# Beyond the phrase ” Not-assumable”

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*(Keywords) Great East Japan Earthquake, unprecedented, unimaginable, imaginative power, inability to think*

Since the Great East Japan Earthquake of March 11 last year, the phrase “not assumable” has been constantly in my mind. It seems to be easily used as an excuse to avoid the responsibility concerning the disaster, and I cannot bear this kind of attitude. On this occasion, from my long experience as a researcher in making and revising technical standards for road bridges, I would like to make some comments on this issue.

Since the disaster, I have tried to persuade my colleagues in the Institute who are involved in revising technical standards for public infrastructure, not to use casually the phrase. It is because I have an intention of making them encouraged to overcome the situation of using the phrase of “Not assumable “in their research works.

Of course, I am aware that this is not easy. But in this message, I am trying to write down what I have considered to avoid the phrase and what should be taken as an actual responsibility. I sincerely hope this message will be served as a useful reference to readers of the NILIM Annual Report.

**Unprecedented and Not -assumable**

Hatamura Yotaro, Professor Emeritus of the University of Tokyo and famous as the founder of the “Study of Failure”, has written a book, “Unprecedented” and “ Not assumable”[1)], which I think many of you may have read. I would like to quote extensively from this work.

“The word ‘Unprecedented’ does not mean ‘Not personally experienced’, but ‘Never before in history’.”

This is natural because the Japanese word for “Unprecedented” which is pronounced “Mizou”, is derived from a phrase in classical Chinese which means, ‘Never before existed’”. Later, it came to be used as “Never experienced”.

Anyway, he says “When a person plans something or decides to make a plan, the person first decides the range they will consider. In this context, ‘Assuming’ means “Defining the boundary of your scope and deciding on the framework of your consideration.”

I was impressed with this simple explanation, which I think is the key to overcoming the phrase of “Not assumable” being easily used as a kind of avoidance.

In scientific research, even when solving engineering problems, you must kick it off with deciding to select which of the relevant factors to be considered as its influential, which will be OK to ignore because of their impact being minor, and in addition, you must think about how will be the range of the considered factors. It is clear that without appropriate predeterminations above, the outcome of research activities will result in ineffectiveness.

This kind of settings at the beginning of the activities means “Framework” or “Assuming” as named by Professor Hatamura. Therefore in the research activities, when the settings causes unexpected consequence, the “Framework” or the “Assuming” itself should be recognized as a failure, not excused as being “Not assumable”. It should not leave alone as an affair of others, which was assumed for sure by you.

**Assuming influential factors is an advanced decision**

I will again quote Professor Hatamura.

“ You can understand ‘Assuming influential factors’ as the word being used at the stage of ‘Setting subjects’. And ‘Considering within the assumed factors” can be translated to the expression of ‘The frame reached to the conclusion of the subject’. Of course the former is much more difficult.”

Ms.Katsuma Kazuyo, a popular management analyst wrote in her recent book “Trap of Earnest attempt on the existing frame”[2)] that McKinsey, the American management consulting firm she used to work for, can charge high fees because it devotes great efforts to discuss completely to set up the customer’s subjects clear as what kind of matters they are .

For example, these stories, just as in research work, support the saying that if you can identify the problem, you are halfway to solving it.

Therefore, we must recognize the importance of setting up subjects, in other words, “Assuming factors with their considering frame”, instead of treating it lightly.

**Classifying the Not-assumable**

As described above, it has become clear “Assuming” is done by you. .

Then, why do you assume something when you try to find solutions? How is your mind moving in such case?

In this regard, I would like to find an answer to why so often the phrase “Not assumable” is used as an excuse. This thought, being super original in my approach, but hopefully some hints will be given us to overcome the trap of using the phrase .

[1] “Not assumable” which means “Could not be imagined”

People often say, “I‘ve never imagined it would happen.” Using “Not assumable” in this context, it is to be a lack of imaginative power.

Even when you are senior, many of you are usually not concerned with things out of your specialty. This is because of you having self -constraints on your mind, so you do not respond to what you are seeing and what you hearing, in case you have no interests in them. Also, what you call bureaucratic compartmentalization or trapped in a narrow specialization are similar phenomena.

To improve imagination power, you have to consciously expand your recognition frame which restricts your dairy life. Predicting how disasters will be like is, I think, a same process of improving this ability, and needless to say, the necessity of constant seeking to increase the accuracy, in spite of no perfection in its efforts.

[2] “Not assumable” which means “Stopped thinking “

Actually, there are many cases you hear”Such cases were thought as no needs to be considered because of no comments in national standards and related manuals.” This is a kind of “Stopped thinking”. Professor Hatamura also warns, “In this case of “Not assumable”, it means you cannot do the job without manuals, and once you got the manual, you abandon your own thinking.”

I think that not only those who are in charge of drafting manuals, but also technology experts should continuously ask the question to themselves, “How do I judge and respond to such case as is in the situation of no manuals. In other words, how do you take actions in ‘Not assumable’ situations?” An engineer who will not be responsible for such behavior may be valued as a cost

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[3] “Not assumable” which means “ Given up”

Other case of using “Not assumable” is happened when you think there is no way to respond, or no possibility of getting budgets, you sometimes give up to proceed, which can be a pattern of “Not assumable.”

I would like to pick up an example for bridge managements; In case of external force increased while using conventional design methods, the goal of calculation may be that the dimensions is to become preposterous or the cost is to be unbearable, and the both approaches will be unfeasible. In this case, I will recommend resetting the subject as to the bridge management in order to change your mind more flexibly. Lately, you know the term “preventing disasters” has often been replaced with “mitigating disasters”, which is itself a sort of resetting the subject.

In the field of road bridge managements, as is already practiced when a new major damage due to earthquake disaster has occurred, a new strategy of how to mitigate the damage has been proposed under resetting of the subject; To ensure toughness (ductility) to prevent collapse if bridge piers cannot withstand earthquake forces, or at least to prevent bridge collapse and save human lives (bridge fall prevention device), and if possible, to limit the consequence of damaged members and to speed up restoration, or to permit only emergency vehicles to cross the bridge, and so on.

[4] “Not assumable” which means “was missed in the assuming “

The final category will be belong to the psychological term of “Normalization bias”. This term refers to a tendency for people to believe that although they know something will occur, they do not think it will harm them. Now that the devastating disaster has been neither unprecedented nor unexperienced, administrative managers are not permitted to express in this story.

Major disasters are rare, but this closely resembles the advance of deterioration of infrastructure which occurs slowly over time. In either case, there is a strong temptation to

overlook it and postpone countermeasures. To overcome this, individual efforts plus initiatives at the organization or system level are required.

**Conclusion**

Concerning the four categories, the indispensable key words are imaginative power (category1), I think, and another is how to think continuously (category2). It seems that, people performing their works for a long time, just like Sun Wu Kong with a band framed around his head, they lose their ability to expand the boundaries enclosing their thinking. In the case of Wu Kong, the Buddha attached the band to admonish him for his conceit, but the band of each of us wearing seems to put on by ourselves or our organization (members of our industry), so as to stop thinking and becoming free from the responsibility. How about occasionally daring to remove the headband (boundaries) to climb upon a cloud and fly in the broad sky of imagination? This will expand your field of vision to stimulate the thought processes.

I will conclude with a warning by Professor Hatamura, who was not the Buddha:

"'Not-assumable' events have not occurred. It was that you had not been thinking anything about them."

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# Perspectives of Providing and Managing Public Infrastructure for the Next Generation

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*(Keywords) National land management, construction management, stock management*

## 1. Introduction

A country with a rugged geography, Japan now faces problems including population decline, a rapidly falling birthrate, aging of society, and limited natural resources. In order for Japan to build and maintain good quality public infrastructure under such conditions and to ensure safety and convenience for the next generation, it is important to conduct research from two perspectives: research on national land management considering broad issues, including disasters, for the entire nation, which is the foundation of people's lives, and research on construction management and all aspects of production systems in order to maintain the infrastructure stock properly and ensure high-quality public works projects from the narrow perspective of efficiently implementing specific methods. This article discusses these two perspectives based on surveys being undertaken by the Research Center for Land and Construction Management.

## 2. Perspective from national land management

Japan is facing unprecedented changes, with frequent massive natural disasters in addition to social weakness caused by the declining population, aging of society, economic stagnation, and other factors. In view of the devastating loss of life and property caused by the Great East Japan Earthquake, we must now revise various established disaster countermeasures in order to reduce damage and provide multi-layered protection. Accordingly, we are now revising national land plans in preparation for the Tokai, Tonankai, and Nankai Earthquakes which are likely to occur in the future. In a public opinion survey in October 2011 concerning people's lives, 45% of respondents reported that since the earthquake disaster, they had become strongly conscious of "preparing for disasters," revealing strong public awareness of disaster protection[1)]. Regarding administrative systems, it is necessary to build social systems that function well not only during normal times, but also when disaster strikes. In addition, finding ways to maintain regional societies and local bonds in order to manage the national land is a challenge which cannot be ignored. Its increasing importance was confirmed by the same public opinion survey, in which 40% of respondents replied: "I value bonds with my family and relatives" and "I value bonds with my region". Therefore, studies are needed on creating national land which integrates safety, the environment, and vigor based on natural and regional environmental conditions and present policies in individual regions. It is important to prevent weakening of this awareness of disaster prevention. Therefore, perhaps disaster prevention awareness needs to be internalized in social systems, for example, by regularly diagnosing the disaster prevention capabilities of social systems. This study will require a broad range of data that accurately represents a region's disaster prevention capability.

## 3. Perspective from building construction management

To create national land which integrates safety, the environment, and vigor, it will be necessary to efficiently provide good quality public infrastructure that conforms to regional characteristics. Another urgent challenge is to prepare for the maintenance and renewal of existing public infrastructure stock as it deteriorates. In construction management, it will be necessary to optimize and prioritize public procurement systems to efficiently build good quality infrastructure and to maintain the existing stock.

As public procurement systems for prioritized, efficient provision of good quality public infrastructure under the Law for Ensuring the Quality of Public Works (2005), a variety of initiatives, such as the comprehensive bidding evaluation method, integrated design and execution procurement method, and construction management (CM) method, were introduced to improve the quality of public works. But to create a bidding and contract system which encourages participating bidders to improve their technological capabilities by analyzing problems in projects managed by the Ministry of Land, Infrastructure, Transport and Tourism, and revisions deemed necessary as a result[2)], these systems must be steadily upgraded.

The growth strategy of the Ministry of Land, Infrastructure, Transport and Tourism enacted in May 2010 aims to expand Japan's superior construction and transport industries, and its infrastructure related industries into overseas markets, and to build a solid presence in the world market. It is therefore necessary to incorporate and promote international ordering and

contracting methods in public works projects in Japan. It is also necessary to study the good points of ordering and contracting rules which have been gradually upgraded around the world, including public infrastructure provision methods using public–private sector links such as PFI/PPP, etc., to make Japan's building production systems even better. It is important to respond to changes in quality assurance methods at the execution stage resulting from technological reforms, and to improve execution management technologies by, for example, full-scale introduction of computer control, monitoring and surveying of public works, revision of standards and techniques to appropriately and efficiently evaluate results, and reliably obtaining high quality products in individual works. Procedures to appropriately reflect the achievements of companies in contract selection processes must also be developed.

**4. Perspectives from both sides**

To prevent harm to the public economy by fatal damage and reduce life cycle costs by prolonging the service lives of public infrastructure while sustaining harmony with the natural environment amid severe natural conditions such as earthquakes, tsunami, storm surges, volcanic disasters, floods, sediment disasters, and heavy snowfall in Japan, it is essential to carry out systematic maintenance based on inspections and deterioration predictions based on the characteristics of individual facilities. We must not only provide good quality stock for construction management, but also maintain that high quality. The comprehensive development project, "Development of Inspection and Monitoring Technologies for Preventive Maintenance of Public Infrastructure", which was conducted for three years beginning in 2010 by the Ministry of Land, Infrastructure, Transport and Tourism, is being implemented jointly with relevant research divisions[3)]. A similar concept of stock management is important for national land management. In the future, it will become increasingly necessary to consider the management of public infrastructure by appropriately responding to changing circumstances while combining the natural and social environments of individual regions, based on management of public infrastructure throughout the country.

**5. Conclusions**

This article introduced the aims of research from a variety of angles regarding national land management and construction management. These challenges are closely related, and it is necessary to conduct comprehensive research while ensuring that one solution does not create new problems. We will bear this in mind when conducting further research.

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# Research on Response to Diverse Environmental Needs

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*(Keyword) environment, global environment, biodiversity*

## 1. Introduction

A review of the history of environmental research by the Ministry of Land, Infrastructure, Transport and Tourism shows that the Environment Division was established in the former Public Works Research Institute of the former Ministry of Construction in 1993, about 20 years ago. Soon thereafter, the Fundamental Environmental Principles were enacted in 1994, clearly stipulating that creating a high-quality environment is a core mission of construction administration, in other words, that it is an internalized goal. Since then, improvements and policies have been implemented to create national land with a high-quality environment as specified by this policy.

However, the purposes of providing public infrastructure are changing as investment capacity declines and the emphasis shifts from provision to management. Through this process, the environment has become increasingly important in providing higher quality social infrastructure.

As Japan's social and economic conditions change, people's lives have changed accordingly. Lifestyles have been transformed through information communication and rapid progress of contents, and people's views of the environment have diversified as their values have become more diverse. Under such circumstances, the future direction of public infrastructure and the environment is debated. The challenges related to these discussions are described below.

## 2. Target directions of environmental research

Various factors related to the provision of public infrastructure have created challenges to achieving the goals needed to form environments. Typical examples are outlined below.

[1] Response to the changing environment and evaluation criteria

Between 1965 and 1975, the target of environmental concepts was improving the familiar issues of health or the living environment such as the atmosphere, noise, and water contamination, centered on pollution policies. Later, emphasis shifted to improving the formation of natural environments, etc. in and around cities. Today, the priority is on resolving global-scale environmental challenges, including climate change. The range of environmental concerns is not only expanding, but also encompassing smaller scale issues such as environmental hormones, viruses, etc., and so the environmental scope to be considered has increased dramatically. It is necessary to follow the expanding range and complexity of environmental issues, by considering problems with complex systems, such as the challenge of preserving biodiversity.

[2] Establishment of methods of evaluating the environment

The foundation of environmental research is evaluation, such as quantifying the state of the environment to be conserved. Just as digital methods for measuring water quality, atmosphere, noise, etc. have been established, some related causal factors cannot be objectively evaluated, because the analysis of factors related to biodiversity has not been completed. Regarding the effectiveness of implementing environmental projects, it is necessary to quantitatively evaluate their cost-benefits and effects on improving the environment. It is also necessary to quantify the state of the environment in monetary terms.

[3] Accurate calculation of impact and response

A big step in environmental research is objectively predicting the load on the environment of actions such as providing public infrastructure (impact) and the effects of the response (response). Accurately evaluating this impact and response is the next step. It is necessary to predict environmental problems before they occur in order to respond appropriately. This is an important challenge to forming national land which is sustainable and in harmony with nature.

[4] Publishing accurate information concerning the environment

Because environmental problems change as new problems emerge, it is difficult for scientific reasoning and quantitative analysis to keep pace with these changes. As a result, various discussions tend to lead to rumors and hearsay based on inference. Quantitative judgments concerning a matter which is qualitatively correct may appear to be incorrect. To make appropriate judgments and take countermeasures, people need a correct understanding of the principles.

## 3. Future research

In environmental research, we wish to aim at the following three points.

[1] Resolving diverse environmental problems

We set research themes in order to resolve and predict environmental problems which are related to the provision of public infrastructure. In addition to continuing existing long-term research on environmental problems such as the atmosphere, water quality, noise, vibration, etc., we are tackling two research themes: those intended to improve the living environment, and those concerning the global challenges of global warming, sustainability, and biodiversity, as well as familiar challenges summed up as, “beautiful, abundant, and lively daily life”. The “Development of Environmental Evaluation Technology for the Life Cycle of Public Infrastructure”, which aims to lower carbon dioxide emissions during the provision of public infrastructure, is an important research theme for the global environment and sustainability. We therefore intend to conduct new technology development permitting more people to participate in this field.

[2] Publishing correct environment related information

Various troubles often arise because of a lack of environment-related information. For this reason, it is important to survey the environment, which is our particular concern, using public funds in public areas, and to distribute and correctly control information to gain understanding. The primary requirement is to collect information by appropriate methods, comment appropriately on this information, and release it to the public.

Regarding river environments in particular, a database has begun to be built, and it has been designed so that data concerning river environments is collected and can be browsed and used to analyze impacts and responses, etc. These efforts will ensure the release of accurate environmental information.

[3] Ensuring interdisciplinary collection of intelligence from various fields

In order to conduct research on the environment, we must establish a research system allowing an interdisciplinary approach by including not only civil engineering, but also the natural sciences and social sciences as necessary, because such research involves resolving problems in complex systems.

Resolving research problems with researchers in other academic fields also causes difficulties due to differences in histories and values. Nevertheless, it is necessary to do so by connecting independent administrative agencies, the private sector, universities and research institutes inside and outside Japan and coordinating them in various ways.

**4. Conclusions**

Concern with safety and security increased dramatically following last year’s Great East Japan Earthquake, but concern about the environment seems to have weakened. Even among environment related measures, climate change was a dominant issue before the earthquake, but as a result of the Fukushima Daiichi Nuclear Power Plant accident, public concern about pollution by radioactive substances and energy conservation has rapidly increased.

Accordingly, in order to practice national land management based on the natural and social characteristics of Japan, it remains important to harmonize the provision and management of public infrastructure with the environment. In order to create splendid national land and urban environments which are in harmony with nature for future generations, we wish to perform research and development concerning conservation, reuse, and creation.

# Reconstructing homes in disaster regions: challenges and support

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*(Keywords) Great East Japan Earthquake, liquefaction, renewable energy, B-DASH, management*

## 1. State of Japan when the giant earthquake occurred

As Japan's society ages and tax revenues fall amid continuing efforts to raise welfare budgets, the national debt is soaring. In the midst of global competition for survival, the Japanese economy has fallen behind those of China, Korea, and other nations, and deficits have appeared not only in its trade balance which has supported the importing of energy and food products, but also in its current account balance.

The Great East Japan Earthquake caused massive damage and casualties over a wide area. As Japan mourns the loss of many lives and works to restore the lives of those who survived, it faces a turning point and must decide how best to make the most of this opportunity to rebuild the nation.

## 2. Damage to sewage systems by the earthquake and countermeasures

The giant earthquake caused unprecedented damage to sewage systems. The Minami-Gamo Sewage Treatment Plant, which receives sewage from most of the 700,000 residents of Sendai City, and many other treatment plants at 120 locations along the coast were damaged by the tsunami. In the Kanto region too, liquefaction on reclaimed land around Tokyo Bay and near the mouth of the Tone River severely damaged buildings and other infrastructure, and also lifted up or pulled out manholes and sewer pipes, filling them with soil and making the systems unusable. In Urayasu City, people were forced to live without sewage services even after the water supply was restored, and in Miyagi Prefecture, polluted water temporarily seeped out onto the surface of roads.

The Water Quality Control Department dispatched two-person teams to the site the morning after the earthquake to set up a field headquarters and investigate the damage. In total, more than 6,000 employees of regional government bodies and private-sector technologists from throughout Japan went to the disaster region and surveyed the damage in spite of fuel shortages. A committee set up jointly by the Ministry of Land, Infrastructure, Transport and Tourism and the Japan Sewage Works Association to study reconstruction technologies (chaired by Professor Hamada of Waseda University), which acted as our administration office (content-related), presented three proposals for emergency and temporary restoration and for final restoration, 1 month, 2 months, and 4 months after the disaster.

Table 1 shows the causes of sewage system damage and countermeasures taken. In the treatment plants on the Tohoku Coast, which had suffered almost no damage in the past, the tsunami caused unprecedented damage to their electrical and mechanical equipment. Under the impact of long-duration cyclic vibrations, pipes in reclaimed land in the Kanto region suffered severe damage caused by widespread liquefaction rather than by the conventional problem of backfill. Present earthquake resistance guidelines contain little

Table 1. Major damage to sewage systems and countermeasures

*New countermeasure

| Cause | Treatment plant | Pipeline |
|---|---|---|
| Tsunami<br>(Wave force, floating debris, inundation) | Destroyed structure or equipment<br>→ Load bearing structure*<br>Damaged equipment<br>→ Elevating, adopting waterproof doors *<br>Gas holder washed away<br>→ Countermeasures to prevent washing away * | Pipe bridge washed away → Inverted siphon*<br>Blockage/manhole lid displaced<br>→ Anchored manhole cover<br>Inundation → Flap gate, movable standby pump* |
| Earthquake motion<br>Liquefaction<br>Bank deformation | Equipment damaged or displaced<br>Pipes damaged or displaced<br>→ Countermeasures under present guidelines<br>Sloshing | Manhole uplifted or displaced<br>→ Completion of countermeasures under present guidelines*<br>Lateral pipe uplifted or pulled out<br>→ Ditto, and flexible joints*<br>(Blockage with sediment/road caved in) |
| Ground settlement | (Inundation, poor drainage) | (Inundation, poor drainage) |
| Power failure | Treatment stopped → In-house generator | Manhole pump stopped → Portable generator |
| Fuel or chemical shortage | Treatment stopped → Increase stock* | |

Present guideline = Guideline to Sewage System Equipment Seismic Resistance Guideline

Table 2. Special features and major effects of the B-DASH revolutionary technology (2011)

| Name (Location) | Corroboration Technology and Major Effects |
|---|---|
| Energy Management System Using Super High-efficiency Solid-liquid Separation Technology (Nakahama Treatment Plant, Osaka City) | ・Super high-efficiency solid-liquid separation: compact, increases sludge recovery<br>・High-temperature digestion of a carrier containing garbage: generates more gas and is extremely compact.<br>・Smart hybrid electric power production: supply/demand control, full use of gas |
| Kobe City, Higashi-nada Treatment Plant, production of renewable energy (same treatment plant) | ・Steel digestion tank containing biogas: increases gas production, lowers cost<br>・High efficiency heating using sewage heat: saves energy, reduces $CO_2$<br>・Package biogas refining: lowers cost |

detailed guidance concerning tsunami. With top priority on drainage and sterilization to protect residents from contact with polluted water overflowing sewage systems, and to prepare for cases where restoration takes a long time, the committee has proposed gradually improving treated water quality, as well as yardsticks for target water quality and restoration periods. The backfilling method of preventing liquefaction at pipelines, which was proposed and included in guidelines after the Chuetsu Earthquake, has only been implemented a few times, but field surveys confirmed that the method is effective. Regarding how to provide effective tsunami countermeasure nationwide, which is a major challenge, the committee issued its fourth proposal on March 8 and will complete a full report at the end of this year.

**3. For new energy and city planning**

The shortage of electric power will continue for a long time and increased imports of fossil fuels have pushed up electricity prices and $CO_2$ emissions. Meanwhile, electricity consumed to treat contaminated water accounts for almost 1% of domestic consumption, and sewage sludge, etc. constitutes a large source of potential energy. In addition to prior research, beginning in the latter half of 2010, new measures were prepared and revolutionary technologies such as for capturing energy from sewage sludge were verified and described in written guidelines. Research to verify these technologies in order to introduce them nationwide, and even worldwide, called B-DASH (Table 2, 2.4 billion yen), started in 2011. Facilities to verify methane gas recovery using local biomass were installed in treatment plants in the cities of Osaka and Kobe and data is now being gathered; in 2012, measurements will continue and preparation of a guideline will begin. Under B-DASH, beginning in 2012 (2.9 billion yen), four technologies—solid fuelization, nitrogen and phosphorus removal, and sewage heat use—were selected through a public request for proposals.

The Sewerage and Wastewater Management Department of the MLITT publicly invited proposals for new technologies to perform advance feasibility studies. As a large earthquake restoration model, Kesennuma City started the “Local Production for Local Use Energy Supply Using Marine Biomass Project,” and Sendai City implemented the “Sewage Heat Recovery Pipeline Renewal Project.”

Regarding the temporary rise in the stored quantity of sludge containing radioactive substances, which was revealed in May, a survey showed that in sludge carried into combined sewage systems by rainfall, the concentration of radioactive substances increased 30-fold during rainfall. Therefore, tests were performed to verify various treatment methods proposed in response to the public request.

**4. Management of a shrinking society**

Torrential rainfall is occurring more frequently due to climate change, and the expert committee of the Central Environment Council has discussed the threat of new chemicals and is studying the impacts of changes in rainfall and sewage treatment.

On the other hand, the population of Japan has begun to shrink, about ten years after the working population started to decline, and a skillful response is needed. The results of past research on low-cost diagnosis methods, etc. for buried pipelines have been compiled in the Guideline to Stock Management Methods, but with severe restrictions on funds, personnel, and other resources, we must also improve efficiency through comprehensive stock management of sewage systems.

Worldwide, the international standard ISO55000 for improving various kinds of infrastructure management organizations is being drawn up with the participation of the Preparation Committee PC251. In May, various countries voted on the committee’s proposal, with the final voting proposal debated in the Czech Republic in June; this is scheduled to come into effect in the spring of 2014 after the final vote. Along with the domestic council, sewage treatment system operators have begun to take part in the debate. This deals with the entire infrastructure, and is likely to affect not only the international expansion of Japanese corporations, but also domestic organizations and corporations in various ways, and so an urgent response is needed.

**5. Creating a Worldwide Marine Products Industry**

Today, it is difficult to survive using conventional approaches, so Japan's marine products industry must also "go global". In addition to aiming for international standardization under B-DASH, members of a sewage system global center are holding policy and technology seminars in China and Vietnam, responding to ISO-related trends, and participating in Japan-China-Korea cooperation.

As government systems continue to shrink, comprehensive management to maintain sewage treatment systems in line with trends in capital will be needed. W will continue to accelerate our global response.

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# How Will We Survive the Era of Rising Flood Disaster Risk and Uncertainty?

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*(Keywords) flood risk, adapting to climate change, uncertainty, disaster mitigation, regional development*

## 1. The challenge, "increasing risk and uncertainty"

Figure 1 shows an example of a trial calculation to clarify the increase in torrential rainfall by global warming till the end of this century, and how this will increase the flood flow rate, required amount of river improvements, and the possibility of flood inundation of land protected by levees. The three solid lines show differences between climate change prediction models used to estimate torrential rainfall.

According to this trial calculation, torrential rainfall will increase by approximately 1 to 1.3 times, the flood flow rate by 1.1 to 1.4 times, and the possibility of inundation (frequency) by 1.8 to 5 times. The required amount of river improvements is an index of the degree of river improvements (improving the capability to safely carry a flood discharge by improving the river course, or lowering the flood discharge flow rate itself by flood regulation facilities) that will be necessary in order to safely handle flood discharge caused by a torrential rainfall of the target scale of flood control planning (basic guideline to river improvement). This will also be between 1.6 and 3.4 times higher than it would be without global warming.

Even if torrential rainfall increases by 20% to 30%, etc., the two indices on the right side of Figure 1 will be the multiplier orders. The nearer the items of required quantity of river improvements and inundation potential are to countermeasure items, the greater the impact of global warming. Although the precision of climate change prediction models has been greatly improved, because of its amplification characteristic, the increase multiplier of the required quantity of river improvements and inundation potential based on global warming impact will have a large range of estimation. Thus, there is considerable uncertainty in the foundation for adapting to this and the increased risk.

## 2. Not hard-to-soft displacement theory

In view of these challenges, people may consider that now is the time to switch from relatively expensive hard countermeasures (building disaster prevention facilities to improve rivers) to soft countermeasures (measures other than building facilities), but this is over-simplistic.

Constructing facilities to reduce the frequency of inundation disasters is uniformly effective, including for the flood plains where all people need protection.

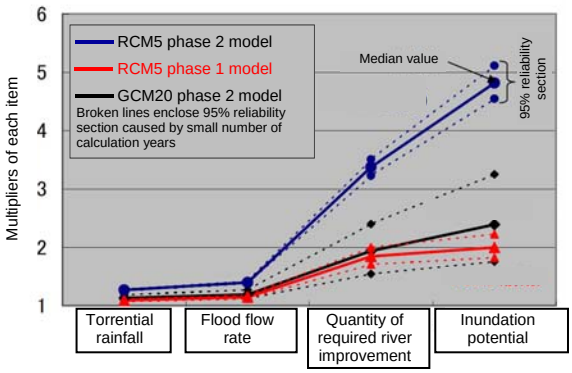


Figure 1. Change of flood control related quantities caused by global warming (The multiplier is the ratio of the end of the century to the present time: the simple mean value of 109 Class 1 river systems: Estimated based on climate change prediction models by the Meteorological Research Institute: RCM5 phase 1, GCM20 phase 2, and RCM5 phase 2)[1)]

But once a flood exceeds the capacity of a facility, a severe disaster may result. On the other hand, assuming that various countermeasures such as suitable evacuation systems based on warnings, or urban development considering evacuation and damage mitigation have been carried out, it is not easy to prevent severe damage. The important point is not to pursue a single magic solution, but to pursue the best mix of diverse countermeasures including both hard and soft countermeasures.

## 3. What circumstances will be created?

Figure 2 shows the form of this "best mix." Facilities prevent disasters caused by the following dangerous phenomena under external forces considered for planning and design (phase on the right side of the figure). If the scale of a dangerous phenomenon exceeds this external force (including cases where the handling capacity of a facility is exceeded while the structure is being built) it is impossible for a facility to completely prevent all risks. Even under such circumstances, by ensuring good city development using various methods, and by providing methods of escape and survival, severe damage will not occur (phase on the left side of the figure.)

Therefore, simply stacking the three building blocks—facilities to prevent or mitigate disasters, good city development, and methods of escaping or surviving—for the phase on the left side of the figure,

will not be sufficient. These must be firmly bonded with each other. Bonding means that good city development that considers how facilities prevent or mitigate disasters is practiced, and that methods of escape or survival which fully reflect such development are provided.

**4. Producing knowledge contributing to the creation of circumstances**

As research on technology policies to create the world shown in Figure 2, it will be necessary to consider three broad pillars. First, refining the method: providing facilities. In addition, maintenance of facilities will be improved and rationalized while clarifying the relationship with the way functions are displayed, information (including weather predictions, when real time or circumstances allow them) will be used to improve the functioning of facilities, the renovation of existing facilities will be expanded, and facilities groups will be treated as systems and the combinations will be optimized for the areas protected from flooding.

Secondly, the ways in which damage occurs when a dangerous phenomenon exceeds the handling capacity of a facility will be clarified more than in the past. For each river system, the relationship of the scale (external force) of the dangerous phenomenon with the damage which could occur will be clarified, and characteristic properties, speed, or points of an abrupt increase in damage for example, or the existence of tipping points or peaking trends, etc. will be confirmed. This requires a good knowledge of how each facility functions and the state of the protected region.

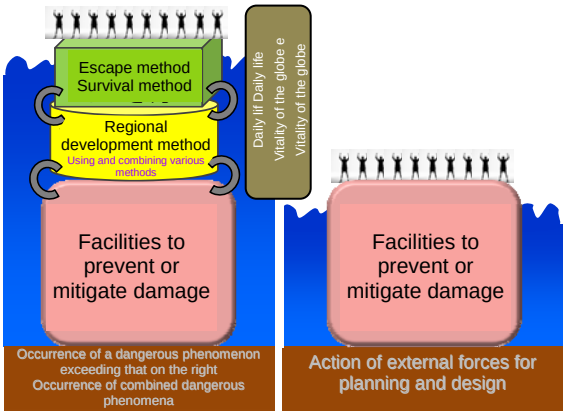


Figure 2. What circumstances will we create in order to intelligently face flood disasters?

Thirdly, based on obtained knowledge and long-term prospects for the way damage occurs, good regional development including towns, and methods of combining methods of escaping and survival will be completed. This study will incorporate two-way exchanges to provide feedback to improve ways that facilities functions. These three pillars will, acting together, be introduced where countermeasures can be continuously checked and expanded centered on multilateral flood risk assessment efforts. The Tsunami Disaster Prevention Regional Development Law enacted in December of last year is an important precursor to the framework of the policies shown in Figure 2. A study should be done on applying such efforts to all flood disasters.

Needless to say, the daily lives of people are not intended to prevent or mitigate disasters. Their main role is normal daily life rooted in each region. How is the world shown in Figure 2 harmonized with normal daily life? Can any innovation allow harmonization that increases the vitality of a region? Answers to these questions will require a deeper and broader vision.

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# Formation of Resilient Road Networks and Reallocation of Road Space

## —Technology Policies for Road Infrastructure Based on Constant Monitoring and a Database—

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*(Keywords) Road traffic census, probes, database, road assets, maintenance, road space reallocation*

### 1. Internationally Competitive 21st Century Road Networks

The Committee on Formation and Operation of Expressways issued its interim report in December 2011, based on changes in social and economic conditions, medium- and long-term future prospects for Japan and for international society, and the experience of the Great East Japan Earthquake. The interim report outlined the functions of expressways—strengthening access to airports and ports, ensuring a service level of 60–80 km/hour between major cities and regions, and ensuring a network that will continue to function during disasters—in line with the basic principles: reorganizing and strengthening the national land in the face of population decline, and increasing people's trust in the national land. Noting that "If it's connected, it's a network!", it sets clear goals for improvements and management to eliminate missing links using easy-to-drive national highways and permanent two-lane expressways.

### 2. Completion of monitoring of road networks

In order to plan, improve, and manage such road networks which cover the national land, a system for constantly monitoring and managing the state of road traffic throughout the country is required. The road traffic census, which is an example of such monitoring, surveys the traffic volume and traveling speed on about 190,000 kilometers of trunk roads throughout Japan every five years, and its findings are used to plan road improvements. The 2010 census actively introduced automated surveys using constant traffic volume observation devices and portable traffic counters, made possible by ITS-based traffic measurements. Traveling data obtained by probe car systems operated by the private sector have also been widely used. Full-scale 24 hour/365 day road traffic monitoring has begun. Systems to monitor road traffic throughout Japan have only partly been established, but a large quantity of data which will be useful for enacting policies has already been obtained. As shown in Figure 1, as a result of population decline, the rise in the number of vehicles and vehicle kilometers traveled have both peaked, and are beginning to fall (average traffic volume down 2.6% from five years ago). In view of this reversal, we should clarify economic conditions, the effectiveness of countermeasures, impact of disasters, etc. using a continuous and high-density observation system. The results of traffic monitoring of high-standard road networks throughout Japan, which were continually observed from immediately after the Great East Japan Earthquake, were effectively used to set alternative routes and to enact emergency countermeasures for carrying people and materials to the disaster region. A trial by automakers, etc. to jointly collect private-sector probe data to publish viable routes on the web in real time was evaluated as extremely effective, and so efforts to integrate this with public probe data obtained by ITS Spots are expected. Figure 2 shows the state of congestion of the road network in the Tokyo region after the earthquake, obtained by analyzing probe data. It accurately reproduced and evaluated the state of congestion for the entire network and for each section, and will help clarify the condition of road networks spanning adjacent management regions when a disaster strikes, and can be used to prepare countermeasures.

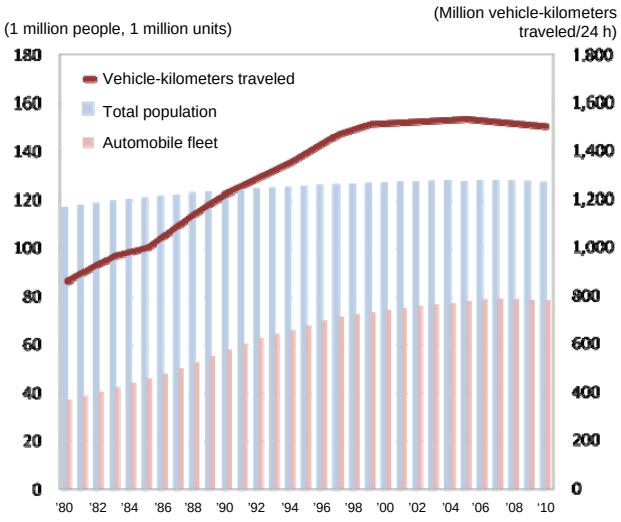
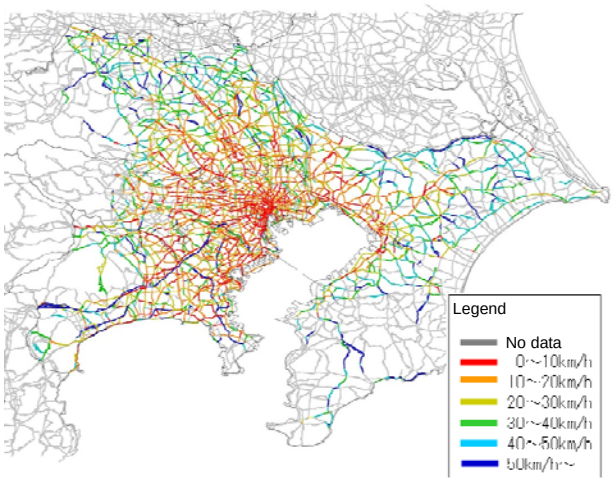



Figure 1. Changing population, automobile fleet, vehicle-kilometers traveled




Analysis of average traveling speed based on probe data
Declined sharply from 21.3 km/hr before the earthquake to 6.2 km/hr after

Figure 2. Reproduction of state of congestion in the Tokyo region after the Great East Japan Earthquake

### 3. Conservation of a resilient national land infrastructure and road assets

The interim report on the review of the Priority Project for Public Asset Improvement (November 2011) includes discussions of strategic maintenance and refurbishment management to deal with the deterioration of public assets under limited budget, and the development of technologies which will continue to function and withstand damage during disasters.

The NILIM is actively analyzing and surveying the damage to road structures following the earthquake, and has used the results to review the standards for road bridges, road earthworks, and other road structures. In addition to clarifying the mechanisms of damage to road structures by tsunami, the NILIM is also considering the need for design standards specifically considering the impacts of tsunami, and is defining earthquake resistance performance required for earthwork structures, which are part of the road network, to ensure that the roads can still be used after an earthquake, and intends to reflect the findings in technological standards. As the quantity of aged road assets increases, many cases of serious damage and accidents to bridges have been reported both inside and outside of Japan. Considering the declining population, falling birth rate, aging of society, and harsh financial conditions, the NILIM is now researching ways to maintain the functions of existing road structure assets as economically as possible, and creating new road structures with superior durability and reliability to minimize the burden of maintenance.

### 4. Reallocation of road space (creating environments for cyclists)

In Japan, as the trunk road network has been established, there have been discussions on changing the objective of road policy from “dealing with the growth in automobile traffic” to “coexistence of pedestrians, cyclists, and other road users”[2]. Specific measures now required include reallocating and effectively using limited road space, and placing priority on pedestrian and bicycle traffic along community roads.

Under such circumstances, while the number of traffic accidents is falling, bicycle related accidents have increased in the past 10 years, so it is necessary to prepare bicycle network plans and establish comprehensive rules for the design and use of safe and convenient bicycle spaces. The Ministry of Land, Infrastructure, Transport and Tourism and National Police Agency plan to draw up a guideline for these policies, which the NILIM is supporting by organizing network planning studies and gathering detailed technological knowledge on the structure of normal road sections and intersections.

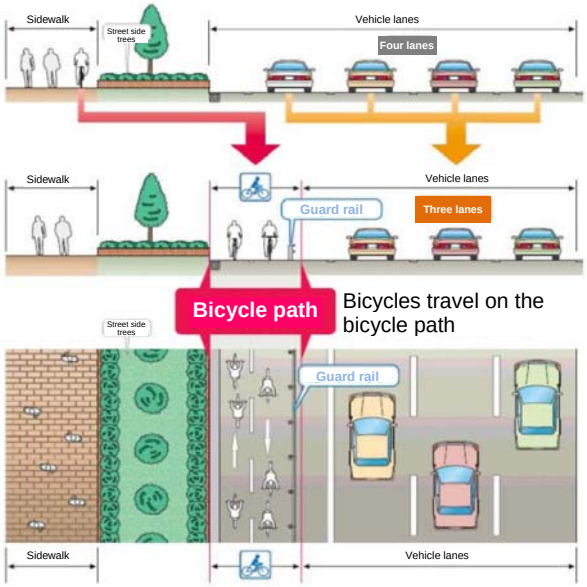



Figure 3. Model of bicycle traveling environment (Nagoya)[3]

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# Are buildings really safe enough to survive earthquakes of “unanticipated” scale?

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(key words) *above-expected earthquakes, buildings, seismic safety*

## 1. Introduction

Through its research in the fields of structures, fire safety, environment and equipment, the Building Department supports building technology standards based on scientific and technical findings.

The subject of this article is seismic safety of buildings, and we have been playing an essential role in setting better building technology standards. All of us may now have a keen interest in this subject, and we tend to ask ourselves whether we can just leave things as they are or we should take further action to better prepare for mega-earthquakes which are likely to occur in the future. Let me explain this subject to you.

## 2. The Unexpected Great East Japan Earthquake

Since the 2011 off the Pacific coast of Tohoku Earthquake (The Great East Japan Earthquake) which hit Japan in March of last year, we have often heard seismologists say the word “unexpected” referring to both the seismic scale and the tsunami’s destructive power.

To non-specialists, this may have sounded like something far beyond the scope of knowledge any human could have, but to skilled people with expertise it may not have been clearly considered at the initial design stage. It is nearly unthinkable that this earthquake was beyond human knowledge. “Unexpected” may not be the type of word we should use talking to ordinary citizens who faced a disaster of that scale.

It is regrettable that we might have lost the chance to carry out a careful investigation by using the term “unexpected”.

It is undeniable, however, that the earthquake and tsunami were huge. It stands to reason that people will now worry if buildings are really safe enough to survive earthquakes of “unanticipated” (I dare to use this word) scale.

## 3. Earthquake and Tsunami of Maximum Magnitude

The interim report submitted by “the Experts Committee to Examine Measures against Earthquakes and Tsunamis Based on Lessons Taught by the 2011 off the Pacific coast of Tohoku Earthquake” formed under the Central Disaster Prevention Council (Jun, 2011) states “To make future assumptions concerning possible earthquakes and tsunamis, we should review the way we thought in the past and must now consider each and every possibility of the largest-scale earthquakes and tsunamis based on scientific findings such as sediment examinations”. They have actually put this into action by reviewing the hypocentral region and tsunami source region of the Nankai Trough. They have now taken a step forward in examining the use of a seismic source dislocation model and a tsunami dislocation model.

On the other hand, institutions such as the Japan Society of Civil Engineers or the Ministry of Land, Infrastructure, Transport and Tourism offered some guideposts (1) to the way of handling evacuation from

tsunami. To prepare for the “level 1” tsunamis which take place once in several dozens of years to more than a hundred years, tangible measures are to be employed to protect human lives and properties. Evacuation will play a key role as an intangible measure in the case of “level 2” tsunami which is a level far beyond the application of tangible measures at “level 1”. They have established a policy stating that dependence on “hardware-centric policy” or constructing continuous facilities such as an embankment, is not economical, although it is theoretically possible, with an ample budget, to build independent facilities like buildings which are robust enough to withstand a “level 2” tsunami.

**4. Are Buildings Really Safe Enough To Survive Earthquakes of “Unanticipated” Scale?**

A consoling aspect of the Great East Japan Earthquake is that direct damage to buildings by the earthquake itself was not huge (2). However, are buildings really safe enough to survive a mega-earthquake like the Nankai Trough Earthquake which is predicted to surely come in the near future?

We have no choice but to rely on tangible facilities to deal with seismic motion which takes place right after an earthquake, even a “level 2” earthquake, as we will not have enough time for evacuation even though the intangible measures mentioned above for tsunami are supposed to basically be taken for “level 2”.

Technical standards for seismic building construction set guidelines 30 years ago stipulating an earthquake happening on rare occasions as “level 1”, and one occurring on “extremely” rare occasions as “level 2”, so the basic methodology applied here for tsunami is the same as that previously applied to earthquake classification. However, technical standards for seismic building construction, even at “level 2”, demand the use of tangible measures so that buildings will not collapse in order to save people’s lives (“hardware-centric policy”). This posture clearly contradicts the Central Disaster Prevention Council’s policy which almost abandons relying only on the use of tangible facilities as the only measures to deal with tsunami. The difference in their attitudes derives from the different ways that damages by an earthquake and by a tsunami are revealed.

It is irrelevant to make a simple comparison between the largest scale earthquakes defined by the Expert Examination Committee of the Central Disaster Prevention Council and the extremely rare earthquakes defined by the technical standards for seismic building construction, because the former assumes specific earthquakes and the latter does not necessarily do so. The latter is also more focused on seismic ground motions than on the earthquake itself.

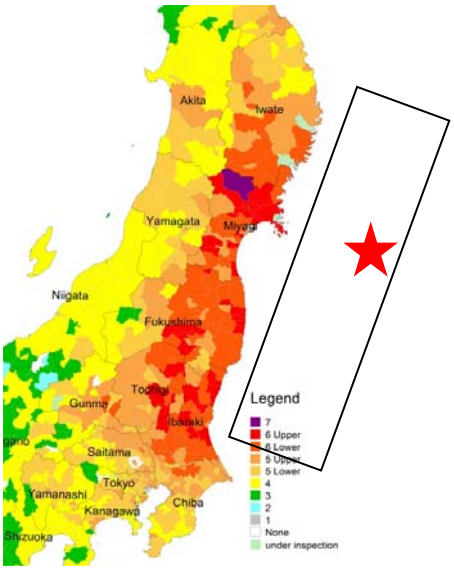


Figure 1. Seismic Intensity of Each Region from the Great East Japan Earthquake

On the other hand, what they have in common is the fact that final judgments are always made by experts based on scientific and empirical information such as the past earthquake damage and observation records.

There is a methodological process of extrapolation, whereby largest scale earthquakes and their subsequent “level 2” ground motions are determined in terms of xx year recurrence intervals using past

observation records as statistical data. But simply applying numerical formula is, needless to say, an impractical way to predict earthquakes and ground motions of maximum magnitude which are thought to be barely predictable. So it is appropriate to make an expert judgment at the present stage to make comprehensive decisions based on a combination of various findings and information.

Figure 1 shows the seismic intensity caused in each region by the Great East Japan Earthquake. Most assessments now available concern the impacts of seismic ground motion on buildings judging from each of the seismic intensities, but the geographical distribution is decided by the shortest distance from the hypocentral region rather than the distance from the epicenter（★）as shown on the chart.

In that sense, the bigger an earthquake, the larger the area of the hypocentral region and of the damaged area. Inversely, tangible measures against ground motions may effectively deal with overly large earthquakes on the condition that the seismic resistances of buildings are verified to cope with past earthquakes which were close to the fault (inland earthquakes, e.g. earthquakes like the 1995 Great Hanshin-Awaji Earthquake which caused tremendous damage). It is a common understanding among experts that the current technical standards for seismic building construction revealed good performance during the 1995 Great Hanshin-Awaji Earthquake, which means less need to modify the current technical standards.

However, the larger an earthquake, the larger the slippage in the hypocentral region. Also, if the area of the hypocentral region is large, duration of the earthquake is prolonged. So we have to watch for reciprocal response of ground motions accelerated by phenomena such as sympathetic vibrations.

**5. Conclusion**

Although most buildings satisfying the current technical standards for seismic building construction may provide sufficient earthquake resistance against larger than expected earthquakes, we still need to be cautious about potential hazards including sympathetic vibration of super high-rise buildings caused by long-period ground motions or liquefaction which is susceptible to the duration of ground motion. On these issues, we are working for measures.

Meanwhile, what we must not forget is that there are still many buildings not satisfying the current technical standards for seismic building construction, so called existing unqualified buildings in cities.

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# Reconstructing homes in disaster regions: challenges and support

OTAKE Ryo
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*(Keywords) Great East Japan Earthquake, housing reconstruction, disaster recovery public housing, regional reconstruction housing*

**1. Damage to housing by the Great East Japan Earthquake**

Many homes were damaged by the Great East Japan Earthquake. More than 120,000 homes including those washed away by the tsunami were completely destroyed, while about 370,000 were partly damaged. Many victims have been forced to live in evacuation centers, but the construction of emergency temporary homes began promptly, and combined with the renting of private dwellings and provision of public housing, a total of about 140,000 emergency homes have been provided. This is different to past disasters; in addition to prefabricated homes, temporary wooden homes have been constructed by local companies, temporary rental homes have been used extensively, and many people are living in temporary homes outside their home prefecture. The reconstruction of durable homes will remain a significant challenge.

In Miyagi and Iwate Prefectures, guidelines and plans for the reconstruction of homes have already been presented (in Fukushima Prefecture, these were being drawn up when this report was being prepared): the Basic Guideline for the Reconstruction of Homes in Iwate Prefecture of October 2011 calls for the supply or repair of 16,000 to 18,000 homes, and the Miyagi Prefecture Housing Reconstruction Plan of December 2011 calls for 72,000 homes.

**2. Challenges to reconstruction of housing**

The Great East Japan Earthquake has created a number of different challenges for housing reconstruction compared with past disasters, due to different historical circumstances. Examples include the massive and widespread scale of damage, and the fact that many of the disaster regions face harsh geographical, economic and social conditions.

[1] Ensuring safety: The construction and location of housing must ensure safety from tsunami.
[2] High volume supply: Necessary land and production systems must be obtained under topographical and other restrictions.
[3] Convenient living: Housing must have all the functions needed to form sustainable communities.
[4] Consideration for the elderly: Facilities for daily life are required because communities have aged remarkably.
[5] Harmony with the environment: The region has a rich natural environment, and restrictions on energy must be dealt with.
[6] Maintaining the history and culture of the region: Homes are part of a region's culture, so memories engraved in the region must be preserved.
[7] Guaranteeing employment: Many places of employment were damaged; jobs near residential districts are needed.
[8] Procuring funds: Assistance for rebuilding houses is needed for people with insufficient resources.
[9] Shortness of time: If reconstruction is delayed, people will continue to live in temporary housing, which may hinder recovery of the population.

