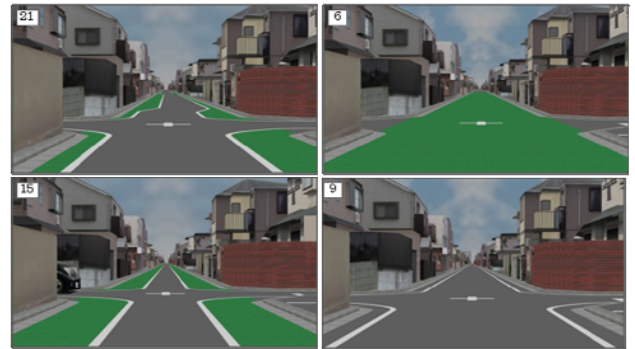


Fig. Examples of CG images used for the DS research (Width 6m)

Left top: Chicane road strip (1m x 2m), Right top: Full color road, Left bottom: Road strip 2m X 2, motorway 2m, Right bottom: Road strip 1m X 2, motorway 4m

### 3. Future deployment

We are to continuously observe the driving speed on the actual road of similar condition without affected by the foot passenger and oncoming vehicle so as to make a summary of the relation with the cross road composition and make comparison with the DS research.

At present, as several examples have shown effect of the enlarged and/or colored road strip, we are willingly to make clear which cross road composition is the most effective to restrict the driving speed and support the traffic safety countermeasure if the community road that is effective and having better efficiency.

### 【Reference】

1) Research on the Driving speed variation due to difference of the road factor composition" by OKIMOTO Hiroto, HONDA Hajime, TAKAMIYA Susumu in the 32<sup>nd</sup> Traffic engineering research presentation papers, September 2012



# Research Trends and Results

## Development of “simplified block performance evaluation system for densely built-up areas”

KATSUMATA Wataru (Dr. of Engineering), Senior Researcher  
Urban Development Division, Urban Planning Department

IWAMI Tatsuya, Senior Researcher  
Construction Economics Division, Research Center for Land and Construction Management

MIKI Yasuhiro (Dr. of Engineering), Senior Researcher  
Residential Environment Planning Division, Housing Department

NISHIZAWA Shigeki (Dr. of Engineering), Senior Researcher  
Environment and Equipment Standards Division, Building Department

(Keywords) Densely built-up areas, Group provisions of Building Standard Law, Harmonious rebuilding rule, Fire prevention / Evacuation, Sunlight / Daylight, Ventilation / Airflow

### 1. Forward

In order to improve disaster prevention performance and living environment within blocks of densely built-up areas where group provisions of Building Standard Law (obligation for a building site to adjoin the road, road slant plane restrictions, allowable building coverage ratio restrictions, etc.) are strictly enforced, it is considered effective to utilize “special methods for harmonious rebuilding”, such as combinations of building design systems and street scenery-improving district planning.<sup>1)</sup> These methods, with permission and authorization of the designated administrative agency to replace general building regulations with a local rule to equivalent standard in terms of performance, promote individual rebuilding at each site within a district. These methods are clearly expressed as a basic policy for promoting development and improvement in the densely built-up areas in “Basic Plan for Housing (National Plan)”.<sup>2)</sup>

### 2. Simplified block performance evaluation system for densely built-up areas

To promote utilization of special methods for harmonious rebuilding, it is important for the administrator and community planning consultant to evaluate the actual harmonious rebuilding rule plan during the consensus formation between the landowners and leaseholders. Specifically, evaluations regarding the ability to secure the same level of block performance (fire safety and residential environment performance) as the general regulation, the improvement level from status quo, in comparison with alternative plans and so forth.

Therefore, National Institute for Land and Infrastructure Management is developing some PC software called “simplified block performance evaluation system for densely built-up areas”(fig.) The system, by entering 3 dimensional

data of such as building, road and site, which is current status and after rebuilding in accordance with harmonious rebuilding rules, and local conditions such as latitude and wind, allows a user to easily evaluate block performance in the area of fire prevention, evacuation, sunlight, daylight, ventilation and airflow.

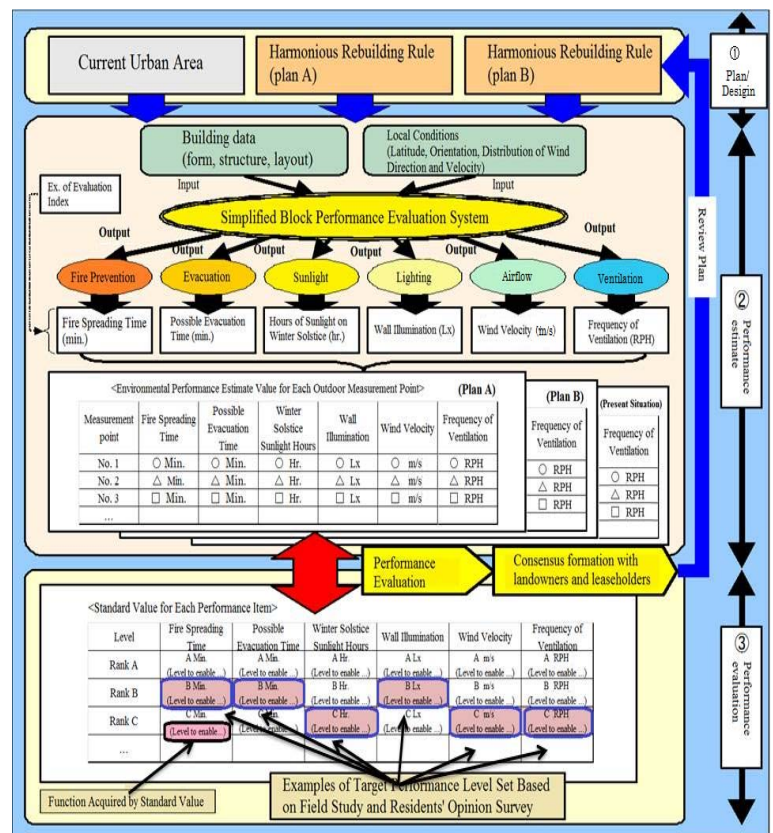


Fig. Image of simplified block performance evaluation system for densely built-up areas

### 3. Future issues

In parallel to the system development, Housing Bureau, academic experts and local municipalities are working

# Research Trends and Results

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together to examine the target level for block performance to be secured in densely built-up areas. By the end of fiscal year 2013, we plan to publish the “guideline on making harmonious rules for rebuilding” with the system, to be fully available at the sites.<sup>3)</sup>

## 【Reference】

- 1) Guidebook on Special Permissions in the Zoning Code under the Building Standard Law to Promote Rebuilding in Densely Built-up Areas” by TECHNICAL NOTE of NILIM (2007)  
<http://www.nilim.go.jp/lab/bcg/siryou/tmn/tmn0368.htm>
- 2)“Basic Plan (National Plan) for living” by Ministry of Land, Infrastructure, Transport and Tourism(2011)  
<http://www.mlit.go.jp/jutakukentiku/house/torikumi/jyuseikatsu/hyodai.html>
- 3)Development of supporting technology on making harmonious rules for rebuilding in densely built-up areas(NILIM Urban Development Div. HP)  
<http://www.nilim.go.jp/lab/jeg/index.htm>

## Research Trends and Results

# Outer wall diagnosis technology for long life use of the building

MAKATAYAMA Miho, Head

Housing Department, Housing Stock Division

TANANO Hiroyuki, Research Coordinator for Quality Control of Building

Building Department

NEMOTO Kaori, Senior researcher

Structure Standards Division

*(Key words) Outer wall diagnosis, Control and maintenance, Periodical report institution*

### 1. Introduction

Appropriate control and maintenance are required to maintain the building outer wall in a good condition and there is a risk that the outer wall drops and results in a serious accident to cause injury on the third party if you failed to keep periodical check and diagnosis.

Revision on the periodical report institution of the Building Standards Act chapter 12 has obliged us to carry out the outer wall research through the overall sounding on the specific building that has passed 10 years from final completion or large degree reconstruction since April 2008. However, practice of the research diagnosis remains low percentage as it is required to prepare a foothold to implement the outer wall research through the overall sounding and it costs high. Although infrared ray diagnosis is utilized as the diagnosis method without foothold, but what is ongoing is the combination use with the overall sounding as the climate and location conditions might make the infrared ray diagnosis difficult to practice.

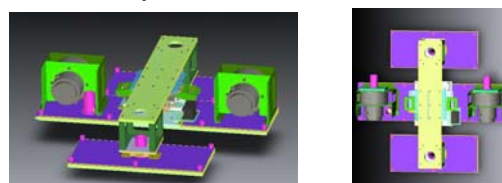
Based on such a situation, we have started to develop the outer wall diagnosis method that is simple and reliable and further possible to have qualitative evaluation and proceeded on the study on how to practice the outer wall diagnosis and what to consider its result on trying experimental verification.

### 2. Developing the outer wall diagnosis system and diagnosis guideline

We have made a prototype of the “Wall face running outer wall diagnosis system” that self-runs on the wall face and implements the sounding diagnosis in a given place in order to realize the outer wall research in a place difficult to approach for the inspector such as on high place outer wall. (Refer to the figure.) The prototype has perpendicular three legs and runs on the wall face stepping the upper and lower two legs and central one leg alternatively. Diagnosis to detect loosen tile and the like is implemented based on the sounding method.

Furthermore, there is a problem of variation on the diagnosis depending on the skill and experience of the

inspector in the sounding inspection that is a basis of the actual outer wall diagnosis. Therefore we have developed the “Manual outer wall diagnosis system” that enables the qualitative evaluation and makes it possible to leave the data of the diagnosis result. We were supposed to have used it in a same manner of using the sounding stick in the sounding inspection and made a specification that can be used in a daily check.



a. Diagonally looked view

b. Looked from upward

Fig. Wall running type outer wall diagnosis system prototype system and method, we have also made the guideline or

The outer wall diagnosis investigation and filed the technology material. In particular, on the reconstructed and/or repaired wall, it is difficult to judge whether deterioration such as loosen parts is increased or not different from the wall before reconstruction. To refine the guideline, we have verified the applicable range of the sounding method and infrared ray method including the reconstructed wall in the study objective and studied on the alternative investigation method and historical data on the reconstruction work required for the control and maintenance. Those results were used for the guideline of the practical method, evaluation and judgment of the outer wall diagnosis.

### 3. Future planning

We are to make the public announcement of the performance and specification of developed wall face running outer wall diagnosis system and do filing of the outer wall diagnosis guideline (Plan) and technology material with the objective of reconstructed wall and start to finalize and control the technology so that the outer wall diagnosis is ensured to put to practice.

# Development of under-floor deterioration diagnosis equipment for preventive maintenance engineering of wooden building

TSUCHIMOTO Takahiro, Head (DAg), WAKIYAMA Yoshio Senior Researcher (DE)

Evaluation System Division, Research Center for Land and Construction Management

(Keywords) *palpation examination, moisture content measurement, dark place imaging, sampling, biodeterioration, boring resistance*

### 1. Background of the study

Nowadays, conversion is progressing from new social investment to 'stock-type society' which keeps past social capital long and takes care of it. Previously, damages, etc. were dealt with respectively and ex post facto. However, considering that damage risks due to aging will rapidly increase in the future, a strategic maintenance is required. This is based on the idea of 'preventive maintenance' which regularly inspects and diagnoses structure conditions, and takes measures prior to development of critical risks with the aim of reducing life cycle cost. Technological development in the inspection field is crucial for efficient preventive maintenance engineering. Particularly, development of the technology is required in order to efficiently inspect many target structures and to inspect locations difficult for visual confirmation.

Therefore, a comprehensive technological development project of Ministry of Land, Infrastructure, Transport and Tourism named 'Development of inspection and observation technology for preventive maintenance engineering of social capital' was implemented. In the wooden building field under the project, narrow and dark underfloor was focused on and the equipment for efficient under-floor diagnosis was developed.

### 2. Sorting out requirements, design and trial manufacture of deterioration diagnosis equipment

Requirements to be met by the deterioration diagnosis equipment, its design principle and contents of trial manufacture and improvements were decided after much discussion in 'Development Committee on deterioration diagnosis equipment for preventive maintenance engineering of wooden building' held by NILIM (Chairman: Professor of Kanto Gakuin University, Masao NAKAJIMA). The results of sorted out requirements to be met by the equipment are as follows.

\* As a result of survey of effective underfloor height of public housing and former Housing Loan Corporation housing (total about 64,000 buildings), the maximum dimension must be 30cm or less.

\*As it is difficult to give a diagnosis for preventive maintenance engineering by imaging only, it is indispensable to conduct palpation examination and moisture content measurement.

\*A small Phillips screw driver is comparatively suitable for the shape of tip section of palpation examination feature.

Based on the above, the underfloor deterioration diagnosis equipment was manufactured experimentally and its functionality was verified empirically.

### 3. Improvements of deterioration diagnosis equipment

As a result of the above verification test of function, the following improvements were required in view of necessity to increase diagnosis efficiency.

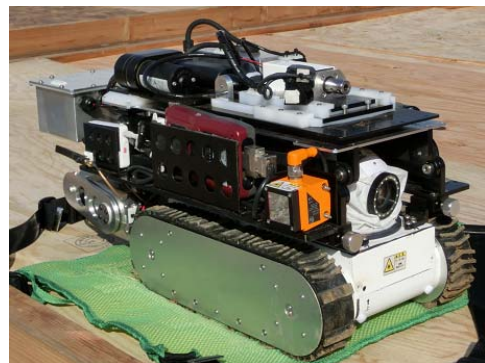
\*To enable to continuously conduct palpation examination in running and orthogonal direction in order to make it easy to continuously conduct palpation examination of underfloor horizontal bracing.

\*To introduce boring resistance measurement of screws, etc. which are easy to judge the presence or absence of biological deterioration in palpation examination.

\*To add a mechanism for sampling of the surface of deteriorated wood and hyphae, etc.

In case all of the above improvements are included, the chassis will be too large. Accordingly, two types of improved version of diagnosis equipment (picture) were manufactured as final products, one of which is to rotate palpation and moisture content measurement mechanism by 90° by remote control and another is to rotate by 90° manually, thereby making the chassis dimensions smaller.

This will lead to improvements in efficiency of preventive maintenance engineering for narrow underfloor to where no one can enter and of deterioration diagnosis aiming at performance evaluation of existing houses.



Picture: Under-floor deterioration diagnosis equipment for preventive maintenance engineering of wooden building (with function of rotation by remote control)



## Research Trends and Results

# Development of inspection and monitoring technology for preventive control of infrastructure

KOHASHI Hidetoshi, Research Coordinator for Construction Management

Research Center for Land and Construction Management

SUZUKI Atsushi, Researcher

Construction System Division

*(Key words)* Preventive control, Inspection and monitoring technology, Aging of the social capital

### 1. Introduction

Infrastructure has played a primary role as the foundation for industrial expansion and was intensely created during a period of high economic growth more than fifty years ago. Now this aging infrastructure is a concern due to an increasing threat of accidents and the potential results of natural disasters upon it that could affect society as a whole, in addition to increasing maintenance costs and reconstruction expense.

To adequately confront our aging infrastructure in the future, we must change into an investment-minded society that designs and builds extended life constructions. For that purpose, in place of reactionary measures used to address present damage, we must implement strategic maintenance and control techniques based on preventive maintenance thinking to attempt to reduce total costs through long-lived facilities. This includes regularly inspecting and diagnosing structures to determine the root cause of failures, and implementing countermeasures before critical defects occur to prevent accidents and disasters from impacting a society that faces a rapidly increasing risk from aging infrastructure.

In this research, we have identified inspection methods applicable to various types of construction in order to change from simply “seeing what is visible” to “observing what we need to observe,” as described below:

- I. Inspection and diagnosis technology on hidden portions of construction
- II. Inspection and diagnosis technology for variations of constructions that are visually difficult to evaluate

### 2. Outline of research and development

I. Development of inspection and diagnosis technology for visually difficult portions of the construction

- ① Inspection and diagnosis technology for buried and covered portions through nondestructive inspection

With a goal of developing nondestructive inspection and diagnosis technology and evaluation standards for visually difficult portions, such as buried and covered portions of concrete in civil engineering constructs, we have developed prototypes for placement inside an auscultation system. Through nondestructive inspection,

structural endoscopes and wall face detectors running over outer walls are able to determine actual performance of structures.

- ② Inspection and diagnosis technology on visually difficult portions through images and data

With the goal of developing inspection and diagnosis technology and evaluation standards for visually difficult portions, such as the interiors of sewer pipes or subfloors of constructions that cannot be approached directly through image and data technology, we have implemented a performance verification test using a prototype screening method of TV camera investigation for road-caving prediction and deterioration diagnosis of wooden subfloor materials.

II. Inspection and diagnosis technology for variations of constructs that are visually difficult to evaluate

- ① Inspection diagnosis technology for leaking constructs using infrared

With the goal of developing inspection and diagnosis technology and evaluation standards to quantitatively understand wet portions of dikes that are difficult to detect with current methods that use infrared ray thermo sensors, we have implemented a performance verification test using an infrared ray thermo sensor in an actual river dike.

- ② Monitoring of structural subjects and variation of detection methods through positional measurement

Utilizing position identification technology through GPS and road management cameras, we have developed and implemented a performance verification test in the field on actual bridges. The inspection and monitoring technology and evaluation standards will allow us to capture accidental and critical variations of structural subjects such as bridges, swiftly and simply.

### 3. Future planning

We are planning to develop inspection and diagnosis technology and evaluation standards for portions and variations of structural objects that are difficult to see, up until now making evaluation visually difficult. Additionally, we will establish a multi-purpose evaluation method and evaluation standard for inspection and monitoring results and implement them as swiftly as possible.



# A Case of Utilizing Results

## The Technique of Planned and Effective Investigation and Judgment of Sewer Pipes

YOKOTA Toshihiro, Head

FUKATANI Wataru, Head Researcher

SUEHISA Masaki, Researcher

Wastewater System Division, Water Quality Control Department

(Key words) facility of sewer pipe, stock management, vinyl pipe, degradation judgment criteria

### 1. Introduction

Recently the number of decrepit pipes is increasing; therefore there are growing concerns about occurrences that has a serious influence on social activities and daily lives, such as road cave-ins and stop of sewage services. To prevent these accidents, it is an important issue of municipality to make and follow the maintenance management plan for prevention and preservation, and the adequate practice of reconstruction and repair. On the other hand, along with the strained state of municipal finances, the rate of annual sewer pipe investigations is as low as 1% of total extension. Therefore more effective investigation methods of sewer pipes are necessary.

To prolong the lifespan of facility, the precise grasp of the present state of degradation (substantiality) is required. However, the length of underground vinyl pipes that consist 60% of the length of total sewer pipes, we do not have much knowledge of deficiency nor of the mechanism of degradation. And there is concern that we do not have degradation judgment criteria compared to other materials. Based on this, National Institute of Land and Infrastructure Management has proceeded these two researches towards the promotion of maintenance management of prevention and preservation to prevent the fatal damage of sewer pipes and the adequate practice of reconstruction and repair.

- ① Screening research method by utilizing pole camera.
- ② The standardization of degradation judgment of vinyl pipes, etc.

### 2. The Research of Screening Method by Utilizing Pole Camera

A pole camera is a piece of investigation equipment that has an extendable operation pole with a camera and light on its top. (photo1) We can inspect and investigate sewer pipes by inserting the pole into a manhole and using zoom functions while staying on the surface. The merit is that the cost of this form inspection is lower than the present detail inspection (TV camera inspection) and more sewer pipe investigations are conducted during a short term. We determined the range of camera eyesight by using experiment instruments and grasped the trend of deficiency that

happens inside a pipe and estimated how much deficiency the pole camera can detect. Based on these results we evaluated the systematic screening method by combining the present detail inspection (TV camera inspection) and the pole camera. We developed a more effective judgment method for accurate investigation, daily progressing amount and expense.

### 3. Standardization of Degradation Judgment of Vinyl Pipe, etc.

NILIM is experimenting to grasp of capability of vinyl pipes with deficiencies. We are also making the judgment criteria of vinyl pipes based on the trend of the deficiency (photo2) through the results of present TV camera inspection, etc. In the judgment criteria, we are going to include the appraisal method of the cracks that occur following the axis, flattening and the deformation that are characteristic for vinyl pipes instead of conventional judgment of reinforced concrete pipe. The result of this study will be proposed into the guide of sewage maintenance management we are considering to revise.



Photo1 Pole camera



Photo2 Example of damage to a vinyl pipe

### 4. Summary

By utilizing these research results, fatal damage of sewer pipes that are caused by road cave-ins can be avoided, the extension of endurance and the reduction of maintenance management cost are expected.

## Research Trends and Results

# Revision of “Specifications for Highway Bridges”

TAMAKOSHI Takashi, Head  
SHIRATO Masahiro, PhD, Senior Researcher  
YOKOI Yoshiteru, Researcher  
Road Department  
Bridge and Structures Division

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(Key words) *Highway bridge, Technical Standards, Specifications for Highway Bridges*

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### INTRODUCTION

NILIM routinely reviews nation-wide bridge inspection data and also conducts the field survey of damaged structures. These are required to feedback the findings to technical specifications and standards and identify what should be done by NILIM in research. One of the recent good examples is the revision of the Japanese Specifications for Highway Bridges in 2012. The revision had been the first time in almost ten years. Following the adoption of durability design in the previous revision such as chloride ingress in concrete members for a design service period of 100 years, the present revision incorporates the latest knowledge and experience that have been obtained for the last ten years in the broader sense of bridge maintenance such as the deterioration and seismic damage to existing structures.

### Lessons learned from recent experience in bridge maintenance

NILIM routinely reviews nation-wide bridge inspection data and conducts the field survey of damaged structures to feedback the findings to the Japanese Specifications for Highway Bridges and identify what NILIM should do in research. One of the recent good examples is the revision of the Japanese Specifications for Highway Bridges in 2012. The revision had been the first time in almost ten years. Following the adoption of durability design in the previous revision such as chloride ingress in concrete members for a design service period of 100 years, the present revision incorporates the latest knowledge and experience that have been obtained for the last ten years in the broader sense of bridge maintenance such as the deterioration and seismic damage to existing structures.

Firstly, the bridge inspection data has reconfirmed that fatigue cracks continue to develop in steel members such as deck plates of bridges carrying a busy / heavy traffic. However, as it turns out, the design guidance for fatigue in steel bridges published in 2002 can cover typical damage types that were observed in the bridge inspection. Damage due to chloride ingress to concrete bridges also shows that the 2002 Specifications for Highway Bridges is still effective to prevent damage due to chloride ingress during the design service life.

Secondly, there were several serious damage cases in truss bridges in the U.S and Japan. The I-35W Mississippi River Bridge, in Minneapolis, Minnesota, the United States, suddenly collapsed in 2007. In Japan, the failure in a truss bar which was embedded through the deck concrete occurred at two national highway bridges on major routes and ceased traffic. These bridges were inspected under their periodic inspection programs but these accidents were not staved off. NILIM conducted field surveys for all these events and analyzed the causes of these collapse and failures. We learned the importance in designing more redundant structures against partial collapse in structural members. For example, the AASHTO design specifications have load modifiers in terms of redundancy and a concept of fracture critical members. In addition, the bridge inspection data obtained in national highway bridges has indicated that the rate of deterioration changes with different members as well as difference portions / zones even within a member. The visual inspection and present deterioration curves cannot completely detect all damage and hidden failure such as corrosion of steel inside concrete. Rapid development of existing damage sometimes appears between the every-five-year inspections unexpectedly.

Thirdly, the Great East Japan Earthquake occurred in 2011. The emergency inspection was conducted by highway administrators and NILIM also backed up them when evaluating the condition of bridges damaged seriously. However, they had difficulty approaching to some portions of the bridge or bridges thereof to check if they were o.k. in such urgent situations. They also had difficulty conducting emergency repair work at such inaccessible portions to open the service of the bridge for emergency vehicles.

### KEY ITEMS INTRODUCED IN THE REVISION REGARDING MAINTAINABILITY

The lessons above brought the following major revisions in the 2012 Specifications for Highway Bridges regarding bridge maintenance:

- 1) The chapter of fatigue design is incorporated into the Specification which was formerly guided in a different design guidance book. The chapter shows design equations and the classification in fatigue strength of

# Research Trends and Results

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welded joints.

- 2) The minimum thickness of steel deck plate is increased to 16 mm based on NILIM's experimental study.
- 3) The following items must be considered in design and specifically described in design reports and drawings.
  - Details to secure so-called load-path redundancy, structural redundancy, and internal redundancy
  - Installation of bridge inspection facilities from the beginning of service
  - Details to make it easy to replace the identified structural members that are supposed / planned to replace during the design service life, such as the installation of mounts for jacks and the pre-reinforcement of associated structural members for the future jack-up etc.
  - Elimination of portions that are not accessible from the inside such as a narrow portion of box cross-section
- 4) Description of expected failure modes or deterioration prone portions / zones and the associated inspection and maintenance strategy in design documents and drawings.
- 5) Preservation of all drawings such as project drawings, shop drawings, working drawings, record drawings, as-built drawing etc. that will be needed in maintenance.

It is worth mentioning that the design for chloride ingress in concrete members remained unchanged from the 2002 Specifications for Highway Bridges based on the findings shown above.

## REMARKS

NILIM has also been working to upgrade the Specifications for Highway Bridges into a partial design factor format and develop repair / reinforcement design specifications particularly for existing structures. The reliability theory can give more reasonable load and resistance factors for existing structures that can consider the present traffic condition and structural condition of the particular bridge on a particular site. The related findings can be seen elsewhere soon.

## Reference

Bridge and Structures Division HP (Related papers posted)  
<http://www.nilim.go.jp/lab/gcg/index.htm>

# Research Trends and Results

## The damage evaluation technique from the point appearance for the highway steel bridge heat affected by a fire

TAMAKOSHI Takashi, Head

ISHIO Mari, Researcher

YOKOI Yoshiteru, Resercher

Bridge and Structure Division, Road Department

*(Key words)* Highway bridge, paint, , Coat, Estimating damaged temperature, Heating test

### 1. Introduction

In recent years, there have been examples of highway bridges being damaged in the fire. With the temperature of a fire the kinetic property of steel materials changes. In order for a road administrator to judge the propriety of access or the contents of repair reinforcement, it is necessary to get to correctly know the temperature of the heat of a fire early. On the other hand, the factors from which painted steel materials change are "temperature" and "the kind of paint." Therefore, it is necessary to clarify the temperature and the relation of painted steel damaged by fire for every paint specification. It is utilizable for the presumption about the damage at the time of suffering from such a calamity. There are situations where the surfaces differ because of the heat on the steel plate with various paints.

The test in which a steel plate was heated in a gas furnace and a electric furnace was carried out to understand the relation between heating temperature and turns of painted steel was investigated. In order to presume the temperature which the steel materials received, "Collection of samples of the painted steel" was published.

### 2. Experiment Method

Test specimens were two kinds of steel plates. The first was a specimen with five kinds of coating which are generally adopted in Japan were prepared. The other that was cut out from a removed bridge was prepared. The two was tested in the furnaces as shown in Figure 1 and Figure 2, a gas furnace and an electric furnace in order to investigate the relationship between the supply of oxygen and damage to the painted steel after the test.

### 3. Test Results

Table1 shows observation of surfaces after the tests.4. Conclusion

We have implemented testing under conditions of various coating types, deterioration degrees, heating

methods and so on so as to make the coating damage samples to estimate the temperature of received heat as existed possibility to estimate the temperature from the state of damaged coating.

From now on, we are to proceed on the heating test of existing bridges with different coating types and deterioration degrees in order to collect sample images. Note also that we would like to make public the heat control method and detailed methods of obtaining sample image data established in this research and image data to be shot continuously in the laboratory.



Fig. 1 Gas furnace Fig.2 Electric furnace

Table1 The specimen released for observation after the test by gas furnace

temperature	Coating type				
	A-1	A-2	B-1	C-1	C-5
before tests					
200°C					
300°C					
400°C					
500°C					
600°C					
700°C					

【Reference】 NILIM Material 710 posted

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



## Research Trends and Results

# Inspection Results and Accuracy of Probabilistic Structural Condition Forecasting for Highway Bridges

TAMAKOSHI Takashi, Head  
OSHIRO Nodoka, Senior Researcher  
ISHIO Mari, Researcher  
Bridge and Structures Division, Road Department

(Keywords) highway bridge, the periodic inspection, check system, BMS (BRIDGES MAINTENANCE SYSTEM)

### 1. Introduction

The road network in Japan was developed rapidly during the rapid economic growth of the 1970s, and the number of road bridges has now reached approximately 680,000 (bridge length  $\geq 2$  m). If the current situation continues, the number of bridges that have been in use for over 50 years will account for almost half of the total bridges in 15 years. A strategy to lower maintenance costs for each bridge while maintaining adequate maintenance standards is essential. In 2004, Japan implemented a policy whereby, out of the 160,000 bridges in the country, the 21,635 bridges under central government management are inspected once every 5 years. In these inspections, the types and units of data collected were determined taking into account the application in BMS (Bridge Maintenance System).

### 2. BMS based on periodic inspection

The periodic inspection records all conditions on a micro-component level of all bridges, and from a unified perspective with the aim of applying BMS. The calculated corrosion deterioration curves are shown in Fig. 1 for the bridge at the location of each bridge component. From these curves, we can see a difference in the progression of corrosion according to the location.

### 3. Utilization of BMS

From inspection results, trends in the location of the damage can also be ascertained.

- We can determine whether the coating is in a sound condition as a whole, but not overlook cases, such as in Fig. 2, where considerable corrosion has occurred at the end.
- By statistically understanding the tendency of the

deterioration which was affected by the construction period, initial quality or bridge building environment, it will be possible to reflect on the establishment of more durable design standards and construction techniques.

### 4. Conclusion

NILIM will continuously proceed with the study for development for more efficient maintenance and management based on the national highways of Japan.

[References]: Bridge and Structures Division HP

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

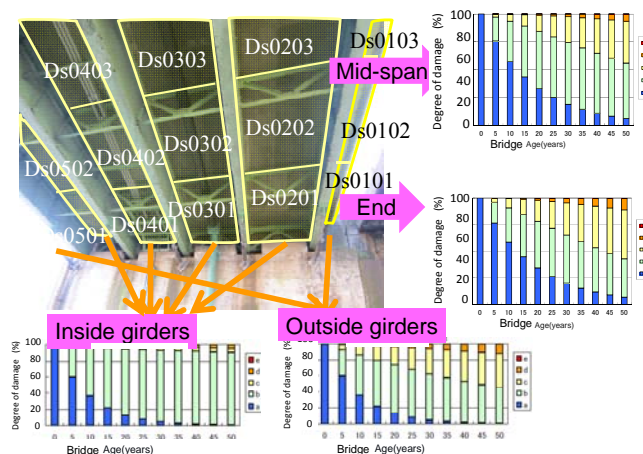


Fig. 1. Creation of deterioration curves for each element.



Fig. 2. An example of a bridge with considerable corrosion at the ends only.



## Research Trends and Results

# Toward setting the frequency of weeding of levee required for flood control function maintenance

HATTORI Atsushi (Ph.D., Engineering), Head

FUKUHARA Naoki, Researcher

River Division, River Department

(keywords) *levee, vegetation management, erosion, penetration*

### 1. Issues in executing rational management

Weeding of river levee has a function to enable to get the situation of the surface of dike body on the occasion of visual inspection and assist to surely detect damages or deformations, and has an effect of maintaining yield strength of the slope against erosion and slide by preventing tall vegetation to grow and the surface to become soil. Weeding is carried out twice a year in principle in case of dikes under national control. It will possibly lead to further rationalization of maintenance if an appropriate frequency of weeding is set up in consideration of the flow rate and duration of action at flooding, the different dike structure and soil property, etc. for each section of dikes. Depending on the location, the frequency of weeding is forced to reduce, but in that case, it must be confirmed in advance that enough yield strength is maintained even if tall vegetation with the possibility of transitions grows. Although the knowledge about short vegetation represented by zoysia and cogon grass has been accumulated in terms of the effect to prevent erosion to what extent<sup>1)</sup>, the knowledge about tall vegetation represented by common reed and reed is not enough. Here is a technological issue which is a bottleneck to judge whether it is possible to rationalize management which evaluates yield strength and secures the prescribed flood control function as before, while allowing transitions of growing vegetation on the slope of dike from short vegetation to tall one.

### 2. Full-scale test using specimen obtained from the actual dikes

River Division conducted a hydraulic test to check the erosion resistance against flood flows and the stability against sliding rupture caused by penetration of rain falls, etc. with the cooperation of the head office of Ministry of Land, Infrastructure, Transport and Tourism and each Regional Development Bureau. The biggest feature of this test was that the test was conducted under simulated conditions of actual flood flows and rain falls by sampling in steel frames a part of the slope with growing vegetation from the actual dike just as it was, and bringing them into NILIM.

In the test concerning erosion resistance, the specifications of vegetation (growth density, plant's height and leaf area, etc.) were measured first and fall over height of vegetation and the flow rate near the ground surface reduced by vegetation and the progression

rate of erosion, etc. were measured by providing the flow rate nearly equal to the one at actual floods. In addition, in the test concerning the stability against sliding rupture, coefficient of permeability (the degree of water penetration) by rhizome mixing in with the soil and the change of soil resistance were examined.

### 3. Obtained knowledge and its utilization

It was found that even under the situation covered by plants, if they were cleared by the flow rate near the ground surface, the progression rate of erosion has the similar relation with the bare ground not covered by plants. In other words, it was thought that the reduction of flow rate near the ground surface by stalks and leaves of plants was the mechanism to exert the erosion resistance of tall plants<sup>2)</sup>. Furthermore, it was confirmed, comparing to the test, that the flow rate near the ground surface can be calculated using the hydraulic model which gives vegetation specifications and hydraulic conditions as parameters. Utilizing these observations, we propose a method to evaluate the possibility to prevent erosion against how much flow rate by organizing the calculation results of variable numbers such as kinds of plants, the height of plants and number of growing plants per unit area.

Rivers throughout the country have different hydraulic conditions, etc. according to the location. Therefore, by assembling the above outcomes, it will be possible to determine the place where the flood control function can be maintained with a reduced frequency of weeding or the place where the flood control function cannot be maintained without an increased frequency of weeding. It is scheduled to assemble the outcomes to be applied to in deciding an appropriate frequency of weeding at each location.

### [References]

- (1) UDA et.al.: Nature-oriented river dike protection works when flood flow occurs, cohesive soil and behavior of vegetation, Public Works Research Institute papers No. 3489, 1997
- (2) Naoki FUKUHARA, Atsushi HATTORI : Test on special characteristics of erosion of river dike slopes where altherbosa grows, River Engineering journal Vol. 18, 2012

# A Case of Utilizing Results

## Revision of Airport Pavement Design, Maintenance and Rehabilitation Manual

IZU Futoshi, Head

TSUBOKAWA Yukitomo (Dr. Eng.), Senior Researcher

Airport Facilities Division, Airport Department

(Key words) *airport, pavement, life extension*

### 1. Introduction

“Airport Pavement Design Manual” and “Airport Pavement Maintenance and Rehabilitation Manual” issued by Japan Civil Aviation Bureau were revised in March 2013 based on the results of research by the NILIM. These manuals provide standards and recommendations for design methods and materials of airport pavement in Japan. In this revision, new standards and recommendations for asphalt concrete were added to the manuals. This report mentions some of the major points of the revisions.

