Missions the NILIM must accomplish

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1. Introduction

Challenges we must face in the future were clarified in 2014. The severity of population decline was widely discussed, revealing a shocking image of the future, when regional cities might disappear if the decline of people continues unchanged[1)]. Natural disasters rampaged, causing severe damage. Record-breaking torrential rainfall never before experienced struck throughout the country. The Hiroshima sediment disasters of August 20 demonstrated that even cities are not safe from the danger of disasters. On the global scale, warming intensified, clearly showing that it is essential to sharply and sustainably reduce emissions of greenhouse effect gases for the next several decades in order to lower emissions to almost zero by the end of the 21st century[2)].

We have begun working to resolve such problems without ignoring them. Looking at the domestic economy, we see that a variety of efforts to end the prolonged deflation are in progress. In response to population decline that inevitably impacts the future of the Japanese economy and the fortunes of its regions, the "Towns, People, and Job Creation Headquarters" has been formed and the government has begun unified efforts to resolve the problem[3)].

The Ministry of Land, Infrastructure, Transport and Tourism has enacted Grand Design of the National Land 2050, which, led by Minister Ohta, looks far ahead to the year 2050, and sharing the people's sense of crisis, presents a philosophy of national land reconstruction that will open the door to a bright future[4)]. In the area of disaster prevention and mitigation, the Sediment Disaster Prevention Act has been partly revised to reflect lessons taught by last year's sediment disasters in Hiroshima. And in the field of maintenance, revision under a ministerial order now requires direct visual inspections of road bridges etc. In June of last year, the revised Act on the Quality Control of Gasoline and Other Fuels, that was enacted to ensure the quality of infrastructure and of people to operate it, also revised the unit cost of labor and stimulated efforts to ensure people to continue the construction industry in the future by, for example, encouraging the employment of young people and women.

2. Five themes

I believe that the NILIM must, through its survey and research projects, resolve these challenges and play a pioneering role in efforts focused on the future. Below I will describe the research activity system at the NILIM.

Survey and research conducted by the NILIM is broadly categorized under the following five main themes.

One is **disaster prevention and mitigation.**

We conduct research to develop means of predicting locations at danger from disasters or spotting precursors to more quickly and accurately inform concerned persons, or of quickly starting rescue and life-saving activities after a disaster and supporting early restoration and reconstruction, and we complete hard and soft countermeasures considering the fact that the way disasters occur has changed.

The second is **Infrastructure maintenance**. We wish to prioritize research that is highly urgent and for which there is a great social need, such as preparing standards that will permit efficient inspections and diagnosis while ensuring reliability.

The third is **intelligently using the existing stock**. We are conducting research in pursuit of ways to effectively and intelligently use existing infrastructure by, for example, mitigating congestion and creating a safe traffic environment through the use of ITS.

The fourth is **forming sustainable and vigorous national land and regions**. We wish to prioritize research to prepare for the future by, for example, responding to global warming by decreasing energy consumption by homes, which is an area where it has increased remarkably, and by providing

environments in which elderly members of the aging society can live without fear.

The fifth is **execution procedure's innovation.** In addition to innovative bidding and contract mechanisms and methods, we wish to also improve productivity by revolutionizing and improving survey, design, and execution technologies and to reduce the burden and increase the efficiency of administrative and construction sites.

3. Four activities

To undertake specific efforts to tackle the five themes, we conduct our activities constantly guided by the four principal pillars.

The first pillar is **research and the preparation of draft technical standards** to support planning and implementing technological policies. It is vital to constantly accurately grasp and to respond to social needs and problems.

The second pillar is offering complete **consulting** services concerning problems that occur in the field. Immediately after the Hiroshima sediment disasters, personnel of the Sabo Department went to the scene to give advice permitting safe and prompt rescue and first-aid activities. An extremely important role of the groups of experts in infrastructure who quickly enter disaster and maintenance areas is to help resolve problems by providing reliable advice. At the end of last year, a technical consultation office was established to provide a unified response to requests for technical advice concerning disaster prevention and mitigation and concerning maintenance. We wish to strengthen our ability to respond quickly and correctly to challenges faced in the field.

The third pillar is **encouraging the transfer of technology** to society. By providing a full program of training for working level personnel involved in disaster prevention and in maintenance, the NILIM is trying to place its technologies, knowledge, and know-how at the disposal of field workers.

The fourth pillar is playing the role of **coordinator**. For maintenance that has barely begun in particular, many technologies have to be developed in a short period of time. So we at the NILIM wish to play the coordinating role we call the "pivot of the parasol", that permits us to deepen our links with other concerned organizations to take an overarching view of the overall problem and past achievements of technological study to obtain results efficiently without duplication.

4. In Conclusion

It is important that the accumulated achievements of surveys and research by the NILIM not only bear fruit in technology policies, but that they are applied in the field that is on the front lines of infrastructure provision. I believe that the four pillars of our activities described above are indispensable roles we must fill in order to bring our achievements to life in the field.

Focusing on putting the argument that public works are unnecessary to rest and ensuring that the accumulated social infrastructure provides our citizens with great benefits, we are establishing an environment in which we will strive to tackle a variety of problems that must be overcome. Convinced that our mission is to find ways we can be of service in the field, we want all our researchers and other workers to strive as one to resolve these problems.

[Sources]

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Pickup ①

Sediment-related Disasters that Occurred in 2014 and Technical Support by Experts

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Key words: Sediment-related disasters, technical support

1. Necessity for technical support in case of sediment-related disaster

Collapse and debris flow change the topography of surrounding areas and cause a concern, even after occurrence, about extensional collapse and damage increase due mainly to erosion /deposition in the flow channel. In addition, since sediment-related disasters often involve human damage, emergency measures and search operation are urgently required. When performing such emergency measures, etc., it is required to ensure safety and technical judgment about the risk of secondary disaster is also required. In Japan, a total of about 1,000 cases of sediment-related disasters occur every year, but the number of occurrence is greatly different according to regions or over years (See the Figure). Therefore, there is also a difference of experience among local governments etc. and technical support is often required from the National Institute for Land and Infrastructure Management (NILIM).

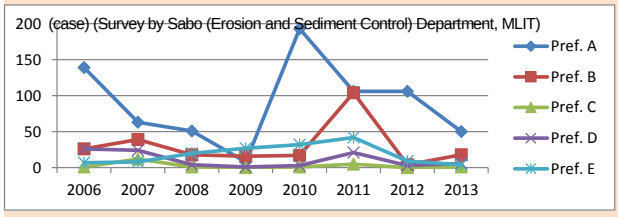

Figure: Difference in number of sediment-related disasters according to regions or over years

2. Sediment-related disasters that occurred in 2014 and technical support

There are various contents for technical support, including development of crisis management system, advice for consideration of emergency measure construction method, and guidance for disaster investigation. Moreover, the time requiring support, i.e. duration from the occurrence of a disaster to emergency restoration, may become long. Therefore, NILIM provides support to local governments and Regional Development Bureaus in cooperation with the Public Works Research Institute (PWRI).

Photo: Explaining points of attention in safety management to police and fire fighting team

In 2014, for the disasters that occurred in Yokosuka City (Kanagawa Pref.), Nagiso Town (Nagano Pref.), Iwakuni City (Yamaguchi Pref.), Hiroshima City, and Ontake Mountain (Nagano Pref. and Gifu Pref.), NILIM and PWRI dispatched a total of 202 employees to provide technical support on the site.

Of these, in the sediment-related disaster that occurred in Hiroshima City on August 20, a heavy rain with rainfall of over 200 mm during 3 hours in a limited area caused debris flow and landslide simultaneously in different places from predawn to dawn and much concentrated damage to the residential area developed on a gentle slope at the foot of the mountain.

Immediately after the disaster, operation of searching missing persons by the Self-Defense Forces, fire department, and police was conducted and emergency measures including sediment carrying and sandbag installation by local residents, etc. NILIM also gave advice and investigated the site according to changes in the weather and progress in the emergency measures in order to prevent secondary disasters etc. including direction of the disaster investigation using TEC-FORCE, advice on the crisis management system of Hiroshima City, and advice on safety management about the search activities by the organs concerned (See the Photo).

3. Future activities

NILIM is considering disaster prevention and mitigation through solving the issues found from disaster response while using the findings from studies at ordinary

times for consulting activities on the disaster site.

[Reference]

1) Matsushita and Fujimura: "August 2014 Hiroshima Sediment-related Disaster Investigation Report, Civil Engineering Journal, Vol. 156, No.11, pp. 4-7, 2014

Pickup ②

Empowering technical officials in MLIT Regional Bureaus and local governments in terms of road bridge preservations

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(Key words) road bridges, maintenance, technology transfer, human resource development, technical assistance

1. Introduction

Timely and relevant maintenance actions are necessary for bridges and structures to maintain their required performance levels as essential elements of road networks. Higher level of expertise is sometimes required for technical officials in road administrators to make decisions concerning the imminence of and details of maintenance action than the level required to design new structures from square one. This is because road administrators must manage to decide the actions with limited information on the damage and bridge conditions, while the decision must be based on the engineering assessment of structural conditions and remaining strengths, the progress predictions and causes of observed damage, and other social restrictions.

Accordingly, Bridge and Structures Division has, as one of its missions, beensharing our knowledge and expertise with road administrators and their engineering officials through the acceptance of short-term liaison engineers from MLIT Regional Bureaus, technical assistance for road administrators, and sending our researchers to their human resource training courses and seminars. Some of the highlighted activities are described in this article.

2. Development of the expertise of training liaison engineers from MLIT Regional Bureau

MLIT Regional Bureaus send liaison engineers to our division so that, in the near future, they can begin playing a leading role in the field of maintenance for bridges and structures in MLIT Regional Bureaus and national highway offices. They are involved in request-basis technical assistance activities for road administrators and the development / improvement of technical manuals, so that they can obtain expertise in bridge maintenance and technical consultation on the job. This activity began in 2014 and 11 liaison engineers spent three months working in Bridge and Structures Division.

Photo Activities of liaison engineers (on-site investigations)

3. Cooperation with MLIT Regional Bureau to issue technical advice reports for bridge maintenance on a request basis from municipal governments

In July 2014, the government ordinance for inspections came into effect, specifying that hands-on inspection shall be conducted for road bridges at a frequency of 60 months. The MLIT provides financial and technical assistance to municipal governments to enable them to follow the government ordinance. One of the technical assistance activities is to evaluate the recommended actions to particular bridges that the municipal

governments which own them are considering based on inspection results that indicate the need for large-scale rehabilitation or maintenance works. In 2014, based upon their requests, the MLIT sent bridge experts from their Regional Bureaus, NILIM, etc to the selected three bridges. Bridge and Structures Division provided technical expertise for the MLIT Regional Bureaus to conduct on-site investigations and draft the technical advice reports on the recommended maintenance and rehabilitation actions for those bridges.

Photo Technical assistance to municipal governments for them to follow the government ordinance (on-site investigations)

4. Remarks

These activities help develop human resources for technical officials in MLIT Regional Bureaus and local governments. Simultaneously, these activities are fed back our researchers in Bridge and Structures Division as firsthand experience in bridge maintenance in the field. The partnership between NILIM and MLIT Regional Bureaus / local governments definitely plays a key role in the transfer of our expertise to the field.

Pickup ③

Supporting Logistics through Public-private Sector Collaboration Using ETC 2.0 Platform

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(Key words) ETC2.0, probe data, logistics

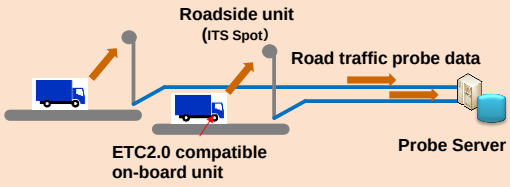
1. Introduction

Truck transport in Japan is the linchpin of the economy, handling about 90% of all cargo in terms of weight. But, the need to support logistics is increasing in response to problems related to safety management and a shortage of drivers. The Intelligent Transport Systems Division is conducting R&D on a logistic support system using road probe data collected by ITS Spots. And since September 2012, we have been conducting Joint Research on industry-academia-government collaboration service development using the "ITS spot common ground" (below, "public-private joint research"). This report introduces a public-private sector linked logistics support system based on ETC2.0 platform built through the public-private joint research.

2. ETC 2.0 Platform

ETC2.0 platform is an infrastructure system that records road traffic probe data such as travel history is recorded on ETC2.0 compatible on-board units and is collected on probe server, when vehicles pass by a roadside unit.

Figure 1 ETC 2.0 Platform



3. Private-Public Linked Logistics Support System

The purpose of the public-private joint research is to promote the development and introduction of working logistics support services using road traffic probe data (specific probe data [1]) that specifies individual vehicles, and to increase the efficiency and level of road management as road administration.

Figure 2 shows logistics support system based on public-private sector collaboration using ETC2.0 platform. The publicly collected specific probe data from ITS Spots installed at about 1,600 locations on nationwide expressways is collected on probe data sharing systems. Specific probe data for the distribution bases and areas around the delivery destinations of logistics companies are collected in logistics company servers from simple type roadside unit the private sector has installed at its distribution bases. The public-private joint research specifies public-private sector communication interface specifications and shares the specific probe data for parts where the public and private sectors cannot collect data online.

This enables the public and private sectors to clarify the movement of logistics vehicles over a broader range. And logistics company operators are counting on controlling vehicle operation, improving distribution efficiency, supporting safe operation, and supporting eco-driving (Table 1).

Figure 2 Private-Public Linked Logistics Support System

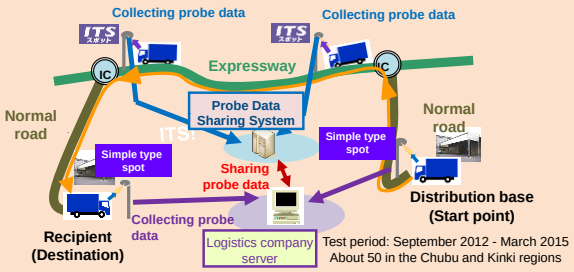


Table 1 Logistics Efficiency Support Services

	Example service	Outline
1	Vehicle 0peration control and operation planning	Setting appropriate delivery routes by clarifying the course and required time between logistics bases
2	More efficient receiving and transshipping	Knowing present location of vehicles and predicting arrival time to shorten time waiting for reception of shipments
3	Supporting safe driving	Analyzing vehicle behavior to prepare maps indicating points where many near-misses occur.
4	Supporting eco-driving	Analyzing driving behavior to compute fuel consumption and provide driving advice to drivers (clarifying accelerations).

4. Conclusion

National scale social experiments in logistics support are scheduled to start in 2015. In the future, we will

study rule-making not only in technology areas, but in the system and operation areas.

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Pickup ④

Fire safety of 3-story wooden school

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(Keywords) 3-story school, large-scale wooden construction, full-scale fire test, quasi-fire-resistive performance

1. Foreword

According to the Building Standard Law, when building 3-story schools, it was conventionally required from the standpoint of fire prevention that the building was a fire-resistive building whose principal building parts like columns and beams were of fire-resistive construction, as well as the principal building parts of wooden buildings whose total floor area exceeded 3000m^2. However, according to the "Countermeasure policies pertaining to regulation/system reforms" (decided June 18, 2010), a research results-based review was requested regarding these regulations. Furthermore, in the "the Act for promotion of use of wood in public buildings etc." (enforced October 2010), the promotion of wood for the construction of institutional buildings was prescribed based on a review of these regulations.

To enable the construction of 3-story wooden schools, NILIM, with the cooperation of organizations conducting the subsidized project of the Ministry of Land, Infrastructure, Transport and Tourism and the Building Research Institute, had conducted two full-scale fire tests, performed a series of fire experiments using real scale classrooms and had been collecting necessary information to review the Building Standard Law since 2011. Based on these findings, a third full-scale fire test (final experiment) was conducted on a 3-story wooden school.

2. Full-scale fire test on a 3-story wooden school (final experiment)

The principal building parts of the 3-story wooden school were quasi-fire-resistive wooden constructions. The building was a 3-story building 24m long, 12m wide and 15m high. Its building area was 310 m^2 and its total floor area was 850 m^2. The building was separated by a fire wall and its opposite side part was used for evaluating fire spread (see figure). The fire wall was set 50cm apart from the exterior wall and interior fire doors were specified opening protective assemblies made of iron. The unidirectional rigid-frame structures with 8m glued laminated timber spans were in the longitudinal direction, and bearing wall structures with 4m spans were in the span direction. There were no balconies or eaves and the classroom walls were made of wood, although quasi-noncombustible materials were used for the ceilings.

The experiment was conducted on October 20, 2013. First, a fire was ignited inside the 1st floor staff-room. The fire-preventative measures on the classroom ceilings helped control fire expansion in the initial fire. As well, even though the columns and beams in the 1st and 2nd floors withstood intense heat for over 60 minutes, the building did not collapse and there was no noticeable fire expansion beyond the fire wall (see photo). It was confirmed there would also be no negative effects in terms of evacuation, fire fighting operations or thermal effects on the surroundings.

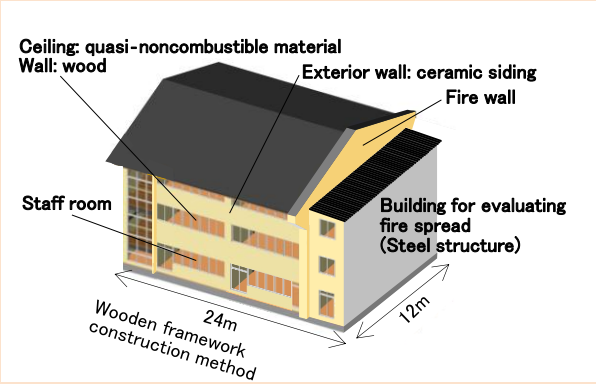

Figure: Test Specimen Overview

Photo: The fire test

3. Revision of the Building Standard Law

The original technical bill based on the experimental results was investigated in a committee for consulting outside experts set up at NILIM, and a partial revision of the Building Standard Law including the revision of Article 21 Clause 2 and Article 27 was promulgated in June 2014. An enforcement order determining the specific technical standards and relevant notification had been developed and promulgated. The revised standards are scheduled to be enforced starting June 2015.

Pickup ⑤

Trends in Research on Internationalization of Technical Standards in the Port and Harbor Field

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(Key Words) Port and Harbor Structure, Design Standard, Vietnam

1. Introduction

In this research, a study on methods for customizing Japanese domestic technical standards responding to the needs of the counterpart country was carried out based on Japanese technical standards in the port and harbor field, through a survey/analysis, etc. of technical standards in the developing countries of Asia and elsewhere.

2. Internationalization of technical standards

To enable Japanese companies to continue to carry out business development advantageously in other countries in the future, for example, in Asian countries where strong demand for infrastructure is foreseen, in addition to top-level sales through the combined efforts of government and the private sector, efforts to secure standards in countries where investment is expected are also necessary. However, because the technical standards which are used in the design of port and harbor structures in Japan are premised on different natural conditions and levels of technology, they are not necessarily suitable in their existing form for the actual conditions in object countries.

Therefore, we are conducting out a study on methods for developing custom-made standards which are based on Japanese port and harbor design standards but respond to the needs of the counterpart country, in collaboration with the Ports and Harbours Bureau of Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT), with the cooperation of the Port and Airport Research Institute, etc. Our partner in this study is Vietnam which is a country where we have built at cooperative relationship through surveys and studies up to the present.

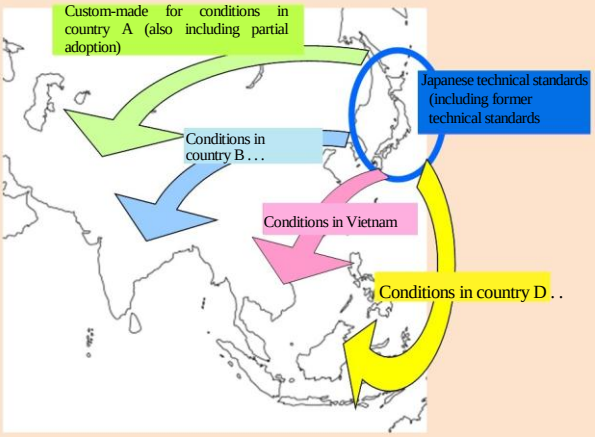

Fig. Custom-made standards responding to conditions in object countries

MLIT and the Ministry of Transport of Vietnam signed a "Memorandum of Understanding on Cooperation in Establishment of National Technical Standards for Port and Harbor Facilities" in Hanoi, Vietnam in March 2014. The two sides are now engaged in joint research based on that agreement.

3. Status of progress in Japanese-Vietnamese joint research

Our counterparts on the Vietnamese side are the Ministry of Transport Office of Science and Technology and Institute of Transport Science and Technology (ITST). We are holding workshops that include persons of knowledge and experience on the two sides, and are also exchanging views regularly. Among the technical standards, during the present fiscal year, we held discussions on the General Provisions, Loads and Actions

and Material Conditions volumes, and prepared a rough draft of standards for Vietnam. The main items discussed were, in connection with general provisions, the thinking on the design working life and degree of importance of structures; in connection with loads and actions, the setting of wave conditions and earthquake conditions; and in connection with material conditions, specifications that consider the durability of steel materials and concrete. The coming fiscal year is the final year of this research. We plan to prepare draft standards for foundations and ground improvement and facility design standards specializing in structural types of breakwaters and mooring facilities which are widely used in Vietnam. We will also finalize the full set of standards in the coming year.

Photo Workshop in Vietnam

【Reference】

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http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0769.htm
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Seven Checks for Better Research

-- from the discussion for building up research appropriate for NILIM

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Key words: Research on technology policy, objective / goal setting, research scenario, research management

1. Is "What issues should be solved and what world should be created?" clear and right?

This is the question asking whether there is a door (major objective) that connects between research and society, which is the starting point of research. The content of research should be so easily understood by people that they say, "O.K. We want you do it by any means." Some may think decisively that long-term, potential, or indirect issues are hard to grasp and therefore have less advantage in setting such an objective, but all the more reason, we should pursue persistently easy-to-understand explanation. Such attitude will lead to upgrade of the research itself and finding of new explanation indicators and frames.

In setting such a level of objective, it is essential to grasp the overall flow concerning the subject of research, select limited and important issues, and ensure concentration on them. To that end, policies and visions serve as an important clue. However, it should be avoided to incorporate an abstract / conceptual target image into goal setting as it is in excess of utilization as a trigger for thinking. When elaborating on research content, it should be replaced with recognition of real and specific issues based on the grasp / understanding of real phenomena. When using vision or concept, it should be tried "Whether three examples that explain it specifically can be surely prepared." Only with this try, possibility of starting with abstract theory and having a hard time later will be reduced.

2. Is the relation between major objective (world to create) and research goal clear?

There is occasionally a case where a great goal is set but becomes an accessory to the research and the logic remains unclear on explaining how the target world is created after the research goal is achieved. Particularly, attention should be paid to a case where the purpose of research is placed on progress in the relevant technical field or making one step forward on the existing research policy. This is a deep-seated problem since it is related to the virtue of researchers, i.e. constant training of expertise. It is therefore desirable to have an attitude of thinking positively how one's expertise is involved in goal achievement without retreating into the shell.

It should also be avoided to choose abstract expressions for goal setting, such as "Enhancement of XXX" or "Preparation of guide to XXX," as well as confusion of means with goals. Goal should be set so that whether achievement thereof can be specifically determined. The true meaning of this is never to be severe with unsuccessful research but to maximize research findings. As long as research goal is specific, research is activated, and even if research is unsuccessful, useful findings for proceeding to next step can be obtained.

3. Is research process specified?

For example, such statement as "In order to build a peaceful world, collect and analyze cases, grasp inhibiting factors, study methods for solution, conduct comparative verification of their effectiveness, organize conditions of application, and document them as a practical guide" is not a research scenario, but "template." It is possible to conduct self-check on "Whether it did not end up with a mere use of template?" by checking "Whether the content could be written by non-researchers?" Research scenario can be written for the first time with understanding of actual conditions and accumulated expertise, and those written only with general culture are excluded.

Once research is started, it should not adhere to the research scenario examined in advance. Significance of research scenario is that it really brings flexibility in fulfilling research. Weak hypothesis is hard to lead to good applied operation.

4. Is positioning of the research appropriate?

Using the overall composition concerning the world to realize and various measures for realization (e.g. Fig. 1), mapping of the research should be conducted in

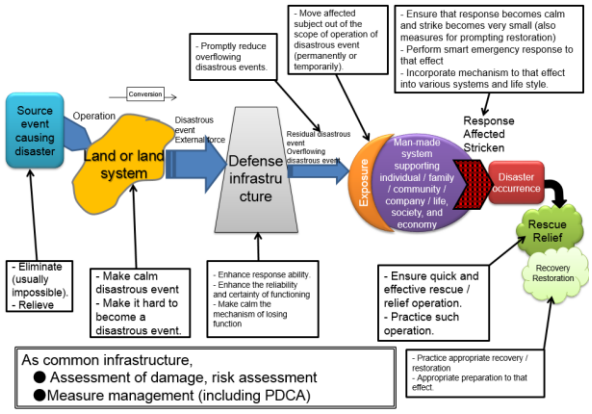

Figure 1. Example of Overall Composition --- Disaster Prevention / Mitigation Measures

Various measure types (box) are written in the "Flow of Occurrence of / Recovery from Disaster." Positioning of this research is examined with this Figure.

combination with various related activities. Based on this, significance of doing the research and influence / development of research findings (a gear wheel to be turned directly and gear wheels that start to turn in conjunction with it) should be confirmed. It is also necessary to grasp mutual relationship with other research activities, determine how to process required collaboration, and work out a coordinate strategy to achieve the goal, without ending up with mere fulfillment of own research. It is an essential factor for improving the quality of not only research but other work to be able to explain the positioning of the relevant research appropriately.

5. Is it clarified what to achieve exceeding predecessors?

Review of previous researches and clarification of the significance of the relevant research are widely known as basic rules for paper writing. The point here is not a thing like how to do research but that learning the efforts of predecessors made to maximize research findings is (all the more reason) important even in researches focused on the practice of measures. It should be grasped what predecessors succeed and failed to solve in their challenges and stated how to break through the remaining challenges with the relevant research.

Particularly when studying the system of nature such as rivers, since its existence and basic properties remain unchanged, failure to complete the research thoroughly may lead to following the predecessors' efforts uselessly and result in low evaluation of researches on the relevant field. Astute awareness of time-based positioning should also be ensured in order not to work out a research plan that is considered as the one that was created 20 years ago.