To overcome these challenges, housing plans and production methods must be linked with town planning to prioritize contribution to regional economies and community-building.

The Government's Basic Guideline to Recovery from the Great East Japan Earthquake (August 2011) includes the following guidelines (abridged) to ensure the stability of housing for disaster victims.

- By planning for entire regions, support shall be given to guarantee durable housing while considering continuing and ensuring employment and guaranteeing living facilities needed by the elderly.
- For disaster victims who do not have the money to reconstruct or buy homes, systems such as disaster recovery public housing leased at low rents shall be improved and used, and their supply shall be increased.
- Housing integrated with community functions and with service functions for elderly people, etc. shall be provided so that the elderly and other occupants can easily obtain local assistance and rebuild their lives.
- Regarding disaster recovery public housing, in regions at low risk of tsunami, wooden construction shall be promoted, and on flat land, these shall include tsunami evacuation functions.

Housing reconstruction not only helps the people living in a disaster region but also stimulates economic activities including the flow of materials and jobs. If housing restoration can be linked with medical care, welfare and support for daily life, etc. for elderly people, who cannot easily reconstruct their homes

with their own resources, and if housing production can be based on local employment using local materials and housing companies, such a region may become a model for a sustainable lifestyle in regions where the population is shrinking, society is aging, and the birthrate is declining. The National Institute for Land and Infrastructure Management is therefore using its knowledge and research on housing policies and reconstruction after past disasters to provide technical support for housing reconstruction. Major initiatives are introduced below.

**3. Survey of disaster recovery public housing**

Disaster recovery public housing, which plays a key role in ensuring housing, must be supplied promptly and efficiently while ensuring stable housing for victims and responding appropriately to regional needs. Under the Great East Japan Earthquake Restoration Special District Law, organizations have been expanded by, for example, enacting special measures concerning occupancy qualifications and handling the transfer of property; 4,000 and 5,000 homes are planned for Iwate Prefecture and another 12,000 homes are planned for Miyagi Prefecture.

To help provide disaster recovery public housing, the Urban Renaissance Agency (UR) took the initiative under a basic agreement signed with some regional governments which met the necessary conditions, and started the Study of Disaster Recovery Public Housing Planning and Supply Methods in December 2011, commissioned by the Housing Bureau of the Ministry of Land, Infrastructure, Transport and Tourism based on the third supplementary budget of FY2011. This investigation included the concepts and standard designs for housing provision, and the results will be distributed to many regional government bodies in the disaster regions.

The investigation was done by region and by theme, with the former considering overall supply plans and proposing plans for 33 cities, towns, and villages in candidate regions (9 in Iwate, 16 in Miyagi, and 8 in Fukushima) which wished to be included among those designated by the Severe Disaster Law. The investigation by theme summarized matters to be considered and specific policies related to disaster prevention and crisis management, regional stimulation, the environment, and community and the elderly.

The National Institute for Land and Infrastructure Management has, in cooperation with the Building Research Institute, given technical guidance for the study by region, summarized proposed plans for housing estates based on regional characteristics, wooden single-family dwellings or RC medium- and high-rise collective dwellings, according to the circumstances and wishes of each city, town, or village, while exchanging views and conducting field surveys in the three prefectures and 33 cities, towns, and villages. This will help rapidly provide disaster recovery public housing in the future.

**4. Regional restoration housing initiatives**

To support housing reconstruction with the resources of the victims and to help create jobs and stimulate industry in the regions while considering the mass construction of housing in future, a system for producing good-quality low-rent wooden housing using local materials must be established with the cooperation of local housing producers. Therefore, the Regional Restoration Housing Liaison Committee formed jointly by the public and private sectors was established in September 2011. Its members come from various fields including local government (housing, forestry), design, construction, materials, lumber, and so on from the three prefectures in the disaster region, with staff of the National Institute for Land and Infrastructure Management participating as academic experts to provide technical guidance and overall project planning.

The study results were compiled as the Regional Restoration Housing Design and Production System Guideline in December 2011, and sample common specifications and model designs were proposed for each prefecture in line with the six guiding concepts of: long-term use, future growth, environmental protection, low price, suitability with the region, and meeting demand. Based on the guideline, groups consisting of carpentry and building contractors' offices, design offices, forestry companies, and lumber mill operators will be formed to handle production and supply. To ensure practical development, the Liaison Committee was reorganized as the Regional Restoration Housing Promotion Consultative Committee in February 2012. In the future, the Consultative Committee is expected to reconstruct suitable local housing by beginning practical work in line with various administrative policies.

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# Aiming for Compact, Low-Carbon Urban Planning

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*(Keywords) Compact urban structure, low-carbon city, sustainable society*

## 1. Introduction

On February 28 of this year, the Cabinet approved the submission of the "Bill on Promotion of Low-Carbon Cities" to the Diet. The Bill asks relevant ministers to jointly establish basic guidelines for the preparation of low-carbon urban plans to be formulated by cities, towns, and villages, and provides special measures based on the plans and measures to disseminate and to promote low-carbon buildings.

Low-carbon urban planning comprehensively promotes measures such as the intensification of urban functions, promotion of public transport utilization, and area management and efficient utilization of greenery and energy in specified areas such as urbanization promotion areas to encourage cities to shift towards low-carbon production. The bill clearly stipulates "intensification of urban functions", and therefore, various measures will be developed concerning intensive low-carbon urban planning.

## 2. On Intensive Urban Structures

It is recognized that to address the population decline, aging of society, and the necessity to streamline urban management costs, we should aim for a compact city with "intensive urban structure" in which a certain number of people live densely in an certain area where a good living environment and space for interaction are efficiently provided by concentrating the urban functions and public services they require. This report presents related trends.

(1) The "Compact City" Concept

The term "compact city" reminds us of initiatives taken by Aomori City and Toyama City, which were taken while the national and local governments were debating various issues in preparation for enacting new laws to invigorate city centers. The beneficial effects of encouraging compactness on the cost of maintaining public facilities and on the conservation of energy were advocated, and people's focus was on concentrating urban functions in city centers and preventing additional expansion .

(2) Act on the Improvement and Vitalization in City Center

This act, enacted in 1998, focused on concentrating urban functions in city centers, improving streets and parking facilities, and providing public transportation networks to city centers, to improve built environments together with the invigoration of commercial activities, while striving to minimize the contribution of the central government

However, city centers did not cease to decline as a result of unachieved designation of land use regulation and the continued competition to locate large stores in suburbs or on former factory land.

(3) The Three Revised Acts on Urban Planning

An advisory given in response to the question "How should urban planning be done in the new age?", submitted in June 2005 by the Sectional Committee on Urban Planning and Historic Landscape of the Panel on Infrastructure Development, noted in its first report in February 2006 the need for "urban restructuring" to replace existing urban structures with concentrated urban structures, in which the locations of commercial, administrative, medical, cultural, and other functions which provide services over wide areas are concentrated to ensure accessibility without reliance on automobiles, thus creating cities in which many people can enjoy convenient daily life. This resulted in the necessity for policies based on an awareness of urban shrinkage.

The three revised acts on urban planning enacted in 2006 (Revised City Planning Act, Act on the Measures by Large-scale Retail Stores for Preservation of Living Environments, and Act on Vitalization in City Center) strengthen the involvement of the national government in approving plans made by local governments, setting and evaluating numerical targets, etc. and require measures to restrict the location of large-scale facilities which attract many customers, particularly in the suburbs of regional cities.

Methods for land-use control in suburbs have increased, but the goals in this case were to help achieve goals established separately for city centers.

(4) Bill for Promotion of Low-Carbon Cities

The Sectional Committee on Urban Planning and Historic Landscape continued studies in response to the question of 2005, and concluded its deliberations on February 17 of last year, when it received progress

reports from the Safe and Secure Urban Planning Subcommittee and City Planning Statutory System Subcommittee.

The report from the City Planning Statutory System Subcommittee clearly states the basic guideline: "In place of past urban planning and related systems which focused on land and supply countermeasures, new systems will be repositioned to implement intensified city structures permitting sustainable urban life, sustainable urban activities, and sustainable environments."

In this basic guideline of the Ministry of Land, Infrastructure, Transport and Tourism, announced in November to promote sustainable and vigorous national land and regional development, "regional intensification (proximity of medical, employment, and residential functions)" and "formulation of low-carbon and recyclable systems" are presented as directions for new policy development to create a sustainable society. The bill conforms to such directions.

### 3. Expectations Following the New Bill

Urban planning and policies intended to create a sustainable society, which is the basic guideline, are expected to bring great results.

The reason is that the purposes of the guideline ought to require, in addition to intensifying functions in a specified area, enacting plans to deal with the shrinkage of low density urban districts and other aspects of cities in general, and the advancement of these policies together ought to deepen the "intensive urban structures", and effectively achieve the goals of other urban policies, such as lowering the carbon emissions of entire cities, reducing the cost of maintaining cities, invigorating city centers, and improving urban landscape by increasing its greenery.

We want to note how local planning bodies will focus on organizing "regional intensification" and "formulation of low-carbon and recyclable systems" as their own policy challenges to skillfully apply "low-carbon urban planning."

### 4. Initiatives by the Urban Planning Department

Urban planning powers are now increasingly transferred to local bodies, and the Urban Planning Department of NILIM is required to provide technical support to local planning bodies to implement this new system to create "intensive urban structures". The Department plays important roles by providing various knowledge regarding technological guidance given by the City Bureau of the MLIT, or by showing planning methods and technologies to local planning bodies.

Accordingly, we have already conducted a number of research programs aware of population decline, established assessment methods for future city structures, challenging objective land-use suitability appraisal, and challenging smooth urban shrinkage method development .

Also to offer public support to private-sector urban developers, we are researching block-level energy saving measures, heat island countermeasures, and measures to ensure greenery.

Further research is still needed on the directions of urban policies to create a sustainable society, with the help of members in other fields.

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# Promoting Diverse Tsunami Disaster Protection Countermeasures

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*(Keywords) tsunami, industry, ports and harbors*

**1. Introduction**

In response to lessons taught by the Great East Japan Earthquake of March last year, earthquake and tsunami countermeasures are being widely studied and numerous plans are being reviewed. These reviews should focus on how to protect the lives and physical safety of the citizens of Japan, but in the future, more advanced and diverse disaster protection countermeasures will be needed.

**2. Impact on industry**

In the manufacturing industry, each company builds its own supply chain, because globally procuring components to manufacture superior products at low cost is a major key to survival. However, the Niigata Chuetsu Offshore Earthquake and similar events have proven that the entire production system of a company may be shut down if its supply chain is broken at any point. Firms avoid this risk by, for example, distributing their primary suppliers, but this earthquake and tsunami had a severe impact by halting the production of semiconductors, auto parts etc. and halting distribution due to disruption of logistics of ports, roads, etc. The disruption to economic activities by both the direct and indirect impacts of the earthquake and tsunami will depress the Japanese economy which has been struggling to recover, and will severely impact Japan as a whole, in addition to the burden of restoring the disaster region and reviving the livelihoods of victims. Images of the disaster have been broadcast worldwide, focusing attention on the risk of damage to Japanese industry, and the impact is likely to drag on. It will not be easy to recover lost assets, without which recovery may be impossible.

The total value of shipments of manufactured products from the Tohoku region accounts for less than 10% of the total for Japan, and many semiconductor and automobile parts factories are located inland where they escaped damage by the tsunami and were restored relatively quickly. The Tokai, Tonankai, and Nankai earthquakes, which are certain to occur eventually, will strike the heart of Japan's industrial and manufacturing region, and as many of these production facilities are located along the coastline, the impact of these earthquakes will be immeasurable. The existing supply chains in Japan cannot adequately absorb and mitigate the risk, and yet moving production centers overseas or beginning to procure components from foreign companies to avoid such risk will destroy the foundation of manufacturing in Japan and weaken the nation. Promoting policies to reduce risk while keeping production functions inside Japan is the key to disaster protection countermeasures in the future.

**3. Response along the shorelines in ports**

The shorelines of ports, where industry is heavily concentrated, are exposed to two risks: earthquake risk and tsunami risk. One way of avoiding the risk of earthquakes and tsunami is to move to a region where earthquakes do not occur or to an inland location which is safe from tsunami. But an earthquake can strike anywhere in Japan, and inland locations face other risks such as landslides. Furthermore, Japan is surrounded by the sea and most physical goods are transported by ship. It is therefore not realistic to avoid the coast, which is convenient for marine transport, in view of maintaining international competitiveness and global supply chains. How can the risk of coastlines and associated risk of tsunami be avoided?

[1] Structural countermeasures

Unlike people, manufacturing plants cannot be evacuated to another location. Present studies follow a policy of not building coastline plants on protected land to withstand a low-frequency tsunami with a recurrence period of more than 100 years. Countermeasures are necessary to protect many plants located on unprotected port land from high-frequency tsunamis.

Considering the situation during the recent

tsunami, the tsunami surges destroyed structures while the ships and other debris carried by the flow exacerbated the damage. The scattered debris has delayed the restoration effort.

Lowering the flow velocity, controlling its direction, capturing debris, etc. might be effective ways of reducing the impact. For example, could the layout of coastline structures, warehouses or multi-story parking buildings which escape tsunami damage, and shoreline roads, fences, and other public facilities be used to control the flow of water and block the inflow of debris? These structures are used during normal times and reduce the financial burden of new disaster prevention countermeasures. Plans for the layout of structures and for land use must be enacted based on simulations focused on preventing tsunami damage in this way and on the results of the simulations. For unprotected areas in particular, it is necessary to count on the tsunami attenuation effects of normal breakwaters. It is also necessary to study the construction of manufacturing plants resistant earthquakes and tsunami, by publicly requiring owners of manufacturing plants to build their plant on higher ground or take protective measures up to the predicted inundation depth.

[2] Non-structural countermeasures

To provide information needed for efficient operation of structural countermeasures, it is necessary to provide systems linking wave height gauges to analyze and transmit tsunami information or the predicted time and routes of inundation water.

Not only coastline industries, but also ports play important roles by linking sea and land transport to form supply chains, so their functions must be maintained and quickly restored during emergencies. Corporations determine the mission of their business continuity plans (BCP) in advance to maintain and quickly restore the minimum activities, but many are now gathering experts to study BCP in order to maintain logistics functions in ports and harbors such as Tokyo Bay or Osaka Bay. This recent tsunami caused widespread damage along the Pacific Coast of Tohoku, so networks including ports on the Japan Sea side were effective. In the future, it will be necessary to study and enact port and harbor logistics BCP by linking ports over a wide range, in Tokai, Kinki, Chugoku, Shikoku, Kyushu, which may be struck by the predicted Tokai, Tonankai, and Nankai earthquakes. It is also important to consider comprehensively providing information about the usability of port and harbor facilities and alternative logistics routes including land transport systems.

**4. Efforts by the NILIM**

The Coastal and Marine Department of the NILIM, primarily the Coastal Disaster Prevention Division, researches damage to facilities caused by floating debris and studies evacuation plans by performing simulations of the evacuation of coastline residents, and has studied the state of damage to ports and coastlines caused by last year's Great East Japan Earthquake in order to establish policies for providing new coastline facilities. The department releases the results of these researches as they become available. But, aware of the importance of research on disaster prevention for coastal regions and the need to diversify and strengthen such disaster prevention measures, the NILIM reorganized the Coastal and Marine Department in early 2012, when it will begin operating as the Coastal and Marine/Disaster Prevention Department in addition to the Research Coordinator for Tsunami Disasters and Crisis Management Research Division.

We are committed to working on existing challenges as well as a broad range of new goals as discussed above. As advanced variations of existing research, we are considering how to use our accumulated knowledge and technologies to develop tsunami observation technologies by applying marine short-wave radar technology, and how to restore marine environments following the loss of marine life or deterioration of the environment, which are now hidden by the human and material damage inflicted by the recent tsunami.

**5. Conclusions**

In his book, "Port Construction (Volume 1, Introduction)", the civil engineer, Hiroi Isami, a pioneer of port construction in Japan, taking the tsunami which struck Urado (Port of Kochi) in 1854 as an example, explained that technologists must enact plans cautiously and meticulously while looking far into the future. Japan is surrounded by the sea, and its major cities, industrial regions, and fishing harbors are along the coasts. Considering Japan's efforts on the last frontier, which is the exclusive economic waters, it is Japan's destiny to defeat and survive disasters such as tsunami, high waves, and storm surges which are unique to coastlines, and it is a

mission that the world requires Japan to accept. We must therefore hypothesize a variety of circumstances, recognize that they could occur, make cautious and meticulous preparations looking far ahead, and undertake diverse research that spans boundaries.

# Ports and harbors to help ensure recovery from both the Great East Japan Earthquake and the deteriorated Japanese trade environment

Dr. SUZUKI Takeshi, Director of Port and Harbor Department

*(Keywords) The Great East Japan Earthquake, trade environment, international distribution, Japan's economic growth*

## 1. Ports and Harbors Damaged by the Great East Japan Earthquake

The Great East Japan Earthquake of the 11th of March, 2011 caused outsized ground motions and tsunamis, inflicting tremendous damage in ports and harbors along the Pacific coast of Tohoku. Ports and harbors almost entirely stopped functioning under the effects of the following factors: deteriorated port and harbor wave protection functions due to collapsed seawalls, sea routes clogged with stranded shipping and floating/piling of disaster debris and other materials, impaired berthing functions because of leaning/subsided quay walls, loading and unloading activities obstructed by collapsed/impaired materials handling equipment (Photo 1) or subsidence or loss of flatness of aprons, difficulty storing goods due to the destruction of sheds/warehouses, roads clogged with disaster debris, etc.

## 2. Influence of Damage to Ports and Harbors

Disaster-stricken ports and harbors stopped functioning and this had huge impacts on economic activities in Tohoku and Northern Kanto areas.

Livestock raising had been one of the core industries in Tohoku and many of the region's farmers reared cattle. Tsunami stopped functioning of grain wharfs and silos at harbors in Tohoku, and adjacent feed mills were also devastated. So cattle were in danger of dying by the disruption of the supply of feed. In response, feed producers in Hokkaido and Kyushu rapidly increased outputs and provided supplies to Tohoku by way of harbors alongside the Japan Sea coast.

Also, as oil refineries and terminals located at harbors in Tohoku or Kanto stopped functioning, the fuel supply stagnated, resulting in fuel shortages at transport facilities and in households and business offices. To tackle this situation, oil refineries throughout the nation increased production and transported their products by sea or by rail (Figure 1).

Various other forms of emergency transportation were adopted, and marine transport in particular is thought to have been far more effective than other forms of transportation. We must quickly conduct research to learn how to prepare for or deal with disasters by making use of such experiences with a view to saving lives from the Tokai, Tonankai, Nankai Earthquake or an inland earthquake directly underneath the Tokyo metropolitan area.

Photo 1. Collapsed Unloaders at Soma Harbor

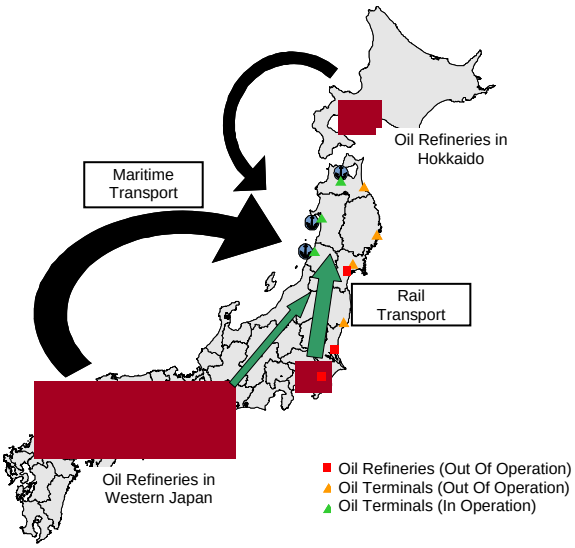


Figure 1. Alternative Provision Routes of Petrochemical Products after the Quake

Income bearing industries will be necessary when people resume their normal daily life one year after the earthquake and tsunami (March, 2011). We also need to quicken the pace of the regeneration of factories in the harbor areas along the Pacific coast of Tohoku, which were broadly and terribly damaged by

tsunami. So we have to effectively and promptly restore the distribution functions and disaster-prevention functions which factories or other entities require. We need to solve a number of problems to make that happen.

### 3. Deterioration in Trade Environments of Japan

The Japanese trade environment is quite severe. The Japanese trade balance fell in 2011 (Figure 2) due mainly to its stagnated exports and increased energy imports. Exports were dragged down by debt crises in European countries, declining trade volumes among Asian countries as a result of the negative impact on the US economy of the Lehman shock after effects, the unprecedentedly high yen, suspended operations of nuclear power plants after the Great East Japan Earthquakes, parts shortages affected by the flooding in Thailand, restriction on electric use, hike in electric charges, rising energy prices, labor costs and social welfare expenses of firms which are perceived to be expensive by world standards, and the subsequent overseas transfers of offices. We fear that deteriorating Japanese competitiveness and overseas transfers of offices might continue, and that more overseas transfers might result in lower domestic employment and tax revenues. Therefore, it is essential for us to develop an environment in which firms can maintain their offices in Japan.

### 4. Enhancing International Competitiveness of Ports and Harbors

Japan lags behind the other East Asian nations in the competition to increase the size of ports and is even in danger of losing primary container routes to prosperous East Asian ports accommodating themselves to the global trend of enlarging vessel sizes.

Japan must enhance its port competitiveness and, by doing so, drive competitive advantage of our economy and thus reduce the cost of importing consumer goods.

Also, we have to capture growth in Asia and plug it into revitalization of our domestic economy. To achieve these goals, we will have to take steps to quickly give our ports the ability to handle larger vessels and improve corresponding services. In light of Japan's severe budget conditions, it will be necessary to carefully select feasible ports and then to concentrate investments in them. With these in mind, the Ministry of Land, Infrastructure, Transport and Tourism chose two regions as "international container strategic ports" in August 2010. MLIT also took steps to select "international bulk strategic ports" in May 2011.

The Japanese government is also in the process of stepping up its trade liberalization to reinforce international competitiveness of Japanese firms through various measures such as overcoming tariff-related disadvantages (Figure 3). Provided that trade liberalization advances, the Japanese trade environment will significantly change.

To promptly and precisely respond to trade liberalization and other changes in trade environments, it is necessary to grasp economic conditions of the countries concerned, barriers against international transport and transactions, fuel prices, management policies of shipping firms, performances/dimensions of vessels, maintenance status of maritime and land infrastructure, and so on. It is also necessary to predict the speed of changes in two-way distribution flows between ports, vessel size/performance, frequency of port calls and cargo volume flows at each distribution port. We in the Port and Harbor Department are firmly determined to pursue our forecasts and analyses in an attempt to achieve our aims.

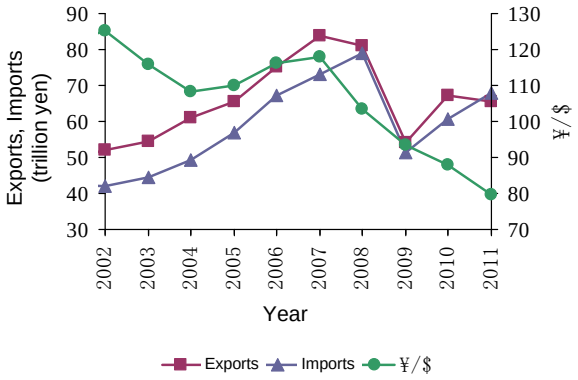


Figure 2. Trade Value and Japanese Yen to 1 USD

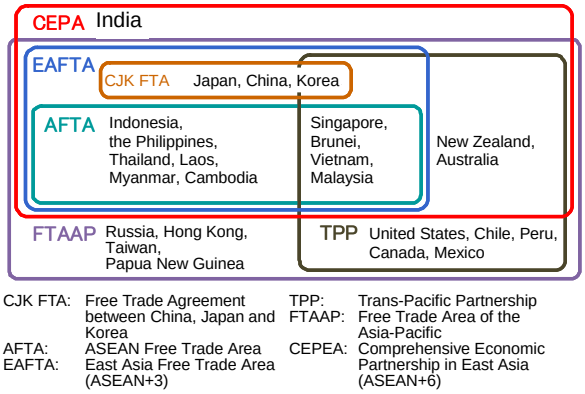


Figure 3. Free Trade Areas IncludingJapan

# Air transportation market and airports stepping into a time of change

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*Key words: LCC, Open Sky, policy simulation, revitalization of regional economies, stock management*

## 1. Entry of LCC and "Open Sky" Airline Deregulation Policy

In 2012, three Japanese Low Cost Carriers (LCC) started operation, and they will compete fiercely with each other. Peach Aviation, in which All Nippon Airways jointly invested, started Kansai International Airport based flights to Sapporo/Fukuoka in March, and other flights are to follow from the same airport to Nagasaki, Kagoshima, and Incheon, Korea. Jetstar Japan, in which Japan Airlines jointly invested, will begin by basing its operation at Narita Airport and in July, start flights to Kansai International Airport, Fukuoka, Sapporo and Naha. Air Asia Japan, a consolidated subsidiary company of All Nippon Airways, will be based at Narita International Airport and fly to Sapporo, Fukuoka and Naha beginning in August and fly to Incheon and Busan in Korea from October. It is estimated that the competition among these Japanese owned low cost carriers will become fiercer as the introduction of more aircraft expands their flight networks in the future. On the other hand, there are already nine low cost carriers regularly flying from countries including Korea, Singapore, Malaysia, the Philippines and Australia.

A Low Cost Carrier (LCC) is a budget carrier which pursues a business model of lean and efficient operation, permitting the carrier to cut operational costs remarkably in comparison to major airlines and successfully offer basic services to customers at extraordinary prices. The key to low cost operation is a high operation rate of aircraft, personnel and facilities. The budget carriers have diversified efforts from company to company so as not to leave aircraft, personnel and facilities idle by getting rid of any waste by ways such as reducing the time to stop at one airport, avoiding busy airports, concentrating on shorter distance flights, swing use of facilities, offering minimal free-of-charge services, having employees hold two and more work positions etc. The LCC are very aggressively developing businesses in markets including Europe and America as well as South East Asia, and it is assumed that the LCC share of the whole air transportation market has already reached the 20-30% level.

Looking at our air transportation market, the "open sky" deregulation in the airline business has been surging and developing very quickly. Airports in the Metropolitan Area, which were excluded from airline deregulation, are now included, and the fifth freedom (beyond rights) has been granted. By January, 2012, Japan had already concluded airline deregulation with twelve countries and regions centered in the US and Asia; and Japan will continue negotiating with China and European countries. One aspect of the background to such rapid development of airline deregulation is the easing of restrictions on airports. The easing of airport restrictions including expanded international flights in airports of the Metropolitan Area has been enabled by an agreement on the increase of annual arrivals/departures at Narita Airport to 300,000 and through an increase of international arrivals/departures at Haneda Airport enabled through the use of runway

D. Concerning airports in the Metropolitan Area, the allocation of airline routes and further expansion are the next tasks to tackle, and coping with busy airports like Fukuoka or Naha is another task that needs to be approached.

**2. Focus and purpose of airline policies**

As mentioned above, the airline industry is in the middle of major changes and the focus of our government policies for airlines and airports will be integrated promotion of the following: Airline Deregulation which will deregulate international flight routes and the number of such flights, the promotion of new business entries by new airlines including LCC with specialized operation styles, and strategic airport operation such as flexible and dynamic setting of landing fees. The effects we target to achieve those policies are: the revitalization of regional economies by the increase of incoming tourists, which will be generated by creating new airline routes or increasing flights of regular international flights and international chartered flights, the enhancement of airport functions to respond to needs of extraordinary business operation like LCCs to achieve efficient flight and operation, and the improvement of customers' convenience by realizing budget fare service, as well as the recovering and further development of the network of flights formerly downsized.

It is the role of the Airport Department to support those policies from the technical side. Concerning challenges including how we can effectively use existing airports or how we can efficiently manage or maintain current facilities, our study theme will be the development of methods which will be used by airports across the board: to develop planning methods, policy simulations methods from the perspective of how the airport should be utilized in supporting improvement of customers' convenience and revitalization of the regional economy, to establish verification methods for performance design, and to develop methods for strategic maintenance and management on the premise of securing safety. It is also essential to consider risk management methods in preparation for future natural disasters by taking advantage of lessons learned from Great East Japan Earthquake. The following are specific research topics.

**3. For the improvement of customers' convenience and revitalization of regional economies**

We promote the development of methods for policies for simulations and the improvement of their accuracy. First of all, we work on further improving forecast accuracy for air transportation demand on the basis of the current air transportation demand forecast model. Further, we construct policy simulation models to evaluate impacts or effects of air policies on the air transportation market in the face of a growing need to create policies concerning how airports should share roles in areas where multiple airports are constructed and how the capacity should be managed at busy airports.

We study the expansion of the airline network, possibilities of establishing new airline routes to respond to the change of the air transportation market and necessary policies to satisfy them in response to the trend towards high-frequency, small-scale aircraft in domestic air transportation and the full-fledged entry of LCC in the market.

We think that forwarders which act as a bridge between the shippers and airlines are playing an important role as one important party involved in the airport choice mechanism in the air cargo market, and we study policies to improve competitiveness while considering the airport choice mechanism in which forwarders seem to play an important role.

We consider how airports should be utilized effectively; through methods to evaluate the role of an

airport in its region's economy correctly based on the theory of economics, and how local airports should play a role in supporting regional revitalization and the promotion of tourism.

The environment surrounding airport operation has been drastically changing, including elements such as a decrease in population, downsizing of equipment, development of LCC, airport budget changes, and we consider ways how airports can be operated efficiently.

**4. For safe, secure and efficient management of facilities**

We study the advancement of technical standards related to airport base facilities. First, we expedite the establishment of verification methods to respond to performance standardization of facility design.

For example, through enabling performance verification of asphalt materials quantitatively based on dynamic and chemical indices, we improve the accuracy of lifecycle costs calculations; further, we establish reasonable design methods adapted to people living longer, realize simplified maintenance and management and enhance strategic maintenance and management.

Further, we develop surface design methods concerning runway safety performance by reflecting characteristics of paving materials and establish lifecycle costs calculation methods so that we can construct reasonable stock management methods for airport base facilities.

We consider a draft for the revision of the calculation standards for airport civil engineering works and an improvement of the calculation system for airport civil engineering works, and consider a draft of construction management standards including common specifications for airport construction and common specifications for investigation.

We work on the advancement and efficiency of the maintenance and management of airport facilities. To maintain safety and punctuality of aircraft, it is necessary to inspect and check the pavement condition of airport runways and to maintain/manage them properly; and such inspections usually need to be executed during short periods at night when the runway is closed. We research and study the establishment of efficient methods for maintenance and management including development of support tools for regular patrols and inspections, and the construction of a system to share technical information through all stages of investigation, planning, construction, maintenance/ management. We further conduct research regarding predictions of deterioration for preventive maintenance.

We perform research on how to be prepared to ensure that an airport performs its role at the time of a disaster. In our study, we will pay attention to the roles of airports changing over time, as well as risk elements, vulnerabilities, facility recoverability, and methods to achieve earlier availability of each airport.

We research the risk management of airports. Based on certain hypothetical situations, our study will pay attention to the assessment axes of results seriousness, frequency of occurrence and vulnerabilities, and to an overall evaluation of countermeasures.

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# Reliable ICT in an Emergency

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*(Keywords) disaster prevention/mitigation, ICT, ITS, information‐oriented construction, unmanned construction, CALS/EC*

## 1. Introduction

One year has passed since the Great East Japan Earthquake. During that time, investigations of rebuilding/rehabilitation and the state of damage have been vigorously carried out in many areas. As a result, details about the situation during the disaster have been revealed .

The earthquake and tsunami smashed the information and communication systems, creating an information vacuum. It is impossible to prevent and mitigate disasters without information and communication systems confirming to various proposals from related institutions. Dr. Toshitaka KATADA, a professor at Gunma University, refers to three major rules for surviving catastrophes: “Do not be shackled with assumptions, do your best, and try to be the first person to run”. Information and communication technology (ICT) plays important roles in this regard.

## 2. ITS (Intelligent Transport Systems)

The information in “Traffic Availability and Suspension Information” proved useful at the initial stage of the Great East Japan Earthquake. This information consists of probe data (travel records) and traffic suspension information from road administrators, which is available on the internet. It attracted great attention at international conferences on ITS. It helped people take first action in the midst of widespread disruptions and information shortages in the earliest stages of the disaster. Large amounts of probe data have been collected by ITS Spots (Road Side Units): ITS spot services have just started nationwide in August 2011, and it was hoped that probe data would be utilized as “bond links”, as it were, by combining their capabilities to help people in an emergency.

Because people are now accustomed to using Twitter, Facebook and other social networking services, they served as effective platforms for people to contact each other and to undertake rescue operations even though ordinary telephone call communication was shut down. People also made good use of Google Person Finder[1] (whereabouts information) whose capabilities were enhanced by combining it with digital mapping information.

It is also necessary that “Road Stations” (rest areas alongside roads) be renewed as recovery bases during disasters. For instance, Takehara(Hiroshima Pref.) Road Station was allocated as a recovery base. A stand-alone power generation facility and a water receiving tank have been installed at this station.

“Connected” has become a keyword of the ITS world recently, especially in an emergency. For example, V2I stands for vehicle to infrastructure communications and several abbreviations’, such as V2V, V2H or V2G, are used to represent the idea of

[1] Google person finder helps people reconnect with friends and loved ones in the aftermath of natural and humanitarian disasters

two-way connections (H: Home, G: Grid of electricity). The ITS world is going into a new phase: vehicles, houses and the smart grid are all connected by means of IT technologies to deal with energy issues as well as traffic issues. There is also a Japanese version of the global navigation satellite system project centered on launching the quasi-zenith satellite in an attempt to link up with space infrastructure.

ITS initiatives have been considered as vehicle-oriented policies to some extent. The new ITS services for cyclists and pedestrians should be considered to deal with the problem of the difficulty people face in returning home from their offices in an emergency. To make that happen, it is also essential to use personal probe data more efficiently. This directly reveals people's movements obtained by mobile phones or transportation IC cards such as SUICA, PASMO or ICOCA to enhance emergency support measures.

### 3. Unmanned Construction (Construction Robots)

Although Japan has the world's highest level of robot manufacturing technology, how useful the robots are is still controversial. The practical usability of robots has not been as efficient as expected, considering the situation at Fukushima Daiichi Nuclear Power Plant, which was damaged by the earthquake.

Unmanned automation technology has been introduced to construction sites, especially in emergencies where it can manipulate robot-like machines. It is particularly advantageous to make use of these devices under the harsh conditions where a secondary disaster is highly likely to follow an initial disaster. Unmanned vehicles were initially remote-controlled using wired communication (amphibious bulldozers applied to the Joganjigawa River disaster, 1969). These unmanned construction technologies were developed for use in the reconstruction after the eruptions of Mt.Unzen by combining wireless technologies and imaging equipment.

The development of robots could easily be abandoned because research work tends to be isolated due to uncertainty that it will ever be practically applied. Fortunately, construction sites are real, not virtual. Thanks to this environment, when they are needed, they will be used because people in the field are continually involved in encouraging the technology by promoting R&D, building equipment maintenance systems and educating operators.

A few issues remain to be tackled. These include the fact that the range of their operation is limited., And electrical wave interference, work inefficiency and construction accuracy (finished work quality) under the effects of problematic radio wave environments also remain to be dealt with. Manipulation from a more remote place will be necessary when it is necessary to deal with radiation. Also the market is not large enough for every private entity to make profits even if there are real sites in place. Therefore we need to find a way to build a system which enables us to maintain long-term operations by taking measures such as applying the technology to a wider range of situations.

### 4. CALS/EC

Reconstruction should be executed quickly and public works should play the major role. CALS/EC[2] is a system intended to drive productivity by converting information created by each process, survey, designing, work executions and maintenance management of public works, into electronic data, and by sharing the information using communication

[2] Continuous Acquisition and Life-cycle Support /Electronic Commerce

networks. This system must be used to speed up the process of reconstructions.

Data distributions related to electronic bidding and electronic delivery are successfully progressing in terms of the data distribution speed. On the other hand, the data stream for designing and work executions are not. The introduction of BIM (Building Information Modeling) has been in progress in the building construction world. The purpose of BIM is to enhance productivity by leveraging building information models which consist of three dimensional building models built on computers and combined attribute data including specifications/performance of materials/components or cost information at each stage: construction designing, work executions and maintenance management.

Civil engineers have been utilizing three-dimensional design data necessary to recognize finished work quality control (earthwork) by Total Stations and the machine control of motor graders. Electronic data conversion is important because it enables us to facilitate linkage with information‐oriented construction and unmanned construction. Electronic data conversion also strengthens risk management by enabling us to get quick access to backup data. A disaster could damage a lot of precious paper information such as plans of buildings which are required to manage rebuilding or rehabilitation. Therefore performing electronic data conversion and backups could support BCP (Business Continuity Planning) by using cloud computing.

At the same time, it is also important that, by valuing speed up conscious perception, we make practical efforts by beginning with what is possible while keeping in mind the ideal construction flow process CALS/EC. This will help diffuse CALS/EC throughout local municipalities resulting in them putting it into full use in the case of an emergency.

## 5. Conclusion

"Only providing precise, prompt and detailed information would be not enough to promote evacuation actions. In addition, it is reported that too much enhanced functionality of evacuation information was found only to deter evacuating actions ("Tsunami Disaster" by Yoshiaki Kawada, Iwanami Paperbacks (in Japanese)). "Information and communication technology" may be imagined as "highly state-of-the-art technology". ICT issues are usually discussed only from a technology standpoint rather than from a user standpoint. We must not forget that it is humans who use either information or communication technology. We are now determined to squarely meet requirements by various people and regions in the society to actually implement the PDCA cycle.

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# To reduce damage caused by natural disasters

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*(Key words) Natural Disaster, reduce damages, monitoring/warning/forecast, evacuation on warning*

**1. Frequent natural disasters**

Looking back on natural disasters that occurred in 2011, Shin-moe-dake of the Kirishima mountains started full-scale volcanic activity on January 26 for the first time in about 300 years; and on March 11, a gigantic earthquake of magnitude 9.0, the biggest ever observed in Japan, hit the Pacific Ocean side of Tohoku region followed by a huge tsunami causing devastating and enormous human and material damage and seriously affecting social and economic activities in broad areas centered on the Pacific coast. Turning to disasters caused by heavy rain, Typhoon No. 6 in July caused continuous heavy rain amounting to 1,000 mm in the Naharigawa River area in Kochi Prefecture, triggering a debris-flow caused by a deep landslide in Kitagawa village, and caused damage to national roads and power plant facilities. Heavy rain in Niigata and Fukushima prefectures, also in July, recorded continuous rainfall of 600 mm and more, causing more than 250 sediment-related disasters. Furthermore, Typhoon No. 12, which hit Japan in September, brought record rainfall over broad areas centered on mountainous areas from western to northern parts of Japan, especially in the Kii Peninsula, where continuous rainfall exceeding 2,000 mm caused many deep landslides and approximately 200 sediment-related disasters including 17 landslide dams. Judging from aerial and satellite photographs taken after the typhoon, it is estimated that the landslides had a volume of approximately 100 million $m^3$. The heavy rainfall disaster turned out to be the most serious of all heavy rain disasters since Word War II.

Approximately 70% of the Japanese land is mountainous or hilly. Its topography is mostly steep, with the geological formation being weak; moreover, there are a large number of active volcanoes, and earthquakes frequently occur. Besides, we have explained that Japan has a high risk of natural disasters because it rains heavily beginning with the seasonal rain front and when typhoons approach or make landfall in Japan. Along with the increase of intensive rainfall in a short period of time due to climate change, recently frequent large-scale earthquakes and volcanic activities including the Great East Japan Earthquake and the eruption of Shin-moe-dake of the Kirishima mountains have occurred At the same time, regional disaster-preventive strength has weakened due to the advance of the aging society and depopulation of mountainous areas, plus natural/social changes including financial restrictions. For these reasons, we can say that 2011 was a year when we strongly felt that the risk of disasters is increasing.

**2. Responding to low-frequency but large scale disasters**

Based on the Great East Japan Earthquake, the Council for Social Infrastructure Development (Shakai Shihon Seibi Shingi Kai) and the Transportation System Planning Section of the Council for Transportation Policies (Kotsu Seisaku Shingi Kai

Kotsu Taikei Bunka Kai Keikaku Bukai) summarized an urgent proposal “Concept of town development to prevent tsunami disasters” in July 2011. That proposal indicated that relatively frequent tsunami of a certain level and tsunami which occur at an extremely low frequency but cause large scale disasters are to be hypothesized as targets for disaster prevention measures based on structures, and that the concept that “measures to reduce damage caused by disasters (protect human lives and reduce damage as much as possible) are executed to achieve the aim of protecting human lives by all means in whatever disasters, the large scale Tsunami may cause.” The proposal also presents the fact that “disasters have no upper limit" as a lesson, and mentions that the most important goal of improving social infrastructure is “to protect the lives and daily life of people” and to consider disasters of all kinds without limiting them to measures against tsunamis; and to execute overall disaster prevention measures by resorting to all possible “hardware” and “soft” measures for reducing damage by low frequency but large scale natural disasters including big earthquakes, storms and flood damages/ sediment-related disasters caused by typhoons, in order to build up a strong foundation for the national land. Besides steadily improving disaster preventive facilities, it is becoming more and more necessary and important to improve capabilities to deal with situations caused by disasters and think of “soft” measures to support the evacuation of residents.

### 3. For the improvement of risk management organization

The following presents research and development which the Research Center for Disaster Management conducts in the midst of the increasing need for measures on the “soft” side - including the early grasp of the damage situation, and monitoring and warning systems for the purpose of reducing damage caused by natural disasters.

#### (1) Monitoring and alerting people to wide area and large scale natural disasters

In the event of a wide-area, large-scale natural disaster, it is essential to get the whole picture of the damage situation as soon as possible and to take initial responses in a proper manner. One example is the case of Typhoon No. 12 which hit Japan in September 2011. Concerning landslide dams which were formed in Nara and Wakayama prefectures, the team started investigating the damage situation on September 4, then on September 8, the team informed the affected local governments about predicted sediment-related disaster areas and the time they were expected in the form of sediment-related disaster warning information. Our team checks the formation of landslide dams, measures their shapes and performs flooding simulations in a very short time in order to have local governments issue evacuation warnings and instructions. The initial investigations when a disaster occurs are mainly investigations by helicopters or taking/analyzing photographs by aircrafts; but those investigations face challenges because night investigations are impossible or the investigations are impossible under bad weather conditions. As one method to permit investigations of the extent of damage even under bad conditions, we are developing an investigation technology that uses synthetic aperture radar (SAR), which is capable of observing disaster damage even during the night or under bad weather conditions, to monitor large scale landslides, landslide dams, flooded areas, and areas with concentrated damage to buildings and public infrastructure.

Furthermore, in order to grasp the occurrence of deep landslides as early as possible, we are developing a “Large scale landslide monitoring and warning system (tentative name)" which combines high precision rainfall monitoring by the above mentioned satellite

remote sensing technology and X Band MP radar, and seismometers to sense ground vibration that is generated when a landslide occurs, etc.

In addition, to reduce damage caused by flooding in small to medium size rivers caused by local intensive rainfall, consideration is being given to a "Monitoring and forecasting system against flood damage" which combines providing real time monitoring devices for an entire drainage basin, inundation inside the levee and inundation by river water; rainfall monitoring using X Band MP radar; and river water level forecast through a distributed rainfall-runoff model and so forth.

**(2) Technology for the immediate estimation of earthquake damage**

Inspections will be made of facilities under management immediately after the occurrence of a large scale earthquake, but it is predicted that it should take longer to grasp the whole picture of the damage in a case where an earthquake occurs at night or in a case where the damage is spread over broader areas and where the damage is severe. For example, after the Southern Hyogo Prefecture Earthquake or the Niigata Prefecture Chuetsu earthquake, it took 10 hours or longer to grasp the entire facility damage status, resulting in a period with an information blank. In order to realize quicker initial responses to disasters, we are now developing methods to estimate the distribution of seismic motion from strong motion earthquake records (seismic intensity, acceleration, SI value etc.) received from the network of seismometers immediately after the occurrence of an earthquake, and methods to estimate damages status to facilities under our own control such as river facilities or road facilities from seismic motion distribution.

**(3) In preparation for excess external force and complex natural disasters**

With the focus on natural disasters including earthquakes, heavy rainfall and volcanic activities, and especially complex natural disasters from excess external force, earthquake, flooding beyond our expectations which have not been well considered, we now review damage caused and the structure of the influence of such a disaster, construction methods for disaster scenarios, and disaster risk and impact evaluations etc.; and we are considering how risk management against excess external force **and** complex natural disasters should be done or how highly robust basic facilities for disaster prevention should be planned.

**4. Improvement of regional disaster-prevention capacity**

We have introduced initiatives from the perspectives of understanding damage status, and of collecting and analyzing disaster information. To reduce damage caused by large-scale natural disasters, communities and residents, who receive this disaster related information, need to properly understand this information and take adequate and efficient actions without losing time. For that purpose, it is necessary to improve the disaster prevention capacity of communities and residents through disaster preventive training, practical disaster preventive drills, passing on the disaster preventive culture to later generations and so forth. For the future, we would like to work on further deepening our considerations about improving area disaster preventive capacity and construct reliable warning and evacuation systems.

**[Reference]**

1) [Concept of town development to prevent tsunami disasters] proposed urgently by Council for Social Infrastructure Development (Shakai Shihon Seibi Shingi Kai), Transportation System Planning Section in the Council for Transportation Policies (Kotsu Seisaku Shingi Kai Kotsu Taikei Bunka Kai Keikaku Bukai) in July 2011.

# Comprehensive Efforts after the Great East Japan Earthquake

## to Reduce Damage by a Comprehensive Interdisciplinary Approach

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*(Keywords) Large earthquake, reconstruction/recovery, interdisciplinary*

### 1. Introduction

On the same day as the Great East Japan Earthquake of March 11, 2011, the NILIM began to send staff to the disaster region to provide technological support by surveying the state of damage and cleanup work on site. Later, the head office and regional development bureaus of the Ministry of Land, Infrastructure, Transport and Tourism (hereafter "MLIT") provided technical support as needed at each stage, either on site or at study meetings, to draw up reconstruction and recovery plans or to prepare various countermeasures such as revising necessary technical standards. By January 27, 2012, the number of personnel, all experts in their respective disciplines, sent to the disaster region under TEC-FORCE had reached 142 (372 man-days), as shown in the table.

### 2. Past efforts

This section introduces the major activities for each phase which the NILIM has carried out.

(1) Immediately after the disaster

The NILIM provided technological guidance to help evaluate the serviceability and quickly restore various social infrastructures which are indispensable for saving lives and rebuilding them. Regarding roads, it provided technical guidance concerning serviceability evaluations and emergency inspections to support the clearing, inspection, and restoration of trunk roads. Concerning rivers and coasts, it provided technical guidance by surveying the state of damage and emergency restoration necessary before a flood discharge. Regarding ports and airports, experts on tsunami and various kinds of facilities surveyed the damage to key ports and to Sendai Airport. For sewage treatment systems, they surveyed the state of damage and provided technical guidance to ensure public hygiene in the event of sewage overflows, and guidance on how to respond urgently to the suspension of sewage treatment plants. In particular, to summarize emergency proposals until sewage treatment plants have recovered, the NILIM has provided technical support with emergency restoration methods and simple treatment methods. Regarding building construction, it has carried out a number of damage surveys, and regarding erosion control, it has given technical guidance on inspecting and evaluating the safety of steep slopes at risk of collapse and sediment disasters.

Table 1. Personnel sent to the region under TEC-FORCE

| Specialization | Total number of personnel dispatched |
|---|---|
| Sewers | 23 (64 man-days) |
| Rivers | 5 (15 man-days) |
| Shoreline | 8 (21 man-days) |
| Bridges | 14 (41 man-days) |
| Dams | 3 (8 man-days) |
| Road disaster prevention | 2 (6 man-days) |
| Building structures | 38 (99 man-days) |
| Building fire prevention | 6 (17 man-days) |
| Airports | 3 (16 man-days) |
| Ports and harbors | 15 (44 man-days) |
| Erosion control | 17 (25 man-days) |
| Earthquake disaster prevention | 8 (16 man-days) |
| Total | 142 (372 man-days) |

* Total of 84 (252 man-days) sent during the month immediately after the disaster

(2) Major past efforts

After emergency activities of this kind, the NILIM and the bureaus of the MLIT jointly examined the damage and its causes, then based on the results, verified the suitability of present technical standards etc. and considered measures to restore facilities.

Typical activities include verifying serious damage caused by the tsunami along the coast, and identifying the scale of the tsunami at coastal locations, then based on the results, conducting joint studies with researchers in various related fields to prepare a handbook on simulating tsunami inundation. To encourage use of this handbook to help prepare restoration countermeasures, the NILIM set up a contact section for consultation by cities, towns, and villages. The results have also helped to set design tsunami levels for coastal dikes, which are essential for restoration and recovery (in cooperation with the Ministry of Agriculture, Fisheries and Forestry, July 11). Studies on methods of designing structures in other fields are also being conducted in line with the concept of setting design tsunami levels. Regarding building construction for example, the Building Structure Standards Committee formed by the NILIM

has studied “Countermeasures to Ensure Safety based on Damage to Buildings, etc.” and has clarified the external forces required to study the structure of tsunami evacuation buildings by, for example, finding out how a tsunami forms a swell-head upon encountering a building. Standards for improving non-structural members and measures to handle long-cycle earthquake motion are also being studied.