### 2. Revision for usage of modified asphalt binder

Straight asphalt binder has been commonly used for asphalt concrete of airport asphalt pavement in Japan. Nowadays, modified asphalt binder is sometimes used in the airport where large aircrafts often pass since large rutting sometimes occurs.

However, it was not clarified in what type of cases the modified asphalt binder should be used for airport asphalt pavement. Thus, new standards concerning to the usage of modified asphalt binder were added in the manuals as below.

1. Construction of new runways, taxiways, aprons and GSE roads where damage caused as rutting, deformation of grooves, potholes and stripping are strongly expected.
2. Repair of existing runways, taxiways, aprons and GSE roads where damage such as rutting, deformation of grooves, pothole and stripping occurred frequently.
3. Repair of existing runways, taxiways and aprons as countermeasure of blistering.

### 3. Revision for asphalt concrete of binder course

Repair of airport pavements is commonly conducted in nighttime so the restored facilities must be opened the

following morning. If both the existing surface and binder course are cut away, new binder course may be opened temporarily for aircrafts soon after repair, and new surface course will be constructed on top of the binder course later on.

However, the binder course is exposed to rain water for the duration that the pavement is opened to traffic temporarily. This exposure may lead to binder course being stripped away and de-bonding between surface course and binder course soon after the repair. Thus, it was added in the manual as new recommendations as of 2013 that asphalt concrete of new binder course which is temporarily opened to traffic should be dense graded asphalt concrete with virgin aggregate as same as the surface course.

Related to above revision, the test condition of immersed wheel tracking test was revised. This test has been used to confirm the stripping resistance of asphalt concrete with recycled aggregate used in the binder course. In the new standard, water immersed depth for the test specimen in case the binder course with recycled aggregate is to be exposed to rain water temporarily must be deeper than that in case the binder course with recycled aggregate is not to be exposed to rain water.



Photo 1 Specimen of asphalt concrete with recycled aggregate after immersed wheel tracking test

# Verification of Vehicles' Driving Route Monitoring Technologies on Actual Roads

KANAZAWA Fumihiko, Head

SUZUKI Shoichi, Senior researcher

TANAKA Yoshihiro, Researcher

TSUKIJI Takahiro, Researcher

SHIMAMURA Yoshitomo, Guest Research Engineer

Intelligent Transport Systems Division, Research Center for Advanced Information Technology

*(Key words) Heavy vehicles, driving route monitoring, driving experiment, Position data acquisition accuracy*

### 1. Introduction

In our country, rapid increases in repair costs and renovation expenses have become a significant problem due to the aging of the structures constructed on and after the period of high economic growth.

The Intelligent Transport Systems Division has been conducting the technical study of the systems to monitor heavy vehicles' driving routes and support their appropriate driving pursuant to the vehicle specifications with the aim of reducing their impact on the life span of road structures.

This report is to describe the outline of the results of the fundamental verification experiment on the technologies for monitoring driving routes using the ITS spot compatible on-board units and/or Tablet devices implemented on actual roads in the fiscal year 2012.

### 2. Experimental method

To verify the technology for monitoring vehicles' driving routes, we used the ITS spot compatible on-board unit with GPS (On-board unit with GPS) and two types of Tablet devices A and B as on-board units. Furthermore, we installed a high-performance GPS antenna capable of collecting GPS data at 0.1 second intervals in the test vehicle in order to verify how the accuracy is enhanced through map matching of the driving position data.

Shown in Table 1 are specifications of on-boards units and the items of data collected. The route (245km) on the Tomei expressway is shown in Fig. 1 is an example of a driving route.

Table 1 On-board units' specifications and the items of data collected

	On-board unit with GPS	Tablet device A	Tablet device B
GNSS type	GPS	GPS	GPS/GLONASS
Probe data accumulation interval	Every 200 m travel/ 45°turning angle	Every 1 minute	
Items of data collected	On-board unit ID, date, time stamp, geographic coordinates etc.	Date, time stamp, geographic coordinates	



Fig. 1 Running route



Fig. 2 Section with sound insulation walls

### 3. Experimental results

In the section with sound insulation walls (Outward and homeward 26km) on the driving route shown in Fig. 1, we have compared the GPS data obtained through the on-board unit with GPS and Tablet devices with the GPS data obtained through the high performance GPS antenna at the same time to verify the accuracy of the measurement data of the respective on-board unit on making the high-performance GPS data as the reference value. Table 2 shows the result. As there were found differences in the accuracy of the measurement data by on-board units, we find that position grasping accuracy of respective on-board unit differs by roadside conditions.

Table 2 The accuracy of measurement data of each on-board unit

Item	On-board unit with GPS	Tablet device A	Tablet device B
Distance from the reference value (average, (m))	8.0	12.9	11.8
Standard deviation (m)	2.89	7.29	7.82
Median (m)	7.75	12.89	7.82
Number of data	132	1231	1131

### 4. Future plan

We plan to verify also the accuracy of the measurement data under different roadside conditions or environments such as high-rise building streets and underneath elevated road structures. We also plan to investigate the judgment method of the route noncompliance by using the obtained driving route data. Hereafter, we will establish the verification testing system based on these results to study how to make the task on nationwide function verification and actual deployment clear.

#### 【Reference】

- Research on Voice-output ITS SPOT-onboard units with GPS system, 10<sup>th</sup> ITS symposium 2011, Vol.10 ,67-72

# Maintenance and operation of the flood control facilities that support the water disaster prevention system

TORII Kenichi, Research Coordinator for Integrated Water Disaster Management (Ph. D., Engineering)

River Department

FUKUSHIMA Masaki, Senior researcher (Ph. D., Engineering)

River Division

(Key words) *Function, Maintenance, Check, Repair*

## 1. Actual state and problem on deterioration of river structures due to aging

A river has, addition to the dike and bank protection, miscellaneous facilities such as water gates, sluice gates, and sluice ducts that are constructed to secure the function of the dike in a junction such as side streams and water channels, weir, ground sill that are constructed running across the river channel as well as the water evacuation yard that is constructed to evacuate the water inside. These river structures are important to support the water disaster prevention system that protects the human lives and properties in the watershed as flood control facilities. If we take examples of the water gates, sluice gates, sluice ducts, weir, ground sill and drainage pump stations, there exist some ten thousands of such facilities under direct control of the government, of which approximately 40% have presently passed forty years of age since construction and that percentage would reach 60% in ten years and 80% in twenty years<sup>1)</sup>.

We are concerned that cracks, opening in joints, caving and land subsidence, resulted from deterioration of the material itself such as cement and steel, local scour by flood flow and uneven settlement of ground will occur in the structure. By that reason, we are confronting them through repair based on the survey and check results made by mainly visual check. The same procedure is applied to aged machinery facilities, gates and pumping facilities.

## 2. Establishment of river structure management research task force

Study on the maintenance and operation of the river structure needs to have the knowledge and experience of researchers in a number of fields as their objective facilities are diversified and constructed on the ground that is a part of the natural levee and likely to suffer from landform change caused by flood flow. Based on that reason, it is required to have continuous organizational collaboration among administrative staff, practicing engineers and researchers. However, to the present, systematic operation has been never implemented on the research task related to the maintenance and operation of the river structures. In particular, satisfactory study is not implemented so far on the technical study concerning the long term prediction on the aging of the river structures and middle and long term management based on that study although it is a significant task of the actual operation.

MLIT Water and Disaster Management Bureau River

Environment Division, NILIM River Department and PWRI Construction Technology Research Department have, under common task recognition and understanding of the situation of overall social capital maintenance, established the river structure management research task force on April 2012 in order to organize researcher group to pursue the structural subject management technology appropriate to the river.

## 3. Operation to ensure the function of the Water disaster prevention system

A number of flood control facilities suffering from aging are something we have to implement maintenance and operation in a good effect securing the efficiency with a restricted budget. For that purpose, it is imperative to give the priority on the executing check and countermeasure on considering the significance of the water disaster prevention system as well as that of deterioration degree of individual facility. What is anticipated further for the maintenance and operation of the flood control facility is to implement check without error through developed check method for invisible portion such as underground, high places and narrow places.

To meet such tasks, the river structure management research task force is considering studying a method to evaluate the effect given by deteriorated materials on the function of the flood control facility and link it to evaluate the function of the water disaster prevention system supported by the flood control facilities. Further we are to implement survey on the actual state of the visual check and repair works executed in the last five years, and do comparison between disturbances checked visually and actual disturbance verified on the repair works in order to submit proposition of the method to use such investigation and check results more effectively. We are to make the example report on the disturbance and repair so as to make clear the characteristics of remarkable disturbances and portion pursuant to the type and location environment of the flood control facilities. Furthermore, we would promote the technology development to implement check and diagnosis of invisible portion under collaboration of industry, academy and administration.

### 【Reference】

- 1) YAMAMOTO Hiroshi and OMATA Atsushi: On the "Master plan for long-life and update of river structure", Pump, No.47, pp.8-13.



# Research Trends and Results

## Analysis on Needs of Daily Life Facilities by Household Structure

OHASHI Sachiko, Senior researcher

TAKEYA Shuichi, Head (Dr. Eng.)

Research Center for Land and Construction Management

Construction Economics Division

(Key words) *Daily life facility, Accessibility, Satisfaction level*

### 1. Introduction

Under the current circumstances where people's ways of life and works are undergoing diversification, facilities and services considered necessary for the people shall vary depending on their attribute and life environment. By that reason, for the future maintenance and control of infrastructure, it is necessary to implement careful surveys to see whether independent citizens are ensured access to necessitated services or not adding to traditional reduction of the time of the access.

Therefore in this research, with the aim of contributing to make social environment that independent citizen is ensured access to necessitated life service, we have made an analysis about who needs what kind of services in life on recognizing the difference in individual attributes, consciousness and magnitudes of the residential city.

### 2. Contents of the research

In this research, we asked the inhabitants the questionnaire to see what the needs for daily life facilities are (Fig. 1), required time to access those facilities and allowable time so as to analyze the relation between the individual attributes and population scale of the residential city. As for the individual attributes, we have put a remark on the child (ren) and/or elderly people included in the objective households.

As for the result, shown in the Fig. 2 are specific needs for respective daily life facility classified by individual attributes. It was found that a household having children needs more facilities. However, this research did not show any specific facility that is additionally required by the household having elderly people. Further, we have made an analysis of the percentage of the people that did not have the required time allowance to access those facilities, only for respondents having such an attribute, by the population scale of the residential city.

Office (cultivated land for agriculture and forestry), clinic, hospital, baby home, kindergarten, elementary school, junior high school, community center, administrative institution, post office, commodities shop, convenience store, railway station, library, park, high-level medical facility, high school, college/professional school, department store, large scale shopping center, bank, cultural facility, amusement facility, sports facility, airport

Fig. 1 Objective daily life facilities

The analysis has revealed that citizens living in the small magnitude city had not the time necessary for access to every required facility even if we have recognized the difference in his or her consciousness. Furthermore, some respondents did not have the required time allowance even if its need was larger, particularly when it was high-level medical facility. It was also found that a larger percentage of the inhabitants in the small magnitude city had not the required time for the high-level medical facility, hospital and clinic compared to other facilities, that there were lower satisfaction levels towards medical.

### 3. Conclusion

We are to implement a study to effectively proceed on the measure focused onto the inhabitants and city difficult to enjoy necessitated daily service, based on the result of this research.

1. Necessary Facilities not related to the Household				
Tolerance Period		Necessity		
		Somewhat High	High	Especially High
Tolerance Period	Short	-	Convenience Store	Bank, Post Office, Stores selling food and other daily goods.
	Medium	Clinics	Railways Stations	Hospitals
	Long	-	-	Large Shopping Centers, Long-term Medical Facilities
	More than one hour	-	-	-
2. Necessary Facilities to Households with Children under the age of 15 (Excl. the Facilities mentioned in 1)				
Tolerance Period		Necessity		
		Somewhat High	High	Especially High
Tolerance Period	Short	Kindergartens, Nursery Schools	-	Elementary Schools, Junior High Schools
	Medium	-	Parks	City Halls
	Long	-	High Schools	Workplaces
	More than one hour	Cultural Facilities, Department Stores, Universities and Vocational Schools, Libraries and Recreational Facilities	-	-
3. Necessary Facilities to Households with Elderly over the age of 65 (Excl. the Facilities mentioned in 1)				
Tolerance Period		Necessity		
		Somewhat High	High	Especially High
Tolerance Period	Short	-	-	-
	Medium	-	-	-
	Long	-	-	-
	More than one hour	-	-	-
Necessary Facilities to Households with Elderly was not extracted.				

Fig. 2 Needs for facilities by household structure



## Research Trends and Results

# Research on how the systematic shrinking of urban areas in depopulating cities should be

Urban Planning Department Urban Disaster Mitigation Division

KIUCHI Nozomu (Ph.D. in Engineering) , Head

Urban Planning Division

SAKATA Tomohiko(Ph.D. in Engineering), Senior Researcher

FUJIOKA Keitaro, Head

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*(Keyword) Depopulation, Urban Structure, Urban Area Restructuring, Systematic Shrinking*

### 1. Switching to Consolidated Urban Structure and Restructuring of Urban Areas

With the ongoing depopulation and tough financial affairs and environment restrictions, one of the recent challenges in urban policy is to realize a “consolidated urban structure”, compact city, as a form of “sustainable city” in provincial regions. 1)

Many cities have recently been implementing such measures such as revitalization of central commercial areas, the consolidation of city functions into a specific zone within the areas designated for urbanization, the promotion of public transportation and its network maintenance, the control of large-scale customer-attracting facility locations, and the prevention of urban expansion. However, with the exception of including measures to prevent the urban expansion in the suburbs, they focus on accepting the migration and the city functions to consolidated areas, and does not include any measures to proactively shrink the urban areas by relocating the population and the city functions from non-consolidated areas.

The Department of Urban Research thinks it is necessary to map out the measures to proactively promote the “systematic shrinking of urban areas” when restructuring the urban areas that are experiencing depopulation, investigating the special characteristics of the cities that need to shrink systematically, the prerequisites to practice such measures, and the effective procedures.

### 2. Shrinking of Urban Areas and Relocation of Residents

The followings are assumed as cases that require some measures to shrink urban areas.

(1) Along with the depopulation, the demand for land lots has decreased and vacant land and houses have naturally increased.

(2) In the period when the situation above is left as it is and until the land lots disappear, QOL (the quality of life), of the residents in the area has dropped and the management cost of administrative service has increased.

(3) The emigration of residents is intended as a policy in the stages from (1) to (2) in order to control the disadvantages in the stage (2).

Based on this, it is clear that a key point is how to proceed with the relocation of residents followed by the depopulation in the area, though there are not so many cases that can be referred to in Japan.

When it comes to agricultural villages, there are quite a lot of records on the depopulating-village relocation project that intends to move from inconvenient-to-live marginal villages within mountains to the foot of them . Oguni-machi in Yamagata has succeeded to systematically proceed with the village restructuring as a municipal, through core-village preparation, village relocation, and methods for living in mountains during summer and at the foot during winter. Yet, since the

# Research Trends and Results

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social circumstances have been changed as the road development and maintenance level has improved, as in the pavement and the snow clearance, we haven't heard of any cases that have been worked on in recent years.

And in urban areas, the collective relocation for disaster prevention in progress in such areas affected by the tsunami disaster caused by the Great East Japan Earthquake, it is relatively easy to reach an agreement on resident relocation and the public burden in the areas that doubt their safety.

Yubari City in Hokkaido developed around coal mines and had a population of 120,000 in its prime but now its population has dropped to just over 12,000 following the closure of the mines. And its growth strategy with promotion on tourism etc. hit a setback and it is now facing a financial predicament, as it has been designated as an organization for fiscal reconstruction in 2010. The master plan of urban planning of March 2012 is almost the only case in Japan that specifies how to shrink urban areas systematically, basically targeting the "compact town development that reduces the urban management costs". It is intended to restructure and consolidate the municipal dwelling houses, old houses for coal miners, in each area at the moment and heads for restructuring through a gradual construction of sustainable regional communities by consolidating urban areas in the north to the south in a long run.

### 3. Summary

The cases we have investigated so far made us realize that the improvement of QOL of residents is a major factor. Currently, we are working out some scenarios for systematic shrinking intending to build a method based on them to indicate the advantages and disadvantages in quantity in the future.

### Reference

Yoshiyuki Shibata "Heading for the Consolidated and Low-CO2 City Development"  
pp.20 – 21, 2012 Report of National Institute for Land

and Infrastructure Management

[http://www.nilim.go.jp/lab/bcg/siryou/2012report/2012nilim\\_I.pdf](http://www.nilim.go.jp/lab/bcg/siryou/2012report/2012nilim_I.pdf)

# Study of how to grasp design information toward understanding the performance evaluation of existing homes

Housing Department : TAKAHASHI Satoru, Research Coordinator for Housing Warranty

Housing Planning Division : MORI Masashi, Head

Housing Production Division : NUNOTA Ken (PhD, Engineering) ,Head

SUMIKURA Hideaki (PhD, Engineering), Researcher

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*(Keywords)* Existing houses, Wooden detached house, Construction methods

### 1, Introduction

In the Ministry of Land, Infrastructure, Transport and Tourism, we organize "Comprehensive plan for renovation and distribution of existing home" in March 2012. In line with this plan, we are promoting several measures, that dissemination of housing performance indication system, or expansion of residential history information system, for improvement of durable and quality of housing stock. In National Institute for Land and Infrastructure Management, We are developing of techniques and methods that can evaluate the performance of the housing, even in situations where the design drawings or specifications are scattered and lost.(1).

In this paper, we will report on the survey on the design specifications of the existing house, which was carried out as part of the study of methods to estimate the characteristics of each part from housing distribution, for design information underlying on the basic of the performance evaluation of existing homes (Information of used materials and part material components).

### 2. Cases overview and analysis of research on design specifications

As data to estimate the materials and construction methods of wooden house, "The specifications of the Government Housing Loan Corporation (GHLC specifications)" is a leading material. We have considered the so-called

conventional wooden house construction methods, and have been built along the transition of the Corporation generally specification. However, an aspect of the variation due to regional differences and production building, have almost not been investigated so far.

Therefore, for the aim of understanding the realities of the design and specifications of an existing wooden detached house built by the regional small and medium housing builder companies, we conducted a survey of existing homes publications of the drawings available, which were built by home building companies with a proven track record of supplying housing which complying with GHLC specifications over the past 30 years. Using the research method of extracting a description indicating the materials and construction method, which is used by the drawings that are stored, we recorded the data by age and material of the structure of the housing, on the actual conditions of the construction methods.

The survey up to FY 2012, we have gained the data obtained about 650 of wooden detached house by 14 builders in Hokkaido, Tohoku, Kanto, Chubu, and Chugoku area.

Figure is obtained by plotting items of transition period related to description of GHLC specifications for each builders. We gained the summary of the item that GHLC specifications is leading and the item which has less relationship in terms of the timing for the introduction of materials and construction methods of each

# Research trend and results

builder for corporation for the transition of the specification shown in Red-wave-line. On the other hand, in order to grasp the regional trend, it will be necessary to obtain more data.

**【Reference】**

1) Comprehensive Technology Development Projects "Development on performance evaluation technologies for home inspection to reduce uncertainty of existing home sales (2011-2014)" <http://www.mlit.go.jp/tec/gijutu/kaihatu/pdf/soupro011.pdf>

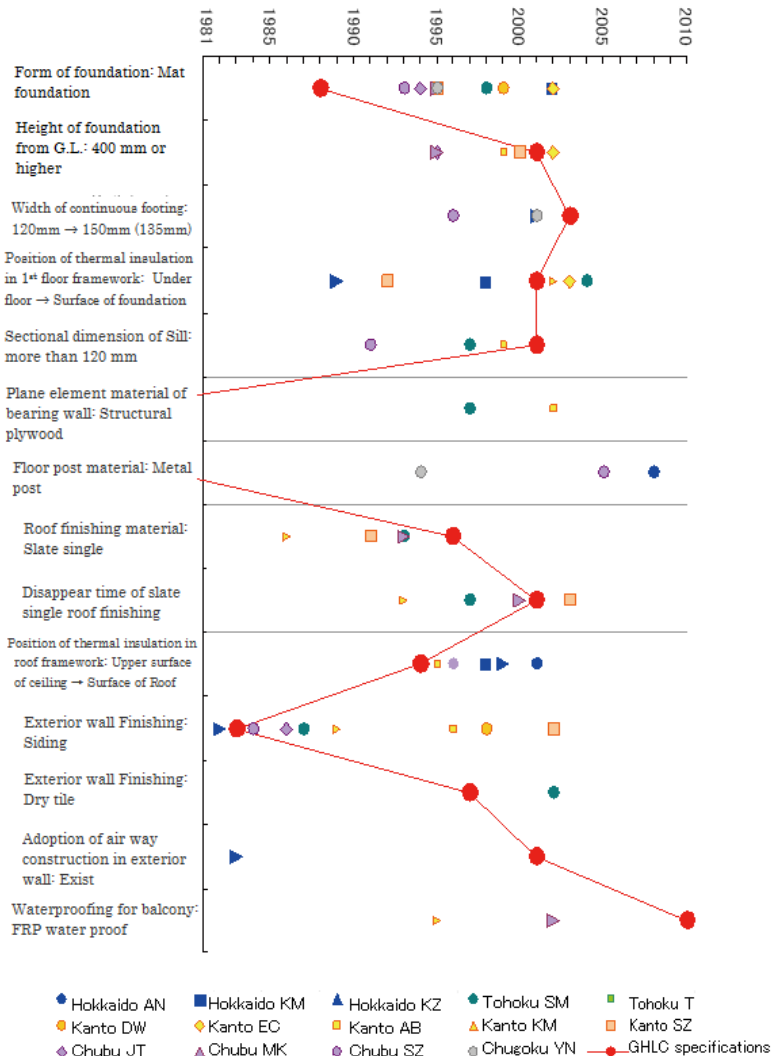


Figure: Transition period of design specifications

### 3. Subject of future investigation

For existing homes the drawing was dissipated, we plan to develop a database of the transition of the design specification with high accuracy for the establishment of a method as a clue to set the "Considered Specifications" deemed the characteristics of the materials and construction methods to retrieve data and to expand the broader realities of construction cases.

# A Case of Utilizing Results

## A New Guideline for the Creation of Safe and Comfortable Bicycle Use Environments

KOBAYASHI Hiroshi, Senior researcher  
 YAMAMOTO Akira, Researcher  
 TAKAMIYA Susumu, Head (Ph. D., Academy)  
 Road Department, Traffic Engineering Division

HONDA Hajime, Senior researcher  
 OKIMOTO Hiroto, Guest research Engineer  
 YABU Masayuki, Head  
 Road Department, Advanced Road Design and Safety Division

(Key words) Bicycle network plan, Bicycle traveling space creation, Selection of the bicycle traveling space type, Design

### 1. Introduction

In November 2012, the Road Bureau of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Traffic Bureau of the National Police Agency (NPA) issued the Guideline to the Creation of Safe and Comfortable Bicycle Use Environments (below called the "Guideline") to road managers (government managed roads, regional governments) and to prefectural police bureaus. The basic concept of the Guideline is that under the Road Traffic Law, "a bicycle is a vehicle, which in principle, travels on vehicle roads." Thus the Guideline shows items to be studied concerning the provision of road space permitting bicycles to travel safely and comfortably on vehicle roads.

NILIM has joined in making the Guideline together with the Road Bureau of the MLIT and the Traffic Bureau of the NPA on comparing and filing the standard related to the selection of the bicycle traveling space type in foreign countries, and on studying the countermeasure based on experiment in the NILIM and the problem filing in the bicycle traveling space creation model districts.

### 2. Points of the Guideline

The Guideline is composed of four view points such as "Planning," "Design," "Obeying Rules" and "Overall Initiatives".

The "Planning" describes procedures and study methods to be applied by regional authorities to enact bicycle network plans. And it also shows the concepts and yardsticks to be applied to select a form of improvement according to traffic conditions of network routes chosen by the plan (Refer to Fig.-1).

The "Design" presents concepts of design of bicycle traveling space on roads including intersections. Particularly for intersections, two plans such as mixed and separated passage of left turning automobiles and bicycles are introduced (Refer to Fig.-2).

### 3. Future schedule

The Guideline will be sequentially revised in response to technical knowledge obtained in the future and to revisions of legal standards etc., and the National Institute for Land and Infrastructure Management will also

	A: Roads where automobiles travel fast	B: Road other than A and C	C: Roads where automobiles travel slowly and the automobile traffic volume is low
Necessity for separation of bicycles and automobiles	Structural separation	Visual separation	Mixed
Type of Bicycle traveling space	Bicycle track	Bicycle lane	Mixed use on vehicle lane <small>As necessary, the road shoulder is colored, or belt-shaped road markings or pictograms are placed inside the vehicle lane on the left side.</small>
Criteria	Automobile speed higher than 50 km/h <small>For example, road with a speed limit of 60 km/h where speed restrictions are not enforced</small>	Road that is not covered by conditions A and C <small>For example, road where a speed limit of 50km/h is enforced, etc.</small>	Automobile speed of 40 km/h or less, and traffic volume of 4,000 or less

Fig.-1 How to choose a form of improvement according to traffic conditions

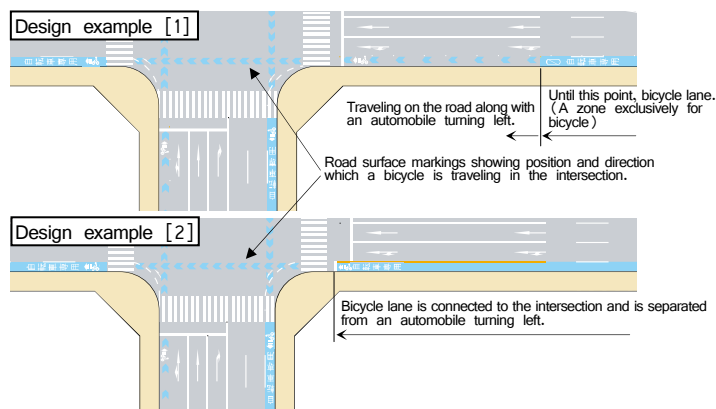


Fig.-2 Examples of Design of Bicycle Traveling Space at a Four-leg Intersection

conduct technical studies based on its application in regions throughout Japan.

#### [Reference]

- 1) MLIT Road Division HP : [http://www.mlit.go.jp/report/press/road01\\_hh\\_000300.html](http://www.mlit.go.jp/report/press/road01_hh_000300.html)
- 2) KOBAYASHI Hiroshi, YAMAMOTO Akira, KISHIDA Makoto, YOSHIDA Hidenori: Comparison with foreign countries on the planning for the selection of the bicycle traveling space type, Civil Engineering Journal, Feb. 2013
- 3) KIMURA Yasushi, HONDA Hajime, OKIMOTO Hiroto, TAKAMIYA Susumu: Study on the geometric structure for the bicycle track through the test on side, Japan Society of Civil Engineering, Proceedings of Infrastructure Planning Vol.46, 2012.11



# Research Trends and Results

## A study on transport mode choice model of domestic marine unit load transportation in view of countermeasures against global warming

Port and Harbor Department Port Systems Division

Head WATANABE Tomihiro Researcher SASAKI Tomoko

(Keywords) Unit load transportation, transport mode choice model, countermeasures against global warming

### 1. Introduction

Adoption of adequate countermeasures against global warming is an urgent problem. In the context of improvement of emissions trading scheme, and application of the exception of petroleum and coal tax for global warming since last fall, it is also assumed that difference of CO<sub>2</sub> emission among transport modes affects to choice of transportation. We have developed the mode choice model and have analyzed how the choice of transportation will be changed in the future by policy of countermeasures on greenhouse gases reduction and carbon tax considering the difference of CO<sub>2</sub> emission among transport modes.

### 2. Development of transport mode choice model of unit load transportation

Regarding domestic marine unit load transportation by ferry, RORO ship (a type of ship that has no passengers on it) and container ship, we developed an OD matrix (between 47 prefectures, but Hokkaido is divided into 4, so it has 50 segmentations) that can grasp real departure and arrival place of cargo based on net flow. We also developed an OD matrix of main items of marine unit load which transported by rail or car cargo.

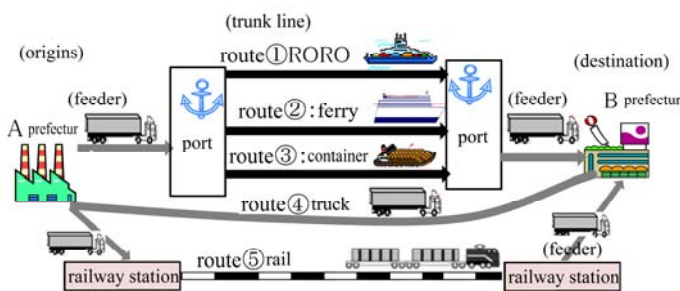


Chart-1 Route of each transport mode (Concept illustration)

And from the OD matrix, about transportation of long distance that exceeds 300km, and medium distance that is between 100km and 300km, the main OD that has large amount of cargo is extracted. Regarding the main transportation of each OD, we estimated parameter which can explain the situation of transport mode (maritime (ferry, RORO ship and container ship), car and rail;

chart-1) choice well, by aggregate logit model which includes transportation cost, transportation time, with or without transshipment, and we developed transport mode choice model.

### 3. Analysis of choice of transportation by countermeasures against global warming

Based on the transport mode choice model, an analysis was done to see how the transport mode rate changes by the difference of tax amount for carbon price and future change of CO<sub>2</sub> emissions of each transport mode.

As an analysis example, if transportation distance is 500km and carbon tax is 30,000 yen /t-C, we compare transport mode rate of 3 cases. Case A: emission of ferry is same as present situation. Case B: emission of ferry is reduced 20% by technical innovation. Case C: emission is the same as case B and speed of ferry is reduced 20%. In case B, share of car is decreased and share of ferry is increased, but in case C, share of ferry is decreased significantly compared to case A. (chart-2)

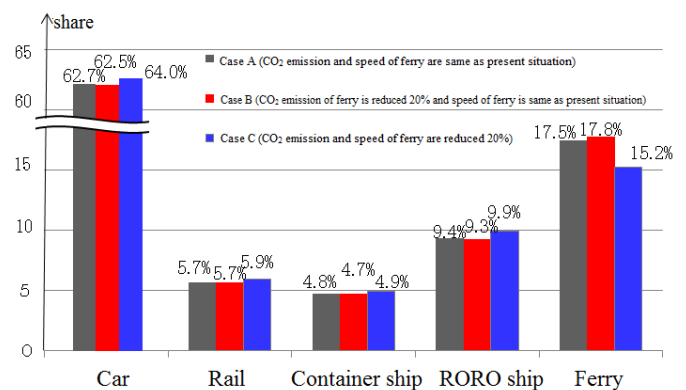


Chart-2 Impact to the transport mode rate by CO<sub>2</sub> emission and speed

### 4. Conclusion

We will consider differences of CO<sub>2</sub> emission by operational speed, and upgrade transport mode choice model.

### Reference

TECHNICAL NOTE of NILIM No.708

<http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0708.htm>

# Research Trends and Results

## Characteristics Analysis of the International Ferry, RO-RO Ship and Transport Cargo

GOTO Shuichi, Researcher,  
 Port and Harbor Department, Port Planning Division.  
 WATANABE Tomihiro, Head,  
 Port Systems Division.  
 ABE Motohisa, Head,  
 Port Planning Division.

(Key words) International Ferry, International RO-RO Ship, Ship Dimensions, Cargo Flow

### 1. Introduction

Now that the relation with Asian economy becomes closer than ever and more rapid and effective transport is required, we see that the needs for the transport by the international ferries and RO-RO ships are more required than ever. Therefore it is necessary to grasp their transport trends and make an analysis so as to contribute to future demand forecasts.

Based on the background, we have conducted the characteristics analysis on the international ferries and RO-RO ships as well as cargo transported by them. Here a part of such analysis is introduced.

### 2. Analysis on the international ferries and RO-RO ships dimensions

Based on the shipping company HP and dimensions Data developed by MDS, Lloyd's and so on, we have made comparisons and analysis of the dimensions such as ship length, width, full load draft, etc. of the international ferries and RO-RO ships providing service in East Asia including Japan, Korea, China and so on, and of ships in areas other than East Asia such as Europe and America. Fig. 1 shows, for example, the ship length plotted on the vertical line and international gross tonnage (GT) on the horizontal line classified by the service area and ship type.

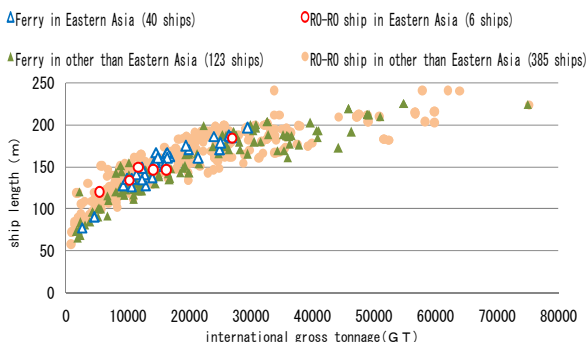


Fig. 1 Comparison of dimensions of the international ferries and RO-RO ships per service region

The figure shows that the international gross tonnage is approximately maximum at 30 thousands GT and ship length is approximately maximum at 200m for the international ferries and RO-RO ships in the East Asia, while it exceeds 30 thousands GT and 200m for those in areas other than East Asia. This shows larger ships are deployed for services in areas than other East Asia.

### 3. Analysis on the hinterland (background area) of the international ferries and RO-RO ships

Based on the 2008 National survey on Import/Export Container Cargo Flow data, we analyzed the hinterland areas of the cargos carried by international ferries and RO-RO ships and compared them with those of container ships. As an example of such an analysis, Table 1 shows the percentage of the hinterland regions regarding the cargo imported at the Hakata port in which the regular services of the ferries, RO-RO ships and container ships are available. Likewise, Fig. 2 shows the percentage of 207 daily life spheres in the cargo total by the RO-RO ships calling at the Hakata port.

Table 1 Hinterland (consumption area) of the imported cargos using the Hakata port

Hakata port	Percentage of respective area in cargo total						Cargo total (Freight tons)
	Kanto	Chubu	Kinki	Kyushu	Others	Total	
Ferry	0.9%	7.4%	0.3%	87.1%	4.2%	100%	32312
RO-RO ship	47.7%	18.3%	13.4%	15.5%	5.1%	100%	10571
Container ship	0.7%	0.1%	1.7%	95.7%	1.8%	100%	97596

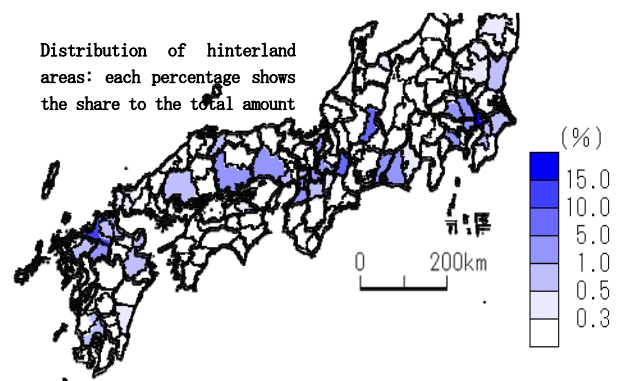


Fig. 2 Distribution of Hinterland (consumption area) of the RO-RO ship cargos calling at the Hakata port

While we see that the 80% or more cargo transported by ferry and container ship are consumed in the Kyushu area, the rate of RO-RO ship is just around 15%. In addition, approximately 50% of such cargos are consumed in the Kanto area, showing that cargo by RO-RO-ship calling at the Hakata port have much larger hinterland areas compared to those of the ferry and container ship.