6. Are the points to appeal as research clear?

This section is related to the preceding section 5. It is important to be able to state briefly the characteristics unique to the research. When focused on the sources of breakthrough / development skills, they are nominated as follows:

Dramatic progress in phenomenon understanding and mechanism identification / dramatic progress in the method of quantification expression / dramatic progress in the information and data acquisition method / substantial expansion and fusion of the target (consideration factor) and resultant dramatic improvement in direct connection to the goal / organic combination between different types of events / conversion of the research base (regime) and novelty of focus / exploitation and utilization of new tools and means / exploitation of new ways of using tools and means / dramatic improvement in the feasibility of relevant measures / magnitudes of ripple effect and effect that causes conjunctive operation.

There is no superiority or inferiority among the above and they may be various. However, as long as it is research, there should be the points to appeal that makes even the researcher exciting. Efforts to explore and validate such points will directly lead to the enhancement of vitality to fulfill the research.

7. Is the research management that integrates various strong points established?

In view of the six sections described, it is found that a wide range of skills and abilities are required to build up a research, such as skills to overlook the whole to address a certain item, "agile" talent to fulfill the research for another item, and ability to bridge between the goal and content of the research for further another item. A single person cannot do all of these items unless he/she is a genius. Therefore, management that skillfully combines individuals and groups that demonstrate different characteristics is important. NILIM is also daily developing such activities that encourage researchers to work out good researches while conducting such management so that participants may be stimulated.

And, "even if it is now wasteland, it is possible to imagine big and tall trees growing from the seeds sown there." This is another way of self-check I was taught from predecessors.

Value Enhancement and Energy / Labor / Cost Saving for Sewerage Systems

TAKASHIMA Eijiro, Director of the Water Quality Control Department

Key words: Sewerage, energy saving, labor saving, cost saving, energy creation, resource

1. Roles of National Institute for Land and Infrastructure Management (NILIM) in Sewerage Field

Sewerage system plays a significant role in the living environment, water environment, water cycle, and resource cycle in national land. Meanwhile the entities providing sewerage service are local governments ranging from big cities to small municipalities, with various financial and technical capabilities.

Water Quality Control Department of NILIM is responsible for solution of issues and improvement of technical level concerning sewerage systems from the viewpoint of national land. Major roles of the Department include the collection and analysis of information concerning the past performance of development and maintenance and needs of local entities and the development / introduction / evaluation of technologies leading to cost reduction, efficiency enhancement, or value improvement. It is also required to issue such information in an easy-to-understand manner.

2. Status and issues of sewerage systems

Sewerage systems in Japan have been developed rapidly since the period of high economic growth, and the percentage of population connected to public sewerage amounted to 77%, the total extension of sewage pipes reached about 460,000 km, equivalent to 11.5 times round the earth, and the total number of treatment facilities came to about 2,200. In the future, aging of the large number of these facilities will proceed rapidly. Also, the percentage of population connected to wastewater treatment facilities including household wastewater treatment tanks amount to as much as 89%. Accordingly, it may be required in the future to reorganize the facilities in developed areas for further cost reduction etc. as well as to develop undeveloped areas.

As for measures to prevent inundation of rain water, inundation damage has often occurred in recent years even in the developed areas due to the increase in local heavy rain. Therefore, technologies are required for mitigating inundation damage, including improvement of facilities and operation methods by analyzing detailed information of rainfall and performance of facility operation.

The management and system of most sewerage projects are faced with severe conditions. Further, the amount of waste water flowing into sewerage is forecasted to reduce substantially across the country in the future due mainly to decrease in population and increase in water saving trend. This is a major negative factor for sewerage service income. Also, streamlining of the personnel has been proceeding in local governments and other organizations.

In order to support the lives of people and maintain the sound water environment, it goes without saying that continuation of sewerage system is required. Therefore, re-inspection or correction of plans and facilities, addition of new value, stock management, risk management, etc. are required.

Emissions of greenhouse gas from sewerage are 6,620,000 t in CO_2 conversion, accounting for 0.6% of the total emissions in Japan. Of this figure, emissions from electricity consumption account for 60% and N_2O, 30%. Accordingly, development and dissemination of energy saving techniques are required, as well as an approach to ensure compatibility between water quality conservation and reduction of energy consumption in treatment facilities for the whole basin. Also, method for controlling N_2O generation is required.

In addition to energy saving, energy creation, i.e. utilization of biomass energy, collection of resources such as nitrogen and phosphorus are also important, but the sewage biomass recycling rate remains 24% (Figure 1).

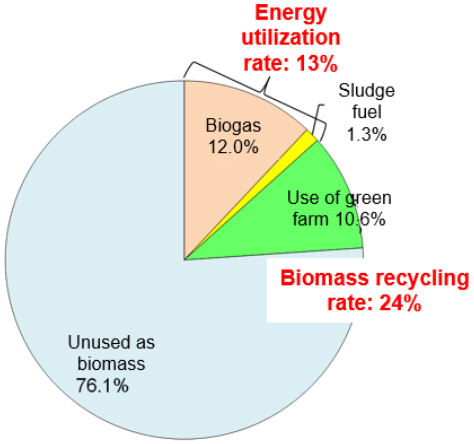

Figure 1. Use of Organic Matter in Sewage Sludge (Fiscal 2012)

3. What is required for sewerage technologies

Various conditions are required for sewerage technologies but are here discussed on the following two points.

(1) Energy, labor, and cost saving

The stock of facilities is now large and many facilities are becoming deteriorated. Since alteration of existing facilities is becoming the main stream rather than construction of new facilities, it is required to introduce facilities that save energy, labor, and cost, as stated in 2 above. Development of technologies to that end is the most important.

Also, in the Breakthrough by Dynamic Approach in Sewage High Technology Project ("B-DASH Project") [1)], field operational tests have been conducted since fiscal 2014 for multiple water treatment technologies emphasizing energy saving. In the first place, B-DASH Project aims at substantial reduction of life cycle cost and energy saving or energy creation, and using its system, it is necessary to introduce the technical development that innovatively advances "energy, labors and cost saving."

In order to grasp efficiently the condition of deterioration in facilities, the investigative technique for facilities is also essential. Sewerage pipelines are laid underground and most of their sections are located in inaccessible areas. For this reason, deterioration diagnoses have been conventionally conducted for each manhole section by step-by-step monitoring operation in the TV camera car (Figure 2). For this operation, it is also required to develop equipment that allows continuous diagnosis in a long distance by successfully responding to level differences and other obstacles in the pipeline and introduce robots and automation to ensure substantial labor and cost saving.

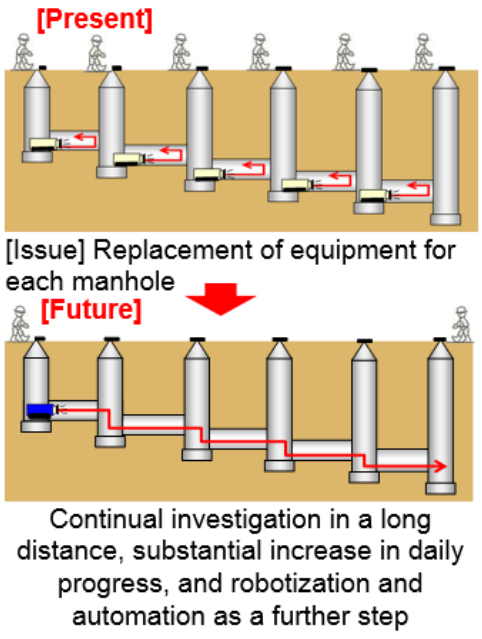

Figure 2. TV Camera Investigation in Sewerage Pipeline

Basic research on stock management of sewerage pipelines as infrastructure of land would be one of the significant missions unique to NILIM.

(2) Value improvement for sewerage system

As stated, the sewage biomass recycling rate is low, but it is expected to maximize the utilization of the energy and resources contained in sewage. For that purpose, major issues are further development of technologies and dissemination and promotion of developed technologies through cost reduction etc. In addition, for small to medium local governments with limited personnel, it is significant to develop conditions what easier to undertake. It is also significant to lower cost and facilitate introduction by advancing unitization of energy creation facilities and packaging of the whole including relevant parts. For this, utilization of B-DASH Project is expected.

Furthermore, in order to enhance the value of sewage treatment facilities, there is also a method of processing local biomasses other than sewage (kitchen garbage, human waste, cut grass, etc.) together with sewage. With these approaches, it is expected to expand the scope of contribution of sewerage system and increase income and energy creation, and methods for achieving them should be further developed.

4. Management of sewerage technologies

At present, Water Quality Control Department of NILIM, as executive office is preparing the "Vision for Sewerage Technology," which serves as mid- to long-term technical development plan for the sewerage in Japan. This mainly provides "Road map for each technical development field", and "Technical development promotion measures." After formulation of the Vision, it is scheduled to set up opportunities for continual discussion and adjustment of the direction and contents of the country's sewerage technologies to grasp needs and seeds, ensure matching of them, follow up the plans, and discuss new themes of technical development. Through these approaches, we want to contribute to the development of sewerage technologies in Japan.

[Reference]

1) Home page of B-DASH Project, Water Quality Control Department, NILIM
http://www.nilim.go.jp/lab/ecg/bdash/bdash.htm

New Stage in Water Field

TORII Kenichi, (Dr. Eng.) Director of the River Department

Key words: Flood disaster, disaster prevention / mitigation, maintenance, river environment, continuity

1. Introduction

In recent years, Japan has often suffered serious disasters, including the Tsunami by the March 2011 Great East Japan Earthquake, Typhoon No. 12, which hit the Kii Peninsula in August 2011, the Northern Kyushu heavy rain in July 2012, and the Hiroshima Heavy Rain in August 2014.

The Ministry of Land, Infrastructure and Transport (MLIT), facing up squarely to such disasters, released "Disaster prevention / mitigation for addressing a new stage" in January 2015, considering the situation that "the way of rainfall is clearly changing as known from such extreme rainfall as anticipated to occur according to progress in global warming" as "a new stage."

Not only the flood disaster field but various water-related fields are facing a new stage, and we herein discuss a new stage in the three fields of flood disaster, maintenance, and river environment.

2. New stage of flood disaster field

As basic concept of the climate change adaptation measures in the flood disaster field, the following three concepts were reported: 1) Prevent occurrence of disasters with facilities against external force with relatively high frequency of occurrence, 2) Minimize damage to the extent possible against external force that exceeds the capacity of facilities using all possible measures, and 3) "Protect the life" and "avoid destructive damage" against external force that considerably exceeds the capacity of facilities with focus on non-structural measures. [1)]

Since the Great East Japan Earthquake, the focus of research activities in the River Department has shifted from disaster prevention to disaster reduction, so its activities have also entered a new stage. For example, in disaster reduction focused on evacuation or crisis management, information, such as prior risk information or real time condition plays an important role. Therefore, we are developing technologies for delivering condition information (rainfall, a water level, inundation) to the persons in need in order to support voluntary evacuation in case of torrential downpour or to avoid disaster refuge in large area or destructive damage, and for realizing a low risk society by showing inundation risk intelligibly to society under the conditions of climate change.

Further, these studies require literacy of people and society who provide technologies and information. Therefore, the River Department, as the issue of intergenerational time scale, is developing new fields, such as research on evaluation of risk communication or natural features effective for disaster reduction as natural / social infrastructure.

3. New stage of maintenance field

Considering the year of 2013 as the "first year of maintenance policy," the MLIT has been strengthening the maintenance policy. Although maintenance has entered a new stage, it is important to further continue it.

In the water field as well, it is increasingly important to ensure safety consistently by maintaining existing facilities appropriately with limited financial and human resources. [2)] In response, the River Law was revised in 2013 and it has become required accordingly to inspect levees and other facilities with eyes at the frequency of at least once every year.

Main targets of river management, i.e. channels and levees, are highly non-uniform, and have therefore been managed based on experiences by accumulating findings obtained from the records on the deformation and damage, disaster relief work, and maintenance and repair and making decisions based on accumulated findings. Accordingly, it is important to transfer management skills accumulated by senior engineers to junior engineers to ensure the quality of inspection.

As the targets of research in this field, there are technologies for supporting inspection using database, reducing re-deposition of sediment on river channels or reducing repeated overgrowth of trees, and diagnosing the condition of levees in case of flood.

In order to ensure safety consistently, it is required to continue to turn the PDCA cycle of maintenance and database must also be a part of PDCA cycle of maintenance. In other words, it is significant to establish a system under which database is daily utilized on the site. To that end, it is necessary in technical development to develop technology in cooperation with the site and follow up the technology as research activity so that it may be incorporated into the PDCA cycle of maintenance.

4. New stage of river environment field

The River Law was revised in fiscal 1997 when the initial budget of expenditure for public works reached a peak and "Development and maintenance of river environment" was defined as the purpose of the Law in addition to flood control and water utilization. Main themes of research in this field at that time were technologies for avoiding or mitigating the effect of works on the environment and for restoration of river environment that deteriorated due to works.

In fiscal 2013, it was reported concerning the future of river environment management to develop activities by considering maintenance / renewal as an important opportunity to improve the management and landscape of rivers and to establish specific goals for environmental management. [2)] Accordingly, technologies to be pursued in research and development need to enter a new stage, i.e. from technologies for maintenance / renewal to technologies for management to achieve goals.

In order to set up a goal, it is necessary to ensure social agreement to the level and resource for achieving the goal (budget, technology, information). For data, accumulation is proceeding through National Census on River Environments and other various surveys, and establishment of a system is required for using accumulated data for environmental management. Further, for development of environmental management technology, it is essential to turn the PDCA cycle through trial execution in close connection of theory and practice and to accurate and share findings. In setting up a goal, it is necessary to establish a goal at a reasonable level considering limitation of resources, not establish one at a high level without step by step approach, and to build consensus among the persons involved.

Technologies related to this field include those for setting up environmental goal using accumulated environmental information and those for restoring nature. Particularly, to launch a goal higher than maintenance / restoration, consensus building among the persons involved is required. To that end, as prerequisite for consensus building, value of the environment, i.e. so-called ecosystem service, should be presented to the persons involved, which requires another approach that is different from conventional way of research.

5. Conclusion

We discussed three fields of flood disaster, maintenance, and river environment as a new stage in the water field. The key word common to these three fields is "continuity."

To "protect the life" and "avoid destructive damage" in water disasters means to continue to sustain the life and society. Moreover, since the occurrence frequency of a catastrophic disaster is very low, we must continue to prepare against it for a long period of time. For maintenance, it is essential to continue to accumulate data obtained, while ensuring the quality of inspection and diagnosis, and to continue activities. Further, since natural environment is the transgenerational property, we should have the awareness of improving river management even a little for succession to next generation.

Importance of continuity has been increasing in each field. Insufficient consideration of continuity would be regarded as one of the causes of the past failures. Technology developed only for a single purpose would be unavailable soon. In order to assure continuity, it is necessary to design the whole system including how the developed technology is used. The River Department intends to continue research so as to be able to provide design proposal for whole system as well as development of technology for a single purpose. To this end, we would have more opportunities to need communications with the site and appreciate your cooperation on such occasions. Also, please feel free to contact us if you have any problem.

1) River Subcommittee, Panel on Infrastructure Development (2015): "Interim Report on Climate Change Adaptation Measures in Flood Disaster Field --- Aiming for a society that shares disaster risk information and sense of crisis to work for disaster reduction"

2) River Subcommittee, Panel on Infrastructure Development (2013): "River Management for Ensuring Safety Continuously"

Countermeasures against Sediment-related Disasters and Research Activities Facing New Development Opportunities

WATARI Masaaki, Director of the Sabo Department

Key words: Sediment-related disasters, technical support, deep-seated landslide, early detection

1. Introduction

In April 2014, the Sabo Department, consisting of 2 divisions, was founded by adding Research Coordinator for Sediment Disaster Prevention and the Sabo Risk-Management Division to the present Sabo Planning Division.

Main responsibilities of the Sabo Planning Division include planning of erosion and sediment control, project evaluation, and comprehensive sediment management in order to solve / mitigate issues related to sediment movement, as well as researches on appropriate facility arrangement and design methods.

The Sabo Risk-Management Division is responsible for researches on methods of survey / observation by remote sensing, control methods such as risk assessment of slope failure, methods for effective information transmission in case of sediment-related disaster, etc.

2. Occurrence of sediment-related disasters and challenges

In fiscal 2014, 1,184 sediment-related disasters occurred and 81 persons were killed. In particular, the debris flow that occurred in Hiroshima in August caused human damage never seen in recent years.

This disaster killed about several tens of people, as in the 2013 sediment-related disaster that hit Izu-oshima, and triggered discussion among society about the way of watching and evacuation for sediment-related disasters. This disaster occurred soon after when the Sediment-related Disaster Prevention Law was quickly revised in order to establish measures for ensuring transmission of required information by administration to local residents in case of sediment-related disaster. However, in view of the facts that the two disasters above occurred at midnight / before dawn and that both areas suffered local heavy rain in a short time, we have to recognize a limit on the current way of watching and evacuation for sediment-related disasters only based on rainfall information. Therefore, efforts are expected to use any and all information available to ensure watching and evacuation at an early stage.

Meanwhile, large-scale sediment-related disasters successively occurred, including the deep-seated landslide in Kii Peninsula and the eruption of Mt. Ontake, and one of the important missions of NILIM is to support the Regional Development Bureaus in survey and study, which engage in urgent investigation under the Sediment-related Disaster Prevention Law. Researches and technical development that are helpful for effective crisis management using limited time, data, and resource are eagerly anticipated.

3. Technical support

In case of a large-scale sediment-related disaster, NILIM provides technical guidance in cooperation with the Public Works Research Institute ("PWRI") on the site for prevention of secondary disasters according to request from the municipality, etc. In fiscal 2014, the Sabo Department dispatched a total of 93 man-days for inspection of sediment-related disaster hazard areas, safety check after rainfall for prevention of secondary disasters, and technical advice for emergency measures, etc. In recent years, request has been increasing for activities using the expertise for measures against sediment-related disasters. In the above-mentioned Hiroshima disaster, where search operation was frequently interrupted due to rainfall etc., NILIM provided information on investigation results to police, fire department, and the Self-Defense Forces at the on-site coordination center etc., conducted investigation in their presence, and supported the establishment of a temporary watching and evacuation system as well as search operation.

Moreover, NILIM has started a practical human resource development program, which utilizes the personnel concurrent service system, from last fiscal year in order to support the quality improvement of personnel in Regional Development Bureaus who engage in the advanced measures against sediment-related disasters. In fiscal 2014, a total of 7 persons from local Regional Development Bureaus joined this program, and the personnel of the Regional Development Bureaus in concurrent service have engaged in on-site technical support activities including the aforementioned Hiroshima disaster together with the personnel of NILIM and PWRI.

In view of the aforementioned Hiroshima disaster, etc, the revised Sediment-related Disaster Prevention Law

was enforced in January 2015, requiring the Minister of Land, Infrastructure and Transport to endeavor to provide necessary advice, information, and other assistance to prefectures and municipalities. In response, we would like to strive to accumulate and utilize necessary findings and technologies so as to conduct technical support activities more appropriately in case of a disaster etc.

4. Research on large-scale sediment-related disasters

For deep-seated landslides, which may cause natural landslide dams and large-scale debris flow, focused research is going on, triggered in part by the 2011 Kii Peninsula flood disaster. Since systematic organization of scientific findings and countermeasure technologies concerning deep-seated landslide was insufficient, "Technical guideline for countermeasures against deep-seated catastrophic (rapid) landslide" was completed in fiscal 2014 as Technical Note of NILIM, describing the concept of classification of disaster events resulting from deep-seated landslide and of the method of assuming disaster scenario, systematization of and considerations for countermeasures, etc.

Further, the Kinki Regional Development Bureau installed "Technical Center for Large-scale Sediment-related Disaster Countermeasures" in April 2014, which is based on Nachi-katsuura, Wakayama, with the aim to conduct surveys, researches, and technical development concerning mechanism identification and countermeasures for deep-seated landslide and large-scale debris flow in academia-government collaboration. NILIM is considering participation in "Research Organization for Large-scale Sediment-related Disaster Countermeasures," in which the aforementioned Center serves as executive office, aiming to achieve successful results in research and development of the relevant field.

5. Effort for early detection of sediment-related disaster

The successful launch of "DAICHI-2," JAXA's Advanced Land Observing Satellite (ALOS), in May 2014 has enabled "regular health check (routine observation)" and "emergency diagnosis (urgent observation)" using Panchromatic L-band Synthetic Aperture Radar (PALSAR-2). We aim to develop technologies for locating the sites of deep-seated landslide and a natural dam by monitoring areas vulnerable to landslide or deep-seated landslide at "ordinary times" and grasping signs (slope movement) of landslide etc. from the data observed by PALSAR-2 so as to undertake measures at an early stage in case of detecting any abnormality, and by conducting emergency observation quickly and efficiently in combination of aircraft-mounted SAR (synthetic aperture radar) etc. with PALSAR-2 at the "first response stage" of a large-scale sediment-related disaster caused by heavy rain and or big earthquake.

It has become possible to detect precursory phenomena of sediment-related disasters, which are important criteria for judging watching / evacuation from sediment-related disaster but were difficult to collect and share among the local community, by analyzing "Twitter" information posted unintentionally on the network. We would like to advance the development of technologies that support determination to evacuate in "urgent stage" by complementing the information issued by users of SNS (Social Networking Service), which is also called "social sensor," with the rainfall observed by radar such as XRAIN etc. to enhance reliability.

Meanwhile, the early detection method using a physical sensor is considered effective. The Sabo Department has a policy of focusing on research of methods, as a new challenge, for forecasting sediment-related disasters with high accuracy using real-time observation / monitoring data, and plans to examine monitoring / observation information on flow rate, sediment discharge, etc. in connection with the occurrence of sediment-related disaster and study methods for setting up standard values to determine the urgency of occurrence of sediment-related disaster using such information. Ultimately, we aim to be able to provide the information concerning the risk of occurrence of sediment-related disaster, which has higher forecast accuracy and communicates urgency more easily than conventional approach based on rainfall information only.

6. Conclusion

Other topics not discussed here, such as examination of various technical standards, measures against driftwood, and comprehensive sediment management, are the fields for which NILIM has to lead activities as a national institution. In collaboration with universities concerned, government and private research institutions, etc., we will advance researches and activities with a sense of speed and a presence and respond to request and expectation from society.

[Reference]

1) 2014 Sediment-related Disasters in Japan (Sabo (Erosion and Sediment Control) Department, MLIT)
http://www.mlit.go.jp/river/sabo/jirei/h26dosha/150120_H26dosyasaigai.pdf

To Smartly Use and Protect Roads and Support Logistics
～Smartly Using Probe Data～

MORI Nozomu, Director of the Road Traffic Department

(Key words) ETC2.0, big data, probe data, effectiveness evaluation, policy management

1. From ETC to ETC2.0

ETC has evolved from an electronic toll collection system to ETC2.0, a driving support system.

To help drivers avoid congestion, it provides wide-area congestion information, permitting drivers to use their car navigation systems to intelligently select routes. To support safe driving, it provides information about the end of congestion ahead, broken-down cars, fallen objects, and other dangerous phenomena through car navigation systems. As quick support after disasters, it is integrated with probe data collected by the private sector to clarify passable routes and support inspections immediately after the disaster and the work to reopen damaged roads is planned based on the information . Other services include a service that performs cashless settlements at parking facilities.

New services such as preferential treatment of detours, managing the operation of heavy vehicles , and managing the operation of commercial vehicles etc. can be introduced, in addition to such services, by utilizing information collected through ETC2.0.

2. Smartly Using Probe Data

It is constantly in demand to support the creation of road space providing smooth, safe, and pleasant environments, regional revitalization , and economic activities such as logistics. As stated above, it permits the collection of big data through the deployment of ETC2.0 and the spread and penetration of ICT into daily life, and its analysis is counted on to expand its use in various new fields.

ETC2.0 probe data are the locations and acceleration, etc. of vehicles with time information, as basically, data are collected on almost all roads traveled by vehicles equipped with ETC2.0. This permits the clarification of information such as origin and destination points, traveling speed, acceleration, routes traveled, and traveling times of vehicles (without identifying the vehicles), and it is possible to clarify the state of road space related to smoothness, safety, and the environment etc. by analyzing these types of information.

1) Selecting routes to travel efficiently

When heading towards a destination, drivers want information about congestion on the road ahead. And if there are predictions of congestion during the time a driver will travel through a route , the driver can select the most convenient route. But it is very difficult to predict congestion on every route of a road network. It will first be necessary to have a method of predicting traffic volume a specified period of time in the future. To establish a prediction method, it will be necessary to grasp the origin and destination points of automobile traffic, routes traveled, trends in changes of routes traveled after congestion appears, etc., and based on these findings, to estimate the state of congestion of the network and changes in state of congestion and selected route, and to predict these based on the results of these estimates. And it will probably also be necessary to predict trends in routes selected by drivers who have obtained congestion predictions (impacting factors not limited to only these). Such information about present conditions and road traffic conditions after a specified time period is utilized by road users to select routes, which results in effective use of traffic capacity of the road network, and such efforts are essential to effectively use the probe data.

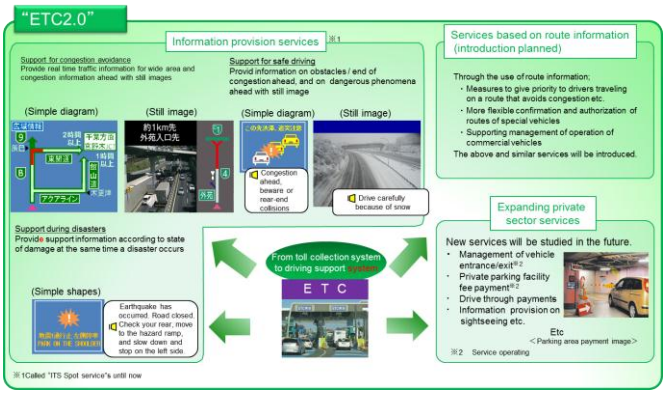

Figure -1 ETC2.0[1)]

2) Efficiently traveling with little wasted time

Time to travel from point A to point B, required time, varies according to the time of day , weekday/holiday and season, etc. Road users probably start out considering how early or how late they can afford to arrive according to their experience or congestion prediction information. But, for both late and early arrivals, the importance varies, and it is probably necessary to take various actions to

avoid arriving early or late. In other words, road users require estimated travel times with a specified degree of reliability, and smooth irregularities of this time. Probe data can be used to clarify such time reliability and to evaluate the effectiveness of countermeasures.