In addition to tsunami damage, this earthquake caused liquefaction resulting in widespread damage. On reclaimed land in the Kanto region, along Tokyo Bay and in the interior, all far from the hypocenter, the earthquake caused severe damage to ordinary homes and other buildings. Meanwhile, public infrastructure such as water mains, sewer pipes, and other lifelines was severely damaged as well as structures, and river levees settled and were breached. The NILIM studied common technical matters for combating liquefaction at meetings with various experts, and helped them distribute the findings of their surveys. The results showed that the FL method, which has long been used for judging liquefaction, can generally judge the occurrence of liquefaction caused by an ocean trench earthquake. Earthquake records obtained during this recent earthquake will be used to study and verify dynamic analysis methods for ground, improve the precision of estimating ground deformation, and help rationalize liquefaction countermeasures. All these issues must be considered when conducting reviews in each field in future.

To study tsunami and liquefaction countermeasures and design concepts, the NILIM will use its strengths as a comprehensive research institute to collect documents and exchange information on countermeasures in related fields, methods of setting the external force of tsunami, etc.

Technical standards for structures which are revised or scheduled to be revised reflecting the results of research by the NILIM include, in addition to the above standards, the Specifications for Highway Bridges and the Guideline to Earthquake Resistance Countermeasures for Sewage System Facilities.

New efforts are also needed. Radioactive substances dispersed by the accident at the Fukushima Daiichi Nuclear Power plant have severely affected many sewage treatment systems, particularly in the Tohoku and Kanto regions. The NILIM is surveying the behavior of radioactive substances in sewage treatment processes, and studying the safe handling of sewage sludge containing radioactive substances.

For information about research in each field and their incorporation in major standards, please refer to reports on research trends and achievements in each field related to the Great East Japan Earthquake in later sections.

**3. Conclusion**

One challenge revealed by the earthquake is, as pointed out by the Central Disaster Prevention Council, the need to conduct nationwide studies of the largest earthquakes and tsunami which occur once every 1,000 years, and to revise preparations for nationwide disasters including West Japan, by for example, forming a Cabinet-level committee to study models of massive earthquakes of the Nankai Trough. The NILIM, to improve crisis management research to prepare for huge external forces and multiple natural disasters, must work on: 1) analyzing historical cases, 2) revising methods of building disaster scenarios, 3) examine robust “hard” (structural) countermeasures, and 4) study the combination of both “hard” and “soft” countermeasures to mitigate disasters, by holding seminars and forming working groups, etc. within the NILIM. As a comprehensive research body that supports the technological policies of the MLIT, the NILIM will not only provide technical support for restoration of the affected regions, but will also support integrated crisis management countermeasures including both “hard” and “soft” measures throughout Japan.

# Providing information to the Port and Harbor Subcommittee of the Transport Policy Council

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*(Key words) Great East Japan Earthquake, Council/Study Committee, damage to ports, breakwater, seawall, parapet*

## 1. Introduction

Data representing damage to ports and harbors by the Great East Japan Earthquake was organized and the information was provided for use in deliberations by a Council and a Study Committee established by the Ministry of Land, Infrastructure, Transport and Tourism.

## 2. Disaster Prevention Section of the Port and Harbor Subcommittee of the Council for Transport Policy

The Division provided information, mainly an outline of port and harbor damage and damage mechanisms, to the Disaster Prevention Section of the Port and Harbor Subcommittee of the Council for Transport Policy, and participated in a general detailed examination at the interim report compilation[1] stage.

Photo 1. View of Damage to a Seawall (by the Backwash)

Taking damage to seawalls (and other shoreline protection structures) as an example, it provided photos taken during field surveys, hypothesized damage mechanisms, and presented problems with stability during backwash and the severe impact of scouring by the flow during overflow and return flow.

For breakwaters, it proposed presentations based on photos captured from videos, permitting the presentation of the state of functions of a breakwater when the first wave stuck.

It also proposed concepts and study directions for "tough structures".

## 3. The Study Committee for Tsunami Countermeasures for Coastlines

The Study Committee for Tsunami Countermeasures for Coastlines organized information about damage to breast walls at the same time as it pointed out the importance of countermeasures for stability, scouring, and suction during backwash, and of drainage measures as future study challenges, and reflected these in the Study Committee's report[2].

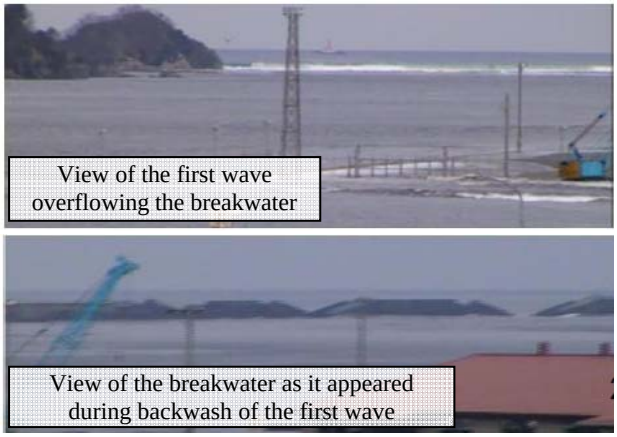


Photo 2. Presentation Using Photos Captured from a Video

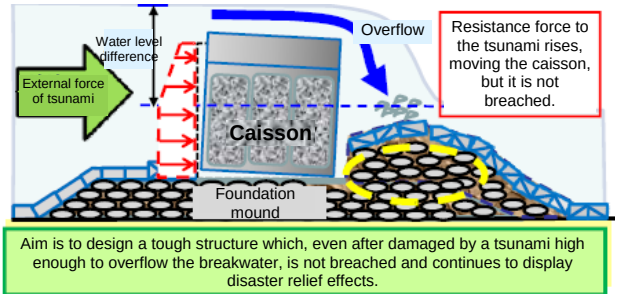


Figure 1. Image of a Tough Structure

[Reference]
1) Necessary comprehensive tsunami measures for ports and harbors (interim report), July 6, 2011, Disaster Prevention Section of the Port and Harbor Subcommittee of the Council for Transport Policy
2) Basic concepts of restoration of coastal dikes etc. damaged by the Great East Japan Earthquake and Tsunami of 2011, November 16, 2011, Study Committee for Tsunami Countermeasures for Coastlines

# Technical study of the creation of communities resistant to tsunami disasters

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*(Key Words) tsunami, swell head, tsunami inundation assumption, tsunami protection facility*

**1. Outline**

Past tsunami countermeasures have been focused primarily on structures such as coastal dikes hypothesizing a tsunami level of constant frequency, but in reaction to the tsunami produced by the Great East Japan Earthquake, the Ministry of Land, Infrastructure, Transport and Tourism has studied and legally prescribed the creation of communities resistant to tsunami disasters. The creation of communities resistant to tsunami disasters is established to protect human lives even when the largest class of tsunami strikes by, based on the inundation assumption and under the concept of "multifaceted protective mechanisms" which, combine structural and non-structural countermeasures, comprehensively promoting the provision of tsunami protection facilities, the restriction of development activities, and the construction of warning and evacuation systems. Among these, methods of evaluating the swell head of tsunami on the front surface of a building etc. serving an as evacuation site, technical standards for filling and cutting of the ground during development activities in districts which might be inundated, and technical standards for tsunami protection facilities were studied.

**2. Methods of evaluating the swell head of tsunami**

When a prefectural governor designates a tsunami disaster caution district or a tsunami disaster special caution district, the government publicly announces a standard water level (inundation depth considering swell head). The mayors of cities, towns, or villages can apply this standard water level to designated objects complying with a fixed standard within the tsunami disaster caution district as designated evacuation facilities. And one essential condition for authorization of a social welfare facility, school, or medical treatment facility etc. (below called a, "designated development activity") in a tsunami disaster special caution district is that the heights of the floors of habitable rooms be equal to or higher than the standard water level.

The standard water level adopted is the maximum value of the specific energy of each calculation mesh obtained by a tsunami inundation simulation performed to hypothesize a tsunami inundation. Its suitability has been confirmed by a tsunami inundation simulation including a hypothetical arrangement of buildings and by a verification using the trace height of past tsunamis.

**3. Technical standards for filling and cutting**

A study is done of a technical standard which ensures that a precipice formed by filling and cutting executed as part of a designated development activity is safe against a tsunami which has run up.

・A precipice which is not covered with a retaining wall shall be protected by sodding instead of sprayed mortar based on the result of using a tsunami inundation simulation to calculate the depth of erosion of the cliff surface based on the flow regime of the tsunami.

・Stability against scouring of the toe of the slope of the precipice shall be analyzed based on circular slip while considering the maximum scouring depth hypothesized, and based on the results, protective work shall be installed or a fill and cut setback shall be formed premised on scouring.

・It is presumed that the overflow of the tsunami will erode the top edge of the precipice, so countermeasures are taken using regulations for the crest work of the low water revetment of the river.

**4. Technical standards for tsunami protection facilities**

Tsunami protection facilities, which are intended to save the lives of people from the largest class of tsunami, include embanked structures, revetments, levee walls, or lock gate, which have functions to prevent inundation by tsunami of the background urban district on dry land. Under the technical standards, after the target achievement performance and safety performance of a tsunami protection facility have been decided, the conditions and the methods which should be considered to verify these shall be organized.

[Reference]
Materials of the technical committee for creation of communities resistant to tsunami disasters.
http://www.mlit.go.jp/river/shinngikai_blog/tsunamibousaitiiki/index.html

# Analysis of damage to coastal dikes by tsunami

—Damage analysis to discover the direction of future countermeasures—

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*(Key words) Tsunami, coastal protection facility, disaster*

## 1. Outline

In response to the damage by the Great East Japan Earthquake, the Central Disaster Management Council compiled an interim report on 26th June, 2012 and mentioned the principles, "With regard to coastal protection facilities, it is also essential that progress be made in the promotion of technical developments for, and installment of structures that will rigorously withstand tsunamis that are higher than those for which they were designed"[1]. We studied structures to ensure the toughness of facilities against tsunami by dividing the coastline from Aomori Prefecture to Chiba Prefecture into about 1,400 sections according to the facility structure, then analyzing the relationship of the state of damage, the structure specifications (landward slope gradient, toe of landward slope covered/not covered, etc.), and tsunami heights to hypothesize the facilities' damage mechanisms. As one example, directions in preventing scouring by covering the toes of landward slopes of coastal dikes with three surface-armoring are showed here.

## 2. Relationship of tsunami overflow depth with state of damage

Figure 1 shows the relationship of tsunami overflow depth with damaged length rate (percentage of total facility length which is damaged) in 118 sections of coastline dikes with three surface–armoring. There were cases where 100% of the dikes were totally destroyed at an overflow depth of about 3m, while in other cases, even at overflow depth over 10m, the damage length rate was 0%, revealing that even under the same tsunami height, the state of damage differed greatly according to section (bottom part of Fig. 1). This could be caused by diverse on-site conditions or facility structures, and it means that a structure which has been effective on one coastline might not be effective on another coastline. It will be necessary to collect as many cases as possible, and clarify the variation in the data, to carefully study ways of handling the data according purpose of use. To scientifically discuss differences in the state of damage, the average values which also consider differences in the length of each coastline (top of Fig. 1) are also important, but in order to protect human lives at all cost, it is necessary to assess safety of structures more strictly than the envelope curve shown in the bottom of Figure 1.

## 3. Differences in state of damage according to whether or not the toe of the landward slope is covered

Regarding the relationship of covering/ non-covering of the toe of landward slopes with the total destruction length rate, the results of totaling data for each section by overflow depth from less than 2m to 4m etc. reveal that within an overflow depth range from 2 to 6m, the damaged length rate was lower when the toe of the landward slope was covered (top of Fig 1). It is necessary to conduct experiments to clarify why there were no differences at and above an overflow depth of 6m.

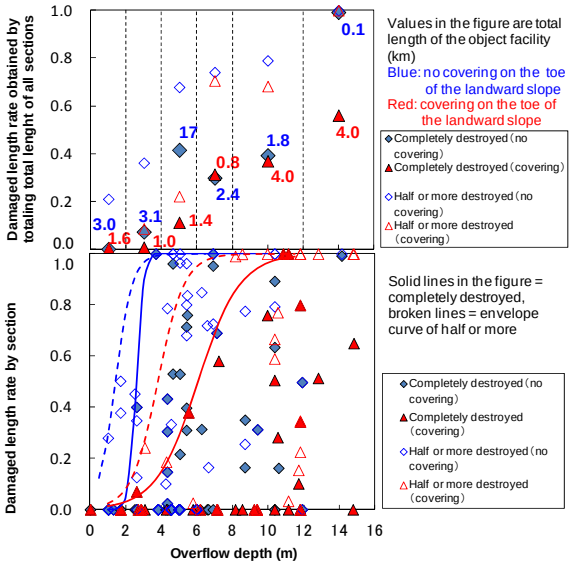


Figure 1. Differences in State of Damage of Coastal Dikes with Three Armored Surfaces With/Without Covering on Toe of the landward Slope

[Reference]

1) Report of the Committee for Technical Investigation on Countermeasures for Earthquakes and Tsunamis Based on the Lessons Learned from the "2011 off the Pacific coast of Tohoku Earthquake" http://www.bousai.go.jp/jishin/chubou/higashinihon/Report.pdf

# Study of earthquake and tsunami countermeasure technologies to prevent sewage treatment system damage

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*(Key words) Great East Japan Earthquake, sewage facility, liquefaction, tsunami*

## 1. Outline of damage to sewage systems by the Great East Japan Earthquake

The Great East Japan Earthquake severely damaged many sewage facilities extending from the Tohoku region to the Kanto Region. In particular, treatment plants and pumping stations along the Pacific Coast were severely damaged by tsunami, and along the shore of Tokyo Bay and in the downstream region of the Tone River in the Kanto, liquefaction throughout the region obstructed the sewage conveyance functions of sewage pipeline facilities (Fig. 1).

Figure 1. View of Damaged Sewage Facilities

## 2. Questionnaire survey

The National Institute for Land and Infrastructure Management carried out a questionnaire survey of local governments in the damaged region (effective response rate: 69%) in order to clarify the causes of damage to sewage treatment plants and sewage pipeline facilities caused by the Great East Japan Earthquake. Figure 2 shows the percentages of damage by cause to individual facilities (categorized as 23 facilities) in sewage treatment plants and to pipeline facilities.

Among sewage treatment plants, 54% were damaged by the tsunami, followed by 41% by the earthquake motion, and 4% by liquefaction. Of the damaged pipes, 90% were damaged by liquefaction, and most of these, at 66%, were damaged by liquefaction of the pipe backfill, which has been a problem since the Niigata Chuetsu Earthquake. And unlike past earthquakes, liquefaction of surrounding ground caused 25% of the damage.

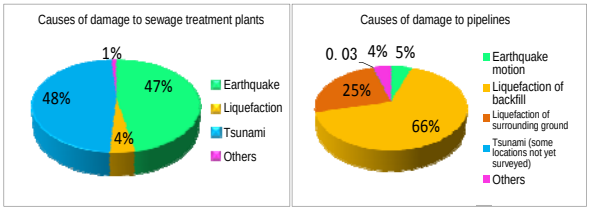


Figure 2. Causes of Damage to Sewage Facilities

## 3. Problems at sewage facilities caused by the Great East Japan Earthquake

Sewage treatment plants in cities along the coastline are natural flow type which must discharge their water into public bodies of water, so the treatment plants are inevitably constructed relatively close to the ocean. Therefore, this tsunami caused extensive damage: the destruction of building structures by its powerful wave force and damage to electrical and mechanical by submersion. But present aseismic design guidelines do not mention tsunami countermeasures, so concepts of sewage facility design considering tsunami-resistance countermeasures based on an early clarification of the state of damage will be compiled and released in the future. And among sewage pipelines, many without earthquake resistance countermeasures were damaged, including those where liquefaction of the surrounding ground caused soil to flow in from the lateral pipes so that the pipes were plugged with soil, obstructing their sewage conveyance function, although the damage to the pipes themselves was minor. Therefore, it is expected that aseismic design guidelines will be expanded in order to deal with damaged backfill by encouraging conventional liquefaction countermeasures, and for facilities damaged by liquefaction of the surrounding ground, liquefaction countermeasures will be taken on lateral pipes, which have not been the object of past measures.

## 4. Utilizing the results

Concepts of sewage facility design considering tsunami-resistance countermeasures and concepts of the expansion of liquefaction countermeasures will be

announced by the Sewage System Earthquake/ Tsunami Countermeasure Technology Study Committee, and later will be reflected in aseismic countermeasure guidelines based on a study by the Sewage Facility Aseismic Countermeasure Guideline Revision Committee.

[Reference]
Fifth Report by the Sewage System Earthquake/Tsunami Countermeasure Technology Study Committee

# Initiatives to prepare proposed building construction related technical standards

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*(Key words) Building construction, technical standards*

## 1. Background

The Building Standard Law stipulates minimum standards to ensure the safety of buildings and prescribes many technical standards concerning all building construction related fields such as structures or fire protection. And in addition to the Building Standard Law, there are other laws such as the Tsunami Disaster Protection Region Establishment Law enacted last year which also stipulate building construction related technical standards.

These building construction related technical standards must be revised as necessary according to progress in survey research and technology development and to disasters trends. Building Standard Provision Promotion Projects have been conducted as projects subsidized by the Ministry of Land, Infrastructure, Transport and Tourism as a way to promote related survey research, and as a system to carry out standardization based on its achievements, the National Institute for Land and Infrastructure Management (below, "NILIM") has operated a system including outside experts since 2011.

## 2. Building Structure Standards Committee

To achieve the above goals, the Building Structure Standards Committee (Chairman: Professor Kubo Tetsuo, University of Tokyo) was established at the NILIM as an organization to reflect the view of outside experts in technical standards proposals prepared by the Building Department.

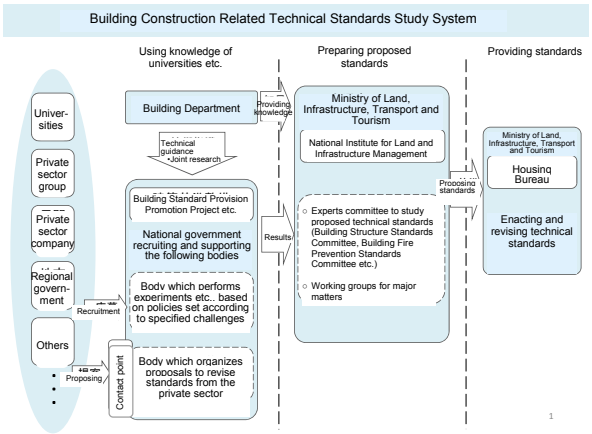
Since the Great East Japan Earthquake of March 11, the building structure field has had to respond quickly to its damage, so this committee was established on April 12, and carried out field surveys of the disaster region on April 21 and 22. Based on this, the committee met for the first time on June 8 to confirm the early reports on surveys of the damage and discuss immediate challenges. It met for the second time in August, when it energetically carried out a study, then at its third meeting in October, it presented and approved the proposal, Provisional Guideline to Structural Conditions Essential for Tsunami Evacuation Buildings Etc. in Response to the Great East Japan Earthquake. Later a notification (Kokujushi No. 2570 of November 17, 2011) was issued by the Housing Bureau, and its contents were reflected in technical standards under the Tsunami Disaster Protection Region Establishment Law.

The committee found extensive damage such as fallen ceilings in large spaces, so it is studying related technical standards.

## 3. Future plans

In 2011, a standards revision system was operated centered on responses to earthquake disaster damage, but in the future, the revision of technical standards will also be studied in response to the progress of survey research.

In February 2012, the National Institute for Land and Infrastructure Management conducted large-scale fire tests in a wooden three-story school building, and in the future it will establish a committee concerning fire prevention and evacuation in order to study the revision of technical standards related to fire prevention based on the tests.



Topics

# Responding to damage to sewage systems caused by the Great East Japan Earthquake

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*(Key words) Great East Japan Earthquake, sewage facility, sewage treatment plant, Sewage System Earthquake/Tsunami Countermeasure Technology Study Committee*

## 1. Damage to sewage facilities by the Great East Japan Earthquake

At treatment plants along the coastline of Tohoku and Kanto, in addition to devastating damage by tsunami, 120 sewage treatment plants and 119 pumping stations were damaged, with their functions either obstructed or shut down. And damage to pipeline facilities caused mainly by liquefaction included damage to 642 kilometers of pipelines in 132 cities, towns, and villages, resulting in obstruction of the provision of continuous sewage services as, for example, use was restricted for about one month.

## 2. Response to damaged sewage facilities

The Great East Japan Earthquake caused damage exceeding the anticipated range of damage under the rules stipulating mutual support between regional governments during a disaster, so the Ministry of Land, Infrastructure, Transport and Tourism undertook the task of coordinating their efforts.

The Sewage Facility Damage Restoration Headquarters was set up in the Tohoku Regional Development Bureau in order to guide response measures, and handle liaison and coordination with concerned organizations, with countermeasures to prevent the discharge of untreated sewage and to prevent it from inundating cities as the top priority challenge. The NILIM dispatched personnel to the region as TEC-FORCE on the day following the disaster to start up the Restoration Headquarters, then for about one month, sent a total of 14 people to give technological guidance.

## 3. Sewage System Earthquake/Tsunami Countermeasure Technology Study Committee

To perform appropriate emergency restoration of sewage facilities damaged by the Great East Japan Earthquake and final restoration to prevent the recurrence of damage, the Japan Sewage Works Association and the Ministry of Land, Infrastructure, Transport and Tourism established the *Sewage* System Earthquake/Tsunami Countermeasure Technology Study Committee, a group of academic experts, on April 12, about 1 month after the disaster. In response to technical problems with the emergency response, emergency restoration, and final restoration, technical proposals and appropriate restoration methods were sequentially compiled and released. The NILIM, acting as the committee secretariat, analyzed causes of damage and carried out technical studies of restoration measures. In the disaster region, final restoration is being carried out based on these proposals.

[Reference]
Press Release issued by the Sewerage and Wastewater Management Department of the Ministry of Land, Infrastructure, Transport and Tourism: Sewage Facility Related Damage, Emergency Restoration and State of Initiatives.

Topics

# The behavior of radioactive materials in municipal wastewater treatment plants and the countermeasures

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*(keywords) The Great East Japan Earthquake, Radioactive material, Wastewater treatment plant*

Since the Great East Japan Earthquake, the Fukushima Dai-ichi nuclear power plant has emitted radioactive particles on the second largest scale in history. The radioactive fallout has flowed into and accumulated in many wastewater treatment plants (WWTPs) via sewer systems, negatively impacting many WWTPs in eastern Japan. Consequently, the concentrated radioactive material has been detected in sewage sludge. Usually, in Japan, approximately 80% of treated sewage sludge can be utilized (e.g. construction material and land application), while the remaining 20% must be disposed of at landfill sites. However, this radioactive contaminated sludge can neither be recycled nor disposed of. Therefore, as of March 2012, approximately 100,000 tons of sludge has been temporarily stored at WWTPs in 12 prefectures.

We investigated the behavior of radioactive materials in WWTPs and addressed methods for safely handling contaminated sludge. High levels of radiation were detected in influent wastewater after rain. Additionally, measurements indicate that a large amount of radioactive material accumulates in aeration tanks and more than 90% of the radioactive material is trapped in the concentrated sludge during the sludge condensation process. Moreover, we proposed specific safe handling, storage, and compaction methods for contaminated sludge in the "Committee to review countermeasures on radioactive material pollution in the sewage system" (MLIT). In the near future, urgent solutions for disposal and recycling of increasing amounts of indisposable radioactive sludge must be proposed and implemented.

[Reference]

Interim guidelines, Committee to review countermeasures on radioactive material pollution in the sewage system. (2011), *In Japanese*.
http://www.mlit.go.jp/common/000183742.pdf

Topics

# Report on a survey of damage to river levees caused by tsunami triggered by the Great East Japan Earthquake

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*(Key words) Tsunami runup, levee erosion, overtopping*

## 1. Introduction

In response to this tsunami damage, the Emergency Proposal of Countermeasures for River Runup of a Tsunami (River Tsunami Countermeasure Study Committee, August 2011) was compiled, organizing the handling of tsunami external force in river management and concept of levee height in facility planning. At the end of October 2011, the Law For the Creation of Tsunami Disaster Prevention Regions was approved by the Cabinet, and plans for the protection of regions from tsunami were enacted based on hypothetical inundation regions. In response to these events, it is necessary for river levees to also fulfill their stipulated functions as levee systems linked to coastline levees, but to achieve this, it is necessary to consider the fact that river levees are, structurally, extremely susceptible to damage by overtopping. For example, when exposed to action of a tsunami a little larger than the tsunami hypothesized for facility planning, it is predicted that temporary overtopping will occur even in river levee sections, so it is important to understand levee behavior in this event. Based on this point, the division looked back at the results of a survey of the state of damage along the Kitakami River, Abukuma River, etc., performed immediately after the earthquake to reorganize the characteristics of river levee damage caused by a tsunami.

## 2. Characteristics of damage to river levees by tsunami

In addition to the results of the on-site survey, traces of the tsunami runup, aerial photographs, and video and other types of data obtained by the Tohoku Regional Development Bureau and the Geospatial Information Authority were used to organize the water level and direction of flow of tsunami runup, and at the same time, link these different types of information to organize the form of and degree of damage to levees etc. The findings are described below.

[1] The second most severe form of damage after the breaching of levees is erosion of slopes on the protected side of levees caused by overtopping. Erosion of the slopes on the river side by the flow of the tsunami runup in the river course generally did not cause damage to the levee sections which appears very serious.

[2] One reason why levees were not breached by overtopping estimated to have exceeded about 1m is presumed to be the effects of a water cushion that restricted erosion of the toe and the slope of the levee.

[3] The flow on the front slope surface which occurred during tsunami runoff was of short duration, even though its flow rate was high, so in some cases, slope erosion is restricted by vegetation.

Judging from the above, erosion of the levee body caused by the flow of the tsunami as it ran up and flowed back downstream inside the river course, was generally smaller than that caused by overtopping, reconfirming that levees are susceptible to damage by overtopping. It was assumed that for levees laid out parallel to the direction of the runup of the tsunami, it is vital to consider not only the overtopping depth, but the water level difference between the river side and protected side of the levee and the duration of this difference, which are related to the scale of the effects of the water cushion.

## 3. Conclusions

The estimation was made by combining the results of the on-site survey with information which could be used until now. To increase the certainty of the results of the estimation and clarify the response of the river levees during overtopping based on differences between their structures etc., aerial measurement data obtained before and after the earthquake will be used to clarify the actual state of deformation of river levees in greater detail.。

[Reference]
Early report on the survey of damage to civil engineering structures by the Great East Japan Earthquake of 2011, Technical Note of the NILIM, No.645, pp. 243-341, July 2011.

Topics

# Method of setting design tsunami water level and guidelines on tsunami inundation simulations

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*(Key Words) Design tsunami, coastal dike, tsunami inundation simulation*

**1. Outline**

Under the interim report of the Committee for Technical Investigation of Countermeasures for Earthquakes and Tsunamis Based on lessons learned from the 2011 off the Pacific Coast of Tohoku Earthquake of the Central Disaster Management Council (June 26, 2011), the provision of coastal protection facilities to deal with a constant tsunami height which occurs relatively frequently will continue, and, by hypothesizing the top class tsunami, comprehensive countermeasures including all feasible methods, both structural and non-structural, will be taken. Regarding the former, ministries related to coastal protection has enacted a method of setting the water level for the design tsunami of coastal dikes. Regarding the latter, the Coast Division has, cooperatively with the Sea Coast Office of the Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism, prepared the guidelines on tsunami inundation simulations for tsunami countermeasures based on the 2011 off the Pacific Coast of Tohoku Earthquake. Prefectures were informed of both on July 8, 2011.

**2. Method of setting design tsunami water level**

The design tsunami, which is needed to provide coastal conservation facilities such as coastal dikes, is basically set for each region's coastline (dividing a coastal region into coherent coastlines considering natural conditions such as the shapes of bays, the distribution of coastal cliffs, etc.).

The water level of the design tsunami is set by the following procedure.

- The actual heights of past tsunami are organized.
- When it is not possible to obtain adequate data concerning actual tsunami heights, the tsunami height is calculated by a simulation.
- A graph is prepared plotting the year of the tsunami on the axis of abscissas and the tsunami height along the coastline on the axis of ordinates. The aggregation of tsunami hypothesized to arrive at a frequency of once in a few decades up to between 100 and 200 years is selected as the object tsunami group for the design tsunami water level setting.
- By performing a simulation of tsunami in the object tsunami group on the condition that tsunami intrusion is prevented at the locations of dikes on the region's coastline, the tsunami water level distribution along the region's coastline is calculated to set the water level of the design tsunami.

**3. Guidelines on tsunami inundation simulations**

The guidelines present a standard method of performing fast and suitable tsunami inundation simulations in order to support the enactment of reconstruction and recovery plans for disaster regions.

The following are the major items in the guidelines.

- The object earthquake fault model is basically set by revising the optimum fault model from the perspective of tsunami (model verified as suitable over a wide area) so that it complies with the trace values along each region's coast.
- Topographical data are basically prepared based on high precision data obtained by a laser profiler after the Great East Japan Earthquake.
- A prediction simulation basically considers damage to structures caused by the earthquake motion and tsunami.
- In order to understand the run up of tsunami on the land, the plane distribution of maximum inundation depth etc. and the cross-shore distribution of the maximum water level on a typical section are output as the results of the simulation.

[Reference]

Guidelines on tsunami inundation simulations for tsunami countermeasures based on the 2011 off the Pacific Coast of Tohoku Earthquake.
http://www.nilim.go.jp/lab/bcg/kisya/journal/kisya110711.pdf

Topics

# Technical study of essential conditions for the structure of tsunami evacuation buildings

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**1. Background to the study**

The Great East Japan Earthquake of March 2011 caused tsunami to destroy or damage many buildings and took many valuable human lives, and in particular, we were reminded of the importance of ensuring structural capacity guaranteeing safety from tsunami for tsunami evacuation buildings and others where people temporarily seek refuge from tsunami.

In response, the Housing Bureau and the National Institute for Land and Infrastructure Management of the Ministry of Land, Infrastructure, Transport and Tourism performed an emergency study based on a field survey of design methods to provide buildings with structural capacity sufficient to withstand tsunami, and knowledge related to the rationalization of the existing tsunami evacuation building design method [1)] was compiled through discussions by the Committee on Building Structure Standards formed at the National Institute for Land and Infrastructure Management. Based on this, the requirement for hydrostatic pressure uniformly 3 times the inundation depth stipulated by the existing tsunami load setting, could be relaxed to hydrostatic pressure 2 times or 1.5 times the inundation depth considering location conditions, and provisions for a study of overturning by buoyancy, consideration of scouring in the design, and consideration of the impact of floating debris in the design were clearly stipulated. The results of the study were standardized as the notification, Enactment of a Construction Method Safe from a Hypothetical Tsunami when Setting Tsunami Inundation Hypothesis (MLIT Notification No. 1318 of 2011)) based on technical guidance released by the Housing Bureau (Supplementary Knowledge Concerning Design Methods for Buildings with Structural Capacity Ensuring Safety From Tsunami (Kokujushi No. 2570 of November 17, 2011[2)])) and the Law Concerning the Establishment of Tsunami Protection Districts.

**2. Future actions**

The Explanation of Essential Structural Conditions for Tsunami Evacuation Buildings, which presents cases of the design of tsunami evacuation buildings based on the explanation of design methods etc. for tsunami evacuation buildings and the said design method, are prepared and lecture meetings are being held in seven places nationwide from February 2012. We pray that the results of the study will contribute to the establishment of future tsunami disaster protection districts.

[Reference]

1) Cabinet office web site, disaster prevention information page: Guideline to Tsunami Evacuation Buildings Etc., June 2005. http://www.bousai.go.jp/oshirase/h17/tsunami_hinan.html
2) Ministry of Land, Infrastructure, Transport and Tourism web site, Press Releases: Supplementary Knowledge Concerning Design Methods for Buildings with Structural Capacity Ensuring Safety from Tsunami, November 2011. http://www.mlit.go.jp/report/press/house05_hh_000274.html

TOPICS

# Disaster Survey for the Great East Japan Earthquake and Tsunami Disaster in Ports and Harbors

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*(Keywords) Great East Japan Earthquake, disaster survey, port and harbor facilities, coastal protection facilities, tsunami traces, seismic motion, microtremors*

**1. Field surveys on damage to port and harbor facilities**

Since the Great East Japan Earthquake, the Coastal and Marine Department and the Port and Harbor Department have conducted the following disaster surveys on a total of 12 occasions.

1) Survey of tsunami traces and damage to facilities as TEC-FORCE / Jointly with the Port and Airport Research Institute (PARI) / March-April

2) Survey on the state of damage to coastal protection facilities / May-Sept.

3) Survey on the state of damage to port and harbor facilities and measurement of microtremors / June-Nov.

**2. Activities as TEC-FORCE**

From March 15th to 30th, a total of eight employees from the two Departments were sent to survey tsunami traces and the state of damage to port and harbor facilities [1].

**3. Survey on the state of damage to coastal protection facilities**

From May 9th to September 1st, a total of seven employees from the Coastal and Marine Department were sent to survey the state of damage to coastal protection facilities [2].

Photo: A field survey in progress

**4. Survey on the state of damage to port and harbor facilities and measurement of microtremors**

From June 9th to November 2nd, a total of three employees from the Port and Harbor Department were sent to survey the state of damage to port and harbor facilities and to measure microtremors. The aim of this measurement was to study the relationship between the state of damage to port and harbor facilities, geotechnical conditions and seismic motion amplification factors. Among others, seismic motion in Soma Port was set based on the results obtained.

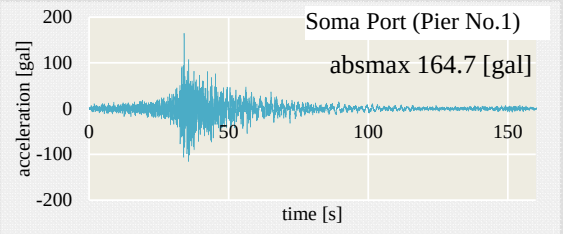


Fig: L1 seismic motion in Soma Port (Pier No. 1) (Top of firm ground)

[Reference]

1) Urgent Survey for 2011 Great East Japan Earthquake Disaster and Tsunami Disaster in Ports and Coasts, Technical Note of the Port and Airport Research Institute (PARI) No. 1231, April 2011, Takahashi Shigeo et al.

2) Field Survey of the 2011 off the Pacific coast of Tohoku Earthquake and Tsunami on Shore Protection Facilities in Ports, NILIM Technical Note 658, Dec. 2011, Kentaro Kumagai et al.

3) Other individual bulletins, etc.
http://www.ysk.nilim.go.jp/oshirase/uc.html

# Regional Disaster Prevention Capability Improvement Countermeasures Focused on Social Capital

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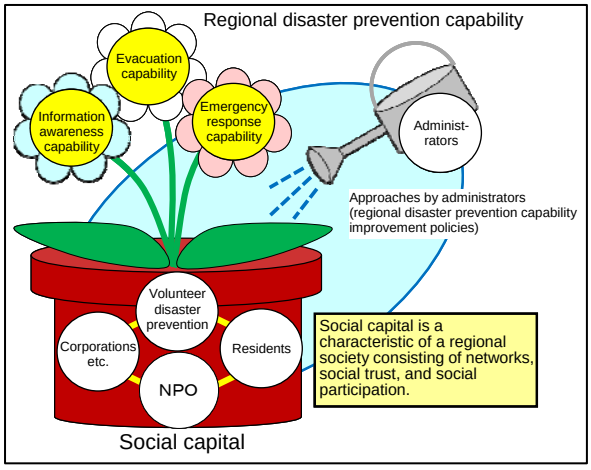
*(Key words) Social capital, regional disaster prevention capability*

## 1. Social capital and regional disaster prevention capability

If knowledge and experience of disasters, supplies stocked in preparation for a disaster, nurturing personnel and organizations, and the ability to respond by evacuating or rescuing people after a disaster are likened to flowers or fruit, the soil in which the flowers grow is social capital, and administrative organizations take action to raise plants by introducing social capital in the form of watering and applying fertilizer.

This survey focused on the actions of organizations which mediate when administrators (facility managers) approach residents etc. to have them improve the disaster prevention capability of the facilities under their authority.




## 2. Intermediate organizations in the improvement of regional disaster prevention capabilities

The intermediate organizations which were surveyed were not organizations such as consultative councils established to implement or promote projects, rather they were cases where organizations originally established to achieve other goals play the role of a go-between and carry on continuous activities. Nineteen advanced cases nationwide were surveyed to establish typical models such as the following.

Model 1: Approaching a key person (or organization) which performs town redevelopment projects or educational activities etc., to encourage efforts to improve disaster prevention capability as a new field of activity.

Model 2: In cases where a scholar etc. with advanced knowledge or expertise initiates activity in a region, urging others to take initiatives in imitation of or in cooperation with the scholar.

Model 3: In a region where a federation of residents' associations or other regional group functions actively, urging initiatives effectively using existing networks.

Scenarios are hypothesized for the initial period, development period, and mature period of each of these models to list precautions.

In the case of Model 1 for example, during the initial period, it is important to provide basic information to a key person, and during the development period, to ensure the successors etc. and continuity when an official is transferred to another post. In the case of Model 3, the roles of the city, town, or village are important during the development and mature period of the organization, and it was learned that in the case of a project spanning multiple cities, towns, or villages, there is correlation with project characteristics in that according to region, differences often occur.

## 3. Summarization and future challenges

By systematically classifying earlier cases where an intermediate organization functions as social capital, methods a facility manager uses to approach an intermediate organization in order to more efficiently improve regional disaster prevention capability could be organized with a certain degree of correlation with regional properties by project type. There is a plan to prepare guidelines to improve regional disaster prevention capability using social capital, by incorporating expertise regarding the maintenance of relationships with intermediate organizations.

# Improving wide area disaster damage monitoring/predicting technologies

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*(Key words) Monitoring/prediction system, ad hoc water level gauge, distributed flood prediction model*

## 1. Introduction

In recent years concentrated torrential rainfall with hourly rainfall over 100mm has occurred frequently in Japan, causing disastrous floods and loss of human life. This means that it is now necessary improve the precision of flood discharge prediction methods, and to develop and build information transmission methods to support appropriate flood fighting and evacuation activities, and take other measures to further improve technologies for the wide area monitoring and prediction of flood damage.

This research was a study of real time observations by ad hoc water level gauges and of a distributed flood discharge prediction model in order to build flood disaster monitoring and prediction systems for entire river basins including medium and small rivers.

## 2. Real time observations by ad hoc water level gauges

Ad hoc water level gauges permit low cost simultaneous water level observations of multiple locations, because the water level gauges themselves are wireless communication units comprising part of data communication use networks. To verify their applicability to real time observation of river water level, proving tests were carried out on the Onda River, which is a tributary of the Tsurumi River. Figure 1 shows the network which was built. The results of the proving testing, which took 4 months to perform, confirmed that they are all fully applicable to observations during flood discharge and for long term observations.

## 3. Building and verifying the precision of the distributed flood discharge prediction model

In order to improve flood discharge predictions in medium and small rivers, which are characterized by the abrupt rise of the water level and short flood discharge arrival times, a distributed flood discharge prediction model capable of directly reflecting the spatial distribution of rainfall in the middle and upstream reaches of the Tsurumi River was built, and the precision of the object model was verified by 7 flood discharges which occurred in recent years. Figure 2 shows the results of verification of a flood discharge on September 21, 2011 at the Ochiai Bridge at the furthest downstream point of the object river basin. The wave forms at the start and near the peak of a flood discharge can be generally reproduced, but in order to further improve precision and reliability, we are studying a method of improving the applicability of a model to the characteristics of the flood discharge of an entire river basin by setting new water level observation points on a river system and reflecting the observation results in the model.

## 4. Conclusion

This research has confirmed the applicability and usefulness of ad hoc water level gauges and the distributed flood discharge prediction model, which contribute to wide area monitoring and prediction of flood damage. In the future, we will continue to boost precision and improve the system to advance flood disaster monitoring and prediction systems.

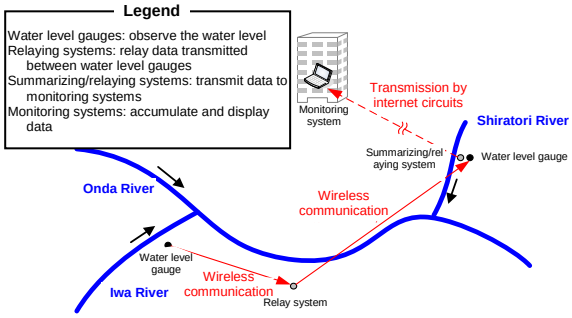


Figure 1. Ad Hoc Network

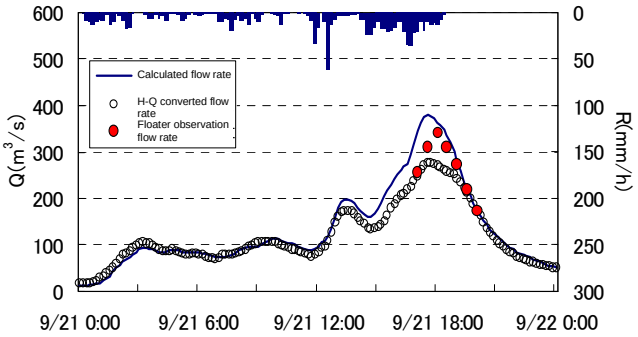


Figure 2. Results of Verification at the Ochiai Bridge (Flood of Sept. 21, 2011)

# Case of early clarification of wide area sediment disasters using satellite images

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*(Key words) Satellite image, interpretation, river course blockage, natural dam*

## 1. Introduction

When an earthquake or torrential rainfall etc. causes a landslide forming a large natural dam etc., there is a danger of a secondary disaster such as an inundation caused by the collapse of the natural dam, so when the Great East Japan Earthquake and typhoon No. 12 of 2011 caused disasters, wide area landslide ground interpretation was performed using satellite images, quickly clarifying the landslide ground which had appeared.

## 2. Interpreting landslide ground over a wide area after Great East Japan Earthquake

During the Great East Japan Earthquake, strong seismic intensity was observed over a wide region, so in order to confirm and clarify the state of the occurrence of large-scale landslide ground, over a wide area without omission, optical satellite images were used to visually interpret the landslide ground. The regions which were the object of the landslide ground interpretation were “regions encompassing districts where the seismic intensity was weak 6 or more, and districts where the seismic intensity was strong 5 or more” (see Fig. 1), based on the estimated seismic intensity distribution announced by the Meteorological Agency. The regions whose images were used for the interpretation were, in order to more accurately discriminate landslide regions, allotted and interpreted beginning with images with high resolution selected from among obtainable images in the sequence: Google Earth images, ALOS stereopia images, ALOS pan-sharpened images, and ALOS-AVNIR-2 images.

The results of the interpretation of landslide ground using satellite images showed that there were approximately 200 landslide locations covering a total of about 300,000 $m^2$ of ground. It also confirmed that there were no landslides large enough to have formed a natural dam.

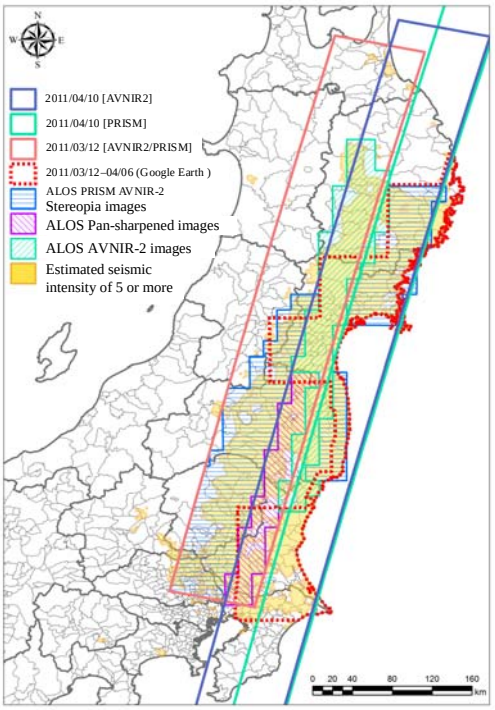


Figure 1. Region with Seismic Intensity of Strong 5 or Higher and Region Interpreted

## 3. Searching for river course blockages (natural dams) caused by Typhoon No. 12 of 2011

Typhoon No. 12 of 2011 brought prolonged intensive rainfall ending September 4, causing severe damage on the Kii Peninsula. So on September 5, a helicopter was used to conduct a survey to check for the formation of natural dams. The results confirmed large-scale natural dams at two places (Nagadono, Kumano), but most of the region was cloud-covered, so it could not be surveyed by helicopter. So satellite SAR images, which are obtained by wide area photography (30km×50km) were used to search for image patterns similar to those of the natural dam formed at Nagadono to interpret landslide ground, abstracting unconfirmed river course blockages at 8 locations including Akatani and Kurihira (see Fig. 2

for example at Akatani). On the following day, September 6, after the weather had returned to normal, the river course blockage locations abstracted by the satellite SAR images were visually confirmed from helicopters, and an emergency survey stipulated by the Sediment Related Disaster Prevention Law was started at the sites of large-scale river course blockages at Nagadono, Akatani, Kurihira, and Kumano.

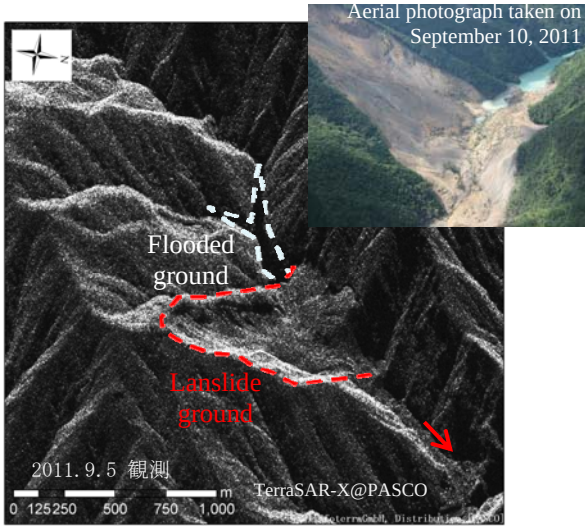


Figure 2. River Course Blockage at Akatani
Discovered by the Satellite SAR

In the past it was impossible to perform surveys to confirm the formation of natural dams at night and during bad weather, but interpreting landslide ground using wide-area satellite SAR images successfully sped up the search for previously unconfirmed natural dams in mountains even during bad weather, accelerating the start of emergency surveys and evacuation of downstream residents as required by the Sediment Related Disaster Prevention Law when a large-scale sediment disaster is imminent.

# Sediment discharge and flow discharge observations in mountain rivers to contribute to general sediment management

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*(Key words) Sediment discharge observation, suspended sediment, bedload, hydrophone*

## 1. Introduction

In order to resolve various problems related to dam sedimentation, aggradation and degradation of riverbeds, shoreline erosion, and other sediment movement, it is necessary to perform general sediment management as part of a sediment transport system. Therefore, it is important to clarify the quantities and the characteristics of flow discharge and sediment discharge from the mountains where sediment is produced.

The Ministry of Land, Infrastructure, Transport and Tourism has been performing nationwide sediment discharge and flow discharge observations and improving this observation system since 2009. The Erosion and Sediment Control Division provides technological support for observation methods, has developed a method of converting observed data to sediment discharge rate, and has developed a database system.

## 2. Outline of sediment discharge and flow discharge observations

Flow rate, suspended sediment discharge, and bedload discharge are observed. Flow rate is obtained by measuring the water level with a water level gauge and solving a water level – flow rate relational equation. The suspended sediment discharge is obtained by multiplying flow rate by suspended sediment concentration measured by a turbidity meter. The bedload discharge sensor is described in the next section.

## 3. Method of analyzing observed data obtained by a bedload discharge sensor (hydrophone)

The device used as a bedload discharge sensor, which is a steel pipe containing a microphone, is called a hydrophone (Photo 1). The sound pressure value is calculated from the impact sound wave of the bedload, then converted to sediment discharge rate[1)]. The sound pressure value is the averaged value of the amplitude of the impact sound waves and it can be used in much the same way as the sound volume. When a sand or gravel particle impacts the hydrophone individually, the sound pressure value is proportional to the volume of a particle. When a group of particles impact it, the more particles, the larger the sound pressure value. However it is not proportional to the total volume. This is because the sound pressure value is reduced due to the destructive interference of sound waves. The reduction rate is large when the number of particles per unit of time is large. For example, even if particles with the same volume impact the hydrophone, the smaller each particle, the more the sound pressure volume decreases because the number of particles becomes larger (Fig. 1). Bedload discharge is calculated based on these relationships by a numerical calculation.

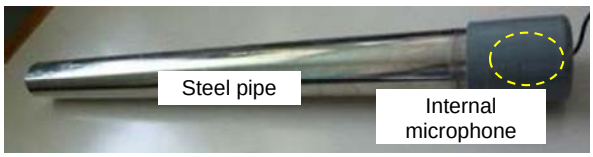


Photo 1. Hydrophone

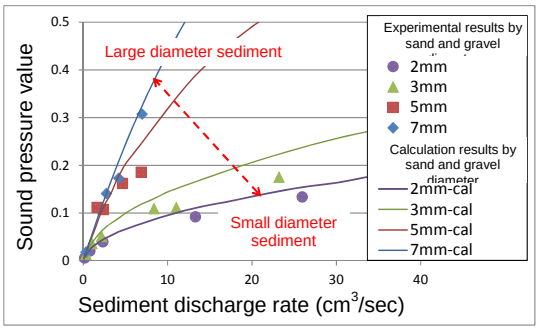


Figure 1. Sediment Discharge Rate - Sound Pressure Value Relationship (Experimental Results and Calculation Results)

## 4. Future plans

The observed data will be used for general sediment management and crisis management. And it is stored in a data base system. The improvement of the method of converting observed data to bedload discharge rate is planned, through the verification of measurement accuracy in field observations.