【Reference】

Technical Note of NILIM No.707, 2012

<http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0707.htm>

# Research Trends and Results

## Research on the possibility of new domestic airline route by downsizing of aircraft and LCC.

HATANO Takumi, International Maritime Policy Analyst

Airport Research Department

(Keywords Domestic airline, cost analysis, LCC, Small aircraft)

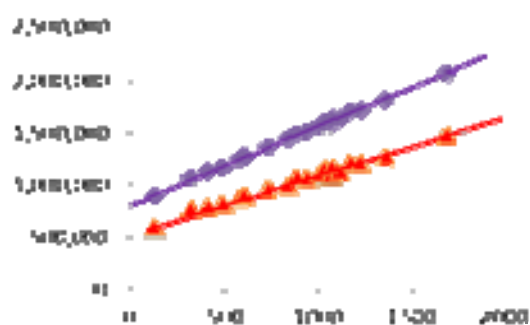
### 1. The purpose and overview of this study

In our domestic air transport, our aircraft was bigger compare to Europe and America, but lately air carriers have phased in so-called regional jets which have less than a hundred passengers. Meanwhile, new air carriers so-called low cost carriers (LCC) that feature low-cost have been expanding their business in Southeast Asia. In 2012, three companies that are full-scale LCC have successively started service in Japan.

Based on the situation surrounding air transport, this is a consideration regarding the formation possibility of new airline routes by downsizing aircrafts and price reduction.

### 2. Cost analysis of domestic air carrier

Regarding domestic air carrier cost, we calculated the cost per flight for flight distance for one model of aircraft, and it's based on the information of an air carrier that publishes a full detail of the cost as IR. Also, we ran the numbers on the cost level of using small aircraft from the comparison of a unit cost per seat and km and indicated the results in chart 1.



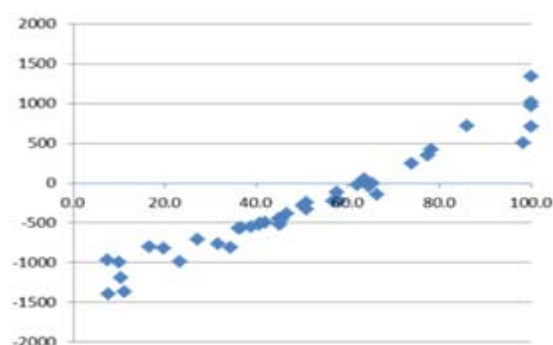
Draw1 Estimated cost (Yen) by flight distance (Km)

### 3. Demand analysis and consideration of new airline formation possibility

For demand analysis that is preconditioned for the airline formation possibility, a demand forecasting model that was developed by The National Institute for Land and Infrastructure Management (NILIM) was used. For basic data, such as economy, an index of 2011 was used. About 45 routes that are subject for this, the numbers are run for two flights per a day that is the most convenient times as an ideal condition.

Regarding airfare level, it is just about the present

level for small craft, and it was calculated as 70% of the present for LCC. Load factor (LF) and assumed freight revenues are estimated for the assumed demand. The results are indicated in chart 2. Based on the results, routes that have airline formation possibilities are indicated in chart 1.



Draw 2 LF and balance of payments (for small aircraft)

Chart 1 Routes that have airline route formation possibilities.

Airlines that are considered as airline formation possibility by using small aircrafts		Airlines that are considered as airline formation possibility by LCC
Matsumito-Naha	Chitose-Miyazaki	Sendai-Tokushima
Kansai-Obihiro	Sendai-Tokushima	Kansai-Obihiro
Sendai-Asahikawa	Chubu-Kushiro	Chubu-Kushiro
Narita-Hanamaki	Niigata-Okayama	Sendai-Asahikawa
Narita-Niigata	Kitakyushu-Sendai	Narita-Kagoshima
Narita-Miyazaki	Sendai-Matsumoto	Narita-Hanamaki
	Narita-Kagoshima	

### 4. Challenges for the future

Change of a situation around airline industry is so fast. The three full-scale LCC companies actually present lower rates than this supposition. Each LCC plans to expand its aircrafts, so follow-up for the situation will be needed in the future.

#### 【Reference】

- 1) TECHNICAL NOTE of NILIM No.698  
<http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0698>.

Airlines that are considered as airline formation possibility by using small aircraft

Airlines that are considered as airline formation possibility by LCC

# Policy Simulation Based on Airport Demand Management Policy and the Market Entry of Low-Cost Carriers(LCCs)

INOUE Gaku, Senior researcher

TANSEI Kiyoteru, Director

Airport Department, Airport Planning Division

(Key words) Airport Planning, Low Cost Carriers (LCC)

## 1. Introduction

Under current circumstances the tight capacity in high-demand airports rises up to the surface, it is now becoming highly required to develop a simulation method in order to evaluate the airport demand management policy (slot limitation restrictions, aircraft bans and tax changes) reflecting the domestic aviation market and the entry of Low Cost Carriers(LCCs). For that purpose, we have enhanced and developed such a method and simulated the effect of airport demand management policy and the market entry of LCCs.

## 2. Enhancing the existing domestic aviation market model

We have enhanced the existing domestic aviation market model, which combined the Cournot Nash Equilibrium model and the flight allocation model, in order to consider the competitive situation with other transport modes such as trains. Then we simulated and analyzed the changes in passenger demands, average flight fares and the number of flights by policy alternatives between three multiple airports region: capital region to Kansai area, capital regions to North Kyushu area, and Kansai area to North Kyushu area. Consequently, we estimated the policy which can trigger desirable airfare deductions and effectiveness from the flight passenger's change of route and rise in total utility level.

## 3. Developing a method of simulating air transport demand changes when low cost carriers (LCCs) enter

We have developed a method of simulating air transport demand changes when low cost carriers (LCCs) enter into the domestic aviation services based on the Bertrand Nash Equilibrium. Consequently, we analyzed

the changes in passenger demands, average flight fares and the number of flights on three major routes: capital region to Kansai area, capital regions to North Kyushu area, and Kansai area to North Kyushu area. The changes are estimated to be significantly different among the routes. Shown below is an example of the case between Kansai area and North Kyushu area. Our simulation result suggests that there would be found little reaction from existing Full Service Airlines (FSAs) though LCCs' airfares would be reduced 10 to 20% when supposed that one of the existing FSAs was substituted by an LCC whose unit cost was around the half of existing FSAs.

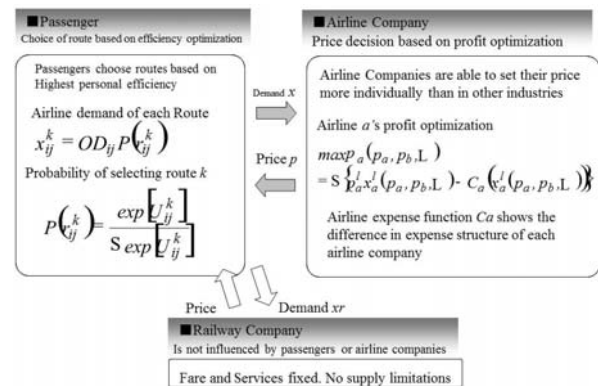


Figure 4: Summary Model of Analysis of Fare Competition

Fig. A proposed method of simulating air transport demand changes when low cost carriers (LCCs) entry

## 4. Closing remarks

We plan to further enhance the model and conduct an empirical analysis on the changes in domestic civil aviation market by the market entry of the LCCs.

【 Reference 】 Technical Note of NILIM No.694 and Proceedings of Infrastructure Planning Vol.46 (137) and (139)



# Research Trends and Results

## International Collaborative Research in ITS Field

KANAZAWA Fumihiko, Head

WATANABE Ryouichi, Senior researcher

TANAKA Yoshihiro, Researcher

TSUKIJI Takahiro, Researcher

Intelligent Transport Systems Division, Research Center for Advanced Information Technology

*(key word) probe data, evaluation tools and methods, international standard*

### 1. Introduction

Intelligent Transport Systems Division is conducting the collaborative research with US and EU in ITS (Intelligent Transport Systems) field. Between Japan and US, we have had the workshop with Department of Transportation every year since 1993 and Japan-US task force meeting comprised of practitioners was set up in 2009 and is held several times a year. Between Japan and EU, we have had the workshop with Communications Networks, Content and Technology office every year since 1994. At the same time we exchange our opinions for making the collaborative research plan through teleconference. In this paper, we will report the trend and results especially about three fields of “probe data”, “evaluation tools and methods” and “international standard”, which are agreed to be examined before anything in the collaborative research between Japan and US.

### 2. Trend and result of research

“Probe data” : through Japan-US task force meeting, we discussed the comparison of probe systems and probe data items between Japan and US and the application candidates enabled by probe data, and put the mid-term report of collaborative research in October, 2012. The summary of the mid-term report was presented and the fact sheets were distributed at ITS World Congress Vienna 2012. Hereafter, we will rank the application candidates, define the services of selected applications and arrange the issues in realizing the system. Then we plan to pull the final report together by ITS World Congress Tokyo 2013.

“Evaluation tools and methods” : in October, 2012, we agreed to the collaborative research plan where we conduct the comparison and analysis of evaluation indicators and measurement methods in experiments or simulation cases on cooperative systems of both sides (Japan and US), the preparation of the definitions of terms, the classification and systematization of evaluation indicators and measurement methods, and the arrangement of issues and lessons learned from the

### List The Application Candidates Enabled by Probe Data

	Application
1	Estimate traffic management measures (e.g., travel time, speed, delay)
2	Identify bottleneck locations
3	Identify accident-prone locations
4	Identify road closures
5	Detect stopped vehicles or obstacles on the roads
6	Identify duration of congestion
7	Determine pavement traction conditions
8	Identify HazMat vehicles
9	Incident management/Emergency response
10	Route guidance
11	Traveler information
12	Intelligent signal systems
13	Freight operations
14	Transit operations
15	Intelligent network (freeway/arterial) flow optimization
16	Eco-Signal Operations
17	Eco-Lanes
18	Dynamic Low Emissions Zone
19	Road and infrastructure deterioration diagnosis

measurement of evaluation indicators, etc. We plan to put the mid-term report of this collaborative research by ITS World Congress Tokyo 2013.

“International Standard” : as an observer, we keep on attending “standardization working group” of “technical task force” on standardization of cooperative ITS, one of the cooperation fields between EU and US governments. Thus we collect information and offer our knowledge about “security management” and “communications protocol.”

### 3. Development hereafter

Based on the result of the research so far, we will conduct the collaborative research by trilateral cooperation of Japan, US and EU hereafter.

(reference)

1) factsheets of the mid-term report on probe data

[http://www.its.dot.gov/factsheets/us\\_japan\\_probe\\_data.htm](http://www.its.dot.gov/factsheets/us_japan_probe_data.htm)



# Research Trends and Results

## Traffic Volume Survey Using Image Processing Technology

Hiroataka SEKIYA, Hiroyoshi HASHIMOTO, Keiji MOROTA, Susumu TAKAMIYA  
Traffic Engineering Division, Road Department

(Key words) Road traffic, Traffic volume survey, Image processing technology, International cooperation

### 1. Introduction

The primary method for measuring traffic volume on arterial roads in Indonesia is the combined use of an inductive loop and a piezoelectric sensor (LPS) as shown in Figure 1. However, this method lacks accuracy. Obviously, an LPS device cannot detect motorbikes that do not pass over it. Also, when several motorbikes are on the LPS device at the same time, they are counted as one vehicle or are not counted at all. In terms of durability, the LPS device often fails due to damage caused by overloaded vehicles. The labor and cost for monitoring and maintaining the sensors are considerable.

In this context, the Institute of Road Engineering (IRE) in Indonesia and the National Institute for Land and Infrastructure Management (NILIM) in Japan launched in 2010 a joint study to devise an optimal method for measuring traffic volume in Indonesia by using image processing technology (IPT). This is one of the activities based on a memorandum concerning cooperative activities that was concluded between the IRE and the NILIM in 2009.

### 2. Traffic measurement using IPT

We used an IPT device that involves the spatio-temporal Markov random field model (S-T MRF model), which was proposed by Kamijo *et al.*<sup>1)</sup>. As shown in Figure 2, when the device detects a moving object within the analysis area in the image, the device starts following it. If the object passes the first check line and the second check line in this order, it is counted as a vehicle. The device also measures the size of the moving object when it reaches the first check line, and can thus classify vehicle types.

### 3. Analyses and Results

By analyzing the traffic images obtained from field surveys on an arterial road in Bandung, Indonesia under several traffic conditions and camera settings (Figure 3), we verified the applicability of the IPT device to traffic volume survey in Indonesia and gained the following knowledge:

- The error ratio of traffic volume measured by the IPT device was on average 5.3% for cars and 13.1% for motorbikes.
- The error ratio for motorbikes tends to increase by

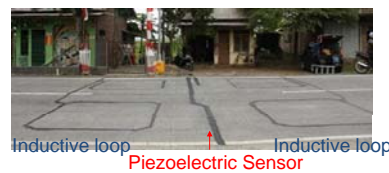


Figure 1 Configuration of LPS

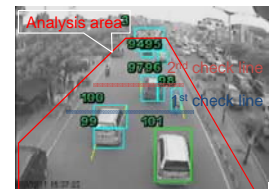


Figure 2 IPT

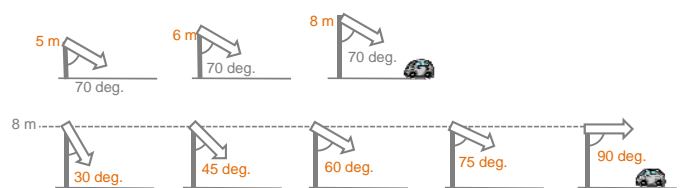


Figure 3 Camera settings

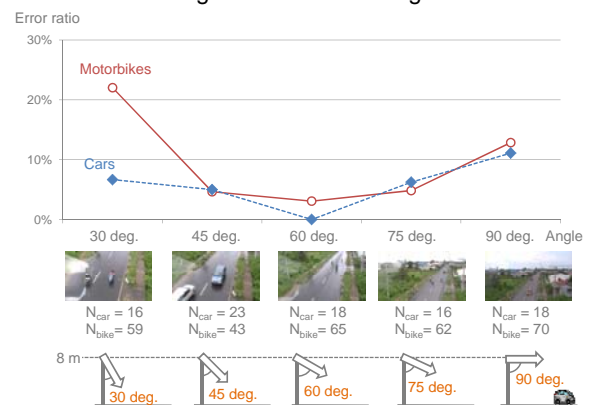


Figure 4 Error ratios with different camera angles

- 10.8% in congested traffic.
- Installing the camera at a greater height (up to 8 m) makes it possible to capture a longer movement of vehicles in an image, which helps reduce the error ratio.
- An angle of 60 degrees from the vertical is optimum to measure traffic volume accurately under conditions where the camera is 8 m from the ground and the traffic is not congested (Figure 4).

### Reference

- 1) Kamijo, S., Matsushita, Y., Ikeuchi, K., Sakauchi, M. (2000) Occlusion robust vehicle tracking utilizing the spatio-temporal Markov random field model. Proceeding of Proceedings 15th International Conference on Pattern Recognition, vol.1, pp.140-144.

# The Interim Report Workshop held in Japan

SONE Shinri, Head

WATANABE Haruhiko, Senior Researcher

MATSUSHITA Tomoaki, Researcher

Planning and Research Administration Department, International Research Division

*(Key words) Technical Standards, Overseas Development, Research Cooperation, Indonesia, Vietnam*

## 1. Introduction

Director General of National Institute of Land and Infrastructure Management (hereinafter referred to as “NILIM”) have signed for Memoranda Concerning the Joint Research with Institute of Road Engineering, Ministry of Public Works, Indonesia (hereinafter referred to as “IRE”) on November 2009, also Director General of NILIM have signed with Institute of Transport Science and Technology, Ministry of Transport, Vietnam (hereinafter referred to as “ITST”) on May 2010.

NILIM is respectively proceeding on the Joint Research based on a Road Map of specific the Joint Research.

## 2. Outline of the Interim Report Workshop

From 25<sup>th</sup> to 29<sup>th</sup> June 2012, NILIM held “The Interim Report Workshop” (hereinafter referred to as “The Workshop”) in Japan with IRE and ITST.



Photo 1 Group photo

The Workshop was held as a place where researchers made interim reports of detailed activities of Joint Research and shared activities of the Joint Research.

Participants were from NILIM, The Public Works Research Institute (hereinafter referred to as “PWRI”), IRE, ITST, and Private Companies.

In The Workshop, after opening speech by Mr. NISHIKAWA (Director General of NILIM), Participants

reported intermediate outcomes of each research category (Road Environment, Road Traffic, Traffic Safety, Pavement, Durable Painting), and discussed details of future the Joint Research with counterparts.

NILIM held Technical Tour at places related to the Joint Research (such as the Experimental laboratory of PWRI, Civil Engineering Research Institute for Cold Region (CERI), etc.). Participants deepened understanding on the civil engineering technology of Japan.



Photo 2 The Workshop and Technical Tour

## 3. Conclusion

NILIM is continuously proceeding on the International Activities and Researches for the overseas development. Further NILIM will be making efforts to disseminate results of Joint Research to the Asian countries, for example, development from the Joint Research to the JICA project etc.

### 【Reference】

NILIM HP (International Activities)

<http://www.nilim.go.jp/lab/beg/foreign/kokusai/kokusaitekikatudou.htm>



# TOPICS

## Opening effect of Shin Tomei Expressway of road traffic seen from the data observed at all times

Road Department Traffic Engineering Division  
 Researcher HASHIMOTO Hiroyoshi Resercher MOROTA Keiji  
 Guest Research Engineer MIZUKI Tomohide  
 Head TAKAMIYA Susumu(PhD.)

(Keywords) proved data, traffic data, Effective road maintenance

### 1, Introduction

Since Shin Tomei Expressway, between Gotemba JCT and Mikkabi JCT opened in April 14, 2012, the double network of Shin Tomei Expressway and Tomei Expressway was formed. (fig.1)

We Road Department are working on the opening of the Shin Tomei Expressway effect analysis with the Chubu Regional Road Maintenance Bureau.

In this paper, we introduce some of the road traffic data and the results of the analysis using the full-time road traffic data observed with the probe data presented by the private companies.

### 2, Change in the amount of traffic on the main cross section in Shizuoka Prefecture

Since the Shin Tomei Expressway has opened, the traffic of Shin Tomei Expressway, Tomei Expressway and Route 1 (Shizuoka Prefecture central cross section) has increased 14%. Total traffic in Shizuoka prefecture has increased: 13% in west cross section, 7% in east cross section)

### 3. Speed and Punctuality of Time required in Shin Tomei Expressway and Tomei Expressway

After the opening of Shin Tomei Expressway, the travel speed of Tomei Expressway is improved. Also we find that the drivers on Shin Tomei Expressway drive faster than Tomei Expressway, which divers on Shin Tomei Expressway can drive at 100km / h in almost all the sections. (fig. 3 above)

Looking at the amount of time required between Gotemba JCT and Mikkabi JCT , before and after the opening Shin Tomei Expressway, we find the significant improvement in punctuality that the variation in the duration of Tomei Expressway has decreased by 34 minutes (101 minutes to 135 minutes) to 12 minutes (100 minutes to 112 minutes).

We have found that in Shin Tomei Expressway, the duration is 90 minutes to 102 minutes, which is shorter than before opening and the variation is about the same. (fig.3 below)

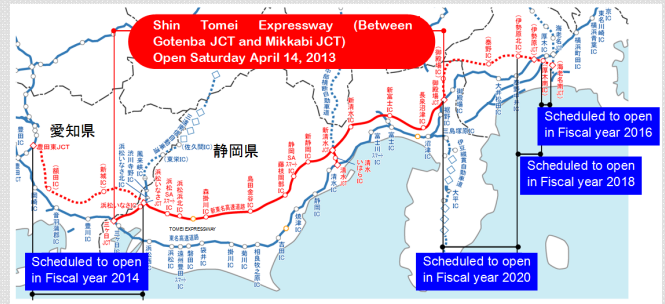


Fig.1 Schedule to open in the future and the opening section of Shin Tomei Expressway

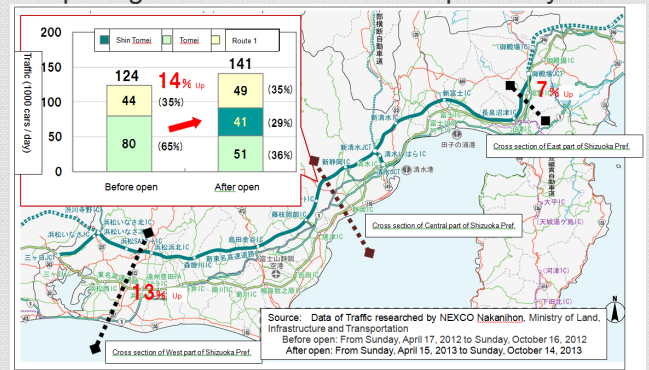


Fig.2 Change in the amount of traffic on the main cross section in Shizuoka Prefecture

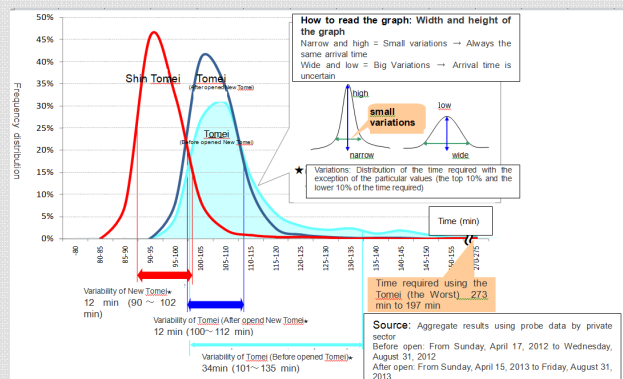
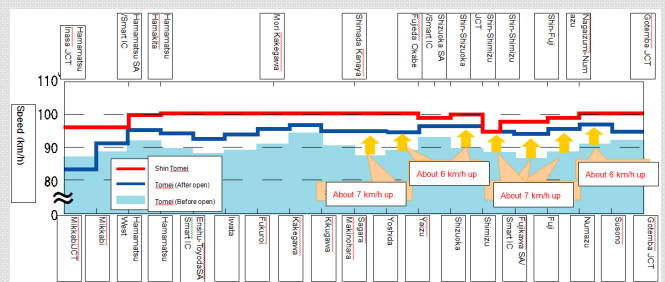


Fig.3 Distribution of travel speed and travel time between Gotemba JCT and Mikkabi JCT

# Impacts on the riverine estuary area of the Kitakami River by the Great east Japan earthquake disaster

NAKAMURA Keigo, Senior Researcher (Ph. D., Engineering)

IWAMI Yoichi, Head

HAGA Masataka, Research Engineer

Environment Department, River Environment Division

(Key words) *Reedbed, Ground subsidence, Tsunami deposit*

## 1. Introduction

Tsunami caused by the Great east Japan earthquake disaster has given extensive damages on the Tohoku region mainly on the Pacific maritime area. That Tsunami has not only deprived people of lives and properties but also given serious damages on the natural environment of those areas.

Here, we are to report the effect that the Tsunami has made on the environment of the riverine estuary mainly on the reedbeds based on the survey results made on the river mouth of the Kitakami River that has passed around one year from the disaster

## 2. Overall condition of the vegetation on the river mouth after disaster

The survey was made on March 2012 in the area from the river mouth of the Kitakami River to Kitakami barrage (17.2kp : Distance from the river mouth (km)) as shown in Fig. 1. Implemented survey items were river geomorphology, vegetation and sediment along the river corridor.

Before the disaster, almost all the flood channels from 2kp to 9kp were covered by mainly reedbeds, and salt marsh vegetation and Ogi (*Miscanthus sacchariflorus*) have grown in a little higher portions at the periphery of the flood channels. Survey after the disaster has revealed that the vegetation area was reduced to the half and almost all of the observed vegetation were reedbeds with only a small magnitude of new salt marsh vegetation observed around 6.5kp.



Fig. 1 Surveyed area in the Kitakami River mouth (downstream of the Kitakami Barrage)

## 3. Effects on the reedbeds caused by the Tsunami deposit and ground subsidence

As probable causes of the effect on the reedbeds in the riverine estuary, it is considered the erosion by the Tsunami, changes in the altitude and salinity by ground subsidence, and burial on land by the Tsunami deposit.

Reedbeds around the Kitakami River mouth were largely flushed away by the Tsunami, in which survived dimension was reduced to the half. Further the vegetation ground level has lowered due to the ground subsidence and we have found that it was difficult to bring up reeds due to the effect of the increased salinity in the area from 0kp to 4-5kp.

Also, though the effect of the salinity was not critical in the upper stream over 5kp, still largely affected by the deposit brought by the Tsunami (mainly sand from the sea), there found no new growth in those places that have thick Tsunami sediments as shown in Fig. 2.

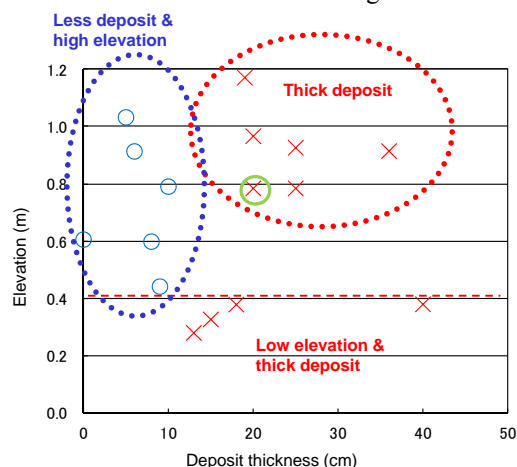


Fig. 2 Impact on Reedbeds by the Elevation Level and Thickness of Tsunami deposits (○ : New growth observed, × : New growth not observed)

## 【Reference】

- 1) NAKAMURA Keigo (2012), "Impacts of the Tsunami of the Great East Japan Earthquake on Riverine Estuary, a case study: the Kitakami River Mouth," Kasen (in Japanese with English abstract), No. 795, October 2012, pp.41-462.
- 2) ENDOU Maremi, ONUMA Katsuhiko and AMANO Kunihiko (2012), "Analysis of the Impact on Estuarine Vegetation from Sinking Ground by the 2011 Off the Pacific Coast of Tohoku Earthquake," Journal of River Engineering, Vol.18, pp. 53-58.

# Development of the Estimation Method of the Sediment Transport using the Chemical Composition

OKADA Tomonari, Head (Ph. D., Engineering)

Coastal, Marine and Disaster Prevention Department, Marine Environment Division

(Key words) Environment, Earth and sand management, Sediment, Sediment transport, Chemical composition, Inner bay

## 1. Introduction

In the port and harbor, we have to manage the earth and sand sediments and sediment transport appropriately on the view point of not only the maintenance of the basic functions of the port such as to ensure the sea route but also the environmental interest such as the cause of water contamination and basis of the inhabitation of living substances.

If we view it from the environment, microscopic particles are likely to catch organic substances and harmful chemical substances and the accumulation of such particles are making the sediment worse. Therefore it is important to grasp the transport of the microscopic particles for actions to improve the sediment. Now that it is currently remarked that radioactive substances adhered to microscopic particles are also moving into the marine area from the land and accumulating, it is increasingly important to grasp the transport of the microscopic particles to improve the sediment. On the other hand, fine sand and sand have functions as good basis for the inhabitation of living substances. It is imperative to grasp the moving route of the fine sand and sand so as not to accidentally block such routes by various works and affect the existing habitats.

Therefore, in this research we have developed a method to use chemical composition of the sediment as a new method to estimate the transport of the sediment.

## 2. Method

We have implemented an analysis using sediments collected from many points in the Tokyo bay. We have used a Wave Length-dispersive X-Ray Spectroscopy<sup>1)</sup>. As this system is applicable to measure from light elements (F) to heavy elements (U) on the Periodic Table, this time we have used the values of Al, Fe, K, Mg and Si. The analysis was implemented on classifying each sample into the silt fraction under 63 $\mu$ m and sand over 63 $\mu$ m as we have considered the adhesive capability of the chemical substances and difference in transport characteristics caused by the current.

## 3. Result

All of the collection points of sediments were classified into five groups as for the silt fractions through the cluster analysis (Fig.). Chemical composition of the silt fractions moved in from the Sumidagawa River, Arakawa River and Edogawa River have belonged to the same group ■. Based on the distribution range of the points of ■, we have estimated that the silt fractions moved in from the

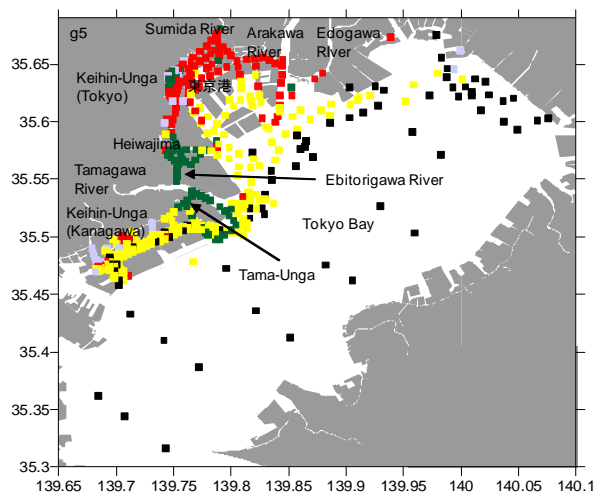


Fig. Grouping through the cluster analysis against the chemical composition of the silt fraction

Sumidagawa River, Arakawa River and Edogawa River were giving strong effects within the Port of Tokyo and over Heiwajima of the Keihin-Unga (Tokyo side). Silt fractions ■ that moved in from the Tamagawa River were estimated to have strong effects river mouth of the Tamagawa River as far as Heiwajima through Ebitorikawa River northward and as far as Daishi-Unga through Tama-Unga southward. The strong effects on the area offshore of the were not clear. Although we have been predicting that there must be difference between the mouth side and head side of the Tokyo bay, they both belonged to the group of the same chemical composition ■.

## 4. Conclusion

We have shown the possibility of using the chemical composition as a new index to estimate the effect range and transport routes of the sediments of different origins. We are further studying the crystal construction as an additional index. This is to segmentalize the elements evaluated as same group based on the chemical composition. Those methods are expected to become useful methods to grasp the sediment transport and implement appropriate management of the earth and sand.

### 【Reference】

- 1) OKADA Tomonari et al (two) (2009) , Estimation of the spacial distribution of sediment using chemical composition and particle-size distribution, Annual Journal of Coastal Engineering, 56, 976-980.



# Estimation of the garbage volume flowing into the Tokyo Bay

HINATA Hirofumi, Head (Ph. D., Engineering)

KATAOKA Tomoya, Researcher

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

(Key words) Sea garbage, Ocean radar, Environment improvement ship, Inverse estimation

## 1. Background and purpose of the research

A floating dock has drifted down to the west coast of America, 90 or more found foreign types, it costed eighty thousands dollars to dispose of them - Problems of the sea garbage that was come up after the Great East Japan Earthquake. Such is the environmental problem of the crossing border type that is becoming serious mainly in the East China Sea and Sea of Japan in our country. In general, first step to resolve the environmental problem is to recognize the actual state through the monitoring (quantification). As for the sea garbage, the most typical monitoring method still being used is garbage collection by human hands, and that is the significant bottleneck to implement the problem solution (reduction). If you want to know the density of the dissolved oxygen (DO), just use a DO meter. But there exists no "Sea garbage meter" to measure the sea garbage so far.

Under such a background we are proceeding to develop the sea garbage monitoring (quantification) technology. There are several methods such as the one to calculate dimensions covered with drifted garbage based on a image shot by Web camera<sup>1)</sup>, another is to estimate the sea garbage generation volume (flow-in volume) based on the Drifting garbage collection data issued by the national and local public agencies<sup>2</sup> and so on. Here, we would like to introduce the estimated result of the volume of garbage - of reeds having the largest collection volume when classified by type - drifted into the Tokyo bay in FY2008.

## 2. Method

For the estimation, we have used the Drifting garbage collection data by the Environment improvement ship "Bay clean" (Kanto Local Management Division) and Inside bay surface current speed yard measured by the Ocean radar. It is possible to estimate the volume and type of the garbage that Bay Clean has collected by referring to the Daily Report and collected points and time based on the ship route data. We have used the Inside bay surface current speed yard by inverting it to backtrack the garbage drifting route from the collected point to find the flow-in source (river mouth) and flow-in time. As for the flow-in volume, we have calculated the green coefficient (to know the percentage of the unit garbage flow-in volume that has arrived at the collected point at collection time) beforehand and determine the flow-in volume by using the least square method so that it becomes equal to the actual collection volume. It is the same method as the Tsunami wave source inversion.

## 3. Application of the estimation result and outcome

There is a distinct relation between the garbage flow in volume and river water flow-in volume (Fig.). It suggests that it is applicable to estimate the garbage flow-in volume from the river water flow-in volume. Flood from the August end to September beginning (10 days) has produced garbage corresponding to 32% of the year total that has flown in. On the other hand, there found almost no flow in garbage in a normal period that has no rain.

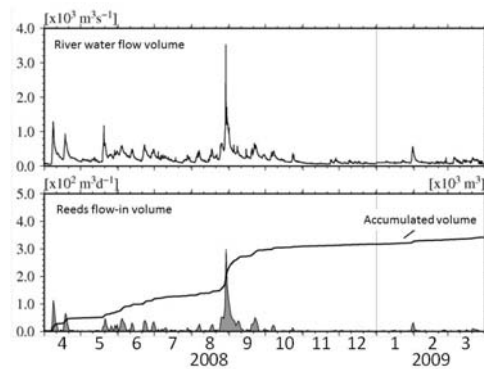


Fig. Estimation result of the river water (upper) and volume of flow-in garbage

If we suppose the accumulated time of the surface current water as some days to ten days, the density of the sea garbage shall be the order of  $10^1$  L/km<sup>2</sup> in normal period and around 100 times in the flood period. At the time of the flood, the garbage shall accumulate around the current rip between the plain water and seawater. On the contrary, in normal time there is garbage of small volume and further they are dispersed as there found no distinct current rip. If we talk about the annual collection volume, the point is how we can collect effectively at the time of flood. However, another discussion shall be required whether or not to put only the annual garbage collection volume as the management target of the Environment improvement ship.

If applied the technology introduced here, it becomes possible to estimate the garbage flow in volume and drifting position from the current "river water" flow in volume and Surface current speed yard (Ocean radar). It becomes possible to do simulation to know how many garbage shall be (or was) collected on what timing and where.