3) Traveling safely

About 60% of traffic accidents involving elementary school children walking on roads occur within 500m from the childrens' homes, so safety measures for neighborhood streets remain essential. To improve the safety of residential roads , measures at potentially hazardous spots , traveling speed reduction, and elimination of through traffic are necessary, and to eliminate through traffic, it is also necessary to smooth traffic on surrounding arterial roads.

By combining data obtained from probe data and drive recorders, it is possible to identify trends in potentially hazardous phenomena (causes and locations of occurrence), the relationships between through traffic volume and routes with the state of congestion on surrounding arterial roads. In other words, it is data that can be used to promote overall countermeasures to improve safety and smoothness in an entire region based on change over time of road traffic conditions on roads in residential districts and on surrounding arterial roads.

4) Rationalizing road maintenance

About 90% of the structural impact on road bridges is by heavy vehicles with illegal loads, so it is necessary to strengthen regulations against illegally loaded vehicles. Essentially, special vehicles must obtain authorization to use a road from the road manager and comply with conditions for authorization. It is possible to confirm the routes traveled by authorized vehicles using probe data, and by linking this to the results of inspections of structures, it is also possible to maintain structures based on the state of travel by special vehicles, and to authorize routes based on the state of soundness of structures. Using it as data to support appropriate management of such special vehicles, will contribute to the rationalization of road maintenance .

5) Supporting logistics

Logistics service operators provide highly rapid and reliable on-time distribution services to their customers, and enact operation plans and manage operations to protect the safety of their drivers and other employees and ensure rational staffing and consider economic factors such as wear on their vehicles and fuel costs. If a logistics service operator can specify its own vehicles, it can track their traveling location in real time, the state of congestion, and driving behavior on the network based on this probe data, and probe data contributes to supporting more efficient logistics operations in this way.

6) Various evaluations using different types of data

The above is no more than a small part of matters now under consideration, and more ideas will appear in the future.

In the future, as cars equipped with ETC2.0 increase , the time and sections where probe data is obtained will also increase, and it will be possible to more accurately clarify the state of traffic conditions. This will permit more accurate evaluations of individual projects, so that it will be possible to assess specified measures by accumulating the effevtiveness of individual projects , furthermore to conduct nationwide evaluations based on the promotion of various policies related to roads (for example, reduction of time lost to congestion or CO_2 emissions by congestion throughout Japan), allowing probe data to be used as data for administration and management.

It will be used as data to help users make more smart selections, such a selecting the routes they want to travel and the times they want to travel based on present state of and predictions of road traffic on expressways, etc.

And although analysis is necessary, we think that probe data will be used to quickly clarify economic and social activities in various regions.

3. In Conclusion

Probe data is information with greater potential than we now think possible. While considering how probe data will be used in the future, and how it can be developed by adding new information and improving collecting information, by forming links with concerned persons and internationally exchanging information , we will strive to take measures to use probe data smartly to smartly use and maintain roads, and support logistics .

[Sources]

1) Council for Social Infrastructure, Road Committee, 13th meeting of the National Arterial Road Subcommittee (held September 19, 2014), selected from document 1.

To Appropriately Create and Efficiently Maintain Road Structures

MASHIMO Hideto (Dr.Eng.), Director of the Road Structures Department

(Key words) Road structure, maintenance, required performance, periodic inspections, technical support

1. Introduction

The deterioration of road structures provided in a short period during and after the high economic growth period has become a severe problem throughout Japan. In Japan, there are about 700,000 road bridges and about 10,000 road tunnels nationwide, and it is predicted that the number of road structures reaching their 50th year since construction will rise sharply, so it is necessary to appropriately maintain road structures while holding down costs in the face of a declining population and falling birth rate. In order to appropriately maintain road structures, it is important to go through the maintenance cycle that consists of inspection, diagnosis, countermeasure, and recording, and it is necessary to build a procedure for doing so. To stabilize the people's livelihoods and stimulate regional economies, it is also necessary to efficiently and effectively create road structures with superior durability with limited budgets. One method of doing this is to use new structure types or materials, but in order to use these new technologies properly, it is necessary to ensure the safety and durability of the structures that are built.

The Road Structures Department prepares drafts of technological standards for bridges, tunnels, earth structures, and pavement etc., conducts surveys and research these require, gives technical guidance and consultation regarding troubles that occur in the field, and nurtures technologists with specialized knowledge in order to give technological support for appropriate maintenance and efficient creation of road structures through links with the headquarters of the Ministry of Land, Infrastructure, Transport and Tourism and other concerned organizations.

2. Appropriate maintenance of road structures

Road managers are obligated by law to perform direct visual inspections of bridges and tunnels once every 5 years, and periodical inspections began in July of last year. The Road Structures Department actively prepared drafts of periodic inspection rules that stipulate the minimal periodical inspection methods and recording items in cooperation with MLITT head office. There is an urgent need to establish methods of designing repair work and retrofitting, because it is predicted that in the future, the number of structures requiring repairs and retrofitting will soar as measures taken in response to results of inspections and diagnoses. It is necessary to systematize the maintenance of earth structures and pavements that are not the object of periodical inspections. The Road Structures Department is, therefore, mainly conducting the following research.

1) Bridges

A non-destructive investigation method to survey state of internal damage that requires diagnosis of bridges where deformation has been externally confirmed, a design method to evaluate traffic characteristics and degrees of damage etc. based on partial factors, and that can evaluate load bearing capacity of bridges damaged as shown in Photo 1 and the effectiveness of repairs and retrofitting countermeasures.

Photo 1 Damaged bridge

2) Tunnels

Analysis of damage cases and of repair and retrofitting cases, effects of repair and retrofitting countermeasures, and methods of evaluating these effects.

3) Earth structures

Abstracting and evaluating locations vulnerable to disaster, rational inspection methods to lower risk, effectiveness of countermeasures to repair and retrofit damaged earth structures.

4) Pavement

Maintenance methods suitable for the type of pavement and state of pavement, lifetime extension effects of patching and similar maintenance work methods.

The department is also analyzing the results of inspections of bridges, tunnels and other structures that are periodically inspected and researching ways to perform more reliable inspections more efficiently. And to establish a management method for systematic maintenance and renewal of road structures under budget constraints, the department is also researching the basic

concepts of asset management and common comprehensive management indexes for structures.

3. Efficient creation of road structures

In order to use new structure types and materials to build structures that are extremely safe and reliably durable, it is necessary to establish a design method that clarifies the performance a structure should ensure and that can rationally evaluate the characteristics of the structure type and the performance of the materials. And to lower the future burden of maintenance, it is important to ensure quality during design and construction considering durability and ease of maintenance, and necessary to reflect knowledge obtained by analysis of inspection results in design and construction. The Road Structures Department is, therefore, mainly conducting the following research.

1) Bridges

A partial factor design method that permits consideration of acting load or safety allowance of materials etc., which are the foundations of performance verification methods to replace the past allowable stress design method, and a method of evaluating durability of bridges with complex stress conditions based on an analysis method.

2) Tunnels

A method of setting the design load and verifying the performance for a case where the analysis method is used to design a tunnel where the standard tunnel support pattern cannot be applied to the design of a tunnel support structure because the overburden is small or the geological condition is bad.

3) Earth structures

Design and construction method to clarify design load and required performance and to ensure required performance in order to permit the performance required of a structure as large as that shown in Photo 2 and a structure with a new type.

Photo 2 Large scale embankment

4) Pavement

Applicability of concrete pavement with durability higher than that of asphalt pavement

The department is also researching concepts of safety performance that must be required to prevent harm to the public, safety allowance setting methods and methods of securing safety even for members other than principal structures.

4. Personnel training and technical guidance and consultation

As technical support for administrators, in addition to preparing drafts of technical standards, the department trains technologists with specialized knowledge and gives technological guidance and consultation in response to requests from road managers.

Regarding the training of technologists, the department cooperates by preparing training texts and dispatching instructors to give practical training and instruction at workshops and training sessions that contribute to nurturing and boosting the technical skills of technical personnel working on administrative duties, including not only Ministry of Land, Infrastructure, Transport and Tourism regional development bureau employees who maintain road structures, but those in local governments.

In the field of technical guidance and consultation, the department provides support by giving technical consultation and field guidance concerning disasters, serious accidents, malfunctions, and technical review and assessments etc. that require expert knowledge such as interpreting advanced standards and so on, and by participating in meetings. In FY2014 in particular, in addition to giving technical consultation as in the past, the department sent employees to the Ministerial Jurisdiction diagnosis of three bridges in Japan done by the Road Maintenance Technology Group formed by employees of regional development bureaus as a measure to support local governments. Through participation in Ministerial Jurisdiction diagnosis, they performed a field survey as a member of a Road Maintenance Technology Group and contributed to providing technical advice to local governments.

Formulating technical standards of buildings

GOJO Wataru (Ph.D (Engineering)), Director of the Building Department

(Keywords) building standards, building confirmation, existing nonconforming buildings, performance-based coding

1. Foreword

At the Building Department, we develop the drafts of technical standards[1)] based on the Building Standard Law and conduct relevant investigation/research activities. As recent examples, we have implemented development of a series of standards to prevent falling of ceilings, which have been enforced since last April, as well as new fire prevention standards for 3-story wooden schools to be enforced in June. And we have been conducting necessary investigation/research work for technical standards regarding measures against long-period earthquakes. For making building standards[2)] to meet society's needs, its contents must be technically valid, fit relevant regulatory systems, be operated appropriately and be applied to buildings without difficulty. I would like to introduce various issues we take into consideration when developing drafts of building standards and conducting other activities, interjecting my own personal views as well. I would be happy if this proves useful in helping you understand our activities.

2. The building confirmation system and building standards

One of the typical procedures that ensure conformity of buildings with the standards under the Building Standard Law is by receiving an application from the building owner to conduct a "building confirmation" or examination of the construction plan to ensure conformity to the standards prior to the construction start. Unlike "permits," which are similar administrative procedures, confirmation is a judgment where there is no room for discretion by the interpreter. Furthermore, standards are required to be established in "definite/unambiguous" terms so that the result of the judgment is the same regardless of the interpreter.

Judgments are easy if the building standards are so-called "prescriptive codes," or, in other words, written by dimensions, shapes, materials allowed to be used, and so on. Actual standards, however, include provisions whose conformity must be judged based on experiments and calculations, and qualitative expressions. As a rule, standards must be established in a manner that the building officials/private inspectors[3)] can understand and make the proper judgment in their confirmation.

In recent revisions of building standards, from the perspective of ensuring proper operations, there has been a shift to use more prescriptive expressions, as well as a shift of active adoptions of entrusted provisions from cabinet ordinances to the Minister's notices (in order to introduce more detailed standards). Especially, with provisions requiring technical judgments by calculations and qualitative expressions, NILIM has also been involved in preparing technical guidelines to prevent uneven interpretations.

As a result of pushing forward such shift of the way of expressing building standards to more prescriptive and detailed ones, there may be a concern that the range of technical choices may become limited. In this regard, performance-based coding has been promoted to rid or reduce this side effect (see "4").

3. Conditions for revising building standards

The Building Standard Law, with regards to the property rights of buildings which should be guaranteed based on the constitution, enforces the minimum requirements in the interest of public welfare, as Article 1 (Purpose) declares the "minimum standards" must be established.

For example, if buildings are damaged in a major earthquake, the need to review the building standard is taken into consideration to prevent its recurrence. While it is effective to increase the safety level of buildings by revising standards and implementing new and more stringent regulations, there is also a need to ensure that the contents of these tighter standards are suitable "minimum standards" and that they are not overly excessive. In this regard, "existing nonconforming buildings" present a particular problem.

While buildings should always meet building standards upon its completion and after its usage has begun, "existing buildings (or buildings under construction)", however, are exempt from this obligation when such standards are being introduced or revised after their completion. Such "exceptional" buildings which do not meet the latest standards are called "existing nonconforming buildings". Yet, when extension work or large-scale repairs are conducted on

them, their "exception" to the rule is annulled. As a result, owners of buildings who carry out such repairs may face a heavy burden[4] for extra works necessary to make their buildings satisfy all the standards. Therefore, when contemplating reviewing or tightening building standards, it is essential to make the decision after analyzing both the necessity and the impact of them.

Among the examples I mentioned earlier, the standard to prevent falling of ceilings is a "tightening regulation" that gives rise to a number of "existing nonconforming buildings." In this case, the target was limited to suspended ceilings above a certain scale, height and weight. And easier-to-apply standards for existing buildings were issued to lighten the burden of the owners.

4. The "performance-based coding" of building standards

"Performance-based coding" of building standards was adopted in the revision of the Building Standard Law enforced in 2000. This coding is a conversion of the expression of technical standards from the "prescriptive provisions" to the "performance requirements." By this system, if a building possesses a required function, the building has then various merits like the freedom of selecting various design methods and materials and new technologies. On the other hand, since it is difficult to judge the direct compatibility of demanded performance, "verification methods (calculation and test methods)" of the performance and the "deemed-to-satisfy provisions (example of solutions)" were also prescribed. Also, by introducing a separate system called the Minister's approval that judges innovative methods and materials, the two purposes mentioned in "2": "ensuring the freedom of design" and "preventing uneven interpretation" can be realized at the same time.

"Performance-based coding" has been adopted in many countries worldwide, and several countries have switched their entire regulations to the performance coding system. But, in Japan, we introduced as many performance-based requirements as possible in our standards. Regarding fire safety regulations, which had been conventional prescribed regulations, the "fire resistance verification method" and the "evacuation safety verification method" have been adopted, although the prescriptive type provisions still remain in some areas.

5. Conclusion

In the latest revision of the Building Standard Law (to be enforced in June 2015), by introducing a new Minister's Approval Scheme (Article 38)[5], alternative methods can be substituted for all provisions including prescriptive fire safety requirements. But to change the whole standards structure into performance-based one still remains a goal to be reached. In order to attain this, as well as other targets to meet society's needs, we continue our activities to better building standards. In this regard, we would like to ask for your ongoing opinions and support.

(Reference)

1. "Technical standards" don't mean such standards as ISO or JIS standards but "technical documents" issued under the Building Standard Law or other similar systems as regulations or requirements to be applied to buildings, etc.
2. Regarding standards based on the Building Standard Law, there are "building regulations" for safety and other requirements applied to individual buildings and also "group regulations" for securing areal environments. Here, I would like to talk about the former (called "building standards").
3. Regarding a certain part of the structural calculation standards, it is also required to get additional checks made by structural calculation reviewers.
4. Due to the enactment of the "Law Concerning Promotion of Anti-seismal System Improvement of Buildings" after the Great Hanshin Earthquake and several revisions to the Building Standard Law, the application of new standards to existing buildings have become more relaxed with regards to the seismic strengthening and small-scale extensions of buildings.
5. Abolished once in the 2000 revision and will be revived again.

Recent results of the Housing Department activities

SAWACHI Takao (PhD. (Engineering)) , Director of the Housing Department

(Keywords) Elderly people, life-extension, safety net, univesal design, energy saving

1. Foreword

As the the idiom "food, clothing and shelter" implies, housing is one of the fundamental factors in human living, and it is our mission at the Housing Department to contribute to the technical aspects of providing housing that allows for "healthy and comfortable living conditions" for our people. Here, we will showcase some of the main research topics that the Housing Department is involved in.

2. Goals the Housing Department are involved in to attain

As one of the related policy goals of housing, measures based on the establishment of a "basic housing plan" (National Plan, 2011-2020) based on the Basic Act for Housing are being promoted. The Housing Department is specifically involved in the attainment of four objectives as defined in this basic housing plan, and research/development for the purpose of analyzing housing related information, drafting measures and spreading technical information will be conducted accordingly.

(The four objectives regarding the basic housing plan)

Objective 1: Structuring a living environment that is safe/stable and prosperous

Objective 2: The appropriate management and recycling of houses

Objective 3: The environmental maintenance of housing market that appropriately attains tenant needs

Objective 4: The securing of stability for tenants, especially those who take securing a house into consideration

On top of the above basic housing plan objectives, research/development will be conducted to contribute to the improvement of indoor environment performance including energy-saving functions in non-residential buildings in the building environment field.

3. Recent results and making it widespread

1) Comprehensive technological development project "Facilitation of the distribution of used housing/development of performance evaluation technology for the recycling of stock" （Completed in fiscal 2014）

Long-life quality housing reform plans for existing houses, standards (plans) that set the current specifications of existing houses have been compiled, and along with the materials/structure database that contribute to the design estimate duties of designers, is scheduled to be proposed and released. As well, regarding inspections of existing housing, an inspection method(plan) of current conditions pertaining to

Table: The main issues the Housing Department believes must be tackled, and its correlation with the nation's policy objectives

	Main policies of the country	Policy purpose etc.	Main issues NILIM should tackle
(1)	Promoting the securing and improvement of living stability in accordance with the basic housing plan based on the Basic Act for Housing	Structuring a living environment that is safe/stable and prosperous	・Development and spread of housing plans and repair technology for elderly/handicapped people ・Maintenance/spread of hardware and software technology contributing to housing for elderly people including senior citizen housing with welfare services
(2)		The appropriate management and recycling of houses	・Maintenance/spread of methods regarding the evaluation/diagnosis of existing houses, operation and maintenance and reforms to promote appropriate maintenance and repairs of the housing stock ・Development/spread of housing life-extension methods
(3)		The environmental maintenance of housing market that appropriately attains tenant needs	・Technical development and enhancement of provided information in the diagnosis/function evalutaon to support the smooth circulation of used housing ・BIM information technology development to optimize design constructions
(4)		The securing of stability for tenants especially for those who take securing a house into consideration	・Technical development contributing to the active utilization etc. of public housing stock for the stable securing/promotion of the housing safety net ・The gathering of knowledge and its spread regarding housing provision/maintenance in disaster restorations
(5)	Promotion of CO2 reduction and global warming countermeasures according to international agreements and the Basic Act on Energy Policy	・Making the conformity to an energy-saving standards mandatory regarding new houses/buildings by 2020 ・Reducing the world's greenhouse effect gas to half by 2050, and reduce by 80% for all advanced countries	・Developing/providing easy to understand software to calculate energy consumption so that housing conforming to energy-saving standards can be provided for small and medium size businesses as well ・Developing shifting methods when electricity use is peaking and its evaluation methods through the respective technologies of heat storage and electricity accumulation

degradation conditions will be swiftly proposed, and will be reflected in the evaluation method standards etc. of housing performance indication regulations. Furthermore, evaluation methods of neighborhood environment standards like sunshine/lighting in urban areas with existing housing, will be reflected in the technical evaluation methods pertaining to the certification standards of long-life quality houses (new and existing structures), which are based on the promotion methods of securing the quality control of housing.

2) The matter of "Research regarding the new maintenance methods for the living security of elderly people" (completed fiscal 2013)

With the rapidly progressing super-aging society, securing housing where increasing numbers of care-dependent elderlies can live a stable and independent life, has become one of the most important policy issues. This research developed planning methods in both the hardware (building/facility design) and software (living support services design/management) facets of senior citizen housing with home-care services provided[1]. As well, the planning method of creating effective barrier-free reforms according to the various psychosomatic conditions of the elderly people has also been developed[2].

3) Result overview of the housing construction investigation costs "Investigation pertaining to the accurate maintenance/provision measures for disaster public housing in a large-scale disaster" (completed fiscal 2013)

Based on the survey results of fiscal 2013, the basic plan of disaster public housing that was created in direct control surveys pertaining to the Great East Japan Earthquake, will be compiled as a casebook, including examination processes that can be easily referenced .

4. Representative research themes that will be newly undertaken in fiscal 2015

1) Comprehensive technological development project "Strategic stock management technology development of regional stable living functions" (2015-2017)

Based on fluctuations in medium-and-long term population structures and demands, individual housing deterioration/situation/performance, we aim to develop policies for the optimum use (integrated/abolished/relocation/life-extension etc.) of individual facilities including public housing and technical methods to justify the rational reform/repair content according to its period of use. From this, we will contribute to the reviews of life-extension plan policies of public housing etc. and enable more effective life-extension planning measures according to the current conditions of future forecasts and facilities of local public bodies.

2) The matter "Developing evaluation standards of evacuation support technology for elderly/handicapped people in residential complexes at the time of a disaster" (2015-2017)

There are still many unresolved issues remaining surround the support technology for weak evacuees, or barrier-free issues, in residential complexes at the time of a disaster. As a result, we will develop downward evacuation support techniques based on building ergonomic experiments, as well as evaluation standards towards building-related laws and ordinances, after conducting systematic rearrangements of evacuation plans and evacuation support technology.

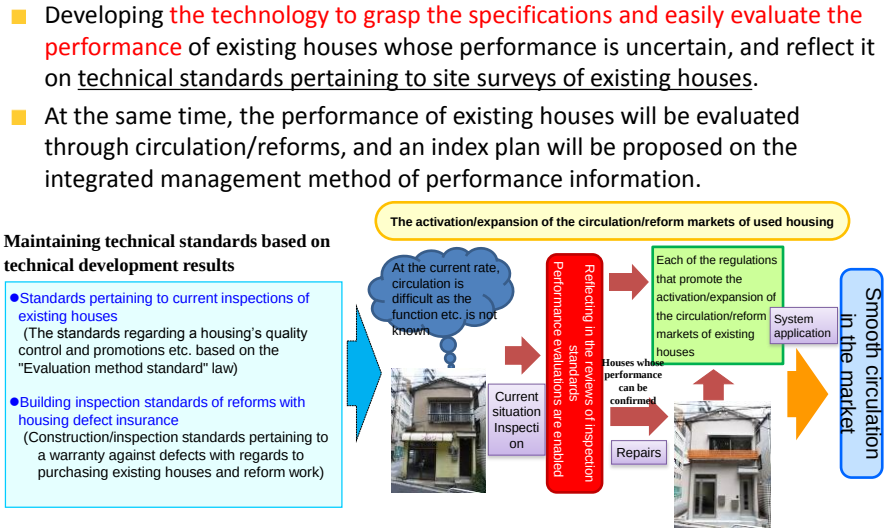

Figure Result overview of Comprehensive technological development project "Facilitation of the distribution of used housing/development of performance evaluation technology for the recycling of stock" （Completed in fiscal 2014）

(Reference)

1) Hiroshi Hasegawa: Research regarding planning methods of senior citizen housing with home-care services provided, NILIM report (forthcoming publication)
http://www.nilim.go.jp/lab/bcg/siryou/rpn/rp_nilim.htm

2) Hiroshi Hasegawa: Knowledge base of barrier-free housing repairs - Research regarding planning methods of barrier-free housing repairs for the housing of elderly people etc., NILIM report (forthcoming publication)
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tn_nilim.htm

Towards sustainable compact city planning in a society facing population decline

KANEKO Hiroshi, Director of the Urban Planning Department

(Keywords) Population decline, super aging society, land suitability evaluation, accessibility, bustling crowd diagnosis, urban restructuring

1. Foreword

Our country's population decline reached its peak in 2008, and the uneven regional distribution of the population is expected to accelerate. For this reason, the Ministry of Land, Infrastructure, Transport and Tourism fixed its sights last July on the year 2050, by announcing the "National Development Plan Grand Design 2050," which indicated principles and ideas that would shape the future of the country. As well, in May of last year, the Act on Special Measures concerning Urban Reconstruction was revised, and its institutionalization and various supporting measures were planned and developed to realize a compact city planning, where medical care/welfare institutions, commercial facilities and housing could be placed in one location with easy access to these public facilities using public transportation so that elderly people and child carers can live comfortably in good health.

2. The direction in which research and development should head

Research and development is demanded from the following viewpoints regarding the further development of compact city planning.

① Long-term future forecast of urban environments: As population decline and a super aging society is expected to continue, it is necessary to forecast how future urban area environments will change, keeping the entire city in perspective as well as the urban area characteristics and resident conditions from the city center to the city suburbs.

② Forecast of the influence to the city infrastructure and services: on the other hand, these chronological forecasts are important from the standpoint of a sustainable city management under financial restrictions, as the burdens of the aging infrastructure, medical care and welfare services are expected to increase.

③ Quantification of the city problem, visualization: regarding the various facilities located in the city, optimization of land use, crowd or urban traffic problems in the city center, it is necessary to develop the technology to "quantify" objective data pertaining to the location so that it is easy to understand and "visualize."

④ The use of ICT and new technology: the application of big data and sensing technology is necessary in order to grasp the actual state of the various facilities and transportation structuring the city and the condition of its residents and companies by its location, so that the current issues can be reflected in future forecasts.

⑤ Reflecting the disaster risk of cities: by reflecting the disaster risk like earthquakes, tsunami and floods of various cities, focusing the use of low disaster risk areas and take strategic initiatives to reduce risks in an urgent matter.

⑥ Explanation of living environment changes and measurement effects: since the understanding of the local residents and company is indispensable for the consolidation of city functions etc., it is important to develop a tool that can intelligibly explain the gradual consolidation process from the assumed future forecasts and the resulting living environment changes and measurement effects.

⑦ Establishment of the city management method: it is necessary to establish a city management method that is based on the cooperation and sharing of roles between the main public constituent with local residents and private businesses, in order to cope with the operation management of each city's

infrastructure, consolidation, maintenance of the urban area's layout, and reorganization efforts for improved functionality of the city in accordance with the vision of the ideal future city.

Below, we will introduce the research content being promoted by the Urban Planning Department.

3. Developing support tools for land suitability evaluations

To enable the current urban policy issue of compacting cities, city planning based on the right admixture of development and maintenance, and public transportation holds the key, however, the rational decision-making information of local public bodies who conduct land use control and location instructions is required. Because of this, "the research regarding land suitability evaluation technology for the strategic management of land use in city planning", a program to evaluate a land's suitability was developed.

In this land suitability evaluation program, land gradient, road proximity, the degree of affinity with adjacent use and the accessibility to public facilities is calculated for each 10m mesh. As well, by calculating the suitability the value of land use based on the information of assumed hazardous flood/landslide disaster sites, for the residence system, customer collection system and agricultural system, suitability results can be expressed on a map in 10m mesh, 100m mesh or block increments. In the future, we plan on creating a user's manual for this program and release it with the program on the NILIM homepage.