[Reference]

1) T. Suzuki, H. Mizuno, N. Osanai, R. Hirasawa, Y.

Hasegawa (2010): Basic study on sediment rate measurement with a hydrophone on the basis of sound pressure data, Journal of the Japan Society of Erosion Control Engineering, Vol. 62, No. 5, p. 18-26, 2010.

# Development of the practical sand pack work method

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*(Key words) Civil engineering use fibers, beach materials, beach nourishment*

## 1. Definition of the sand pack work method

The sand pack work method is filling large cloth bags made of civil engineering use fibers with sand, which is field test ocean beach material and beach nourishment material. Research on this method began in response to a growing public demand for easily removable structures to replace concrete structures and for the reduction of overall project costs. To be used as a method to replace various kinds of shoreline structures, problems related to structural stability, workability, and durability must be solved.

This research has been carried out since the autumn of 2010 jointly by three private sector civil-engineering use fiber material makers, as “Research on technologies to evaluate the performance of sand-bag filling work for shoreline conservation.”

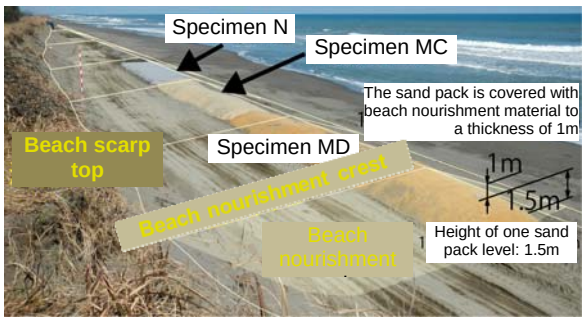


Photo 1. Sand Pack Field Experiment on the Sumiyoshi Shoreline

## 2. Efforts to realize the method

As shown in Figure 1, shorelines where the external force (waves, weather) differ were selected as the sites for field tests and exposure tests, while stability and material properties were tested in a laboratory. Figure 2 shows the locations of the shorelines where the exposure tests and execution tests were performed.

Beginning in the middle of March in 2012, on the Sumiyoshi Shoreline in Miyazaki Prefecture, sand packs were placed and tested as a supplementary method to lower the loss of beach nourishment materials as shown in Photo 1 and then the site was monitored for one year, confirming its effectiveness and stability under rough waves. As a result of installing sand packs on the sandy ground in this way, the ground was deformed by localized erosion of the ground surface. Figure 3 shows the test performed to investigate the tensile force acting during deformation. Through these efforts, the practical application stage has been reached. We wish to systematize and provide the results in usable form as the Sand Pack Work Method Handbook (Draft). Information about this research is available on the web site of the Coast Division (http://www.nilim.go.jp/lab/fcg/).

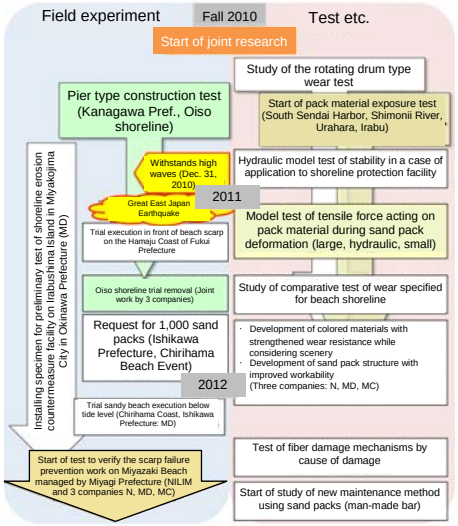


Figure 1. Chronology of the Course of the Research

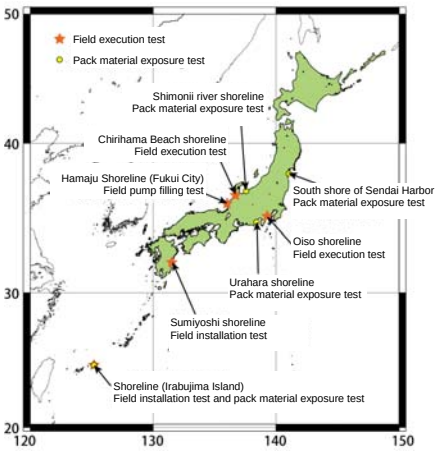


Figure 2. Shorelines where Pack Material Exposure Tests and Field Tests were Performed

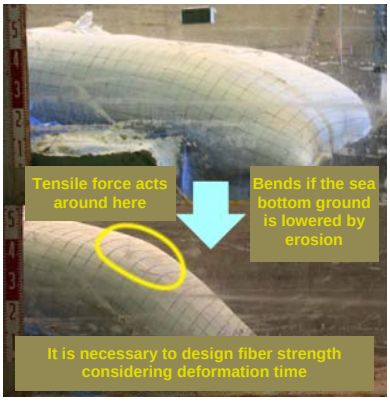


Figure 3. Model Test of Tensile Force Acting During Deformation Caused by Erosion

# Large-scale sediment disasters caused by Typhoon No.12 in the Kii Mountains

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*(Key words) Deep-seated landslide, river course blockage (natural dam), landslide soil volume*

## 1. Introduction

Typhoon No.12 approached and made landfall on the Japanese Archipelago in early September 2011, causingd a severe disaster on the Kii Peninsula. Rain was long-term relatively intensive rainfall, which began to fall on August 31 and continued for 5 days, ending on September 4. In the village of Kamikitayama in Nara prefecture, although the maximum hourly rainfall was less than 50 mm/h, the total rainfall reached 1,800 mm.

Based on a report by the Erosion and Sediment Control Department, Ministry of Land, Infrastructure, Transport and Tourism of October 26, the rainfall resulted in a total of 100 sediment disasters occurred in the three prefectures of Nara, Wakayama, and Mie, resulting in 56 dead and missing persons.

## 2. Outline of the sediment disasters

This typhoon caused many deep-seated landslides, forming river course blockages (landslide dams) at 17 locations (Photo 1). At five of these locations where the height of landslide dam was 20 m or higher, and where there are about 10 or more buildings with habitable rooms downstream from the landslide dam, emergency surveys were performed by the Ministry of Land, Infrastructure, Transport and Tourism under the Law for Partial Revision of the Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas, which was enacted on May 1, 2011[1].

Photo 1. River Course Blockage at Nagadono Valley in Totsukawa Mura in Nara Prefecture

## 3. Landslide ground distribution

The spatial distribution of the landslide was surveyed by performing an in-situ survey and using aerial photographs and satellite images. The surveyed area was 4,800km$^2$. The landslide volumes at each landslide were calculated using an empirical equation concerning landslide area and landslide volume[1].

Table 1. Results of Interpreting Landslide Ground and Estimating Landslide Soil Volume

| | All landslides | Large-scale landslide* |
|---|---|---|
| Number of landslides | 3,077 | 76 |
| Landslide areas (m$^2$) | Approx. 10 million | Approx. 5 million |
| Landslide volume (m$^3$) | Approx. 100 million | Approx. 80 million |

* Landslide producing sediment volume of approximately 100,000m$^3$ or more

It was estimated that landslides occurred at 3,077 places in the survey range, the landslide area (only scar, excluding runout and deposited area) reached approximately 10 million m$^2$, and the landslide volume was approximately 100 million m$^3$.

The Public Works Research Institute has surveyed inventories of large-scale deep-seated landslides (volume larger than 100,000m$^3$) caused by torrential rain or melting snow since the beginning of the Meiji Period (1867-1912), and confirmed 188 cases. In contrast, Typhoon No.12 caused 76 large scale deep-seated landslides with landslide volume of approximately 100,000m$^3$ or more. This fact shows that although there were differences in survey methods, Typhoon No.12 caused more deep-seated landslides than past disasters. Landslide area shows that large-scale deep-seated landslides accounted for about 50% of total landslide area, and that about 80% of landslide volume was produced by large-scale landslides. This suggests that large-scale deep-seated landslides have an extremely great impact on sediment production.

[Reference]
1) Civil Engineering Journal, Vol. 53, No. 12, p. 4-7, 2011

TOPICS

# Field Survey on the Recovery Process after the Hurricane Katrina Disaster

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*(Keywords) Great East Japan Earthquake, Hurricane Katrina, disaster recovery*

## 1. Outline

In April 2011, we carried out a field survey on the recovery process following the Hurricane Katrina disaster in the USA (August 2005). Our aim in doing so was to derive new lessons in terms of recovering from a heavy inundation disaster, to assist the recovery from the Great East Japan Earthquake of March 11th last year.

The specific details enumerated in the survey were: (1) the system of budgets and content of measures for recovery both by the federal government (through FEMA, USACE and other bodies) and by the state government, as well as the actual state of recovery; (2) the process whereby recovery policies and plans were drawn up at the various levels of federal, state and local government (county, city, community) and the system of support; (3) the situation of population recovery in New Orleans, the city at the center of the disaster area; and (4) implications for Japan based on the above.

A more detailed analysis can be found in the NILIM Technical Note referenced below. This paper will introduce just two particularly interesting results to emerge from this survey.

## 2. The rationale on functional strengthening (long-term recovery)

Efforts to restore infrastructure and individual housing (which accounted for a significant proportion of the Katrina disaster) were mainly handled by the system of support (PA, IA) from FEMA, the Federal Emergency Management Agency. In contrast, the Community Development Block Grant (CDBG) funded by the Department of Housing and Urban Development is playing a central role in aspects of long-term "functional strengthening" going beyond restoration (although there is also the FEMA-HMGP program funded by FEMA). A characteristic of CDBG is that it provides blanket grants with no specific purpose of use specified by the central government. The Louisiana State government decides the content of CDBG spending, on condition that recovery plans drawn up at local level are consistent with the policy and vision set out by the Louisiana Recovery Authority (LRA) at state level.

Even the recovery of levees by the United States Army Corps of Engineers (USACE) was not simply a case of restoration, but involved the introduction of a more robust structure. Basically, levees were designed to withstand floods at an intensity occurring once every century, but would not be completely destroyed even by 1-in-500 year floods.

## 3. Present situation of population recovery in New Orleans

Five months after the disaster, the city of New Orleans announced a recovery plan that would involve integrating residential districts under the guidance of the then mayor. Owing to strong opposition from local residents, however, the plan was withdrawn, and a new plan for recovery of all districts with resident participation was drawn up 22 months after the disaster.

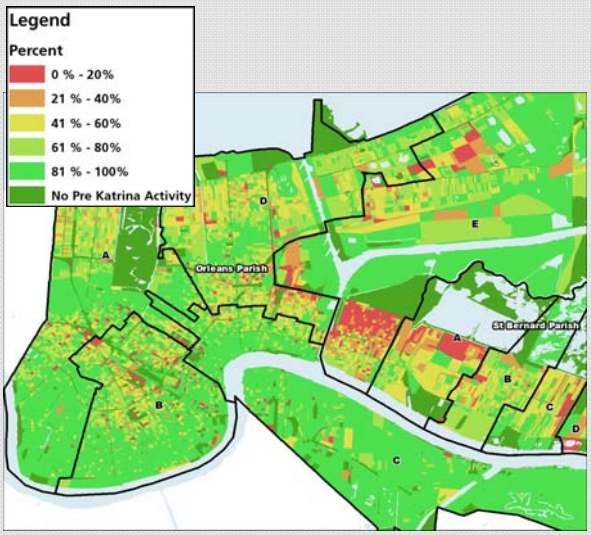


Figure Situation of population recovery in various districts of New Orleans (as of July 2010). Coloring indicates the population ratio compared to pre-disaster levels in each district; dark green areas are non-residential land.

But now, more than five years later, population recovery in some districts is still very slow, as shown in the image below; the population of New Orleans as a whole is still only 75% of what it was before the disaster. In view of this, a new flexible Master Plan with incentives aimed at integrated habitation – not coercive but based on various measures – was drawn up in 2010.

**4. Conclusion**

Today, more than six years after the Hurricane Katrina disaster, functional strengthening and recovery of population are still in progress. This merely serves to underline the fact that recovering from a disaster is a long process, one that requires support based on long-term commitment.

[Reference]

Ryuichi Shibasaki, Recovery Process from Hurricane Katrina Disaster – Implication for Recovery from the Great East Japan Earthquake, NILIM Technical Note No. 650

# Research on early verification method for traffic safety countermeasure effectiveness based on traffic behavior observations

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*(Key Words) Traffic behavior, early verification of countermeasure effectiveness*

## 1. Introduction

Traffic safety countermeasure effectiveness is verified mainly using accident data. However, the occurrence probability of traffic accidents is low so it takes about four years to collect the accident data necessary for verification of effectiveness, and there are cases where, if a follow-up countermeasure is needed, the confirmation of its need and its implementation are delayed.

So the National Institute for Land and Infrastructure Management aims to establish a method of rapidly verifying the effectiveness of countermeasures by observing change of traffic behavior after the implementation of each countermeasure.

## 2. Verification of traffic safety countermeasure effectiveness by observing traffic behavior

This research was a trial verification of countermeasure effectiveness based on a number of indices. The following is an example.

The object location is a location where the number of right turn collisions was reduced by the right turn guide line. The right turn guide line which was installed guides cars whose drivers intend to turn right to the appropriate position to stop and wait before turning right at the intersection. Its purpose is to make it easy for these drivers to confirm the locations of cars traveling straight from the opposite direction (oncoming cars), so they do not start their turn at a dangerous time.

First, as an index to quantitatively represent change of traffic behavior (time to start the right turn) to be improved by the right turn guide line, the position of oncoming cars at the time the right turn begins (time when the car turning right passes the waiting location indicated by a white line on top of the right turn guide line) was measured. The location of the oncoming car is represented by the distance to the stop line from the car among oncoming cars which is nearest to the stop line. Figure 1 organizes the correlation between the frequency that the oncoming car location at the time a right turn starts was at or below the thresholds (30m, 40, 60m) with the average annual number of right turn collisions. The number of cars turning right during the

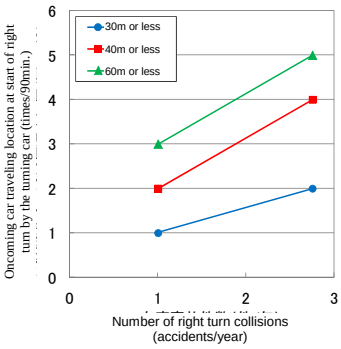


Figure 1. Locations of Oncoming Cars at Start of Right Turn

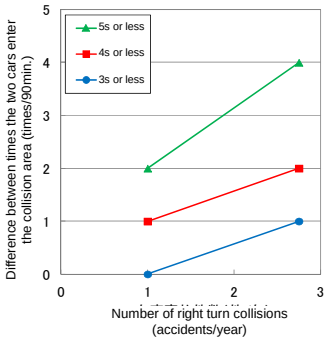


Figure 2. Difference in Time of Entry to Collision Are

time period of the measurements was 18 before the countermeasure and was almost identical at 17 after the countermeasure. A positive correlation was seen between change of the number of accidents and change of the index, and it is assumed that it is possible to measure the reduction of accidents based on the reduction of the frequency the location of the oncoming car when a driver started a right turn was at or lower than the threshold value.

It is considered to be possible to verify the effectiveness of a countermeasure based on an index which represents the change of traffic behavior to be improved by the countermeasure in this way.

Next, as an index which quantitatively represents the danger of a collision, the area where the traveling courses of a car turning right and an oncoming car overlap was defined as the collision area, and the difference between the times the cars enter this area was measured. Figure 2 organizes the correlation of the frequency that the difference in entry time is at or below the threshold (3 seconds, 4 seconds, 5 seconds) with the annual number of right turn car – oncoming car accidents. There is a positive correlation with the number of accidents, so it can be hypothesized that accidents are reduced by lowering the frequency that the difference between the times of entry to the

collision area is at or lower than the threshold value.

It is assumed to be possible to verify countermeasure effectiveness, even with an index representing the danger of collision in this way.

**3. Summing up and future challenges**

The above results show that in order to verify the effectiveness of a countermeasure based on traffic behavior, selecting the index is important. In the future, it will be clarified what kinds of traffic behavior indices should be used for which kinds of accidents and traffic safety countermeasures, to establish early verification methods for countermeasure effectiveness based on traffic behavior.

# Block Performance Levels and Resident Awareness in Densely Built-up Areas

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*(Keywords) Densely built-up areas, Zoning Code, block performance, sunlight, daylight, ventilation, resident awareness*

**1. Introduction**

The "special method of harmonious rebuilding" promotes rebuilding case-by-case in land plots in a given area in accordance with local rules, when the usual building rules are replaced by performance equality standards through permits and approval by Designated Administrative Agencies. This method is seen as an effective way of improving disaster prevention performance and living environments inside "*anko*" zones of densely built-up areas where building restrictions based on the Zoning Code of the Building Standard Law (road connectivity obligation, road slant plane restrictions, allowable building coverage ratio restrictions, etc.) are particularly harsh [1)]. This method has also been specified as a basic measure for promoting the improvement of densely built-up areas in the Basic Plan for Housing (National Plan) [2)], which defines the national government's policy for improving densely built-up areas.

Thus, in order to study levels of "minimum performance required at block level" that should be secured in densely built-up areas when drawing up local rules, we measured block performance levels achieved in densely built-up areas and surveyed residents' awareness. In this paper, we introduce some of the results.

**2. Survey results**

(1) Sunlight [3)]: Fig. 1 shows the relationship between the hours of sunlight at the main opening to the living room in winter and the level of residents' satisfaction with sunlight exposure [(1)]. According to this, more than 50% are "Satisfied + More or less satisfied" with about 6.5 hours, this decreasing to about 3.5 hours when "Neither" is added.

(2) Daylight [3)]: Fig. 2 shows the relationship between vertical plane illuminance at the main opening to the living room during cloudy weather in winter daytime and the level of residents' satisfaction with brightness [(1)]. Here, more than 50% were "Satisfied + More or less satisfied" with about 2000Lx, or about 1500Lx when "Neither" is added. 1500Lx is the level at which minor visual work is possible indoors for a very short time using only natural illuminance coming in through the opening [4)].

(3) Ventilation: Fig. 3 shows the relationship between average wind speed near the main opening to the living room in summer and the level of residents' satisfaction with ventilation [(1)]. Here, "Satisfied + More or less satisfied" failed to reach 40% in any sample day or night, but if "Neither" is added, the total is more than 50% at around 0.3m/s during the day and around 0.4m/s at night.

**3. Future challenges**

In future, we plan to study proposals for block performance standards that should be achieved in densely built-up areas, based on the results of this survey. At the same time, we will attempt to develop a "System for simple evaluation of block performance in densely built-up areas" [5)].

Note

(1) We asked residents to evaluate their satisfaction in five stages, namely (1) Satisfied, (2) More or less satisfied, (3) Neither, (4) Somewhat dissatisfied, and (5) Dissatisfied.

[Reference]

1) National Institute for Land and Infrastructure Management (2007) "Guidebook on Special Permissions in the Zoning Code under the Building Standard Law to Promote Rebuilding in Densely Built-up Areas" http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0368.htm
2) MLIT (2011) "Basic Plan for Housing (National Plan)" http://www.mlit.go.jp/jutakukentiku/house/torikumi/jyu

seikatsu/hyodai.html

3) Wataru Katsumata, Yasuhiro Miki, Tatsuya Iwami and Shigeki Nishizawa (2011) “Research on the evaluation of block performance in densely built-up areas (Part 1) Performance of sunlight and daylight and feelings of residents in typical densely built-up areas” “AIJ FY2011 Annual Meeting (Kanto) Summaries of Papers at Annual Meeting” F-1, pp.507-508

4) Wataru Katsumata, Yasuhiro Miki and Norimitsu Ishii (2008) The relationship between the shape and allocation of buildings and the illuminance on their exterior walls by daylighting: Basic study on the performance standard of daylighting environment in urban building districts (Part 1) “Journal of Architecture and Planning” AIJ Vol.73, No.628, pp.1275-1280

5) “Development of a system of support when making harmonious rules for rebuilding in densely built-up areas” (Urban Development Division website) http://www.nilim.go.jp/lab/jeg/index.htm

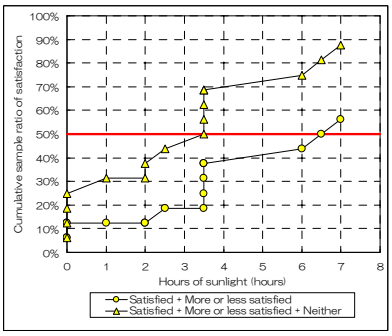


Figure 1. Relationship between hours of sunlight at main opening to living room in winter and level of residents’ satisfaction with sunlight exposure

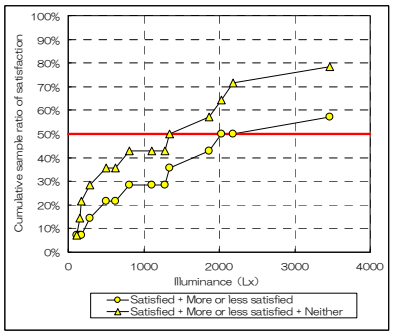


Figure 2. Relationship between vertical plane illuminance at main opening to living room during cloudy weather in winter daytime and level of residents’ satisfaction with brightness

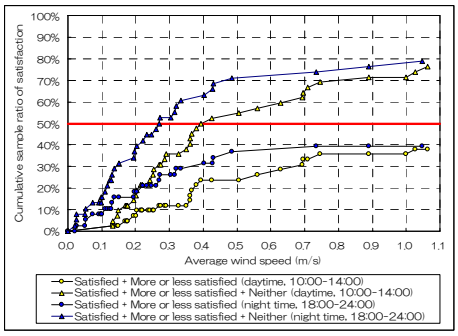


Figure 3. Relationship between average wind speed near main opening to living room in summer and level of residents’ satisfaction with ventilation

# An Initiative for Traceability of Concrete Using IC Tags

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*(Keywords) Concrete, traceability, IC tags, application*

## 1. Introduction

In 2008, a problem of inferior concrete members arose in some buildings because ready-mixed concrete (RMC) products made from prohibited materials had been shipped and used.

In response to this, a group consisting of NILIM, the Building Research Institute, Hiroshima University, and RMC industry cooperatives of five prefectures in the Kanto region started joint research on developing a prototype system of RMC traceability using IC tags, having investigated the feasibility and problems of the technology concerned. As one aspect of this, we developed basic applications using UHF- and HF-band IC tags on a trial basis, with the aim of a correctly relaying information between concrete manufacturers and users.

## 2. Posited traceability system

In view of the current level of commercially available IC tags, etc., we designed the proposed traceability system as shown in Fig. 1. The principal characteristics are that (1) the system adopts an ID method whereby data are logged in a database (DB) and linked to IC tags, (2) the data logged are the RMC mixture plan, weights and various test results, and (3) IC tags are introduced to RMC when unloading. We developed a basic application for reading and writing IC tags in line with this proposed system.

## 3. Outline of basic application

The hardware configuration of the basic application, as shown in Photo 1, consists of (1) IC tags, (2) a reader/writer, (3) a server (DB), (4) a wireless router, and (5) a PC.

Data records logged in the DB are displayed on the reader/writer or PC screen via the IC tags. Taking non-wireless communication environments into consideration, we also made it possible to directly write data such as the results of various tests in the user domain of the IC tags. In a demonstration experiment using a concrete factory as a field, we confirmed that the basic application works without problem.

## 4. Future plans

To accelerate the creation of a concrete traceability system using IC tags, we plan to continue studying the necessary technology, etc., in future.

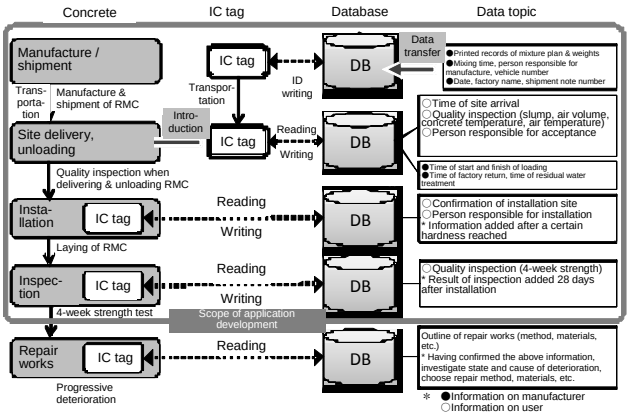


Fig. 1. Proposed traceability system

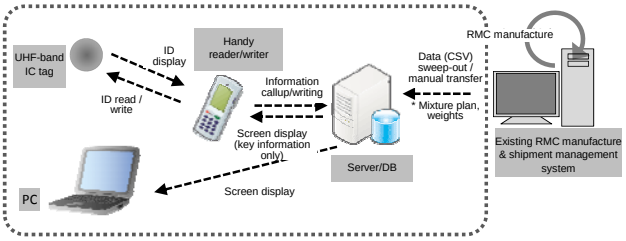


Fig. 2. Development image of the basic application

Photo 1. Hardware configuration of the basic application

# Analysis of Levels of Rebuilding in Relation to Urban Characteristics, and Incorporation in a Revision of the Policy for Improving Densely Built-Up Areas in the Basic Plan for Housing (National Plan)

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*(Keywords) Densely built-up areas, rebuilding rate, urban characteristics, database, Basic Plan for Housing*

## 1. Introduction

Dangerous and densely built-up areas mainly consisting of old wooden houses where large-scale urban fires could break out in the event of an earthquake still exist over a wide area of Japan; these areas need to be redeveloped with greater urgency in order to improve their disaster prevention performance. However, the urban characteristics affecting rebuilding of densely built-up areas are diverse, and levels of rebuilding leading to improved disaster prevention performance and effective measures of redevelopment are expected to differ from district to district. It is therefore important to ascertain the rebuilding rate in relation to the physical, social and economic properties of a district. These will include the state of road foundations and scale of land lots, population structure including declining birth rate, aging and population decline, and economic potential.

However, the rebuilding rate in each densely built-up areas has not become clear, owing to the difficulty of obtaining data. As a result, it has been impossible to compare the rebuilding rate in different types of urban area, or to quantitatively analyze the relationship with a district's physical, social and economic properties, which may be considered contributing factors in terms of rebuilding.

## 2. Construction and analysis of a macro database on urban characteristics of priority densely built-up areas throughout Japan

NILIM has therefore constructed a macro database after gathering data on individual districts in a total of 400 "priority densely built-up areas" nationwide (meaning "densely built-up areas where large-scale fires could break out in the event of an earthquake, etc., and where priority improvement is required" as announced by MLIT on July 11th, 2003). The data collected include physical indicators (building stock classified by construction year, small lot ratio, narrow street ratio, etc.), socio-economic indicators (population change, aged ratio, population by 5-year age groups, 5-year settled domicile ratio, land prices and trends in the same, etc.), and policy or project prioritization. With regard to the rebuilding rate, data on "newbuild renewal ratio" were calculated by dividing the newbuild floorspace area in recent years by stock, using data on the property tax ledger. This enabled us to ascertain the state of rebuilding for each district, compare this by type of urban area, and quantitatively analyze the correlation between the rebuilding ratio and other physical, social and economic indicators.

The analysis results quantitatively confirmed that the newbuild renewal ratio differs according to the type of urban area (Fig. 1), and that a district's newbuild renewal ratio is influenced, among others, by urban characteristics such as the aged ratio, small lot ratio, narrow street ratio (Fig. 2), distance from the nearest station, rented land ratio, and designated floor-area ratio. These have previously been pointed out empirically and qualitatively as factors hindering rebuilding.

## 3. Incorporation in a revision of the Basic Plan for Housing (National Plan)

In March 2011 the Basic Plan for Housing (National Plan) that defines the government's policy on improving densely built-up areas was revised. As a new target for improvement, it was indicated that approximately 6,000ha of densely built-up areas that would be markedly dangerous in the event an earthquake, etc., would be mostly eliminated in 10 years. As for basic measures aimed at achieving the improvement target, meanwhile, the Ministry conducted a study to find which measures would be effective to suit the type of urban area and urban characteristics. This was based on the results of research

by NILIM on the state of rebuilding in priority densely built-up areas, seen in terms of different types of urban areas and urban characteristics such as the narrow street ratio. As a result, in addition to conventional measures involving the rebuilding or removal of dilapidated buildings posing a high risk of fire spread or collapse, the need for finely detailed measures in relation to local characteristics were incorporated into the Plan as basic measures aimed at achieving improvement targets. These include evacuation routes and firefighting environments in historical urban areas and other similar districts where rebuilding cannot be expected. They also include the use of relaxed restrictions related to road width based on the Building Standard Law, to encourage rebuilding in districts where the narrow street ratio is high (road frontage conditions are bad).

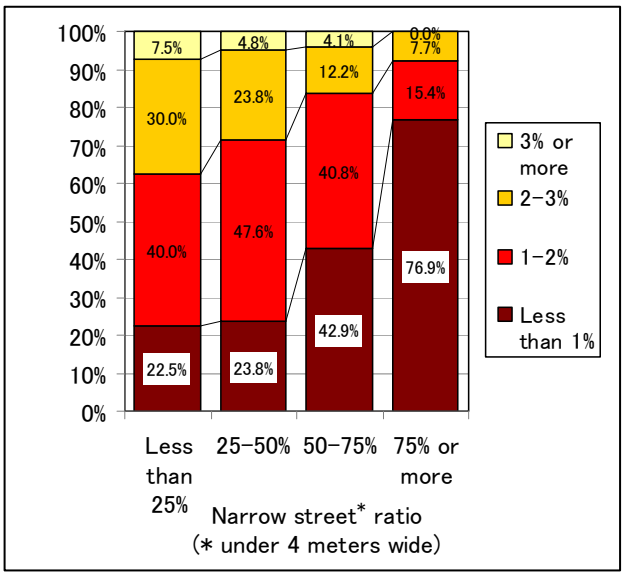


Fig. 2 Newbuild renewal ratio by narrow street ratio in connection with priority densely built-up areas nationwide (based on total floorspace area)

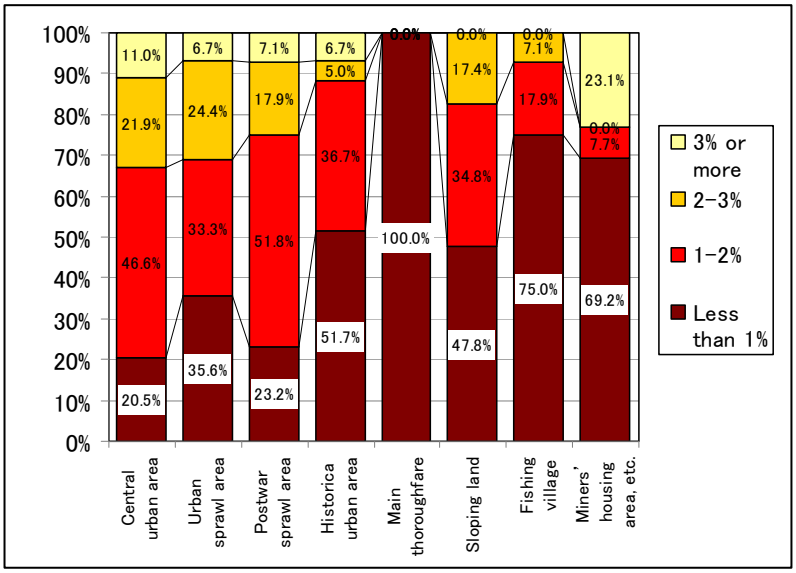


Fig. 1 Newbuild renewal ratio by type of urban area in connection with priority densely built-up areas nationwide (based on total floorspace area)

Topics

# Evaluation and future development of bicycle travel environment improvement model districts

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*(Key words) Bicycle, bicycle network project, intersection design, guideline*

**1. Background to and history of recent bicycle countermeasures**

In 2008, the Ministry of Land, Infrastructure, Transport and Tourism and the National Police Agency designated a total of 98 areas nationwide as Bicycle Travel Environment Improvement Model Districts, clarified problems with improving bicycle travel environments and studied countermeasures. Later, in 2011, they formed the Study Committee for the Creation of Safe and Pleasant Bicycle Utilization Environments, which evaluated and verified efforts made in the above model districts and proposed the preparation of guidelines.

The NILIM collected and aggregated documents about the model districts and helped the committee evaluate and verify efforts made in the model districts.

**2. Evaluating and verifying efforts in model districts**

The evaluation and verification in the model districts clarified two facts: [1] because the improvement effects are not fully achieved simply by partially improving bicycle traveling space, it is important to do the improvement as a network, and [2] because there are cases where the connection between the uninterrupted flow section and intersection are not provided connected in a straight line, so that the improved bicycle traveling space is not fully utilized, it is important to ensure continuity and straightness of bicycle traveling space at intersections. So the concept of stipulating bicycle network projects in the guidelines and the concept of intersection design methods were proposed.

**3. Future challenges**

The Ministry of Land, Infrastructure, Transport and Tourism and the National Police Agency will supplement the committee's proposals with technical opinions to prepare and release the guideline.

[Reference] Committee web site.
http://www.mlit.go.jp/road/ir/ir-council/cyclists/index.html

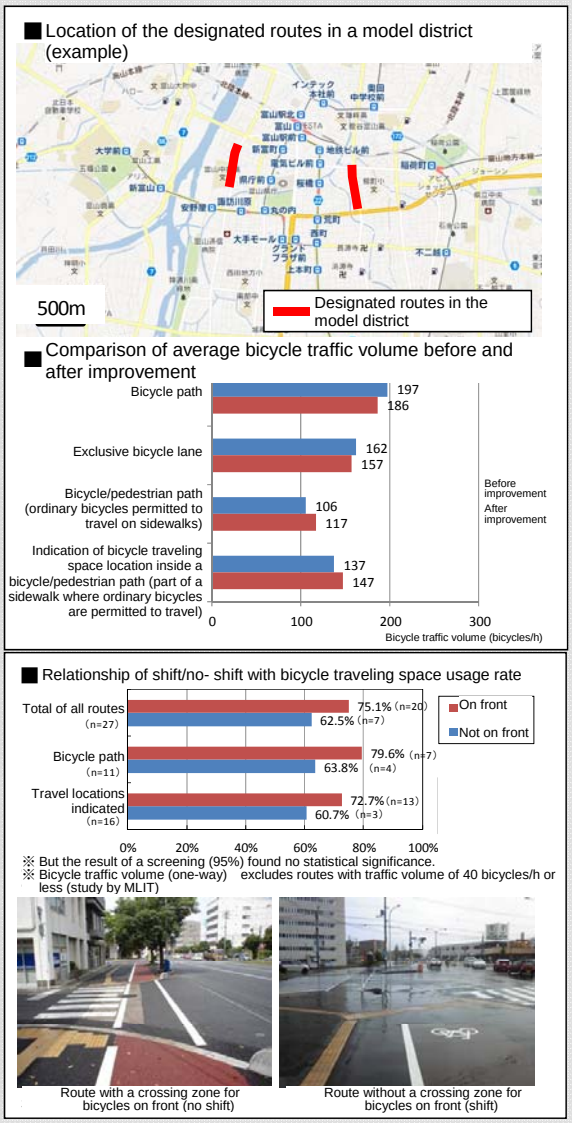


Figure Example of evaluation/verification of model district (excerpted from committee documents)

# Stock management for sewer pipes

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*(Key words) Sewer pipes, stock management, soundness prediction formula, reconstruction and rehabilitation*

**1. Stock management for sewer pipes**

Sewer systems in Japan were first constructed in Yokohama and Tokyo around 1880. The sewer system accounts for about 75% of the totale sewerage construction cost including collection and treatment systems. The length of existing sewers in Japan is now more than 430,000 km thanks to sewerage development. The life of civil engineering structures is generally 50 years, and in the near future, sewer pipes constructed during the period of economic growth around 1965 will reach the end of their service lifetime at the same time. Reconstruction and rehabilitation projects have just begun, so a way must be found to maintain deteriorated sewer pipes in sound condition under harsh economic conditions. Stock management (SM) has attracted attention in this regard.

**2. Results of research by the NILIM**

To introduce SM, it is necessary to clarify the present soundness of sewer pipes in order to appropriately predict their future deterioration, and based on the results of the prediction; propose a rational project plan based on a prediction of medium to long term project volume. The NILIM has proposed a sewer pipes soundness prediction formula and established a project standardization method in order to promote the introduction of the SM.

**3. Handbook on the Sewer Pipes Stock Management Method (draft)**

The Study Committee for the Sewer pipes Stock Management Method, which was established by the Sewerage and Wastewater Management Department of the Ministry of Land, Infrastructure, Transport and Tourism, announced the Handbook on the Sewers Stock Management Method (draft) on September 30, 2011, as an instruction manual for SM method introduction. This handbook, which reflects the results of research by the NILIM, is counted on to promote the introduction of SM in cities with little knowledge or data necessary for SM.

# Towards theintroduction of the partial factor design method to road bridge design standards

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*(Key words) road bridge, technical standards, performance-based specifications, partial factor design method*

## 1. Introduction

The Technical Standards for Bridges and Highway Bridges (below called, “Specifications for Highway Bridges”), which are design standards for road bridges, consist of a system based on the allowable stress design method, which designs member sections so that the stress produced in each member by the action of loads does not exceed the allowable stress of the member. Under technical standards for infrastructures on the other hand, performance-based specifications are implemented to flexibly design various types of structures, and at the same time, the partial factor design method, which permits the consideration of bridge-building environmental conditions or the degree of reliability of the safety allowance of materials in order to clarify the required performance, is being introduced with rising frequency.

NILIM studies an overall system of technical standards, settings of the basic required performances for bridges, analyses of the safety allowances for the existing standards, and settings of load factorsbased on analysis from the perspective of reliability.

## 2. Setting load factors

Introducing the partial factor design method, it is necessary to set partial factors considering the safety allowances which should be ensured for each type of factor. In order to clarify the load coefficients, NILIM studies the analyses of the safety allowances to secure reliabilitybased on evidence of load regulations for the conventional standards with regard to dead load, live load, wind load, temperature, earthquakes, snow load, earth pressure and other load factors after collecting the latest available data. Moreover, in order to study effects of partial factorization, we extracted road bridges with the proven structure’s types and scales in Japan and conducted numerical simulations considering the characteristics of loads obtained by an analysis of their design service lifetime (100 years) to analyze the bridge performances from a variety of perspectives such as the safety allowances which has been ensured by the existing standards.

## 3. Future research policies

An introduction of the partial factor design methodto the Specifications for Highway Bridges will makeit possible to reflect designs based on appropriate evaluations, and to conduct designs rationally and economically.

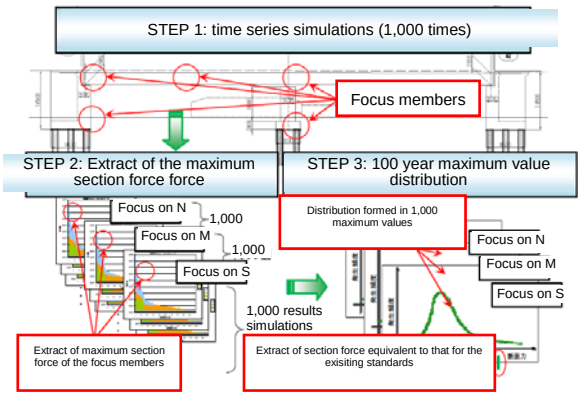


Figure 1. Numerical Simulations

Until now, we have conducted the setting the load factors by analyzing against representative structural forms or focused members. In the future, we will continue to increase trial calculation cases and widely conduct a survey to verify the appropriateness of the factors at the practical design level, and at the same time, we will study applicability to repair and reinforcement design. We will perform various kinds of studies in cooperation with various related institutions to achieve an early introduction of the partial factor design method to the road bridge design specifications.

[Reference]
Bridge and Structures Division web site (contains related paper)
http://www.nilim.go.jp/lab/gcg/index.htm

# Publication of Evaluation Guidelines for New Road Bridge Technologies (Draft)

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*(Key words) Highway bridges, new technologies, performance evaluation method, guidelines*

## 1. Introduction

In recent years, examples of the contract method with technical proposal have been increasingly introduced, and on the other hand, examples of the adoption of 'new technologies' applying to materials, structures, and design methods not specified in the Technical Standards for Bridges and Highway Bridges (below called, "Specifications for Highway Bridges") have also increased.

Specifications for Highway Bridges regulate "standard methods" assuming that performances such as the required safety allowances are surely obtained, based on the required performance and past research and experiences. However, they do not indicate a verification method or concrete evaluation standards to verify that the performances of the new technologies equivalent to or greater than cases based on "standard methods" are obtained.. Therefore, verification methods and the contents are set separately with reference to each condition in practice levels, and the verifications matching with standards are conducted through a process of trial and error, (below called, "performance verification").

In response to these background circumstances, the NILIM has published guidelines as universal and practical references focused on main items and points to remember when conducting individual performance verifications. (Technical Note of the National Institute for Land and Infrastructure Management No. 609, Guideline to Research Concerning Road Bridge Technology Evaluation Methods and New Technology Evaluations (Draft), September 2010).

## 2. Framework and Outline of Evaluation Guideline for New Technologies

[1] Part I, Common

In Part I, items necessary to verify performance individually by experiments or analyses and the basic concepts of the new technology evaluations are indicated from No.4 to No.8 of Part I as shown in Table 1.

Table 1 Framework of evaluation guideline for new techniques, Part I

| Part I Common |
|---|
| 1. Basics of new technology evaluation |
| 2. Selection evaluation methods |
| 3. Perspective of technology evaluation |
| 4. Deviation from the range of standard specification<br>(Examples) Deck slab span length, abbreviation of members |
| 5. Materials and structures with characteristics different from standard regulations<br>(Examples) Application of high strength reinforcing bars to concrete members<br>Welding steel unstandardized as welding structures |
| 6. Design principles and mechanisms different from standard regulations<br>(Examples) Welding joints unstandardized in 'Fatigue design guidelines for steel road bridges'<br>Structures abbreviating cross frames or lateral bracing<br>Shear connector mechanisms other than stud shear connectors |
| 7. Construction conditions different from standard regulations<br>(Example) Effects of concrete placement of steel-concrete composite slabs |
| 8. Conditions for maintenance different from standard regulations<br>(Example) Steel-concrete composite slabs and weather resistant steel materials |

[2] Part II, Case Examples of New Technology Evaluation

Part II indicates examples of road bridge verification items and performance verification methods using new technologies studied in recent years in order to design and construct road bridges based on 'Specifications for Highway Bridges'. Even new technologies not included in these examples are considered to lead to more complete performance verifications by referring to common parts such as focus points and points to remember.

[3] Part III. Examples of preparation of evaluation manuals

Part III indicates examples of setting specific verification items and performance verification methods referring to examples of PC box girder bridges with corrugated steel web and steel-concrete composite slabs. It can be used as a reference for methods of establishing plans to evaluate new construction methods.

## 3. Summary

We hope that the guideline will help provide society with infrastructure with high reliability as further appropriate technology evaluations referring to the basic concepts and examples of new technology evaluation in the guideline are established. .

# Revision of Airport Pavement Maintenance and Rehabilitation Manual

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Airport Department

*(Key words) Airport, paving, maintenance*

## 1. Introduction

The Airport Pavement Maintenance and Rehabilitation Manual (draft version) was revised and issued officially in April 2011. This manual provides standards and recommendations for inspection, evaluation, design and construction for the rehabilitation of airport pavement. In this revision, the design method for rehabilitation was changed from the specification based method to the performance based method just like the new pavement design method already changed in 2008. Furthermore, standards and recommendations for inspection, evaluation and construction were also revised based on the result of research by the NILIM. This report mentions some of the major points of the revision.

## 2. Inspection

De-bonding between asphalt concrete layers has been inspected by an impact acoustic method using a hammer. However, it takes many days to complete the inspection by this method at a large airport. To develop a new efficient method to detect de-bonding, NILIM conducted a study to verify the applicability of the infrared thermographic inspection method. This method is based on the surface temperature difference between bonded and de-bonded areas caused by de-bonding as shown in Figure 1. The result clarified that this method could detect de-bonding quickly in both the daytime and nighttime in the summer. In the revision of the manual, this method was added as new inspection method.

## 3. Material and Construction

Grooves, whose width is 6mm and depth is 6mm, are constructed on the surface of a runway to drain water quickly and to maintain skid resistance. To prevent failure of the grooves soon after the construction as shown in Figure 2, grooves shall be constructed 2 months after construction of the surface course. This means that the surface condition of runway is “non-grooves” for 2 months after rehabilitation works. However, a laboratory loading test has revealed that grooves constructed on modified asphalt concrete have higher stability than those on straight asphalt concrete. Thus, trial construction of grooves was done on a runway to confirm the stability of grooves. The result of the trial construction verified that grooves on modified asphalt concrete constructed 1 month after construction of the surface course have high stability. In the revision of the manual, the curing term for grooves was shortened to 1 month in cases where modified asphalt concrete was used for the surface course.

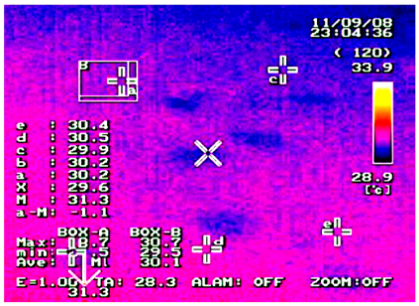


Figure 1. Infrared image (center blue circles indicate low temperature part due to de-bonding)

Figure 2. Failure of grooves

[Reference]
Civil Aviation Bureau, Ministry for Land, Infrastructure, Transport and Tourism: Airport Pavement Maintenance and Rehabilitation Manual, 2011.

# Attempt to detect seepage in levees from thermal images

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*(Key words) Levee inspection, thermal image, seepage, infrared radiation*

## 1. Introduction

River levees are long structures which have, throughout the long history of flood control, been constructed accompanied by repeated reinforcement and repair according to the state of past disasters. So in order to ensure the safety of river levees far into the future, it is important to perform inspections closely coordinated with reinforcement to efficiently and reliably detect locations which impact safety and to monitor their condition[1)]. An inspection of a river levee is done basically by walking on it to visually examine its condition, and such inspections are performed over the full length of every levee once a year. It is necessary for inspections to be done by limited personnel and restricted budgets, so more efficient methods are needed. And because the results of visual inspections vary in some cases because of differences in the skills of inspectors, it is important to develop methods of using measuring instruments to accurately quantitatively clarify and analyze the state of deformation. So as such a survey method, a method of combining multiple physical exploration methods such as electricity and magnetism to clarify soil quality inside the levee, and a method of measuring the shape of a levee in detail using an automobile equipped with laser measuring instruments and GPS are being studied.

The River Division is conducting research intended to integrate, rationalize, and increase the efficiency of inspections and reinforcement by evaluating the extent that safety is ensured by levee inspections in the same way as reinforcement work. As part of this effort, the Division is studying a method of detecting seepage on the surface of levees using thermal images.

## 2. Challenges to the application of the infrared inspection method to river levees

The inspection method using infrared radiation is now used to inspect and diagnose concrete structures by measuring the diel variation of the surface temperature caused by sunlight, air temperature change, etc. as thermal images, to detect defects based on temperature differentials caused by differences in thermal capacity etc.

Table Challenges to the Application of the infrared inspection method to river levees

| | |
|---|---|
| Challenge 1 | Does a temperature difference great enough to be distinguished by a thermal image appear at seepage on the slope of the levee? |
| Challenge 2 | The levee slope is covered with vegetation, but is it possible to detect a temperature difference on its surface? |
| Challenge 3 | The soil quality on the levee slope surface is heterogeneous, but to what degree does the soil quality impact temperature differences? |
| Challenge 4 | On a long levee, it is difficult to obtain thermal images under identical weather conditions, but is it possible to detect defects regardless of conditions? |
| Challenge 5 | Is it possible to perform an efficient inspection based on long-distance photography in relation to the above? |

The above table shows challenges to its application to river levees.

## 3. Results and future challenges

Temperature and soil water content sensors were buried in the slope surface of an actual levee and used to measure diel variation at the same time as thermal images were obtained using an infrared thermo-sensor. The results confirmed that if the surface is bare ground unaffected by vegetation, parts with seepage and parts without seepage create temperature differences (Challenge 1). In the future, the results will be further analyzed to clarify weather conditions which are represented by large differences in the temperature. Deepening studies will be conducted concerning other challenges to be resolved to introduce the method: the impact of the degree of vegetation coverage and plant height (Challenge 2), differences in soil material values of the levee (Challenge 3), study of times of day when detection is possible (Challenge 4), and impact of photography distance limit and angles (Challenge 5). The Division wishes to continue studies so that the results of the research will contribute to more efficient and higher quality inspection technologies to be used to inspect river levees.

[Reference]
1) Manual for River Works in Japan, Management (River), MLIT, 2011

# Trial calculating impacts on maintenance costs and river environments at the river improvement stage and applying the results to river course design

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*(Key words) Maintenance, flood control safety, river environment*

**1. River improvement and maintenance and the importance of harmony with the river environment**

In the future, river improvement guidelines must be enacted nationwide and specific river improvement methods such as river course excavations and tree felling etc. must be established. When that is done, it will be important to specify concrete improvement considering harmony between flood control and the river environment in addition to river improvement and maintenance intended to ensure flood control safety. The River Division has, by introducing the concept of a margin as sediment deposition space, developed a method of uniformly evaluating the cost of river improvement and maintenance, and proposed a method of minimizing the total cost of river management[1]. It will be a particularly useful method on river courses where sediment tends to be deposited at segment change points and at the river mouth. As a result, it was possible to deal with improvement and maintenance as a single activity, but as pointed out under Neo-Natural *River* Reconstruction, it is more important to strive to improve a river to its form several decades in the future than to its present condition. To do so, change of the river course must be predicted to assess its indirect impact on the river environment, then concrete improvement measures must be established.