### 【Reference】

- 1) Kataoka et al., MPB, No.64, 1829-1836, 2012.
- 2) KATAOKA et al, Coastal ocean research, No.49, 113-126, 2012.

# Manual of the slope revegetation method for conservation of regional ecosystem

IIZUKA Yasuo, Senior researcher

OONUKI Makiko, External researcher

KURIHARA Masao, Head

Environment Department, Landscape and Ecology Division

(Key words) *face of slope, slope revegetation, native species, surface soil, soil seed bank*

## 1. Introduction

On the slope face that is constructed accompanied by development business, afforestation has been implemented mainly by using exotic plants to the present, but there arose a problem of giving bad effect on the local ecological system through partial exotic plants growing outside the slope face.

Further, in an area that has a good natural environment, it is required to decrease effects on the local ecological system by utilizing native plants that is the regionality system (plant group having a certain commonality in genes).

This guideline is the outline of the method to afforest the slope face by utilizing native plants in the area in order to resolve the problem of exotic plants.

## 2. Outline of the Manual

As the slope face afforestation method using the local native plants, there are three construction methods such as “Surface soil use method,” “Natural invasion promotion method” and “Local seeds and nursery trees use method.” (Fig. 1) Each of them is respectively a method of afforestation utilizing the soil seeds buried in the surface soil of the developed land or seeds or seeds/nursery trees of the native plants growing in the developed land, which is a method to create vegetation appropriate for the targeted afforestation.

### (1) Surface soil use method

It is an afforestation method to utilize the soil seeds buried in the surface soil, which is appropriate in case where earlier afforestation was required. The condition is that there should be surface soil containing buried seeds of target vegetation around the slope face in question. More specifically, there exists a method that collects and stores the surface soil beforehand and after having created the slope face, mix that soil with the vegetation material and implements the work through the vegetation material blow work.

### (2) Natural invasion

### promotion method

It is a method to capture those seeds invaded from natural vegetation around through the wind dispersal and bird dispersal and expect the vegetation recovery by bud break and settlement of those seeds on the vegetation mound, which is appropriate in case where a certain period was allowed to create vegetation. The condition is that target vegetation exists adjacent to the slope. More specifically, there is a method to locate vegetation mats in order to capture invading seeds easily.

### (3) Local seeds and nursery trees use method

It is a method to utilize the seeds collected from natural vegetation around as well as nursery trees brought up from them, which is appropriate in case where ensured and earlier vegetation was required. The condition is that seeds or nursery trees of target vegetation are secured. More specifically, there is a method to implements the work through putting collected seeds on the vegetation material blow work, planting work of nursery trees, and nursery tree set blow work that mixed two methods.

## 3. Public announcement of the result

We have published this result as the TECHNICAL NOTE of NILIM No.722. We expect that this guideline contributes to develop a slope face that confronts the denudation and secure and maintain the biodiversity.

<http://www.nilim.go.jp/lab/ddg/>  
(Landscape and Ecology Division)




	Surface soil use method	Natural invasion promotion method	Local seeds and nursery trees use method
Application	Case where earlier afforestation is required. There exists surface soil that contains buried seeds of afforestation targeted vegetation (woods or field) around the slope.	Case where a certain period was allowed to create vegetation. There exist vegetations of targeted afforestation adjacent to the slope (Seeds flying in expected).	Case where ensured and earlier afforestation is required. There exist vegetations around that can secure seeds and/or nursery trees of the plants of targeted afforestation.
Outline	Afforestation method that utilizes buried seeds contained in the surface soil. <u>Work example of Surface soil + Vegetation material blow work</u>  (Just after the work) (Six years from completion of the work)	Afforestation method that utilizes those seeds that naturally invaded from periphery. <u>Work example of the Vegetation mat construction</u>  (Just after the work) (Six years from completion of the work)	Afforestation method that utilizes seeds and/or nursery trees collected in periphery. <u>Work example of the Local seeds and nursery trees plant construction</u>  (Just after the work) (Six years from completion of the work)

Fig. 1 Examples of construction works “slope face afforestation method using the local native plants”

# A Case of Utilizing Results

## Preparing *michishirube* (a guidepost) to create a beautiful country”(Provisional Name)

OGURI Hitomi, Senior Researcher

SONE Naoyuki , Researcher

KURIHARA Masao, Head

Landscape and Ecology Division, Environment Department

(Keywords) public works, landscape creations, city planning, *michishirube*, effects

### 1. Background of preparing *michishirube*

When considering landscape creations by public works, it is required to bring a good effect on city planning of the surrounding areas, instead of finishing with decoration and restoration of its facilities. However, it is hard to say under the current situation that really useful information for business sites is well established when working on landscape creation by public works, including how to deal with the area, and what effects are brought to city planning of the area, and when and what actions are to be proceeded to produce these effects.

Thus, in order to achieve beautiful city planning where landscape creation by public works and regional landscape formation are well coordinated, we have put together the knowledge and information into “Preparing *michishirube* (a guidepost) to create a beautiful country (provisional name) ~ For linking the landscape consideration by public works with regional city planning” so that engineers working at public work sites enable to proceed with landscape improvement while they are conscious of the effects on regional city planning.

### 2. Outline of *michishirube*

See Figure 1 for the composition of *michishirube*. To begin with, we explained simply the meaning of considering the effects of landscape creations by public works on the area in Chapter 1, and then, explained various effects which are produced by landscape creation in Chapter 2, and suggested approaching techniques and points for producing those effects in Chapter 3, while giving some examples for each item. On *michishirube sheet* in Chapter 2 and Chapter 3, we summarized 31 effects and 17 techniques extracted from examples of advanced landscape creation giving specific descriptions and examples, and organized relations between those effects and techniques using visual materials, and added comments about the method of grasping those effects.

### 3. Results announcement

*Michishirube* will be announced as data of NILIM. (<http://www.nilim.go.jp/lab/ddg/seika/>)

We are expecting that this *michishirube* will be a help to beautiful city planning where landscape creation by public works is linking with regional landscape formation.

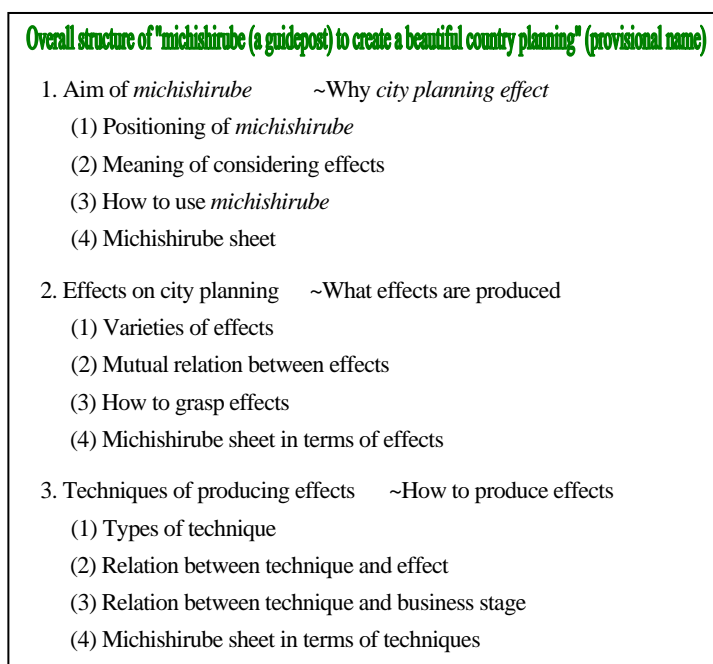


Figure-1 Overall structure of *michishirube*



Figure-2 Example of effects



# A Case of Utilizing Results

## Guideline to develop low-carbon cities based on city planning technology for heat island countermeasures and utilization of ‘Eco-City Act’

KAGIYA Koji(PhD. Engineering), Senior Researcher

Urban Development Division, Urban Planning Department

ASHIE Yasunobu (PhD. Engineering), Head

Environmental and Equipment Standards Division, Building Department

(Keywords) heat island, low-carbon city development, wind trail, city planning

### 1. City planning technology for heat island countermeasures

In order to promote heat island countermeasures effectively and systematically, the following city planning technology has been developed and reflected in a policy with the aim of utilizing it.

#### (1) Assessment tools for heat island countermeasures

Assessment tools for heat island countermeasures (detailed version and brief version) which can foresee CO2 reduction effect in addition to air cooling effect by heat island countermeasures have been put into practical use so that local governments, etc. can effectively promote to develop low-carbon cities as well as heat island countermeasures (Fig. 1). The detailed version is a detailed tool for review to be used in project planning by local governments, etc. and the brief version is an interactive explanatory to be used in a meeting and the like to explain to local residents.



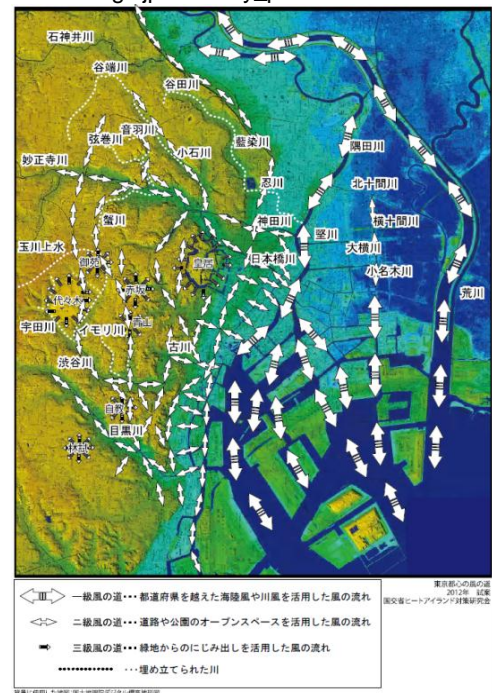
Fig. 1 Assessment tools (left: detailed vers

#### (2) Heat island countermeasure map and guideline

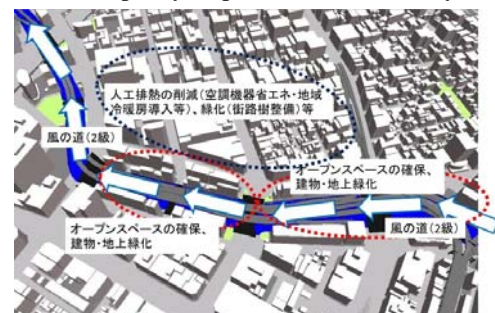
In order that local governments, etc. can effectively take heat island countermeasures as part of city development, a countermeasure policy including ‘wind trail,’ etc.. has been studied using the above assessment tools, etc. on the basis of the actual conditions of temperature and wind trail, and, ‘heat island countermeasure map’ (Fig. 2) which indicates the countermeasures on the map has been prepared. In addition, guidance of effective measures in coordination with urban planning has been compiled, a city development guideline (tentative name) utilizing ‘wind trail’ which contributes to heat island countermeasures has been prepared.

guidelines, etc.

The manner of utilization of the above outcomes is shown in the following: (i) the guideline for low-carbon city development by Ministry of Land, Infrastructure, Transport and Tourism (2010), (ii) the basic principles of ‘Eco-City Act’ (Act concerning promotion of low-carbon cities) enforced in December, 2012 and (iii) manuals to formulate low-carbon city development planning ([http://www.mlit.go.jp/toshi/city\\_plan/eco-machi.html](http://www.mlit.go.jp/toshi/city_plan/eco-machi.html))



Countermeasure policy map of ‘wind trail’ on city scale



Countermeasure policy map on district scale

Fig. 2: A trial example of heat island countermeasure policy map

### 2. Application of outcomes from acts and



# Proposition of Information Sharing System between the Citizens and River Management Administration

IWAMI Yoichi, Head

TSURUTA Mai, Researcher

Environment Department, River Environment Division

(Key words) Cooperation with citizen, Information sharing, River environment management, River environment research

## 1. Introduction

Now that there are more significance is being placed in the cooperation with the citizens and the river administration, such as making use of citizens' knowledge in various field, careful handling based on the local situation, developing the inhabitants' consciousness on the river and outlying area (recognition of the significance of the river as region-specific public property), respective area has a series of ongoing cooperation in the environment management, environment research and so on.

However, as problem in such cooperation is also pointed out, one of the proposed solutions is the need for the information sharing. In this research, we are proceeding on the development of the Information sharing system through the Internet to comprehend the actual state and problem in information sharing on the river environment among the citizens and river management administration and realize the means to share information easier.

## 2. Situation of the information transmission and information needed by citizens

After having implemented the round-table talk and survey by query among the civic associations, the results were as the following;

- Various means (such as websites, mail, bulletin, phone call, workshop, etc.) are used to send and collect the information from various entities such as the river management administration, other civic associations, association members and so on. Further more, such means are selected one by one to be appropriate for the objective and occasion.
- River management Web is posting little information needed by the civic association (e.g. a river environment conservation a group who wants to have detailed information on maintenance and management such as the river repair, grass mowing, etc.) Or, it's difficult to know the location of information.
- It needs to have a general web page of the river, for people interested in the river can easily use.

## 3. Development of the river environment information sharing system

The system design has been aimed at easy accessibility, objective and general information on river environment

possessed by the administrative agency such that making it easier to gain access to the information needed by the person interested in the river. At the stage of design, frequency on hearing about the needs of system functionality and the like from the civic association is the purpose as the main user is being conducted.

### 【Function and characteristics of the System】

- Information on the river organisms, water quality and flow that was highly needed by the civic associations, survey results of the MLIT (data) can be sought through the map (WebGIS). Water quality and flow data are also displayed by graph.
- As the function of a window to the required information, the outline of various sites have been introduced on such as sites concerning the river organisms, water quality and flow, the site held by the local river management staff and the site held by the civic association and the like who are active on the river. It is also possible to search through the WebGIS.

Trial operation which is aimed at certain area is being conducted. From now on, research is being done into how to improve the system on keeping cooperation between civic associations through discussion and query survey.



Fig. River Environment Information Sharing System (Top page)

【Reference】 River Environment Division HP (Posted papers related to this report. Information Sharing System site will be made public.)

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

# Study on the medium scale flashing discharge in the dam

IWAMI Yoichi, Head

SAKIYA Kazutaka, Senior Researcher

Environment Department, River Environment Division

(Key words) Dam, River environment, Flexible management, Flashing discharge

## 1. Introduction

In the downstream of the dam, there arises change in the river environment such as decrease of disturbance pursuant to the degree of effect on the stream situation changes caused by the dam.

For improving that effect, in the trial execution of flexible management, which utilizes the flood control capacity, flashing discharge has been implemented to cause disturbance in the downstream river. However, it remains mainly in clearing away the river bed sediment only since the discharge is limited to a small-scale by the restriction of available water capacity.

It is required to establish a new method to utilize much more water capacity to perform broad effects such as to maintain and form the water pool, wand (pond like formation) and natural bare land.

## 2. Medium scale flashing discharge

We are currently studying on the medium scale flashing discharge method, which utilizes much more water capacity than flexible management and is equivalent to the flood of several times a year.

As the method of the medium scale flashing discharge, we can raise such a method to utilize the snow melting flood, draw down, later period discharge at the time of floods and so on. (Fig. 1)

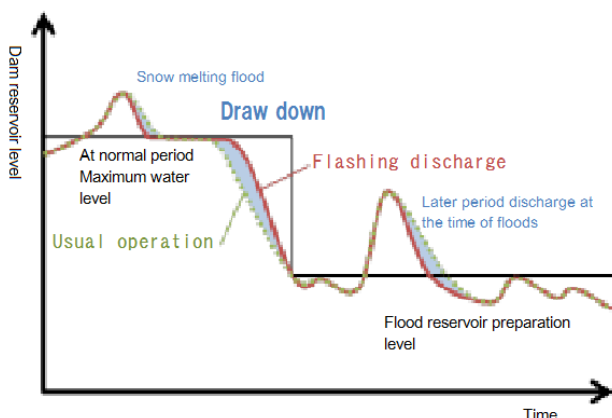


Fig. 1 Method of medium scale flashing discharge

## 3. Field test in the Satsunaigawa dam

In the past, there have been broad grave fields in the Satsunaigawa of the Tokachigawa river water system, in which broadly distributed the Kesho-yanagi, a kind of willow that grows only in limited area of Japan.

But on recent years, decrease of such grave fields due to the afforestation of the river channel brings us the concern on the effects on the ecological system. By that reason, to recover the grave fields, the medium scale flashing discharge utilizing using the draw down has been made a trial run aiming at the periods just before the seeds disperse from the Kesho-yanagi in the Satsunaigawa dam. Maximum discharge volume was approximately about 112 m<sup>3</sup>/s, which corresponds to approx. 65% of the annual maximum flow volume approx. 172m<sup>3</sup>/s (average of 1997 to 2010).

After the trial run, we have found changes in the river channel as we have confirmed sediment and scour at the point KP54.7 (downstream of the dam around 5km) (Fig. 2) and also observed was flow out of the seedlings of another type of the willow which are like established in the land area. We are continuing to detailed analysis on the flow speed, river bed material, attached algae, vegetation, river bed creature and fishes.

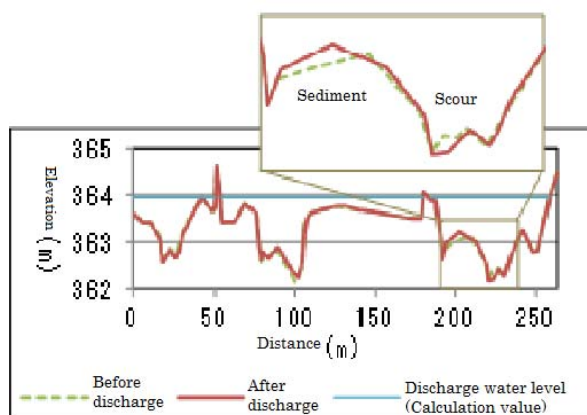


Fig. 2 Change in the cross-section before and after the discharge (KP54.7km point)

## 4. Conclusion

It is necessary to accumulate trial runs by different method to establish the method of the medium scale flashing discharge. For now, we would like to execute trial runs in several dams to make up a manual of the medium scale flashing discharge.

# Research and study for planning future measures for roadside atmospheric environment

KADOYU Katsunori, Head  
 DOHI Manabu, Senior Researcher  
 KANDA Taro, Researcher  
 Road Environment Division, Environment Department

(Keywords) Roadside atmospheric environment, NO<sub>2</sub>, SPM, PM<sub>2.5</sub>

## 1. Introduction

In recent years, roadside atmospheric environment is improving significantly by tightened automobile exhaust emission control based on the Air Pollution Control Act and the Road Trucking Vehicle Act, restriction on use of diesel cars and introduction of post-setup PM reduction device at once in metropolitan area based on the Automobile NOx/PM Act, and improvement of traffic flow and trial introduction of purifying air technique by the road administrator, and so on. On the other hand, some roadside automobile exhaust monitoring stations mainly in traffic-intensive intersections are not satisfying the environmental standard for NO<sub>2</sub> concentrations in the atmosphere as of the year 2010.

NILIM is now conducting a research and study for correctly understanding the current situation of roadside atmospheric environment and its future transition in order to abstract roadside atmospheric environmental measures to be implemented predominantly from now on.

## 2. Study for understanding the current situation of roadside atmospheric environment

NILIM is conducting a seasonal survey of NO<sub>2</sub>, SPM, and PM<sub>2.5</sub> at the edge and hinterland (about 200m from the edge) of roadsides and highways which daily traffic volume is tens of thousands cars. See Figure 1 for an example of survey results. The figure shows while the NO<sub>2</sub> concentration at the edge of the roads is about twice as much as that at the hinterland, the concentrations of SPM and PM<sub>2.5</sub> are shifting with almost at the same level both at the edge and the hinterland of the roads.

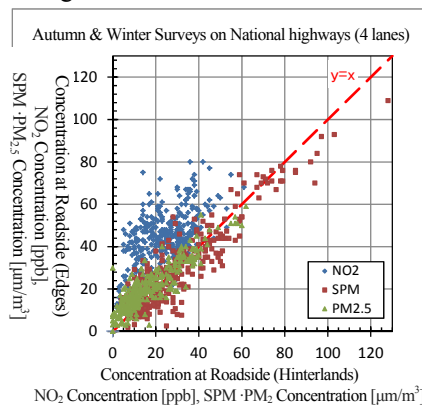


Figure 1. Results of roadside atmospheric study

## 3. Provisional calculation of future transitions in roadside atmospheric environment

Although the automobile exhaust emission control has been tightened so far, it will take more than ten years until the cars conforming to this regulation spread across the country because the regulation is applied only to new cars. For this reason, the environmental burden is expected to be reduced further by replacing the existing cars with new ones in the future. (See Figure 2.)

NILIM calculated future transitions in environmental burden in the surrounding areas of intersections based on effects of measures. One example of calculation results is shown in Figure 3. This indicates that the environmental burden will reduce substantially by 2020 and its main factor is a spread of cars conforming to exhaust emission control across the country.

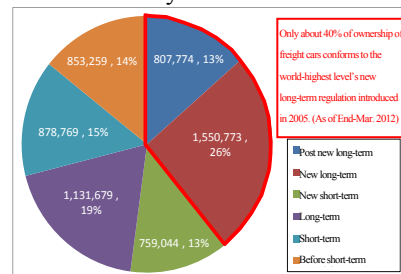


Figure 2. Share of freight cars conforming to exhaust emission regulations by years

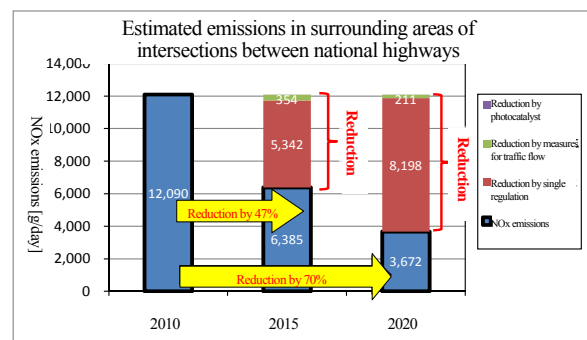


Figure 3. Estimation of NOx emissions in surrounding areas of intersections

## 4. Future direction

According to these study results, we think future measures for roadside atmospheric environment should specialize only in NOx physically, and be concentrated on spreading the cars conforming to more tightened exhaust emission regulation across the country promptly.

# Progress of Future Road Traffic Noise Abatement

KADOYU Katsunori, Head

YOSHINAGA Hiroshi, Senior researcher (Dr. Engineering)

Road Environment Division, Environment Department

(Key words) Road traffic noise, loud vehicle, Enlightenment, Eco-driving

## 1. Actual state of the Road traffic noise

Noise barriers, porous asphalt concrete pavement and vehicle noise emission limits have improved the achievement status of environmental quality standard of automobile noise (in the area facing the road) to approx. 92% on 2011 from approx. 77% on 2000<sup>1)</sup>. However, as it is difficult to achieve 100% over a short period only through conventional noise abatement measures, we need other measures based on a new idea. Fig. 1 shows the measured value of the noise generated by heavy vehicles on public roads. As shown in the simulated illustration in Fig. 2, noise of a loud vehicle is much bigger than that of ten quiet vehicles.

## 2. Progress of Future Road Traffic Noise Abatement

We are implementing the following survey with the target of contributing to the policy to convert a loud vehicle to a quiet vehicle.

[Noise of a low-pollution car] It was proved that the noise of a low-pollution car (medium heavy vehicle class) measured on the test road was almost 1/3 (= -5dB)<sup>2)</sup> to that of average car (Fig. 3).

[Noise of a high noise car] We have measured the noise in several places in the country as to estimate the effect of loud vehicles. The example presented in Fig. 4 shows that values restricted to the top 10% of loud vehicles achieves the reduction of about 1.3dB of the daily average noise level, which does not

include sudden big noise in the late-evenings to early mornings.

[Quiet driving instructions] Reducing the speed and amount of acceleration while driving is expected to reduce the noise and vibration generated, reduce fuel consumption, reduce and prevent accidents and road kills, lessen of the deterioration of roads and vehicles. Although the transport related parties are very aware of eco-driving, they are actually obliged to follow the speed of traffic around them. We have a concept that it is required to educate not only the transporters but all other users of the road as well, therefore we would like to propose posting of banners as an effective way and plan to investigate its effect (Fig.-5)<sup>3)</sup>.

- 1) Ministry of the Environment: Automobile traffic noise actual state survey report on fiscal year 2011, MOE web site.
- 2) YOSHINAGA Hiroshi, SONE Shinri: A study of road traffic noise reduction by reducing vehicle noise, Environment System Study Report Presentation Papers, Vol.38th, pp.233-238 (2010).
- 3) YOSHINAGA Hiroshi, SONE Shinri, KIMURA Keiko, ANDO Shingo: Enlightenment for drivers as a potential noise abatement measure, Institute of Noise Control Engineering of Japan, Papers in presentation, Vol.2011, Fall-time, pp.267-270 (2011).

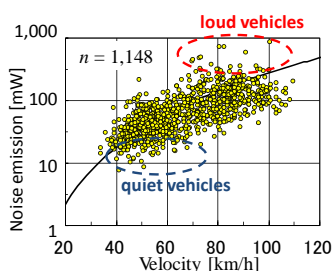


Fig.-1 Noise of the heavy vehicle on public road.

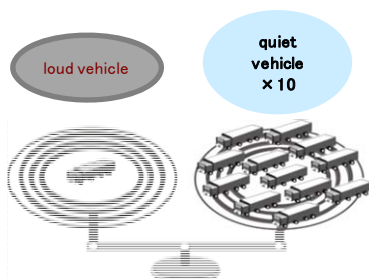


Fig.-2 Loud vehicle vs. Quiet vehicle.

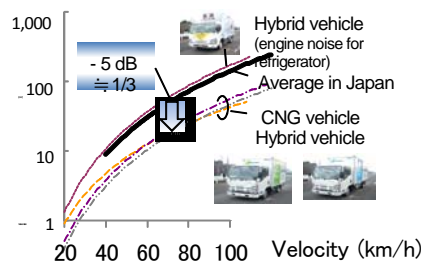


Fig.-3 Noise of medium vehicle on Test road.

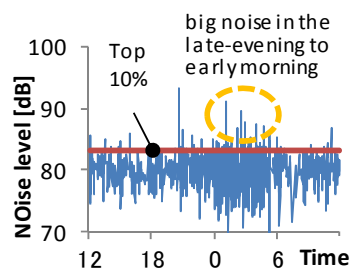


Fig.-4 Example of 24 hour measurement at site.



やさしく静かに運転してね

Fig.-5 Idea of the banner to encourage quiet driving.

Please drive quietly and softly



# Research Trends and Results

## Results of Research Regarding Complaints of Residents Associated with Building Use and Countermeasures against its Effects on Surrounding Areas

KATSUMATA Wataru (Dr. Engineering), Senior Researcher

Urban Development Division, Urban Planning Department

(Keywords) Group provisions of Building Standard Law, Restrictions on building use, Environment of urban district, Complaints of residents, Physical effect, Countermeasures against effects on surrounding areas

### 1. Introduction

In operation of building use restrictions in group provisions of Building Standard Law, it is important to take measures against effects of building use on surrounding areas by knowing the physical effect characteristics of each building use to prevent effectively environment degradation of the urban district that is associated with the physical effect of building use (especially disadvantageous effect on surrounding areas such as noise and foul odors). To do that, it is effective to analyze complaints that come from neighborhood residents to the local government's environment division for noise and foul odor that are associated with business and operation of each building use and the content of specific administrative guidance for those complaints.

### 2. Research summary

The total analysis has been done by receiving data (8,514 valid samples) regarding complaints of residents that are associated with business and operation of the building use, offered from environment divisions in 20 cities across the country where we received the cooperation for the research. With doing a total analysis for pollution-causing characteristic of each building use (pollution by type, occurrence factor, etc.), tendency of high complaint building use in each use district provided under City Planning Law, and measurement of physical effect (noise level, etc.), the specific countermeasures against effects to surrounding areas taken for pollution source origin and cause has been extracted and sorted out. Examples of the results are indicated in Fig.1-4. Please see reference 1 for the details of the research results.

### 3. Conclusion

The research results are expected to be used as a basic data for consideration of technical criterion (provisory permission standards on Article 48 of Building Standard Law) and / or reconsideration of contents of the restrictions on building use in Appendix 2 of Building Standard Law and district plan.

### Reference

- 1) NILIM Urban Planning Department (2012) "Report for the research regarding complaints of residents associated with building use and countermeasures against its effects on surrounding areas" <http://www.nilim.go.jp/lab/jeg/kujou.pdf> (Japanese only)

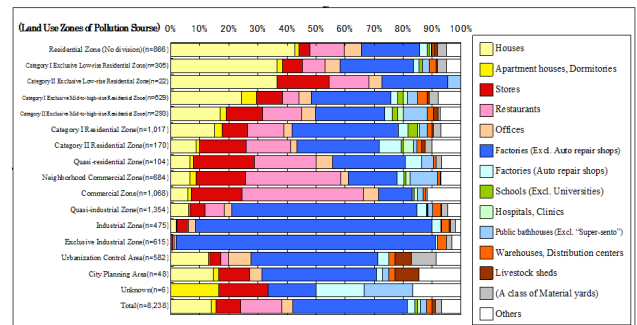


Fig. 1. Component ratio of complaints classified by Land Use Zone and building use of pollution source

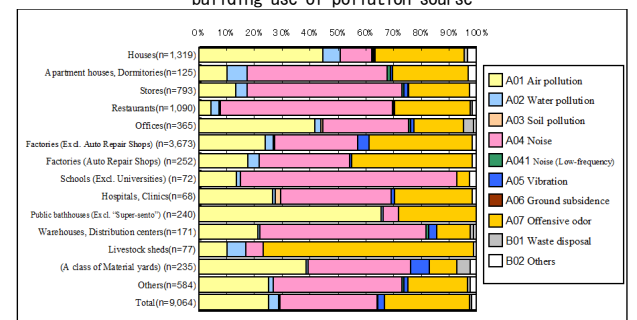


Fig. 2. Component ratio of complaints classified by building use and type of pollution

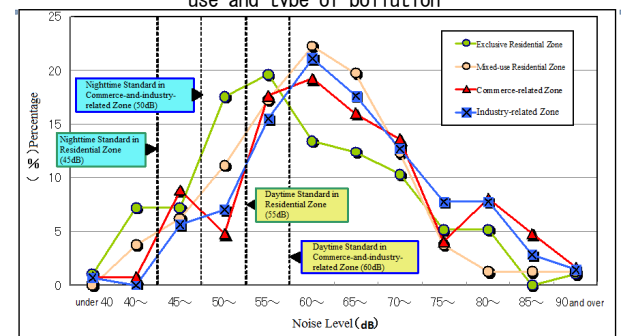


Fig. 3. Distribution of noise complaints by Land Use Zone

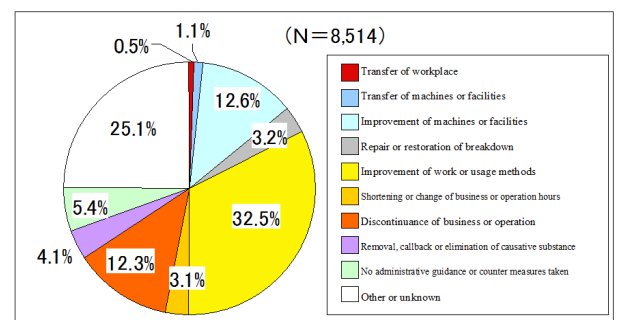


Fig. 4. Component ratio of complaints by countermeasure against pollution source

# Recover the Seashore vegetation utilizing the waves

WATANABE Kunihiro, Researcher (Ph. D., Agriculture)

SUWA Yoshio, Head

River Department, Coast Division

(Key words) Sand beach, Vegetation, Site survey

## 1. Background and purpose

Though Sea coast projects aiming at maintaining the beach sand has been implemented throughout the nation, it was proved that some cases have failed to develop natural seashore vegetation even when the sea sand was recovered. The cause being that too much tranquilized sea surface due to the off-shore facility, although a method to cultivate periodically the beaches sand has been executed, in the future we think we need to introduce the seashore management that enables the self-sustaining recovery on recognizing the establishment and maintenance mechanism of the seashore vegetation.

As the essential research for that purpose, we have been carrying out the site survey on the formation process of the seashore vegetation on Kitafujihara work area in the Isewan south-west coast (Fig. 1). This beach is the one that has implemented the “Set back” to change the construction site onto the inland when reconstructing the old beach dike in 2009, which has created a new sand space at the front of the beach dike.



Fig. 1 Old and new dike location at Isewan south-west beach

## 2. Formation process of the seashore vegetation

After we have carried out the vegetation survey once to three times a year from just after the completion of the dike reconstruction work, though almost no seashore plant has appeared in the earlier stage, it was confirmed that grass land plants such as Mehishiba (*Digitaria ciliaris*) and Himemukashiyomogi (*Conyza canadensis*) have swiftly grown as far as to cover almost all the beach. After such a state has remained unchanged for two and half years, it has immediately

moved into the seashore vegetation mainly based on the Hamahirugao (*Calystegia soldanella*) during the period as short as two months and half after September 2011 (Fig. 2). As this transition has occurred in a very short period and it has never appeared in the survey line shielded from the wave, it was estimated that it was caused by the disturbance made by the wave of significant wave height 2.5m observed in the same period at site. Afterward, beach lower trees such as Hamagou (*Vitex rotundifolia*) have appeared in that place, types of the seashore plants are increasing gradually.

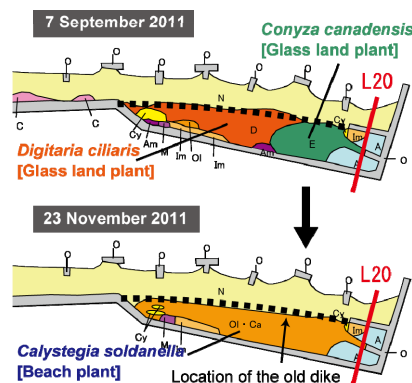


Fig. 2 Change of the vegetation distribution before and after disturbance due to waves

On the other hand, as it has been observed also the increase of the land hardness and ignition loss in the sand in the survey line shielded from the wave (L20 in Fig. 2), the place is changing into a hard land including a lot of organic substances, not appropriate for the seashore plants. It is being the plant compositions close to the waste inland, proved result that appearance of the sand space could not create the seashore vegetation by itself.

## 3. Future deployment and utilization of the results

We are to make clear the environmental factor controlled to the condition better for the seashore plants by the wave disturbance and degree of the wave disturbance required for the maintenance of the seashore vegetation to use those results to help the nationwide beach management. Results of this research are expected to become the reference to see how much period is required to recover naturally the seashore vegetation destroyed by The Great East Japan Earthquake and what kind of means are effective to promote the recovery, if possible.

# Project with government, citizen and researcher towards Integrated Coastal Management

Coastal, Marine and Disaster Prevention Department  
 Research Coordinator for Coastal and Marine Affairs (Dr. Eng.)  
 FURUKAWA Keita

(Keywords) nature restoration, citizen participation, spiny goby

## 1. Integrated Coastal Management

ICM ( Integrated Coastal Management) was described in Agenda 21 that was adopted in Rio Summit 1992 to achieve continuous development. Also in Japan, it is positioned as Basic Act on Ocean Policy adopted in 2007 through The 5th Comprehensive National Development Plan (cabinet approval in 1998) and Guideline for Integrated Coastal Management Plan (National Land Agency, 2000).