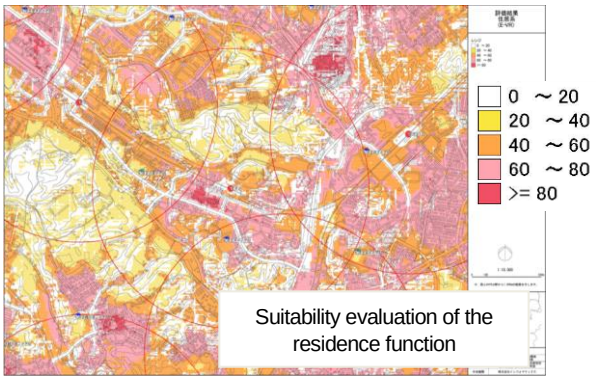

Figure: Example of a land suitability evaluation

4. Developing tools to evaluate urban accessibility

As the reorganization of future urban structures and renovations are being pushed forward under the premise that population decline and a super aging society will continually progress, many regional hub cities are striving for a "compact city planning centered on public transportation."

Because of this, we are developing an "accessibility index" to calculates the ease of access to public facilities etc. including wait times for public transportation using objective data on a map, and at the same time creating a user's guide that we are releasing on the NILIM homepage. As well, we are developing a program that can easily calculate and map the "accessibility index" using the geospatial data of public facilities etc. and traffic information of public transportation, which we are scheduled to release with a user's manual on the NILIM homepage.

5. Developing tools to diagnose bustling crowds in the city center

To support the planning initiatives that prioritize pedestrians in declining city centers of provincial towns, it is required to accurately grasp the conditions of pedestrians and to strategically develop policies that will bring the bustling crowds back.

Because of this, simple steps were taken to grasp the pedestrian conditions using bicycles with GPS-equipped miniature cameras and conducting hearing surveys. At the same time, using the "spatial network analysis" method, the distribution and a migration route of the bustling crowds, the visualization of the facility location situation and the present problems were arranged from a spatial viewpoint. Through the indexing of the pedestrian environment's spatial structure, the spatial factors affecting the present condition was clarified and methods on how to propose policies to create more bustling crowds was drafted into a manual and released.

6. Developing forecast methods of future district images in the suburbs

In order to systematically advance the city's consolidation, developments are being made in the simple forecast and operation and maintenance technology in future district images as a method to objectively evaluate and select the downsizing urban

areas/restructuring candidate districts in the city suburbs.

Regarding simple forecasts of future district images, based on the forecasts of future population/household structures in a fluctuating society, evaluations will be conducted on living-related services and medical care, the continuation of welfare and public utilities facilities etc., and the classification methods of districts where downsizing/restructuring countermeasures will be enforced, will be developed.

As well, regarding the maintenance method of the suburban areas that have agreed to the downsizing/restructuring measures, the technological development of a gradual and optimal reduction/closing program for the urban area and infrastructure service will be provided according to the service life of the infrastructure as well as the lifestyle and intentions of the residents. A restructuring business scheme that will be integrated with the former business is also scheduled for proposal.

7. Future initiatives for creating a compact city

In the future, we will continue to promote the research and development of these initiatives and promote the wider use of the results. At the same time, we will also work with related departments starting from the next fiscal year in the "strategic stock management technology development of regionally secure residential functions," to develop the evaluation technology of appropriate locations for city functions to support local residents in anticipation of a super aging society. As well, we also plan on participating in the "development of strategic disaster risk reduction methods in cities under climate change" to develop an integrated flood risk evaluation method and low risk society construction frame for cities under climate change.

We hope these research results will be utilized in the sustainable compact city planning initiatives in each city.

Considering Directions for Response to Intensification of Storm Surge due to Global Warming

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Director of the Coastal, Marine and Disaster Prevention Department

(Key Words) Global Warming, Storm Surge Inundation Risk, Damage Prediction

1. Introduction

In September 2013, the IPCC approved the Fifth Assessment Report, Working Group I, Summary for Policymakers (hereinafter, referred to simply as AR5). AR5 states that the mean sea level will rise from 26cm to 82cm, and there is an "extremely high possibility" that the "occurrence and height of extremely high storm surges will increase" by the end of the 21st century. Sea level rise and increased storm surge deviation above high water level increase the risk of inundation by storm surges in coastal areas.

When Typhoon No. 30 crossed the middle part of the Philippines in November 2013, strong winds and storm surges caused enormous damage, resulting in the deaths of more than 6,000 people. According to the Japan Meteorological Agency, the maximum central pressure of the typhoon was 895 hPa, which was the same as Japan's Ise Bay Typhoon (1959), and the maximum wind speed was 65 m/s. Images of the storm surge and reports of maximum winds reaching 90 m/s (US. Army standard) shocked Japanese society.

In July 2014, Japan's Ministry of Land, Infrastructure, Transport and Tourism (MLIT) announced the Grand Design for National Spatial Policy 2050. According to this document, if current birthrates and other trends continue, in 2050, areas where the population decreases to less than half the current level will include more than 60% of current residential areas. Population change will cause changes in regional social and economic activity, and this in turn will also change regional assets. Therefore, it is important to consider population change when predicting the risk of damage by storm surge inundation.

In order to consider responses to the increased risk of storm surges due to global warming, it is necessary to analyze how far sea level rise and increases in storm surges due to global warming will progress, and how much damage Japan may receive as a result.

2. Sensitivity analysis of damage by storm surges

AR5 presents the future global mean sea level rise and temperature rise for four Representative Concentration Pathways (RCP) of greenhouse effect gases. Based on those RCP, we predicted the condition of inundation by storm surges in Japan, and also predicted the inundation area and monetary amount of inundation damage, considering population decrease and other factors.

The following knowledge can be obtained from the estimation results. These points offer suggestions on regions that require attention, the progress of responses over time, and how we should react to population decline.

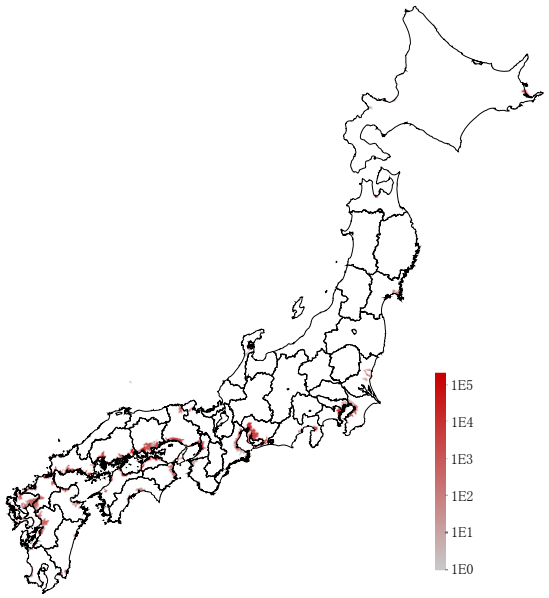
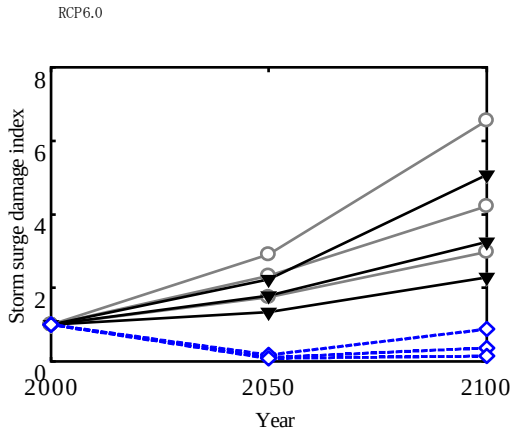


Fig. 1 Example of inundation damage index (monetary damage) in 2100



Note) ○: Base condition, ▼: Condition of population decrease, ◇: Condition of improvement of coastal facilities

Fig.-2 Example of changes in storm surge damage index (monetary damage) over 100 year period

① Inundation risk is relative large in Japan's three major bays (Tokyo, Osaka, Ise), the Seto Inland Sea, and the Ariake/Yatsushiro Sea areas.

② Coastal defense is shared by the four divisions of rivers, ports and harbors, fishing ports and farming villages (ratio of length of coastline requiring maintenance, 36 : 29 : 22 : 11). The areas with large damage are reclaimed land in the Ariake/Yatsushiro Sea, and in addition to this, ports and harbors.

③ The rate of increase in the damage index in the first half and second half of the period from 2000 to 2100 does not change greatly, except under the worst-case RCP. Thus, there is a possibility that a response can be made by gradual measures.

④ Under the population decrease scenario, the inundated population and amount of inundation damage decrease approximately in proportion to the rate of decrease in the national population as a whole.

Since the object of these estimates is the entire country and the future in half-century units, there is a possibility of roughness, skewing and high uncertainty in the preconditions, data, calculation methods, etc. Therefore, in studies aimed at actual implementation, it is necessary to ascertain the actual progress of climate change, to make estimates with higher reliability, for example, by narrowing the range and period of predictions, etc., and to carry out the study based on the results.

3. Viewpoints when considering response to intensification of storm surge by global warming

(1) Two types of targets

In order to promote efforts related to global warming, it is necessary to set a target for efforts as a whole. While that target must be ambitious so that we can have hope, it is not possible to set a target that can be implemented in all aspects, including the technological aspect, economic aspect, predictive aspect. Therefore, when making an actual effort, careful study of the multiple purposes of that action and limiting conditions, setting of a target that can realistically be implemented, and making efforts to achieve the target are necessary.

(2) Mobilization and use of policy/organization

In responding to the large problem of global warming under the difficult financial situation in Japan, there are limits by only bureaucratic efforts like those to date. In case implementation is difficult due to the heavy load if complete achievement is assumed as a precondition, there is a possibility that new measures can be deployed, which

enable improvement of the current condition by allowing incomplete achievement; it is necessary to promote this type of measures a larger extent than heretofore. Organizationally, if a pyramid-type organization is adopted under the current condition of diversifying needs, an enormous organization will be necessary. Therefore, while operation of a network-type organization is more difficult, consideration which enables an efficient organizational response by utilizing network-type organizations to a greater degree than in the past may also be necessary.

Fig.-3 Method of mobilizing policy/organization

(3) Renewed recognition of the worst case

When considering preparations for large-scale disasters, it is frequently said that we should consider and prepare for the worst case (WC). By definition, this means "the most dangerous condition that can be conceived." However, this is an extremely severe condition; response is difficult, and efficiency is very poor. Therefore, what should be discussed is a conditional WC for considering the direction of response and implementation targets. In discussions of the WC, a clear recognition of this fact is necessary.

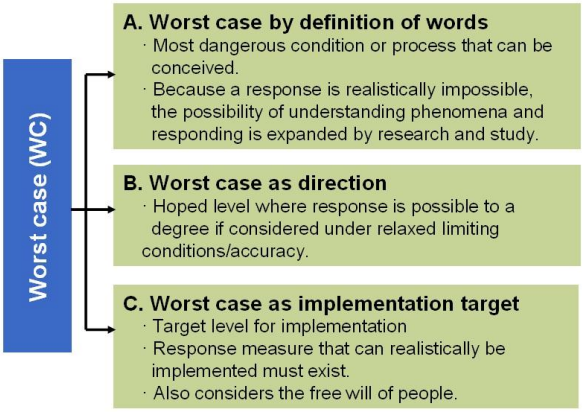


Fig.-4 Worst cases which should be considered

【Reference】

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http://www.nilim.go.jp/lab/bbg/kouenkai/kouenkai2014/kouenkai2014.htm

Trends in Port and Harbour Technology and Future Outlook for Technology Development

Koizumi Tetsuya, Director of the Port and Harbour Department

(Key words) *International Ferry, Inspection and Diagnosis Guidelines for Port and Harbour Facilities, Large-scale Temporary Works*

1. Research on technologies contributing to regional revitalization and strengthening of international competitiveness

In recent years, a number of regional issues related to port and harbour technology have become apparent, including changes of socioeconomic conditions and logistics networks, development of more advanced technologies for disaster prevention/disaster mitigation based on the lessons of the Great East Japan Earthquake of 2011, and response to strengthening of operation and maintenance technologies for deterioration of social infrastructure with age, among others.

Globally, structural changes that will result in new patterns of international marine transportation are progressing rapidly, such as expansion of the Panama Canal and the Suez Canal, construction of larger scale container ships, etc. Moreover, the decreasing area of Arctic osean ice is encouraging increasing use of the NSR, and it is assumed that this will also affect port improvement in the East Asian region over the long term.

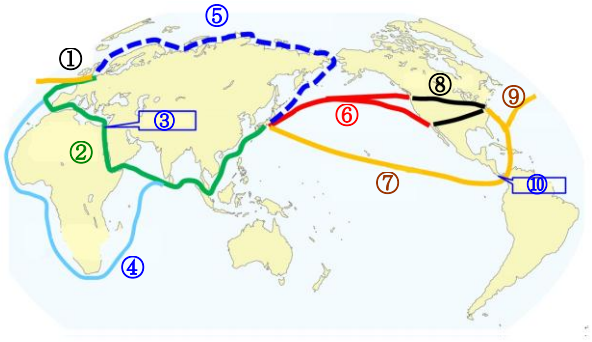

Fig. Main global navigation routes, Arctic passage, etc.

①European route (via Panama Canal)
②European route (via Suez Canal)
③Suez Canal
④Cape of Good Hope Route (Europe)
⑤NSR (Northern Sea Route)
⑥North America West Coast route
⑦North America East Coast route (via Panama Canal)
⑧DST (railway)
⑨North America East Coast (to Europe)
⑩Panama Canal

Calculation of the direct effects and ripple effects of these changes in freight transportation on related parties and promotion of effective port improvement and contribution to regional revitalization through individual cost-benefit analysis calculations, etc. are demanded.

In design and construction technologies, the Port and Harbour Department is studying responses to various issues and proposals for next-generation technical standards based on the needs of port authorities, companies located in ports, and other port users. To secure the safety of aging/deteriorating port and harbor facilities with limited fiscal resources, we are working to reduce and level maintenance/renovations costs and to realize labor saving responding to limited manpower.

Based on the present issues and future outlook for port and harbor technology, this article presents the aims of the research which is currently in progress in this department, as well as policies for future research, and introduces efforts to incorporate the results of research on strengthening of international competitiveness and

development of technology in Japan.

2. Research on international ferries

To address the need for more efficient transportation in the East Asian region, we analyzed trends focusing on international ferries between the Asian region and various parts of Japan, proposed draft standards for mooring facilities, developed a tool for forecasting the navigation route network and performed impact analyses for changes in the level of transport service and related policies (Research project for 2010-2013, "Study on transport facilitation measures corresponding to expansion of Asian international ferry transport).

Using a nationwide survey of import/export container cargo flows, we developed a model for estimating the condition of flows of international ferry and RORO ships (ferries, etc.) in a form that also includes container ship transportation, estimated the time value distribution of transportation between Japan and Korea and China (central area) by imports and exports and developed a model that makes it possible to estimate the condition of freightage by ferries, etc.

As a result, although the partial reproducibility of some parts of the freightage by individual transportation route cannot be called adequate, and in particular, in the model of the central area of China, there are remaining issues in the reproduction of the volume of freight transportation by international ferries, etc., which have a small freight volume/share in comparison with transportation by containers ships, we constructed a model that makes is possible to reproduce to a certain extent the freight volumes by international ferries, etc. for Osaka Bay and the northern Kyushu region by a minimum sacrifice model. This is a model which assumes selection of the route that minimizes the total sacrifice, defined as the sum of the cost of transportation and monetary conversion of the required transportation time.

Moreover, in addition to cost and time, transport routes are frequently selected so as to minimize vibration or impact. Therefore, for cargos for which transportation by international ferry, etc. is selected, we also examined how this and similar factors will be considered in the minimum sacrifice model in the future.

3. Changes in marine transportation

Expansion of the Panama Canal is currently underway, aiming at completion in 2015, and will make it possible for large-scale ships and LNG ships to use the canal. A major expansion of the Suez Canal is also in progress, spanning approximately 72km on the southern side. The possibility of using other routes is also being study, for example, determination of rules for navigation of the Arctic passage. On the other hand, from the viewpoint of ships, media reports have mentioned further upscaling of container ships, including construction of container ships of 20,000TEU class.

Thus, forecasting for planning of future port policies with a gaze fixed firmly on these large environmental changes has become critical. To strengthen international competitiveness, in the future, the Port and Harbour Dept. will promote research on port and harbor logistics responding to changes in the structure of marine transportation, as exemplified by the trends toward larger scale container ships and the use of NSR.

4. Revision of technical standards/study guidelines and efforts related to port construction and operation and maintenance

The Port and Harbour Dept. is currently grappling with research on Japan's Technical Standards for Port and Harbour Facilities with the aim of solving various problems, such as strengthening disaster prevention and disaster mitigation measures, establishing technical standards suitable for an era of operation and maintenance, strengthening international competitiveness, establishing technical standards for realizing stable imports of resources, energy, etc. and fostering a climate which supports overseas development by Japanese companies through internationalization of Japanese technical standards (revisions of Technical Standards for Port and Harbour Facilities and Guidelines for Study of

Ports and Harbours, study of large-scale temporary works, etc., support for establishment of technical standards in Vietnam, etc.).

With enforcement of the revised Ports and Harbors Law (December 2013), periodical inspections, etc. are required in maintenance of object facilities of the Technical Standards. Items concerning inspection and diagnosis are specified in the related ministerial ordinances/notifications. The "Guidelines for Inspection and Diagnosis of Port and Harbour Facilities" issued in July 2014 consisted of two parts, Part 1, "General Principles," which describes common matters, and Part 2, "Implementation Procedures," which provides concrete implementation methods, etc. for inspections and diagnoses of individual facilities which are objects of the Technical Standards. Inspection and diagnosis methods, etc. are described in easy-to-understand language so as to enable implementation of the minimum necessary inspections and diagnoses, even with limited human and financial resources (see Table).

Table Timing of periodical inspection/diagnosis

	Facilities subject to normal inspection/diagnosis	Facilities requiring priority inspection/diagnosis
General periodical inspection/diagnosis	Minimum of 1 time within each 5 years	Minimum of 1 time within each 3 years
Detailed periodical inspection/diagnosis	Minimum of 1 time at appropriate timing during service period In case design service period is extended	Minimum of 1 time within each 10-15 years For designated facilities, etc. subject to Technical Standards, which front on important navigation routes, minimum of 1 time within each 10 years

As in the case of welding defects remaining at the time of fabrication, which are said to be one cause of fatigue in steel bridges, issues related to operation and maintenance are not limited to deterioration after completion of the facility, but frequently include defects that occur after the passage of certain time due to poor workmanship, construction errors, etc.

The Port and Harbour Dept. intends to carry out research with the aims of improving the reliability and safety of construction by more advanced design and construction, such as use of 3-dimensional design data, etc., conducting proper maintenance and inspection using construction data., and when improvement/repair is necessary, performing design work by utilizing that data.

Due to the larger scale of structures and the need for improved construction efficiency in port and harbor construction in recent years, construction accompanying by complicated, large-scale temporary works, etc. has increased. Construction under severe meteorological and hydrological conditions and complex ground conditions has also become more common. The following may be summarized and suggested as key items requiring attention in construction work in order to prevent accidents in large-scale offshore civil construction.

· In the process from shop fabrication to construction at the site, it is important to understand the effect on construction safety of the various types of temporary works provided depending on the circumstances of construction.

· Because various external forces act in combination in work at sea, it is important to understand the action of those forces and their effects on construction safety.

· More detailed safety countermeasures corresponding to the location and features of work, such as further mechanization, are important.

Based on these points, the Port and Harbour Dept. will promote research on large-scale temporary works, etc. with the aim of accumulating generally-applicable knowledge and technology in connection with large-scale temporary works, etc. in port and harbor construction so as to contribute to securing safety in port and harbour construction as a whole.

[References]

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Multi-Faceted Efforts Supporting Aviation Administration

SUGANUMA Fuminori, Director of the Airport Department

(Keywords) *Aviation Demand Forecasting, Risk Management, Liquid Ratio, Airport Pavement*

1. Introduction

In 2014, Dubai International Airport in the United Arab Emirates (UAE) in the Middle East overtook Heathrow International Airport to become the world's largest airport in terms of annual airport passenger volume. Because Dubai has the shortest average flying time to the world's leading cities, including 7 1/2 hours to London and Singapore and 13 hours to New York, and connecting flights, etc. are also convenient, annual passenger volume exceeded 70 million.

Up to 2032, air passenger volume is expected to grow at an average annual rate of 6% or more in the Middle East and Asian regions. Likewise, according to statistics for 2013, passenger volume in Japan also exceeded that in the previous year on both international routes (63.29 million passengers) and domestic routes (56.25 million passengers), and showed a recovering trend continuing from the Great East Japan Earthquake of 2011.

As shown in **Fig. 1**, NILIM's Airport Department proposes tools supporting Japan's aviation administration policies that respond to this global increase in air passengers, and also carries out activities supporting infrastructure management. Here, I would like to touch on several current efforts of the Airport Department in connection with key policy issues.

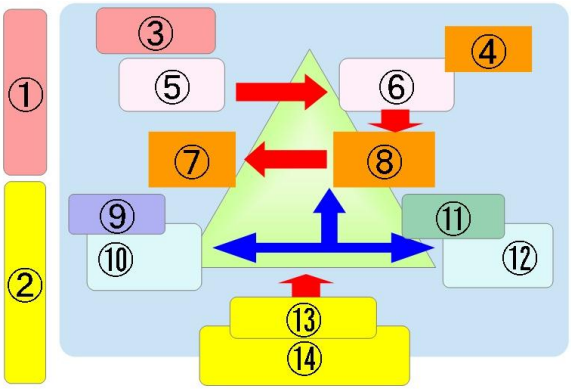

Fig. 1 Multifaceted support for airport policy and infrastructure management

①Civil Aviation Bureau, airlines, etc.
②Airport Dept., NILIM
③Removal of restrictions by expanding arrival/departure slots
④Efforts centering on airports in metropolitan areas
⑤Decision of slots by bilateral agreements between countries (conventional)
⑥Promotion of "Open Sky" (liberalization of aviation)
⑦Ripple effect of growth to local regions through domestic network
⑧Attraction of tourist/business traveler demand, beginning with the growing Asian region
⑨Airlines
⑩Promote participation by LCC
Provide incentives
Countermeasures for public taxes and charges, etc.
⑪Airport operation
⑫Secure airport capacity, disaster-prevention countermeasures, higher efficiency and improved service by privatization, etc.
⑬Research supporting airport infrastructure management and policy support
⑭
○ Risk management of airport operation against large-scale disasters
○ Technologies for forecasting air traffic demand → Forecasting of facility capacity which should be secured, and ensuring effective investment
○ Technologies for economical, efficient renewal and maintenance of runways, etc.
· Efforts to secure/improve quality (various standards, development and dissemination of new technologies, etc.)
· Promotion of international technical cooperation and support in ICAO (International Civil Aviation Organization)

2. Multidimensional forecasting techniques for changes in aviation demand

As seen in the bankruptcy of Skymark Airlines in January 2015, cost competition between airlines has intensified, particularly due to the entry of low cost carriers (LCC) in recent years. It is also possible that passengers who had used railways in the past may switch to LCCs, which offer prices near those of railways, and there is a potential for creation of new demand for long distance travel, depending on the route.

Conventional demand forecasting techniques could not directly consider this type of switching of demand between modes of transportation and fare-cutting competition between companies responding to fare setting for the same mode and same route. The Airport Department is studying more sophisticated forecasting technologies, for example, forecasting that considers the transportation mode choice actions of passengers in response to fare setting on routes, and analysis of users' choices by questionnaires and reflection of the results in creation of new travel demand.

On the other hand, as mentioned in the introduction, the aviation network with other countries is also expanding, beginning with increases in the number of tourist visiting Japan and metropolitan airports. The basic thinking when forecasting international air passenger traffic in the past focused only on the flows of passengers with origins/destinations in Japan. However, considering the above-mentioned increase in the number of transit passengers travelling via Dubai as an example, although connecting traffic as such is not a passenger flow with its origin/destination in the country concerned, the side effect that transit passengers contribute to securing and maintaining stable international air routes for that country cannot be ignored. Thus, identifying and forecasting the characteristics not only of passenger flows with origins/destinations in Japan, but also passenger flows in related regions as a whole, beginning with the Asian region, is essential for accurate judgment of demand for international air routes in Japan. The Airport Department is engaged in multifaceted research from this viewpoint.

As described above, we are conducting research which takes a multidimensional view of the factors that influence aviation demand in order to strengthen Japan's international and domestic air networks, with increasing aviation demand in Asia as a whole as a driving force.

3. Earthquake/tsunami risk management

Japan's airports have played a critical role in recovery and reconstruction efforts after large-scale disasters, including the Niigata Prefecture Chuestsu Earthquake in 2004 and the Great East Japan Earthquake in 2011. In the former case, Niigata Airport immediately became a base for transportation of emergency supplies, and Niigata-Haneda flights were established on a temporary basis, and in the latter case, Sendai Airport served as a substitute for the Tohoku Shinkansen, which was out of service for an extended period, even though the airport was also closed as a result of the tsunami. Moreover, it is particularly noteworthy that liquefaction countermeasures for airport facilities functioned effectively in both cases.

Of course, securing airport functions is not limited to runaways and other hard functions, but also means securing the totality of a diverse range of functions that also includes soft functions, such as securing air traffic control, CIQ and passenger terminal systems, among others. Therefore, if the degree to which all functions are secured during an earthquake/tsunami disaster can be evaluated objectively, and those with the potential to become bottlenecks in airport functions as a whole can be extracted, a variety of countermeasures can be deployed efficiently and effectively.

In research which we are now conducting, the risks of earthquake/tsunami natural disasters are arranged as a probabilistic hazard database, and facility strength and operational system security are treated as probability distributions. As a result, it is increasingly possible to quantify the risk of airport functions by comparing and contrasting the two. For example, as shown in **Fig. 2**, it is

possible to make a trial calculation of the effect of earthquake risk on the concession-holder in the case of operation based on a concession right implementation agreement.

At present, the Civil Aviation Bureau is studying the proper form of airport facilities in wide-area earthquake/tsunami disasters, and we are now grappling with research on systematizing airport risk management for wide-area earthquake/tsunami disasters.