**2. Evaluating the impact on living organisms of change of the physical infrastructure**

River improvement and maintenance directly alter the physical infrastructure, so for this study, instead of preparing a complex ecosystem change model including competition between living organisms, a living organism response model in conformity with the change of the physical infrastructure is prepared and its impact on the river environment is evaluated. Specifically, the riverbed change calculation model which considers the advance and retreat of vegetation, and a living organism model which responds to change of the physical infrastructure were linked to prepare a river ecosystem change prediction model capable of evaluating the indirect impact after a flood discharge in addition to the direct impact of river improvements (below called the “change prediction model”). The concept of flow capacity margin was added to this to perform integrated evaluations of flow capacity, impact on living organisms, and maintenance costs under the guidelines to river management, multiple drafts of which had been provided. The change prediction model was prepared for the Kita River on the Gokase River System, where large-scale river course excavation had been executed about ten years earlier forming a research field for river ecology research. With the focus on the crab, Deiratonotus japonicas, the fish, Sicyopterus japonicas, and the raccoon dog, which are typical life on the Kita River, the response of these living organisms to the river improvements were evaluated. For example, in a case where a high water channel has been excavated to conserve the underwater environment, it is relatively difficult to evaluate its indirect impact on living organisms, and there are even cases where flood discharge after the improvement greatly changed the water route or riverbed materials, resulting in the sharp deterioration of the underwater environment.

**3. Directions of studies to establish concrete improvement methods**

Calculations to reproduce the short-term change of the physical infrastructure, which was subjected to several flood discharge processes, were done to evaluate their impact on the decline of flow capacity and the living organisms. To decide on concrete river improvement methods, conditions for a study extremely varying its impact on the target living organisms should be set. Long-term calculations are done to totally evaluate the cost flow capacity, and impacts on living organisms in a case where, for example, excavation of dry land was the main improvement, where underwater excavation was the main improvement and where the necessary river section was ensured by combining excavation of dry land with underwater excavation. Therefore, the key to practically applying the change prediction model is how precisely the indirect impacts of river improvement on living organisms can be predicted.

[Reference]

1) Takeuchi et al.: Concepts and specific methods for management to provide a margin to flow capacity, NILIM Report 2011

Topics

# Initiatives for knowledge succession in dam engineering

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TORII Kenichi, Head
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*(Key words) Dam engineering, knowledge management*

**1. Present state and problems with the knowledge succession in dam engineering**

Dam engineering has been developed and succeeded by constructing many dams in Japan. A "knowledge cycle" has been established as follows;

① Various technical standards and know-how possessed by dam engineers have been applied to the construction of dams.
② New knowledge has been learned.
③ Further research and development has been conducted based on this knowledge.
④ At the same time, many experts with this knowledge have appeared one after another.
⑤ Advanced knowledge has been applied to later dam construction through improved technical standards and by experts.

In recent years, technical information and human resources which support this "knowledge cycle" have shrunk and become regionally unbalanced due to a decline of dam construction sites.

On the other hand, there has been a gradual increase in dam alteration projects such as constructing additional large outlets to use the existing dams and reservoirs more effectively. We are forced to carry out design and execution under harsher condition than any previously experienced.

We have to continue challenging such new subjects to make dams safer, more economical and more efficient. For this reason, we need to ensure a requisite "knowledge cycle" for knowledge succession in dam engineering.

Therefore we have studied knowledge management methods to share technical information between regional blocks throughout Japan and permit future generations to succeed to this information.

In 2011, we have, jointly with the Water and Disaster Management Bureau and nationwide regional development bureaus of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT), and the Public Works Research Institute (PWRI), begun initiatives to do so.

**2. Specific methods**

(1) Sharing information through dam engineering study meetings

We organized a dam engineering study meeting (administrator: River Department of the NILIM) which included dam engineers in the Water and Disaster Management Bureau, nationwide regional development bureaus, the PWRI and the NILIM so we could share the results of each activity for knowledge succession. We also created opportunities for dam engineers in nationwide regional development bureaus to study skills and exchange opinions on dam construction sites in various regions (Photo 1).

Furthermore, we built a data base to pigeonhole the contents of technical guidance by experts and preserve them because they will be very important to revise technical standards and have in many cases, been forgotten over time.

(2) Technical guidance by dam engineering advisors

It is also necessary that technical guidance be given smoothly by experts in the future. Therefore the River Department of the NILIM will centrally appoint persons with rich experience and technical guidance achievements as "dam engineering advisors" to provide advice concerning the selection of appropriate persons according to the needs of construction offices.

Photo 1. Technical Committee on Tsuruda Dam Redevelopment Project
Thirty-one dam engineers from regional development bureaus throughout Japan attended
(November 17, 2011)

# Attractions of regions as revealed by migration to rural regions

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*(Key Words) Attractiveness of regions, UJI turn, migration, permanent residency, consciousness survey, national land management*

## 1. Introduction

People are now migrating to rural regions, a phenomenon called the UJI Turn, and the attractiveness of rural regions is being reconsidered. This research analyzed the attractiveness of rural regions through a consciousness survey of people who have migrated to rural regions, a trend which will continue in the future, in order to provide infrastructure based on the values of diverse regions and their citizens. As case studies, the survey was conducted in Ono Town in Fukushima Prefecture, Nichinan Town in Tottori Prefecture, and Tarumizu City in Kagoshima Prefecture, which have aggressively supported migration and have welcomed many migrants (Fig. 1).

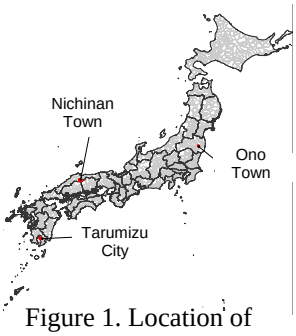


Figure 1. Location of surveys areas

## 2. Values of migrants

Values which migrants consider important in their lives were surveyed in this study. Then the results were compared with the National Survey on Lifestyle Preferences, which was a public opinion survey, to analyze trends which are seen particularly among migrants.

Figure 2 shows characteristics of migrants shown by the survey. When migrating, migrants prioritize whether or not there is work and if it is worth-doing, and seek an environment which provides ample holidays and leisure time. The results of a study of migrants' destinations show that they prioritized the living environment and felt uneasy about whether or not they would get along well with the local people. After migrating to the rural region, they prioritized their family and living environment, other aspects of the environment surrounding them in their daily life, and human relationships with local people.

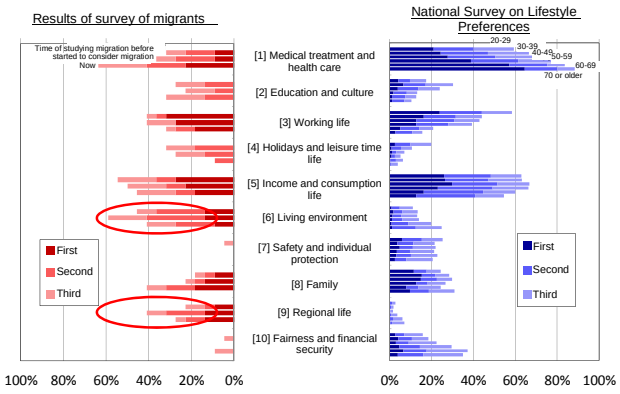


Figure 2. Values of Migrants
(Range of "Important" responses)

## 3. Attractiveness of rural regions seen in reasons for migration

An interview survey of people's reasons for migrating was conducted to analyze the attractiveness of the rural regions from the perspective of migrants. Table 1 shows the results. Judging from the consciousness of migrants responding to the survey, an environment in which they can "Enjoy material resources of the region.", "Use the material resources of the region.", and "Contribute to and to be part of regional human resources", are attractive features of rural regions.

Table 1. Consciousness of Reasons for Migration

| Statements during interviews | Characteristics |
|---|---|
| • Seem to have come for the hot springs.<br>• Having food nearby is attractive. | Wish to enjoy material resources of the region. |
| • Has long been interested in famous natural farming methods.<br>• Wanted to conduct a business taking advantage of sightseeing resources<br>• Moved by never before experienced delicious taste of local vegetables. Wish to expand it as a food product. | Wish to use material resources of the region. |
| • There is a job I want to do, so it was necessary<br>• Was interested in advanced efforts in the medical treatment and welfare field and wanted to work here. | Wish to contribute to and to be part of regional human resources |

## 4. Conclusions

In the future, based on the attractiveness of rural regions as it was revealed by the survey, efforts will be made to enhance the attractiveness of regions and to conduct surveys of the resolution of challenges , through links and exchanges between regions.

[Reference]

Ohashi et al.: A study on characteristics of values in migration to the countryside, Collected Papers of the Japan Society of Civil Engineers, Special Edition F4, Vol. 67, No. 4, December 2011.
Ohashi et al.: Survey of attractiveness of rural regions in the consciousness of migrants to rural regions, Collected Research Papers on Civil Engineering Planning, Vol. 44, November 2011.

# Toward Urban Sustainability and Assessment of Future Urban Images

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*(Key words) Population decline, urban structure, sustainability, prediction/assessment methods, land use and transportation models*

## 1. Introduction

The Urban Planning Department is carrying out "Research on assessment of future images of urban/rural regions during a period of population decline", with the cooperation of the Research Center for Land and Construction Management. . Its purpose is to support the implementation of modulated urban and regional policies typified by "compact cities", which will be sustainable under tight financial and environmental restrictions in local cities, where the population is expected to continue to decline in the future, by developing assessment tools and methods permitting a more rational selection of policies related to future urban structures, by objectively comparing multiple alternative proposals consisting of groups of policy measures[1)2)].

## 2. Outline of achievements of the research

Figure 1 shows the structure of the assessment tools which have been developed and an outline of the flow of assessment using the tools. The tools consist of a model which estimates the impact of alternative policy measures on future urban structures, and a model which evaluates the estimated results, both of which run on a personal computer.

As the Future Urban Structure Estimation Model, a land-use transportation model, which ise used in such cases overseas, is adopted, and introduces perspectives needed for the period of population decline, and responds to a wide variety of entry data. The Future Urban Structure Evaluation Model, on the other hand, can calculate 36 kinds of indices spanning five themes: daily life, safety, environment, vitality, and cost. Case studies were carried out of three cities and regions with differing characteristics, confirming their effectiveness.

In the near future, the aim is to prepare and promote the wide use of a guideline to assessments of future images, in order to contribute to the application of these research achievements by regional governments, etc. It has already been introduced at the National Conference of Urban Planning Department Managers sponsored by the Ministry of Land, Infrastructure, Transport and Tourism, as "an example of a Scenario type Assessment Method" for proposed revision of "Urban Planning Operational Guidelines".

## 3. Conclusions

The use of assessment tools which were developed and the implementation of "Fuuture Urban Image Assessment", will permit rational selection based on objective quantitative comparisons of alternative proposals and allow the study of specific images of "compact cities" suited to each city. And by preparing alternate proposals and comparing the results during citizens' participation deepen understanding of desirable urban structures by citizens, leading to greater involvement of citizens in urban planning.

[Reference]
1) K. Yamashita: City Renovation to Survive the Depopulation and Super-aging Age, Annual Report of the NILIM, 2009.
2) N. Kiuchi et al.: Development of Assessment Method for Future Urban Visions in the Depopulating Period, SB11 Helsinki World Sustainable Building Conference, 2011.

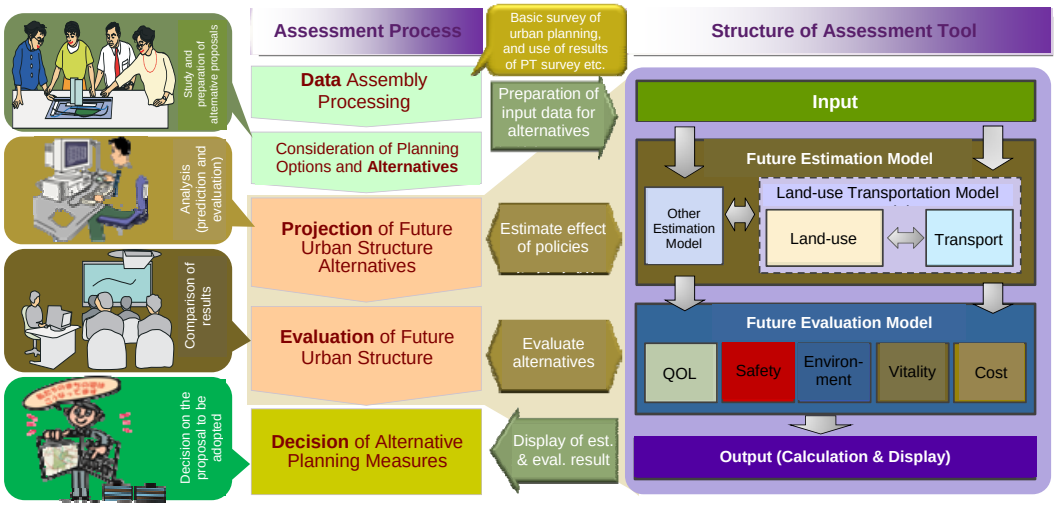


Figure 1. Image of Assessment and Outline of Tools

# Collection of recent cases of efforts to prepare the improvement manual for electric power pole removal

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*(Key words) Electric cable burying, electric power pole removal, simultaneous improvement, electric power pole removal by non-burying method, under-eave cables, rear cables*

## 1. Introduction

Plans to bury electric power cables and to remove power poles have been revised about every 5 years since 1986. And the removal of electric power poles is now being done based on the "Guideline to the Removal of Electric Power Poles" (Fig. 1). Among present improvement methods, electric power cable utility tunnels, originally introduced in 1995, are spreading widely, and there are cases where the more economical shallow burying method is adopted if other site conditions are satisfied. These methods are already stipulated in improvement manuals of many regional development bureaus.

On the other hand, the Simultaneous Improvement Method※1 has not widely penetrated because there is no technical document which describes a specific procedure, and some regional governments have made advanced efforts to use the electric power pole removal by none-burying method※2. There are also cases of innovations such as installing above ground devices at various locations.

The National Institute for Land and Infrastructure Management has collected cases of advanced improvement methods which have not penetrated nationwide, and cases of innovations thought to be effective by distributing information in various regions, and has prepared technical documents which regional development bureaus can use to reflect these improvement methods in their own improvement manuals.

∗1: *"Simultaneous execution" is a method of coordinating work periods to perform simultaneous execution in cases where an electric power cable utility tunnel and sidewalk improvement works are planned for the same period. "Simultaneous improvement" is a method of simultaneously newly constructing or widening a road and constructing an electric power cable utility tunnel at a location where it is predicted that it will be necessary to remove electric power poles in the future.*

∗2: *"Method of installing electric power cables in eaves of buildings or in back alleys etc.*

## 2. Advanced improvement methods

This simultaneous improvement method is superior to the normal electric power cable utility tunnel method in terms of work period and improvement cost, and because it is hypothesized that it will be used where there are few existing buried structures and that its tunnels will be linear with few bends, it will be possible to select this economically superior method (for example, adopting the shallow burying method or the I-shaped special parts to branch or connect electric power cables (integrating electric power and communication lines)). There are also cases presented for reference of the innovative adoption of the electric power pole removal by non-burying method in various regions through cooperation between road managers, electric power line managers, and roadside residents who discuss the cable installation methods and layout of aboveground devices. Photo 1 shows an example of such an innovative case.

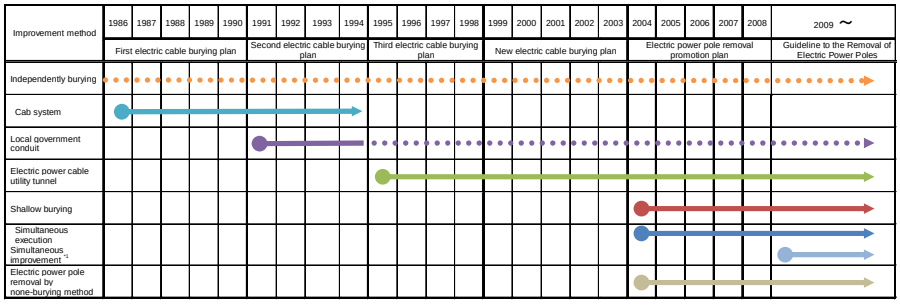
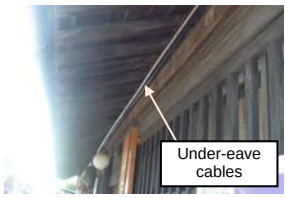
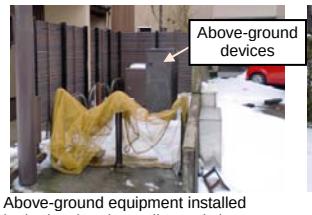



Figure 1. Electric Cable Burying and Electric Power Pole Removal Plans and Changing Improvement Methods

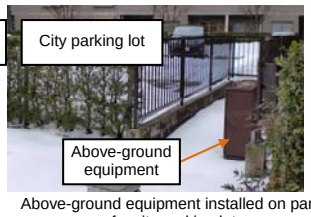
Transformer is in a back alley, eliminating above ground equipment.




This low voltage power line is colored to match the building




Above-ground equipment installed in the local garbage disposal site




Above-ground equipment installed on part of a city parking lot

Photo 1. Under-eave cables and examples of innovative layout of above-ground equipment

**3. Conclusion**

In the future, sample cases of advanced improvement methods which have been collected and technical documents which contribute to lowering the cost of removing electric power poles will be compiled and this information will be distributed throughout the country.

# A Study of Bicycle Travel Speed

Traffic Engineering Division, Road Department
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UESAKA Katsumi (Doctor of Engineering)

*Keywords: Bicycle, travel speed, cycling space*

## 1. Introduction

Bicycle travel speed is seen as a promising indicator for studies of bicycle network plans aimed at promoting bicycle use and securing safe cycling spaces.

While studies of spot speed are available in existing research, there are few studies on long-distance travel speed. In this paper, we present an interim report for a study of travel speed during cycling on flat roads of 5 to 6 km in length.

## 2. Free bicycle travel speed

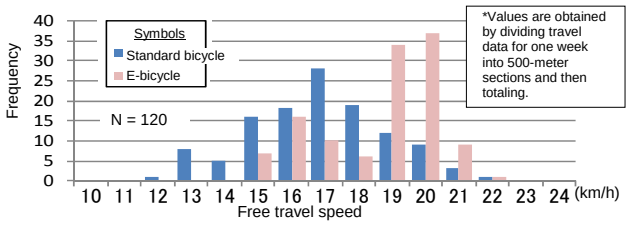
We defined free travel speed as cycling speed that is not affected by road width, traffic volume, traffic signals, or other factors. Then, using NILIM's test course (approximately 6.1 km for one circuit), we conducted an actual cycling study using a standard bicycle for casual riding and an electric power-assisted bicycle (hereafter "e-bicycle"). The results showed that, while the e-bicycle was faster than the standard bicycle in terms of average free travel speed, their maximum speeds were the same (Figure 1). Moreover, we found that the faster a person cycles on the standard bicycle, the more the speed difference between the standard bicycle and the e-bicycle narrows (Figure 2). In addition, although we found some differences in free travel speed due to gender and age, these differences were not significant.

## 3. Bicycle travel speed on public roads

We set up a course with a circuit of approximately 5 km that was comprised of a bicycle lane, sidewalk for use by bicycles and pedestrians, vehicle lane, and narrow street in Kameido, Koto Ward, Tokyo. We then conducted an actual cycling study on this course. From the results, we found that travel speed that includes waiting for traffic signals was much lower than free travel speed (Figure 3). This is thought to be a result of the signal waiting time and the cycling spaces. When we studied travel speed by type of cycling space, we found that speed dropped significantly on the sidewalk for use by bicycles and pedestrians (Figure 4). In addition, we discovered that travel speed on this sidewalk had a positive correlation with pedestrian density (sidewalk crowding).

## 4. Conclusion

Looking forward, we plan to quantify the effect caused by waiting at traffic signals and study a simple equation for estimating bicycle travel time.




| | Average | Median | 85th percentile | Maximum | Standard deviation |
|---|---|---|---|---|---|
| Standard bicycle | 16.8 | 16.8 | 18.2 | 21.7 | 2.1 |
| E-bicycle | 18.6 | 19.1 | 19.8 | 21.7 | 1.8 |

Fig. 1: Distribution frequency of free travel speeds and pertinent data

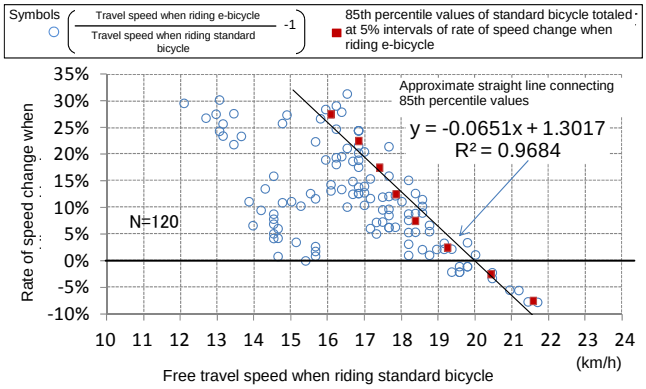
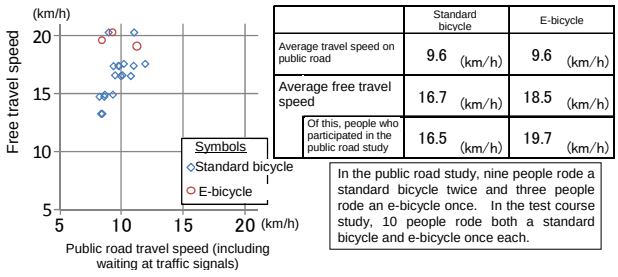



Fig. 2: Comparison of speed differences of standard bicycle and e-bicycle




| | Standard bicycle | E-bicycle |
|---|---|---|
| Average travel speed on public road | 9.6 (km/h) | 9.6 (km/h) |
| Average free travel speed | 16.7 (km/h) | 18.5 (km/h) |
| Of this, people who participated in the public road study | 16.5 (km/h) | 19.7 (km/h) |

In the public road study, nine people rode a standard bicycle twice and three people rode an e-bicycle once. In the test course study, 10 people rode both a standard bicycle and e-bicycle once each.

Fig. 3: Comparison of travel speed and free travel speed on public roads

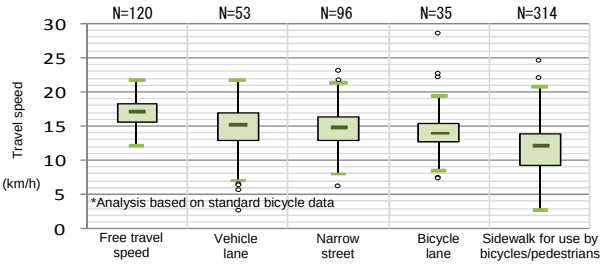



Fig. 4: Relationship between travel space and bicycle travel speed

# Development of Transportation Route Analysis Tool for Container Cargoes Using the Sacrifice Model

Port Systems Division, Port and Harbor Department
IYAMA Shigeru, Senior Research Officer
WATANABE Tomohiro, Head of Division

*(Keywords) Container cargo, transportation route, sacrifice model*

## 1. Introduction

When implementing effective measures and efficiently developing ports and harbors in future, it will be vital to conduct quantitative verification and analysis based on various environmental changes surrounding international maritime container distribution both in Japan and abroad (such as the rapid economic growth mainly in Asian countries and the designation of international strategic ports).

This paper summarizes the construction of a model that will make it possible to analyze changes in routes of international maritime container distribution, and associated changes in transportation cost, based on changes in the distribution environment between Japan and principal regions.

## 2. Outline of the developed model

The model was constructed using the sacrifice model, whereby cargo transportation time is converted to a cash equivalent and the route with the smallest sacrifice volume consisting of the two elements of "time cost" and "transportation cost" (Eq.(1)) is selected.

$$Sr = Cr + Tr \cdot \alpha \quad \text{..... (1)}$$

*Sr*: total sacrifice volume, *Cr*: cost, *α*: time value, *Tr*: time

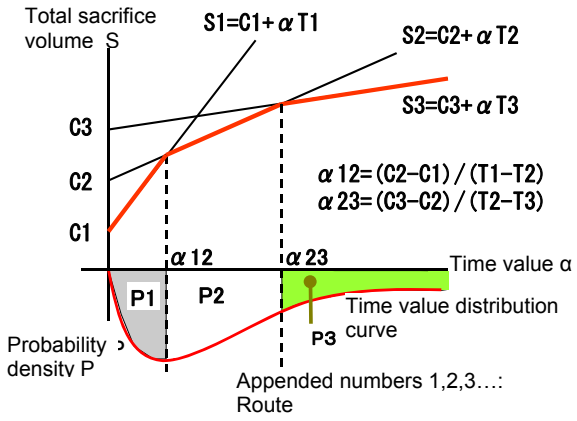



Figure 1. Result of time value estimation (Asian cargoes)

The three straight lines in Fig. 1 show the sacrifice volume for each route expressed in Eq. (1). These show that, when a cargo's time value changes, the route with the minimum sacrifice volume also changes. When constructing the model, we estimated the time value distribution so that cargo operators could select a route consistent with actual cargo transportation data that can be ascertained from the Container Cargo Movement Survey (2008, MLIT).

Figure 2 shows the result of a simulation of cargoes handled by different ports based on the estimated time value distribution. Although there is some discrepancy (for example, the simulation for Ise Bay is smaller than the actual value while that for Hanshin Port is larger), the trends in volumes handled are generally well reproduced, including other ports with smaller cargo handling volumes.

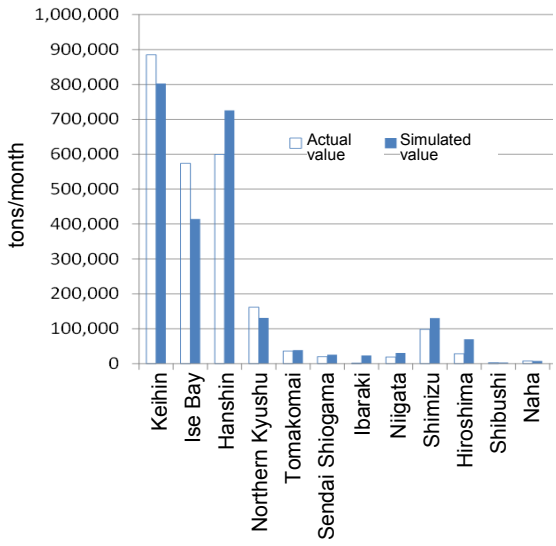



Figure 2. Model simulation values for cargo handling volumes in principal ports

## 3. Use of the developed model in the Basic Policy on Ports and Harbors

This model was used when estimating container cargo volumes for principal ports in the Sept. 2011 change to the Basic Policy on Ports & Harbors (Notification of the Minister of Land, Infrastructure and Transport), based on the forecast of total cargoes handled by Japanese ports under the import and export cargo estimation model.

[Reference]
NILIM Technical Note No. 589, 2010

# Model Development to forecast port cargo volumes related to the Basic Policy for Ports

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IYAMA, Shigeru, Senior Researcher

Port and Harbor Department, Port Systems Division

*(Key words) Basic Policy, port cargo, demand forecast, estimation model*

## 1. Introduction

Regarding future plans for ports in Japan, under the Ports and Harbors Act, port managers enact port plans, but the Minister of Land, Infrastructure, Transport and Tourism has enacted the "Basic Policy for the Development, Use and Maintenance of Ports and Harbors and Development of Sea Routes Designated to be Developed and Maintained" (below called, "Basic Policy") as a guideline which must be followed to enact a port plan. It presents prospects for port cargo volumes and container cargo volumes throughout Japan for the next 10 to 15 years, and prospects for port cargo volumes formerly revised in the autumn of 2004 were revised again in September 2011. A prediction model developed by the NILIM was used for this calculation. An outline of this model follows.

## 2. Outline of the Export/Import Port Cargo Volume Estimation Model

The Export/Import Port Cargo Volume Estimation Model is a model which is divided into the Value of Trade Prediction Block, which estimates the value of trade with major countries and regions of the world, beginning with Japan, and the Port Cargo Volume Calculation Block, which calculates port cargo volumes and container cargo volumes based on the value of trade which has been estimated, with, as its purpose, estimating the port cargo volume and the container cargo volume shipped from or to Japan (see Fig. 1).

The Value of Trade Prediction Block consists of the [1] Manufactured product price prediction sub-model that predicts future manufactured product prices for each country or region considering future change of industrial structure, [2] Trade coefficient prediction sub-model that estimates how much of the manufactured goods which each industry in each country or region needs will be procured from which country or region, and [3] Export/import value prediction sub-model that predicts future value of trade with each country or region, and value of trade by marine transport based on the future final demand by each country or industry. And the Import/Export Port Cargo Volume Calculation Block calculates the port cargo volume and container cargo volume based on value of marine trade, and calculates the future port cargo volume and container cargo volume which will be shipped to or from Japan in the future.

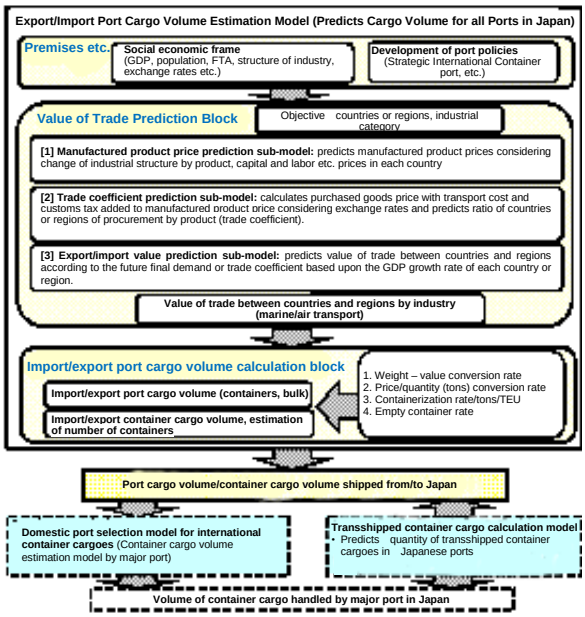



Figure 1. Configuration of the Export/Import Port Cargo Volume Estimation Model

## 3. Application of the Development Model to the Basic Policy

To estimate the predicted port cargo volumes in the Basic Policy which was revised in September 2011 based on the above Export/Import Port Cargo Volume Estimation Model, export-import port cargo volume and foreign trade container cargo volume for 2020 and 2025 were estimated and applied in accordance with various scenario settings including future GDP, exchange rates etc. set by the Ports and Harbors Bureau. And to study prospects for port cargo volumes of the Basic Policy, transshipped containers from overseas which were transshipped in a port in Japan entered with dotted lines in Figure 1 were added at the same time as container cargo volume was predicted by major port in Japan to calculate the future container cargo volume by major port.

[Reference]
- NILIM Report No. 49, Model Development on Estimating Import and Export Port Cargo Volume considering the International Trading and Industrial Structure, December 2011
- Ministry of Land, Infrastructure, Transport and Tourism; Basic Policy for the Development, Use and Maintenance of Ports and Harbors and Development of Sea Routes Designated to be Developed and Maintained, September 2011.

# Proposal for Port Entry Operation to Increase Port Entry Draft of Bulk Carriers

Port Planning Division Port and Harbor Department
AKAKURA Yasuhiro, Head of Division (Dr.Eng.)

*(Keywords) Tidal level, UKC, fairway depth, maximum draft, J-Fairway*

**1. Current status of tidal level use**

Bulk carriers and other large vessels normally use tidal levels when entering and leaving ports. This method means waiting for tides, but enables vessels to enter and leave port with a larger draft. Fig. 1 shows the relationship between fairway depth and maximum draft; the fairway depth added to the tidal level is equal to the maximum draft added to the UKC (Under Keel Clearance). In Australia, USA, Netherlands and other countries, UKC is managed by consulting weather and sea condition forecasts; this system makes effective use of tidal levels when vessels enter and leave port. In Japan, on the other hand, port entry operation is fixed; UKC is required to be about 10% of the maximum draft irrespective of weather or sea conditions.

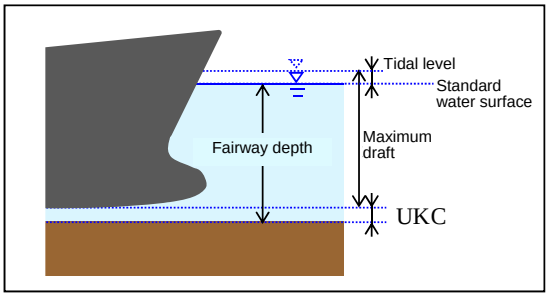



Figure 1. Relationship between fairway depth and maximum draft

**2. Port entry operation using J-Fairway**

J-Fairway is a program for Class 2 verification of fairway dimensions included in the 2007 amendment to “Technical Standards and Commentaries for Port and Harbour Facilities in Japan”. It can calculate the required fairway width and depth to suit various vessel types, weather and sea conditions. Fairway design is computed using the port entry limits for weather and sea conditions. However, in a normal navigational environment in calm waters, the required fairway depth is smaller than the port entry limit conditions. Thus, if the required UKC when navigating the fairway can be calculated in advance by using predictions for waves and tidal level, it will be possible to navigate with a larger draft without losing navigational safety. As an alternative option, the tide waiting time can also be reduced.

**3. Confirmation of effectiveness**

Table 1 confirms the effectiveness of port entry operation using J-Fairway, based on the largest class of bulk carrier conceivable under present circumstances in five ports (selected from international bulk strategy ports). Compared to conventional fixed operation, the port entry draft increased by the “UKC difference”, making it possible to increase the cargo by about 3% of total load capacity. When using the same draft but reducing the tide waiting time, it was confirmed that the fairway navigable time was vastly increased. Using J-Fairway for port entry operation allows operators to make effective use of existing facilities. As such, it is hoped that positive changes to operational standards will be considered in each port.

Table 1. Results of case studies
(2 weeks in June 2011)

| Port | UKC difference (cm) | Increase in cargo tonnage (MT) | Navigable time ratio (average daily ratio) | |
|---|---|---|---|---|
| | | | UKC10% | J-Fairway |
| Onahama | *34* | | *14.0% (3.4)* | *59.8% (14.4)* |
| Kashima | *60* | *9,000* | *56.5% (13.6)* | *91.4% (21.9)* |
| Kisarazu | *55* | *11,200* | *83.0% (19.9)* | *96.1% (23.1)* |
| Nagoya | *37* | *2,400* | *77.7% (18.6)* | *90.5% (21.7)* |
| Shibushi | *35* | *2,300* | *43.8% (10.5)* | *71.4% (17.1)* |

[Reference]
Transport Policy Studies’ Review Vol.15, No. 1
NILIM Research Reports No. 47

# Launch of a Download Site for the Calculation Program for Fairway Dimensions, “J-Fairway”

Port Planning Division, Port and Harbor Department
AKAKURA Yasuhiro, Head of Division (Dr.Eng.)

*(Keywords) Fairway, width, depth, J-Fairway*

**1. Calculation Program for Fairway Dimensions**

The 2007 amendment to “Technical Standards and Commentaries for Port and Harbour Facilities in Japan” prescribes a Class 2 verification method of fairway dimensions. This is a design method that takes account of the performance of vessels and other factors as concretely as possible when it is possible to specify the design vessel and the navigational environment. At the same time as the design method, the Japan Institute of Navigation and NILIM have now developed the calculation program J-Fairway for the benefit of designers.

**2. Studies by PIANC**

In its WG49 “Horizontal and vertical dimensions of fairways”, the international navigation congress PIANC has discussed methods of calculating fairway dimensions on numerous occasions since 2005. In particular, Japan’s new design method has been highly praised, and is due to be included in the final report.

**3. Launch of download site**

To make J-Fairway easily accessible by anyone wishing to use it, PIANC WG49 has requested the operation of download site. Therefore, with the assistance of the Technological Information Division of the Administrative Coordination Department, a download site has been launched on the NILIM web site. Even though the final report of PIANC WG49 has not yet been published, J-Fairway was downloaded 55 times by users in Japan and abroad between the start of operation in October and the end of the year. Designers are encouraged to make positive use of this program when planning fairway dimensions.

[Reference]
http://www.ysk.nilim.go.jp/kakubu/kouwan/keikaku/J-Fairway-e.htm

# Analysis of international air passenger flow in Asia and study of improvement of air travel demand predictions

Airport Department
INOUE Gaku, Senior Researcher

Airport Department, Airport Planning Division
NIU Kiyoteru, Head

*(Key words) International air passenger transport, air travel demand predictions, OFOD statistics, quantitative time series analysis*

## 1. Introduction

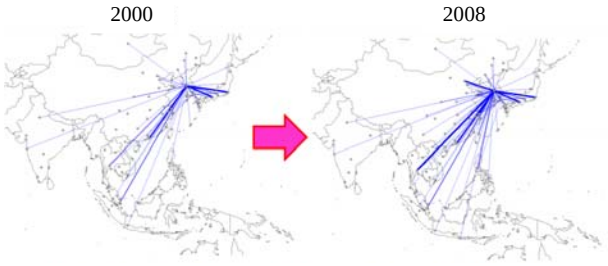
The International Civil Aviation Authority (ICAO) predicts that between 2005 and 2025, air passenger volume in the Asia-Pacific Region will approximately triple (annual average + 5.8%). Such an abrupt change of the air travel market will have a big impact on Japan's aviation and airport policies. There is no air travel demand prediction method that expressly incorporates such a changing trend. So (1) the flow of international air passengers in Asia was organized and analyzed, and at the same time, (2) the applicability of the quantitative time series analysis method was studied as part as basic research to improve air travel demand predictions.

## 2. Flow of international air passengers in Asia

Between 2000 and 2008, the basic structure of international air route network in Asia did not change, but overall the density of the route network was seen to increase. It confirmed that the density of the network of routes originating in China or Korea in particular increased remarkably (see Figure on right). Cluster analysis etc. has quantitatively shown that many of routes on which demand has increased remarkably originate in China, India, Vietnam, and Mongolia, which have seen spectacular economic growth in recent years.

## 3. Applicability of quantitative time series analysis methods to the prediction of air travel demand

The quantitative time series analysis method, which permits analysis based on data which can be obtained relatively easily, is already applied in a wide range of fields such as economics and finance. Of these, the applicability of an autoregressive moving average model (SARIMA) which can consider seasonal fluctuations, to predicting air travel demand was studied, reaching the following conclusions.




Notes:
Thickest lines: 1 million passengers/year or more
Thick lines: 500,000 passengers/year or more
Thin line: 10,000 passengers/year or more

Figure. Changes of the International Air Route Network in Asia (Korea)

(1) A time series analysis method can be effective for short term predictions (about 5 years) of domestic or international air travel passenger demand, which can be analyzed by a differential series.
(2) For a long-term prediction based on a prediction period of 5 to 10 years or longer, the hypothesized section prediction is broad and it is difficult to directly apply this method at the present time.

## 4. Conclusion

Based on recently organized time series data and knowledge obtained, we wish to specify all factors which will have a great impact on the international air travel market in the future, and clarify the impact on Japan's international air travel passenger and cargo flows. And a study will be performed of a model which can consider changes in the state of demand prediction methods to have a great impact on air travel demand trends.

[Reference]
Technical Note of National Institute for Land and Infrastructure Management, Nos. 643 and 652.

# Characteristics of passenger flows departing from local airports

UCHIKADO Mitsuteru, Researcher

Airport Department, Airport Terminal Division

*(Key Words) Local airports, Promotion of the Airport, Characteristics of Airport Passenger, Passenger Large flows*

## 1. Introduction

In Japan's local airports, a paradigm shift from provision to operation or from construction to improvement and promotion of airports is occurring. It is increasingly necessary to improve and use airports corresponding to the characteristics to achieve new goals of promoting tourism and stimulating the regions in the future. We have performed a questionnaire survey at Fukuoka, Oita, Kumamoto, Miyazaki, Hiroshima, Takamatsu and Matsuyama airports in Kyushu and the Seto Inland Sea District to clarify flows of large areas which cannot be grasped by the existing survey. In this study we analyze the results and clarify the characteristics of the passenger flows. We also suggest survey methods which will be used when planning to reform and use the local airports.

## 2. Characteristics of air passengers

The results of analyzing the characteristics of passenger flows departing from local airports based on the results of the questionnaire survey show that the characteristics of passengers differ according to airport and purpose of travel. (Fig. 1)

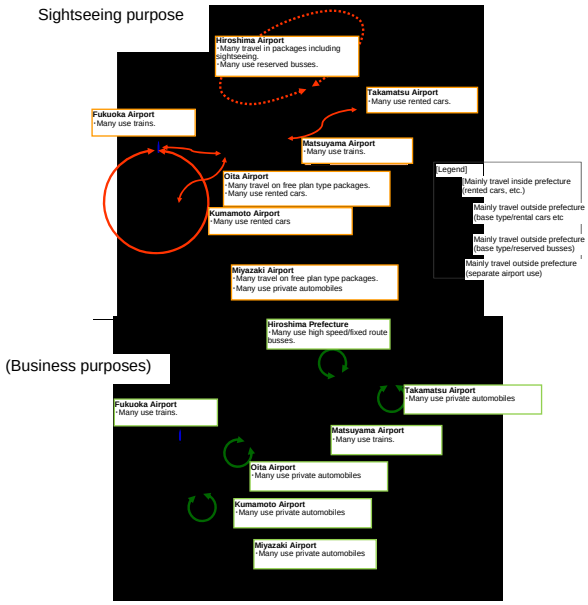



Figure 1. Behavior Characteristics of Travelers (Sightseeing purposes, business purposes)

## 3. Directions of promotion and linkage policies for each airport

Because the form of travel by passengers and the range of passenger flows vary according to airport, policies governing promotion and linkage policies also differ in this way. Figure 2 positions the directions of promotion policies for the purpose of sightseeing, which reveal the characteristics of wide-area flow transcending prefectural borders in particular.

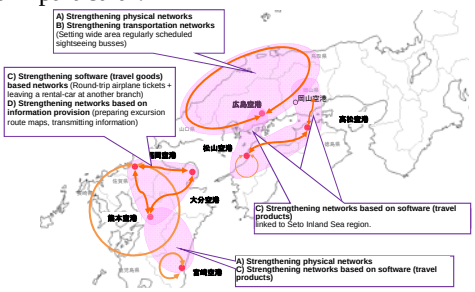



Figure 2. Directions in Promotion and Linkage Policies (Sightseeing Purposes)

## 4. Proposal of the questionnaire survey method to enact promotion policies

In the future, plans for the use of local airports must be prepared based on the clarification and analysis of behavior characteristics at each airport and in each region. Figure 3 shows the required survey flow.

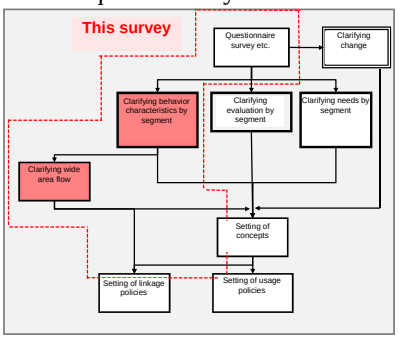



Figure 3. Proposed Survey Flow

## 5. Conclusions

In the future, it will be even more important to strengthen networks spanning prefectural borders. So when setting and implementing promotion policies, it will be necessary to link regional governments and parties

concerned with airports.

[Reference]

○Technical Note of National Institute for Land and Infrastructure Management, No. 242, No. 374

TOPICS

# The Impact of the Great East Japan Earthquake Disaster on Ship Movements

Port Planning Division, Port and Harbor Department
SEMA Motohiro, Researcher
ANDO Kazuya, Research Officer

*(Keywords) Great East Japan Earthquake Disaster, ship movements, AIS data, ship calling data*

## 1. Introduction

The Great East Japan Earthquake Disaster of March 11th, 2011, caused immense damage to port and harbor facilities, particularly in the Pacific coast regions of eastern Japan. Moreover, the accidental release of radioactive substances following a fire at TEPCO's Fukushima No. 1 nuclear power plant had a major impact on the international cargo flow and ship calling of Japan. We therefore organized AIS data and LLI ship calling data to discover the impact of the disaster on ship movements.

Here, AIS data are data observed from signals (vessel name, positional information, etc.) transmitted by the Automatic Identification System, which ships above a certain scale are obliged to carry.

## 2. Impact on ship movements

Firstly, we used AIS data to glean general trends in the impact on ship movements. Fig. 1 shows year-on-year change in total monthly transits by ships through the three main bays (Tokyo Bay, Ise Bay and Osaka Bay), organized by ship type (January = 1.00). The year-on-year decline by pure car carriers after the disaster is particularly stark; this is thought to result from reduced production of finished vehicles owing to the disaster. A sharp decrease was seen even in general cargo ships in April. Tankers, on the other hand, increased from April onwards. This is thought to be because output by refineries in western Japan was increased to fill the gap caused by damage to refineries in Tokyo Bay and on the Pacific coast of Tohoku due to the disaster.

As well as this, we used ship calling data to ascertain in greater detail the state of damaged ports (from Hachinohe to Kagoshima) as compared to ports on the Japan Sea side (from the Japan Sea side of Tohoku to the Hokuriku region). Fig. 2 shows the aggregated ship calling frequency of full container ships, bulk carriers and general cargo ships by month, as well as trends in these.

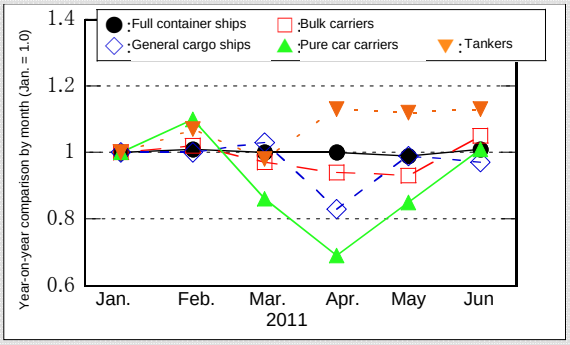



Figure 1. Year-on-year change in total monthly transits through the three main bays

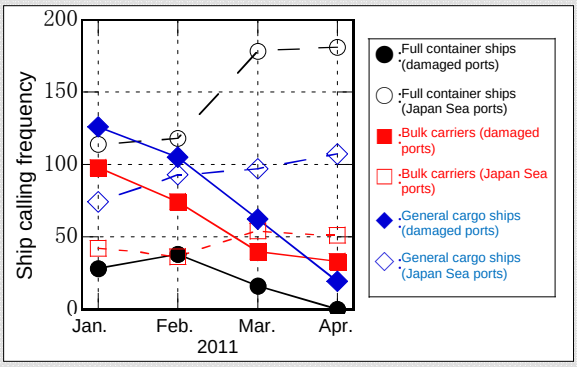



Figure 2. Trends in ship calling frequency

This study confirmed that, while the ship calling frequency in damaged ports decreased after the disaster, it increased in Japan Sea ports, particularly among full container ships, and that therefore the Japan Sea ports served as substitutes for the functions of damaged ports.

[Reference]
NILIM Technical Note No. 649
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0649.htm

TOPICS

# State of Damage and Recovery of Distribution and Industry in Port Cities Following the Great East Japan Earthquake

Port and Harbor Department
SHIBASAKI Ryuichi (Dr.Eng.), Senior Researcher
*(Keywords) Great East Japan Earthquake, port cities, distribution and industry*

The tsunami caused by last year's Great East Japan Earthquake claimed a terrible toll of human life and property, but also destroyed factories, offices and other commercial facilities, causing immense disruption to corporate production and distribution. But since damage to private companies and their recovery processes in such events essentially fall into the category of private activity, they are less likely to be recorded in the public domain compared to cases involving public infrastructure. This tends to be true even when corporate surveys and similar studies are conducted.

Therefore, based on publicly disclosed information in the form of newspaper articles (national, regional and specialist newspapers) and statistical data including trade statistics, we enumerated the damage suffered by companies in each port city and industrial sector and examined their recovery processes (focusing on manufacturing industries and power stations). Enumerating these data enables us to ascertain a number of matters, including (1) the relationship between ground conditions, inundation depth and other factors resulting from a company's geographical location and its damage and recovery process, and (2) the characteristics of damage and recovery processes in different sectors.

For example, on examining the relationship between the inundation depth of disaster-hit factories and the number of days needed for a complete recovery, the observed tendency was that a full recovery takes at least 100 days if the inundation depth is more than 2 meters. On the other hand, in some cases when the inundation depth was less than 2 meters, a recovery had been made one month after the disaster.

Repeating this kind of investigation should make it possible to use the enumerated results as basic data when discussing disaster prevention measures that reflect the impact on corporate activities in future. The details of this study are currently being prepared in the form of a NILIM Technical Note.

# Development of a new model capable of calculating the spatial distribution of age of seawater which has entered a river mouth

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ENDO Maremi, Researcher

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*(Key words) Riverine Estuary, retention time, age, water quality analysis*

## 1. Introduction

Riverine estuaries have complex water environments where fresh water from the river and seawater are mixed in various proportions both in temporally and spatially. This research is intended to support water quality and ecosystem preservation plans for riverine estuaries by clarifying the mechanism which produces oxygen deficient water masses in the bottom layers and various other water quality phenomena which are problems for riverine estuaries by developing a new model[1)] which can be used to quantitatively evaluate the elapsed time (age) after sea water flows into the riverine estuaries.