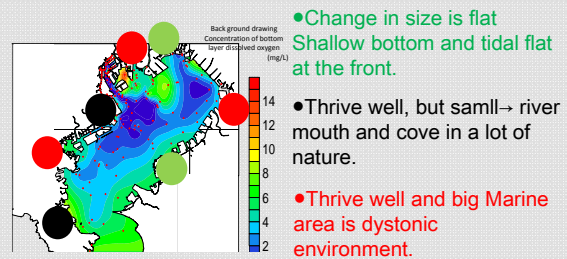
By implementing ICM, it considers the expanse of place and business, and it is thought that custom-made environment preservation / reclamation is possible based on participation of various elated persons. NILIM has been trying various menus of ICM as an ecological correctness means.

## 2. Abode of spiny goby search project

In ICM, a goal of action which should be easy to understand for related people is needed. With that, a research was carried out and that was focused on spiny goby that is typical fish in Tokyo bay.

The research had been carried out between July and September in 2012. Special research sheets, rulers for measuring spiny goby were created, and it was reported by fax. (<http://www.meic.go.jp/edohaze>) 。 From the beginning, the general outline and recruitment for the research placed in fishing news papers / magazines and so on with the cooperation of the fishing journalist group. With a focus on fisherman, 240 people in total participated, and data of about 140 points and 8,000 fish is collected. (<http://www.meic.go.jp/edohaze>)

(<http://www.meic.go.jp>) 。 Therefore, these are became evident; average of fishing outcome is 20 fish per person in one hour in this season, and average of the entire length is 9 cm in July, 10 cm in August and 12 com in September. And along with it, effectiveness of featuring spiny goby as a symbol for Tokyo bay reclamation was indicated and it was presented in the 13th Tokyo Bay Symposium and placed in fishing magazines.



➔ River mouth and cove are effective, because small individual can become established.  
 Marine area where is not dysoxic environment will be needed.

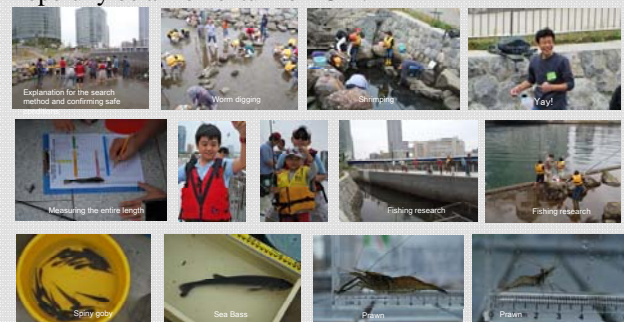
Fig. Graphic Conclusion of abode of spiny goby search project

## 3. Joyful use of urban tidal flat research team

Activation of activity as a citizen beyond area and affiliation are one of the important elements to promote ICM.

(<http://www.meic.go.jp/wiseflat>) 。 Participatory abode of creatures search research was conducted in an urban maritime park (Takashimasuisaisen Park) that has a tidal pond. (<http://www.meic.go.jp/wiseflat>) It was experienced as follows; worm digging research by tidal flat team of the tidal pond, and shrimping and goby fishing research using the worms by tidal pool team.

It was found as a potential desire for sea nature experience through these efforts. And those will hopefully be a momentum of ICM.



Pictures Abode of creatures

This research was achieved by a lot of related persons such as NPO, community residents, environment creation department city of Yokohama, Yokohama Minatomirai 21, Kanagawa Marine Fisheries Research Center, NILIM including Hamabetsukuri research group, Hamanoumiwoomou group, Tokyo Bay Sea Bass Project and etc.



# Examination on method of setting the minimum water level for smooth introduction of small hydro power generation in mountainous rivers

KAWASAKI Masaki , Head

TOYODA Tadahiro, Researcher

Water Management and Dam Division, River Department

(Keywords) *renewable energy, small hydro power generation, mountainous rivers, water utilization investigation*

## 1. Background of research

Even today, the electric power situation is still critical followed by the suspension of nuclear power plants in Japan after The Great East Japan Earthquake that occurred in March 2011. Also in a future energy policy, “renewable energy” is gaining attention as development of electric power resources without using nuclear power. In such a situation, small hydro power generation is expected to increase in the future because a purchase price of renewable energy has become higher than the past after feed-in tariffs (FIT) for renewable energy started on July 1st, 2012.

Under these circumstances, the Ministry of Land, Infrastructure and Transport is now considering to simplify the water utilization procedures relating to small hydro power generation and encourage its introduction. Especially, a mountainous river is a favorable environment for small hydro power generation to be introduced since its water is not used at present. However, since the form of mountainous rivers is different from that of rivers on the plains, knowledge concerning the effects of water utilization on the rivers has not been acquired. Therefore, it is difficult to decide easily under the present condition whether or not the water should be used. For that reason, we examined a method of determining the minimum water level of mountainous rivers.

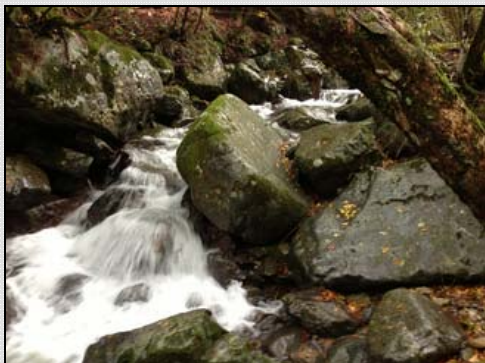


Photo 1. Rivers under study (Kaji-gawa River in Tottori Pref.)

## 2. Contents of research

Although the minimum water levels of rivers on the plains were examined and determined mainly concerning nine items including the effects on living organism, fishing and tourism, these items were limited to two items which are effects on living organisms and landscapes, considering the characteristics of mountainous rivers.

Concerning the effects on living organism, we decided to determine the minimum water level by modeling the structures peculiar to mountainous rivers such as a riffle, a pool, and a step-pool for hydraulic calculation and verifying changes in water level of the river channel depending on flow condition by model calculation. For building the model and grasping the effects on living organism, we conducted a field study on rivers.

Concerning the effects on landscape, we went back to the elements relating to landscape peculiar to mountainous rivers in this examination, although it is considered to be suitable for flow demand as an indicator in the existing method for rivers on the plains that the width of water surface of a river should be equivalent to 20% of the width of the river. In a questionnaire using photographs showing flow conditions of mountainous rivers, we investigated in which parts of the photographs people *feel the volume of water*, and it was found that most people feel it in whitened parts of ruffling surface arising from drops and other in these flow of mountainous rivers. For that reason, we grasped the relation between the occurrences of ruffling surface and the physical conditions of rivers through this survey and examined for indexing.

## 3. Future plans

Together with these survey results, we will arrange the results of examinations at the time of implementing existing hydroelectric power and organize the way of thinking the flow demand of mountainous rivers, exchange opinions with scholars based on examined knowledge to conduct water utilization investigation smoothly, and put them together as indicators for water utilization investigation.



# Margins of forecasting the future increase in torrential rains controlling adaptation to climate change

ITAGAKI Osam, Senior Researcher  
 KATO Takuma (Ph.D., Engineering), Researcher  
 Water Management and Dam Division, River Department

HATTORI Atsushi (Ph.D., Engineering), Head  
 River Division, River Department

YOSHITANI Junichi (Ph.D., Engineering), Research Coordinator for Watershed Management  
 FUJITA Kouichi, Director (Ph.D., Engineering)  
 River Department

(Keywords) climate change, torrential rains, flood control projects, increase rate, sensitivity analysis

## 1. General condition of river development for flooding prevention and climate change

Even the safety level of flood control of the average first-class rivers in Japan has been improved by accumulated river development, it has not yet meet a target level indicated in a river development policy. On the other hand, land use is becoming densely therefore even the same scale of flooding may cause further damages. Furthermore, it is pointed out that torrential rains may increase due to global warming. If torrential rains occur more frequently while river development is making progress, it is easily supposed that the safety level of flood control will not improve as before. Therefore, it is required to think about how to adapt to the situation while forecasting the increase in torrential rains in the future and enforce measures strategically. In that case, there is a *margin* in the forecast predicting a degree of increase in torrential rains, and it is being questioned how to deal with them while looking at the margin (and the larger margins just in case). In the River Department, the divisions relating to flood damages are cooperating with each other for addressing this issue. As a first step, calculations using the latest forecast for climate change were made concerning the degree of increase in torrential rains and the rate of increase in the possibility of flooding arising from it, and the scale of additional efforts for river development in case of setting the equivalent target level to the present level to improve the possibility. At the calculation, we studied how much a future vision could be changed when the rate of increase in torrential rains changes a little, by giving the forecast results of torrential rains some margins

## 2. Impacts of increase in torrential rains on flood control

We calculated the increase rate of torrential rains showing how much the largest yearly amount of rainfall used for river development will increase in the future [at the end of 21st century] compared to the present, targeting the directly controlled 109 river systems based on the four forecasts<sup>1)</sup> on future climate change. Looking at the average of all river systems, forecast results are ranging from 1.12 to 1.27 on average and a difference (confidence interval 95%) between the maximum and the minimum forecast is ranging from 0.02 to 0.11. Together with such increase in torrential rains, the flow equivalent to the target level will also increase. As the result, we calculated “how many times of increase in the probability of flooding exceeding the river flow equivalent to a target level in the future compared to the present” and “how

many times of increase in insufficient cross section of flow in a river course necessary for safety flow down of the water volume equivalent to the target level in the future compared to the present”. (See the increase rate of flow, increase rate of probability of flooding, and increase rate of river development efforts in the figure.)<sup>2)</sup> It is found that as for the national average, the torrential rains will increase 1.16 times, the river development efforts 1.88 times, and the probability of floods 2.87 times greater than the present. In other words, it means even if river development meeting the present target flow level is completed, the probability of flooding will increase 2.87 times, and required efforts will be 1.88 times to prevent this. This resulted in that only about 0.16 times of increase in torrential rains leads to multiplying the probability of flooding and efforts for river development and therefore future situation may change drastically even if the increase rate of torrential rains is within the *margin* stated before.

## 3. Measures supposing the future with margins

Thus, future forecasting is not easy. It will be required to expand the practicable measures both in terms of software and hardware free from the limitation of existing measures for flood control by entering on the basin of rivers. Moreover, it is important to appropriately use and combine various measures so that their effects are maximized, and reach the way of strategy planning without having regrets on the assumption the future is uncertain even if prediction is wrong. In the River Department, we are now examining for solving the issues while analyzing flooding risks so that specific damages by flooding for each river system and the effects of measures can be evaluated.

<Reference> 1) MEXT: Innovative Program of Climate Change Projection for the 21st Century “Projection of the change in future weather extreme using super-high-resolution atmospheric models, 2011 Study report, 2012. 2)Mr. Hattori and others: Macro-evaluation of climate change impact on flood control measures in Japan, Advances in river engineering, Vol.18, 2012)

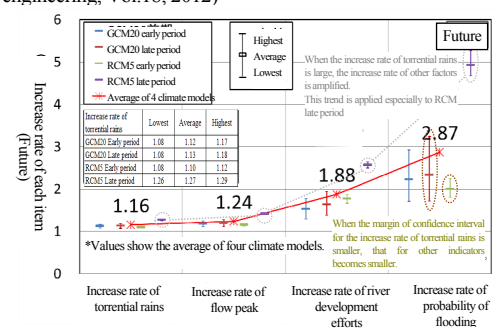


Figure Impacts of torrential rains increase on indicators

# About the future water resource management considering the climate change

- Evaluation of the analysis technology aiming the appropriate use and maintenance of the underground water-

KAWASAKI Masaki, Head

NISHIMURA Sorin, Senior researcher

River Department, River Management and Dam Division

*(Key words) Climate change, Underground water, Water resource management, Flow analysis, Water balance analysis*

## 1. Introduction

To create sustainable and powerful national land and local area, it is imperative to secure the stable and good quality water supply based on the health and sane water recycle. In particular recently, as it is estimated to see increasing drought risk due to climate change, increasing water demand due to global population increase and further tough competition on the water business, under the circumstance future tight water demand and supply is concerned, we have to proceed on working toward upgrading the water resource management

Specifically, we are required to achieve integrated water resource management to use various water resources including underground water and rain water on effectively utilizing respective characteristics going away from the conventional water resource management based on the surface stream water.

## 2. Process and task concerning the underground water management

Underground water has been broadly utilized for the daily life water and various purposed as good quality, convenient and cheap water resource.

However, as too much water intake caused by the industrialization has resulted in underground water obstruction such as ground sinking, we have seen a process to convert the resource to the surface stream water on restricting the water intake of the underground water by the Industrial Water Act.

Further, to the character of the underground water as a private property attached to the land, with the recent point of view that the underground water is a significant factor to compose the water recycle, it is required that the public nature of the underground water prevails as the socially-accepted idea.

Accordingly, activated use of the underground water is, still securing the underground water appropriately, a conversion of the paradigm, and it is required to achieve reliable quantitative research result that contributes to such a breakthrough, make concepts and further to make a new rule.

On the other hand, as for the analysis of the underground water, analysis theory and numeric value analysis technology to resolve it are already established. However, there is a problem of lower accuracy in the analysis since the given condition of such an analysis such as the data of the underground water level, water intake volume, earth quality condition were not grasped sufficiently.

## 3. Outline of this research

This research has adopted the watershed of the Chiyogawa river, the first class water system as the case

study watershed so as to construct both the flow analysis model and water balance analysis model and predict the future on the effect that the climate change gives to the surface stream water and underground water, in which we still proceed on the analysis.

In the flow analysis, we have supposed a model with a point of view to grasp and make visible the underground water flow in the watershed as precisely as possible. This is because we are to submit the result for the purpose of making a common concept among concerned parties and for the judgment whether or not to expect the underground water as an alternative water resource at the time of the drought, thus to make it the analysis technology to support the general water resource management in respective area. We have made this model a water recycle model using the "integrated water recycle simulator" that is able to analyze the surface stream water and underground water perfectly all together.

For the water balance analysis, we have supposed a model in a viewpoint of the convenience. This is for the purpose of making it a macroscopic analysis technology that contributes to grasp the long-term wide spread area change of the water balance that can be submitted to the discussion of what is the nation wide water resource management including the underground water. We have made this model a tank model composed of the dam watershed, residual watershed and underground water basin.

## 4. Future perspective

We are currently collecting data of the underground water level in the country together with the above analysis. From now on, we would like to make an analysis of the trend of recent underground water level and future prediction of the effect on the surface stream water and underground water caused by the climate change in a nationwide view so as to study what should be the future water resource management considering also active utilization of the underground water.

### 【Reference】

- 1) Study group "What should be the integrated water resource management considering the risk by the climate change and so on"  
<http://www.mlit.go.jp/tochimizushigen/mizsei/07study/07study.html>
- 2) TECHNICAL NOTE of NILIM No.322 Study on the underground water model  
<http://www.nilim.go.jp/lab/bcg/siryuu/tmn/tmn0322.htm>
- 3) TOUSAKA Hiroyuki: Mathematics of the ground area water recycle, University of Tokyo Press 2006.12

# Promotion of Effective Inundation Countermeasures to Prepare for the Future Increase of Heavy Rain

YOKOTA Toshihiro, Head

SHIGEMURA Hiroyuki, Senior Researcher

HASHIMOTO Tsubasa, Researcher

Water Quality Control Department, Wastewater System Division

(Key words) Increase of heavy rain, Inundation countermeasure, Unsteady flow model

## 1. Introduction

In recent years, heavy rainfalls of 50 mm/h or more and heavy rainfalls concentrated into short time spans of 10 minutes have occurred more frequently throughout Japan. Although various cities have been developing inundation countermeasures to prevent inundation damage, looking at the long term, the characteristics of rainfall are changing, and existing inundation prevention measures alone might not be able to handle the future increase of heavy rain. Accordingly, the NILIM is studying the countermeasures for the increase of heavy rain and is extracting problems on making the rainfall countermeasure plan, considering all the above and improvement measures.

## 2. Countermeasures to deal with the increase of heavy rain

In the result for the past year <sup>1)</sup>, 10-minute rainfall intensity and 60-minute rainfall intensity of 5 or 10 year probability are likely to increase, and the increasing rates are estimated 1.3 or 1.4 times in 50 years at most. Based on this result, we have made out patterns about the rainfall scenario in the following table with the view point of the effected appearance of inundation countermeasures and practice potentialities. Peak cut type countermeasures such as storm water storage pipes and storm water reservoirs for flood control, and countermeasures to increase the discharge capacity such as supplementary pipes and by-pass pipes were evaluated as being effective in every Rainfall scenario. To the Rainfall scenario A, mutual connections of pipe channels and replacing street inlet covers with grating covers were also evaluated as being effective. To the Rainfall scenario B, making networks of large scale trunk sewers, new constructions and additional constructions of storm water pumps were evaluated as being effective.

Furthermore, we have made a simulation using two

virtual discharge areas of different discharge dimensions in order to classify quantitatively the contents of the inundation countermeasures pursuant to the inundation caused in respective areas. It has revealed that peak cut type reservoir facilities are effective to branch discharge areas and short time heavy rain. To the heavy rain continuing over a long period in trunk line discharge areas, it has revealed that it is important to combine the countermeasure facilities such as flow down facilities and reservoir facilities in order to upgrade the whole discharge area.

## 3. Problems and improvements in making methods of rainfall countermeasure plans

To study the combination of plural inundation countermeasures to meet the future increase of heavy rain, we consider that there will be increased need for unsteady flow models. Accordingly we have implemented the query survey and the like aiming at 24 local governments so as to file up the application cases of the unsteady flow model and its merits and demerits. We have also made a proposition on most appropriate selection method of design in accordance with the countermeasure study with the target of the method using rational formulas and the method using unsteady flow analysis models.

The error of the flow items in calibration such as total flow rate, peak flow rate and waveform are one of the points of concern on using the unsteady flow models. From now, we have scheduled to file up quantitatively effects on the scale of the facility plan and countermeasure effect caused by the error of the flow items in calibration by means of the simulation using the data of actual discharge area.

### 【Reference】

- 1) TECHNICAL NOTE of NILIM No.654 pp.21-36  
<http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0654.htm>

Table Setting of Rainfall scenarios

		Rainfall scenario A	Rainfall scenario B	Rainfall scenario C
Objective rainfall intensity	10 minutes	Over scheme	Within scheme	Over scheme
	60 minutes	Within scheme	Over scheme	Over scheme
Characteristics of the rainfall over schemes		<ul style="list-style-type: none"> <li>● Short rainfall continuation</li> <li>● Strong 10-minute rainfall intensity</li> <li>● Small total rainfall volume</li> <li>● Limited area rainfall</li> </ul>	<ul style="list-style-type: none"> <li>● Long rainfall continuation</li> <li>● Strong 60-minute rainfall intensity</li> <li>● Large total rainfall volume</li> <li>● Large area rainfall</li> </ul>	<ul style="list-style-type: none"> <li>● Long rainfall continuation</li> <li>● Strong 10- and 60-minute rainfall intensity</li> <li>● Large total rainfall volume</li> <li>● Large area rainfall</li> </ul>
Assumed rainfall		Local and short time focused heavy rain	Heavy rain that passes over current sewerage construction standard (60 minutes rain volume) (such as typhoon).	Focused heavy rain such as the largest rainfall as ever that largely passes over current sewerage construction standard
Assumed main inundation causes		Flow down capacity shortage of branch sewers	Flow down capacity shortage of trunk sewers	Flow down capacity shortage in the whole discharge area composed of trunk sewers and branch sewers

# Research Trends and Results

## Approaches for assessment of CO<sub>2</sub>-reduction effect by using low-carbon technology

KADOYU Katsunori, Head

KANDA Taro, Researcher

SUGABAYASHI Keita, Guest Research Engineer

Environment Department Road Environment Division

(Keywords) Global warming, Low carbonization, Carbon dioxide excretion, LCA, Low carbon technology, long-life technology

### 1. Introduction

By “Infrastructure LCA”, we came to be able to calculate of CO<sub>2</sub> emissions in the construction field including infrastructure improvement. Low carbonization of the construction field is needed for practical realization of Infrastructure LCA. General versatility that can assess various technologies is desired. But long-life technologies can't be evaluated by Infrastructure LCA.

In this study, NILIM examined how to evaluate long-life technologies. Additionally we evaluated other technologies, and examined prospects for low-carbon future by evaluation results.

### 2. Consideration of assessment method of long-life technology

Long-life technology emits a large quantity of CO<sub>2</sub> during construction and reinforcing / repairing. But CO<sub>2</sub> emissions of entire in-service period are small. For instance, if the period is set by durable years of structure, long-life effect is assessed. On the other hand, if it is actually taken down before the durable year, it is possible to be overrated. If the period is set short, considering uncertainty of future, the long-life effect will not be assessed.

Fig-1 shows a calculation result for concrete modifier that is expected to prevent cracks by applying to concrete structures. This technology is expected to decay 20% of the rate of deterioration of bridge, and to extend the durable years from 50 years to 60 years. If the period is set by durable year, the long-life technology is advantageous.

But if the bridge is replaced at 40 years and 20 years before the durable years, the result is changed.

After this, we plan to set installation strategy of

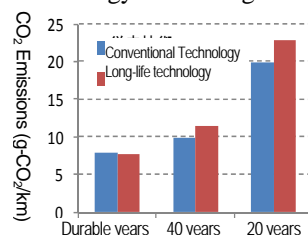


Fig-1 The calculation result, concrete modifier

the period by condition, to be able to assess the long-life technology, and to improve general versatility of Infrastructure LCA.

### 3. Assessment of CO<sub>2</sub> reduction effect by low carbon technology

It is possible to assess most of the technologies, except the long-life technology, in Infrastructure LCA. Fig-2 shows the results of estimate CO<sub>2</sub> emissions and costs for 27 low-carbon technologies.

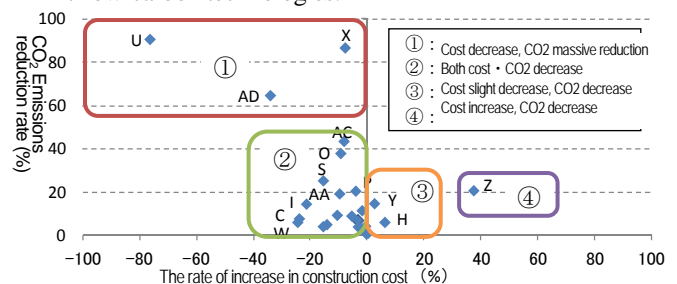


Fig-2 The relationship between the rate of CO<sub>2</sub> emission reduction and cost increase / decrease

According to Fig-2, most of low-carbon technologies belong to ②. Therefore, we concluded that the development of the technology which reduces both CO<sub>2</sub> emissions and costs has proceeded.

Also, by assuming the number of the adoption of 27 technologies, and by multiplying CO<sub>2</sub> reduction to the number of the adoption, CO<sub>2</sub> reduction effect of using low-carbon technologies was assumed about 400,000 t-CO<sub>2</sub>.

### 4. Conclusion

In order to achieve low-carbon society, it is effective to adopt the Infrastructure LCA into the social system. “Index Integration Committee” and “LCI Calculation WG” gave support to this study, and we wish to acknowledge valuable discussions with them.

<http://www.nilim.go.jp/lab/bcg/siryou/kpr/pm0036.htm>



## Research Trends and Results

# Demonstration Study of Breakthrough by Dynamic Approach in Sewage High Technology Project (B-DASH Project)

Water Quality Control Department    Wastewater and Sludge Management Division  
Head HARADA Ichiro    Senior Researcher YAMASHITA Hiromasa  
Researcher FUJII Tsuyako    Researcher IGUCHI Hitoshi

(Keywords) Sewerage, Energy saving, Resource saving, Cost reduction, Greenhouse gas, Innovative technology

### 1.Introduction

For global warming and tight resources / energy demand and supply, conversion to a sound material-cycle society and formulation of low carbon society is desired. Sewerage is necessary social capital for people's life such as life environment improvement and water quality control in public water body, and these potential applications such as energy use of biosolids and wastewater heat and recycle of phosphorous resource use are needed.

Though new technologies have been developed in accord with those societal demands and government needs, many sewerage works administrators are in a careful manner to adopt them because there are few actual implementation results. Therefore Ministry of Land, Infrastructure, Transport and Tourism (MLIT) Sewerage and Wastewater Management Department has started Breakthrough by Dynamic Approach in Sewage High Technology Project (B-DASH Project) since 2011, and The National Institute for Land and Infrastructure Management (NILIM) Sewerage Research Department has been an implementing agency for the demonstration study. The purpose are achieving cost reduction and creation of renewable energy in sewerage work through the demonstration and widespread use of excellent innovative technology and supporting overseas operations of water business by Japanese companies.

### 2.Outline of B-DASH Project

The outline of B-DASH Project is as follows,

i) MLIT adopt innovative technology through the public competition according to the expert's judgment.

ii) Research organization assigned by NILIM contract install a full-scale plant in a sewage treatment plant to demonstrate cost reduction and greenhouse gas emissions reduction effect.

iii) NILIM establish guideline for installation of those technology based on the demonstration results.

Experts' evaluation and advice were utilized through the study progress, results integration and guideline establishment.

Two research projects, a technology system of water treatment, biogas recovery and generation and a technology system of biogas recovery and refinement, are adopted in 2011. The demonstration study has continued in 2012 to demonstrate the effects and establish the guideline. Outline of the demonstration plant is shown in

Fig 1 and 2.

Five research projects, biosolids fuel technology, raw sewage heat recycle technology, removal technology of nitrogen and removal and/or recycle technology of phosphorous that come from sludge treatment process have been implemented.

### 3.Future Development

NILIM will continue to play a leading role for the demonstration studies, to establish a guideline for sewerage works administrators to consider installation of innovative technology based on the study results and to enhance implementation of those technologies widely.

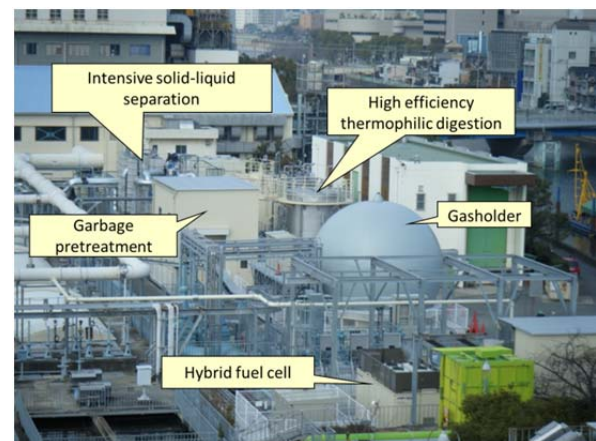


Fig. 1. Demonstration plant (Demonstration study for an energy management system using intensive solid-liquid separation technology)

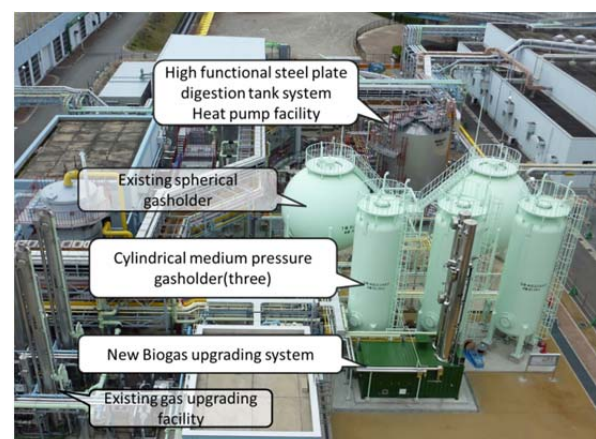


Fig. 2. Demonstration plant (Kobe, Higashinada innovative biogas production system)

## Research Trends and Results

# Global warming countermeasure in sewage works

HARADA Ichiro, Head

YAMASHITA Hiromasa, Senior Researcher

MIYAMOTO Ayako, Researcher

TSUSHIMA Ikuo(PhD. Engineering), Researcher

OGOSHI Masashi(PhD. Engineering), Researcher

MATSUHASHI Manabu, Researcher

Wastewater and Sludge Management Division, Water Quality Control Department

(Keywords) Global warming countermeasure, Nitrous oxide, Recycled water, Energy efficiency

### 1. Introduction

Sewage works emit greenhouse gasses directly from wastewater treatment plants and consume much energy, and it is being a main emission source of greenhouse gasses that comes from office operation of the local government. Global warming countermeasures in sewage works need multifaceted efforts such as energy use efficiency along with reduction of greenhouse gas generation. In our department, investigation research has been done from every point of view.

### 2. Nitrous oxide emission control from wastewater treatment processes

Nitrous oxide ( $N_2O$ ) that has 310 times the greenhouse effect of carbon dioxide, is emitted from wastewater treatment processes. However the emission situation at actual plants is not understood, and specific emission control countermeasures have not yet been established, because the generating mechanism has a lot of unclear points.

Therefore, regarding  $N_2O$  that is emitted during wastewater treatment processing, we investigated the  $N_2O$ -generation situation in actual plants with different treatment methods (picture). As a result, there was a lot of emission in standard activated sludge process that has short sludge retention time, and it becomes suppressed in membrane separation activated sludge process. Therefore it was assumed that  $N_2O$  emission becomes suppressed if nitrification is progressed well. In the future, establishment of emission control technology will be determined by the proceeding clarification of  $N_2O$  generating mechanism along with paying attention to microbial community structures in reaction tanks.

### 3. Global warming countermeasure by use of reclaimed wastewater

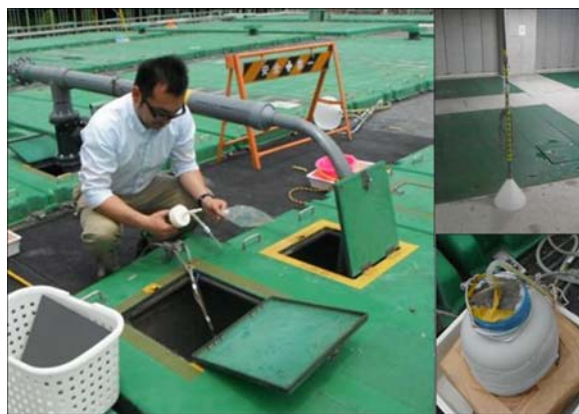
Global water resource shortage is a cause for concern and use of reclaimed wastewater has caught attention. In this situation, the assessment of the effect of the use of reclaimed wastewater has also been needed from the point of view of global warming. The department has proceeded to develop an assessment measure of greenhouse gas reduction effect by using reclaimed wastewater, and the following results were obtained by 2013.

According to the result of an investigation of carbon dioxide generation by life cycle assessment measure

(LC-CO<sub>2</sub>), it is suggested that LC-CO<sub>2</sub> of area-wide circulation of reclaimed wastewater is lower compared to on-site circulation within a building, and the water-saving effect from area-wide circulation is high. Also, by comparison by type of wastewater treatment technology, a possibility of energy saving is indicated by using membrane bio reactors as pretreatment. It is planned to continuously consider the structural analysis of energy consumption and assessment measures of new technology.

### 4. Improvement of energy efficiency by cooperation with other businesses

To further improve energy efficiency and the reduction of greenhouse gasses in sewage works, cooperation with other energy consumers and suppliers is expected along with using countermeasures of their facilities. With that, a cooperation measure in terms of technology and business along with city planning that relates closely to sewage works has been considered, and the results were summarized. A diagnostic tool has been created that can easily calculate prospect of profit of the project by developing project feasibility study methods of collaborative technology along with developing the latest technology menu that can be applicable to sewage works and other business and arranging check items. These achievements are planned to be published, and it is expected to be used for consideration or assessment of collaborative project.



Picture: Research of  $N_2O$  that is emitted from the wastewater treatment process.

# Research Trends and Results

## Exhaust Gas Characteristics of Freight Vehicle on the Real Road

KADOYU Katsunori, Head

DOHI Manabu, Senior Researcher

SUGABAYASHI Keita, Guest Researcher

Road Environment Division, Environment Department

(Key words) motor vehicle emissions, carbon dioxide (CO<sub>2</sub>), nitrogen oxide (NO<sub>x</sub>), on-board emissions measurement system

### 1. Introduction

Among the loads on environment by motor vehicles in Japan, the influence by freight motor vehicles and buses take 40% in CO<sub>2</sub> and 80% in NO<sub>x</sub>. So it's important to understand the actual conditions of exhaust emissions on the real road. Therefore, how to understand the influence coming from driving on real roads was an issue.

In this investigation, on-board emission measurement system was used for analysis of exhaust gas.

### 2. The Summary of the Results

This analysis was executed under 2 conditions. One was measured on test road, the other one is on real road.

As the result of experiments, amount of emissions of CO<sub>2</sub> by real road traffic was more than that of test road traffic. (reference figure-1). After analyzing the data, this difference comes from the influence of acceleration and deceleration on the real road.

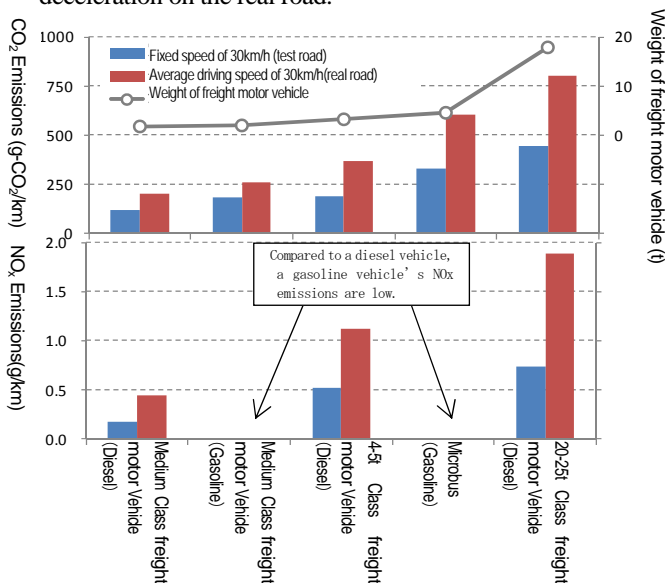


Figure 1 Exhaust Amount of CO<sub>2</sub>,NO<sub>x</sub>

### 3. Grasp of Exhaust Gas Characteristics

According to the analysis of the driving time and exhaust gases of 20-25t class heavy freight motor vehicles (diesel), during acceleration the vehicle

discharged twice the CO<sub>2</sub> emissions compared to that of fixed velocity. (reference figure-2)

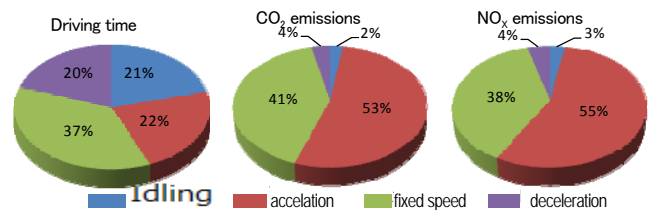


Figure 2. The ratio of Driving Time, Exhaust Amount of CO<sub>2</sub>,NO<sub>x</sub> (Heavy Freight Motor Vehicle 20-25t Class--Diesel)

We showed the same kind of analysis result which object was an ordinary motor vehicle (gasoline). (figure-3) Compared with figure-2, the ratio of hourly exhaust amount of CO<sub>2</sub>, NO<sub>x</sub> while idling was greater. From this viewpoint, the idling stop measure for cars was deduced to be effective.