4. Techniques/technologies for efficient operation and maintenance

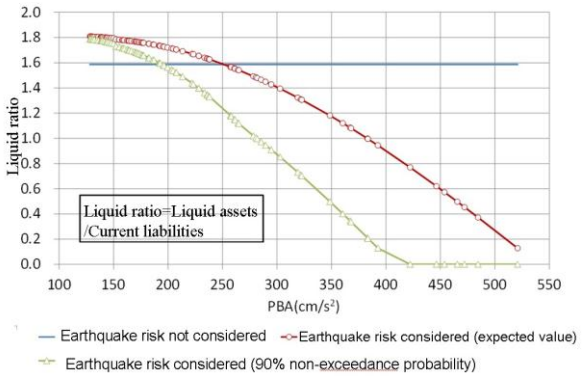

Fig.2 Reduction of liquid ratio by earthquake risk management

It is a fact that the time allocated to operation and maintenance of airport facilities is continuing to decrease due the effect of increasing numbers of flights, including night-time, particularly at airports in metropolitan areas.

However, if a runway is damaged, operation of aircraft is not permitted without repairs, even in case of delamination of only several cm^2 of the asphalt pavement surface. It is no easy task to carry out inspections for such damaged parts, or signs of future damage, without overlooking any problems during a limited time while using night-time lighting, and to make all necessary repairs within the available time.

In technical studies in MLIT on the problems of airport operation and maintenance, study of new inspection and repair technologies that support higher efficiency in site work, and active adoption of high durability materials and efficient construction methods in the repair stage are being promoted.

The Airport Department is promoting extraction and evaluation of existing technologies that can contribute to efficiency and reduce workloads at the site, and confirmation of their applicability to the site. We are also engaged in research on materials that will lead to higher efficiency in paving work and long pavement durability.

In order to raise the level of technical capabilities in operation and management-related work among airport administrators as a whole, including airports administered by other public bodies, we intend to provide training, technical guidance in local areas, etc., and to conduct activities continuously on every occasion in the future.

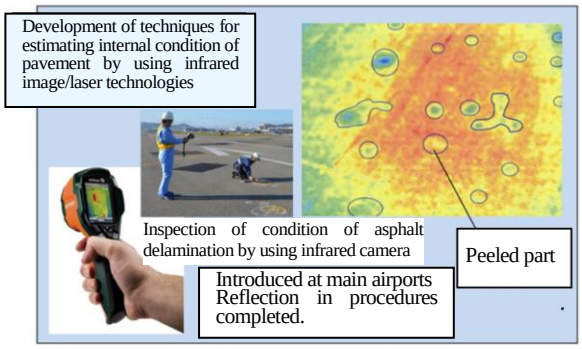

Fig. 3 Investigation for interlayer delamination of asphalt by using infrared image

One Year after the Opening of the Center

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Director of the Research Center for Land and Construction Management

(Key words) *Disaster Prevention, Maintenance, Construction Management, Information Infrastructure*

1. Introduction

The Research Center for Land and Construction Management was established in April 2014 as an organization to do research on cross-sectional themes related with roads, rivers and other fields. As part of the reorganization of the NILIM, divisions of 3 centers and 1 department were rebuilt into this single center. It places particular emphasis on tackling current major governmental agendas such as prevention or reduction of damage caused by frequent disasters including the Great East Japan Earthquake, and maintenance of the seriously deteriorating infrastructure. It also succeeds to research on construction management that was previously undertaken by the former Research Center, by developing new perspectives. The following chart shows the Center's organization and major research themes.

Research Center for Land and Construction Management's Organization and Research Themes

Center Director	Research Coordinator for Construction Management	Researcher Coordinator for Advanced Information Technology	Researcher Coordinator for Land Management and Disaster Prevention
Construction system Division	Research on standards for public works procurement processes, evaluation and reduction of construction costs, and maintenance management		
Construction Economics Division	Research on potential roles and effects of public capital in support of social and economic life and methods of communicating with the people		
Construction Management Division	Research on evaluating public capital development projects, construction management (bidding and contracting methods based on more efficient construction projects and technical capability evaluation)		
Landscape and Ecology Division	Research on tackling global environmental problems such as global warming countermeasures and ensuring biodiversity, and environmental matters such as conserving and creating greenery		
Maintenance Information Technology Division	Research on foundation technologies concerning the collection, processing, and use of information through surveys, design, construction, and maintenance.		
Disaster Prevention Division	Research on advance measures to prevent damage by earthquakes and tsunami etc., crisis management response and reconstruction measures after disasters, observing earthquake motion and setting design earthquake motion, etc.		

2. 1 Major research efforts in the first year

(1) Disaster prevention and reduction

Under SIP, the Cabinet Office's new R&D budget system, the Center has started "Development of Real Time Infrastructure's Damage Information Collection, Summarization and Sharing Technologies" in order to realize rapid initial response when a disaster occurs. Along with the Disaster Prevention and Reduction Research Committee formed inside of the NILIM, the Center works cooperatively with the head office of the MLIT and the regional development bureaus to operate the Disaster Prevention Technology Development Committee and to undertake R&D of disaster prevention technologies.

(2)Maintenance

As a research theme of the Maintenance Research Committee, the Center is working to build a maintenance process that incorporates the perspective of risk assessment in order to contribute to streamline the maintenance process for various facilities.

Besides, the Center is also conducting researches on ordering, estimation, inspection methods for infrastructure maintenance and repair works and on the construction of a database of past facilities' records.

(3) Quality control of works

In June of last year, the Bill for Ensuring the Quality of Public Works was revised, stipulating measures to foster potential future labor to prevent the shortages, clarification of the employer's responsibility for appropriate design and estimation, and strengthening measures to introduce and apply diverse bidding and contract systems to achieve suitable procurement.

To achieve these goals, two guidelines are being prepared: the new "Technical Proposal Negotiation Method" implementation, and the application of diverse bidding and contract systems.

(4) Information Infrastructure

The Center conducts researches on the utilization of road related information obtained by GIS, in order to enhance road management and utilization.

It has performed trial operation of road information distribution using the Road Section Identification Data set based on government-private sector cooperation. And Fundamental Geospatial Data of Road has reached the trial stage of its use in a model office for efficient management, for example, monitoring the state of its owned facilities and property of other authorities, etc..

3. Future developments

From the point of view of dealing with cross-sectional issues, that is a purpose of the establishment, the Center aims to achieve innovations in work processes as its ultimate goal. It will, therefore, connect such main research topics as disaster prevention, information infrastructure, and construction management, and tackle the following major tasks.

(1) Disaster response's innovations

[1] Early clarification of conditions

Regarding initial response to disasters at the earliest stage when it is difficult to obtain information, but when it is considered possible to improve greatly the quality and to expand the quantity of information with the aid of the latest tools such as satellites or unmanned air vehicles and new information acquisition technologies such as image processing technologies. In particular, it is necessary to be able to quickly gather information from remote locations concerning the scale of the disaster and precise information about damage, which were types of information collected by manned patrols or field surveys previously.

[2] Reconstruction measure management

Along with early damage clarification technologies, other important themes are establishing restoration organizations according to the damage level and operation technologies.

The Center is researching methods of estimating the required personnel necessary and quantities of equipment and materials according to the scale and degree of damage, methods of setting activity units etc. and calculating the necessary reconstruction period according to the reconstruction organization scale, and it is expected to establish a disaster response operation method based on the results of these efforts.

(2) Innovations in construction production systems

[1] Computerized construction

Progress in CAD technologies enables the simplified use of 3D data as construction information, and improves the efficiency and quality of all work in the process: design, construction and maintenance.

In the area of computerized construction using 3D design data, the Center is gradually advancing its application into construction sites. Besides, progress control using total stations has been more and more introduced mainly for the earthworks.

In order to reduce the further burden on both the employer's and the contractor's sides, it is desirable to widely apply the said data to the contract implementation procedures by using construction information in the series of supervision and inspection processes, applying it to the progress payment method and so on. We wish to conduct research on utilization methods while cooperating with construction sites.

[2] Establishing a quality assurance cycle

Every stage of the procurement processes affects the quality of the works from the technical evaluation before signing a contract to the supervision and inspection during the construction. The quality assurance method to be emphasized differs according to characteristics of the works: those that place high expectations on improvement of quality by technical proposals by the contractor, those that must prioritize certain execution by a contractor considered technically reliable who has accurately assessed the execution environment and so on.

For the works executed by local companies, the level of the works is not always very high. In such cases, it is important to select a reliable contractor that can perform work reliably and to appropriately check and inspect the works' execution process. It is vital to establish a system that takes past performance of the contractors, which is based on precise evaluating criteria for quality of work including the difficulty of the work according to the execution environment and execution process etc., into account during the bidding evaluation process. It permits sustainable improvement of the companies' technical ability and the quality of works.

[3] Collaboration of technologies

The players in the construction production system—the employer, the designer, and contractor—must supply the Japanese nation with good quality infrastructure by providing technical capabilities according to their respective roles. Timely communication is, however, limited due to the transparency in some cases, and this limitation appears to affect the efficient utilization of each player's technologies, which would result in inefficiency of production or quality degradation of the products.

The "Technological Proposal and Negotiation Method" that is a new bidding and contract system, is a method that allows the contractor to participate in the process of design, and also permits sharing know-how with the other players, which have been separated. We wish to establish effective utilization methods to apply to works requiring advanced construction technologies.

4. At the end

The Center's research targets basic areas for several fields and, at the same time, its achievement is to be evaluated and improvement methods are to be studied only in the implementing process. For that reason, we will continue researches through collaboration among each field's R&D and related departments.

Establishment of Database for Seismic Damage to Sewer Pipeline

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Key words: sewer, pipeline, earthquake, database, earthquake-proofing

1. Introduction

In the 2011 Off the Pacific coast of Tohoku Earthquake, many sewerage facilities suffered damage. Therefore, prompt establishment of earthquake countermeasures, such as earthquake-proofing of sewerage systems or preparation of BCP, is required for expected massive earthquakes. The National Institute for Land and Infrastructure Management (NILIM) has established a database of seismic damage to sewer pipeline, which enables damage trend analysis of sewer pipeline facilities under various seismic conditions in order to advance efficiently and effectively earthquake-proofing of the sewers in local governments, which is urgently required but needs a lot of budget and time.

2. Creation of the database of seismic damage to sewer pipeline

To create this database, we re-examined the information collected from separate viewpoints each time an earthquake occurred, and unified the items of data, and organized data in an integrated manner. The earthquakes studied were the following major earthquakes: 2007 Noto Hanto Earthquake, 2007 Mid Niigata Prefecture Earthquake, 2011 Off the Pacific coast of Tohoku Earthquake, and 2011 Northern Nagano Prefecture Earthquake. For the information of damage from the last two earthquakes, we organized the information based on the disaster assessment data, and for the other earthquakes, we organized the information based on the existing damage investigation data by NILIM and the Public Works Research Institute ("PWRI"). Information registered in the database consists of the data on spans (upstream manholes, downstream manholes, and pipeline between them) that were damaged in part or whole, specifications of pipeline facilities for each span (pipe type, depth, etc.), damage information (damage situation and uplift of sewage manholes), and earthquake information related to them (measured seismic intensity, microtopographical classification, etc.) (Table 1). At present, the information on about 5,000 spans is registered in this database.

3. Damage trend analysis using the database

Table 1. Items of Database

Basic information	Earthquake name	Information of damage to pipeline facilities	Damage of pipe
	Date of occurrence		Deformation of pipe
	Municipality name		Loose / meandering pipe
Pipeline facility specifications	ID		Pipe joint displacement
	Upstream manhole number		Crack in pipe
	Downstream manhole number		Infiltration water
	Pipe diameter (mm)		Mounting pipe projection / defective connection
	Pipe type		Upstream manhole stagnant water depth (cm)
	Form		Downstream manhole stagnant water depth (cm)
	Extension (m)		Upstream manhole uplift (cm)
	Upstream manhole type		Downstream manhole uplift (cm)
	Downstream manhole type	Earthquake relevant information	Microtopography classification (Reclaimed ground, hill, valley bottom plain, etc.)
	Upstream manhole depth (m)		Measured seismic intensity
	Downstream manhole depth (m)		SI (kine) (Indicator representing the extent of turbulence by earthquake in general structures)
	Upstream sewer earth covering (m)		
	Downstream sewer earth covering (m)		

Utilization of this database allows analysis of the damage trend of sewer pipeline facilities under various seismic conditions. For example, with regard to the damage ratio of sewer pipeline facilities, as the result of comparison between the 2011 Off the Pacific coast of Tohoku Earthquake, which was a subduction-zone earthquake with longer frequency and duration time, and the 2007 Mid Niigata Prefecture Earthquake, etc., which is an epicentral earthquake [1], the damage ratio was slightly large in the epicentral type when the measured seismic intensity was smaller than 5.3, and was large in the subduction-zone type when the measured seismic intensity was larger than 5.3 (Figure 1). We will continue to conduct more detailed trend analysis and examine damage contributing factors.

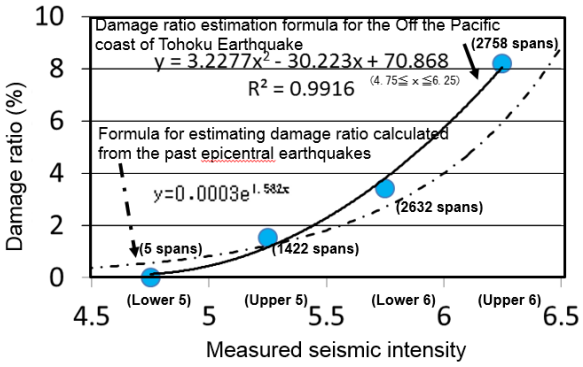

Figure 1. Measured Seismic Intensity and Damage Ratio

4. Conclusion

In this research, we organized the information of seismic damage on sewer pipeline as a database and analyzed damage trend. We also plan to improve the damage database and use it for examination of method for seismic damage risk assessment for sewer pipeline facilities and establishment of method for evaluating the priorities of earthquake resistant measures. Release of this database to the public is expected to promote earthquake research in local governments, universities, and private sector researchers and to develop technologies for earthquake resistant measures for sewer pipeline facilities.

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Empirical Study on B-DASH Project (Inundation Countermeasure Facilities Operation Support System Using ICT)

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Key words: B-DASH, ICT, urban inundation countermeasures

1. Present situation of urban inundation countermeasures for sewerage

In recent years, heavy rain concentrated on local area in a short time, which is called "localized torrential rain," frequently occurs in many places in Japan. Moreover, as a result of the decrease in forests and farm land, through which rain water penetrates into the ground, due to the progress in urbanization, the amount of rain water that directly flows into sewerage or other drainage facilities has increased, and the risk of flood damage in urban areas is rising due to the concentration of population, assets, etc. due to urbanization. In individual cities, various measures for preventing inundation damage are ongoing or still on the way to development, and particularly for measures based on structural development; prompt action is difficult since they require a lot of cost and time. In urban areas, however, since various facilities including sewerage have been developed to a certain level, it is possible to mitigate damage using them as stock.[1)] For these reasons, information on such facilities and observation results should be accumulated and damage factors should be analyzed, before aiming to reduce damage using existing stock.

2. Outline of empirical study

This research is based on empirical study aiming for mitigation of inundation damage through establishment of a system that integrates individual technologies using ICT for the detection, transmission, analysis, and offer of information on precipitation, water level, etc and efficient operation of existing inundation countermeasures, and targets the Enami area, Hiroshima, as empirical field.

The Enami area is located at the mouth of the Ota River, which flows through Hiroshima Prefecture, and is long and thin from north to south. Urbanization is proceeding in the area, especially in the residential zones. On rainy days, rain water is supplied to the area using pumps from the outside (Yokogawa and Yoshijima areas). As topographic characteristics, the ground level is relatively high in the land facing the river and northern and southern land, and is lower than 1.0 m above sea level in other land. Therefore, the area has often suffered inundation due to rainfall. In this research, rainfall and water level in sewers in the area are measured with 3 ground rain gauges (including existing ones) and 13 water gauges. Also, observation data of XRAIN is used to obtain rainfall information. All these information is collected in real time through the optical fiber cables laid in the area with a total extension of about 4 km and used to provide information on inundation forecast and support of pump operation, etc. (See Figure)

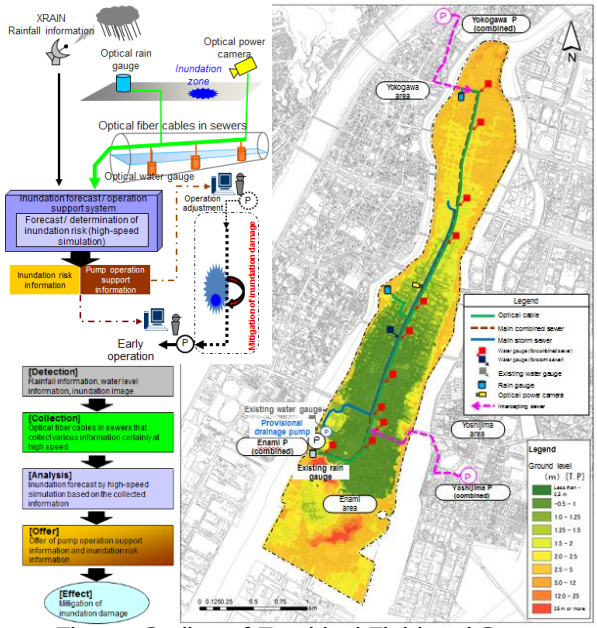

Figure: Outline of Empirical Field and System

3. Utilization of empirical study results

At present, the system construction has been completed and data collection and monitoring of have just started. In the future, we verify, with collected data, the effect of damage reduction in the case of utilizing the system's support information. Further, for the technologies used in this research, we are going to prepare a technical guideline based on the obtained results in order to disseminate them widely.

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Preparations Due to Climate Change for Flood Risks Exceeding the Capacity of Flood-Control Infrastructure

- Disaster Reduction Management for Preventing Destructive Damage Caused by Floods Beyond the Design Level of Infrastructure

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HATTORI Atsushi, Head (Dr. Eng.)
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Key words: Excessive flood, climate change adaptation measures, disaster reduction management

1. Flood risks exceeding the design / improvement level of flood-control infrastructure

There is concern over the increased scale and frequency of intense rainfall that may cause a large-scale flood disaster due to global warming. This is stated as "there is no room for doubt" in the fifth report of the U.N. Intergovernmental Panel on Climate Change (IPCC). We have already understood the existence of such risk through recent illustrating events such as flooding along the Yabe River because of heavy rain in Northern Kyushu in July 2012 and flooding in the Shingu River System caused by heavy rain when Typhoon No. 12 hit the Kii Peninsula in September 2013.

2. Proposal of framework for disaster reduction management to control the occurrence of damage in case of excessive flood

In order to minimize the damage in the whole basin even under excessive flooding where a disaster cannot be avoided, the National Institute for Land and Infrastructure Management ("NILIM") has proposed, as a future direction, a framework for "disaster reduction management" that identifies changes in a flood damage characteristic curve of each river basin caused by the combined effects of various infrastructure improvements (structural measures) and non-structural measures (Fig. 1: 4 types of conditions are assumed), and controls the occurrence of damage according to various scales of excessive flooding.[1] In other words, in order to avoid the occurrence of immediate destructive damage in excess of the design level of structural measures and minimize the increase in damage in the whole basin as much as possible (although the prevention of all damage in local sites is impossible), the framework aims to control the occurrence of damage by appropriately combining non-structural measures including evacuation, land-use management, etc., while utilizing the toughness and other features of structural measures to the utmost. In this framework, it is essential to fully understand the effect, limit, and uncertainty of structural and non-structural measures to be combined and to study how to expand the menu of such measures. NILIM has developed a flood risk assessment method for the whole basin in consideration of the uncertainty of bank response in case of a flood exceeding river-channel flow capacity.[1] The combination of this method with the above-mentioned framework enables detailed analyses, e.g. selection from a variety of measures based on the evaluated flood risk for the whole basin and how the risk changes in consideration of the balance between upstream and downstream. Case studies are already ongoing in some river basins. For other research achievements, refer to the literature.[1),2)]

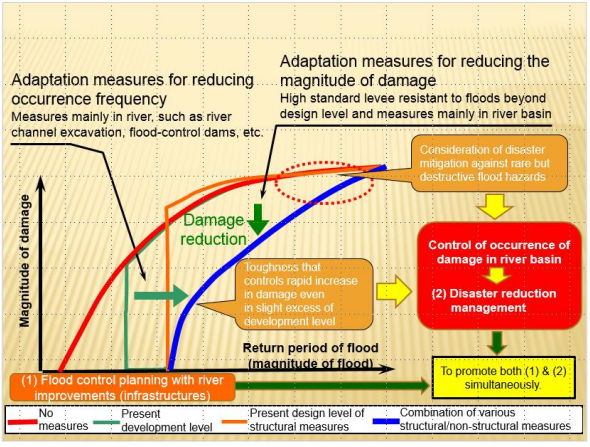

Figure 1: Disaster Reduction Management to Cope with Excessive Flooding

3. Reflection of the proposal in the report of the Council for Social Infrastructure

The framework discussed above was used in discussions of the Subcommittee for Flood Control Measures Adapted to Climate Changes in the River Subcommittee of the MLIT Council for Social Infrastructure, and served as an important factor that supported the concept of its interim report. NILIM also intends to offer the maximum technical support for planning measures for adaptation to excessive flooding in each river basin.

[Reference] 1) Technical Note of NILIM, No.749, 2013.
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0749.htm

2) Civil Engineering Journal, Vol. 56, No. 12, Special Issue: 5-Year Researches in Climate Change Adaptation Research Group, 2014.

How should Multiple Disaster be considered in Measures against Natural Disasters?

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Key words: Complex disaster, precedent disaster, successive disaster, earthquake, flood

1. Characteristics of measures against multiple disaster

"Multiple natural disaster" ("multiple disaster") used herein is defined as a disaster in which the magnitude of damage becomes larger than the simple sum of the magnitudes of damage from independent occurrence of each disaster due to the outbreak of another natural disaster ("successive disaster") on the way of recovery from a natural disaster ("precedent disaster"). For example, occurrence of a flood on the way of restoring a river bank sunken by liquefaction of the ground due to earthquake. As we examined the past earthquakes and floods, 20 cases where an earthquake with a seismic intensity of 5 or more was followed by a flood exceeding the warning water level within a time duration of less than one month in the past 110 years, so it is difficult to say that multiple disaster rarely occurs.

However, measures against multiple disaster are not widely implemented. One of the reasons for this is considerable uncertainty added in setting a damage scenario required for examination of countermeasures due to the characteristic of multiple disaster that magnitude of damage in successive disaster greatly varies according to the condition of damage / recovery in disaster prevention facilities, houses, etc. resulting from precedent disaster since various ways of combination of magnitudes of precedent and successive disasters and time durations between the two disasters are possible.

This research is based on the understanding of the current situation that there is a restriction on implementation of measures focused on multiple disaster from the viewpoint of cost benefit, etc. and aims to study the effect of damage reduction in case of multiple disaster with the measures against disaster prevention / reduction in independent disaster as well as the crisis management measures that not only reduce damage but shorten, to the extent possible, the duration of restoration exposed to danger in which successive disaster may occur with an enormous number of potential death toll (e.g. over 10,000 people). With such understanding and aim, this research provides simulation procedures required in studying multiple disaster measures and identifies the considerations for studying measures by using cases of multiple disaster of earthquake and flood, modeling the conditions of restoration after precedent disaster as in detail as possible in reference to past disasters, and setting comprehensively the magnitudes of various earthquakes and floods and the duration of the occurrence between both disasters.

2. Results of simulation for model river

Figure 1 shows the results of simulation for the model river extending about 60 km (Earthquake: scale corresponding to the Nankai Trough Massive Earthquake, Flood: scale corresponding to that of the Fundamental River Management Policy). When evacuees of the earthquake return to their homes in accordance with restoration, if a flood occurs about 30 days after the earthquake (in the case of the model river in this research), the number of death toll will increase, but such increase can be reduced by accelerating restoration of the bank and restricting return of evacuees.

3. Conclusion

In case of multiple disaster, emergency response ability of on-site personnel is particularly required, and it would be effective for newly assigned personnel etc. to imagine in advance the situation of multiple disaster through practice using the approach discussed herein. Further, with the same approach, it is possible to study disaster reduction measures that combine various disaster prevention measures according to basins and regional characteristics. For example, earthquake-proofing of houses will reduce the operation of rescue from the collapsed buildings after the earthquake, and result in increase in the number of machines available for restoration of the bank and reduction of the duration of bank restoration, which consequently mitigates the risk of flood damage.

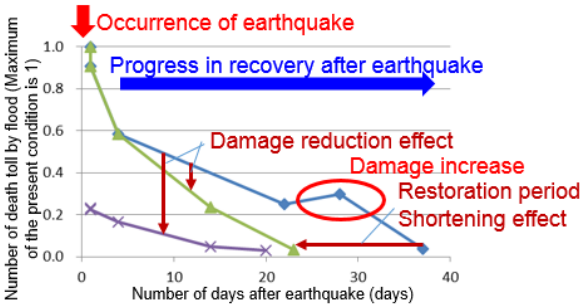

Figure 1. Example of Flood Damage Calculation by Point of Time after Earthquake

* Blue: Existing facilities, Yellowish green: Virtual expansion of material and equipment for bank recovery, Purple: Virtual earthquake-proofing of bank (the costs of the last two cases are almost the same)

[Reference]
1) ITAGAKI Osamu, MATSUURA Tatsuro, HATTORI Atsushi, 2014: Case Study on Characteristics of Effect of Damage Reduction Measures against Multiple Disasters of Earthquakes and Floods, The 14th Japan Earthquake Engineering Symposium, proceedings, pp. 1354-1363

Start of Workshop for Nature and Local Infrastructure

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WATANABE Kunihiro (Dr. Agr.), Researcher
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Key words: Nature and local infrastructure, cross-sectional, tsunami

1. Nature and local infrastructure

In accordance with the enforcement of the Law for Development of Tsunami Disaster Prevention Areas in December 2011, individual municipalities are preparing "Plan for Comprehensive Promotion of Development of Tsunami Disaster Prevention Areas" ("Promotion Plan") assuming the inundation that may occur when hit by the maximum level of tsunami.

In order to increase promptly the time and route available for evacuation, it is necessary to use all possible resources effective for disaster prevention, such as natural features such as dune and swamp, features of local scale such as trees, temples and shrines taken good care of by local community, and even human resources and transfer of experience, as well as public disaster prevention facilities. The National Institute for Land and Infrastructure Management (NILIM), collectively referring to the above as "nature and local infrastructure," has started research in fiscal 2014.