## 2. Age calculation model

Normal numerical analysis of salinity in riverine estuaries and inner bays calculates the mass balance of salinity for each grid. This process is expressed in terms of advection and diffusion. Necessary values for this calculation such as flow velocity and diffusion coefficients are given from a hydrodynamic model which analyzes the temporal and spatial distribution of flow. The mass balance equation based on advection and diffusion is shown in Figure 1, but if the flow velocities and diffusion coefficients are given by the hydrodynamics model, the only unknown variable is the salinity *C*, so the equation in the Figure 1 can be treated as a linear equation. Thus, even if the calculation is done treating the fractionated salinity by the time each flowed into the river mouth as separate variables, when these are totaled, the value is identical to the concentration calculated in the ordinary way without fractionating the salinity.

If the salinity is fractionated by the time it flowed from the sea through the lateral section of the boundary between the ocean and the river into the river channel, it is possible to obtain the concentration and age for each of the fractionated salinities, so the average age of the existing salinity can be computed for each calculation grid set in the riverine estuaries.

Figure 2 shows the salinity at the river mouth and the average age after flow into the river mouth in vertically two-dimensional distribution, revealing that the age is longer on the upstream side.

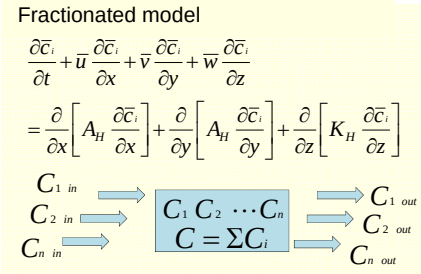


Figure 1. Salinity Mass Balance Equation and Salinity Fractionation

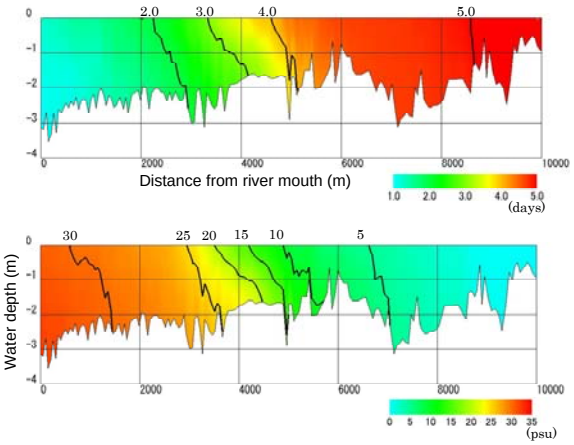


Figure 2. Average Age (Days) of the Salinity and the Salinity (psu)

## 3. Conclusion

The elapsed time (age) of the water mass plays an important role in the fluctuation of water quality in a riverine estuaries. Our new model can quantitatively evaluate this, permitting the clarification of the mechanisms of water quality fluctuation in such areas.

[Reference]
1) Amano et al.: Numerical analysis of environmental effects on the retention time of sea water in riverine estuaries, Journal of the Japan Society of Civil Engineers G (Environment), v. 6, n 7, 2011.

# Analysis of conditions for growth of vegetation in estuaries and application of the results

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*(Key words)estuaries, vegetation, ground level, tides, average submersion depth*

## 1. Introduction

In riverine estuaries, halophytes, reeds and other vegetation which are characteristic of such areas grow thickly, contributing to the formation of the ecosystem. Clarifying conditions for the growth of these types of vegetation will contribute to appropriate river management which considers the environment of riverine estuaries.

This report introduces the results of research intended to generalize preferences in reeds and halophyte communities.

## 2. Relationship between vegetation, ground level, and average submersion depth

We have investigated the Natori River, Ibi River, Yodo River, Ota River (Ota River Floodway) Yoshino River, and Chikugo River, all with differing characteristic such as the scale of their tides. Based on the results of topographical surveys (grid point surveying at 50m intervals and vegetation boundary line surveying) and vegetation surveys carried out by various local management offices in 2009, elevation and vegetation data were organized in 10m meshes by interpolation using GIS to analyze their mutual interrelationships. We have normalized the elevation using the equation defined below.

$$\text{Ground level relative to tidal oscillation} = \frac{\text{ground level} - \text{synodic mean low tide level}}{\text{synodic mean high tide level} - \text{synodic mean low tide level}}$$

Reference document [1] shows the results of an analysis for each community in each river. We defined the mean submersion depth as the value obtained by dividing the total depth of submersions through the year at each ground level by the submersion time ($\int$(water level – ground level)$dt$/submerged time) , analyzed the relation between the ground level relative to tidal oscillation and the mean submersion depth in each district surveyed, and plotted the ground levels at which the reed communities begin to grow and at which their area of growth was largest (peak) in the figure. (In case of the Natori River, the peak is not clear, so it is not plotted.). Although there is some scattering, excluding the Chikugo River where the tides oscillate greatly, growth began at mean submersion depth of 40 to 70cm, and the vegetation growth area peaked at between 15 and 30cm.

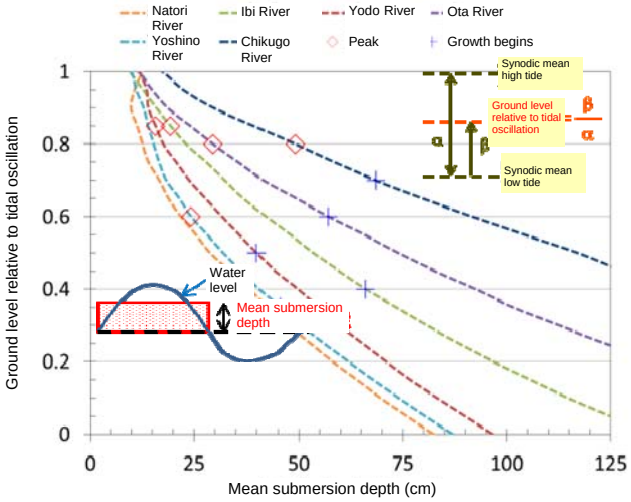


Figure Relationship of the Ground Levels where Reed Communities begin to Grow and where they Peak with the Mean Submersion Depth

## 3. Utilization of the results

In the Ota River, the Chugoku Regional Development Bureau constructed experimental tidal flats for restoration with three types of cross section shapes (completed in March 2010). At that time, it was designed based on the results of a survey of the ground level etc. of halophytes growing thickly in the upstream part of the test area, and the area of growth of Artemisia fukudo and other halophilous plants are gradually expanding. As the above shows, the progress of the research on conditions for the growth of vegetation can contribute to the appropriate river improvement and construction of tidal flats considering the environment.

[Reference]

1) Onuma, Endo, Amano, Kishida: Distribution of vegetation and analysis of its relationship with the tide level on shorelines of brackish water areas in

rivers, Collected Reports on Hydraulic Engineering, Vol. 55, 2011.
2) Onuma, Fujita, Mochizuki, Amano: Research on the framework of river mouth tidal flat design and management methods taking the discharge channel on the Ota River as an example, Collected Reports on River Technology, Volume 17, 2011.

# Research on the effects of public works projects on city planning and community development from the viewpoint of landscape

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*(Key words) Public works project, landscape, effects, city planning, community development, classification, guideline*

## 1. Background/purpose of the research

The Ministry of Land, Infrastructure, Transport and Tourism has expanded landscape policies in public works projects since it promulgated the Beautiful Country Creation Policy in 2003. And city planners are more strongly demanding the creation of landscapes by public works projects, which effect regional landscape and city planning.

But under past landscape policies, sufficient knowledge was not accumulated to answer the question; “Through what kinds of initiatives and processes, are the effects on city planning and community development of landscape creation by public works projects made manifest?”, and it would be difficult to state that the information which public works project leaders can apply has been established.

Under such background circumstances, research concerning the effects on city planning and community development of landscape creation by public works projects is being undertaken to prepare the guideline, a compilation of knowledge and information to be applied to create landscapes with impact on city planning and community development, for field technologists executing public works.

This research classifies the effects on local city planning and community development of landscape creation through public works projects based on analysis of cases. Based on this, the interrelationships between effects and the relationship between effects and landscape creation methods are analyzed to clarify the effects manifestation process. The guideline will be prepared based on the results of these analyses.

This report describes the classification of the landscape creation effects prepared based on past analysis.

## 2. Classification of landscape creation effects

In order to clarify the effects on local city planning and community development of landscape creation by public works projects, 13 landscape creation projects were analyzed to clarify 30 landscape creation effects.

These landscape creation effects are classified by, as shown in Figure 1, focusing on “way effects are manifested” (axis of abscissas) and “cause of manifestation of effects” (axis of ordinate), setting four items “social capital”, “environment”, “economy”, and “recognition”, and setting three detailed items, “setting project framework”, “project implementation method”, and “achievements of project”.

## 3. The future

Based on such a classification of effects, the interrelationships between effects and the landscape creation methods which contribute to the manifestation of effects will be analyzed to clarify the effects manifestation process. And based on the results of such analysis, the guideline for use by field technologists implementing public works projects will be prepared.


Photo 1. Examples of Landscape Creation Analyzed

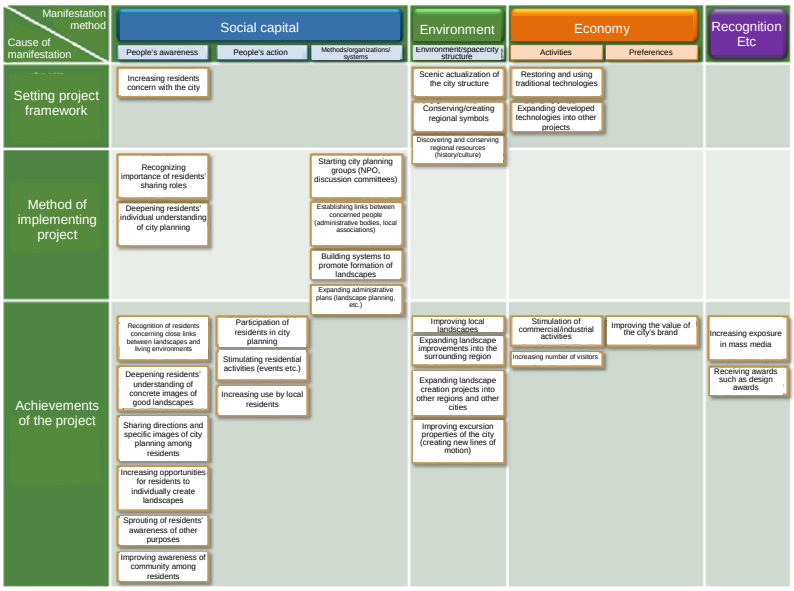


Figure 1. Classification of Effects of Landscape Creation

[Reference]
T. Abe, M. Matsue, H. Fukushima: Research on the effects of public works projects on city planning and community development from the viewpoint of landscape, Collected Research on Landscape and Design of the Japan Society of Civil Engineers, Vol. 7, 2011

# Application of membrane utilization technology to sewage systems

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*(Key words) Maintenance, international standardization, membrane, membrane cleaning, MBR*

## 1. Introduction

Since the development of reverse osmosis membranes in the United States in the early 1960s, research has been conducted to develop a variety of kinds of membranes and to apply separation technologies using membranes, and at this time, they are used in a wide range of fields including manufacturing industries, medical treatment, water treatment and so on. In the sewage and wastewater treatment fields in Japan, the first treatment system using membranes was introduced in 1988 at a night soil treatment plant in Gojome Town in Akita Prefecture. Its application in sewage systems was a little delayed until, in 2005, the public sewage final treatment plant in Fukusaki Town in Hyogo Prefecture was constructed applying a Membrane Bioreactor [*1] (below called, "MBR"). Since then, the number of MBR constructed has increased, with a total of 17 plants (including one provisional facility and one verification trial plant) in operation as of January 2012, and the increase in the use of the method will speed up in the future.

## 2. Intention to apply the technology to sewage systems

MBR, which has become the international standard method of applying membrane utilization technology to sewage systems, is counted on to play the new role of creating water reuse/use networks intended to establish sound water cycles, and to add this role to the original roles of sewage systems, which are ensuring public hygiene and preserving public use water areas. This is a result of the fact that in addition to the ability of MBR to almost completely remove suspended solids and bacteria etc. from sewage, it removes viruses far more effectively than conventional treatment methods, and that it makes it easy to transform an existing facility into an advanced treatment facility.

## 3. Initiatives taken as part of this research

The NILIM has taken action to expand its use by providing technical support by, for example, making a general evaluation of MBR[*1] and by enacting the Guideline to Introduction of Membrane Treatment Technology to Sewage Systems (First Edition, Second Edition). At the present time, in order to prepare a draft MBR maintenance standard, it is collecting general data concerning facility operation and performing field surveys and interviews, to clarify the challenges to maintenance and to study countermeasures. Among these, it is preforming a priority survey of chemical cleaning of membranes, which is the key to clarifying whether or not MBR operation should be introduced, because performing this more efficiently while consuming less power is vital. The results of a past survey[*2], have confirmed that differences between types of membrane and cleaning method etc. have impacts such as temporarily lowering biological treatment functions. On the other hand, it suggests that it is possible to reduce this impact by improving the cleaning method, so in the future, specific improvement measures will be studied.

## 4. International standardization trends

Seven years have passed since the start of activity to promote international standardization of MBR technology by the EU, but at this time, there is no surface movement to realize this. MBR has been introduced not only into industrialized countries, but into many other countries, and ISO standardization is now considered to be important. Japan intends watch trends in Europe while it promotes standardization in cooperation with China and Korea, where the MBR introduction environment is similar to Japan's, and the NILIM will, in order to participate in this, join a committee formed by NEDO (New Energy and Industrial Technology Development Organization).

[Reference]

*1. NILIM web site, "Completion of the General Evaluation of MBR –Evaluation as a Method of Sewage Treatment which can be Applied Nationwide—
http://www.mlit.go.jp/report/press/city13_hh_000100.html

*2. Technical Note of the National Institute for Land and Infrastructure Management, No. 654, pp. 71-76.

# Water utilization effects of rainwater and recycled water

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*(Key words) Use of rainwater, closed system circulation method, impact during droughts*

## 1. Introduction

Rainwater and recycled water can be positioned as water sources which are part of the water cycle along with rivers. A quantitative evaluation of the effect of water use was performed to estimate future water usage in order to ensure the balance of regional water supply and demand, taking into account the fall of drainage caused by the decline of rainfall and water saving measures taken during a drought

## 2. Estimates for recycled water and rainwater

The study was conducted in Fukuoka City, where the use of rainwater and recycled water is promoted. Rainwater reservoirs are installed in private homes and there are systems installed in buildings and public facilities. Recycled water is used in three ways. They are, individual circulation, district circulation, and regional circulation. Individual circulation is a method of reusing gray water by installing a recycling system independently in buildings or other individual facilities,for this study, we shall assume that it is used in conjunction with rainwater. District circulation and regional circulation are methods to use reclaimed water which was treated by sewage treatment facilities. The Difference between them is the difference between the uses of scale. In Fukuoka City, housing rainwater is used along with individual circulation according to regional circulation. This study, and the quantity of water used is calculated considering the water saving rate during droughts with reference to statistical data.

## 3. Results of the estimation

It is hypothesized that circulation is the individual method and the source is wastewater reused in the building, but when a drought lowers the water supplied to the building, also reducing wastewater, the amount of recycled water used will also fall. In this study, processing of recycled water is assumed to be stably maintained as long as the water supply is not depleted even during a drought, and its relationship with the amount of water usage was calculated. The quantity of recycled water used for individual circulation was estimated to be about 1.1% of all water supplied in Fukuoka City. Figure 1 shows one example of the calculation result. As a result of utilizing individual circulation, the amount of the water supply is usually less under normal circumstances. Even during a drought, for part of the recycled water to supplement the decline in water supply, high resistance to drought is a decrease in water use within the facility will be gradual as compared to normal use. In the future, it will be necessary to also increase the cost of facility improvement, maintenance etc., so it will also be necessary to consider the cost balance of drought damage and facility cost etc., but it is assumed that increasing the quantity of recycled water used could increase resistance to droughts.

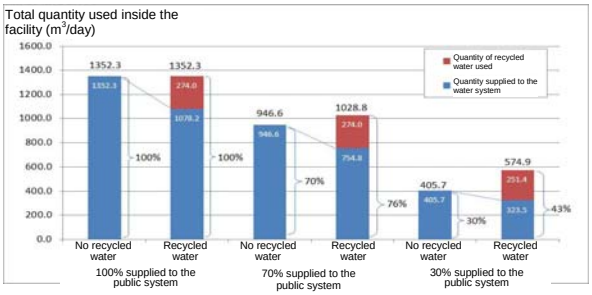


Figure 1. Example of Estimation of Quantity of Recycled Water Used by Individual Circulating

In addition, the future quantity used was also estimated based on rainwater use per detached house and on regional circulation and future numbers of facilities[1)2)].

## 4. Conclusion

It was estimated that the effectiveness of water use as a total quantity for all of the methods of use is only a few percent. This evaluation is an evaluation from the perspective of water use, and multi-faceted evaluations also considering flood control, the environment, etc., are expected to be even more effective. And in light of the fact that new water resource development is difficult, it is important to try and expand from the existing form of water supply to discover new utilization possibilities.

[Reference]

1) S. Mitsuishi et. al.: Study of water utilization effectiveness of general purpose service water in

Fukuoka City, Collected Papers on Hydraulic Engineering, No. 65, March 2012.
2) K. Torii: Water utilization effects based on rainwater and recycled water etc., Base statistical documents, Construction Industry Survey Association, March 2012.

# 3D Landscape Simulation of Leveling Hills

## - New release of plug-in for visualizing changes of land shape -

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*(Key Words)*

### 1. Background

Based on the latest version, 2.09, of the Landscape Simulation System[1)] which was published March 14th, 2011, we developed a new plug-in (flow.dll) for simulating change of landscape caused by leveling of hills, which we released in December 16th, 2011.

After the Great East Japan Earthquake, the Geography Survey Institute elaborated lots of data, which identify the areas inundated by the tsunami, precise land shapes after the tectonic deformation (2m and 5m mesh DEM) and digital maps of objects which classify the buildings and infrastructure into 3 damage level categories. These accurate data, which are quite useful for planning the reconstruction and rehabilitation, had been available only in the metropolitan areas before the disaster.

### 2. Usage of the plug-in to simulate Leveling of Hills

At first, users load the DEM data of the target area, and convert them into the TIN model. On this land, the area to be leveled will be defined through plotting the vertices of surrounding polygons in the orthogonal view. Also, the desired altitude of the area and grading of cut & pile slopes can be numerically defined. After clicking the 'Execution' button, the system automatically calculates the cross-sections among land, slopes and created flat land, and shows it in the main window. If the result is not acceptable, the user can then cancel the operation and readjust the parameters before executing the calculation again.

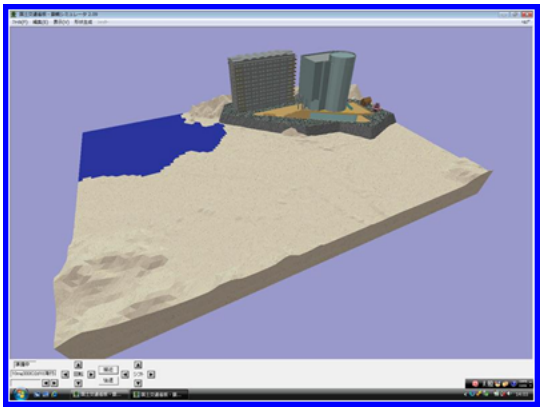

Figure 1. Example, elaborated by a child at a festival

Shapes of a continuous bank or ditch can be also modeled by this plug-in, by defining the narrow and long area to be leveled.

After testing this new plug-in by applying it to several actual land shape data, by normal and reasonable operations for modeling in a laboratory, it was tested by unexpected operations performed by innocent children who visited a festival held in our institute (Nov.19).

However, they could easily understand how to operate it to create flat land in a hilly area, and plotted houses and facilities on the created land. Then a conventional 'Walk-Through' simulation or 'Visible Area Analysis' was performed to check the views from the created land open to the ocean, or views of created slopes from the lower coastal land.

### 3. Usage, application and further improvements

The new plug-in has been freely available since Dec. 16th from our website[2)]. Anyone can attach it to the main system which is also freeware. Along with the publicly delivered land-shape data, community-level usage at affordable cost will be promoted. Planners or designers can also utilize this to create and edit the precise shape of a planned complex on sloping land consisting of house-lots at different levels.

Further improvements will be carried out on the data assimilation between e.g. accurate 3D data of a housing complex and the surrounding rough land shape. Also, volumes of cut and piled soil will be estimated through geometrical calculation.

In other related research, Augmented Reality viewing of the modeled 3D data on site, using the tablets was achieved by the end of February 2012. The permanent preservation of 3D data of lost houses or designed future plans, including un-adopted ideal ones, is another target of our research[3)].

[Reference]

1) "The Architecture of Landscape Simulation System Ver.2.09, provided by MLIT"
Research Report of NILIM No.42, March 14, 2011.
2) http://sim.nilim.go.jp/MCS/flow/flow1.asp
3) http://sim.nilim.go.jp/MCS/phi/phi.asp

# The Handbook of Historic Preservation

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*(Key words) historic preservation, handbook, collected cases, the Law on the Maintenance and Improvement of Historic Landscape in a Community, local plans for maintenance and improvement of historic landscape*

**1. Background and purposes**

The Law on the Maintenance and Improvement of Historic Landscapes in a Community (also, "Historic Preservation Law") was enacted in May, 2008, to promote historic preservation linked with city planning administration and cultural properties administration. As of December 6, 2011, 27 cities throughout Japan had received approval for historic preservation plans based on the Historic Preservation Law, and have begun historic preservation projects taking advantage of their own region's history and culture.

To carry out a historic preservation project, it is vital to appropriately preserve, utilize and restore buildings which are the major elements of historical scenery in line with regional historical characteristics (Fig. 1). But many regional governments have neither appointed employees with specialized technical knowledge or skills, nor been given adequate information concerning preservation, utilization, and restoration procedures or methods which accord with conditions of buildings etc.

So in order to support initiatives taken by regional governments to carry out historic preservation projects and to appropriately enforce the Historic Preservation Law, we have prepared the Handbook including specific methods and implementation processes to implement preservation, utilization, and restoration suitable to each region's historical characteristics of buildings etc. which contribute to maintenance and improvement of their historic environment accompanied by sample cases of advanced historic preservation.

**2. Outline of the Handbook (Draft)**

Figure 2 shows the structure of the Handbook.

First, "1. Historic Preservation in Japan", organizes the genealogy of past measures related to historic preservation in Japan, to organize the significance of and problems with initiatives for historic preservation.

Next, "2. Perspectives and Investigation Methods", presents perspectives of and methods of investigating the historical characteristics—origins of the town, historical resources etc.—of the region, which are the premise for historic preservation.

Then "3. Examples of Initiatives, Methods Etc. for Historic Preservation" organizes historic preservation initiatives and methods accompanied by specific examples for each constituent element of historical scenery.

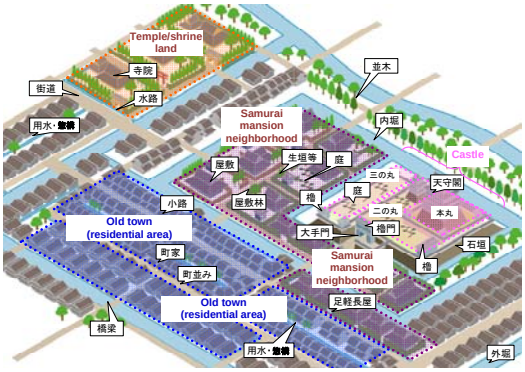


Figure 1. Major Constituent Elements of Historical Scenery in a Castle Town

**3. Using the Handbook**

The Handbook will be released as a Technical Note of NILIM.

(http://www.nilim.go.jp/lab/ddg/seika.html)

The Handbook is counted on to support historic preservation initiatives taken by regional governments.

**1. City Planning Using History"**

**2. Perspectives and Investigation Methods**

- 2-1. The start of Japan's unique towns and the structure of its cities
- 2-2. History of the transformation and change of towns up to the present
- 2-3. Trends in regional planning and contents of regulations and incentives
- 2-4. Organizing cultural properties and other historical resources of a region
- 2-5. Setting directions for historic preservation based on the regional context and resources

**3. Examples of Initiatives, Methods Etc. for Historic Preservation**

- 3-1. Using the structure of a city which is a historical characteristic
- 3-2. Repairing and restoring landmarks and symbols and ensuring their visibility
- 3-3. Maintaining, preserving and restoring elements which are resources for historic preservation.
- 3-4. Precautions concerning the harmony, forms, work methods etc. of materials and structures to improve the scenery
- 3-5. Preserving cultural bonds between the town and its people: festivals and other unique regional events.

# Manual of the countermeasures for tree failure of street trees

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*(Key words) Street trees, lodging, degree of danger, diagnosis, maintenance*

## 1. Introduction

Street trees, which can be lodged by typhoons or other strong winds, may block traffic or obstruct pedestrians and in the past, have caused accidents including personal injuries.

The Manual proposes diagnostic methods to clarify structural tree trunk infirmities and treatment measures to reduce danger in order to minimize the danger posed by lodging of street trees.

## 2. Outline of the Manual on Lodging Countermeasures for Street trees

Lodging countermeasures for street trees are implemented by the following procedure (Fig. 1).

(1) Preliminary diagnosis

The preliminary diagnosis is done to easily visually clarify any problems with the shape or vitality of trees, tree trunk infirmities, etc. in order to identify dangerous trees which require tree soundness inspections or planting environment inspections from among the many trees along roadsides.

(2) Tree soundness inspections

Tree soundness inspections are performed to clarify: [1] defective root system elongation resulting from poor growth of trees, [2] and the decline of supporting strength caused by structural infirmities such as hollows or decay caused by wood-rotting fungi intruding from breaks in the bark on the tree trunk, which are the major causes of lodging during typhoons or other strong winds.

(3) Planting environment inspections

Planting environment inspections include inspections of growing conditions performed to clarify the planting ground, weather conditions, and state of support poles or other supporting materials, and obstruction inspections which predict obstructions which will be caused when a street tree has actually lodged.

(4) Improvement measures

Improvement measures are measures necessary to eliminate or mitigate danger from trees shown by a soundness inspection to be extremely dangerous, considering their functions as street trees.

(5) Lodging verification inspection

When a street tree has caused an obstruction by lodging etc., after determining the cause of the lodging, the suitability of tree soundness inspection or improvement measures is verified.

## 3. Public announcement of results

The achievements have been announced in Technical Note of the National Institute for Land and Infrastructure Management, No. 669.

The Manual is counted on to maintain healthy street trees to contribute to the conservation of abundant green living environments.
http://www.nilim.go.jp/lab/ddg/(Landscape and Ecology Division)

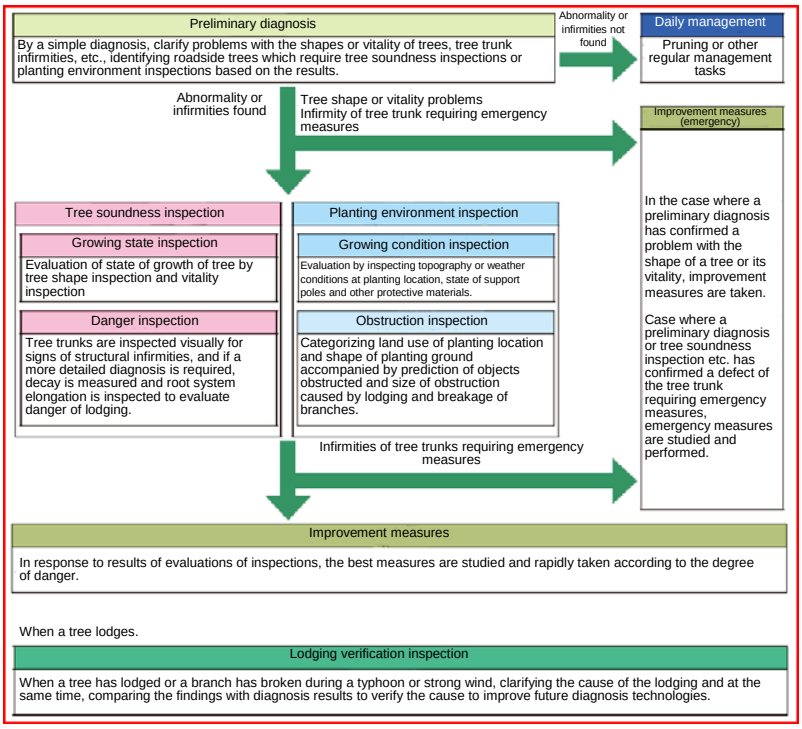


Figure 1. Street Tree Lodging Countermeasure Flow Chart

# Balancing Energy Conservation by Office Task and Ambient Lighting with Amenability

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*(Keywords) Power-saving measures, energy conservation, task and ambient lighting*

## 1. Introduction

After the Great East Japan Earthquake Disaster, many offices conserved power by switching off some of their lighting fixtures ("reduced lighting"). But although reduced lighting brings significant energy-saving effects, it also forms undesirable lighting environments with dark areas beneath switched-off fixtures. This problem arises because Japanese offices most commonly use a general system of lighting in which fixtures are equally distributed across the ceiling to provide lighting at desk level.

By contrast, the system of task and ambient lighting widely adopted in Europe and America is thought effective from the viewpoint of achieving sufficient brightness at desk level while conserving energy. This system follows the rationale of "the right lighting in the right place at the right time", achieved by using individual desk lamps (task lighting) to provide brightness at desk level while slightly reducing the surrounding brightness (ambient lighting). When a position is unoccupied, the desk lamp can be switched off. If properly planned, this system can be used to form visual environments with a good balance between light and dark while at the same time conserving energy. On the other hand, merely introducing a different system of lighting tends not to improve the amenability of the lighting environment.

In this paper, as a simple example, we introduce a case in which renovations were made to improve the amenability of task and ambient lighting introduced with priority on energy-saving characteristics, but without increasing the consumption of energy, resulting in improved evaluation by users.

## 2. Example of further renovation to task and ambient lighting

We introduced task and ambient lighting with priority on energy conservation using LED light sources in an actual office, and then further renovated it to improve the perceived brightness (Fig. 1). To obtain a sense of spatial brightness with the minimum possible increase in consumed power, we used ambient lighting to illuminate dark areas of walls and ceilings. We also surveyed the power consumption and evaluation by office workers before and after the renovation. From the results of the survey, it was shown that a vast improvement in evaluation by office workers (such as a sense of spatial brightness) could be achieved after renovation even when the power consumption of the task and ambient lighting method was kept low compared to the general lighting method (Fig. 2).


Figure 1. Task and ambient lighting before and after renovation

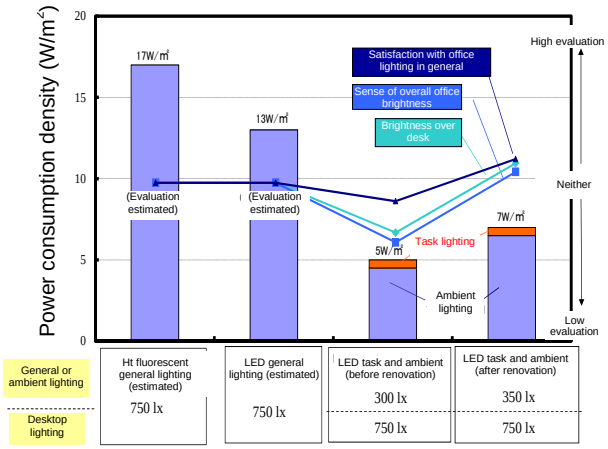


Figure 2. Relationship between lighting method, energy saving and evaluation

## 3. Conclusion

While the task and ambient lighting method could be seen as effective for conserving energy in offices, the case in this paper shows that the quality of the light environment needs to be fully considered in order to balance this with amenability. This research used the results of the MLIT "FY2010 Basic survey on methods of evaluating energy consumption for building standard development promotion projects and commercial buildings" (representative: Tadahiko Ibamoto, Tokyo Denki University).

# Development of technologies for city planning to take effective urban heat island countermeasures

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*(Key words) Urban Heat island, ventilation path, simulation, city planning*

## 1. Introduction

The NILIM has been, through cooperative research with the Building Research Institute, conducting a research project jointly with the concerned bureaus of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) to provide simulation tools and urban planning guidelines to local governments in order to enable them to systematically implement effective urban heat island (UHI) countermeasures.

## 2. Ventilation path as a heat island countermeasure

In order to clarify the actual state and effectiveness of ventilation paths, which have attracted attention as a UHI countermeasure, we are performing large-scale meteorological observations at 190 locations on streets and rooftops of buildings in central and bay area in Tokyo and carrying out numerical simulations using super computer.

It has, for example, been predicted that as the result of creation of a ventilation path accompanying large-scale redevelopment around Tokyo Station, airflow will improve, lowering the air temperature by up to 2°C (Fig. 1) over a wide area.

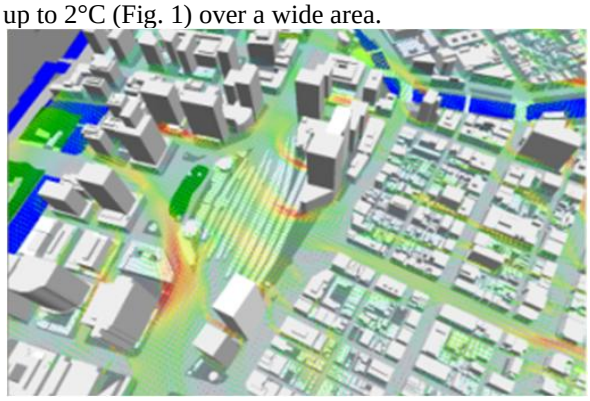

Figure 1. Example of a Simulation of the Effectiveness of a Ventilation Path

## 3. Development of technologies for urban planning

To enable regional governments to predict various countermeasure effects of greening, water retentive paving, ventilation path and so on in city planning, super computer calculation programs have been combined with personal computer software to be used as practical simulation tools capable of predicting the effects of district scale countermeasures. This software has been used by local governments such as Chiyoda Ward in Tokyo, Osaka City, and Kita-kyushu City.

And an environmental atlas called Climatic Atlas of Urban Environments was trial prepared with numerical simulations visualizing the thermal environment including air temperature distribution and airflow etc. as reference information for city planning. Figure 2 is an example of a prototype based on the countermeasure effects of ventilation path etc.

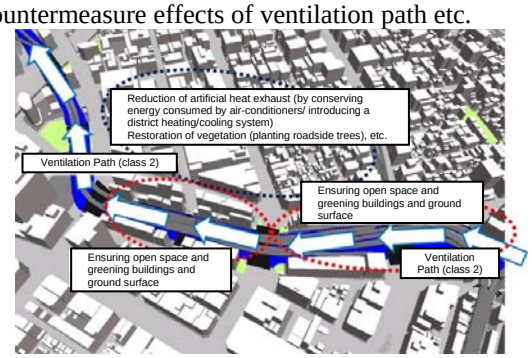


Figure 2. Example of a Prototype of Climatic Atlas for Urban Environment for City Planning

## 4. Achievements and future developments

Its achievements have been reflected to MLIT's Low Carbon City Development Guidance, city planning guidelines or UHI countermeasure plans of several local governments and a future image of a city by a local community development committee.

The future aim is to reflect in the guidelines for operation of city planning of MLIT and spread of the use of technologies which have been developed to promote countermeasures to be implemented effectively linked with low-carbon city planning.

[Reference]

1) Report on NILIM Project No. 20, Development of Synthetic Evaluation Technologies for Improving Urban Thermal Environment, January 2008
2) Technical Note of the NILIM, No. 583, High resolution numerical simulation on the urban heat island of the entire 23 wards of Tokyo using the earth simulator, March 2010

# Study of the implementation of SEA (Strategic Environmental Assessments) in road projects

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*(Key words) Environmental Impact Assessment Law, Strategic Environmental Assessment (SEA), concept stage PI*

## 1. Introduction — Amendment of the Environmental Impact Assessment Law and Introduction of SEA—

Under the amendment of the Environmental Impact Assessment Law (promulgated in April 2011), the procedures of the Planning Stage Environmental Consideration Statement (SEA) will be carried out beginning April 1, 2013. SEA legislates environmental impact statements when a project's position and scale etc. are studied at an earlier stage than the existing Environmental Impact Assessment (EIA), in order to effectively avoid or mitigate serious environmental impacts.

In a road project, at the concept stage (stage when the general route and the basic structure are decided), flexible and smooth communications (PI) with the residents and other concerned parties are accompanied by comprehensive judgments and setting of plans from a variety of perspectives including the environmental, social, economic, etc. Guidelines to the implementation of legally designated SEA at the concept stage of road projects are studied.

## 2. Analysis of the process of concept stage PI cases

Four cases were abstracted from among concept stage PI implementation cases (24 cases) at projects subject to the Environmental Impact Assessment Law (National Expressways and national highways with 10km of four lane sections or more) etc., and the following situations and challenges were clarified by collecting information and conducting interviews.

・The system is operated as follows in line with the "Plan Enactment Process Guideline at the Concept Stage of a Public Works Project (April 2008, Ministry of Land, Infrastructure, Transport and Tourism)".

[1] Initiation→[2] sharing challenges→[3] setting multiple proposals and evaluation items→[4] comparative evaluation→[5]selecting proposed plan

・The introduction of SEA legislates part of these processes (evaluation from the environmental perspectives). It is necessary to clearly display this operating guideline at a site.

## 3. Effectiveness of introduction of concept stage PI

A project planned without performing concept stage PI (case without introduction of PI) and a project planned by performing PI (case with introduction of PI) in adjoining sections on a single route were compared. In a case with PI introduction in a city in particular, the time and cost etc. required at the EIA and city plan setting stage are greatly reduced, clarifying the importance of obtaining the residents' understanding of the project at the concept stage (Table 1).

Table 1. Comparison of Cases With and Without Introduction of Concept Stage PI

| | | | Yokohama ring road, Northwest route (PI introduced) | Yokohama ring road, North route (PI not introduced) |
|---|---|---|---|---|
| EIA, city planning period | | | Approx. 5 years | Approx. 14 years 3 months |
| Cost at EIA, city planning stage | Explanation meetings/public hearings | | • Environmental impact statement explanation meeting: 4 times, 201 participants<br>• Public hearing: once, presentation by one person | • Environmental impact statement explanation meeting: 9 times, 1,470 participants<br>• Public hearing: 4 times, presentation by 83 people<br>• Supplementary explanation meetings: 191 times |
| | Position document | EIA | • 398 (Scoping documents)<br>• 11 (Draft Environmental impact statements) | • 295,947 (Draft Environmental impact statements)<br>• Opinions on all environmental items |
| | | Proposed city plan | • Opinions in opposition to the proposed city plan 1, opinions of approval 17. | • Opinions in opposition approx. 134,000, opinions of approval approx. 83,000. |
| | Discussion of need for and suitability of the project | | Opinions limited | Opinions diffused |
| Environmental countermeasures | Opinions on environmental conservation measures | | Two items are objects of submission of opinions, contents limited | Nine items are objects of submission of opinions, contents diffused |
| | State of implementation of environmental conservation measures | | Environmental conservation items implemented for 9 of 17 items | Environmental conservation items implemented for all items (15 items) |

## 4. Study of correct operation of SEA

Based on the above, a committee of young academic experts (Chairman: TERABE Shintaro, Associate Professor, Tokyo University of Science) in related specialized fields (civil engineering planning, public administration) was established to study how to correctly operate SEA at the concept stage. It has compiled the Correct Operation of SEA at the Concept

Stage of a Road Project (Material for Further Discussion). (Fig. 1)

1. It is most important to operate it to obtain (not reduce) trust in administration.
2. Precautions during each process

| | | |
|---|---|---|
| [1] Initiation | | Specifying implementation of SEA |
| [2] Sharing of challenges | | Environmental side challenges are essential. |
| [3] Setting multiple proposals/evaluation items | | Environmental side items are essential |
| [4] Comparative evaluation | SEA procedures | Evaluation of environmental aspect for each proposed plan (preparing the Consideration Statement etc.) |
| | | Later, comparative evaluation including social and economic aspects. |
| [5] Selecting proposed plan | | Comprehensively judging environmental, social, and economic aspects |

3. Hearing opinions of the Consideration Statement done as a process integrated with the concept stage PI.
4. Selection of appropriate experts and clarification of their roles

Figure 1. Outline of Correct Operation of SEA (Material for Further Discussion)

**5. Future Plans**

The items changed by the amendment of the Environmental Impact Assessment Law including SEA, and the most recent scientific knowledge will be reflected in the Environmental Impact Assessment Technique for Road Project (Manual) (see below) which will be revised by the middle of 2012.
http://www.nilim.go.jp/lab/dcg/gijutsu/gijutsu.htm

# Evaluating the impact of climate change on the natural flow regime of rivers

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*(Key words) Climate change, climate model, drought*

## 1. Introduction

Climate change will greatly change future rainfall patterns in Japan. It is feared that declining snow accumulation and earlier spring thaw than in the past may increase the risk of droughts. The NILIM has, as part of the Innovative Program of Climate Change for the 21st Century, obtained climate model based predictions as information which contributes to evaluating impact on water resources and studying the application of countermeasures, translated these into hydrological information for regions throughout Japan, and analyzed change of the flow regimes of rivers flowing into dams distributed in climate zones throughout Japan in the future (end of 21st century) and near future (30 years from now). This was accompanied by the presentation of differences in the change of flow regimes revealed by the results of four different climate models, in order to be able to resolve the uncertainty of climate models.

## 2. Climate models used

The climate models used to calculate future river flow regimes are the four models shown in Table 1 considering the fact that they output values throughout the year and that they satisfy the spatial resolution (about 20km) necessary to calculate a river flow regime.

Table 1. Climate Models Used

| Climate model | Emission scenario | Calculation period | | |
|---|---|---|---|---|
| | | Present | Near Future | Future |
| Reform Stage 2: GCM20 | A1B | 1979-1998 | 2015-2039 | 2075-2099 |
| Reform Stage 1: GCM20 | A1B | 1979-2003 | 2015-2039 | 2075-2099 |
| Coexistence: GCM20 | A1B | 1979-2003 | — | 2075-2099 |
| Meteorological Agency RCM20 | A2 | 1981-2000 | 2031-2050 | 2081-2100 |

## 3. Estimating the river flow regime

The flow regimes of the flow into reservoirs in the future and the near future were calculated for 15 dams which are the furthest upstream dams in their respective rivers throughout Japan. The rainfall values used for the calculation are climate prediction model values with their biases corrected by AMeDAS observed values. And the rainfall and snow were again distinguished based on ground surface temperature, then corrected so they were in harmony with the observed accumulated snow depth value. The quantity flowing into the dams was estimated using a four-level tank model, and the discharge caused by the spring thaw was handled as the quantity flowing into the top level tank.

The results of the analysis show that in the near future and future, tendencies common to the four climate models will appear: large annual fluctuation as the flow rate falls during years of light rain and rises in years of heavy rain, accompanied by a remarkable fall of the summer flow rate beginning in May at dams in Hokkaido, Tohoku, Kanto, and Hokuriku, where the spring thaw runoff is remarkable. Because similar trends appeared in all four climate models, it is hypothesized that it seems to be quite certain that these trends will appear in the future. Figure 1 shows an example of calculation results (inflow into a dam on the Japan Sea coast side of Hokkaido).

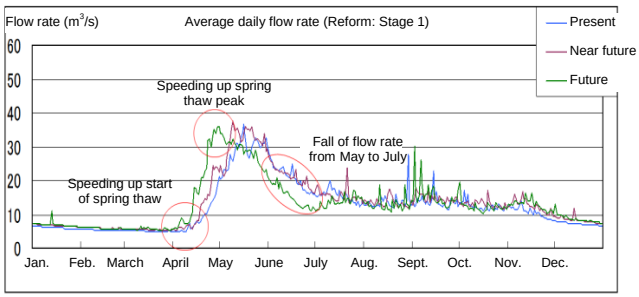


Figure 1. Estimated River Flow Regime (Dam on the Japan Sea Coast of Hokkaido)

## 4. Future endeavors

In the future, examples of proposed application measures will be presented by analyzing differences between the change of regional flow regime trends and by assessing drought risk including predicted change of water use.

[Reference]
Ministry of Education, Culture, Sports, Science and Technology: The Innovative Program of Climate Change for the 21st Century, Prediction of the Change in future weather extremes using SuperHigh-Resolution Atmospheric Models, Report on Research Achievements of 2011, March 2012.

# Effective inundation countermeasures to prepare for the future increase of heavy rain

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*(Key words) Increase of heavy rain, inundation countermeasure, unsteady flow model*

## 1. Introduction

In recent years, heavy rain of 50mm/hr or more has fallen frequently in various parts of Japan[1)]. Measures to prevent disastrous inundation are being taken by local governments, but it is considered possible that in the long term, as a result of change of the rainfall characteristics, present inundation countermeasures alone might be unable to handle heavy rain with 5-year probability or 10-year probability. So the NILIM is conducting studies to clarify future heavy rain increase trends and countermeasures to deal with this increase, and abstracting problems related to the enactment of rainfall countermeasure plans and studying improvement measures.

## 2. Studying countermeasures to deal with the increase of heavy rain

We used annual maximum rainfall intensities from 1960 to 2009 at 57 meteorological observatories nationwide to predict the increase rate of 10-minute/60-minute rainfall intensity with 5-year/10-year probability during the next fifty years in each observatory. The results showed a trend for 10-minute/60-minute rainfall intensity with 5-year/10-year probability nationwide to rise to a maximum of between 1.3 and 1.4 times the present levels (95 percentile values) fifty years in the future. Based on this, inundation simulations were performed for three districts to evaluate the impact on existing inundation countermeasures of the future increase of heavy rain, revealing a case where it is predicted that the area inundated to a depth of 20cm or more will increase between 4% and 9%. The results also suggest that in a case where the rainfall drainage capacity is insufficient over a wide area, or in a case where local inundation is caused by the drainage capacity of a branch channel, it will be necessary to take countermeasures appropriate considering the cause of inundation in each district.

In the future, we will universally evaluate the impact that the increase of heavy rain will have on inundation countermeasures to suggest specific measures according to the characteristics of inundation.

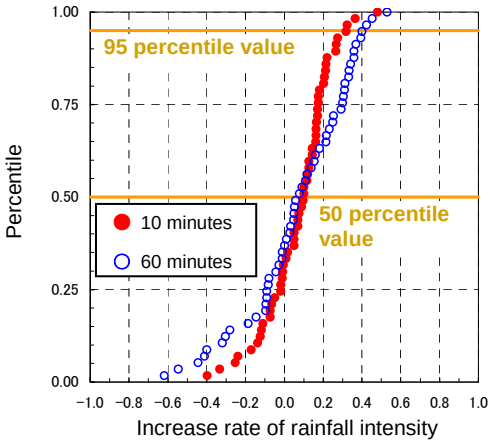


Figure 1. Distribution of Increase Rate of 10-minute/60-minute Rainfall Intensity at 57 Observatories Nationwide (5-year probability)

## 3. Survey of rainfall countermeasure plan enactment methods

In order to deal with the future increase of heavy rain, it is becoming increasingly important to efficiently enact rainfall countermeasure plans by combining several inundation countermeasures using an unsteady flow model. But in many cases, because objective judgment standards for setting the scale of countermeasure facilities have not been generally introduced, an unsteady flow model is only used as an evaluation tool to discover operation methods and temporary countermeasures for facilities designed applying previously used rational formulas.

Based on this situation, we collected information about cases of the enactment of rainfall countermeasure plans for about 20 cities nationwide, and are now abstracting problems with rainfall countermeasure plan enactment methods and studying improvement measures.

[Reference]
1) Ministry of Land, Infrastructure, Transport and Tourism, Sewerage and Wastewater Management Department website
(http:/www.mlit.go.jp/mizukokudo/sewerage/crd_sewerage_tk_000117.html)

# Evaluation of dam flood control using rainfall prediction

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*(Key words) rainfall prediction, dam flood control operation*

## 1. Introduction

Dam flood control operation using rainfall predictions has been suggested as one way to improve the flood control functions of existing dams. It can optimally and efficiently use the flood control capacities of dams. However, the result of flood control operation based on rainfall predictions may be even worse than that by conventional regular flood control operation which does not use rainfall prediction when the actual rainfall greatly exceeds the prediction. Therefore, rainfall prediction has not been quantitatively utilized in practical dam flood control operation . This report aims to describe the method which evaluates merits and demerits of dam flood control operation based on rainfall prediction by considering rainfall prediction errors.

## 2. Evaluation by anticipating the inundation damage

Fig.1 shows a comparison of the inundation damages for several floods with different scales. Each flood was controlled by the two types of flood control operation. The one operation (hereinafter operation A) is the conventional regular flood control operation and the other (hereinafter operation B) is the operation which sets the outflow discharge smaller than that of operation A by 100 $m^3/s$. Those experimental floods were obtained by multiplying several scale factors to a certain hyetgraph. In a case where the scale factor is small, the inundation damage with operation B a which stores large volume of flood water is smaller than that of operation A. On the contrary, the inundation damage by operation B becomes larger than that of operation A in the case where the scale factor is large because operation B causes the flood control capacity of the dam to be full earlier than operation A. As a whole, operation B is superior to operation A on the condition that the scale factor is smaller than 1.7 and operation A is conversely superior to operation B on the condition that the scale factor is larger than 1.7. This relationship appears when a rainfall prediction is referred to. In particular, if the scale factor is replaced with the error of the rainfall prediction,, operation B is superior on the condition that the actual rainfall is smaller than 1.7 times the rainfall prediction and vice versa. This relation is one of the reasons that rainfall predictions cannot be practically applied to dam flood control operation. The expectation of inundation damage is proposed in this research to comprehensively evaluate dam flood control effect while considering the error of rainfall prediction. It is expressed as the integral of the multiplication of the probability on the error of rainfall prediction and inundation damage (Eq.1).