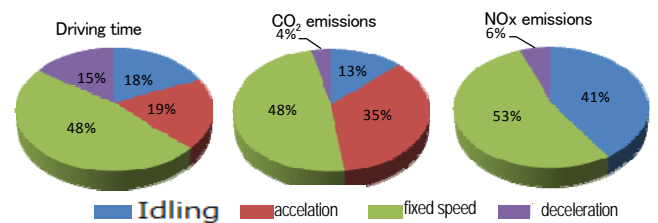


Figure 3 The ratio of Driving Time, Exhaust Amount of CO<sub>2</sub>,NO<sub>x</sub> (car-gasoline)

### 4. Conclusion

From the investigation, we clarified that the exhaust gas characteristics differs by the kinds of motor vehicle, especially the acceleration of freight motor vehicle have the great influence on the exhaust amount of CO<sub>2</sub>, NO<sub>x</sub>. Because those vehicles need time and driving power to accelerate them.



# Field Operational Tests to Examine the Driving Practice for Congestion Mitigation at Sag Sections

Research Center for Advanced Information Technology, Intelligent Transport System Division

KANAZAWA Fumihiko, Head

SUZUKI Kazufumi, Researcher

IWASAKI Ken, Guest Research Engineer

(Key words) expressway sag sections, traffic congestion mitigation program, Field Operational Tests

## 1. Introduction

About 60 percent of the traffic congestion on highways occurs at an upslope of sag sections. It easily causes a change on the inter-vehicle spacing by involuntary speed reduction at sag sections which gently changes the grade of the road from down to up. It is also considered that an unstable traffic flow due to the excessively long or short following time gap is a factor of traffic congestion.

Therefore, information providing services have been developed: (a) information providing service for drivers to recommend the driving practice which leads smooth traffic flow before traffic congestion occurs via ITS Spots compatible car navigations and/or other devices, and (b) services integrated with ACC (Adaptive Cruise Control) vehicle which is able to maintain a certain vehicle speed and/or following time gap that has been commercially available in recent years as a vehicle advanced technology, in order for preliminary detection of traffic congestion by road side sensors<sup>1)</sup>. This article reports a summary of the field operational test (FOT) for (a) that was conducted on the public road to carry on a basic study to find possibility of the service actualization and drivers' acceptance and effects on traffic flow.

## 2. Driving practice for traffic congestion mitigation at sag sections

This service expects traffic congestion mitigation in terms of realizing smooth traffic flow by adjusting excessively long or short inter-vehicle spacing by requesting drivers to maintain a certain inter-vehicle spacing at traffic congestion-prone point such as sag sections described on Figure 1. For actual drive practice to keep a certain following time gap, the drivers' ease of acting is considered while remaining smoothness and safety, thus it was targeted to maintain as fixed for the following time gap (time interval from the passing of front vehicle to the driver's vehicle at a certain spot) as 2 seconds.

## 3. Summary of driving test on public road

The driving test was conducted at Yamato sag section Tomei highways (20.0kp~23.0kp) and was conducted in the early morning on Saturdays and national holidays at which traffic demand excess in November and January 2012. To conduct the experiment at a higher traffic volume before occurrence of traffic congestion on the passing lane to confirm the effects of a certain control of inter-vehicle spacing time, it was chosen at 120 vehicles or more / 5 minutes as a condition of the experiment start.

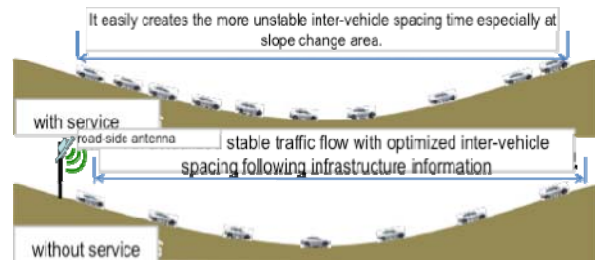


Fig. 1 The inter-vehicle spacing optimization service by road vehicle coordination.

It was prepared 8 passenger vehicles as experiment vehicles.

At the FOT to maintain the following time gap 2 seconds, subject drivers (collected from general drivers) were asked to count the following time gap by verbally counting "0102(zero, ichi, zero, ni, pronunciation of zero, one, zero two in Japanese)"<sup>2)</sup> while driving, in order to confirm possibility of actualization and acceptance to maintain a certain following time gap. Also, to analyze the change of the traffic flow rate, change of each following time gap by putting vehicles that maintain a certain inter-vehicle spacing, occurrence and propagation status of deceleration shockwave, driving behavior data such as the vehicle location of latitude and longitude, speed, acceleration and deceleration speed were acquired by GPS logger mounted on the test vehicles in addition to video image of the roadside cameras.

## 4. Conclusion

Utilizing the data collected from this driving test, the traffic congestion mitigation effects by mixing ratio of vehicles that maintain a certain following time gap will be identified by the traffic simulation and the more effective information service method for drivers will be studied.

### 【Reference】

- 1) Intelligent Transport System Division web site Traffic congestion mitigation program integrated with road information and vehicle control technology <http://www.nilim.go.jp/lab/qcg/kadai/acc/acc.html>
- 2) "For expressway users" (Metropolitan Police Department web-site) <http://www.keishicho.metro.tokyo.jp/kotu/kousoku/osirase1.html>



## Research Trends and Results

# Wireless power supply system for running electric vehicles

OBARA Hiroshi, Senior researcher

YOKOJI Katsunori, Guest Research Engineer

Information Technology Division, Research Center for Advanced Information Technology

(key word) *electric vehicle, noncontact electricity supply, electricity supply in running state*

### 1. Electric vehicle

Electric vehicles available in the market today are considered one of the most remarkable ways to approach environmental issues we have, due to their high efficiency in energy utilization.

However, those electric vehicles have their own restrictive conditions, such as “extreme increase in electricity consumption caused by high speed run and their heavy weight” and “short running distance in order to lower the price”. In order to improve these issues, much research has been carried out on improving efficiency in electricity consumption, as well as advancing storage battery technologies. These studies have been effective in improving the usability and uptake of electric vehicles currently available, but at the same time, are limited to the technology in the vehicles themselves. Instead, our focus here is to develop technology to charge the battery by supplying electricity to moving vehicles. For that reason, technological development on road facilities also plays an essential part. The National Institute for Land and Infrastructure Management has recently commenced basic research using several models, in partnership with Tokyo University, in order to achieve this goal.

### 2. Wireless power supply technology

The most common way to charge battery for an electric vehicle today is using a cable, however, many studies have been carried out on developing wireless charging technology. While many of these use microwaves or electromagnetic induction techniques, we have been looking at the “magnetic field resonance system”, recently introduced by MIT, as a way of establishing a wireless power supply system on roads.

The benefits of the magnetic field resonance system are its longer transmission distance and higher resilience to positional gaps, compared to the electromagnetic induction technique. In addition, as opposed to the microwave system which uses the far-field (the region where the electromagnetic field disperses), it offers magnetic coupling between transmitter and receiver in the near-field (the region where electromagnetic wave doesn't disperse but stays around the transmission device), thus we believe it to be an easier approach to provide safety measures for optimizing controls and preventing leaks of electromagnetic radiation.

### 3. Wireless power supply using a Magnetic Resonance System

When installing a transmission system in a road, it is

best not to change the current road format in order to maintain the level of convenience for driving. Also, it is most desirable to place the transmitter under the road, so that stable power supply conditions can be achieved while accommodating different car sizes, without demanding special driving skills. For road structure and maintenance reasons, it should be installed within the roadbed, more than 60cm deep, rather than in the asphalt surface.

The magnetic field resonance system is regarded to be excellent as a power supply technology for running vehicles for the following reasons: (i) The magnetic field being hardly affected by the gravel or asphalt used for building roads, (ii) the distance between transmitter and receiver can be as much as 1~2 meters, (iii) a higher tolerance for positional gaps.

### 4. Supplying electricity for running vehicles

The majority of recent studies on wireless power supply technologies target off-road electricity supply while the vehicle is parked; thus many of existing magnetic field resonance systems use transmitters and receivers of same size and shape, which make them inappropriate for supplying power to running vehicles. At the National Institute for Land and Infrastructure Management, we have verified transmission capability in an experiment using a model, enabling a stable electricity supply on the move by using a transmission coil and a receiver coil that are very different in size. (See the image below)



Image: The experimental model

In the future, aiming for a life-sized experiment, we will work on improving transmission distance and efficiency, as well as attempting to eliminate magnetic radiation leaks to the surroundings. We will continue to develop technology to enable electricity supply for running electric vehicles on the road.

## Research Trends and Results

# Research on the application of the local production for local consumption type renewable energy in urban areas

YAMAGISHI Yutaka, Senior researcher

SONE Naoyuki, Researcher

KURIHARA Masao, Head

Environment Department, Landscape and Ecology Division

(Key words) Biomass, Plant waste material, Energy application, Gasification power generation, Local production for local consumption

### 1. Introduction

One of the policies to create the low-carbon city is the application of cut branches and mowed grass generated from park green spaces, roadside trees etc. (hereafter referred to as "plant waste material derived from urban area") as an energy resource. Furthermore, after the Great East Japan Earthquake disaster, application of the plant waste material derived from urban area is expected to prevail from the view point of securing self-sufficient energy at the time of disaster. Under such a background, we would like to release a report of contents of the "Research on the application of local production for local consumption type renewable energy in urban areas" that the Landscape and Ecology Division is working on.

Shown in the figure is a series of processes to apply the plant waste material derived from urban area as an energy resource.

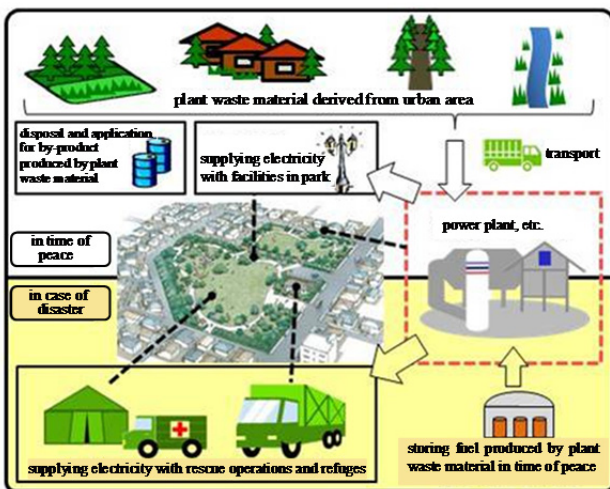


Fig. Process of the application of the plant waste material derived from urban area

### 2. Study on the method to apply the plant waste material derived from urban area as energy

In this research, surveys were carried out on the nationwide generated volume of the plant waste material derived from urban area as well as on the energy consumption of electricity, urban gas, kerosene, etc. in general parks and so on. Furthermore, we studied how to make solid fuel such as chips and pellets from the plant waste material derived from urban area as well as energy application methods such as heat utilization by stove and boiler, electricity utilization through gasification and the

like so as to carry out a case study of the energy application using the plant waste material derived from urban area and conducted it.

### 3. Experimental study on the renewable energy application technology in National Government Parks

As the energy application method considered as appropriate for the plant waste material derived from urban area, we have the gasification power generation technology capable of achieving comparably high efficiency even by small scale system that can be located in a park or similar areas. Now that this power generation technology is going through the demonstration stage, gasification is a process to pyrolyze the biomass such as wood under low oxygen or anoxic condition so as to generate combustible gas such as hydrogen, carbon monoxide, methane, etc. and convert such generated gas to electricity through a motorized electricity generator.

In this research, we verified the feasibility of a small scale gasification power generation system by adopting Michinoku Lakeside National Government Park and Showa Kinen National Government Park as the field.

### 4. Conclusion

As the plant waste materials derived from urban areas are generated broadly and thinly dispersed in the urban area, it is important to study the process of plant waste material application in the whole urban area such as facility location, collection and transport adding to develop the technology appropriate for their generation volume and material characteristics. To meet such a task, Parks, Green, Spaces and Landscape Division of City Bureau in the MLIT performed the demonstration experiment in collaboration with the model local governments (Kita-kyushu and Matsumoto city) in 2012.

As a final goal, we are to reflect the scientific and technological findings of the energy application method of the plant waste material as the result of this research on the study on an examination to draw up a guideline on the introduction of the local production for local consumption type renewable energy in urban areas in the ministry and a proper guideline will be issued.

### 【Reference】

- 1) SONE Naoyuki, YAMAGISHI Yutaka, KURIHARA Masao: The promotion of the use of locally produced and consumed renewable energy in cities ~ Research on technology of making energy locally from pruning and mowing waste ~, Civil Engineering Journal, 55-1(2013)



# Publication of Hydrogen Supply Experiment in Joint Ditch

MUKAI Akiyoshi, Director of Building Department

ASHIE Yasunobu(Ph.D., Engineering), Head

KUBOTA Yuji, Senior Researcher

Environment and Equipment Standards Division, Building Department

(Keywords) Hydrogen, New Energy, Joint Ditch, Polymer Electrolyte Fuel Cell(PEFC)

## 1. Background

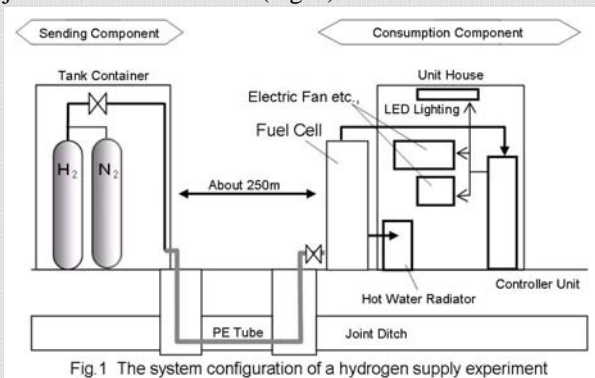
Hydrogen is the promising energy medium which replaces fossil fuel. A fuel cell which is driven directly by hydrogen gas does not discharge CO<sub>2</sub>, and because both electricity and heat are utilizable, it is said that synthetic efficiency exceeds 80%.

The National Institute for Land and Infrastructure Management is conducting the technical development for supply and use of hydrogen as a new energy medium in the research project, "Development of the urban system technology towards low carbon and practical use of hydrogen energy in society (2009~2012)."

As part of these efforts, the open experiment which supplies hydrogen using a joint ditch which is the city infrastructure of Tsukuba, and drives a polymer electrolyte fuel cell (PEFC).

## 2. Outline of Open Experiment

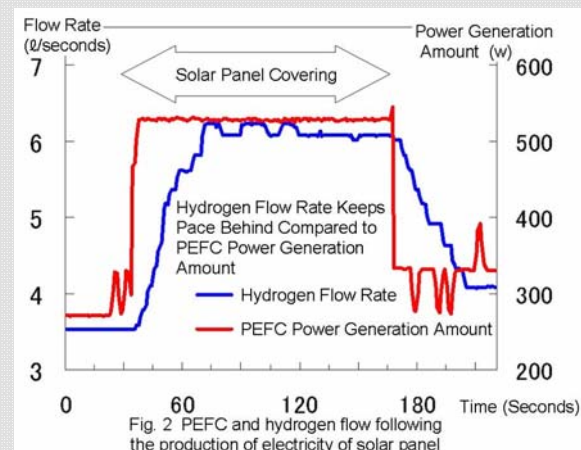
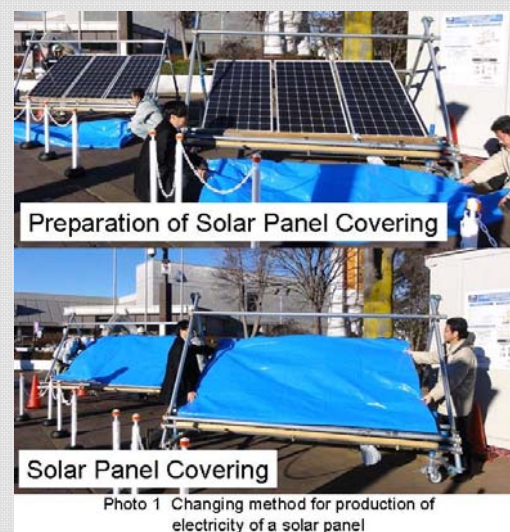
The experiment uses a prepared tank container the supposed gas utilities and a unit house which imitated a near future residence connected in two places with the joint ditches of Tsukuba. (Fig. 1)



For the purpose of using the device in regards to a hydrogen experiment, in addition to a gas-leak alarm machine, the gas leak detecting device by acoustic velocity and constant monitoring of flow rate of the gas, and also the emergency exhaust system were equipped in case of emergency.

At the unit house, imitating a near future residence, the electric supply from an electric power company in addition to a fuel cell, photovoltaic supply, and a storage

battery were equipped, and a operational experiment for each combination was carried out. (Photo 1)(Fig.2)



PEFC has characteristics similar to a battery and the electricity production changes according to electric power load.

Moreover, it is also possible to change the production of electricity according to change in the photovoltaic electricity production.

In addition, while installing the exhibition panel around the Unit House, the experiment was opened to the public and more than 100 people participated. Among them were administrators and researchers having inspection tours of the hydrogen piping inside the joint ditch.



# Geothermal Application for Building

MUKAI Akiyoshi, Director of Building Department

ASHIE Yasunobu(Dr. Eng.), Head

NISHIZAWA Shigeki(Ph.D(Eng.)), Senior Researcher

Environment and Equipment Standards Division, Building Department

(KEYWORDS) Renewable Energy, Earth Thermal Application, Energy

## 1. Background

The carbon-dioxide emissions from residences and buildings show the upward tendency every year, recording of 31.9% increase in the business sector, and 34.9% increase in the residential sector in the fiscal year of 2010 (compared with 1990).

For saving energy of residences and buildings, the low carbon building authorization standard was promulgated in December 2012, and the energy conservation standards are revised based on the estimation of primary energy consumption. Although this method is introduced to estimate the energy saving technology of building envelope and equipment comprehensively, some renewable energy technology (geothermal use and so on) is not evaluated. It is necessary to evaluate the technology on the same framework of the estimation method of primary energy consumption

In there search on "introduction of new technologies for buildings with a focus on the renewable energy (2011-2013)", the estimation method is developed from the experimental evaluation about renewable energy technology (solar energy, geothermal energy, etc.).

## 2. Experiment of Geothermal Application

Various technologies have been developed for the use of geothermal energy as a function of the period (daily or yearly cycle), usage (directly or as heat source of heat pump) and groundwater level.

The information of developmental status about the technologies have been organized, and the experiment is conducted to evaluate energy saving effect of heat pump system with geothermal use. Two U-tubes (inside diameter: 25mm) were installed in the ground to a depth of 50 meter (Photo 1), and thermal response experiment has been conducted to check the heat exchange performance between soil and water in tubes (Fig. 1). And heat pump with the water supply from U-tubes as heat source is installed for air-conditioning in the experimental room, and the energy saving effect of heat pump system with geothermal use is examined compared with general air-conditioning system which will be installed in another room which is kept in same condition.



Photo 1 Installation of the U-tubes

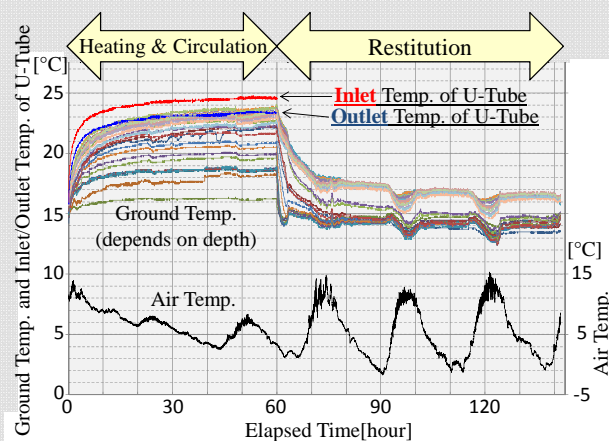


Fig.1 One trend of thermal response experiment

## 3. Conclusion

The experiment which uses geothermal for air-conditioning of a building is conducted, and the efficiency of the heat pump system with geothermal use will be examined. Hereafter, the estimation method of energy saving effect is built based on these observations.

### 【Reference】

- 1) Technical information about the energy-saving standard of residences and buildings, and the authorization standard of a low carbon building (In Japanese)

<http://www.kenken.go.jp/becc/index.html>



# Research Trends and Results

## The latest trend of procurement systems in the field of consultant engineering

MORITA Yasuo, Head  
OTANI Satoru, Senior Researcher  
YOSHIDA Jundo, Researcher  
MINAMI Masahiro, Guest Research Engineer

Research Center for Land and Construction Management, Construction Management Division

(Keyword) Consultant engineering, bidding system, Quality and Cost Based Selection (QCBS), low cost bidding provision

### 1. Introduction

Since 2007 the Quality and Cost Based Selection (QCBS) has been introduced to get totally proper contract considering engineering as well as bidding amount. In this paper, the latest trend of bidding systems in the field of consultant engineering structured by Research Center for Land and Construction Management are outlined.

### 2. Current contract situation by procurement method

The number of orders that were made during in 2011 was ended up with fractional increase due to the disaster reconstruction works for the Great East Japan Earthquake comparing to the previous fiscal year. On the rate of the number of each method to the whole order number, although QCBS has been achieved approximately 43% but about 34% is still competitive price selection and 20% is Quality Based Selection (QBS).

### 3. Generation status to prevent dumping

The rate of low price of successful biddings has greatly decreased to 9.7% in FY2011 from 40.9% in FY2008. Especially the rate of QCBS has dramatically decreased to 0.7% in FY2011 from 39.1% in FY2008. Because of the introduction of the assessment system for certain accomplishments (multiply the number by 0.0 to 1.0 and engineering points of a bidder who's bidding price is lower than the threshold price for low price inquiry), and by raising of applied ceiling price range in FY2011 (ceiling price over ¥ 20 million to over ¥ 10 million in FY2011). On the other hand low price bidding is still frequently generated in competitive price selection and QCBS in cases where the ceiling is set to be lower than ¥10million.

### 4. Bidder's status in QCBS

Successful bidders who obtained first place in engineering point are increasing every year and it has become as much as 88.6 % in FY2010. Also the number of successful bidders who do not obtained first place of price points exceeds successful bidders who obtained first place in price in FY2011. (See drawing)

### 5. Performance evaluation points by procurement type

Average value of operation performance evaluation points of each type in FY2011 is 76.4 point in QBS, 75.9 point in QCBS, and 74.4 point in price competition selection. We estimate that switching over from recent competitive price selection to QCBS is contributed to quality assurance in consultant engineering.

### 6. Future investigation

As described above it becomes clear that introduction of the assessment system for certain accomplishment prevents dumping, and enlargement of QCBS contributes to quality assurance. On the other hand price competition selection and QCBS in case ceiling prices is lower than or equal to ¥10 million still frequently exists low priced successful bidding. Currently, the Regional Development Bureau who operates the procurement system made its own system by setting the standard value equivalent to threshold price for low price inquiry targeted to ceiling price lower than or equal to ¥10million. In future we intend to analyze the effect of such preventions of dumping.

Further we also intend to consider streamlining the procedure for QCBS to reduce the burden of bidders on the Regional Development Bureau.

### Reference

Details are referred to following URL (Japanese)

<http://www.nilim.go.jp/lab/peg/theme03.html>

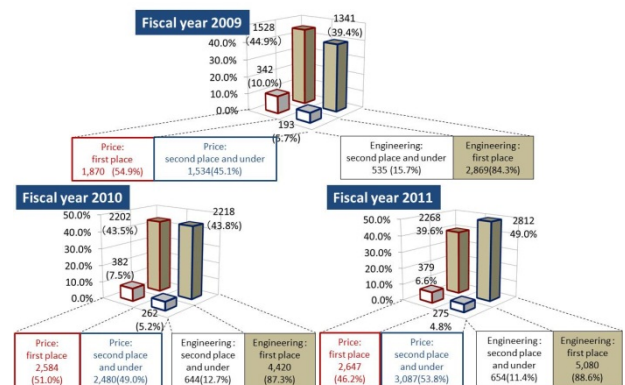


Figure: Successful bidder's status in QCBS

## Revision of operation guideline on Quality and Cost Based Selection for public works projects under direct control of Ministry of Land, Infrastructure, Transport and Tourism

Research Center for Land and Construction Management

Construction Management Division

Head MORITA Yasuo Senior Researcher OKANO Minoru Researcher TAJIMA Takashi

Guest Research Engineer UENISHI Taisuke

Guest Research Engineer UMANO Koji Guest Research Engineer NAKAMURA Keiji

*(Key word) Direct control of Ministry of Land, Infrastructure, Transport and Tourism, Quality and Cost Based Selection(QCBS), improvement suggestion, operation guideline*

### 1. Introduction

Application rate of the Quality and Cost Based Selection (QCBS) for public works projects under direct control of Ministry of Land, Infrastructure, Transport and Tourism is approximately 100%. On the other hand, there remain unsolved issues such as increasing burden on both competitive bidders and owners related to technical proposals and reviews, and deviations from policies of utilization of technical skills of private sectors or quality assurance. Therefore, QCBS has been improved at the end of fiscal year 2011.

Full-scale application of QCBS based on the improvement suggestion (hereinafter called “New Method”) is scheduled from fiscal year 2013 after a trial run at the Regional Development Bureaus (including HOKKAIDO and OKINAWA) in 2012 fiscal year. For the purpose of appropriate application of this New Method, Research Center for Land and Construction Management has revised the operation guideline in this year, which is described in the following sections.

### 2. Structure and outline of operation guideline

#### (1) Structure

This operation guideline is mainly composed of 3 parts: 1) Background of introduction and improvement of QCBS, 2) Implementation procedures of New Method, and 3) Outline of trial method related to QCBS. The structural outline is shown in the following table.

Table: Features of the operation guideline structure

Three pillars	Structural feature (Chapter)
(1) Background of introduction and improvement of QCBS	1. Background of introduction and improvement of the QCBS
(2) Implementation procedures of New method	2. Implementation procedures of QCBS
	3. Method of QCBS
	4. Public announcement of results of QCBS
	5. Assurance of evaluation results of QCBS
(3) Outline of trial method related to QCBS	6. Trial run of QCBS

#### (2) Outline

##### 1) Background of introduction and improvement of QCBS

Principle of improvements in this revision and a remedial approach to address such cases as bid-rigging in Kochi Prefecture are described in Chapter 1.

Polarization of the concept of QCBS into two types, which is the core of the improvement policy, is shown in the figure below.

# A Case of Utilizing Results

Current practice					
Simplified type	Standard type		Advanced Technical Proposal Type		
	Type II	Type I	Type III	Type II	Type I

↓

Polarization					
Evaluate construction capability		Require technical proposal in addition to construction capability			
Construction capability evaluation type		Technical proposal evaluation type			
Type II	Type I	Type S	Type AIII	Type A II	Type A I

## Polarization of QCBS type

### 2) Implementation procedures of New Method

In Chapter 2, basic procedures for “Construction capability evaluation type” and “Technical proposal evaluation type” are described, including procedural flows taking account of the stepwise selection method (trial run) and schedules for interviews with site engineers, classification of qualification requirements of participating bidders and items of QCBS, and also the evaluation method of technical proposals for technical proposal evaluation type A. Basic concept of calculation for evaluation values or technical evaluation points, public announcement method for evaluation and bidding results, and citation in special specification document to require execution of items in technical proposals are described in Chapter 3, Chapter 4, and Chapter 5.

### 3) Outline of trial run method related to QCBS

Basic concept of methods such as “Stepwise selection method” implemented at the trial run stage is described in Chapter 6.

[References/Website Information]

For details, please refer to the following URL at Construction Management Division’s homepage.

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

# Research Trends and Results

## Utilizing bridge 3D data over the course of design, construction, and maintenance

Information Technology Division, Research Center for Advanced Information Technology

Senior Researcher AOYAMA Noriaki

Researcher Ph.D. (Information Science and Technology) TANIGUCI Hisatoshi

Head SHIGETAKA Koichi

(Key word) CALS/EC, Bridge, 3D data

### 1. Introduction

In the Ministry of Land, Infrastructure, Transport and Tourism, we are considering circulation and utilization of 3D data over the course of survey, design, construction, and maintenance as the effort to CALS/EC.

In this paper we introduce the method of circulating 3D data from design to construction and maintenance, to streamline our operations in the field of bridge construction.

### 2. Control point

In current engineering when drawing bridges, no coordinate value is entered therefore coordinate value is frequently recalculated at construction stage. This could cause mismatching of installation positions or connecting points between the upper member and lower member.

Also at the maintenance stage, estimation of deformation based on only actual structure size without the dimension entered in drawing.

Therefore, installation positions or connection points of the structure preventing miss-installation (Structure installation reference mark) and monitoring point to grasp displacement or torsion of the structure (Monitoring reference mark) are set as position coordinates (Control point) to circulate throughout design stage, construction stage, and maintenance stage. The following Figure 1

is a materialized figure of the control point.

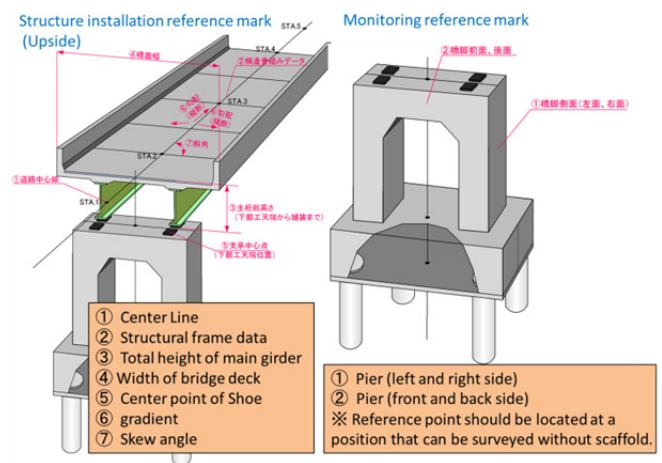


Figure 1: Example of Control Point

### 3. Data circulation

Three dimensional coordinate of structure installation reference marks shall be entered into coordinate graphics as 3D design data when handing over the drawing from the design section to the construction section. Also surveyed measurements of reference marks are added to coordinate graphics that is handed over from design section and the coordinate graphics shall be returned to design section as construction blueprints. By this procedure builders can easily prepare data for monitoring reference marks from the design drawing and road administrators also can have merits to keep construction blueprints for a long time.



#### 4. Using skeleton model

Following Figure 2 is comparing skeleton models before and after an earthquake.

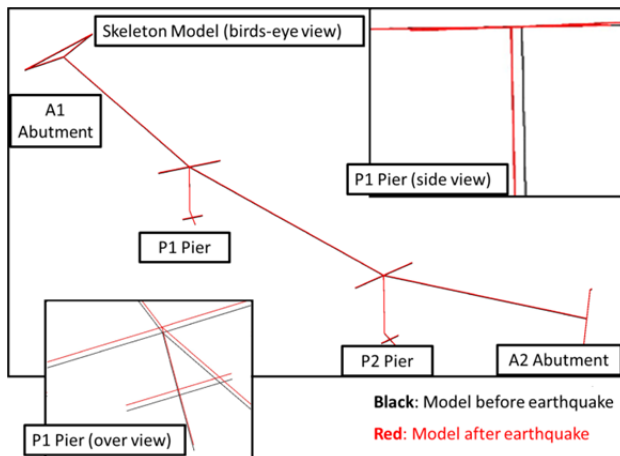


Figure 2: Comparing Skelton Models

A Skeleton model means a three dimensional model drawn by connecting control points by using straight line. Monitoring reference marks at IC Bridge installed over the Heizou River (kept by Chiba national highway office) in 2010 fiscal year were surveyed and a skeleton model was drawn up and practicality of skeleton model was verified.

By comparing two models before an earthquake and after an earthquake as shown in Figure 2 the following bridge conditions are easily grasped.

As a result, “The entire bridge has moved approximately 17cm toward southeast and sunken 5cm – 12cm” and “Almost no relative displacements are observed at each bridge abutment and bridge column, also no deformation such as lean or torsion is observed.”

In the future we are going to verify the effect of this method by implementing circulation, introduction, and trial run construction work related to designing and reviewed using this standard 3D data (control point and external shape).

[Reference]

Operation guideline related to bridge 3D data circulation

[http://www.nilim.go.jp/lab/qbg/cals2012/guideline/guideline\\_bridge.pdf](http://www.nilim.go.jp/lab/qbg/cals2012/guideline/guideline_bridge.pdf)

## Making of Software Function Confirmation Guidelines Concerning the As-built Measurement using TS with 3D-design-data

KAJITA Hiroki, Senior Researcher

KITAGAWA Jun, Researcher

SHIGETAKA Kouichi, Head

Information Technology Division, Research Center for Advanced Information Technology

(Key words) computer aided construction, construction management, as-built measurement, total station(TS)

### 1. Introduction

National Institute for Land and Infrastructure Management (NILIM) is studying “the As-built measurement using TS with 3D-design-data” (below this, TS-assisted as-built measurement) that is one of the construction technology of information. TS-assisted as-built measurement installs exclusive software in TS (total station) and reads the designing data of three dimensions. Thus, not only can the constructors get the efficiency of as-built measurements, but it also allowed the purchasers to get the efficiency of supervising, inspecting and can confirm the credibility. To get the efficiency, in the antecedent of the function using ICT (information and communications technology), we introduce operation rules different from the conventional methods. Therefore, it is important to secure the credibility in the function of the software we use.

### 2. The Purpose of the Function Confirmation Guidelines

When TS-assisted as-built measurement is conducted, we must install the function shown in “the specification paper for function requirement” that NILIM decided. In “the specification paper for function requirement”, as well as the function for efficiency, we oblige to install the functions that aim at the rise of credibility, such as

limitations of measure distance, and prevention of measurement data manipulation. Based on this function, the operation rules aim to reduce the investigation frequency and data presentations comparing with the way that they measure with the level and tape and record the figures on the field notebook. Therefore, it is important to secure the credibility of this function in the software we use. However, according to the yearly increase of introduction cases into the constructions under the direct control of the Ministry of Land, Infrastructure and Transport (MLIT), the developing of the software by new entry dealers is on the way. In this situation, there is a possibility that the software developers could misunderstand the language of the specification paper for function requirement. So we made the function confirmation guidelines as a means to confirm if the software installs the right functions.

### 3. The Outline of the Function Confirmation Guidelines

These guidelines decide the concrete way of confirming on each function of software shown in the specification paper for function requirement. As the main method, they read in the attached sample data, and confirm the software movement and calculation result to accord with right result shown by the guideline.