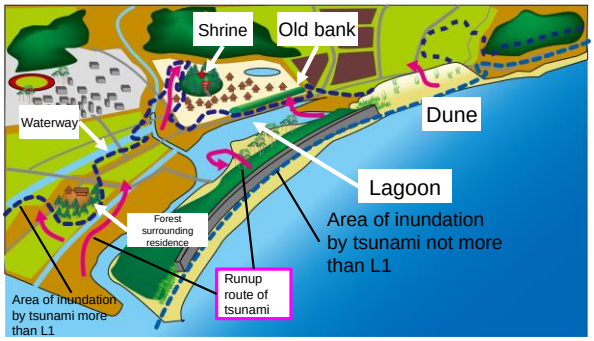

Figure 1. Image of Disaster Reduction by Nature and Local Infrastructure

Figure 2. Workshop concerning of Transfer of Experience in Tsunami Disaster

2. Holding cross-sectional workshop

Since nature and local infrastructure include those with various scales and qualities, scientific groups to which researchers belong are various. It is indispensable not only to conduct research individually but also to establish the method of synthesizing the findings of researches ongoing in each field in local plans.

Therefore, NILIM has decided to hold cross-sectional workshops in order to facilitate information exchange between the researchers of various fields studying "tsunami disaster reduction" and between private sector, industry, academia and government. In fiscal 2014, NILIM held "Workshop for Transfer of Experience in Tsunami Disaster" inviting representatives from private sector, academia, and government who study on transfer of experience for tsunami disaster reduction.

In the workshop, Professor SATO Shinji, University of Tokyo, served as coordinator and researchers in Kagawa University and Tohoku University, representatives from the Department of Public Works, Miyagi Prefecture, and representatives of NPOs developing activities in Rikuzen-Takata City presented topics, and they discussed what they can do and how they can collaborate in the positions of private sector, academia, and government, respectively in order to make country-wide activities for transfer of disaster experience more effective.

3. Future development

The aforementioned workshop was held as an internal meeting in the initial year (fiscal 2014) but will be held in collaboration with the Cabinet Office and local Regional Development Bureaus. Details of this project are to be disclosed in the following homepage.
http://www.nilim.go.jp/lab/fcg/labo/02_07.html

[Reference]

1) KATO Fuminori et al (2014) "Measures against Tsunami Exceeding Designed Level -- Resilient Coastal Dikes and Utilization of Nature and Local Infrastructure," Civil Engineering Journal, Vol. 56, No.1, pp. 12-15
http://www.pwrc.or.jp/mokuji26.html#m001
2) SUWA Yoshio (2014) "What are Nature and Local Infrastructure?", RIVERFRONT, Vol. 79, pp. 11-15
http://www.rfc.or.jp/pdf/vol_79/mokuji.html

Main Points of Experiment Manual for Hydraulic Model of Artificial Reef Armor Blocks

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NOGUCHI Kenji, Senior Researcher
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Key words; Artificial Reef Design Guide, armor block, disaster standard, hydraulic model experiment manual

1. Relationship with "Artificial Reef Design Guide"

Artificial reef is a submerged mound-type structure that applied the phenomenon that waves are broken when the depth of water is shallow and wave height is lowered. Although "Artificial Reef Design Guide" (the "Guide") was published, there was no manual that described the standard experiment method concerning the stability of armor blocks. Then, we decided to create this manual to supplement the items of stability review for armor blocks described in the Guide.

2. Characteristics of "Armor block hydraulic model experiment manual"

(1) Provision of disaster criteria for artificial reef armor blocks

If even a single armor block constituting an artificial reef is dispersed, adjacent blocks and mound material may also be dispersed in a chain reaction, and the target performance of artificial reef is highly likely to be lost immediately. Then, we defined the disaster standard for "armor block works" of artificial reef as disaster to a single armor block. Further, we decided to create a chain of damage diagram as shown in Figure 1 for each type of block by observation from side and above. This will serve as a useful material in on-site inspection to be conducted when hit by high wave.

(2) Conditioning for final positioning of hydraulic model experiment

The Guide recommends checking stability by hydraulic model experiment.

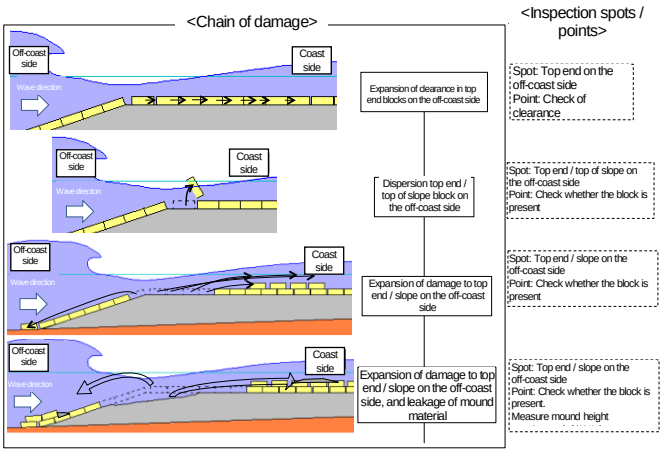

Figure 1. Example of Chain of Damage Diagram Prepared According to Blocks

The design using the weight calculation formula can be interpreted as advanced implementation of this hydraulic model experiment. Based on this, we defined experiment conditions that can generally cover site conditions. The depth of installation was defined to be within the breaker zone, which is close to actual condition, since artificial reef is often installed with the depth at which a complicated hydraulic phenomenon, i.e. breaking waves off the artificial reef (Figure 2). This is also included in the scope of application of this manual. The sea bottom slope is set to 1/30 as the representative value for the coast of Japan. For the wave height and cycle, which are external force conditions, wave steepness is set based on the design wave of the coast facing an open sea.

Further, in order to position hydraulic model experiment as precursor experiment, we improved accountability by showing the conditions validated in the experiment, calculation line of stability factor, and experiment results so that block selectors may be able to confirm the experiment.

3. Aiming at artificial reef hard to suffer damage

This manual is to be published as Technical Note of NILIM in fiscal 2015. Actually, some artificial reefs have suffered damage, so we expect this manual to contribute to elimination of disaster.

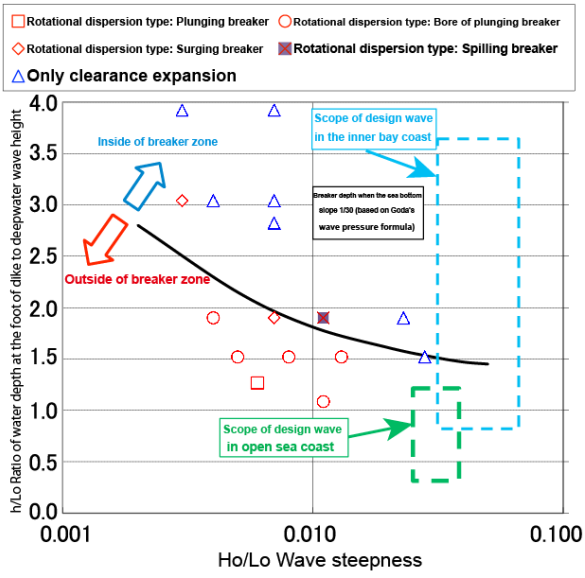

Figure 2. Relationship between Block Damage Form and Wave Breaking

A New Survey Technique for Solving the Roles of Sand of Sea Shore - Trench survey -

SUWA Yoshio, Head
NOGUCHI Kenji, Senior Researcher
Coast Division, River Department

Key words: Sand beach, deposition structure, beach nourishment

1. Why is trench survey in the coast a new approach?

In accordance with the progress of numerical simulation in the coast field, it has become possible to reproduce the topography of the coast consisting of multiple grain sizes that meet the characteristics of Japan's coast as well as changes in bed material. At present, reproduction is possible up to the average water level but is expected to cover seashore (land) in the future. It is, however, essential to grasp depositional environment from beach to dune, while grasp of actual area conditions, which is available as verification material, is never sufficient. To grasp such actual condition, surveys for obtaining as many samples as possible have been mainly conducted, such as boring and pit excavation to obtain point information and survey on the surface of bed material. With such surveys, it is difficult to grasp the history of deposition (growth of seashore). Therefore, the Coast Division has been conducting trench surveys in order to solve deposition phenomenon (Figure 1).

2. Findings from trench survey (Figure 2)

Since results of the survey show that high shores are formed near the river mouth where there is a lot of sand and that sand is also deposited up to the back (mountain side) in the area where drift sand is deposited due to the increase in the ratio of sand, it was found that the height of the ground in the back depends on the amount of sand supply. [1)]

Moreover, it has become possible to grasp the cross section in case of the maximum erosion, which provides significant information for maintenance of coastline.

In Japan, many of the shores consist of gravel and balance of sand and gravel creates "characteristics of coast." The Coast Division will continue to identify information that serves to solve the mechanism of formation of "characteristics of coast" through trench survey.

[Reference]
1) Journal of Japan Society of Civil Engineers, Ser. B2 (Coastal Engineering), Vol. 70, No.2, pp. I _681-1_685
https://www.jstage.jst.go.jp/article/kaigan/70/2/70_I_681/_article/-char/ja/

Figure 1. Scene of Trench Survey

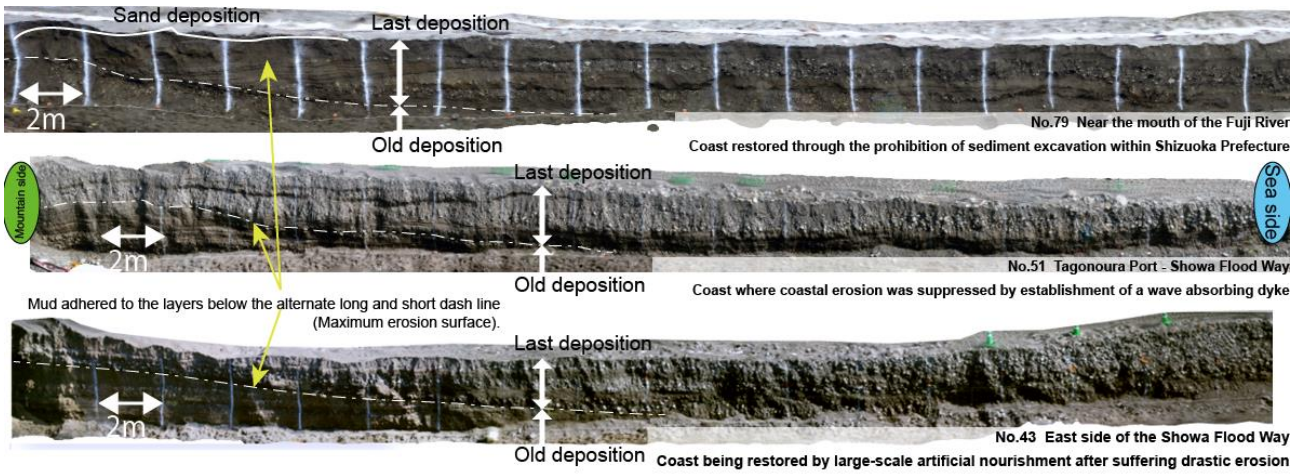

Figure 2. Serial Images of Cross Sections Created with Three-dimensional Space Model Software

Coastal Erosion in a New Phase

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Key words: Coastal erosion, submarine topography, monitoring

1. Trend conversion of sandy beach area changes in recent years

Table 1 compiles erosion and accretion area of sandy beach by examining the topographic maps of the Geospatial Information Authority. From latter 1970s to the early 1990s, the coastline considerably retreated, while from early 1990s to 2000s, the coastline slightly advanced. It shows trend conversion of sandy beach erosion recently.

Table 1. Long-term Changes in Coastline (except Okinawa Pref.)

		Erosion (ha)	accretion (ha)	Balance (ha)	Rate (ha/year)
Period (1905-1978)	Ⅰ	17,908	14,479	−3,429	−47
Period (1978-1992)	Ⅱ	5,377	3,203	−2,174	−145
Period (1992-2006)	Ⅲ	2,788	3,098	310	28

(Derived by examining the topographic maps of the Geospatial Information Authority)

2. Beach erosion still continues

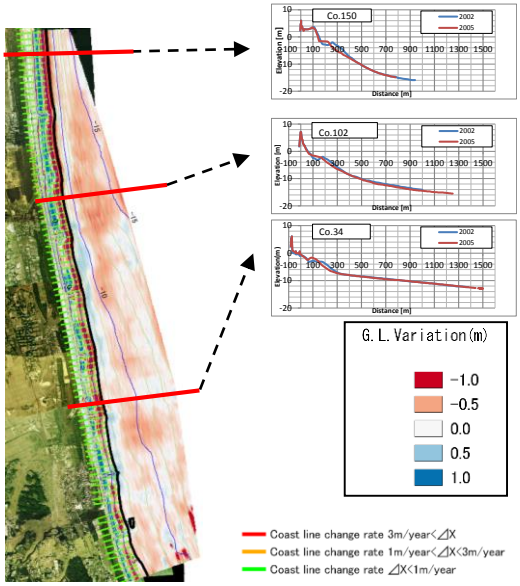

Figure 1. Littoral distribution of coastline change rate(1992-2006) and, planar distribution of ground level change(2002-2005)

Figure 1 shows littoral distribution of coastline change rate (m/year) derived in the same way as previous section, and ground level change (m) change by sonar sounding in Southern Sendai Bay Coast. Green line shows the rate of erosion is less than 1(m/year) or accretion, this shows coastal erosion are controlled.

However, for topography changes under the water surface, the ground level fell except very shallow area (Figure 2) . In the shallow area from the area of 7 m in depth up to the beach above sea level, there are increase and decrease due to bar shift, but on the whole, sand volume has decreased at a rate of 196,000m3/year. In the wide area where water depth is 7 m or more, , sand volume decreased at a rate of 483,000m3/year. Consequently the possibility of increase in run-up height and damage to coastal structures has increased.

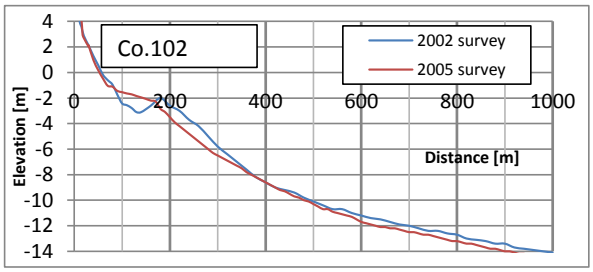

Figure 2. Enlarged view of cross-section (Survey line Co-102)

The National Institute for Land and Infrastructure Management (NILIM) has been surveying changes in coastline and submarine topography in major coasts eroded, and there are some coasts where retreat of the coastline has been prevented but volume of submarine sediment has reduced, as in Southern Sendai Bay Coast.

There are many eroded coasts where the coastline retreated up to revetment with no room for retreat or many coasts where retreat of coastline is being stopped as the result of implementation of various erosion control measures, but monitoring including submarine topography is necessary to determine whether the risk of high wave disaster has been controlled. In other words, it is considered to have entered a phase that the trend of coastal erosion cannot be grasped simply by surveying coastline.

Research Starts for Mitigating Disasters from Storm Surge and High Waves

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Key words: Storm surge, high wave, assuming storm surge inundation

1. Background

Large-scale storm surge disasters have often occurred in various places of the world, including the 2005 Hurricane Katrina in America and the 2013 Typhoon Haiyan in Philippines.

Inundation in New Orleans

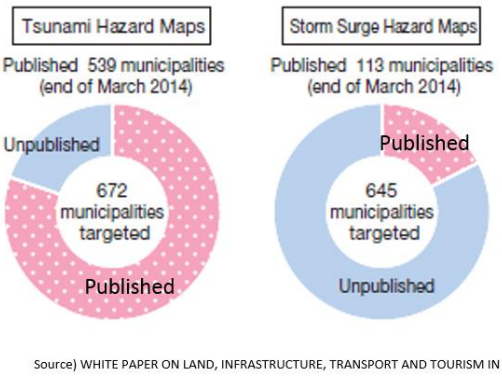
Transfer by swamp boat

(Source: HP of FEMA)

Photo: Disaster Caused by Hurricane Katrina

Japan has also suffered major storm surge disasters such as the 1959 Ise Bay Typhoon, and there are zero-meter areas in the Tokyo Bay, Ise Bay, and Osaka Bay, where population and assets are concentrated and the risk of storm surge disaster is high.

Meanwhile, the ratio of hazard map preparation concerning storm surge is low across the country as compared with tsunami, so it is not clarified which area is dangerous in case of storm surge.



Source) WHITE PAPER ON LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM IN JAPAN, 2013

Figure. Hazard map preparation for tsunami and storm surge

Therefore, necessity for preparation and publication of estimated inundation by the maximum scale of storm surge was provided in the "Ideal disaster prevention / mitigation for addressing a new stage," which was prepared by the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) in January 2015. In February of the same year, "Technological Examination Committee for Strengthening Storm Surge Flood Control" (the "Committee") concerning the method, etc. for setting the assumptions of the maximum scale of storm surge inundation, in which the MLIT and the Ministry of Agriculture, Forestry, and Fisheries ("MAFF") serve as executive office, was founded.

⦿ ISOBE Masahiko	Vice-President, Kochi University of Technology
SATO Shinji	Professor, Graduate School of Engineering, the University of Tokyo
SEKIYA Naoya	Associate Professor, Interfaculty Initiative in Information Studies, Graduate School of Interdisciplinary Information Studies, the University of Tokyo
TAKAHASHI Shigeo	Chief Director, Port and Airport Research Institute
NAKAKITA Eiichi	Professor, Disaster Prevention Research Institute Kyoto University
NAKAYAMA Akiyoshi	Head, Fisheries Engineering Department, National Research Institute of Fisheries Engineering, Fisheries Research Agency
YAMADA Tadashi	Professor, Department of Science and Engineering, Chuo University

⦿: Chairperson (titles omitted, in the order of the Japanese syllabary)

Table. Technological Examination Committee for Strengthening Storm Surge Flood Control

2. Main issues and activities of the National Institute for Land and Infrastructure Management (NILIM)

Coast Division, as conditions for setting the assumptions of storm surge inundation, is conducting surveys and researches concerning the following:

1) Conditions for the maximum scale of typhoon (central pressure, radius of the maximum cyclostrophic wind speed, traveling speed, route);
2) Conditions for coastal levee break; and
3) River conditions considering simultaneous occurrence of flood and storm surge;

and also provides data useful for technological examination by the Committee.

3. Future schedule

In the future, the Committee, based on internal discussions, will technically support the documentation of "Manual for Assuming Storm Surge Inundation (tentative title)" by the executive office (MLIT and MAFF) and study how to manage information useful for warning and evacuation, including water level and wind speed in case of storm surge.

Wave Runup Forecast Started to Operate Effectively for Successive Invasion of Typhoons

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TAKESHITA Tetsuya, Senior Researcher
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Key words: Storm surge, high wave, wave runup

1. Introduction

Large-scale storm surge disasters have often occurred in various places of the world, including the 2012 Hurricane Sandy in America and the 2013 Typhoon Haiyan in Philippines.

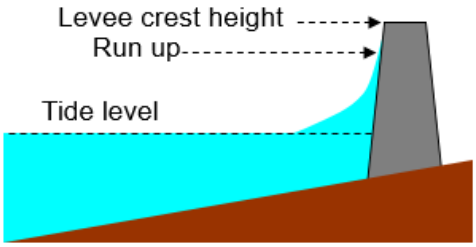
Japan was also hit by large scale disasters, including 2004 storm surge disasters by Typhoons Nos. 16 and 23 and the 2008 high wave disaster in Kurobe, Toyama. In order to minimize damage from such disasters, it is significant to grasp the risk of storm surge and high wave at an early stage and to use grasped information for disaster prevention behaviors.

Accordingly, the Coast Division conducted a project in the typhoon season of 2014 to provide actively the information obtained from "Wave Runup Forecast System," developed by out Division, to coast administrators, and we report the outline of the project as follows.

2. Outline of Wave Runup Forecast System

Wave runup height is a height when waves developed by a typhoon or low pressure run up a coastal levee etc. Since the risk of damage to levee will increase when wave runup exceeds the levee crest height, we developed "Wave Runup Forecast System" in order to forecast wave runup in advance.

As main mechanism, this System conducts the predication calculation of wave runup based on the storm surge / wave prediction data and terrain information of the Meteorological Agency and is able to forecast the condition after about 30 hours at 81 spots in Sendai Bay, Tokyo Bay, Sagami Bay, Suruga Bay, Ise Bay, Osaka Bay and Harima Sea, Toyama Bay, and Ariake Sea.



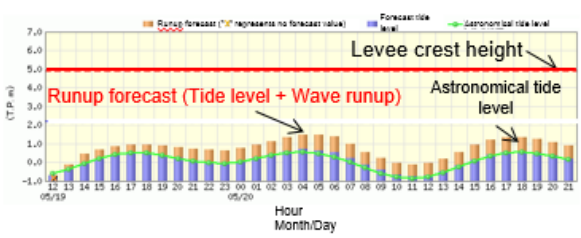


Figure 1. Schematic of Wave Runup Forecast System

3. Activities in the 2014 typhoon season

This system had been operated on a trial basis as part of research and development activities, and in the 2014 typhoon season, the Coast Division personnel collected and organized forecast information on wave runup and actively provided the information to the coast administrators concerned. (Figure 2 provides a photo of the Harima Sea (Toban Coast))

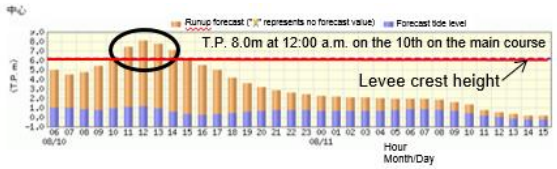


Figure 2. Forecast Information on Typhoon No. 11 (Aug. 10) (Toban Coast)

Photo: Toban Coast (around 11:00 a.m., Aug. 10)

4. Future development

In the "Ideal disaster prevention / mitigation for addressing a new stage," which was prepared by the Ministry of Land, Infrastructure and Transport (MLIT) in January 2015, importance of time line (time-series action plan) is indicated from a viewpoint of disaster prevention / mitigation. With the concept of this time line, we will continue to study how this forecast system is utilized by coast administrators.

Further Strengthening of Local Heavy Rain Monitoring System

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YAMAJI Hideyuki, Researcher
TUCHIYA Shuichi (Dr. Eng.), Researcher
Water Cycle Division, River Department

Key words: Radar precipitation information, X-band MP radar, C-band MP radar

1. Introduction

The Water and Disaster Management Bureau of the Ministry of Land, Infrastructure and Transport (MLIT) has allocated 26 units of C-band wave (wavelength of approx. 5 cm) radar, which is a single polarization radar that transmits / receives one type of radio wave, and 38 units of X-band (wavelength of approx. 3 cm) MP radar ("XMP radar"), which is a dual-polarization radar that transmits / receives two types of radio waves (horizontal and vertical). With these radars, the Bureau monitors local heavy rain, which causes inland flood and other water disasters in various locations in Japan.

As compared with XMP radar, C-band radar has a wider range of quantitative observations but is inferior in accuracy of observation and needs correction of observation data with a ground rain gauge, and therefore cannot distribute real-time precipitation information. XMP radar has the minimum observation area of 250m mesh and requires only one or two minutes for transmission. It can distribute high-resolution and real-time precipitation information but strong rain may cause a radio wave dissipation area. This study aims to interpolate the unobservable area of XMP radar to further upgrade radar precipitation observation by synthesizing the precipitation observation data obtained from the C-band MP radar ("CMP radar"), which was developed by upgrading (converting to MP radar) C-band radar to dual polarization radar and XMP radar.

2. Rainfall observation by synthesis of XMP radar and CMP radar

With the radar precipitation image (Left Figure) of XMP radar in Typhoon No. 12, which developed in August 2014 and the synthesized precipitation ("MP radar precipitation) image (Right Figure) of XMP radar and CMP radar, it is confirmed that the radio wave dissipation area of XMP radar is covered by synthesis of CMP radar. Moreover, as the result of comparison of the time series data on ground precipitation and XMP radar / MP radar precipitation, precipitation underrated by XMP radar due to the effect of radio wave dissipation could be grasped and it was confirmed that MP radar precipitation is almost the same as ground precipitation from the beginning to end of rainfall.

3. Future perspective

We have confirmed that the unobservable area of XMP radar can be interpolated with CMP radar by synthesizing the radar precipitation of XMP radar and CMP radar. In the future, we plan to systematize the above-stated technologies and start test operation. At present, MLIT allocated 5 units of CMP radar and plans to allocate additional 4 units of CMP radar by the end of fiscal 2015. Expansion of rain gauge network using high-precision MP radar is expected to further strengthen the flood disaster monitoring system.