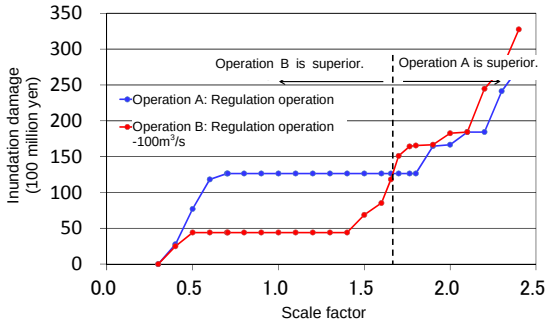


Fig.1 Scale factor change on inundation damage

$$E = \int P(r) \cdot C(r) dr \qquad \text{Eq.1}$$

Here, $r$ is the error rate of rainfall prediction defined by actual rainfall/rainfall prediction, $P(r)$ is the probability density function on $r$ and $C(r)$ is the function of the inundation damage on $r$.

The expected inundation damage is estimated by introducing the probability of error rate on rainfall prediction to the result of Fig.1 and those values are 1.26 and 4.6 billion yen for operation A and B respectively. This means that operation B is superior to operation A as the expectation of inundation damage. However, it is essential to be aware that there is little possibility that flood control by operation B might result in higher inundation damage than that by operation A.

## 3. Conclusion

The practical application of the proposed method will be studied by analyzing the rational method of setting the probability density function $P(r)$ based on accurate evaluation of a rainfall prediction and the impact of $P(r)$ and $C(r)$ on the estimated expectation of inundation damage.

# Predicting the impact of water temperature increase on cold water fish that may be induced by climate change

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*(Key Words) Climate change, global warming, river water temperature, cold water fish*

## 1. Introduction

It is predicted that global warming will be accompanied by climate change, but it is difficult to quantitatively evaluate its impacts on river ecosystems. This research hypothesized that global warming will increase river water temperature to study its impact on the fish species inhabiting rivers.

## 2. Evaluation of water temperature dependency of fish species

Data representing river water quality and the national survey for river and riparian ecosystems were analyzed for 109 Class A river systems in Japan. The frequency distribution of river water temperature values at locations confirmed to be habitats of 5 common fish species and 6 stenothermal cold water fish species were obtained, then compared with the frequency distribution of all measured river water temperatures nationwide, to analyze water temperature dependency of these fish species. We have used 24-year period data for river water temperature analysis.

The frequency distributions of water temperature measured at confirmed locations of 5 common fish species were almost identical to the frequency distribution of all data, but the measured water temperatures at locations where yamame trout or other cold water fish were confirmed were biased towards low temperature and the frequency it exceeded 25C° was particularly low (Fig. 1). When the mean annual maximum temperature was obtained and analyzed, at

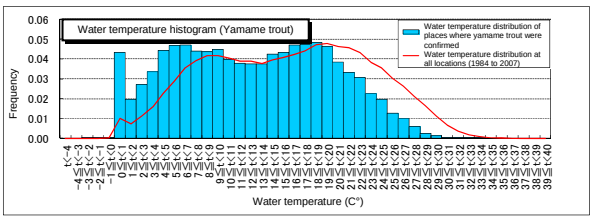


Figure 1.Water Temperature Frequency Distribution at Locations Where the Cold Water Fish, Yamame Trout, were Confirmed (Blue) and Water Temperature Distribution in Rivers Nationwide (Red)

locations where cherry salmon or yamame trout were confirmed, the temperature never exceeded 26C°, and it can be concluded that the surrounding water temperature is the limit for the habitation of cold water fish [1)].

## 3. Sensitivity analysis of water temperature increase and summary

Figure 2 shows the estimated mean annual maximum water temperature distribution based on the results of the nationwide water quality survey of public water bodies. The mean annual maximum water temperature is below 26C° in and north of Tohoku , and in regions to the west, it is partially distributed in Shinshu or in mountainous regions.

If we assume the mean annual maximum water temperature increases by 1C° nationwide, focusing on the change of the area with temperature below 26C° where cold water fish will be able to live, their habitable range which equals about 9% of the national land will be lost, with possible negative impact on the habitats of cold water fish such as cherry salmon that are widely distributed in western Japan [1)]. And if the maximum temperature rises by 5 C°, the area of the national land where rivers in which cold water fish can live are distributed will fall to about 5%, so they will

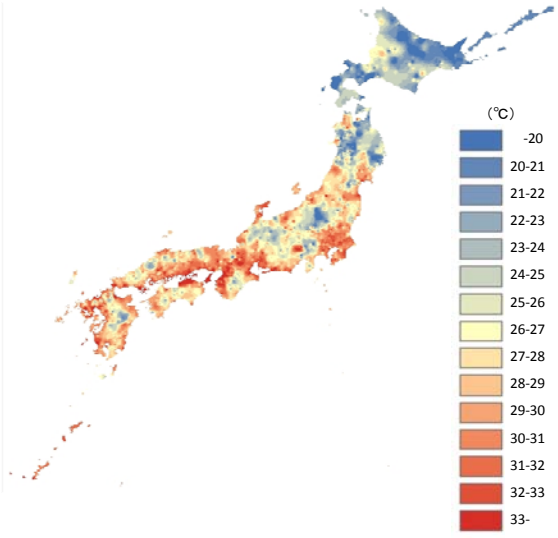


Figure 2. Nationwide Distribution of Estimated Mean Annual Maximum Water Temperature

no longer exist anywhere in Honshu, making it very difficult for cold water fish to survive.

[Reference]

1) Amano, K. and T. Mochizuki: An assessment of the dependency of fish and aquatic invertebrates on water quality using the national survey for river and riparian environment, Advances in River Engineering, JSCE, Vol.17, 2011.

Topics

# Expanding torrential rainfall monitoring regions with X-band MP radar

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*(Key words) X-band MP radar, torrential rainfall monitoring*

## 1. Expanding torrential rainfall monitoring regions

In recent years, drownings and flood disasters caused by localized heavy rainfall and concentrated torrential rainfall have occurred increasingly often. So the *Water* and Disaster Management Bureau of the Ministry of Land, Infrastructure, Transport and Tourism has introduced X-band MP radar, strengthened the resolution of radar rain information, and enhanced its real-time availability in order to strengthen rainfall monitoring systems. The National Institute for Land and Infrastructure Management is building data processing and transmission systems to realize more advanced radar rainfall information, conducting technical studies of scan modes, parameter tuning etc. needed for trial operations of X-band MP radar, and studies to improve precision by advancing rainfall observations, the correction of attenuation, and synthesis methods. X-band MP radar started trial operation in some regions in 2010, and new trial operation regions will be added beginning in July 2011, expanding the area where torrential rainfall is monitored (Fig. 1). This is extending the observation range to all government ordnance designated cities except Sapporo to strengthen torrential rainfall monitoring systems in cities. The monitoring systems around Mt. Kurikoma and Sakurajima Island, both regions at high risk of sediment disasters, were strengthened.

In the Niigata Region, one more X-band MP radar base will be established to start monitoring by two bases beginning in 2012, in order to reduce the areas where monitoring is impossible during torrential rainfall. Land subsided and river levees were damaged as a result of the earthquake and tsunami caused by the Great East Japan Earthquake, so to strengthen torrential rainfall monitoring systems in this disaster region, where safety from flooding has declined, X-band MP radar will be introduced in Tohoku and the Northern Kanto.

## 2. Examples of the use of X-band MP radar rainfall information

In Niigata, where trial transmission started in 2011, X-band MP radar based rainfall information was used by regional governments as reference information to order flood-fighting activities and evacuations during the Niigata/Fukushima torrential rainfall of 2011. When typhoon No 12 of 2011 triggered the collapse of soil, blocking river courses, X-band MP radar rainfall information for the Kinki Region was used as rainfall information to monitor the collapse of the soil blocking the rivers.

## 3. Developing technologies using X-band MP radar

The National Institute for Land and Infrastructure Management, regional development bureaus, and universities and research institutes, are developing technologies using X-band MP radar to achieve early detection of torrential rainfall, to improve rainfall predictions, and to increase the precision of inundation predictions.

The National Institute for Land and Infrastructure Management is carrying out studies using X-band MP radar rainfall information to improve inundation simulations of urban regions, and advance evacuation information systems in water parks. In the future, the NILIM plans to perform research on the detailed evaluation of precision of monitoring by X-band MP radar and on the precision of calculation of average river basin rainfall.

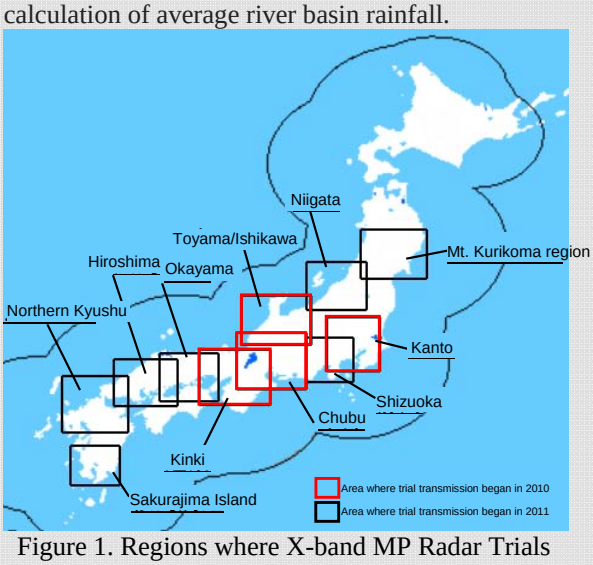


Figure 1. Regions where X-band MP Radar Trials have Begun

# Toward environmentally sustainable infrastructure development using an LCA tool

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KANDA Taro, Researcher
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*(Key words) Sustainability, LCA, environmental load coefficient, carbon dioxide emissions, final disposal of wastes, natural resources consumption*

## 1. Introduction

We developed an LCA method for infrastructure (Infra-LCA). This paper introduces efforts now being made to put this calculation method into practical use.

## 2. Publication of the LCA manual and the database of environmental loads coefficients table

The Infra-LCA manual and the database of environmental loads coefficient tables are available from "http://www.nilim.go.jp/lab/dcg/index.htm". The following are special features of the infra-LCA method.

- The environmental loads coefficients tables are classified into three groups. Each group is used at a different level of decision making. The first group is used to compare environmental loads according to structure types at the planning level, the second group is used to compare environmental loads according to work type at the design level, and the last group is used to compare environmental loads according to material and construction machine types at the construction level (see Fig 1).
- Categories of the coefficients correspond to the element of cost estimation.

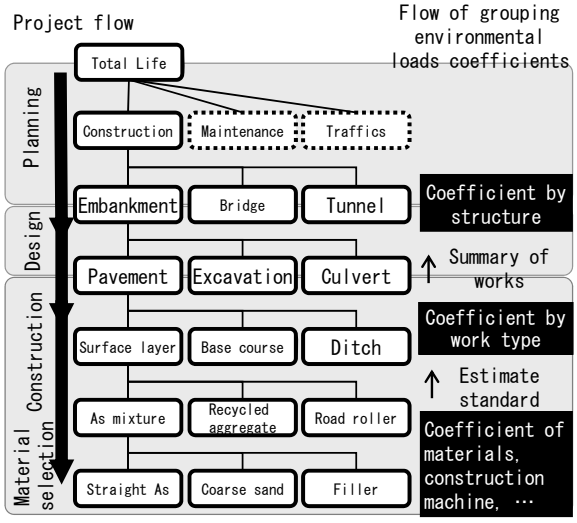


Figure 1. Group of environmental loads coefficients

- The environmental loads of new technologies can be calculated under the completely same conditions as the ordinary environmental loads.

The environmental loads coefficients cover carbon dioxide emissions, final disposal of wastes, and consumption of natural resources.

## 3. Confirming the usefulness of the calculation method for infra-LCA

Validation of infra-LCA is being conducted by a working group established by the Japan Society of Civil Engineers. The working group consists of scholars specialized in LCA and members of construction consultant companies and construction companies. The working group pointed out that the environment loads of miscellaneous expenses, which are estimated by multiplying a certain ratio to cost of labor, material or something, should not be ignored although it is difficult to determine this using the present calculation method. We will closely examine the miscellaneous expenses, and set a method of calculating the environmental loads if necessary.

## 4. Finding low-environmental loads technologies

The working group has been conducting many case studies to find how we can reduce the environmental loads in design and construction technologies and how much cost will be needed to achieve the reduction targets. Past studies show that the construction field has many more technologies to reduce cost as well as environmental loads than other fields.

## 5. Introduction of infra-LCA into practical use

Introduction of infra-LCA is undertaken in some specific usages. One usage is the standard to designate proposal items as environmentally recommended items under the Act on Promotion of Procurement of Eco-friendly Goods and Services by the State and Other Entities. Besides this, the application of carbon dioxide emissions coefficients in a technical guideline of pavement published by Japan Road Association is planned.

# Carbon dioxide uptake by recycling concrete rubbles

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*(Key words) Concrete rubble, recycling, carbon dioxide uptake, sound material-cycle society, low carbon society*

**1. Emerging expectations of construction recycling**

"The 2nd fundamental plan for Establishing a Sound Material-Cycle Society" shows that establishment of a sound material-cycle society should be promoted in harmony with a low carbon society. Construction recycling has maintained a high recycling rate for the past 10 years, contributing to a sound material-cycle society. In addition to this role, construction recycling is now expected to contribute to the reduction of carbon dioxide ($CO_2$) emissions.

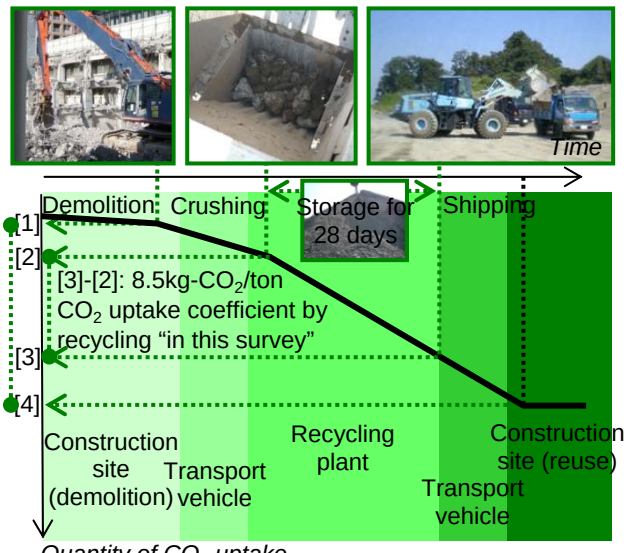
**2. $CO_2$ uptake by recycling of concrete rubbles**

Concrete rubble is the major construction waste. We have shown that recycling of concrete rubbles absorbs 8.5kg/ton of $CO_2$ due to neutralization (see Fig. 1). This result means 260,000 tons of $CO_2$ are absorbed in Japan every year through construction recycling, comparable to 40% of the $CO_2$ absorbed by restoring urban vegetation. The $CO_2$ emissions coefficient of recycled concrete aggregates is much lower than that of natural crushed stone.

**3. Current Research**

Road construction works have maintained sufficient capacity to accept all the recycled concrete aggregates. However, future recycle is anticipated to be difficult because of increasing old buildings and decreasing construction demand. Then efforts will be made to develop new recycling uses of concrete rubble. In order to continue contributing to the low carbon society, a $CO_2$ uptake coefficient based on new uses should be evaluated. We have started to examine the $CO_2$ uptake coefficients regarding new recycling uses.

We have also started to develop an on-site method of estimating the $CO_2$ uptake coefficient quickly and easily because the $CO_2$ uptake coefficient will vary according to the recycling method even if recycling use remains the same. We focus on the color distribution of concrete rubble which appears when a pH indicator (phenolphthalein (PP)) is sprayed. PP has been widely used to check the durability of concrete structures. We found that the color of the concrete specimen is distributed in a specific manner (see Fig. 2) and is related to the quantity of $CO_2$ uptake.




[4]-[1]:$CO_2$ uptake coefficient by recycling "in the ordinary sense"

Figure 1. Present $CO_2$ Uptake Coefficient by Recycling of Concrete Rubble

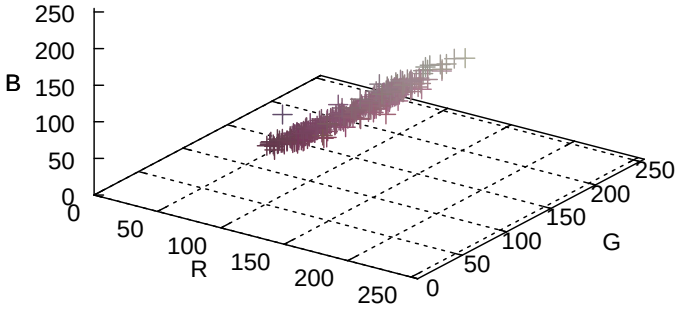



Figure 2. Example of RGB Distribution of Concrete Specimen by PP Reagent

(Note) RGB: Indices of the strength of red (R), green (G) and blue (B) which are the three primary colors of light. Here the scale from 0 to 255 which is widely used for image processing is applied.

# Verification of the superiority of motorcycles as a road traffic mode kind to the global environment

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*(Key words) Global warming, carbon dioxide emissions, motorcycles*

## 1. Introduction

The carbon dioxide emissions by the transportation section account for a constant share internationally, and it is necessary to continue to restrict them. On the other hand, it is predicted that in the countries of Asia, continued economic growth will be accompanied by a switch to 4-wheel vehicles from motorcycles, which now have an overwhelming share. This survey will serve as a reminder of the fact that the motorcycle is a road transport mode superior in its ability to lower global environmental loads and result in proposals for international policies. This survey is now in progress as bilateral joint research with the RDCRB, Indonesia.

## 2. Comparative survey of carbon dioxide emissions from 4-wheel vehicles, motorcycles and electric scooters

In order to confirm that motorcycles and electric scooters are road transport modes kinder to the global environment than 4-wheel vehicles, a comparative survey of carbon dioxide emitted by these vehicles during actual driving was performed. The survey was carried out in Tokyo in the daytime for a total of 12 hours—3 hours per day on three weekdays from September 27 to 29, 2011—on an ordinary road which is always congested (9.2km from Yoyogi Park to Hibiya Park). The vehicles used for the survey were a 4-wheel vehicle, motorcycles (250cc, 125cc, 50cc) and an electric scooter (equivalent to 50cc). The vehicles selected had average vehicle specifications for vehicles in each class. The carbon dioxide emissions were converted from the quantities of fuel consumed and electric power consumed. The quantity of fuel consumed was obtained by measuring the actual quantity of oil supplied while the quantity of electric power was determined by measuring the quantity charged after driving.

Photo 1 View of the Performance of the Survey

## 3. Outline of the survey results

Figure 1 shows the relationship between traveling speed and carbon dioxide emissions based on the result, while Table 1 shows the average traveling speed and carbon dioxide emissions by vehicle type. The survey revealed the following trends.

1. Carbon dioxide emissions decline in the order: 4-wheel vehicle (air-conditioning on), 4-wheel vehicle (air-conditioning off), motorcycles, and electric scooters.
2. Average traveling speed in the congested section was higher for the motorcycles (250cc, and 125cc) than the 4-wheel vehicles.
3. The carbon dioxide emitted by all vehicles decreased as the average traveling speed increased.

In the future, the synergistic effects of the two superior aspects of motorcycles (lower carbon dioxide emissions, greater traveling speed during congestion) will be analyzed.

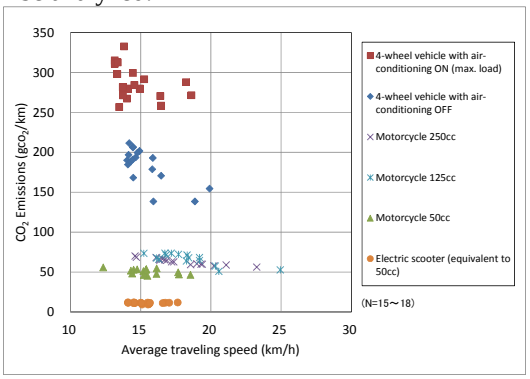


Figure 1. Relationship of Traveling Speed to Carbon Dioxide Emissions

Table 1. Average Traveling Speed and Carbon Dioxide Emissions by Vehicle Type

| Vehicles surveyed | Items surveyed | Average traveling speed (km/h) | Average $CO_2$ Emissions ($gCO_2$/km) |
|---|---|---|---|
| 4-wheel vehicle | air-conditioning ON (max. load) | 14.7 | 287.2 |
| 4-wheel vehicle | air-conditioning OFF | 15.3 | 184.0 |
| Motorcycle | 250cc | 17.9 | 62.7 |
| Motorcycle | 125cc | 18.4 | 66.3 |
| Motorcycle | 50cc | 15.5 | 50.4 |
| Electric scooter | equivalent to 50cc | 15.5 | 11.0 |

**Acknowledgments :** Authors are grateful to Yamaha Motor Co. Ltd. for temporarily providing the electric scooters.

# Initiatives by the Wastewater and Sludge Management Division to respond to global warming

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*(Key words) Biomass energy, carbon dioxide, resources recycling*

**1. Controlling the production of greenhouse gas from treatment processes**

The Wastewater and Sludge Management Division has striven to prevent the production of greenhouse gas (GHG) by performing statistical surveys to estimate the quantity of GHG produced at sewage treatment plants, surveys to clarify the state of and the restriction of the production of methane (below "$CH_4$") and nitrous oxide (below "$N_2O$") in sewage treatment processes etc., and surveys of the quantity of carbon dioxide gas produced through the consumption of resources and energy for wastewater treatment and reuse. From the results, the GHG production rate is generally clarified and countermeasures are almost fully established, excluding that for $N_2O$ produced by biological treatment. Regarding another source of GHG from sewerage systems, it has been pointed out that $CH_4$ released in sewer pipes and $N_2O$ emission in receiving waters are important.

**2. Restricting production through the use of sewage resources**

Various technology developments are advancing energy recovery from the heat and biomass resources in sewerage systems, and their spread as GHG reducing technology should be encouraged. So the Sewerage and Wastewater Management Department of the Ministry of Land, Infrastructure, Transport and Tourism started the Breakthrough by Dynamic Approach in Sewage High-technology Project in 2011, and Wastewater and Sludge Management Division is now proving multiple systems under a contract from the above department (see the example in the Fig.). This project will be continued with a call for the submission of new challenges in 2012. In addition to such demonstration studies, the Division is conducting research to enact a guideline to evaluating the feasibility of introducing technologies to sewage treatment plants considering the characteristics of regions, in order to promote the wide introduction of these technologies. And in cooperation with the Urban Facilities Division of the Urban Planning Department, the Division has evaluated energy saving partnership among public sectors in cities such as sewerage works, and the improvement of block level energy supply system, and has studied the impacts of regulatory and incentive policies based on city plans and of a domestic emission trading system.

**3. Studying the warming adaptation strategies based on water reuse**

As global warming advances, floods and droughts will occur more often, lowering usable water resources, and it is presumed that urbanization will advance warming trends, harming urban environments. Reusing water is presumed to be an effective way to adapt to such phenomena. The Division has been studying the evaluation of the environmental load and of the economics of a variety of adaptive strategies implemented using recycled water, and ways to increase the safety of recycled water to lower the health risk of its use. In the future, the Division will continue these endeavors to aim to propose a method of comprehensively evaluating reuse as an adaptive strategy.

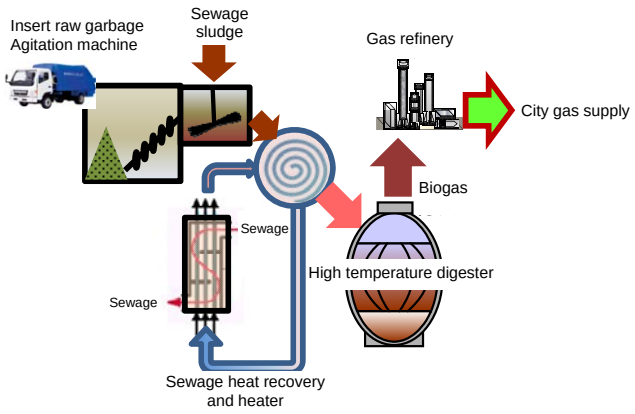


Figure Example of a Project to Verify Reformed Sewage System Technology

# Towards the utilization of hydraulic energy in river basins

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*(Key words) Generating electricity for dam management use, maintenance, inspection frequency*

## 1. Introduction

The nationwide shortage of electric power caused by the Great East Japan Earthquake may continue for a long time, and hydroelectric power, which is a reusable energy, is expected to be utilized and promoted more than ever. Among dams managed by the Ministry of Land, Infrastructure, Transport and Tourism and by the Japan Water Agency, management use electric power generation equipment which uses maintenance discharge and water supply discharge from dams had already been installed at 28 dams nationwide (January 2011), and while they supply electric power to be used for dam management, they have further reduced the cost of dam management through the sale of surplus electrical power. More than 30 years have passed since the start of operation of the first management use electric power generating equipment, which was installed around 1980, and the cost of renewal and maintenance of the equipment is predicted to increase in the future. And because the quantity of electric power will continue to increase, it is essential to increase the efficiency of maintenance to boost the cost-benefits of installing new electric power generating equipment.

This research studied measures to increase of the efficiency of maintenance of management use electric power generating equipment in order to make greater use of unused hydraulic energy of river basins.

## 2. Present state of maintenance of dam management use electric power generating equipment

When management use electric power generation is shut down, purchasing management use electric power increases maintenance cost while income from the sale of electric power falls, so it is necessary to absolutely minimize system shut down time. A questionnaire survey of inspections, renewals, and other maintenance of electric power generating equipment was carried out at the 28 dams equipped with management use electric power generating equipment. The results show that the systems are shut down for inspections or by malfunctions an average of 14.7 days/year, and of these, electric power generators are shut down for periodical inspections of the electric generators or gate equipment an average of 4.1 days. But, if equipment is inspected by dismantling maintenance, power generation is shut off an average of 41.8 days. Electric generating equipment was only shut down by a malfunction 16 times, but the impact was severe, because the average length of time it was shut down for restoration was an average of 41.3 days. Electric power generating equipment was shut down by malfunctions an average of 14.2 years after it started operation. Renewal of equipment now almost entirely involves electric parts and occurs an average of about 19 years after the start of operation.

Photo 1. Management Use Electric Power Generating Equipment (Sagae Dam)

## 3. Efficient electric power generating equipment maintenance methods

Through an analysis of maintenance costs revealed by the questionnaire, it was discovered that approximately 3/4 of inspection and maintenance costs is the cost of dismantling maintenance. Looking at the reason for performing dismantling maintenance shows that about 3/4 is carried out according to an ordinary inspection cycle for each part (time plan). For this reason, it is possible to further reduce maintenance costs by performing dismantling maintenance at a low frequency but often enough to prevent malfunctions caused by insufficient maintenance. This research classified ways of renewing each type of part (preventive maintenance, post-maintenance) based on degree of importance and restoration period. At this time, data concerning past malfunctions and renewals are limited, so in order to decide the appropriate frequency of inspections and renewals, continuous data must be accumulated in the future.

**4. Future study guidelines**

In the future, to explore further potential uses of hydraulic energy, we will study measures to increase electricity by selecting new installation locations for management use electric power generating equipment and renewing the reservoir water level operation of multi-purpose dams, and study challenges such as the impact of implantation on river environments and systemic restrictions, etc.

# Movement towards the revision of energy saving standards for buildings

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*(Key words) building, state of energy consumption, energy saving standards*

## 1. Introduction

Carbon dioxide emissions from buildings used as offices, stores, schools, hospitals etc. increased 31.2% since 1990 (as of 2009). And further countermeasures are required as with residential buildings. In response, from 2008 to 2010, the NILIM conducted "Research on a Comprehensive Evaluation Method and Design Method Related to Energy Conservation Performance of Non-residential Buildings", researched energy consumption of buildings and equipment systems according to the way they are used, and studied energy consumption estimation methods based on actual performance.

## 2. Research on energy consumption of building equipment

Energy consumption of buildings and equipment varies greatly not only according to the configuration of equipment systems, but to the way the building is used. "Research on a Comprehensive Evaluation Method and Design Method Related to Energy Conservation Performance of Non-residential Buildings" analyzed past energy consumption data with a focus on office buildings, and obtained detailed data to prepare more precise models. Detailed data of central air-conditioning systems (heat source, auxiliary machinery, heat supply system) is measured, and the characteristics of each type of equipment and system are examined (Fig. 1). Office automation equipment and freezing and refrigerating equipment, which generate air-conditioning load, were measured to model the relationship between the machines' behavior, electric power consumption and heat production. For elevator and lighting, the usage condition and power consumption were researched to prepare technical documents.

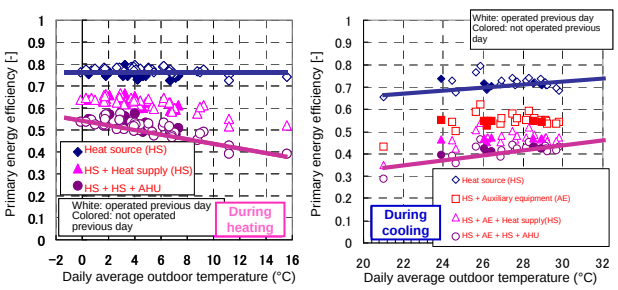


Figure 1. Results of Assessment of Efficiency of an Air-conditioning System

## 3. Towards the revision of energy saving standards for buildings

Energy saving standards for buildings, which have been assessed based on the Perimeter Annual Load (PAL) and the Coefficient of Energy Consumption (CEC), are now being studied with their revision scheduled for 2012. Under the new standards, a method of assessing the envelope and opening performance of buildings and of equipment systems (air-conditioning, ventilation, lighting, hot water supply, elevators (Fig. 2)) based on the primary energy consumption of the whole building will be introduced. This assessment method, which will be made an obligation in the future, is based on concepts similar to the assessment method already introduced by Standards of Judgment for Residential Construction

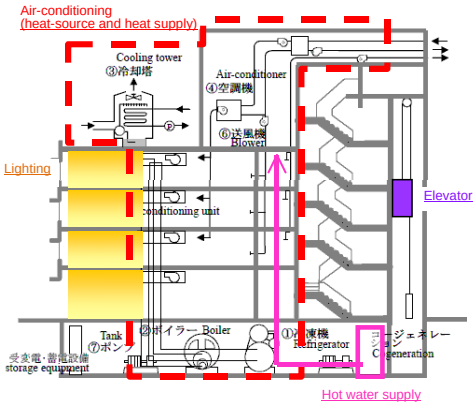


Figure 2. Example of the Building and Equipment Systems Evaluated

Clients.

[Reference]

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# Empirical study of traffic smoothing service at sag sections on expressways by means of vehicle to infrastructure communication

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*(Key Words) Sag or ascending slope, road-vehicle links, adaptive cruise control, traffic smoothing, traffic simulation*

## 1. Introduction

Approximately 60% of congestion on inter-city expressways in Japan occurs at sags or ascending slopes. The Intelligent Transport System (ITS) Division is conducting a series of research projects intended to develop a new service for mitigating traffic congestions by means of vehicle to infrastructure (V to I) communication at sags or ascending slopes[1]. Congestion at sags or ascending slopes occurs as a result of drivers unconsciously slowing down at the points where gradient changes and driving aimlessly after encountering congestion. It is possible to restrict or prevent these negative human factors by taking advantage of ACC vehicles' (Adaptive Cruise Control equipped vehicles) characteristics, which can control their speed and headway, so this service would contribute to mitigate congestion at those points.

A microscopic traffic simulator was built to clarify the congestion mitigation effects of the inclusion of ACC vehicles. This paper will report the results of a series of trial calculations of congestion mitigation by using the microscopic simulator.

## 2. Congestion mitigation measures by means of ACC vehicles to Infrastructure communication

Figure 1 shows an image of the service which uses V to I communication, and which was the object of the estimation of congestion mitigation effects based on inclusion of ACC vehicles. In response to information (for instance: appropriate traveling speed, headway, etc.) provided from ITS Spots (road side units), ACC vehicles activate their ACC function to maintain a preset speed or headway.

## 3. Trial calculation of congestion relief effects of ACC vehicles

To clarify the congestion mitigation effects of including ACC vehicles, the microscopic traffic simulator capable of reproducing the unique vehicle behavior on sag sections and ascending slopes already clarified by past research[2] was built to trial calculate congestion mitigation effects. Figure 2 presents the congestion loss hours according to ACC vehicles inclusion rate and the rate of reduction from the present situation (ACC vehicles inclusion is 0%). The results of the trial calculation have clarified that the more ACC vehicles are included in traffic flow, the more congestion mitigation rate is improved.

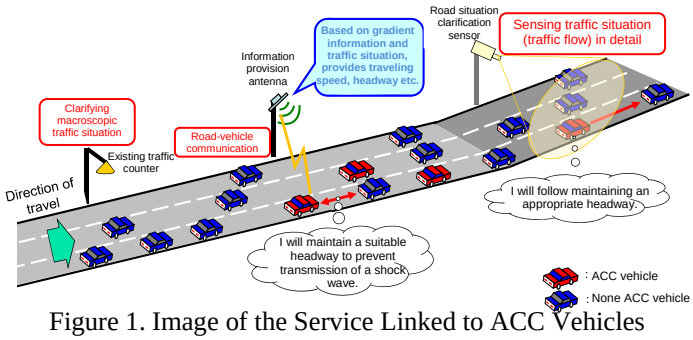


Figure 1. Image of the Service Linked to ACC Vehicles

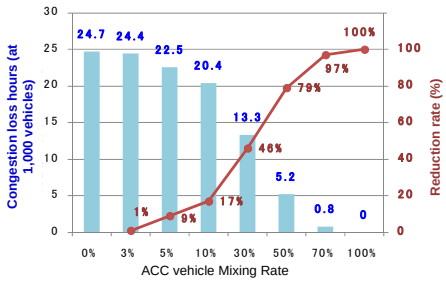


Figure 2. Results of Trial Calculation of Congestion Loss Hours by ACC Vehicle Mixing Rate

## 4. Summing up

In this report, the results of a trial calculation of the microscopic traffic simulation show that congestion mitigation effects increase according to the ACC vehicles inclusion rate. In the future, more detailed estimations will be made by performing simulations under different conditions at the same time as the research will be conducted to realize the services by conducting feasibility studies.

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Topics

# Support for the development of an evaluation method for energy saving in houses concerning the Energy Saving Standard

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*(Key words) Energy conserving, assessment, refurbishment, housing*

**1. Evaluation of energy saving for newly built houses**

A new standard for the evaluation of energy saving of newly built detached houses was introduced in April 2009 (Top Runner Standard for Houses). In this standard, in order to comprehensively evaluate diversifying energy saving methods such as the solar water heater and heat pump technologies, energy saving performance is evaluated based on the primary energy consumption instead of the thermal envelope performance. Primary energy consumption can be calculated by the equation in the figure. In addition to correctly evaluating the envelope performance, it is therefore important to evaluate the efficiency of the equipment and appliances such as DHW systems, ventilation systems.

**2. Evaluation of the efficiency of residential equipment and appliances**

For example, gasoline mileage depends on how to the vehicle is driven. Similarly, the efficiency of the equipment and appliances is largely dependent of the operating condition and usage of the occupants, NILIM has performed a study to clarify which parameters effect the efficiency of the equipment and appliances in houses under the real condition, and developed a framework for the evaluation of energy saving.

Related research projects started in 2001[1)], and through the recent research results[2)], the research results are used in the calculation of the energy saving performance in Top-Runner Standard for House. The framework of the evaluation for the housing equipment and appliances has already been completed, and the research continues in order to develop more accurate assessment methods for particular technologies.

**3. Evaluation of energy saving renovations of existing detached houses**

As the effective utilization of the existing houses has become important in recent years, it is now also necessary to develop the energy saving potential for renovating existing houses in addition to developing the energy saving potential for newly built houses. NILIM is therefore carrying out a research project in order to develop the evaluation method for energy saving potential of renovations[3)]. To calculate and compare the primary energy consumption of the houses before and after renovation, we are developing calculations or calculation rules such as, [1] evaluation of the thermal performance for the construction unique to the renovation such as windows replacements, [2] evaluation of the partial renovation such as renovating only the envelope of a living room, and [3] evaluation of the thermal and energy performance of the existing envelope and appliances whose performance is difficult to clarify by some inspections. This research will be used for some kind of the standards for energy saving renovation.

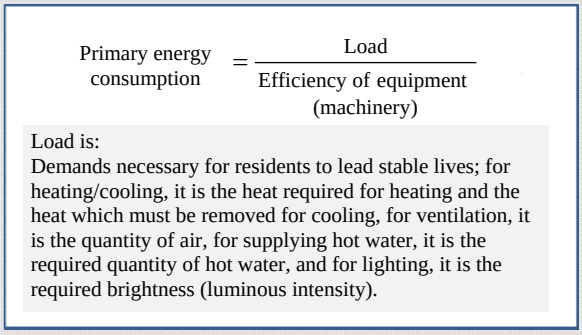


Figure Concept of Calculation of Primary Energy Consumption

[References]

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the Development and Promotion of Energy Saving Technologies on Houses (2003- 2005)
3) Development of Energy Consumption Performance Evaluation Methods for Various Types of Houses (2010 - 2012) http://www.nilim.go.jp/lab/icg/4_shouenekaishuu.htm

# Research to advance the evaluation methodology of public works projects

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*(Key words) Social discount rate, uncertainty, sensitivity analysis*

## 1. Introduction

Public works projects of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) are evaluated three times: when a project is newly adopted, when re-evaluated, and after the project is completed, and many evaluations are done every year. Evaluation methods are not completed, so to perform more appropriate project evaluations, it is necessary to continuously review the methodology and to improve it based on social and economic conditions and ongoing survey research. So now since setting the social discount rate and dealing with uncertainty have a great impact on project evaluation results, the surveys and points of contention are organized with the two themes.

## 2. Setting the social discount rate

In an incomplete market where there are distortions caused by taxes and by asymmetric information, there is no agreement on which rate to use as the social discount rate, and each country and organization sets this rate based on its own information. Table 1 shows the values of the social discount rates and their setting methods in the major industrialized countries.

As overall trends, in the industrialized countries of North America and Oceania, it is set as relatively high values between 7% and 8% based mainly on the return rate on investment of private sector, but in the United Kingdom, France, Germany and other industrialized countries of Europe, the rates are between 3% and 4%, mainly as values based on the social time preference. In Japan, 4% is set as the average of real yields on long-term government bonds as the opportunity cost of capital, making Japan a member of the lower group among the major industrialized countries.

The major points of contention concerning a more appropriate social discount rate in Japan are as follows : [1] suitability of the method of calculating the social discount rate, [2] considering intergenerational equity related to policies which impact multiple generations, [3] propriety of adopting a time declining discount rate, and [4] the appropriate way to deal with the uncertainty of the social discount rate.

## 3. Dealing with uncertainty

Because public works projects are long term, the future cost, effectiveness, and project duration etc. may change. So when a project is evaluated, these changes, or in other words, the uncertainty, must be considered. One method of considering uncertainty is sensitivity analysis of cost-benefits analysis, and the Technological Guidelines to Cost-Benefits Analysis of Public Works Project Evaluation (General Principles) (revised by MLIT in June 2009), stipulates implementing the sensitivity analysis when making cost-benefits analysis.

Table 1. Social Discount Rates in Major Industrialized Countries

| Country | Social discount rate | Calculation method |
|---|---|---|
| United States. | 7% | Return rate on investment of private secter |
| Canada | 8% | Weighted mean of private sector return rate and market interest rate |
| New Zealand | 8% | Return rate on investment of private secter (capital asset pricing model) |
| United Kingdom | 3.5% | Social time preference (Ramsey equation) |
| France | 4% | Social time preference (Ramsey equation) |
| Germany | 3% | Yield on long-term government bonds |
| Japan | 4% | Yield on long-term government bonds |

The major points of contention concerning dealing with uncertainty including sensitivity analysis are as follows: [1] methods of systematically accumulating, organizing and analyzing the results of foreign and domestic project evaluations (particularly, the post project evaluation), [2] organizing and analyzing causes of and response to uncertainty, [3] improving technologies for sensitivity analysis, and [4] establishing uncertainty evaluation methods including items which cannot be converted to monetary value.

## 4. Future initiatives

Setting the social discount rate and dealing with uncertainty will continue to be organized and analyzed with the focus on points of contention, contributing to the advance of project evaluation methods.

# The location referencing method for distribution diverse road related information —Establishing the Road Section Referencing method—

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*(Key Words) location referencing method, road section referencing method, road information provision, intelligent transport systems*

## 1. Information

With the advance of Intelligent Transport Systems, diverse road related information is circulated using maps. And if it circulated smoothly between organizations and between fields, it would be possible to improve existing information provision services and to create new services. The Information Technology Division has established the location referencing method “Road Section Referencing method (below called “ID method”), necessary to realize the creation of new services.

## 2. Outline of the ID method

Applying the ID method, a permanent ID is assigned to a road section and to a reference point, relatively expressing the location based on the section and reference point and on the route from the reference point. Figure 1 shows how the ID method is used to represent the position of a gas station on the left side at the 150m point of a road (section) starting at an intersection (reference point) on the road and linking intersections. Using the ID method in this way, even if various organizations which use information use different maps, they can circulate information with accurate location representations.

## 3. Situations where the ID method is used

A few situations in which the ID method is used are introduced. Following the Great East Japan Earthquake, the public and private sectors cooperatively created and provided information about open roads and closed roads in the disaster region[1)]. But because the methods of expressing the location in their information differed, they were forced to collect and process the information employing human wave tactics.

If the ID method were applied in such a case, even if each organization used its own unique location representation method, it would be possible to unify the location representation methods to circulate the information between the organizations. As a result, visualization using maps and preparation of spreadsheets would be performed efficiently, achieving prompt and accurate information provision (Fig. 2).

## 4. Conclusion

At this time, the Information Technology Division is working to build a technique for circulating road-related information through public-private sector links using the ID method, and plans a social experiment in 2012. We are eager to continue to work to achieve our goal of realizing circulation of diverse road related information.

[Reference]

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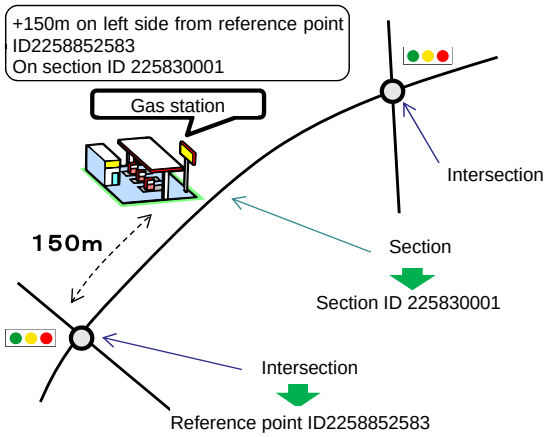
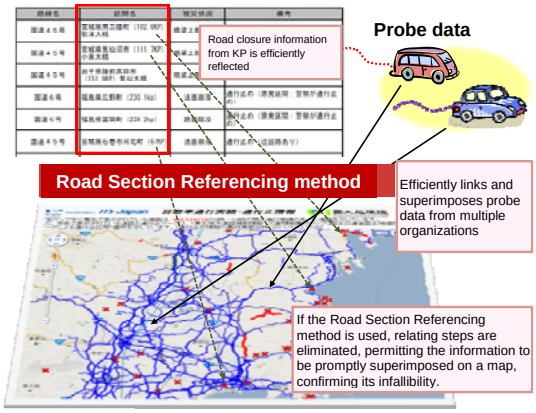



Figure 1. Example of Representation of Location Reference by the Road Section Referencing Method

Selected from Great East Japan Earthquake (Report No. 46)




Source of map image: http://www.its-jp.org/saigai/

Figure 2. Image of Use of the Road Section Referencing Method During a Disaster

# Calculating Traffic Volume 24 Hours a Day/365 Days a Year through Effective Use of Vehicle Detectors

Traffic Engineering Division, Road Department
HASHIMOTO Hiroyoshi (Research Engineer), MATSUMOTO Shunsuke (Research Engineer), MIZUKI Tomohide (Guest Research Engineer), MONMA Toshiyuki (Senior Researcher), UESAKA Katsumi (Head)

*(Keywords) Vehicle detector, processing of singular/missing values, estimation of traffic volume, regular observation traffic-data system*

## 1. Introduction

The Ministry of Land, Infrastructure, Transport and Tourism collects daily traffic volume data on a regional basis by estimating traffic flow between adjacent road zones using vehicle detectors installed on national roads throughout Japan. An issue that has emerged in the course of this work is how to reduce workload required to process singular and missing values of obtained vehicle detector data (Figure 1).

Here, NILIM developed a method for processing singular and missing values as well as a method for estimating traffic volume using vehicle detector data, and then arranged them into a set of "road traffic survey guidelines." It also prepared a "traffic volume calculation tool" that automatically processes vehicle detector data and incorporated it into practical operations.

## 2. Method for calculating traffic volume through effective use of vehicle detectors

For the processing singular and missing values, we utilized not only accumulated past data from vehicle detectors but also data from adjacent vehicle detectors (reference regular observation point). In estimating traffic volume, we observed the fact that the traffic volume ratio between the estimated zones and adjacent vehicle detector (base regular observation point) is roughly constant. Then we multiplied the ratio of traffic volume at both points (calculated using past actual observations in the estimation zones) by traffic volume at the base regular observation point (Figure 2).

Characteristics of the developed method are that it recognizes that locally generated singular values (such as road construction-related restrictions) have a region-wide impact in terms of estimated traffic volume, and that it differentiates between localized singular values (such as road construction-related restrictions) and regional traffic volume fluctuations caused by typhoons, etc. (Figure 3).

## 3. Conclusion

With the goal of bringing greater efficiency to traffic volume calculation, NILIM has launched project research* to study specifications for a new regular observation traffic data system that will incorporate the developed method for calculating traffic volume.

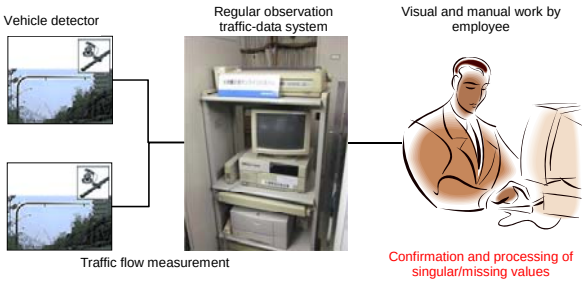



Fig. 1: Conventional processing of singular and missing values

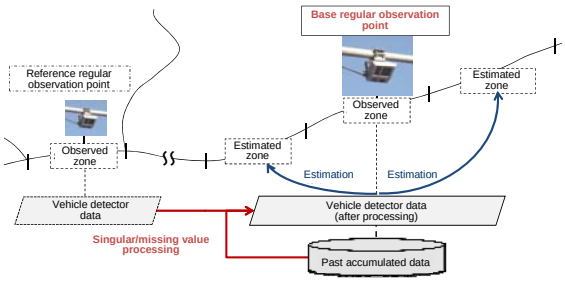



Figure 2. Relationship between vehicle detectors and estimation zones

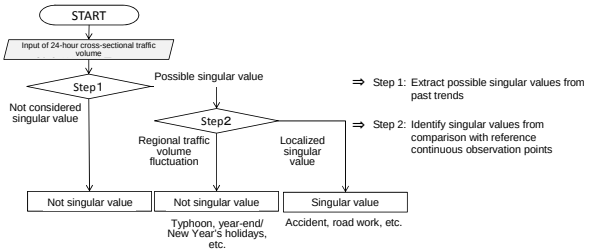



Figure 3.Method for differentiating singular values

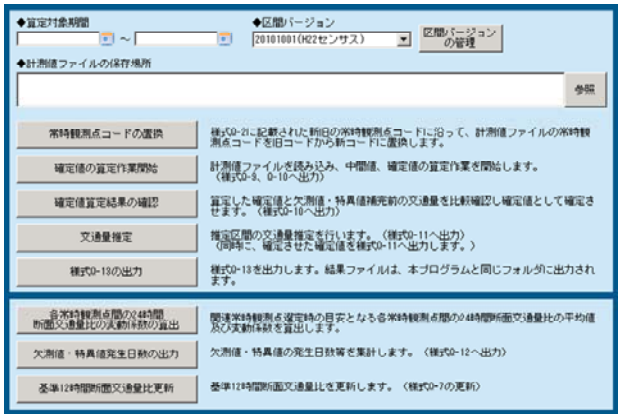



Figure 4: Initial screen of the traffic volume calculation tool

* Study on Further Development of the Collection, Analysis, and Utilization of Regular Observation Data for Road Traffic (2011 to 2013)

# A Road Traffic Survey Platform Application of “Reference Road Segments and Reference Intersections”

Traffic Engineering Division, Road Department

MATSUMOTO Shunsuke (Research Engineer), HASHIMOTO Hiroyoshi (Research Engineer), MIZUKI Tomohide (Guest Research Engineer), MONMA Toshiyuki (Senior Researcher), UESAKA Katsumi (Head)

*(Keywords) Traffic survey, digital road map, database*

## 1. Introduction

NILIM has developed a “Standard for Traffic Survey Unit” as a platform for traffic surveys. The standard was introduced into the FY2010 Road Traffic Census and is expected to have broad application in the future. Within the standard, reference road segments (hereafter “reference segments”) are established as the smallest survey units for various surveys. They are divided at the points shown in Table 1 to allow easy inter-application, analysis, and aggregation of survey results.