(Reference HP) <http://www.nilim.go.jp/lab/qbg/ts/>

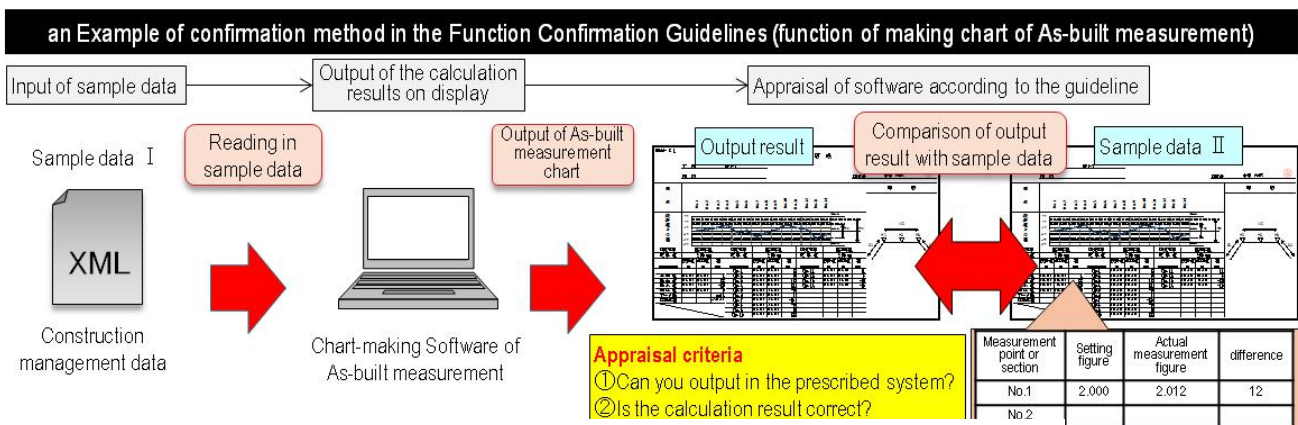


Figure : an Example of Function Confirmation using Sample Data

# Research Trends and Results

## Toward Upgrading the Evaluation Method for Public Works

~Dealing with the Non-monetary Effects ~

OTANI Satoru, Senior Researcher

SADO Chikako, Researcher

Construction Management Division, Research Center for Land and Construction Management

( key word ) public works, evaluation of works, benefit / cost, total evaluation,

### 1. Introduction

In the public works, except for maintenance, repair, disaster recovery and so on, it is required that the benefit cost ratio (B/C), which is an index to show the economic efficiency, is greater than 1. The effects of public works covers not only the direct effects such as the reduction of damage through flood prevention projects and the reduction of driving time and reduction of driving cost in road projects, but also the activation of the district, the conservation of environment and so on. However, not all of these effects are counted as benefits. In the evaluation of public works in our country, the items out of B/C, as well as B/C, are quantitatively or qualitatively listed up and totally evaluated. Therefore, to upgrade the evaluation method for public works, we are researching the project evaluation systems of other countries and domestic cases about how to manage the efficiency without currency conversion.

### 2. Evaluation of Public Works in Other Countries

In regards to evaluation of public works in other countries where B/C is placed as an important index, in Germany and New Zealand, it is required that  $B/C > 1$  for the adoption of projects. In UK and France, B/C is an important evaluation element, however,  $B/C > 1$  is not necessarily a requirement. Decisions are made to adopt the projects including these items without estimating the benefit and evaluating the combination of B/C and the items except B/C totally, or about how to distribute the budget to projects.

When we compare the items of other countries with ours, we find that they outnumber ours as a whole. There are some countries that estimate the benefit of the influence on local economy, the effects on the preservation of environment, and so on, which are dealt as non-monetary items in Japan. But they are careful about not to double count. The items calculated as benefit vary by country and by project type.

The evaluation method of non-monetary items also varies. In UK the selection or the priority order of the

projects is decided in reference to the total points calculated from B/C and other items using multi-criteria analysis. On the other hand, in Germany, they select projects with  $B/C > 1$ . Then, using qualitative items concerning the national land development plan they give the priority order to the projects. In US, some projects concerning disaster prevention put the stress on the fact that lives and property are in danger.

Generally in other countries, considering the wide-range effects of public works, while they put the stress on economic efficiency, they build the mechanism to take the wider effects into evaluation and pursue its fulfillment.

### 3. The Opinions of Local Organizations

The opinion of some Regional Development Bureaus (RDB) that practice the projects are the consideration on local characteristics ( ex. urban and local ) that practice the projects, the effects on the districts, making the standard of minimum services to give and review the units and levels of projects evaluation. We see the same opinions as this in the proceedings of the committees on projects evaluation and surveillance which are established at every RDB.

### 4. Prospect

We will continue the investigation on the trend and movements of other countries and domestic projects. According to these results, in concern with the project evaluation of public works, we are going to arrange the treatment of effects with non-monetary items and the disputed points in case it is incorporated into the evaluation method. We will proceed to investigate about these disputed points.

### (Reference)

- 1) Department for Communities and Local Government : Multi-criteria analysis : a manual, 2009, Department for Transport : Transport Analysis Guidance, April 2011
- 2) Federal Ministry of Transport, Building and Urban Development; Federal Transport Infrastructure Plan 2003, 2003

# Research Trends and Results

## Reliability index on traveling time in road transportation

Road Department Traffic Engineering Division    Research Coordinator : Mr. Kenji MOROTA  
Senior Researcher : Mr. Hirotaka SEKIYA  
Head (Doctor of Academy) : Dr. Susumu TAKAMIYA

(Key word) Road transportation, Travelling time reliability, Probe data

### 1. Preface

Recently, large number of data can be available by development of information technology and understanding of travelling time for running vehicle in given zone is also becoming possible.

Road Laboratory Room is conducting concerning calculating method of travelling time reliability index by using this probe data.

### 2. What is travelling time reliability index?

Travelling time reliability is intending to indicate reliability of the travelling time of variability to the same zone. 「90% tile traveling time」 is frequently used as traveling time reliability index.

This travelling index 「90% tile traveling time」 indicates that 90% of days (9 days out of 10 days) can be traveled within 55 minutes and remaining 10% (1 day out of 10 days) is required more than 55 minutes when 90% tile traveling time is 55 minutes and reliability in the same time zone is targeted for example as shown in Figure 1..

### 3. Relation analysis between data missing state and calculation accuracy

To execute accurate analysis, correct data acquisition is required. Not always proof data can be adequately available during analysis targeted time zone. It is assumed that required accuracy for travel time reliability index could not be secured when data missing are many. So analysis is executed targeting at relation between data missing state and accuracy of traveling time reliability index. As an analysis example of targeted 30km zone that data acquisition at 7 in the morning was made for 60 days was analyzed and introduced in this report. Following are procedure of analysis.

- (1) Medium value and 90% tile value during traveling time are calculated based on acquired all the data. (These values are assumed as true values.)
- (2) For all the calculated values in procedure (1) are assumed acquired data temporary setting missing zone and acquired date.
- (3) Calculate medium value and 90% tile value using obtained data in procedure (2) and assess if the data satisfy the criteria shown in Figure2.

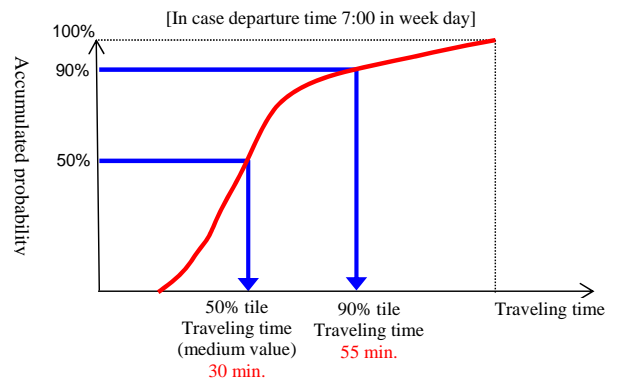


Figure 1. Distribution of traveling time and 90% tile traveling time

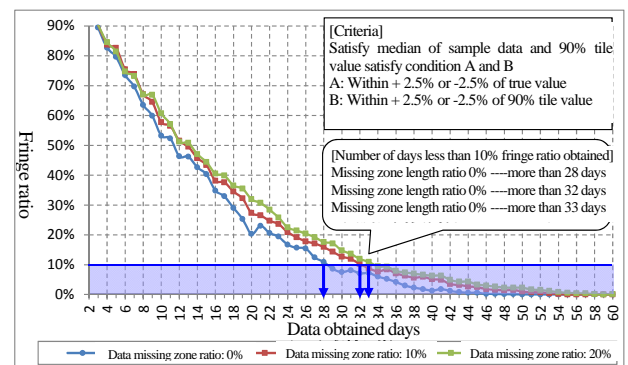


Figure 2. Relationship between the situation of missing data and calculation accuracy

- (4) Every data missing zone length ratio (0%, 10%, and 20%) and data acquired days (from 2 days to 60 days) repeat procedure (2) 1,000 times in random manner then calculate fringe ratio (ratio that the value is not satisfied the criteria in process (3)).

Analyzed result is shown in Figure 2. Naturally the more missing ratio is improved the more accuracy is improved. Figure 2 indicates that more than 33 data acquired days out of 60 days are required to obtain 10% fringe ratio when data missing zone length ratio is 20%. By using this method accuracy can be presented from index value obtained from acquired data.

In future we are going to summarize calculation method of travel time reliability index as manual including knowledge obtained from this study adding further analysis.



# Research Trends and Results

## Analysis of Relation between Trend of Social Economy and Index of Road Traffic

OHASHI Sachiko, Senior researcher

OTANI Satoru, Senior researcher

Research Center for Land and Construction Management, Construction Economics Division

( key word ) *traffic volume, economic trend, sightseeing /tourism, road transportation in winter season*

### 1. Introduction

Traffic volume is measured by vehicle sensors placed at fixed observation points. In recent years, the technology to deal with these data has progressed and the possibility of utilizing these data has widened. In this research, on the base of road transportation data such as continuously observed data of traffic volume and probe data of general vehicles recently accumulated and so on, we tried to grasp the social economic trends. If we can read social economic trends through road transportation data, from the viewpoint of immediacy of gaining data, it will become possible to widely supply profitable information to society.

### 2. Relation with Economy

About business climate, we analyze the relation between continuously observed data of traffic volume and index of business conditions and each index consisting this. In this analysis, we focus on if the index of traffic volume goes in front of business climate, correspond with it or come after it. We also focus on how we should handle the data of traffic volume to use it adequately.

### 3. Relation with Tourism

We are analyzing the relation between tourism and continuously observed traffic volume. Tourism is a local industry in the trend of social economy. As the index concerning tourism, there is a statistical investigation of incoming tourists. According to “Universal Standard Concerning with Statistics of Incoming Tourists (2009, 12, Ministry of Tourism)” it is arranged within 5 months and announced in the cycle of quarter. Comparing with these statistics, the cost is low because road traffic data is not observed by manpower, and quick summing is possible in short term or short time zone because of all time observation. It could be used for the trend prospect in numbers of tourists until the announcement of precise statistics. We analyze the

relation between traffic volume and the number of incoming tourists at the targets of some sightseeing places. Considering the characteristics of the district such as the relation between the locations of continuously observation points and sightseeing places, the influence of common traffic inside the sightseeing place and main transportation of tourists, we are to pick up sightseeing places that enables to grasp the trend of tourist’s number through road traffic data.

### 4. Influence of Snowfall

In the regions with snow coverage and low temperature, snowfall during the winter season has a large influence on local economy and daily lives. By removing the snow, they try to lessen the influence, however, the profits gained by removing the snow has not been measured properly. There are the regular observation traffic data at every observation point whenever it’s snowfall or not. Together with the weather data, such as the depth of snowfall, the relation between the situation of the road face and the traffic data at the observation points can be found. Moreover, using probe car data, there is a possibility that we can find more details in the relation between the road face situation and the traffic data on the road network. In our research, using this method, we try to analysis an estimate of the profits of snow removing.

### 5. Conclusion

Road transportation data such as continuously observed traffic volume has been used in the phase of infrastructure maintenance and management. However, utilizing in the phase of social economy for wider supply of information is to be researched hereafter. We plan to announce the results of analyzing what we have introduced here at any time.

# Research Trends and Results

## Utilization system of probe information collected via ITS spot

Intelligent Transport System Division, Research Center for Advanced Information Technology

KANAZAWA Fumihiko, Head

SAWADA Yasuyuki, Senior Researcher

TANAKA Yoshihiro, Researcher

NAKAMURA Satoru, Guest research Engineer

(Key word) Probe, Utilization system, ITS spot

### 1. Collection of Road Traffic Probe Data

ITS spots allocated centrally at about 1,600 points all over Japan along the highways starting in 2011 year receive transmitted probe information (travel record, etc.) on the road side using vehicle loaded ITS Spot-compatible car navigation system (sold starting in 2009 year) corresponding to ITS spot. With this system large amounts of data can be collected at low cost when ITS Spot-compatible car navigation systems become common. Also to monitor and provide highly accurate road traffic information, efficient and an upgraded low cost road management operation can be realized because records of travel speed can be collected by broad range and in zone unit.

### 2. Development for prototype of utilization system

National Institute for Land and Infrastructure Management is currently developing an utilization system which allows facilitated data collection and display using Road Traffic Probe Data and integrated probe information (Integrated group composed of Road Traffic Probe Data and private sector probe data) intending to allow road administrators to monitor road condition, etc.

We have developed a prototype system operable as standalone selecting following functions considering the needs of road administrators, feasibility, and accumulated data amount, and practicality at trial runs as the initial year referring to the operation of road administrator.

#### (1) Time-space diagram writer

This is the function that displays pattern diagrams on screen (Figure) together with outputting the summary result of average travel speed classified in a specified route zone (DRM link) and time zone in report format. Applications for quantification of effects through ex-post evaluations (reduction in travel time, etc.) is expected.

#### (2) Required travel time tabulator

This is the function to output summation of average required time classified into a specified route zone (DRM link) and time zone in report format. Applications in project effect evaluation, etc. can be considered.

#### (3) Sudden acceleration and brake area mapping

This is the function that displays emerged areas of sudden acceleration (back and forth acceleration), traveling direction, and size (ranked color coding) in specified area. Application is considered in cases such as extraction of place where traffic safety measures are required (areas where rapid deceleration frequently occur), and traffic safety measure effect (comparison of abrupt deceleration frequency before and after countermeasure taken).

### 3. Improvement of probe utilization system

Trial use of the prototype system was implemented by road administrators and comments were recorded. With the result of the comment reviewing such needs as "Improvement of operability", "Summing of data in each month or in each prefecture" and "Summing of data classified by Standards for reference road section for traffic surveys", etc. were requested.

Based on these requests we are promoting system improvement to realize a usability improved system such as an internet applied system and operability improved system, and responding to wide range applications by selecting given summary zones (DRM and Standards for reference road sections for traffic surveys).

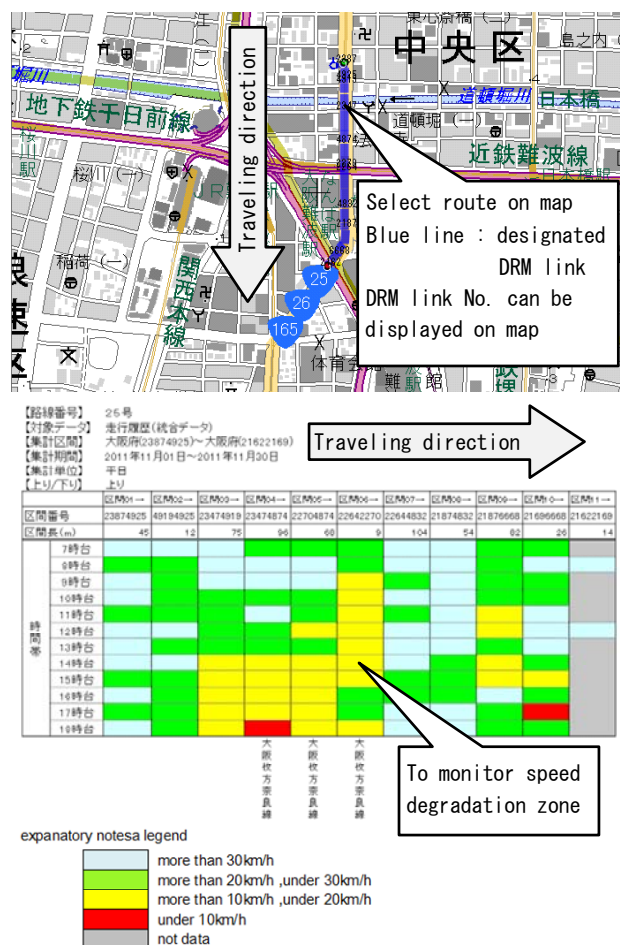


Figure Output example of time-space diagram writer

# Research Trends and Results

## Movement of people and infrastructure of information and Working on the application of transportation planning

Information Technology Division, Research Center for advanced information

Researcher IMAI, Ryuichi PhD(Engineering)

Researcher IBOSHI, Yuki

Research Center for advanced information

Research Coordinator for Green Innovation HAMADA Shun-ichi

(Keywords) Movement information of people Flow line data

### 1, Introduction

In transportation planning, the results of statistical surveys, such as the movement of people information about the road traffic census surveys and PHS are utilized.

On the other hand, based on the experience of the Great East Japan Earthquake, the importance of creating systems that can be handled flexibly in some freshness information "movement of people" has been recognized.

In this paper, we construct a platform (platform) that can collect and analyze information on the movement of people that can be retrieved by the ICT (Information and Communication Technology) and an overview of the efforts and plans to apply to traffic.

### 2. Current state of the use of information collection and movement of people

The aforementioned statistical survey has been conducted by a large amount of investigators that has been prepared in advance, and its findings which the data representing a particular day of the year or 10 years, cannot take advantage of such a disaster and the situation where the movement of non-routine travelers and the preparation time that cannot be predicted.

On the other hand, with the development of ICT in recent years, with each media such as Smartphone, Car navigation systems and Transportation Smart card system, information on a variety of high freshness movement of people has been collected over a wide range and large number 24 hours a day, 365 days a year to each operator.

Being based on the above social trend, it is

expected that the development of combinatorial analysis utilizing particular features of the movement of people through a variety of media.

However, now we remain analysis using of single mode movement information (i.e. the trace of the vehicles), therefore we cannot be grasped that there is no mechanism to coordinate the movement of people information that has been collected in each company, a series of traffic behavior (point of moving all the time).

### 3. Development of human movement information platform

With the above situation, in this study, we are working on making the platform (including operational and institutional mechanisms) that can collect and analyze the low cost of human movement information collected by a variety of media that can be obtained by ICT

Thus, it is possible that the research to complement the current statistical survey, which conduct timely and efficiently at low cost. And it is also expected to contribute the efficiency and sophistication of official and private services that the transportation planning and disaster prevention planning, etc. that respond to the characteristics of the human attentive.

Now, through the experiment to collect and analyze information on the movement of people in the area model, we make an great effort to develop and design the systems the platform (prototype) to the practical use.

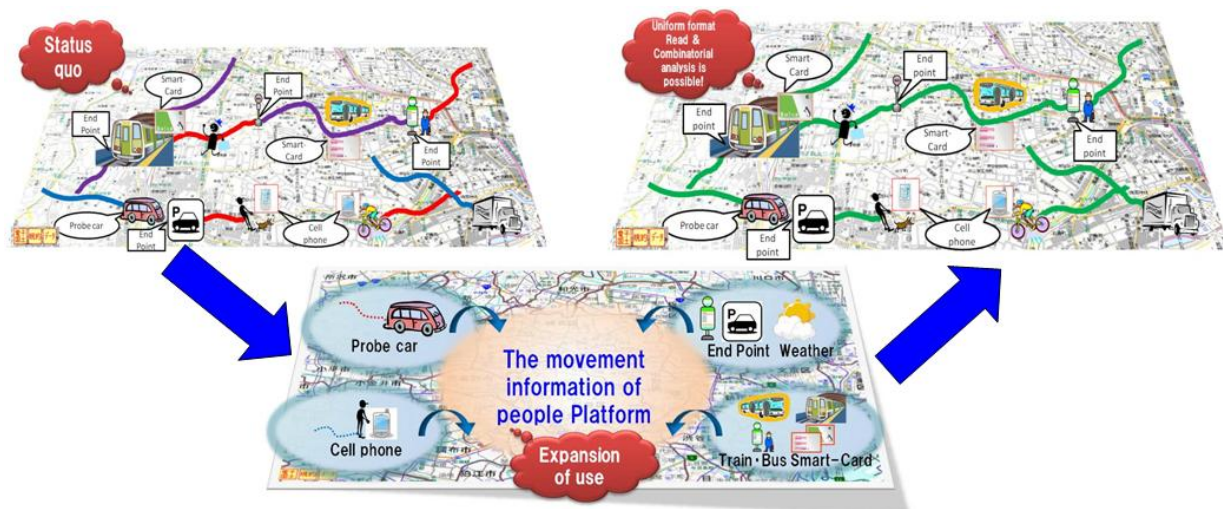


Fig. The image of the platform: the movement information of people



# Research Trends and Results

## Efforts to draft construction-related technical standards

Building Department Standards and Accreditation System Division Head FUKAI Atsuo  
Senior Researcher INOUE Namihiko Senior Researcher IWATA Yoshihiro  
Researcher KABEYASAWA Toshikazu Researcher YOKOTA Yoshihiro

(Keywords) Architecture Technology standards

### 1, Architecture

Technical standards to ensure safety in accordance with the building have been stipulated in the Building Standards Law.

We appropriately need to review these construction-related technical standards in accordance with the development of research and technology and the disaster.

Therefore, as the research results conducted by National Institute for Land and Infrastructure Management (NILIM) and as the system to promote standardization (Ministry of Land, Infrastructure, Transport and Tourism Auxiliary business and Project to assist the search cost to business entities that country to set research agenda selected by the public) based on the results (In fiscal year 2012, "Building Construction Standards Committee (Tetsuo Kubo, Professor Emeritus, University of Tokyo, Chairman)", in fiscal year 2013, Building fire protection Standards Committee "(Tokyo University of Science Professor Makoto Tsujimoto Chairman) was staffed in NILIM), we established a system to create a draft technical standards taking into account the opinions of external experts.

In addition, we set up a "contact point" in cooperation with relevant organization for the advanced rationalization of technical standards, and we widely support the proposal of the development and review of standards from the private sector. (Fig.1)

### 2, Building Construction Standards Committee

Considering the damage to buildings in the Great East Japan Earthquake, in fiscal year 2012, we created a draft of technical standards on the structure of the requirements concerning the tsunami evacuation building.

In fiscal year 2013, based on the damage the earthquake, we are continually advancing the discussions on measures of the falling of escalators and the ceiling dropping.

After the fourth committee was held on July 9, we continue the investigation based on the feedback that has been received, subjected to public comment on the draft technical standards from the end of July to September 15.

### 3, Building Fire Protection Standards Committee

We held the first committee on October 10 and deliberated the plans of subsequent experiments and the criteria for the fire protection with regards to the three-story wooden school referring to the results of Full-scale fire experiment of three-story wooden school (preliminary experiment) carried out

on February 22, 2013 to promote the construction of a large wooden building.

Continuously, we plan to study the related technical standards for fire protection that takes into account the experiment.

### 4, Contact point

At the contact point, we accept the proposal of the review and maintenance of standards in terms of technical standards, such as stand-alone provision of the Building Standards Law from the private sector, gaining the cooperation of the Building Research Institute (an independent corporation), and we also have studied from a technical standpoint at NILIM.

In fiscal year 2013, we accept 10 new proposals, and review and technical standards, we also treated with 33 out of the proposals which had been accepted in previous years (as of December) by the decision to review of technical standards or the decision not to be reviewed.

(Reference website : General Administrative Information Center Building Foundation  
[http://www.icba.or.jp/cp/cp\\_top.html](http://www.icba.or.jp/cp/cp_top.html))

### 5, Future plans

Being based on the movement of Panel on Infrastructure Development, we are scheduled to consider the review of technical standards in accordance with the progress of the investigation and research will continue.

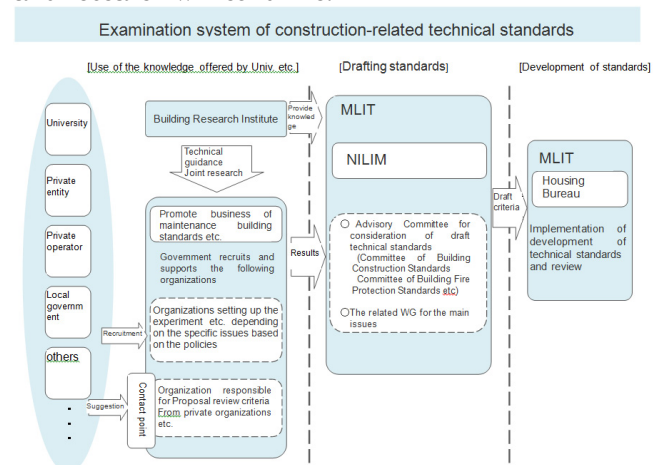


Fig.1 Examination system of construction-related technical standards



## Research trends and results

# Studies on the effect of reducing the stress in the ground by aircraft

NAKASHIMA Susumu, Head  
KATO Mitsuru, Deputy Head  
SASHOU Tomoyuki, Researcher  
Airport Department Airport Construction Systems Division

(Keywords) Airport, Structural design, Aircraft load, Stress in the ground in the vertical direction, Multilayer elastic analysis

### 1, Introduction

Traditionally, stress in the ground vertical direction acting on underground structures by aircraft load has been calculated by the method of load distribution (Law of Boston code). However, in recent years, it has become possible to calculate under appropriate conditions to take into account the pavement by the generalized multi-layer elastic analysis program.

In this study, using the multi-layer elastic analysis, we calculated the vertical stress in the ground which includes underground structure and is paved with the material such as concrete slab which have high load dispersion effect. And we confirmed the effect of reducing the vertical stress by comparing it to the vertical stress in the homogeneous isotropic (no pavement) ground.

### 2, Relationship of stress due to the presence or absence of pavement

As a cross-section calculated by a standard design of pavement conditions in major domestic airports (20,000 times cyclic design action, LA-1 segment design load, 25MN/m<sup>3</sup> of K value or CBR10%), for the three cases: asphalt pavement (AS pavement : 15cm base layer), prestressed concrete pavement (PC pavement: 24cm thick plate), and unreinforced concrete pavement (NC pavement: 42cm thick plate), we calculated the maximum value of the vertical stress in the ground by multi-layer elastic analysis program (GAMES) for 40 models of domestic aircraft and compared to homogeneous isotropic (no pavement) ground stress. Figure 1 shows an example of the result. If the pavement exists, the higher the stiffness of the pavement, the smaller the stress is. (As Pavement (16° C) < PC pavement < NC pavement) And the shallower the depth of the ground, the bigger the difference becomes in the case of no pavement. With the NC pavement, there was a reduction of about 40% to 80% stress compared to the case without a pavement.(Fig. 2), and reduction rate was increased, especially in the shallower than 1.5m.

### 3, Conclusion

In this study, we were able to confirm the effect of reducing the vertical stress in the ground considering the pavement. Thus, the structure embedded in the ground under the pavement of high rigidity enables the

cross-section structure to design economically. Therefore, for revision procedure, we show some examples of specific calculation methods, and we plan to create a rough draft which is considered the efficiency of the design.

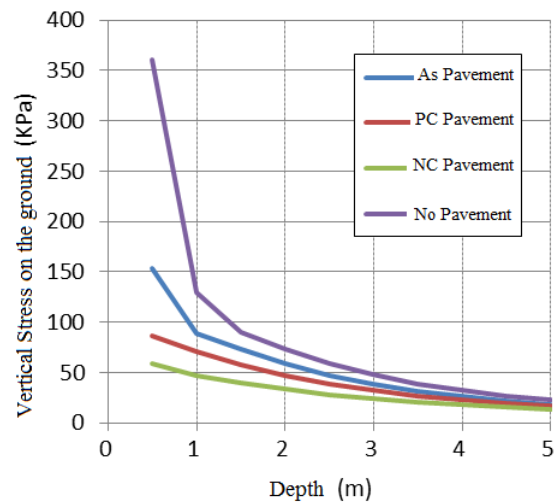


Fig.1 Vertical stress in the ground (B777-300)

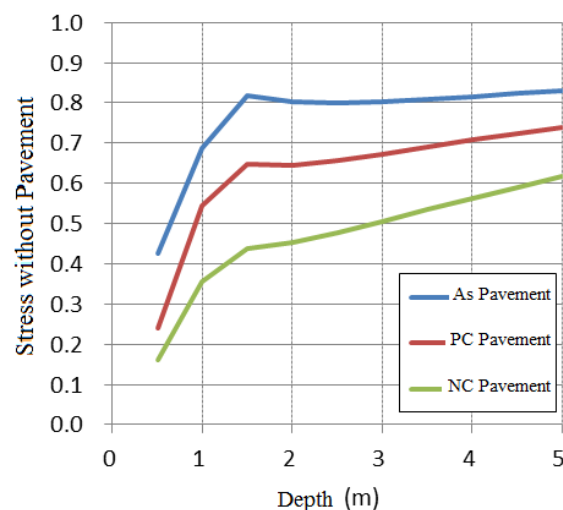


Fig.2 Effects of pavement / no pavement (B777-300)

### 【References】

Civil Aviation Bureau Ministry of Land, Infrastructure and Transport • Edited by National Institute for Land and Infrastructure Management : Civil structural design guidelines and a design example airport facility, Service Center of Port Engineering, 2012

# A Case of Utilizing Results

## Maintenance of technical standards in collaboration with practicing engineer and researchers

River Department River Division Senior Researcher FUKUSHIMA Masaki(PhD, Engineering)  
Head HATTORI Atsushi(PhD, Engineering)

River Department Director FUJITA Koichi (PhD, Engineering)

Environment Department River Environment Division

Senior Researcher NAKAMURA Keigo (PhD, Engineering)

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*(Keywords) Technical standards for rivers works, Methods of investigation, Revision*

### **1, Revision and maintenance of technical standards for river works: Practical guidelines for methods of investigation**

For the first time in 15 years since 1997, water and disaster management bureau, Ministry of Land, Infrastructure, Transport and Tourism has revised technical standards for river works: practical guidelines for methods of investigation (Hereinafter called Investigation guideline), which has been used as a practical guideline for river administration<sup>1</sup>. Technical standards for river works consist of four practical guidelines for planning, design, maintenance and methods of investigation mentioned above. Investigation guideline specifies methods of investigation to make a proper implementation of plan, design and maintenance in the field of river, erosion control, landslide, steep slope, avalanche and coast, and these methods reflect current state of art,

NILIM has listed as one of the mission of drafting technical standards, and is also involved in the special approval system of ministers and revision of practical guidelines for plans, design and maintenance. Many researchers have developed such as a method for daily technical research concerning river works. In the future, in addition to surveys and collection related information, we will work on

a regular basis to keep track of the latest research methods, technical knowledge and problems by listening to the opinions of scholars and other people related. And we have decided to carry out maintenance tasks as appropriate to review the contents of the investigation guideline. In the following, on revision of investigation guideline, we introduce the ingenuity added to technical standards and the efforts of NILIM to keep maintenance of the guideline.

### **2, Devising technical criteria development**

In the revision of the investigation guideline, we have classified each item <concept>, <mandatory>, <standard>, <recommend> and <examples>. By clarifying the position on the application, we have described <recommend> and <examples> as investigation techniques which could not be applied to the standard in terms of performance and range of use. Thus, we have created for a variety of users to know easily the latest findings. Additionally, we described notifications related, guidance, and manuals etc., as <related notifications>, and described as <reference materials> which can be used when you adopt the techniques <recommended> and <example>. Thus, we devised to make it easier to ensure that the latest knowledge is being used.

Moreover, we have ceased publication with the

# A Case of Utilizing Results

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print and distributed the investigation guideline via the Internet as an electronic file editing. Consequently revision process can now be carried out smoothly..

### **3, Efforts of NILIM for the maintenance of technical standards**

To implement continuous efforts to revise the technical standards, we clarify the structure of the contact point and discussion of each chapter and section. And we have decided to respond quickly to issues that have been obtained through exchanging the opinions to universities and the certain field. Under the framework of this review, we put the focus on the thing that we get the users to understand the point of the revision with the water and disaster management bureau, and have been conducting conference presentations, published in professional journals, and briefings in each region to inform the revisions as presentation activities. We held a briefing session at the 9 places at each region in Japan, and researchers (the contact person above) mainly explained the point of the revised every chapter and verse. Total of about 1,400 people took part in the nation and we got several valuable feedbacks for improvement of investigation guideline. We have set up a “form accepting comments and suggestions” on the website<sup>1)</sup>. And we are continuously looking for comments and suggestions, including proposals for research methods and analysis techniques, the basic idea of research and analysis for improving investigation guideline.

We would like to ask the proposal, improvements and aggressive feedbacks from the user of investigation guideline, developers of survey technology and researchers at the University through the website.

### **【Reference】**

1) Technical standards for river works: Practical guidelines for methods of investigation, June FY2012

[http://www.mlit.go.jp/river/shishin\\_guideline/gijutsu/gijutsukijunn/chousa/index.html](http://www.mlit.go.jp/river/shishin_guideline/gijutsu/gijutsukijunn/chousa/index.html)

# Complete revision of ‘Environment Impact Assessment Technique for Road Project’

~ corresponding to consideration document procedures, etc.

following assessment law amendment ~

INOUE Ryuji Senior Researcher KADOYU Katsunori Head YAMAMOTO Yuichiro Researcher  
Road Environment Division, Environment Department

(keywords) Environment impact assessment, road project, planning stage consideration, monitoring surveys during/after construction

## 1. Background of revised technical methods (amendment of assessment law)

‘Environment Impact Assessment Technique for Road Project’ (hereinafter called technical methods) is a guide book to be referred to in selecting items (environmental items) and studying the methods for survey, prediction and assessment when road business operators conduct environment impact assessment (assessment). Based on the revision of the assessment law and its technical guide, ministerial regulations (enforcement in April, 2013), the technical methods were completely revised accordingly, the outline of each item showed in the figure is presented herein.

Two procedures were newly obligated in the amended assessment law. First, environmental consideration (SEA system in the report of Central Environment Council (February 22, 2010) ) at earlier stage than the previous assessment (EIA) was obligated as consideration document procedures. In addition, report and announcement of surveys during/after construction, etc. in conducting the project after assessment was obligated as report procedures.

To correspond to such obligations newly made and to reflect the latest scientific knowledge and related system revision, the technical methods were completely revised using the previous outcomes of related studies in cooperation with Landscape and Ecology Division, and Geology and Geotechnical Research Group of Public Works Research Institute. At the time of revision, deliberation of the investigative committee consisting of learned persons from various environmental fields (Chairperson: Tetsuo YAI, Professor of Tokyo Institute of Technology) was made and opinions of Regional Development Bureau, etc. were asked. The revised technical methods were compiled in Technical Note of NILIM No.714 and Technical Note of Public Works Research Institute No.4254.