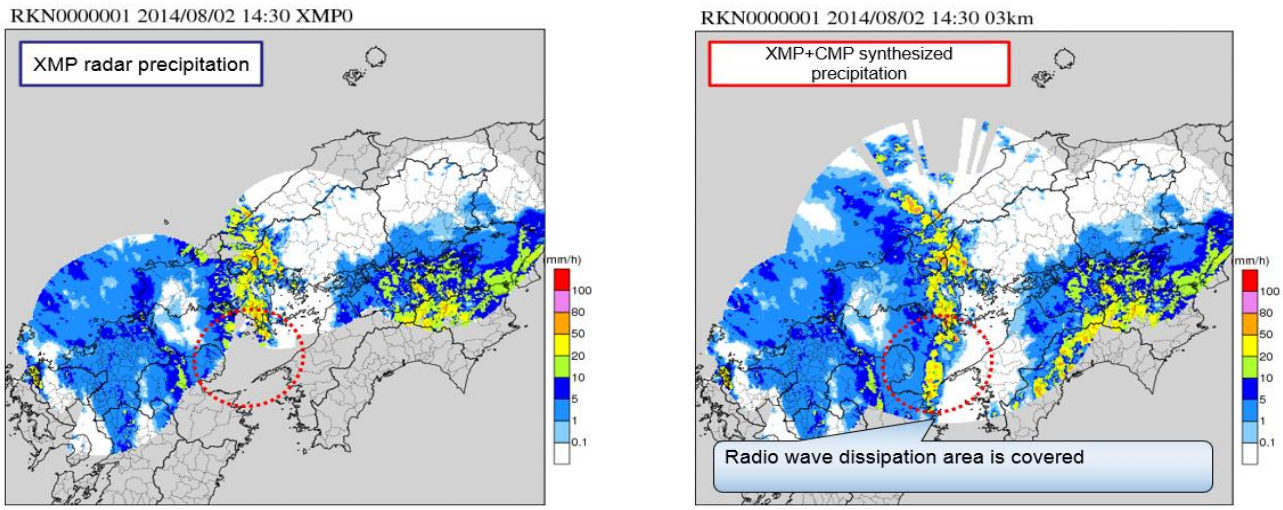

Figure. Radar Precipitation Image of Typhoon No. 12 in August 2014

Establishment of River Level and Inundation Forecast Approaches for Appropriate Evacuation and Flood Control Activities

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Key words: River level forecast, inundation forecast, SIP

1. Introduction

In recent years, torrential rain and local heavy rain (so-called "torrential downpour") are increasing, and flood disasters have occurred frequently. In order to strengthen the monitoring of such flood disasters that are suddenly caused by rapid development of cumulonimbus clouds, the Ministry of Land, Infrastructure and Transport (MLIT) has allocated 38 units of X-band MP radar across the country and is distributing almost real-time precipitation information on spatial and temporal resolutions to be updated every one minute with 250m mesh. In order to ensure more secure disaster prevention / mitigation, it is desired to provide real-time information / warning appropriate for location that "triggers evacuation" by translating such precipitation information etc. into inundation forecast information, using ICT. Then, the River Department, participating in "Strengthening resilient disaster prevention / mitigation functions" in SIP (Cross-ministerial Strategic Innovation Promotion Program), which started in fiscal 2014, has been studying for development and social implementation of new technologies concerning observation / forecast / analysis to ensure secure disaster prevention / mitigation against flood disasters resulting from heavy rain etc. in collaboration with the National Institute of Information and Communications Technology ("NICT"), the National Research Institute for Earth Science and Disaster Prevention ("NIED"), etc. (Figure 1).

In this study, research and development as well as system construction are conducted in order to translate the precipitation information from the next-generation radar developed by the NICT and the precipitation forecast information developed by the NIED and into practical river level forecast and inundation forecast information and provide the information in real time. Accordingly, we plan to introduce techniques for assimilation of river level and inundation monitoring data and examine optimization of algorithm, etc. to enhance the accuracy and speed of the river level and inundation forecast, and establish a prototype system in fiscal 2016 based on results of such activities. We also aim to complete this system through feasibility tests in and after fiscal 2017.

2. Outline of inundation forecast and river level forecast systems

As the result of discussion with the organizations concerned about needs and practical use of inundation forecast and river level forecast systems, we have decided to establish an inundation forecast system for the basins of Kanda River and Shakujii River and a river level forecast system for the basin of Arakawa River, and therefore created an inundation forecast model and a river level forecast model. The inundation forecast model integrated the river, sewerage hydraulic analysis, and flood analysis models so that inland flood and river flood can be treated in an integrated manner. In the river level forecast model, dependence on flush volume was eliminated to the extent possible by using the distribution pattern runoff model and the one-dimensional unsteady flow model. We improved the accuracy of this model by incorporating the data assimilation technique using a granular filter.

3. Future study

For the inundation forecast, in addition to improvement of resolution focused on the important points and their peripheral areas, such as underground shopping center and subway entrance, and to enhancement of the accuracy and computing speed by parallelization of algorithm, etc., we plan to examine inundation monitoring in order to improve monitoring of inundation phenomenon and forecast accuracy by assimilation of inundation monitoring data.

For the river level forecast, in addition to improvements including expansion of modeling areas, we will also examine visualization of computation results from the viewpoint of users and, based on such examination, establish a real-time computation / display system for inundation forecast and river level forecast and identify issues for establishment of prototype system.

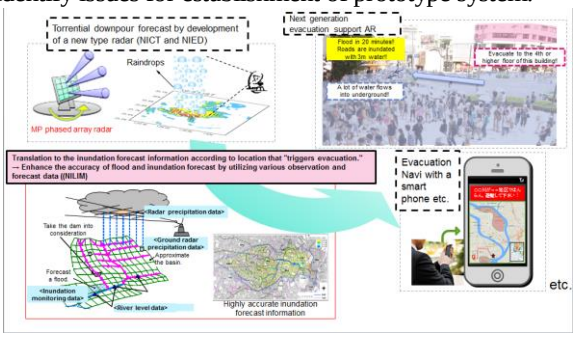

Figure 1. Concept of Collaboration in Technical Development for the Observation, Analysis, and Forecast of Flood Disasters

For Extending Forecast Lead Time in Flood Forecast --- Probabilistic Flood Forecast using Ensemble Forecast

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Key words: Ensemble forecast precipitation, long-time flood forecast

1. Introduction

As part of the measures against flood disaster, which is considered to become larger than ever before, development of the time line (disaster prevention action plan) to prepare for a large-scale flood disaster is progressing. In the time line type disaster prevention behavior, in view of the time required for responsive actions such as mass evacuation in wide area, it is necessary to decide whether to implement responsive actions in full advance to occurrence of damage (e.g. about 48 hours before). However, in the present specifications of flood forecast, which serves as a ground for determining implementation, forecast lead time is at most about several hours and there is no information about reliability of the forecast. Therefore, there is an issue that it is difficult to decide the implementation of responsive action based on the forecast conducted. Here, we introduce long-time flood forecast with reliability information for contributing to the time line type disaster prevention.

2. Long-time flood forecast based on ensemble forecast precipitation.

As a tool for conducting long-time flood forecast with reliability information, ensemble forecast precipitation is used. Ensemble forecast is based on the recognition that deterministic forecast with one initial value is difficult, and evaluates the width of forecast obtained by conducting forecast calculation for multiple initial values. Figure 1 represents the water levels for 84 hours of forecast lead time, obtained by computing ensemble forecast precipitation for the 2013 Typhoon No. 18 and inputting the calculation result into runoff calculation. The Figure shows simultaneous conduct, as ensemble forecast, of water level forecast based on multiple forecast precipitations as well as one forecast precipitation. Figure 2 indicates the results of Figure 1 with the probability (= number of ensemble members that exceed the normal water level / total number of ensemble members) of exceeding the normal water level, such as overflow danger level, according to forecast lead time. The flood indicated by the Figure considerably exceeded the overflow danger level, and according to Figure 2, the water level forecast based on ensemble forecast precipitation shows "Exceed the overflow danger level within 54 hours with the probability of not less than 60%." Such information is expected to encourage implementation of more active responsive behavior as compared with the information obtained from the present flood forecast.

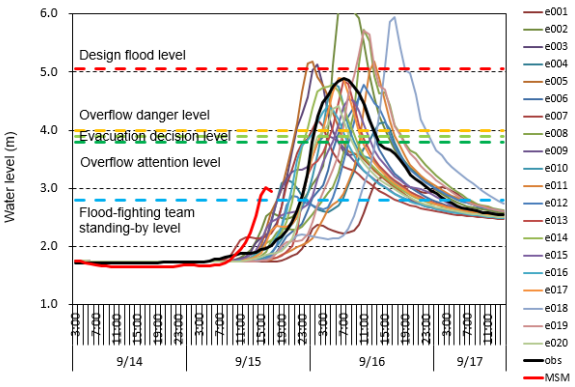

Figure 1. Flood Forecast Calculation Using Ensemble Forecast Precipitation

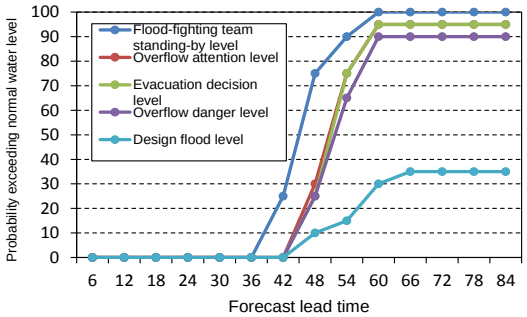

Figure 2. Probability of Exceeding Normal Water Level according to Forecast Lead Time

3. Conclusion

The long-time flood forecast with reliability information introduced herein is expected not only to contribute to the time line type disaster prevention behavior but also work effectively in all aspects of flood control measures including evacuation of elderly people and avoidance of night-time evacuation. What needs to discussed for this study is organization of the issues related to real time operation, including addition of the number of examples and calculation time required.

Grasp of Sediment Movement for Basin Sediment Management after Large-scale Sediment Production

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Key words: Large-scale sediment production, sediment management

1. Background

Heavy rain or earthquake may cause a large-scale slope failure or simultaneous multiple slope failures, and as a result, a lot of sediment may be supplied to torrents, rivers, etc. (Photo 1). After such a large scale of sediment production, a large amount of sediment discharge is expected to continue for a long term. Thus, several years after sediment production are considered as one of the important periods for advancing comprehensive sediment management. Then, we have been implementing the project research titled "Research on comprehensive sediment management for sediment transport after large-scale sediment production" since 2012 in order to upgrade the basin sediment management. This project research has grasped the sediment movement after large-scale sediment production and evaluated the methods of forecast / evaluation by numerical computation and man-made effects. This report introduces two out of the cases where we grasped the actual condition.

Photo 1. Example of Natural Dam Formed by the 2008 Iwate-Miyagi Nairiku Earthquake.

2. Examination of cases caused by heavy rain or earthquake

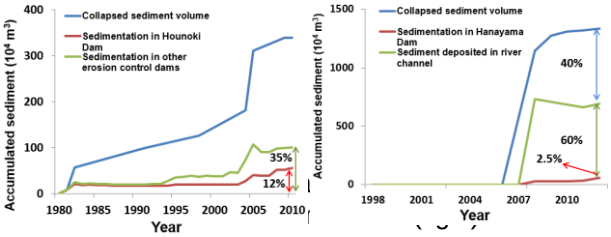
We examined the effect on the amount of sediment discharge after large-scale sediment production using the amount of sediment deposit in the erosion control dam in the target basin and the amount of collapsed sediment calculated with the collapsed land area map, etc.

○ Case by heavy rain

Target basin: Kawabe River (upstream basin of Hounoki Sabo Dam in Kuma River System)
Year of disaster: August and September 2004 and September 2005
Characteristics: Sediment deposit in Hounoki Sabo Dam considerably changed in the year of the disaster and the inflow of sediment into the Dam was large for the 5 consecutive years from the disaster. From the sediment balance for 5 years after occurrence of the disaster, it is considered that 12% of the sediment produced deposited in the Hounoki Sabo Dam, 35% reached other sabo (erosion control) dams, and other sediment deposited on river channels and slopes (Photo 1).

○ Case by earthquake

Target basin: Ichihasama River (upstream basin of Hanayama Dam in Kitakami River System)
Year of disaster: Iwate-Miyagi Nairiku Earthquake in June 2008
Characteristics: Sediment deposit in the Dam considerably changed in the year of the disaster, up to about 11 times the average value before the Earthquake, but changed little thereafter. This is considered attributable to the deposit of sediment in the natural dam formed in the basin. According to the sediment balance for 5 years after occurrence of the Earthquake, 2.5% of the sediment produced reached the Hanayama Dam and a large amount of sediment accumulated in the basin, and from the topographic survey using a laser profiler, it is considered that 60% of the sediment in the basin deposited on river bed and 40%, on the slopes (Figure 1).



3. Conclusion

From the study on the two cases above, it was found that sediment discharge after large-scale sediment production can be influenced considerably by heavy rain, earthquake, or other causes and by the presence of a natural dam. Accumulation of the results of analysis of such cases and organization of approaches for reflecting them in erosion control plans are expected to contribute to sediment management and crisis management after large-scale sediment production.

[Reference]
1) UCHIDA Taro, NIWA Satoshi, KANBARA Jun-ichi: "Sediment Discharge after Large-scale Sediment Production" Civil Engineering Journal, Vol. 56, No.10, pp. 24-27, 2014

Topics

About "Technical guideline for countermeasures against deep-seated catastrophic (rapid) landslide"

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Key words: Deep-seated landslide, structural measures, hazard map

1. Introduction

Deep-seated landslide occurs less frequently than usual sediment- disasters, but once it occurs, it may have very large magnitude and cause enormous damage (Figure 1). However, conventional measures against sediment-disasters may be insufficient for deep-seated landslide, e.g. it is difficult to say that existing erosion and sediment control facilities may not have sufficient resistance or scale for deep-seated landslide or for natural dams etc. that are caused by deep-seated landslide.

Figure 1. Deep-seated Landslide Generated in Kii Peninsula in 2011

2. Measures against deep-seated landslide

In order to reduce damage from deep-seated landslide, it is necessary to implement not only individual measures but all possible measures including prior structural measures, land use, warning and evacuation, and emergency measures. Of the damage caused by deep-seated landslide, for deep-seated landslide that may cause particularly large damage, it would be difficult to eliminate material damage etc. thoroughly. Therefore, even if complete elimination of damage is difficult, measures to mitigate damage should be considered, such as at least save people's lives. To this end, it is essential to organize the present technologies and research findings systematically. However, no material has ever organized systematically scientific knowledge and countermeasure technologies for deep-seated landslide. Then, we organized "Basic technical matters for the measures against deep-seated landslide" as Technical Note of the National Institute for Land and Infrastructure Management (NILIM) (Figure 2).

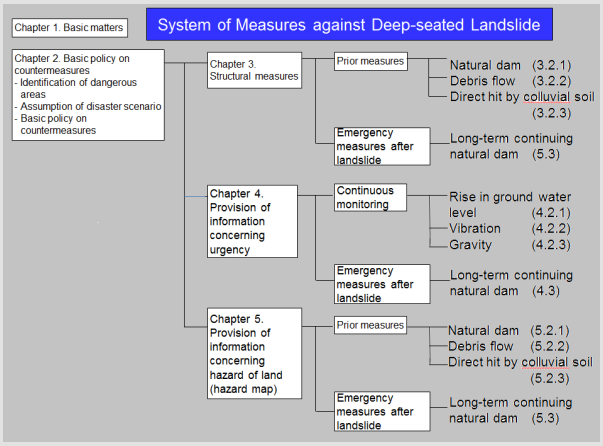

Figure 2. System of Measures against Deep-seated Landslide

3. Conclusion

For deep-seated landslide, examination concerning the risk of occurrence of deep-seated landslide is ongoing, e.g. publication of "Deep-seated Landslide Estimated Frequency Map" in 2009 from the Ministry of Land, Infrastructure and Transport (MLIT) / Public Works Research Institute. We expect this material to be utilized in implementing various measures to mitigate damage from deep-seated landslide as well as conducting hazard assessment.

[Reference]

1) Technical Note of NILIM, No. 807 "Technical guideline for countermeasures against deep-seated catastrophic (rapid) landslide" Jun'ichi KAMBARA and Taro UCHIDA
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0807.htm

Efforts to Grasp Precursors from "Twitter Information" for Mitigation of Damage by Sediment-related Disaster

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Key words: Sediment-related disaster, precursor, social media, twitter information

1. Introduction

About 40 percent of deaths in natural disasters are said to have been killed by sediment-related disasters, and various places in Japan have suffered serious damage by sediment-related disaster as represented by the Hiroshima Sediment Disaster caused by heavy rain in August 2014. In such situations, in order to avoid at least human damage, the Cabinet Office requires local governments to use the announcement of sediment disaster warning information as a decision criterion for evacuation recommendation. However, since sediment disaster warning information is announced at the initial stage where possibility of sediment-related disaster has increased, another indicator is required to determine increase in urgency after announcement of the same information. Then, the Guideline above positions precursors such as "rumbling of the mountain" and "flow of woody debris" as a criterion to decide evacuation instructions. In order for administration to grasp the occurrence of such precursors, it has to rely on information provided from residents who perceive such precursor, but there are few cases where precursor was reported when recognized, which is not sufficient from the viewpoint of use as disaster prevention information.

For these reasons, the Division has started a research to find out precursors of sediment-related disasters contained in users' "twitters" stating uncertainties or fears about heavy rain etc. and incorporate them into the warning / evacuation system by analyzing social media information in real time which exists on the Internet in a large amount jointly with Fujitsu Laboratories.

2. Details of research and analytical cases

In this research, we are considering the use of twitter, which is characteristic of real-time information and easy exchange / transfer of information with / to other users, and the adoption of an approach that collects twitter information with key words related to precursors and estimates "time" "location" of posted information to grasp increase in urgency of sediment-related disaster in applicable areas. As an example, we examined the Aso Area, which suffered enormous damage by the July 2012 Northern Kyushu Heavy Rain, and found twitters posted (Figure 1-(a), (b)) concerning the occurring of landslide in the neighboring area before the time zone (Figure 1-(c), (d)) when debris flow etc. occurred intensively. Therefore, twitter information may be available as precursor information for intensive landslide. For other cases of disasters, it was also found that it is possible to collect information concerning the precursor of sediment-related disaster, etc. at an early stage by analyzing twitter information in real time in case of heavy rain and estimating the location of municipality.

3. Conclusion

With this research, we aim to identify locations being exposed to danger and then grasp precursors etc. for sediment-related disaster, and enhance the reliability of the grasped information by combining objective information such as rainfall distribution so that techniques in this research may be utilized for issuing evacuation instructions etc. at an early stage and for independent evacuation by residents. With this aim, we will continue the research.

[Reference]

1) KUNITOMO Masaru and KAMIYAMA Joko: -- Can twitter grasp the precursor of sediment-related disasters?" Monthly J-LIS, Vol. 1, No. 10, pp.44-49, 2015

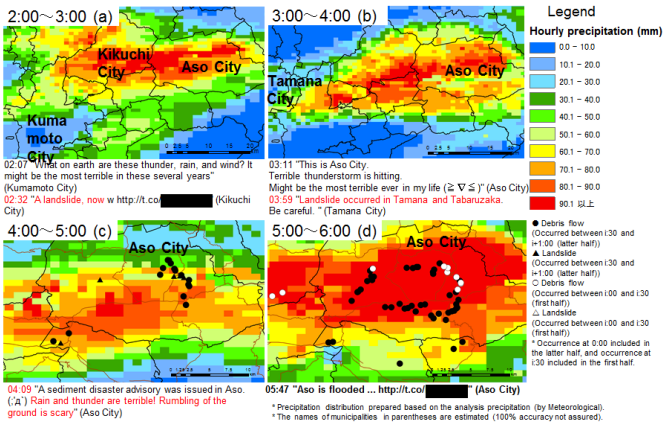

Figure 1. Changes in Locations of Sediment-related Disaster and Main Twitter Information

Developing shock resistance test methods for flying debris on the cladding

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(Keywords) flying debris, cladding, shock resistance, tornado

1. Foreword

Cladding damage comprises much of the damages to building caused by strong winds and wind gusts from tornadoes or typhoons. Apart from damages caused by wind pressure, however, it is also known that substantial damages are also caused by flying debris that strikes the building as a result of the strong winds. Until now, the shock-resistance of cladding was evaluated only with regards to wind pressure resistance, with no evaluating method regarding flying debris. On the other hand, regulations and ISO standards in the United States include shock resistance testing methods of glass in the claddings and openings of buildings. As well, shock resistance under strong winds is evaluated with impact tests, whereupon steel balls and various wood chips of different sizes are collided with a test body at high speeds, which is later subjected to repeated pressure load tests.

Accordingly, NILIM began examining resistance testing methods regarding flying debris upon the cladding in one of its issues: "The development of tornado countermeasures technology" within the comprehensive technological development project called "Developing continuous function technology for disaster base buildings" (in the fiscal years 2013 to 2016). The purpose of this research is to develop a testing method regarding shock resistance of flying debris upon the cladding, for which a standard has yet to be established in our country.

2. Required performances regarding strong wind disasters on buildings

As shown in Table 1, buildings were classified into five groupings (storages or facilities involved with hazardous materials, disaster base buildings, shelters, facilities with a plurality of users, and others) based on its required performance during a disaster. Overviews and case studies of the buildings and facilities, the classification and size of the external force and required performances are also indicated.

Regarding the required performance of disaster base buildings (government buildings, police stations, fire station-related facilities, hospitals and Self-Defense Forces-related facilities etc.), with reference to the 1994 Ministry of Land, Infrastructure and Transport notification 2379 "standard regarding administrative buildings and the position, scale and structure of its ancillary facilities" and the integrated earthquake resistance and anti-tsunami standards of government buildings,

Table 1: Types of disaster base buildings and its required performance towards tornadoes and typhoons

Type of building			Target phenomenon and external force	Required performance
Name	Overview	Example		
I Storages or facilities involved with hazardous materials	Facilities that could severely affect the surrounding area if its function is stopped by a disaster (including leakage of hazardous materials)	Nuclear power plants, oil plants	Collisions of flying debris and wind pressure resulting from F4 tornadoes and the largest typhoons	Continuous function of the facilities
II	Facilities	Police	Collisions of	Securing the

Disaster base buildings	whose continuous function is required during and directly after a disaster	stations, fire station-related facilities, hospitals, government buildings, Self-Defense Forces-related facilities, data centers	flying debris and wind pressure resulting from F3 tornadoes and extremely rare strong winds	safety of human life Continuous function of the facilities
Ⅲ Shelters	Facilities designated as shelters and other similar facilities	Schools, gymnasiums, meeting places, hotels	Collisions of flying debris and wind pressure resulting from F2 tornadoes and extremely rare strong winds	Securing the safety of human life
Ⅳ Facilities with a plurality of users	Facilities where the general public gather	Department stores, stadiums	Collisions and wind pressure resulting from F2 tornadoes and rare strong winds	Securing the safety of human life
Ⅴ Others		Housing	Collisions and wind pressure resulting from rare strong winds	Securing the safety of human life

Note: F2 to F4 inside the table indicates the Fujita scale.

it was declared that disaster base buildings must "not only secure the safety of the human life, but fulfill its .function as a disaster base building at the time of a disaster." Here, the external wind force was set at the Building Standard Act's limit strength calculation for the maximum wind strength of typhoons (return period corresponding to 500 years) and F3 (Fujita scale 3) for tornadoes. The largest tornadoes in our country's recent history were also of an F3 class, namely in Mobara (1990), Toyohashi (1999), Saroma (2006) and Tsukuba (2012) etc.

Storages or facilities involved with hazardous materials like nuclear power plants and oil plants require a performance greater than disaster base buildings regarding the continuous function of the facility as they could severely affect the surrounding area if its function is temporarily stopped as a result of being struck by a disaster. Accordingly, for storages or facilities involved with hazardous materials, an external force level larger than disaster base buildings was set at F4 for tornadoes with a return period corresponding to 1000 years for typhoons.

Shelters, on the other hand, do not require the same level of functional continuation as disaster base buildings. However, the same performance level is required in terms of securing the safety of human life for those inside the facility. Accordingly, with shelters, the same external force level as disaster base buildings was set at the maximum level for typhoons as set in the Building Standard Act (extremely rare strong winds, with a return period corresponding to 500 years). However, with regards to tornadoes, an F2 class was set, taking into consideration the probability of the disaster to strike a single building unit.

With regards to facilities where large groups of the public gather, like department stores and stadiums, the safety of human life for those inside the facility is also required. However, since typhoon-related information is provided prior to the storm by the Meteorological Agency, it is believed that those facilities would not be used when there are rare outbreaks of extremely strong winds. Consequently, the securing of the safety of human life for those inside the facility was determined a requirement with regards to flying debris and wind pressure caused by gusts of wind from tornadoes etc., as well as its structural resistance to withstand flying debris and wind pressure resulting from strong winds (rare strong winds) as established by the Build Standard Act regarding typhoons.

In terms of housing, houses are required to secure the safety of human life for those inside the rooms against strong winds (rare strong winds) as established by the Build Standard Act and any resulting flying debris. However, in this case, the effects of wind gusts from tornadoes did not have to be taken into consideration.

3. Shock resistance of flying debris on the cladding for disaster base buildings etc.

Regarding the shock resistance of flying debris upon the cladding of disaster base buildings etc. it was considered that there should "not be any damaged cladding that may be a hindrance to the disaster base building in performing its required performance at the time of a disaster." Specifically, the following functions of the cladding were required as indicated in Table 1.

(1) The cladding must protect the room from flying debris penetrating the room in the assumed event of strong wind gusts from a tornadoes and typhoons. However, as long as there is no remarkable damage to the room inside the cladding, damage to the outside of the cladding is permitted. Remarkable damage refers to damages that will cause a hindrance to activities inside the room resulting from wind and rain penetrating the room, following damage to the cladding.

(2) Furthermore in the event of a typhoon, the damage to the cladding by flying debris should not escalate, thereby resulting in a large opening beyond a certain size, with regards to a specified wind pressure.

4. Shock resistance test for flying debris

In the shock resistance test for flying debris, a test equipment as shown in Figure 1 was used to confirm the shock resistance of flying debris on the cladding. As shown in Figure 2, two experiments were conducted for tornadoes and typhoons. The specifications for each of the objects colliding into the buildings and facilities were established in the classifications listed in Table 1. The specifications for the colliding objects are defined in Table 3, based on overseas standards and possible examples of flying debris in our country. The F scale in the table represents the Fujita scale in the assumed event of a wind gust from a tornado, and the specifications of each colliding object and Fujita scale rank was associated with a numerical simulation.

5. Conclusion

Henceforth, one of the issues of our integrated technology development project "Developing continuous function technology for disaster base buildings," the shock resistance test method for flying debris on the cladding was presented.