Table 1: Reference road segment division points

| Division point | Purpose |
|---|---|
| 1) Point of intersect with other arterial road | Minimum unit suitable for ascertaining traffic volume, deceleration, and traffic service |
| 2) Point of access to major facility | Consideration of individual handling of zones with significant differences in traffic conditions |
| 3) Point of change in road manager jurisdiction | Consideration of aggregation with road manager units |
| 4) Start point of expressway | Consideration of differences in traffic characteristics and aggregation of expressway data only |
| 5) Point of intersect with municipal boundary | Consideration of aggregation by municipality |

## 2. Analysis by route, intersection, and network

Analysis of individual routes and municipalities can be performed easily by using route attributes in the reference segment. Moreover, analysis at the individual intersection and network level are also possible by using reference intersection data that are automatically generated using intersecting road connection information established for the start and end points of the reference segment (Figure 1).

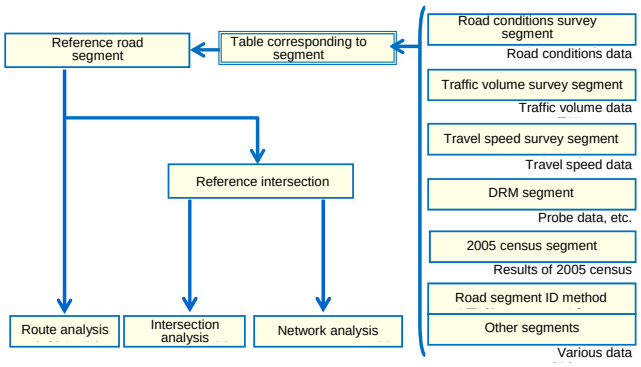



Figure 1. Analysis at the route, intersection, and network levels

## 3. Application in congestion analysis at the intersection level

Using reference intersection data, it is possible to conduct, for example, evaluations by aggregating congestion-caused losses in all directions from intersections that tend to be traffic bottlenecks. Figure 2 shows the results of a calculation of lost time due to congestion at specific intersections in the Kanto area.

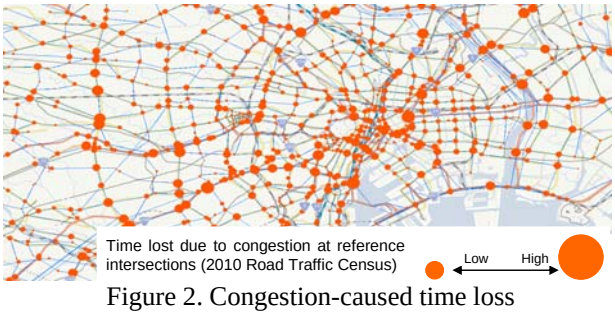



Figure 2. Congestion-caused time loss (intersection level)

Figure 3 shows calculated lost time for each intersection on National Route 6 in Ibaraki Prefecture. It can be seen that intersections having large lost times compared to surrounding intersections largely match with major congestion points.

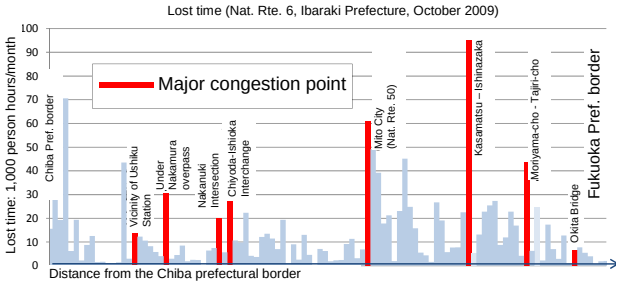



Figure 3. Congestion-caused time loss in Ibaraki Prefecture (intersection level)

**4. Division of roles in data updates**

We will update traffic survey reference road segments each fiscal year and reflect them on the latest road network. To ensure work efficiency, regional development bureaus will update reference segments and NILIM will use the updated data they supply to automatically update reference intersections throughout Japan.

Topics

# The FY2010 Road Traffic Census Results of the General Traffic Volume Surveys (Overview)

Traffic Engineering Division, Road Department
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*(Keywords) Road Traffic Census, traffic volume survey, travel speed survey, traffic survey reference segment*

## 1. Introduction

The Road Traffic Census is conducted roughly once every five years to ascertain actual conditions surrounding Japan's roads and road traffic. Given that FY2010 was a census year, NILIM took steps to further develop and bring greater efficiency to the census's surveys. These steps are described in NILIM's 2011 report. The results of the general traffic volume surveys (traffic volume survey, travel speed survey, and road conditions survey) were compiled and then jointly presented to the media by MLIT's Road Bureau and NILIM in September 2011. The following gives an overview of these results together with the results of subsequent studies.

## 2. Overview of survey results

Figure 1 shows changes in average traffic volume. On urban expressways, traffic volume decreased by 6.4% compared to FY2005 (2.6% decrease on all roads) due to traffic dispersal and other effects generated by network development. On the other hand, on national expressways, average traffic volume increased by 7.4% due to toll-free expressway trials and other reasons, while traffic volume on ordinary roads decreased by 5.8% and that on prefectural roads, etc., decreased by 4.3%. These outcomes suggest that traffic is shifting to national expressways.

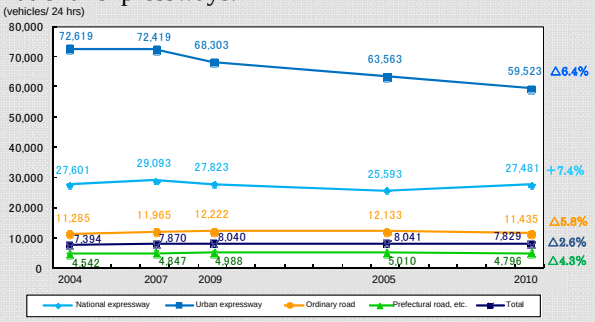


Figure 1. Changes in average traffic volume by road classification

Next, Figure 2 shows results obtained from a comparison of the travel times of congested and non-congested periods using newly introduced probe data from ordinary vehicles. The figure shows that, while there are large fluctuations in speed caused by temporal variations in traffic volume on expressways, speed differences caused by congestion on ordinary roads are small, remaining below several kilometers per hour. It is surmised that, in the case of ordinary roads, the dominant factor is the effect of traffic signals rather than changes in traffic volume. Additionally, differences in travel speed (service level) due to road classification are small on ordinary roads, indicating that stratification of road functions has not progressed. Thus, it will be necessary to reinforce the travel functions of ordinary roads in the future.

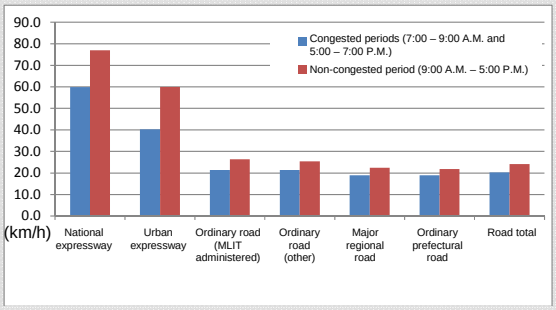


Figure 2. Comparison of travel speeds of congested and non-congested periods (DID)

The improvement of survey items in the road conditions survey has made it possible to engage in fundamental study toward the rebuilding of road spaces. This makes it easier to prepare road timetables aggregate survey and analysis results for individual municipalities by introducing traffic survey reference segments (new census segments) (see page A Road Traffic Survey Platform

Application of "Reference Road Segments and

Reference Intersections”). As an example, Figure 3 shows $CO_2$ emissions per one kilometer of road length that were calculated at the municipality level from the traffic volume and travel speed surveys (Figure 3).

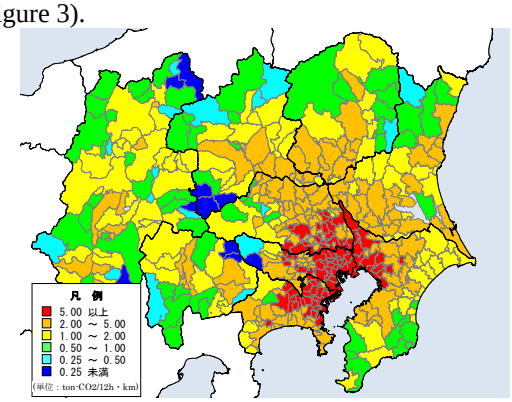


Figure 3.$CO_2$ emissions per 1-km road lengths by municipality

* Results of the FY2010 Road Traffic Census are available via the IR website of the Road Bureau, MLIT.
http://www.mlit.go.jp/road/ir/ir-data/ir-data.html

# Full scale Fire Experiment using a Three-story Wooden School Building (Preliminary Experiment)

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*(Key words) Three-story wooden school building, full-scale fire experiment, fire safety*

## 1. Introduction

Because wood absorbs $CO_2$, as trees grow, they effectively prevent global warming, using wood to construct buildings stimulates the forest industry, and by encouraging forest growth, prevents disasters such as landslides. Wood's superior capacity to adjust humidity contributes to greater interior comfort, and by taking advantage of the technical skills of local craftsmen, its use can be counted on to train technologists and stimulate regional industries.

Japan's Building Standard Law stipulates that three-story school buildings must be fire-resistive buildings to ensure fire safety, but the Act for Promotion of Use of Wood in Public Buildings Etc. enacted in October 2010 requires a review of building standards guided by necessary research.

In response to this need, the Building Department began to collect data necessary to provide technical standards for three-story wooden school buildings in 2011 and started research to prepare proposed standards in order to review the Building Standards to permit the construction of quasi-fire resistive three-story school buildings which would use wooden material more easily when certain specifications are satisfied.

## 2. Aim of the full-scale fire experiment

At this time, members such as columns, walls etc. of a three-story school building must ensure fire resistance performance such that they are neither broken, transfer heat, nor crack even after 1 hour of exposure to heat, but specifications limit the quantity of wooden materials which can be used. To encourage the use of wood, in addition to quasi-fire resistive performance which requires performance during heating that is easily achievable even using combustible wood, full-scale experiments etc. will clarify the requirements necessary for fire safety (stipulated specifications, etc.). It is now hypothesized that, for example, surrounding open space which reduces the impact of toppling etc. will be ensured.

First, specifications for wooden interior finishing material etc. will be hypothesized based on a survey of schools, next, based on specifications which clarify the performance based on member experiments and class-room scale fire tests, an actual building will be constructed on the NILIM site and used for the fire experiment (Photo 1).

This experiment is positioned as a preliminary experiment because it is an experiment of unprecedented scale, then with specifications and experiment method adjusted based on its results, the full scale fire experiment will be carried out based on specifications which hypothesize standardization in fiscal 2012.

The aim of the full-scale fire experiment is to gain knowledge concerning the process of spread of fire and smoke flow in an entire building, degree of impact of flying sparks and radiant heat on the building's surroundings, whether or not the building collapses, and if so, the extent it collapses, all knowledge which could not be confirmed without performing a fire experiment using a full-scale building.

## 3. Conclusions

The results of the two full-scale fire experiments described above will be used to prepare proposed standards which ensure the fire safety that will be required of a three-story wooden school building.

Photo 1. The Experimental Three-story Wooden School Building

# Experimental research on rain infiltration of wooden housing

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*(Key words) Wooden housing, rain infiltration, spraying test*

**1. Background to the research**

Along with studies of the prevention of rainfall infiltration in order to contribute to the smooth enforcement of the *Law* for the Execution of Warranty Against Housing Defects enacted in October 2009, measures to prevent infiltration of rain must be studied in order to establish future technological standards. Cases where rain infiltrates from exterior finishing material to conspicuously deteriorate body material and connecting material have also been reported, and the external finishing material's bonding force declines so that when an earthquake strikes, peeling off the external finishing material, fire prevention performance and seismic resistance are impacted. Consequently, the NILIM has carried out a variety of fact-finding surveys of design and execution, surveys of rainfall infiltration, outdoor exposure experiments, and accelerated deterioration tests in order to ensure the safety and assets of inhabitants, and this is a report of some strong wind and rain tests.

**2. Outline of the tests**

2.1 Specimen

The specimen consisted of a structural body made by the conventional frame construction method and exterior finishing made by the ventilation construction method executed using ceramic siding. The major object members were a roof without under-eave ceiling, external wall tie-ins, and balconies, which are locations where rain often infiltrates.

2.2 Testing method

The testing was done by, hypothesizing that the members of the wood house to be tested would be subjected to a typhoon or other strong wind and rain, applying wind and rain at wind speeds at intervals of 5m/s from 5m/s to 20m/s for 15 minutes at each speed accompanied by a water spray of 32 liters per minute. The directions of the spray on the roof and exterior wall tie-ins were one direction each to the eave sides and to the verge (right angles to the eaves), and for the balconies, from the sides of the outside surfaces.

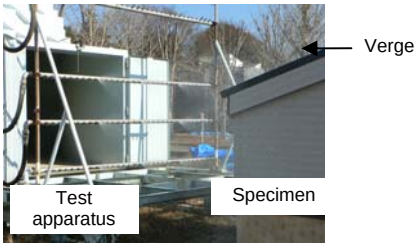


Photo 1. State of Specimens and Testing of Strong Rainfall Testing

**3. Major test results**

Even when rain infiltrates inside the ventilation layer, because there is usually a permeable waterproof sheet, the rain does not easily infiltrate inside the wall but, because the permeable sheet used for the test easily curled up vertically when it was laterally applied as an effect of the layer configuration etc., or because there was no tape between it and the foundation drain, at a wind speed of 5m/s, rain was observed infiltrating into the room between the permeable waterproof sheet and the foundation drain (see Fig. 1).

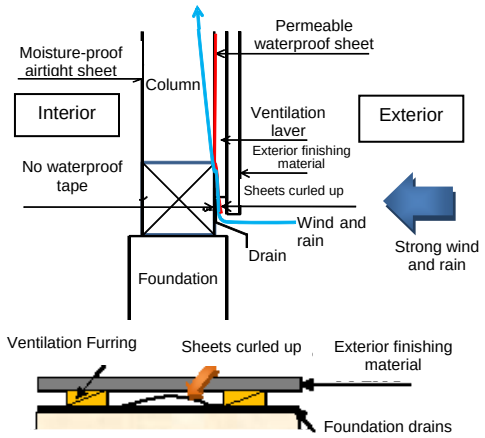


Figure 1. Rain Infiltration Through Curled up Permeable Waterproof Sheets

Recently, as a result of setback line limits and design trends, many roofs have short extended eaves and extended verges, so at the same time as a lot of rain strikes exterior wall surfaces, it is difficult to waterproof the area around the eaves, so rain often infiltrates. The test caused rain to infiltrate at a wind

speed of 5m/s, confirming that it is necessary to fully ensure extended eaves and extended verges. And at the tie-in of exterior walls and roofs, to ensure long-term waterproofing performance, it is important to not only perform sealing, but to appropriately apply metal plates. It is important to prevent deterioration of body material by applying waterproof tape between the permeable waterproof sheets and the foundation drains. During the balcony test, rain did not infiltrate between the FRP and sashes, but it is necessary to separately study long-term impacts, because of vibrations caused by the opening and closing of sashes and by earthquakes, and continuous minute tremors.

# Quality Control and Designation of Specified Design Strength for Structural Steel

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*(Keywords) Structural steel, quality control, specified design strength, uniform elongation, rupture elongation*

## 1. Introduction

When using high-strength structural steel and other new materials as principal structural members of buildings, the specified design strength required for structural calculations (values forming the basis for allowable stress, etc.) needs to be designated, accompanied by ministerial approval under Article 37 (ii) of the Building Standard Law pertaining to the quality of building materials. Until now, however, there has been no unified method of designating the specified design strength of structural steel. Therefore, we studied designation methods with a view to achieving unified operation by designated performance evaluation bodies, in addition to ministerial approval. The outcome of this was that we classified structural steel into categories based on yield ratio and uniform elongation, and presented a unified method of designating the specified design strength for each category (referred to below as the "proposal for provisional treatment"). Now, designations of specified design strength for structural steel are being applied on the basis of this proposal.

## 2. Outline of the proposal for provisional treatment

The quality of structural steel is determined by various mechanical properties, the most important ones of which are yield strength, tensile strength, yield ratio and uniform elongation. In the proposal for provisional treatment, steel materials are divided into three categories – ductile, intermediate and elastic – taking the yield ratio and uniform elongation as scales. The proposal focuses on three steel material products – thick plate, shaped steel and steel pipes – and specifies methods of designating specified design strength for each category. Fig. 1 shows an outline of the proposal for provisional treatment. Here, the yield ratio as the vertical axis represents the yield strength of structural steel divided by the tensile strength, expressed symbolically as σy / σu. The uniform elongation as the horizontal axis represents permanent strain in relation to tensile strength. The areas marked * in the graph are those that can be given leeway, taking various factors into account.

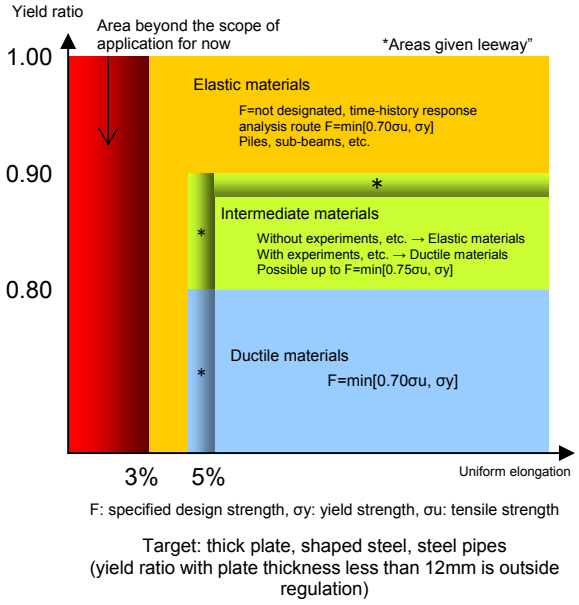


Figure 1. Schematic diagram of the outline proposal for provisional treatment

In actual practice, quality control of structural steel is not based on uniform elongation but on rupture elongation, and a conversion rule between the two will be required when applying this proposal. Therefore, NILIM and the Japan Iron and Steel Federation (JISF) carried out joint research on "Elongation performance of structural steel for determination of specified design strength", and experimentally studied the relationship between uniform elongation and rupture elongation of structural steel at varying levels of strength when the dimensions of the specimen were changed. The outcome of this research has been published in a NILIM Technical Note [1].

[References]

1) Nishiyama, Mukai, Iwata et al: Effect of dimensions of specimen on elongation of structural steel, NILIM Technical Note No. 662
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0662.htm

# A Method of Designing Reassurance from Crime in Urban Street Spaces to Encourage Outdoor Activity by Children

Urban Planning Department
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AKASHI Tatsuo, Urban Planning Division Director

*(Keywords) Urban street spaces, children, crime prevention through environmental design, Reassurance from Crime, roadside usage*

## 1. Focus on users' evaluation of street spaces

In the Urban Planning Department, we regard urban streets as three-dimensional spaces including privately-owned roadside land as well as public open space, and have been seeking effective ways to make street spaces comfortable for various pedestrians.

Here we introduce a study in which we analyze the use of urban street spaces by children (elementary school 3rd graders), focusing on their parents' evaluation of reassurance from crime.

The study proved that whether children go outside a lot or not is affected by their parents' sense of reassurance (from crime and car accidents), and that 90% of parents set restrictions on the directions and routes for children's outdoor activities. In other words, it is important that routes leading to parks and other places frequented by children are spaces where parents can feel reassured. In that case, what are the compositional elements of urban street spaces that contribute to a sense of reassurance?

## 2. Elements related to reassurance from crime

We conducted a questionnaire survey on children's outdoor activity and their parents' awareness, in terms of both crime prevention and road safety. The survey targeted the parents of children in all 3rd grade classes of two elementary schools whose catchment areas included ordinary residential areas developed by a land readjustment project in a regional hub city (217 valid responses).

Figure 1 shows urban street segments where anxiety is felt and those where reassurance is felt, in terms of crime prevention, with the individual responses entered on the map aggregated for each segment. The segments with the most respondents expressing reassurance are shown in blue, and those with the most expressing anxiety are shown in red.

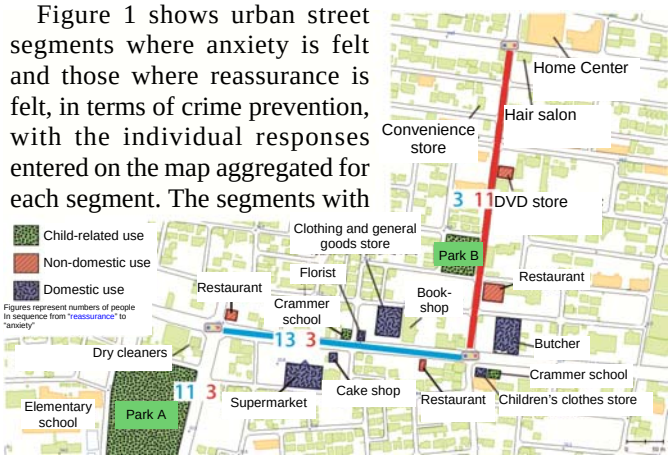


Figure 1. Reassurance segments (blue) and anxiety segments (red)

We also conducted a field survey to ascertain spatial compositional elements (street structure and roadside conditions) as well as the amount of street traffic. We then used multiple regression analysis to analyze the relationship between these "physical factors" and "psychological factors" connected with reassurance or anxiety in terms of crime prevention. Fig. 2 shows the impact of each spatial compositional element on the parents' reassurance from crime (t value) (1% significance elements only, $R^2 = 0.59$).

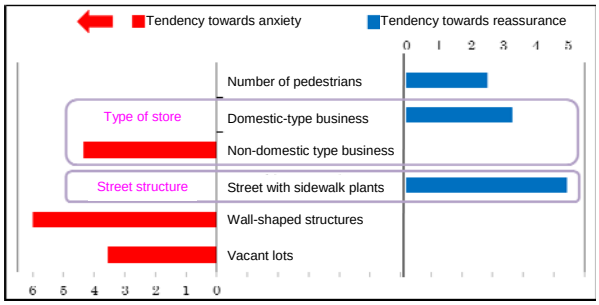


Figure 2. Impact of each element on reassurance or anxiety

From this analysis, we identified urban street spaces with elements that would give parents reassurance in terms of crime prevention and persuade them to let their children go outdoors. These are street spaces that have services for neighbors such as daily requisite stores arranged at the roadside, are structurally separate from passing motorized traffic, and have pleasant sidewalks containing plants.

As a result of this study, we found that the category of land use along neighbourhood streets firmly affects the sense of reassurance among parents, so that it should be planned carefully in order to encourage the sound growth of children.

[Reference]
Takayanagi & Akashi "Spatial Components on Safer Street Space for Children in Terms of Crime Prevention" Toshi Keikaku Ronbunshu (Papers on City Planning). Vol.46. No. 3 (Oct. 2011)

Topics

# Efforts to perform survey research of safety measures for amusement facilities

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*(Key words) Amusement facility, safety measures*

**1. Background to efforts related to safety measures for amusement facilities**

Amusement facilities are positioned as mutatis mutandis-structures under the Building Standard Law. On the other hand, as shown by an accident which occurred last year, efforts to ensure their safety including operating management continue to be important.

To contribute to such efforts, the National Institute for Land and Infrastructure Management, held a symposium, maintenance and inspection site tour, and other activities for safety managers etc. in February of last year at an advanced amusement park in Osaka.

And in FY2011, survey research related to safety measures for amusement facilities was performed as a Ministry of Land, Infrastructure, Transport and Tourism Building Construction Standards Provision Promotion Project.

**2. Survey of standards and criteria in the U.S. and elsewhere**

As part of this survey, we participated in the international conference of the International Association of Amusement Parks and Attractions (IAAPA) held in the U.S. to survey overseas standards concerning constraining devices, and separation distances necessary to ride in vehicles and conducted a fact-finding survey of U.S. amusement parks.

Regarding ASTM and EN standards, which are mainly reference standards in other countries, standards for constraining devices with acceleration as their indices are enacted. And at amusement parks, we saw cases where innovative measures were taken so that riders can personally try out constraining devices before boarding vehicles and innovations allowing operators to visually and easily make sure that riders have correctly put on the constraining devices. And concerning separation distance, we saw facilities where measures such as shaping constraining devices to prevent riders from extending their hands of feet outside the vehicles were taken.

**3. Future efforts to improve safety**

We are studying the provision of technical support to further improve safety by organizing such information and in conjunction with the above project, taking steps to provide this information to amusement park operation companies.

# Users' evaluations of ITS Spot Services in Full-Scale Operation

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*(Key Words) ITS Spot, users' evaluations*

## 1. Introduction

In Japan, ITS Spot Services had begun full-scale operation at about 1,600 locations mainly on expressways nationwide by August 2011.

ITS Spot Services provide road traffic information and safe driving support related information from ITS Spots (roadside units) to ITS Spot-compatible car navigation systems, which then provide the information to drivers in visual images and voice announcements. Specifically, real time road traffic information for a wide area with a maximum of 1,000km is transmitted by ITS Spots and the car navigation units perform Dynamic Route Guidance, which searches for the fastest route in real time. The ITS Spots also provide safe driving support information, which alert drivers to sharp curves, the tail end of congestion, fallen obstructions, and so on.

## 2. Users' evaluations of ITS Spot Services

The Ministry of Land, Infrastructure, Transport and Tourism has lent ITS Spot-compatible car navigation systems to about 700 monitors nationwide since 2011 to perform a monitor survey in order to collect the views of users to be used to clarify the effectiveness of the introduction of ITS Spot Services in full-scale operation, and to study ways of improving these services.

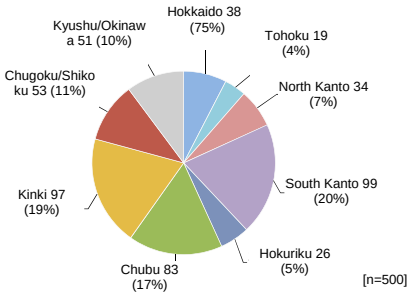
The monitors include general drivers, executive officers, affiliates of Chamber of Commerce and Industry, affiliates of Trucking Association, bus drivers, taxi drivers, and rental car drivers. Three questionnaire surveys will be conducted: one on the website and one interview survey from September 2011 to February 2012.

The questionnaire include inquiries regarding driving purpose, driving frequency, whether monitors are or are not familiar with the service, situation of utilization of the service, effectiveness of the service. Part of the results of the questionnaire surveys are shown in Figure 1. At the time of the survey, the services had been operating only a short time, so less than half of the monitors had received the information. On the other hand, more than 70% of those who had experienced receiving information answered that it was actually "Very useful", or "Useful", revealing that the users generally gave positive answers regarding the services.

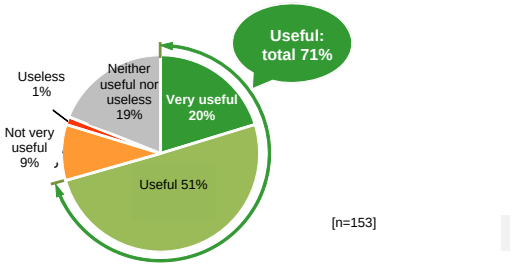
## 3. Summary

In order for ITS Spot Services to steadily benefit society by, for example, relieving congestion or reducing accidents, ITS Spot compatible on-board units must further penetrate. To do so, information must be provided to general drivers so they will easily understand the effectiveness of ITS Spot Services as clarified by the monitor survey, and the services must be improved with reference to the users' evaluations.

Q. Which region do you live in?




Q. Was dynamic route guidance actually useful?




Q. Was safe driving support information (road closures, obstruction information) actually useful?

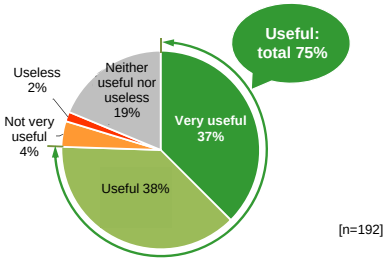



Figure 1. Questionnaire Survey
(Carried out November 2011)

[Reference] ITS Spot Service web site
http://www.mlit.go.jp/road/ITS/j-html/spot_dsrc/

# Collection System for Probe information from ITS SPOTs

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*(Key words) Probe, ITS Spots, traveling speed survey*

## 1. Introduction

In the autumn of 2009, private companies began to sell ITS Spot compatible car navigation units, and road traffic information provision and safe driving support information provision services (ITS Spot Services) using ITS Spots started operating. In 2011, ITS Spots were installed nationwide and are now operating at about 1,600 locations, mainly on expressways.

The communication technology used to operate ITS Spot services is characterized by the ability to perform high speed and high volume two-way communications, so that it not only provides road traffic information in one direction from roadsides, a capability of communication technologies already in use for ordinary road traffic information provision services (downlinking), it also permits information to be transmitted from vehicles to the roadside systems (uplinking).

So the Ministry of Land, Infrastructure, Transport and Tourism has, based on specifications prepared by the National Institute for Land and Infrastructure Management, built a system which collects probe information (vehicle position (latitude, longitude, time etc.) and behavior (forward acceleration, lateral acceleration etc.) from ITS Spot compatible car navigation systems through IT Spots (below called “probe system”) and began collecting data in April 2011 (Fig. 1).

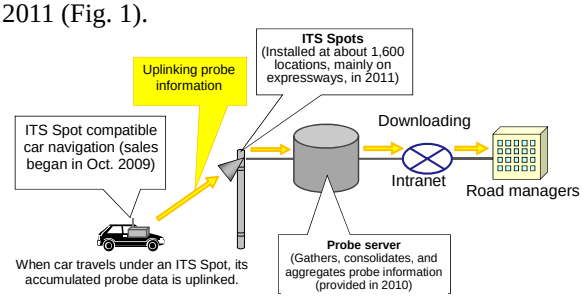


Figure 1. Configuration of the Probe System (Simplified)

## 2. Application to traveling speed surveys

Traveling speed obtained by traveling speed surveys is the most basic index used to represent the road service level. In the past, results of traveling speed surveys, mainly for specified single days (business day, holiday) were reflected in policies, but using probe information to constantly monitor traveling speed permits monitoring of the fluctuation of the service level on a road (clarifying and assessing singularities or seasonal fluctuation etc.), which could not be learned by past surveys, permitting more advanced and efficient traveling speed surveys.

So a probe server, which is part of a probe system, can aggregate and process the collected probe data to calculate the traveling time for fixed sections of a road, permitting constant monitoring of traveling speed. Road managers can download travel time data through the internet (Fig. 2).

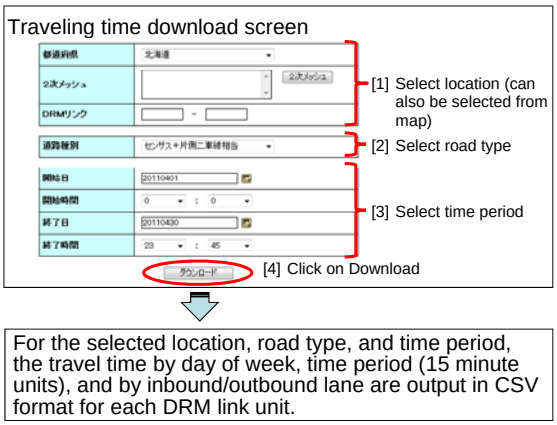


Figure 2. Traveling Time Download screen

## 3. Future development

Applications will be developed to analyze probe information and display the results so that the characteristics (precision for example) of probe information collected by probe systems will be clarified at the same time as road managers will be able to monitor changes in road traffic conditions during disasters or to clarify and explain the effects of projects such as the construction of new roads.

# Establishment of the environment for technical measures for the operation of ITS Spot services

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*(Key Words) ITS Spot, operating technique study working group*

## 1. Introduction

ITS Spot services were launched nationwide in March 2011. About 1,600 ITS Spots are installed, mainly on expressways, providing wide area road traffic information and safety driving assist and other services. It is expected that compatible OBUs (On-Board Units) will be installed in about 10 million vehicles during the next five years.

The ITS Division of the NILIM has established the Operating Technique Working Group to ensure the smooth operation of ITS Spot services. Specializing in technical aspects of the operation of ITS Spots, it clarifies challenges etc. and solves various problems. Besides that, the Division built a test course at the NILIM, and technically makes the causes obvious and evaluates the effects of countermeasures. Its members include the ITS Program and Policy Office of the Road Bureau, Regional Development Bureaus, and highway companies, plus private sector OBU makers, and RSU (Road Side Unit) makers, and it has been held about every three months since June 2010. This paper reports the studies at the Operating Technique Working Group.

## 2. Technical measures

In 2010, to start nationwide services at the end of the year, it studied methods to conduct connection tests, harmonizing technical standards and services.

In 2011, after the start of nationwide services, it took various measures for errors and problems which appeared immediately after the startup. The important measures are reported as below.

### (i) Countermeasures against defects which appeared after the launch

Highway companies and Regional Development Bureaus reported results and problems with interoperability among various RSU and OBU makers at the working group in April 2011. Many of them were kinds of errors fixed separately, such as “inability to make communications” or “failure to output voice information” in some combinations of RSUs and OBUs due to the combination of different makers. Especially in the case of RSU, which frequently cause errors or other problems, OBUs specially designed to check and analyze were used to record data-log and clarified. The initial problems were almost all resolved by these activities.

### (ii) Arrangement of standards for maintenance of ITS Spot equipment

The working group defined the inspection items and inspection cycle needed for each type of equipment. It has set inspection standards not only for ITS Spots, but for servers and other center side equipment.

### (iii) Building the NILIM Test Course

The test environment on the testing track at the NILIM was built in order to provide an actual environment which enables us to take measures for errors caused by combinations of RSU and OBU made by different makers, and to perform interoperability tests when new functions are added or software is upgraded.

Roadside equipment made by six makers operating on expressways was installed on the test course, so that test vehicles equipped with OBUs can be tested on the test course. It has the following beneficial characteristics.

- Two-way communication testing between equipment from all makers can be done.
- An actual environment can be reproduced (traveling speed, communication with multiple vehicles, etc.)
- Testing can be done efficiently and rapidly.

The installation of RSU was completed in November 2011, and the working group members performed tests in order to technically evaluate causes of problems and countermeasures.

## 3. Summary

The establishment of the Operating Technique Working Group and the building of the test course have created an environment allowing measurement of technical problems rapidly with ITS Spots. In the future, the working group will aim to improve the reliability of the system, operate it smoothly, deploy ITS Spot services, and contribute to safe, comfortable, and eco-friendly road traffic.

# Advanced road management using imagery probe information

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*(Key Words) ITS, imagery probe information, road management, anomalous phenomena detection*

## 1. Introduction

In the past, studies to apply technologies for the analysis of images collected by cameras installed on road sides have been used to clarify anomalous phenomena and traffic conditions in order to manage roads more effectively and more efficiently. In recent years on the other hand, it is predicted that the number of vehicles equipped with on-board cameras to improve traffic safety will increase in number. And researches have been performed to develop technologies which will utilize imagery probe information that combines imagery information obtained by such in-vehicle cameras with positioning information to judge the dryness/wetness of the road ahead[1)], and research on the concept of drive recorder systems comprised of full-time-archived drive recorders in combination with smart phones [2)]. This report introduces an outline of a study in the ITS field which, by combining image processing technology and information communication technology, will be developed for advanced road management by letting road operators use imagery probe information.

Photo 1. Example of an In-vehicle Camera Installed on a Rear-view Mirror

## 2. Conceptual model for utilization of imagery probe information

Figure 1 shows a conceptual model for utilization of imagery probe information. The model is comprised of four functional units. The first is “Data collection” which means collecting images and positioning information; the second is “Phenomena detection” which uses the data collected to detect some phenomena; the third is “Data transmission” which is transmitting collected data or the results of detection; and the fourth is “Data management” which is using transmitted data for advanced road management. Of these, “Phenomena detection” is performed either on the on-board unit side or the center side according to the adopted technologies and the functional requirements.

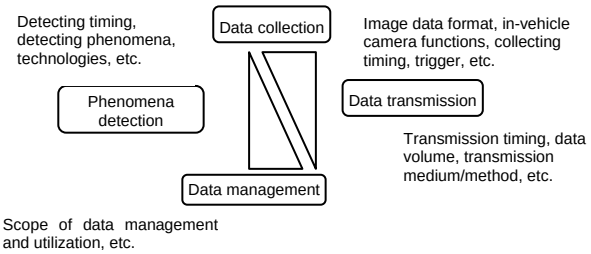


Figure 1. Schematic Figure of Conceptual Model and Examples of Technological Challenges

## 3. Future prospect

In order to use imagery probe information for advanced road management, we will clarify technological challenges in each unit of the conceptual model and carry out research and development to resolve them. Moreover, we will study how to treat security and privacy issues of imagery probe information, and a business model for using imagery probe information for advanced road management.

[Reference]

1) Tanaka, Morie, et al.: Dry/Wet Judgment of Road Surface Using Gabor Filtering of Vehicle Camera Images, IEICE Technical Report, ITS2010-63, IE2010-138, p.263-267, February 2011
2) Shimada, Inoue et. al.: System Proposal of Always-archived Drive Recorder by using Smart Phone and “Vider” New Video Services, IPSJ SIG Technical Report, Vol. 2009-ITS-38 No. 2, September, 2009

# Possibility of applying digital trail data to traffic planning

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*(Key Words) Trail data, bus smart card data, probe car data*

## 1. Introduction

The Research Center for Advanced Information Technology is researching methods of obtaining and using multiple digital trail data using Information Technology as a measure to effectively support the enactment of traffic plans by the national government and regional governments. In 2011, the Center performed research on methods of using trial data obtained by bus smart cards and probe cars, focusing on the enactment of plans for the improvement of traveling near bus stops and on the clarification of the effectiveness of small-scale road improvements.

## 2. Use to prepare measures to improve traveling near bus stops

Trail data from bus smart cards was used to abstract from among all bus stops in Saitama City (1,116 bus stops), the top 30 in terms of number of users, and clarified the actual state of use by busses (usage rates during commuting periods, on holidays, etc.). Then trail data from probe cars (ordinary automobiles) was added and the actual state of travel by busses and by ordinary automobiles (average traveling speed, or fluctuations) was clarified. The rate of obstruction of travel at bus stops was calculated based on the traveling speeds of busses and of ordinary automobiles, and a comparative verification with the local situation was done, confirming its effectiveness (see Fig. 1). In order that analysis results are easy to use to prepare traffic plans, the state of traffic for each bus stop was clarified (visualized) in chart form.

## 3. Verification of the effectiveness of a road improvement

Two kinds of trail data were used to measure the expressed effect of intersection improvement done by extending the right turn zone by 60m. Specifically, trail data obtained from bus smart cards and from probe cars were used to calculate the distribution of average traveling speeds by time of day, by time of day by day, and by month and the average traveling speed of busses (see Fig. 2), confirming that cars were no longer prevented from entering the right turn lane, improving the punctuality of busses and smoothing the progress of automobiles turning right.

## 4. Conclusion

This research confirmed that it is possible to apply analysis combining multiple trail data to traffic planning. In the future, we want to study methods of use including digital trail data obtainable from mobile phones in addition to transportation (bus and railway) smart cards and probe cars.

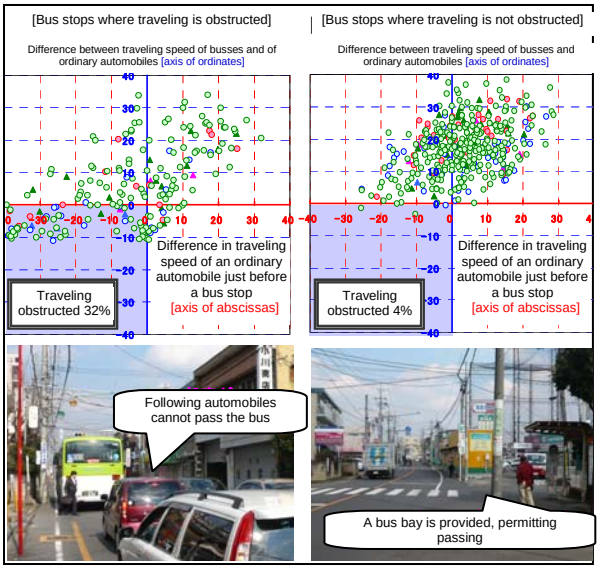


Figure 1. Example of the Identification of Locations where Travel is Obstructed

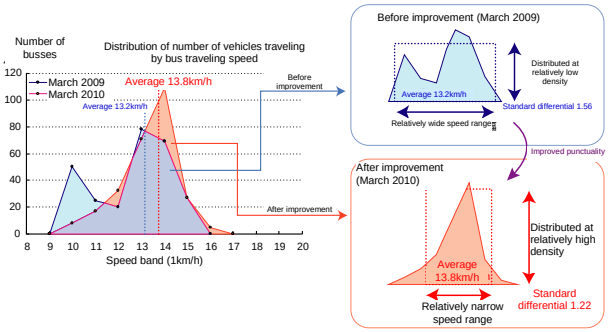


Figure 2. Change of Bus Traveling Speed Distribution by Road Improvement

[Reference]
Hamada, S. Imai, R. Iboshi, Y.: Support for the study of improving bus traveling using trail data and verification of the effectiveness of road improvements, *Civil Engineering Journal*, pp. 22-25, October 2011.

# Public release of the CommonMP Element Model Library

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River Department

*(Key words) Hydraulics/hydrological analysis, element model, consortium*

## 1. Introduction

The River Department publicly released the CommonMP (Common Modeling Platform for water-material circulation analysis) on its web site[1)] in March 2010. CommonMP is a platform for analysis models which can be run linked to multiple hydraulic and hydrological models (flood routing or inundation models, hereinafter referred to as “element models”) in order to analyze water and material circulation in river basins on a personal computer. This is a report on the recent start of operation of the Element Model Library, which lets anyone register and use element models.

## 2. Operating the Element Model Library

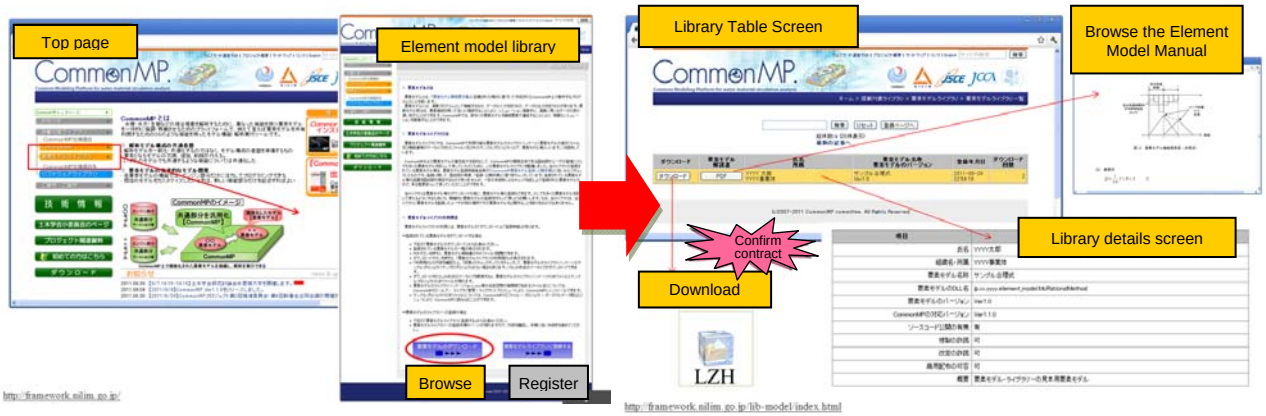
The first version of the platform was released in March 2010, but with insufficient types of element models, the use of the CommonMP was limited. The Element Model Library has been provided so that the NILIM, which developed the CommonMP in order to expand the use of CommonMP and element models, can let as many users as possible use element models. Element models that are registered in this library have been self-checked by element model registration applicants themselves according to the CommonMP element model registration and public release procedures, permitting the unrestricted use of these element models within the range of usage authorization conditions. And users themselves can register element models they have developed in the library.

## 3. Future endeavors

To register an element model, its developer personally performs a self-check. Regarding the check method of registration, members of the CommonMP development and operating consortium[2)] have argued that it is suitable for it to be done by a certification body in order to ensure objectivity. In the future, registration in the element library will be promoted at the same time as certification by a certification organization will be made a reality.

[Reference]

1) http://framework.nilim.go.jp
2) http://framework.nilim.go.jp//news-link/090807.html




Element Model Library

# Major Disaster Surveys

1 Field survey and guidance based on the nature-oriented river works advisor system for emergency projects to deal with severe damage and disaster assistance projects (Niigata Prefecture, Wakayama Prefecture)

From July 27 to 30, 2011, parts of Niigata and Fukushima Prefectures were struck by record breaking heavy rain exceeding the torrential rain which struck Niigata and Fukushima Prefectures in July 2004, causing damage along the Igarashi River, the Agano River and so on. We advised on forms of revetments and embedding according to the causes of the damage, and gave advice on the design of new channels and the treatment of revetments and watersidess taking account of environment, for the Igarashi River, Shiotani River, and Hane River. Because the Agano River includes a river cruising course, we gave guidance about revetments considering the scenery and the height of polders.

Typhoon 12 brought record-breaking torrential rainfall exceeding a total of 1,800mm at places on the Kii Peninsula, causing damage on rivers including the Hidaka River, Ota River, and the Nachi River. For the Hidaka River, we gave advice on methods of improving the levees after confirming the flood control functions of the open levees. For the Ota River, we advised on excavation method which conserved the riparian forests growing continuously at the waterside of the low water channel. For the Nachi River, we advised on the setting of the channel profile foreseeing its future change which had been buried by this disaster and provided guidance on a method to consider the world treasure, the Nachi Taisha Shrine.

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FUKUSHIMA Masaki, Senior Researcher
River Division
AMANO Kunihiko, Head
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Environment Department, River Environment Division

2. Damage survey on the Igarashi River of the Shinano River System after the Niigata-Fukushima torrential rainfall

Torrential rainfall in Niigata and Fukushima Prefectures in July 2011 caused severe damage to river management structures, including breached levees on the Shinano River System and the Agano River System. The River Division responded to a request for the dispatch of staff to survey the damage, by inspecting the Shinano River, Igarashi River, and Kariyata River on the Shinano River System, and the Agano River on the Agano River System. They confirmed the state of breaching and leakage of levees, and discussed their causes, and at the same time, confirmed the state of damage to revetments etc., which had been restored after damage which occurred in July 2004, and discussed future countermeasures.

HATTORI Atsushi, Head
River Department, River Division

3. Survey of damage to the Onodani River on the Shingu River System caused by Typhoon 12

The impacts of Typhoon 12 caused record-breaking rainfall in the southern part of the Kinki Region, triggering large-scale failure of mountain sides along the Shingu River System and in the surrounding mountainous land, and at the same time, severely damaging management facilities on the downstream river courses, by breaching levees for example. The River Division responded to a request to dispatch staff to inspect the damage, by carrying out inspections on the Shingu River and Onodani River on the Shingu River System and on the Nachi River on the Nachi River System. The inspectors confirmed the state of damage in a case where a polder was completely submerged by a flood discharge far higher than the levees, and state of damage when a river course in a narrow mountainous area was blocked by sediment so the flood discharge flowed across the protected area. They also discussed future countermeasures.

HATTORI Atsushi, Head
River Department, River Division

4. Field Survey of damage to bridges due to the Niigata and Fukushima Torrential Rainfall of July 2011

Concentrated torrential rainfall which occurred in Niigata and Fukushima prefecture from July 27 to 30, 2011 abruptly raised the river's water level, causing damage including inundation and landslides. Many bridges in the river basin were damaged due to the effect of inundation.. The Bridge and Structures Division conducted a survey of the damaged bridges , mainly on Route 252 alongside the Tadami River. They confirmed conditions of the superstructures which were washed away, damage conditions in regards to abutments and piers, and damage to stiffening girders deformed by the effect of the rising river water.

TAMAKOSHI Takashi, Head
Road Department, Bridge and Structures Division

# Major International Conferences

1. The 27th US-Japan Bridge Engineering Workshop and the 15th MLIT/FHWA Bridge EngineeringMeeting (Japan: November 7 to 9, 2011)

The US-Japan Bridge Engineering Workshop is held annually, alternately by the U.S. and by Japan, as an activity of Working Committee G (traffic systems) established under the US-Japan Panel on Wind and Seismic Effects, making up the United States-Japan Cooperative Program in Natural Resources (UJNR).

At this workshop, which was held in Tsukuba, participants presented papers concerning the Great East Japan Earthquake, tsunamis, seismic retrofitting, evaluations of load bearing capacity, maintenance, inspections, etc. (Japan side 17, U.S. side 13), and discussed and exchanged views concerning the papers.

The MLIT/FHWA intergovernmental conference is a meeting with the US Federal Highway Administration concerning bridge structures, which is a cooperation theme under the US–Japan Agreement on Cooperation in Research and Development in Science and Technology. At this meeting, the participants exchanged views concerning methods of applying inspection data to bridge maintenance, impact of long duration earthquake motion based on experience of the Chile earthquake which had occurred in February 2010, and the impact on bridges of tsunami caused by the Great East Japan Earthquake of March 2011. They also confirmed that both sides would carry out continued exchanges of information and survey research in the future.

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NAKASU Keita, Senior Researcher
NOMURA Fumihiko, Researcher
Road Department, Bridge and Structures Division

2 The 18th ITS World Congress and Bilateral Meetings (U.S.: October 16 to 20, 2011)

The Intelligent Transport System Division, in cooperation with the Road Bureau of the Ministry of Land, Infrastructure, Transport and Tourism, participated in the 18th ITS World Congress held in Orlando (U.S.). In addition to announcing papers (6), its delegates took the rostrum to give presentations at special sessions (4 sessions), and at the same time, participated in international side events held in conjunction with the World Congress (2 workshops). And at bilateral meetings (with the U.S., European Commission, China, Korea), the delegation exchanged information and discussed future cooperative research with each ITS related authority, and at the same time, participated in several meetings and collected the most recent information concerning EU-U.S. Joint Task Force activities on cooperative ITS.

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