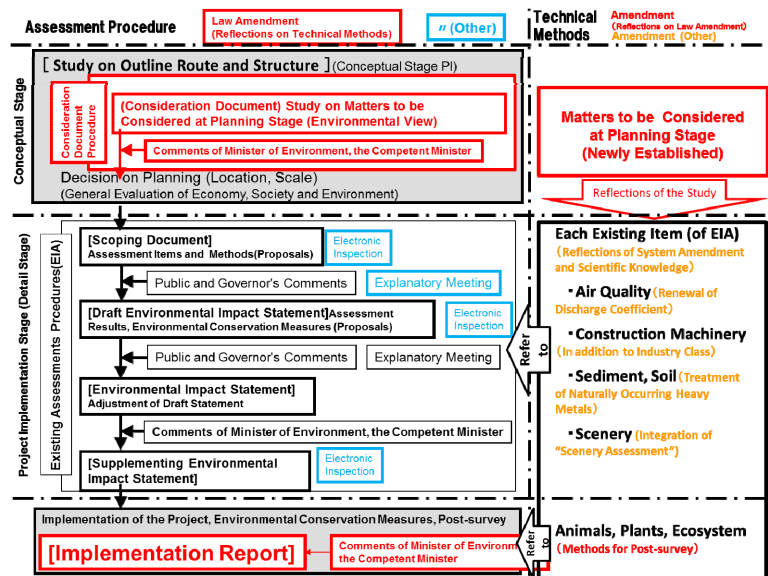


Figure: Assessment law revision and technical methods revision

## 2. Main revised points

(1) Newly established ‘Matters to be considered at planning stage’

It has been obligated that business operators conduct a ‘Study on matters to be considered at planning stage.’ In case of road projects, this is to compile environmental consideration when studying outline routes and structures at a conceptual stage in a form like EIA such as ‘understanding characteristics of the project and the region’, ‘selection of matters to be considered at planning stage (environmental items)’ and ‘results of survey, prediction and assessment’.

A chapter on ‘Matters to be considered at planning stage’ was newly incorporated in the technical methods as a common content organizing all environmental items. Using analysis results in this Division regarding the process and the environment assessment methods of PI case at conceptual stage of the road projects, etc., a simple procedure to assess environmental impacts by the positional relation between the object to be considered about environmental impacts (examination object) and outline routes • structures (multiple plans) based on existing papers was presented. With regard



## A Case of Utilizing Results

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to air • noise, etc., city areas • schools • hospitals, etc. are the examination objects (assessment objects) and as to animals • plants, locations where important species are observed and reported and their required habitat • growing environment, etc. are the examination objects (assessment objects). In addition, items such as avoidance and decrease conditions which should be studied in detail in EIA were to be organized.

Moreover, as for the natural environment in particular, utilizing the result of the study on available existing information and the possible consideration methods when outline routes and structure are studied, a concrete idea of survey, prediction and assessment was set forth in the reference materials (Technical Note of NILIM No. 720) separately.

Furthermore, additional comments to each item of existing EIA were made to the effect that the gathered information as described above will be utilized and the result of the study will be reflected.

(2) Materialization of methods for surveys during/after consideration

In order to conduct more appropriately future surveys during/after consideration which is subject to an official announcement based on the revised assessment law, methods for the surveys are added to 'animals • plants • ecological system' which account for the majority of practical examples. Utilizing the result etc. of analyzing cases of the surveys(transplanting and relocation of animals, consideration toward raptors under construction, etc.), clarification of maintenance targets, the level of details of survey corresponding to the purpose and approximate survey period, etc. were explained.

### 3. Official announcement and utilization of the technical methods

Completely revised technical methods were officially announced in the following.

<http://www.nilim.go.jp/lab/dcg/kadai/kadai1/gijutsu.htm>

The methods described in the technical methods have so far been employed in most items of every road assessment and utilization of revised technical methods will be expected in assessment including new procedures after the law revision.

# Research Trends and Results

## A joint research concerning the next generation's cooperative ITS development

Kanazawa Fumihiko, Head  
Sawa Junpei, Senior researcher  
Watanabe Daisuke, Researcher  
Sano Hisaya, Guest Research Engineer

Intelligent Transport System Division, Research Center for Advanced Information Technology

(key word) Road-to-vehicle communication, Inter-vehicle communication, Cooperative ITS

### 1. Introduction

This joint research examines architecture, system, and domestic and foreign general development about next generation's cooperative ITS, and it comprises 14 companies in total; 2 expressway companies, a mobile phone company, 8 electric machine manufacturers and 3 car companies, and NILIM.

The first stage of the joint research takes place from September, 2012 to the end of October, 2013. This text reports on the grasped content of the joint research.

### 2. Current state of ITS service

There are several forms of information service between road infrastructure such as ITS spots and car navigation by communication (road-to-vehicle) and car communication such as ASV (inter-vehicle communication), and each one is currently constructed as an independent system.

The cooperative ITS coordinates communication methods and data form regarding road-to-vehicle and inter-vehicle communication, and it achieves many ITS service applications by linking both systems and supporting each other. (Figure)

In Europe and America, international standardization concerning the cooperative ITS is rapidly advanced by being strongly supported by the government, and development of ITS cooperative system is important in an international development of Japanese ITS technology.

### 3. Selection of object service

The investigators adjusted opinions of the object service and selected 196 services. These were classified into seven fields such as, safety drive support, smoother traffic flow, environment improvement, comfort ability improvement, emergency treatment, administrative support activity and economic support activity.

Next, about each service, it defined the details referring to "Service details definition sheet" used by "System

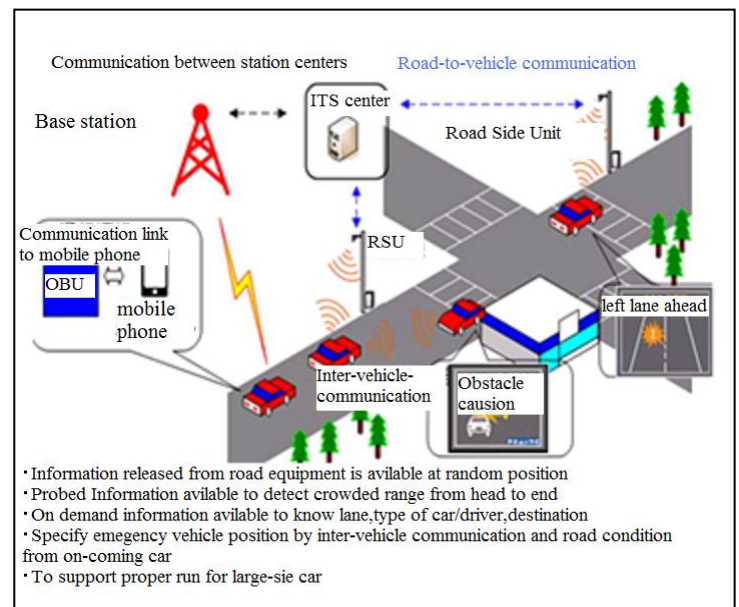


Figure. Image of cooperative ITS

architecture related to ITS" in November, 1999 (cf. Reference)

And, it examined the physics model arranging the relation of information exchanged between user and systems in each service, and the logical model arranging the relation of function and information treated.

### 4. How to advance the research in the future

It is scheduled to select the service emphatically, to examine the system configuration, and to make the road map for the domestic development by October, 2013.

It is scheduled to make specify the prototype, to examine the development, proving test, and to make the technological specification & standard after November, 2013.

#### 【Reference】

System architecture related to Intelligent Transport System (The National Police Agency, the Ministry of International Trade and Industry, of Transport, of Posts and Telecommunications, and of Construction in November, 1999)

# Research Trends and Results

## Effort Towards Implementation of Information Service Under the Cooperation Between the Public and Private Sectors Using Road Section ID System

ARUGA Kiyotaka, Guest Research Engineer

IMAI Ryuichi (Ph.D. Eng.), Researcher

SHIGETAKA Koichi, Head

Information Technology Division, Research Center for Advanced Information Technology

(Keywords) Road section ID system, Road related information circulation, ITS

### 1. Introduction

The writers have been addressing on new service creation and upgrading the information service using 『Road section ID system』 (hereafter ID system) that is the location reference system around roads<sup>1)</sup>.

On the other hand, if you focus attention on Hanshin Expressway, for example, the information service of road administrator, information that helps road safety has been provided through media such as advertisement and web pages. However, implementation of an information service that is appropriate for road users is an agenda.

Here, to deliver knowledge (hereafter contents) regarding safe, secure, comfortable drive assists that Hanshin Expressway has, the effort of 『Project Z NAVI de HANSHIN!2)』 that is reported to be under the cooperation between the public and private sectors through public offering of participant by three originators that are NILIM, Japan Digital Road Map Association and Hanshin Expressway Public Corporation.

### 2. Effort of Project Z NAVI de HANSHIN!

This effort is a three-year-plan, and contents that Hanshin Expressway has, was provided in ID system as a first step. Advanced information measure that is combined with large-scale road maps will be considered from next year.

Composition of the first step is indicated in graphic-1. It is delivered to each private company by converting information from ID system transmitted to the location of contents of which there are three kinds (high-accident location, reminder of fork, junction and construction schedules) that Hanshin Expressway possesses. Each private company provider received contents from road users by using a map that responds to ID system.

### 3. Image of information service

Each private company has developed two things: applications for smart phones that provide real-time information that responds to attributes (daytime or nighttime and gender) of the road user, and website for prior confirmation that is indicated in chart-2. Appropriate provision of contents that Hanshin Expressway possess is expected to be shared with the road users.

### 4. Conclusion

At the beginning of January, 2013 when this report was still under writing, the system was being user tested, and it

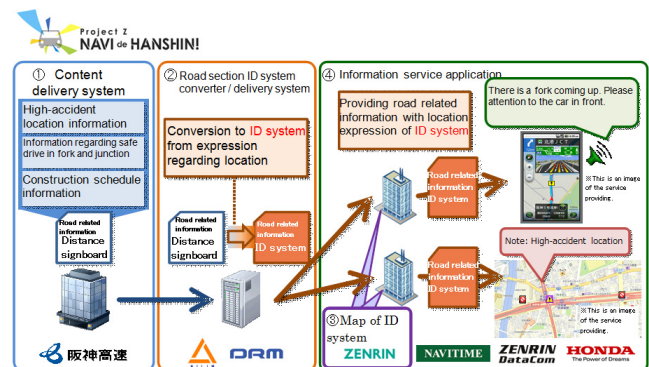
will undergo further testing in the future. This endeavor is the first information service using ID system. To increase success painstaking work is being continued.

### Reference

1) ARUGA Kiyotaka and others: Information service of safety drive assist in urban expressway using road section ID system under the cooperation between the public and private sectors, The 11th ITS symposium 2012, ITS Japan, 2012.12

2) Project Z NAVI de HANSHIN!

<http://navi-de-hanshin.jp>



Graphic-1 Composition of information service



Graphic-2 Image of information providing service

# Developing Information Sharing Platform for Road Management

OBARA Hiroshi, Senior Researcher

UEDA Eiji, Guest Research Engineer

Information Technology Division, Research Center for Advanced Information Technology

(Keywords) information sharing, road management, geographical space information

## 1. Outline

The information sharing platform for road management (“Road Management PF”) has been developed for the purpose of information sharing between road management administrators, by adding new functions necessary for road management projects to the Space Information Sharing Platform (“Space PF”) which was originally built by the National Institute for Land and Infrastructure Management.

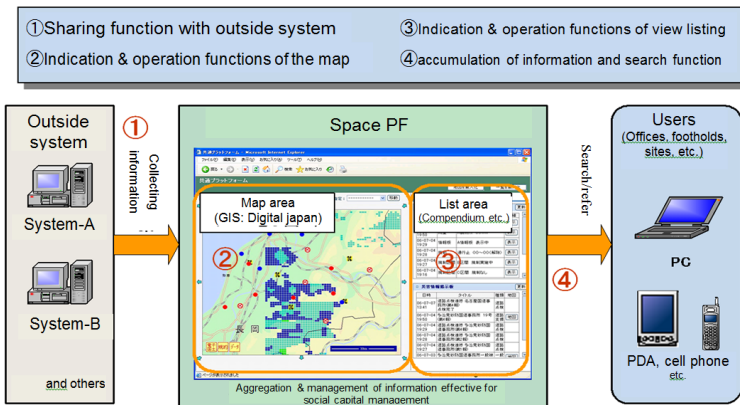


Figure 1: The structure of Space PF

## 2. Location references in road management

Space PF displays a summary of various information (meta-data) from several administrators at once on a digital map, using the “Digital GSI WEB System” provided by the Geospatial Information Authority of Japan. However, because the Space PF was initially created by combining existing technologies, to test if it could be applied to social capital management, location references were made only in longitude and latitude, and it could not handle digital road map (“DRM”) format or VICS (Vehicle information and communication system) format, which are commonly used in road management. These points have been improved in the Road Management PF. (See Figure 2).

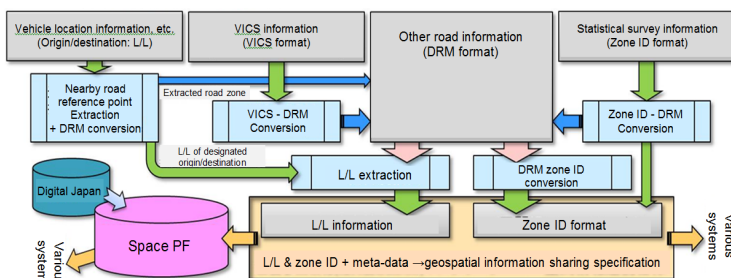


Figure 2: function to convert location information

## 3. Implementing useful road management functions

In order to improve work efficiency in data input and usage, some additional functions have been implemented in the Road Management PF. These functions include: (i) “Route extraction between two locations” which indicates the route between two locations on the map using a line with longitude and latitude and (ii) “Trafficable route estimate function (Figure 3)” which extracts trafficable routes using registered traffic control information.

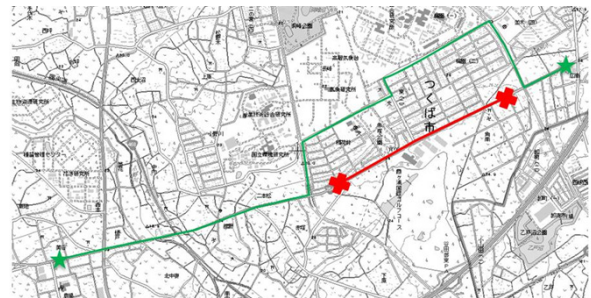


Figure 3: Trafficable route estimate function

## 4. Aggregating information using Road Management PF

In addition to the expansion of basic functions, aggregating disaster information, using meta-data sharing functions, has been a key aspect in developing the Road Management PF..

An efficient development of work application and cross-sectional use of information have been made possible, by aggregating various information from different road administrators in the Road Management PF, and using external applications to implement functions such as report, format preparation and history management.

## 5. Conclusion

The test operation of Road Management PF will commence at the beginning of the 2013 fiscal year. In the meantime, we will evaluate its utility for aggregating disaster information, while verifying its performance in actual operation.

While providing technical support for road management administrators at regional development bureaux, the National Institute for Land and Infrastructure Management aims to gain a better understanding of the needs for further improvements, regarding information sharing using Road Management PF.



# Release of Common MP Hydrological Data Acquisition Tool

KIKUMORI Yoshito, Senior Researcher, Climate Change Research Team  
 YOSHITANI Jun-Ichi (Ph.D.), Research Coordinator for Watershed Management  
 River Department

(Keywords) hydrological database management system, Common MP, data acquisition tool

## 1. Introduction

The hydrological database management system<sup>(1)</sup>, of which national hydrological data under the jurisdiction of the Water and Disaster Management Bureau of Ministry of Land, Infrastructure, Transport and Tourism, that can be inspected and acquired by anybody, is commonly utilized. However, there have been inconvenient points such as a distinct restriction on the data volume accessible in a lump for analysis and a difficulty in working with application software for water · material circulation analysis. In addition, it has been an important issue to configure an interface to the database in Common MP<sup>(2)</sup>, a software developed and operated by NILIM, and improve usability of the analysis application, with the objective that engineers can easily conduct hydraulic and hydrological analysis and make a technical judgment based on ample studies and so forth.

Therefore, we report here that a hydrological data acquisition tool<sup>(3)</sup> (Figure), which can acquire hydrological data in a lump from the hydrological water quality database, has been developed and released.



Figure: Screen image of hydrological data acquisition tool for hydrological water quality

## 2. Outline of hydrological data acquisition tool

The hydrological database management system is equipped with standard interface,<sup>(4)</sup> which can provide data in reply to requirements of the client PC, and an application software conforming to this can freely acquire data.

Common MP hydrological data acquisition tool is prepared in conformity with this standard interface and it is possible to acquire data from more observation stations and for longer duration comparing to using web browser (Table) and accordingly, it is convenient for analysis to be conducted. Also, acquired data can be used as it is in

Common MP simulation. The hydrological database management system, furthermore, stores real time data as well and it is also possible to prepare real time flood forecast system by combined use of this data and concurrent computing facility of multi simulation project incorporated in Common MP Ver1.2.<sup>(5)</sup>

Table: Comparison of data volume which can be acquired in a lump

		Data hydrological acquisition tool		Web browser	
		Period	Number of observation stations	Period	Number of observation stations
Real time data		-	50	-	1
The past	10 minutes data	Seven days	50	Seven days	1
	Hour data	One year	50	31 days	1
	Day data	10 years	50	One year	1
	Year statistics data	Whole period	50	Whole period	1

## 3. Future development

A new function to connect hydrological data to software by developing the hydrological data acquisition tool was added. It is scheduled, from now on, to enhance software which utilizes this tool and to promote application to practical business such as river projects.

[Sources]

- (1) Hydrological database management system: <http://www.l.river.go.jp>
- (2) Common MP: <http://framework.nilim.go.jp>
- (3) Data acquisition tool: <http://framework.nilim.go.jp/tool/index.html>
- (4) Guideline for river GIS and river application standard interface: River Bureau, Ministry of Land, Infrastructure, Transport and Tourism, 2006
- (5): Yoshimiki KIKUMORI et.al: Function improvement of CommonMP for real time flood forecast, Japan Society Civil Engineers, Annual conference of scientific lectures, Collection of lecture summaries Vol.67 No.II-145, pp.289-290, 2012.

## Activity of Technical Emergency Control Force (TEC-FORCE) of NILIM

### 1. About NILIM technical support

In times of disaster, NILIM dispatches specialists who have advanced, technical knowledge in each field such as, sewer, river, landslip protection, roads, and buildings based on the request from the Regional Development Bureaus or local government of the stricken areas. The dispatched specialists conduct the site investigation corresponding to the disaster situation, and conduct technical support etc. for the site and Ministry of Land, Infrastructure, Transport and Tourism to restore the area urgently and permanently.

During the Great East Japan Earthquake, 262 people (592 man-days) in total proceeded to the stricken area in the interim of immediately after the disaster of March 31, 2012, and conducted the evaluation for social capital facilities indispensable for life rescue and urgent restoration, and technical guidance for emergency restoration etc.

In FY2012, during the tornado disaster of Ibaraki Prefecture in May and the landslip disasters in the Tohoku and Kinki regions caused by Typhoon No.17 in October etc., it dispatched 27 people on 19 occasions in total (on January 25, 2013, following is same).

### 2. About TEC-FORCE of NILIM

The Ministry of Land, Infrastructure, Transport and Tourism dispatched specialist to the field as Technical Emergency Control Force (TEC-FORCE) when especially large-scale disaster stroke. In NILIM, 31 members were appointed as specialists who were the main TEC-FORCE, and the researchers who had the necessary technology were nominated

anytime as temporary members.

In FY2012, it dispatched 8 people in total (11 man-days) (see table) as members of the advanced technical guidance group TEC-FORCE for the seasonal rain front downpour centered on the Kyushu and the Kinki areas

### 3. Facing enhancement of the disaster support system in the future

In the future, it will be utilized for the decision of further technological standards, and for succession of advanced disaster technology and findings discovered through accumulating information of disaster and support into knowledge as a data base through engineering support.

And, it aims at more satisfactory correspondence by expanding TEC-FORCE members and conducting study courses



Figure Activity in the Kagetsu river

Table Dispatch results of TEC-FORCE in 2012 fiscal year (on January 25, 2013)

	Date	Location	Purpose	Dispatcher
Correspondence to seasonal rain front downpour from July 3	July 4	Chikugo river basin, Kagetsu river (Hita City, Oita Prefecture)	Disaster investigation, technical support and advice of restoration policy	River Department River Division HATTORI Atsushi, Head FUKUSHIMA Masaki, Chief researcher
	July 12 - 13	Shirakawa river basin, Shirakawa river and Kurokawa river Kikuchi river basin, Goshi river (Kumamoto City, Kumamoto Prefecture)	Disaster investigation, Technical support and advice of restoration policy	River Department TORII Kenichi, Water disaster prevention system researcher River Division Fukuhara Naoki, Researcher Research Center for Disaster Management Flood Disaster Prevention Division ITO Hiroyuki, head
	July 15	Yabe river basin, Yabe river and Okinohata river (Yanagawa city, Fukuoka Prefecture)	Technical advice of restoration policy etc	River Department River Division HATTORI Atsushi, Head Research Center for Disaster Management Flood Disaster Prevention Division KUBOTA Keijiro, Chief researcher
Correspondence to Heavy rain from August 13	August 20	Uji river basin, Midajiro river (Uji City, Kyoto Prefecture)	Confirmation of dike destruction mechanism and Technical guidance about the future correspondence	River Department River Division HATTORI Atsushi, Head

# Disaster investigation such as TEC-FORCE of the river sector and Utilization of the result

TORII Kenichi (Ph.D. Eng.), Research Coordinator for Integrated Water Disaster Management,  
River Department

Hattori Atsushi (Ph.D. Eng.) , Head

FUKISHIMA Masaki (Ph.D. Eng.), Senior researcher

FUKUHARA Naoki, Researcher

NAKAJIMA Hiromasa, Researcher

River Division, River Department

(key word) TEC-FORCE, Disaster investigation

## 1. Introduction

The river department of the NILIM conducted the field investigation when the technical support was requested by the river administrator, and advised on restoration methods and design of river channels afterwards based on emergency policy and cause of the disaster.

It may dispatch Technical Emergency Control Force (Hereafter, TEC-FORCE), when emergency support and advanced techniques are needed especially. This year, it dispatched staff to the rivers (see table) where the river management facilities had been damaged by large-scale floods.

Table Main damaged river in 2012

Date	Cities, Towns, and villages	Water System River Name(Administrator)	Type of Disaster (Numbers)
3-Jul	Hita city Oita pref.	<b>Yabe river, Yabe river water system (State, pref.)</b>	<b>Dike collations</b>
		Arita river, Chikugo river system (Pref.)	Over flood
	Nakatsu city Oita pref.	Yamakuni river, Yamakuni river system (State, Pref.)	Over flood
12-Jul	Kurume city Fukuoka pref.	Kose river, Chikugo river system (State, pref.)	Over flood
	Kumamoto city, Kumamoto pref.	Shirakawa, Shirakawa river water system (State, pref.)	Over flood
	Aso city, Kumamoto pref.	Kuro river, Shirakawa river water system (State, pref.)	Over flood
14-Jul	Kikuchi city, Kumamoto pref.	Goshi river, Kikuchi river water system (State)	Over flood
	Oguni Town, Aso county, Kumamoto pref.	Jotachikawa, Chikugo river water system (State)	Over flood
	Yanagawa city, Fukuoka pref.	<b>Yabe river, Yabe river water system (State, pref.)</b>	<b>Dike collations</b>
22-Jul	Hita city, Oita pref.	Kagetsu river, Chikugo river water system (State, pref.)	Over flood
	Kurume city, Fukuoka pref.	Kose river, Chikugo river water system (State)	Over flood
	Ukiha city, Fukuoka pref.	Kumakami river, Chikugo river water system (State)	Over flood
	Nakatsu city, Oita pref.	Yamakuni river, Yamakuni river water system (State)	Over flood
	Tosa city, Kochi pref.	Driving channel, Hege river mouth (State)	Rubber dike damage
14-Aug	Uji city, Kyoto pref.	Midajiro river, Yodo river water system (Pref.)	Water way wall damage(40ha flood)
	Uji city, Kyoto pref.	Shizu river of Uji river branch Yodo river water system(Pref.)	Land-slide
18-Aug	Uji city, Kyoto pref.	Midajiro river, Yodo river water system (Pref.)	First aid restoration again stricken

※Red : Dike collations

## 2. Activity as TEC-FORCE

In Kyushu on July, 2012, a big disaster killing 31 lives occurred, caused by the heavy rain hitting the Oita and Fukuoka prefecture on July 3, and heavy rain hitting the Kyushu northern area from 11th to 17th in July.

There damage occurred on river management facilities like dike break etc on the Kagetsu river on July 3, Shirakawa on July 12th, Yabe river, Kagetsu river and Yamakuni river, etc. on July 14.

And, the downpour in the Kyoto southern area in August caused flood damage, breaking the waterway sidewall of Midajiro river in Ujigawa water system managed by Kyoto Prefecture

For the both downpour disasters, the TEC-FORCE was requested by the river administrator to dispatch, and the joint survey team was quickly organized together by the MLIT Water and Disaster Management Bureau after the disasters. It discussed and advised about staff dispatch, local area investigation, emergency treatment and further restoration.

## 3. Utilization of investigation

The investigation at the time of disaster is useful not only to quickly and properly restore after the disasters, but to analyze the cause of damage, to utilize for revision of technological standards, to steadily reflect on design and management by accumulating and sharing findings, and is useful to improve design and evaluation methods of facilities and to rationalize them 2).

The NILIM shows restoration method examples, check points, and care points when designing facilities to the river administrator by making the investigation data of TEC-FORCE and analysis result into a data base

Especially, if there are a lot of similar disaster examples, and if advanced examination is necessary due to disaster complexity, it conducts the emphatic investigation and analysis, and utilize them as basic data to update technology standards for river debris-slide protection and guidance. And, from this year, it set up the "River structure management research task force"3), and is working on technological consultation and follow regarding check and deterioration of river structure, on technological examination concerning deterioration prediction influencing various river structures, and on the technological opportunity research concerning mid/long-term management of the river structures.

### 【reference literature】

- 1) Disaster dispatch news, such as Kyushu northern area downpours, Construction technology data, in July, 2012, Vol.54, NO.9 P4-9,2012
- 2) The version of river debris-slide protection technology standard investigation Version 10 disaster investigation [http://www.mlitt.go.jp/river/shishin\\_guideline/gijutsu/gijutsukijunn/chousa/index.html](http://www.mlitt.go.jp/river/shishin_guideline/gijutsu/gijutsukijunn/chousa/index.html)
- 3) River structure management research task force homepage <http://www.nilim.go.jp/lab/fag/index.html>

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# Major Disaster Surveys

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## 1. Field survey on the slope failure on National Road No. 57. caused by torrential rains which fell in the northern part of Kyushu in July 2012.

The torrential rains which had fallen in the northern part of Kyushu from July 11th to 14th, 2012 caused 11 slopes to fail on National Road No. 57 in the Sakanashi district of Ichinomiya town of Aso City, Kumamoto Prefecture, resulting in the total closure of the road. In response to a request from the Kyushu Road Maintenance Bureau, the Road Research Department conducted a field survey to assess the scale of the devastation. The survey was focused on the failed slopes, which had inflicted the most severe damage. The Road Maintenance Bureau confirmed the effect of spring conditions and the fragmented rocks caught by the damaged rope netting covering the slope. They also provided technical support on measures to lift the temporary traffic closure in that area.

Kazuhiko Mizutani, Research Coordinator for Road Structure  
Road Department.

## 2. On-site technical advice on the sediment disasters in Kimotsuki town, Kagoshima Prefecture

The torrential rains triggered by the rain front from June 27 to 28th, 2012 in the mountain areas of Kimotsuki town, Kagoshima Prefecture, caused a number of debris flows and slope failures leaving many houses damaged and traffic routes closed with some villages totally isolated. In response to a request to conduct disaster survey from Kagoshima Prefecture, the Sediment Control Research Department conducted a field survey in Kimotsuki town, as well as a survey via helicopter on June 30th. We provided technical advices to Kagoshima Prefecture and Kimotsuki town on the safe traffic control on National Road No. 448, the evacuation system, as well as emergency measures.

Yasuhiro Nomura, Researcher  
Erosion and Sediment Control Division  
Research Center for Disaster Management

## 3. On-site technical advice on sediment disasters in Yufuin town, Yufu City, Oita Prefecture.

The torrential rains triggered by the rain front on the evening of July 1st, 2012 caused debris flows in the Gakuhon River, which is a water system of the Oita River in Yufuin Town of Yufu City in Oita prefecture, inflicting damage on houses, causing flooding and debris flows in the hot spring town located in the downstream of the river. In response to a request from Oita Prefecture, the Sediment Control Research Department conducted a field survey and one via helicopter on July 5th and 6th. We provided technical advices on how debris flows occurred, the effect of the existing erosion-control dams, future evacuation measures, and maintenance of erosion-control facilities, including removal of gravel accumulated on the existing erosion-control dams.

Atsushi Okamoto, Head  
Erosion and Sediment Control Division  
Research Center for Disaster Management



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#### 4. On-site technical advice on the sediment disasters caused by torrential rains in Kinki district

The torrential rains which had fallen in the southern part of Kyoto and Shiga Prefectures from August 13th to 14th, 2012 caused many slopes failures, generating debris flows, floods, etc. in Otsu City and Uji City, as well as in the surrounding mountainous areas. The torrential rains had inflicted large scale damage on houses and loss of human lives, and leaving some villages totally isolated. In response to a request for a disaster survey from Shiga Prefecture and the Regional Development Bureau of Kinki District, the Sediment Control Department conducted a field survey from August 16th to 17th. We focused on the site where debris flows had occurred in Otsu City and Uji City, providing technical advices on the evacuation system, as well as emergency measures to those local governments.

Yasuhiro Nomura, Researcher  
Erosion and Sediment Control Division  
Research Center for Disaster Management

#### 5. On-site technical advice on the sediment disasters in Saijyo City, Ehime Prefecture

The slope on the left bank of the Tonotanigawa River, which is a water system of the Kamo River in Saijyo City, Ehime Prefecture collapsed on September 4th, 2012. The river channel was closed due to the landslide and the bridge over the Tono River on the Tozai Line of the city road was stricken by the disaster. In response to a request to the disaster survey, the Sediment Control Research Department conducted a field survey, providing on-site technical advice. We checked the condition of the collapsed slopes and the closed river channel, examining the possibilities of further slope failure. We advised of the need to conduct continuous monitoring of the slope conditions, as well as the river water level of the water channel. In addition, we emphasized the need to formulate future policies based on the comprehensive assessment of reconstruction of the road and the water channel, as well as the measures for the slope.

Yuki Okuyama, Researcher  
Erosion and Sediment Control Division  
Research Center for Disaster Management

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# Major International Conferences

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## 1. The 16th MLIT / FHWA Intergovernmental Conference and the 28th US-Japan Bridge Engineering Workshop (USA: October 8 to 10, 2012)

The United States and Japan Bridge Engineering Workshop is alternately hosted by both countries annually as an activity of Task Committee G (Transportation System) in the Panel on Wind and Seismic Effects, the U.S.-Japan Cooperative Program in Natural Resources (UJNR). The 28<sup>th</sup> Workshop took place in Portland, Oregon, in the U.S, in which the main issues were the inspection and maintenance of road bridges, seismic strengthening, and tsunami. Both countries shared and exchanged their recent knowledge extensively. An MLIT/FHWA meeting followed the US-Japan Bridge Engineering Workshop with representatives from governmental agencies from both countries for the exchange of information and discussion regarding the technical policy on highway bridge design, construction, operation, and maintenance.

TAMAKOSHI Takashi, Head  
SHIRATO Msahiro, Senior Researcher  
Bridge and Structures Division  
Road Department

## 2. The 19th World Conference, Bilateral Meetings, PIARC, ITFVHA, FOT-net, AASHTO, VC Workshop (Austria: October 18 to 27, 2012)

ITS Division, with the Road Bureau of MLIT participated the 19th ITS World Conference and PIARC, ITFVHA, FOT-net, AASHTO, VC Workshops that were taken place in Vienna (Austria) to promote international collaboration of ITS, and Presentations (9 sessions) in a special session and so on along with article publication (7 papers) have been done. Also, information and opinion exchange with ITS related departments and agencies, and discussion regarding future collaborative research conference between two countries (The United States, European Commission, China and Korea) have been done. Along with that, investigation regarding foreign latest IST technology development and deployment strategy for utilization measure of safety improvement and probe data by using vehicle-to-infrastructure cooperation have been done.

KANAZAWA Fumihiko, Head  
SUZUKI Shoichi, Senior Researcher  
SUZUKI Kazufumi, Researcher  
Intelligent Transport System Division  
Research Center for Advanced Information Technology

## 3. The 8th Japan and Italy Sediment Disaster Prevention Technology Conference (Japan: November 30, 2012)

The conference has been taken place in Japan or Italy every two years since 15 years ago between MLIT Sediment Control Department and National Research Council of Italy (CNR). We discussed latest policies, measures and research for prevention of sediment disaster at the past conferences. Also, Japan and Italy have done much collaborative research according to discussions in the past conferences. In this conference, it was agreed to proceed with collaborative research more closely in the future. Research Center for Disaster Management provided two presentations and organized the conference with MLIT Sediment Control Department.

UCHIDA Taro, Senior Researcher  
SABO (Erosion and Sediment Control) Division  
Research Center for Disaster Management

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#### 4. Completion of Project on Hazard Mapping for Sediment-related Disasters at UNESCAP/WMO Typhoon Committee (China: November 26 to 30, 2012)

Since 2002, at UNESCAP/WMO Typhoon Committee (TC), SABO (Erosion and Sediment Control) Division has continued to implement projects for dissemination of Japanese non-structural countermeasures against sediment-related disasters that is thought to be effective in developing countries. Following the “Sediment-related Disaster Forecasting Warning System Project” in 2002 to 2008, “Project on Hazard Mapping for Sediment-related Disasters” has been implemented since 2009. At the final year of the project, 2012, in the TC 7th Integrated Workshop (Nanjing, China), presentations regarding the project results during the 4 years, i.e. workshops for dissemination of technology in China and Vietnam etc., was held. Also, the final report of the project has been published in December that summarized the activities of the project and contents of the lectures in the workshops.

HAYASHI Shinichiro, Researcher  
SABO (Erosion and Sediment Control) Division  
Research Center for Disaster Management

#### 5. International Disaster Prevention Society and Sediment Control Administrator Conference (France: Apr 2, 2012)

International Disaster Prevention Society (INTERPRAEVENT) has been organizing conferences about every four years since 1967 for engineers and researchers to discuss natural disaster prevention. In 1992, Sediment Control Administrator Conference, advocated by the Ministry of Construction Sediment Control Department (at that time), 1992, for responsible persons of national sediment control administration to exchange information, knowledge, experience etc., during the period of the conference organized by INTERPRAEVENT. This time, it took place just after the conference organized by INTERPRAEVENT in Grenoble, France, and representatives from 8 countries participated. It was agreed that the next administrator’s conference will be held in Japan, 2014. Moreover, consensus was reached about the importance for a new concept for a provision for disasters that exceeds the ordinal scale. Erosion and Sediment Control Division has made 2 scientific presentations at the conference organized by INTERPRAEVENT and also operated the administrator’s conference in cooperation with MLIT Sediment Control Department.

UCHIDA Taro, Senior Researcher  
SABO (Erosion and Sediment Control) Division  
Research Center for Disaster Management