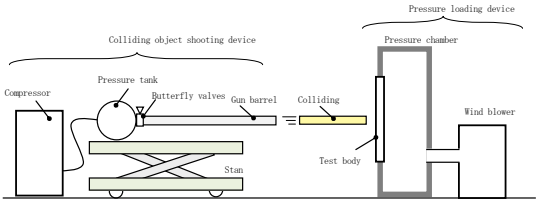

Figure 1: Example of the test equipment for the shock resistance test for flying debris on the cladding

Table 2: The return period of the type and wind load of the required colliding object

Type of building	A. Tornado test		B. Typhon test		
	Colliding object		Colliding object		Wind pressure return period (years)
	10m≦h	h >10m	10m≦h	h >10m	
I Storages or facilities involved with hazardous materials	⑥	⑤	⑤	④	1000
II Disaster base buildings	⑤	④	④	③	500
III Shelters etc.	④	③	③	②	500
IV Facilities with a plurality of users	④	③	②	①	50
V Others	−	−	②	①	50

h is the cladding height (m) Number ○ is the colliding object number in Table 3

Table 3: Specifications of the colliding object

Colliding object	Presumed F scale	Mass (kg)	Speed (m/s)	Operating energy (J)	Corresponding existing standards	
①	Below F0	0.91	15	Approx.100	ASTM-B	
②	F0	2.0	12	Approx.200	ASTM-C	ISO-B
③	F1	4.1	15	Approx.500	ASTM-D	ISO-C
④	F2	4.1	24	Approx.1000	ASTM-E	ISO-D
⑤	F3	6.8	22	Approx.2000		ISO-E
⑥	Over F3	6.8	35	Approx.5000	FEMA361, ICC-500 (tornado) lower limit	

Development of functional continuation technology of critical post-disaster buildings

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(Keywords) Great East Japan Earthquake, critical post-disaster buildings, tsunami, tornado, continuous use

1. Foreword

Based on the damage from the Great East Japan Earthquake and tsunami and tornadoes of recent years, we have implemented a four year integrated technology development project called "the development of functional continuation technology of critical post-disaster buildings" to develop functional continuation technology so that buildings involved in emergency and restoration activities can continue to function directly after a disaster. These initiatives aim to further the design technique and evaluation method for the functional continuation of critical post-disaster buildings to prepare for predicted future disasters like the Tokai/Tonankai Earthquake and Tokyo metropolitan earthquake.

2. Developing countermeasure technology for tsunamis and tornadoes

We have developed a design method that appropriately considers the tsunami loads that act on buildings. Static loading tests and hydraulic tests were implemented on external walls. With regards to ALC panels, which fractured and broke away from their connections, it was made clear that the ultimate strength in the hydraulic tests could be estimated from the maximum strength in the static tests. Based on the test results, we have proposed a design method considering the reduction effects of tsunami loads by the breakaway of external walls.

Photo 1: Hydraulic test on external walls

On damage prevention to the outer wall and the windowpane resulting from flying debris during tornadoes and typhoons: We also implemented shock resistance evaluation tests by applying the assumable force of flying debris in a tornado onto the cladding and put together a shock resistance experiment/evaluation method (plan) for flying debris, with regards to the required performance of the cladding for each of the critical post-disaster buildings classifications.

3. Developing earthquake countermeasure technology

A suspended ceiling system with a member to suppress an earthquake's horizontal vibration will be developed. Static experiments were conducted to test the strength of the ceiling sub-system, while dynamic ones tested the structural performance of the ceiling system, some of which were comprised of HVAC units and lighting fixtures.

A full-scale loading test was carried out in order to demonstrate a new structural system utilizing a wing wall. The specimen was a 1×2 span, 19m tall, five-story reinforced concrete building. The frames consisted of columns with wing walls and beams, and the gap (slit), which was generally formed at the joint between the wall and column, was shifted to the inside of the wall. From this test, it was verified that a structure's strength and stiffness could be heightened without raising the costs, and story drift during earthquakes could be reduced. This can totally mitigate the damages on nonstructural elements and beam−column joint which are often difficult to repair after the earthquake.

Photo 2: A Full-Scale Loading Test on Five Story Reinforced Concrete Building

As well, public hearings were conducted on local governments damaged by the Great East Japan

Earthquake, and a time line scenario was arranged up to the point that the functionality of the buildings was restored after the disaster. The useful post-disaster technologies for building facilities were also listed based on the data collection.

4. Conclusion

Based on test results provided by this research and development, the new design guidelines targeting critical post-disaster buildings are scheduled to be drawn out in the fiscal year 2016.

Creating new standard plans pertaining to countermeasures against ceiling collapses in buildings

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(※)Position and post as of the end of December, 2014

(Keywords) Ceiling, building standards

1. Backgrounds

Technical standards regarding countermeasures to prevent ceiling collapses in buildings were issued in August 2013, based on the Building Standard Act (Ministry of Land, Infrastructure and Transport notification No. 771 and others) following the human/physical damage caused by ceiling collapses in gymnasiums and large-scale halls in recent earthquakes, especially in the Great East Japan Earthquake.

The basic concept behind the technical standards is to control the seismic displacement of suspended ceilings by using bracing members to avoid collisions with the surrounding walls and providing sufficient space (clearance). (Figure 1)

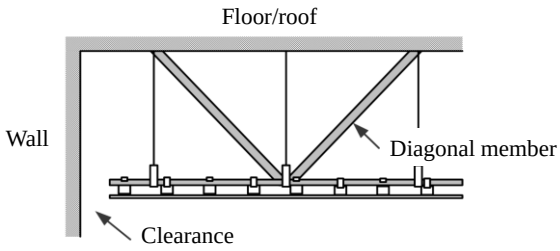

Figure 1: Image of the current standard

On the other hand, in order to increase the flexibility of design and construction, bracing members will not be provided where it could be an obstacle for the placement of equipment like air-conditioning ducts, for example. The standardization of a new structural method that does not require clearance between the ceiling plane and the surrounding walls is desired as well.

Based on the results of the 2013 Building standard maintenance promotion business S4 issue "Examination into the upgrading of standards pertaining to the earthquake-resistant design of suspended ceilings," and with technical support from the Building Research Institute, a new standard proposal (hereafter "New standard plan") pertaining to ceiling collapse countermeasures is being considered.

2. Overview of the new standard plan

The New standard plan attempts to secure structural safety by allowing the external force exerted on the ceiling plane during an earthquake to be transferred to the building's structural member not through the bracing member but through the surrounding walls. (Figure 2)

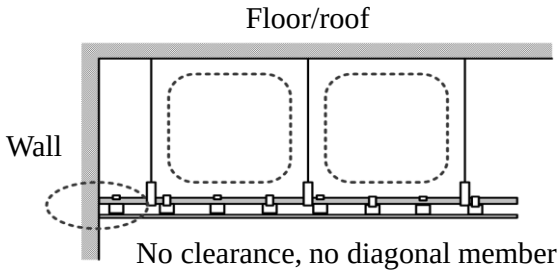

Figure 2: Image of the New standard plan

Regarding the new standard plan, the following two points are important.

i) The components of the ceiling plane and surrounding walls shall have enough rigidity and strength to avoid damage by external forces including the force exerted by collisions.

ii) The ceiling plane will be on a level plane with no spaces between the surrounding walls

However, we do not have sufficient knowledge to minutely analyze the impact force exerted by collisions.

Therefore, the new standard plan generally limits

specifications, such as unit mass, joints suspension length and etc., to the range confirmed through experiments. The ceiling's scale (width/depth) is limited according to the strength of the ceiling plane tested by experiments and the calculated horizontal seismic coefficient at the floor level.

The new standard plan is aimed to reduce ceiling collapses in the event of an earthquake larger than a moderate earthquake by preventing damages caused by a moderate earthquake. In this regard, it is same as the current standard.

3. Future Work

Based on the New standard plan, revisions will be scheduled by the Housing Bureau regarding technical standards based on the Building Standard Act (2013, Ministry of Land, Infrastructure and Transport notification No. 771 and others). In order to enable the smooth enforcement of the new standards, NILIM will edit a practical reference manual for design and building confirmation.

(Reference)

http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0751.htm

Full-scale structural experiment of a partial frame reinforced concrete construction using fiber reinforced concrete on the nonstructural wall

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(Keywords) Fiber reinforced concrete, nonstructural wall, reinforced concrete construction, structural experiment

1. Foreword

The Great East Japan Earthquake of 2011 caused severe damage to the nonstructural walls of housing complexes designed/constructed in the existent earthquake resistance standards with reinforced concrete (RC structure), forcing many to give up their daily activities to live in evacuation shelters. With these events in hindsight, our division has been conducting research into RC structures in which people can continue to live in even after disaster strikes, by suppressing damages to the secondary walls, as stipulated in our issue: "Research regarding earthquake damage mitigation techniques for middle−to−low layer buildings in a giant earthquake (research period: fiscal year 2014 to 2016). Here, we will introduce the overview of the full-scale structural experiment implemented in 2014 of a partial frame RC structure with fiber reinforced concrete nonstructural walls.

2. Experiment overview

The experiment is shown in Photo 1. The test specimen is a full scale, partial frame, with a portion of the first floor corridor plane simulating a 1 layer, 1 span middle−to−low layer RC multiple dwelling. For pressurization, a load equivalent to the weight of the upper floor was applied using two vertical force actuators, while a horizontal pressure equivalent to the seismic force was applied using four pressurizing hydraulic jacks.

Photos 2 and 3 show the damage condition when the story deformation angle reached 1/200rad and 1/100rad respectively. At 1/200rad, widening cracks in the wall (partial wall) between the window opening and door opening were found, although the same cracks were rarely found in other areas. As well, at 1/100rad, widening cracks could be found on the corners of each opening, however, extensive damage like detached concrete could not be found. Furthermore, pressurization was finally conducted at 1/50rad, however, the widening of cracks or detached concrete were likewise, not observed in other areas.

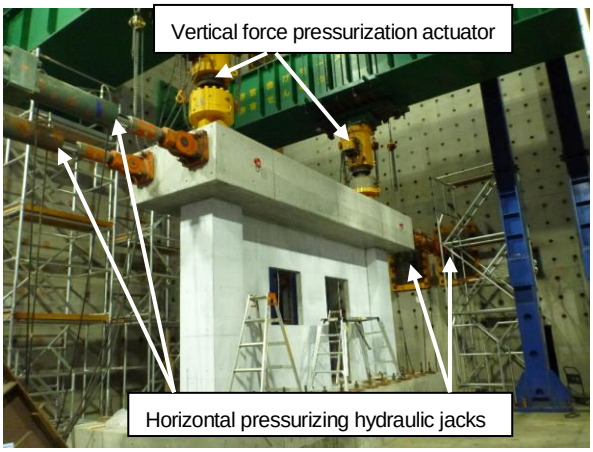

Photo 1: Test setup

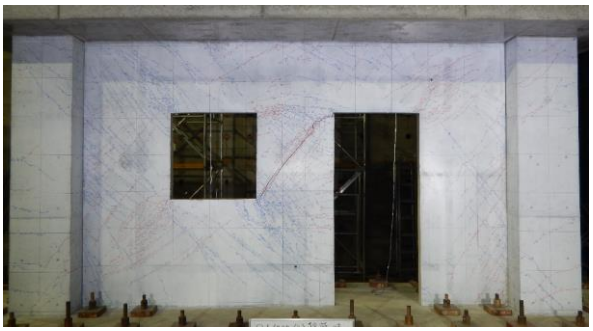

Photo 2: Damage conditions at story deformation angle 1/200rad

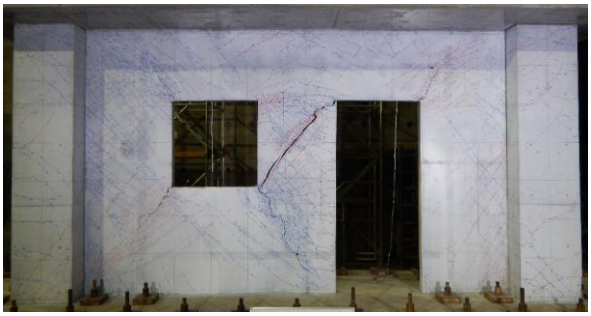

Photo 3: Damage conditions at story deformation angle 1/100rad

3. Conclusion

In the future, the detailed experiment data regarding damage suppression results and structural performance evaluation methods will be analyzed and collected as technical data.

(References)

1) NILIM resource No.674, Building Department Resource No.136 pp.5.2-4～5.2-5

Exfoliation prevention functions of outer walls with tile finishing on reinforced concrete building during earthquakes

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(Keywords) Outer walls with tile finishing, exfoliation prevention functions, earthquake-proof safety, large size specimen

1. Foreword

Examinations into damages caused by earthquake vibrations, such as the exfoliation of tile finishing have been ongoing since last year. This year, a horizontal pressing experiment was conducted on a wet process reinforced concrete construction wall specimen to investigate among various structures with tile finishing; exfoliation resistance against large shear deformations, many existing buildings with tile finishing over mortar beddings, the rapidly widespread use of mortar in direct tension and organic adhesives. These were the results we acquired.

2. Experiment overview

Five reinforced concrete wall specimens were created with pillars and beams, of which each wall surface was constructed using one of the eight tile constructions shown in Table 1. For the two test bodies No.1 and No3, one surface was of tile finishing, while its reverse side was used to observe damage to the concrete. For test bodies No.2, No.4, and No.5, tile finishing was arranged on both sides, with one side featuring a standard joint filled with mortar, and the other in a deep joint construction without filling. The 50mm×100mm mosaic tiles that were used were positioned in the same pattern on both sides. The lower part of the concrete was fixed and pressure was statically applied alternately on the upper part of the beam. As the drift angle of the apex interlayer was controlled, cracking and tile detachment/exfoliation was observed until the concrete fractured.

3. Results and conclusion

Photos 1 to 3 show the state of: the concrete at a drift angle of 1/100 (Photo 1), a standard joint with mortar in direct tension and organic adhesives (Photo 2) and a standard joint and deep joint construction with a two-level mortar base tile finishing (Photo 3). Cracking consistent to that of the concrete occurred on tile finishing grounded in mortar, however, with adhesives, cracks were centered on the joints and hardly noticeable on the tiles. As well, on two-level mortar bases in both standard and deep joints, cracking began at a drift angle of 1/1600 and exfoliation began to occur at a deformation angle of 1/250. Furthermore, all detachments occurred on the boundary surfaces of the tile and bonding mortar. Exfoliation occurred mostly on deep joint constructions, reinforcing the known risks of exfoliation with regards to deep joints. Cracking was observed at a drift angle of 1/1600 for both adhesive and direct joints. However, exfoliation did not occur until there was damage to the concrete at 1/100 for adhesives, and was not observed for direct joints until there was considerable deformation at 1/200. In the future, using small test bodies, we will consider conducting simple test methods to evaluate the seismic safety of tile finishing construction methods.

Table 1: Tile finishing construction method

№	Joint	Finishing construction
1	Standard	Uneven adjustment mortar + organic adhesives
	—	None
2	Standard	Organic adhesives (common name adhesive joint)
	Deep	Organic adhesives (common name adhesive joint)
3	Standard	Thickly applied 5cm premixed mortar foundation
	—	None
4	Standard	Mortar in direct tension (common name: direct joint)
	Deep	Mortar in direct tension (common name: direct joint)
5	Standard	2 layer mortar coating foundation
	Deep	2 layer mortar coating foundation

(Drift angle 1/100)

Photo 1: Concrete

(Standard joint/organic adhesives)

(Standard joint/mortar in direct tension)

Photo 2: Drift angle 1/100

(Standard joint)

(Deep joint)

Photo 3: Drift angle 1/100 two-level mortar base tile finishing

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

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(Keywords) Nonstructural components, Structural performance verification, External force evaluation, Experiment method

1. Research Background

This research is aimed at investigating the seismic force evaluation and experiment methods and to arrange a technical reference for the structural performance verifications of building members, primarily targeting nonstructural components that have not been paid much attention until the recent earthquakes. The main experimental subject of this research is the glass screen system that would assumedly be affected greatly by out-of-plane deformation and inertial force. The three-year research will include strong motion observations, structural analysis and full-scale shaking table tests. A full-scale shaking table test was carried out in 2014.

2. Full scale test on glass screen system

A full-scale glass specimen (Photo 1) was shaken in normal direction to the glass pane (10mm thickness.) Two ground motion records were selected as the source of input waves, as glass screen breakage was found near the sites. One site was JMA Ninohe EW, which was the east-west component recorded at JMA Ninohe in the 2008 Iwate prefecture north shore earthquake, and the other was JMA Sendai NS, the north-south component recorded at JMA Sendai in the Great East Japan Earthquake.

The main input waves used in the shaking tests were scaled waves and random sine waves to confirm the natural frequency..

The first natural frequency of the glass pane in the normal direction was observed to be 6.1 Hz in the free vibration test conducted before the shaking tests. Shaking tests were carried out seven times with scaled JMA Ninohe EW (20-200%) amplitude levels and eight times with scaled JMA Sendai NS (20-250%) amplitude levels, and although the glass pane bent out-of-plane, it did not break. After shaking tests of scaled observed ground motions were carried out, a sweep test (6-8Hz) was conducted and the entire glass pane broke at approximately 7.3 Hz. The breakage was presumed to have started not at the center of the glass but at the corners, judging from the high-speed video footage and the broken glass condition.

3. Study in this year

In this final research year of 2015, we will compile a technical reference for structural performance verifications along with results of the strong motion observations, structural analysis and full-scale shaking tests conducted in the last two years.

Photo 1: Damaged glass screen by earthquake after its damage

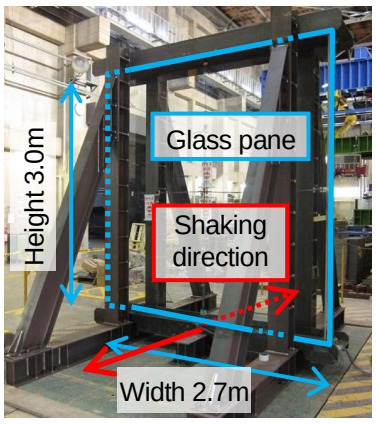

Photo 2: Whole view of the specimen

Photo 3: Glass plane

Initiatives taken for the stability of the Fukushima nuclear disaster refugees residence

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(Keywords) Fukushima Prefecture, nuclear disaster refugees, public disaster housings, collaborations with welfare

1. Foreword

As a result of the Great East Japan Earthquake, which triggered an earthquake, tsunami and a nuclear disaster at the Tokyo Electric Power Company's Fukushima Daiichi Nuclear Power Plant in Fukushima Prefecture, although four years has elapsed since that event, roughly 130,000 people still remain in a refugee status. Indeed, the maintenance of disaster public housings, which functions as their life base in Fukushima Prefecture, has become a major issue for the long-term project refugees as a result of the nuclear disaster.

Because of this, we have continuously been providing a variety of technical support (teaching) for projects pertaining to the disaster public housings for Fukushima Prefecture since the disaster. As well, since a large percentage of the long-term project refugees seeking residence in the disaster public housings tend to be in the elderly age bracket, we are researching collaborative measures with welfare to aid the stability in the refugees' homes.

2. The situation/plan of providing housing/services to the refugee municipalities

The following situation and plan regarding providing housing/services has been arranged for five municipalities in particular (Namie-machi, Futaba-machi, Okuma-machi, Tomioka-machi, Iitate-mura) facing issues of long-term project refugees. (1) Transition of the number of refugees in the municipalities, (2) the location of the temporary housing, (3) activities of the elderly support center being set up/operated (content of the services provided), (4) implementation status of elderly care by the social welfare council, (5) locational characteristics of the public disaster housings (life base for the long-term refugees) where the residents concerned will dwell etc.

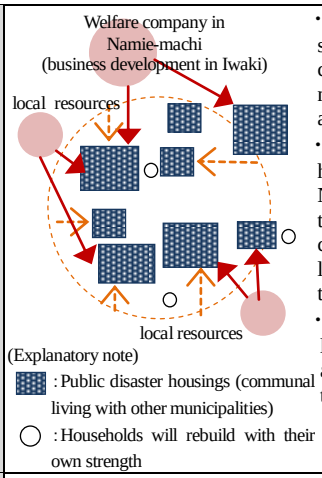
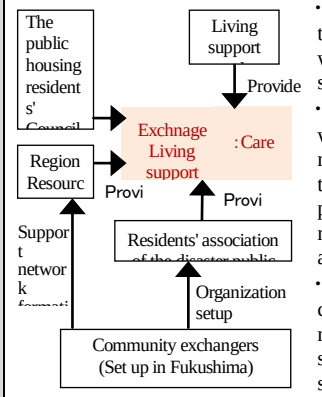
3. The vision of making the transition from public housing to public disaster housings and providing living support in the case of Namie-machi

All of Namie-machi's 21,000 residents are refugees. The number of refugees inside the prefecture is roughly 15,000, spread amongst the municipalities of Fukushima (3,500), Iwaki (2,600), Nihonmatsu (2,300), Koriyama (1,700) etc. (as of June 1, 2014).

"Elderly support centers" were opened in the cities of Nihionmatsu, Motomiya, Fukushima and Koori, to provide temporary and rental housing and living support to the refugees.

Public disaster housings to accommodate refugees from Namie-machi are scheduled in Fukushima, Nihonmatsu, Koriyama, Iwaki and Minamisoma etc. The vision and issues pertaining to the transition to public housing and providing living support differs with the relation between the scale of the housing complex and the municipalities, as well as the conditions of the existing living support being provided. The vision and the issues pertaining to forming the living base in Iwaki are presented in Table 1.

Table 1: The vision and the issues of forming the living base in Iwaki

Vision of transferring to a disaster public housing		・The housing complexes range in size (eight districts) and with communal living between all municipalities. A new residents' association will be created. ・There are no support centers, however, businesses inside Namie-machi will open and run the elderly facilities inside the city. Using these local resources, living support will be provided to the residents. ・The Council of Social Welfare living support consultants will also continue to provide care for the households.
The scheme and issues of providing living support		・The issue is the burden upon the townspeople and the collaboration with regional resources to provide services to the townspeople. ・The issue with communal living with residents from various municipalities is how to structure the collaborations with the service providing bodies of other municipalities and the creation of a residents' association. ・Since Iwaki has many housing complexes with residents from multiple municipalities, the structuring of an integrated support system that also includes other municipalities, is an issue that will supplement the burden on the refugee municipalities.

4. Future issues concerning the collaboration with housing and welfare

There are many housing complexes providing communal living for refugees from multiple local governments in Iwaki and other cities in the prefecture. The issue is how to create collaborations between the receiving local government end and the multiple local governments of the refugees in order to create community support through exchanges in the prefecture and provide care and preventive care for the elderlies.

Urban area improvement plan methods that attain smooth tsunami evacuations

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(Keyowrds) tsunami evacuation, simulations, improvement for urban districts

1. Foreword

Based on the experience of the Great East Japan Earthquake, and to reduce the tsunami damages for the predicted Nankai Trough Quake, smooth tsunami evacuation measures will be required for urban district improvements (tsunami evacuation buildings, evacuation routes, emergency stairs, evacuation sites and others). However, from the perspective of smoothening evacuations effectively and efficiently, perhaps urban renewal planning has not been established as sufficiently as it should.

NILIM has been dealing with the development of the tsunami evacuation safety evaluation methods from the standpoint of urban district improvement. Here, we will introduce the development situation of the tsunami evacuation simulator and the concept of urban improvement methods based on the simulation results.

2. Tsunami evacuation simulator

A tsunami evacuation simulator is being developed based on selection models of destinations/evacuation routes, where evacuations begin when the tsunami disaster risk rises above a certain level and the risk minimizes after evacuation begins. The simulator also targets two means of escape: on foot or by car.

Using existing traffic simulation models for reference, evacuations by car was limited to traffic behavior requiring evaluation in order to smoothen tsunami evacuations, and was thereby, substantially simplified (Figure 1).

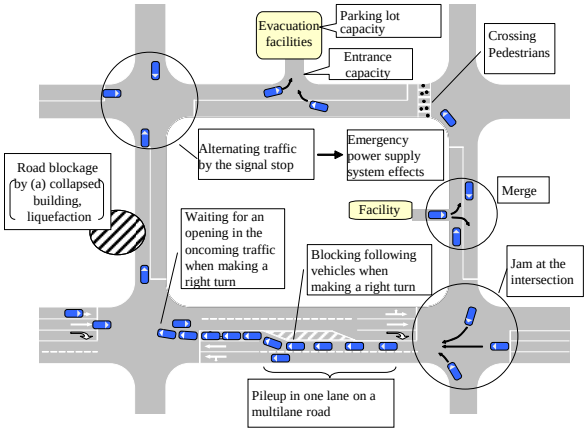

Figure 1: Traffic behavior expressed by the tsunami evacuation simulator

3. Urban district improvement methods based on the simulation results.

Urban district improvements, which are meant to smoothen tsunami evacuations, will extract and conduct procedures to improve areas and factors (congestion, capacity shortage etc.) hindering the tsunami evacuation, based on results acquired from the tsunami evacuation simulator, which was directed at current urban areas (Figure 2). After the improvement plan is created, it will be subjected to the tsunami evacuation simulator, and through comparisons with present conditions, greater awareness of the improvement effect will be grasped, and the validity of the plan will be evaluated.

The obstacles and factors hindering the evacuation, such as evacuation routes, evacuation sites will be tallied and specified in the items listed in Table 1, along with the overall evaluation range.

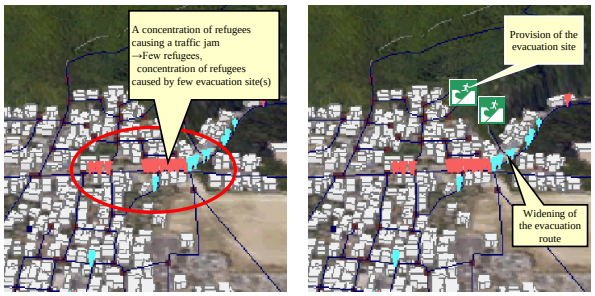

Figure 2: Vision of urban district improvement that smoothen tsunami evacuations

Table 1: Evacuation condition tabulation system

Tabulation target	Tabulation item
Overall evaluation range	No. of people waiting, No. of people evacuating, No. of people who evacuated, No. of people who failed to evacuate, No. of people who failed to evacuate according to cause
Evacuation route	No. of people waiting, No. of people evacuating, No. of people who evacuated, No. of people who failed to evacuate, No. of people who failed to evacuate according to cause, maximum evacuee density, average migration velocity, No. of cumulative passers
Evacuation site	No. of evacuees, mean transit time, No. of evacuees according to departure district
Evacuees	Evacuation start time, evacuation completion time, time required to move, migration length
Departure district	No. of people waiting, No. of people evacuating, No. of people who evacuated, No. of people who failed to evacuate, No. of people who failed to evacuate according to cause

4. Conclusion

Through these case studies, we are scheduled to summarize the methods for urban district improvements to effectively smoothen tsunami evacuations.

Creating a guide plan regarding considerations of securing urban disaster -preparedness functions for tsunami disaster mitigation city planning

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(Keywords) tsunami disaster prevention city planning, disaster prevention base, Nankai Trough Quake, Great East Japan Earthquake

1. Foreword

Up to now, the focus of initiatives for disaster prevention city planning was the disaster mitigation of direct damages (building collapses and urban area fires etc.) caused by accident occurrences associated with major earthquakes. However with the Great East Japan Earthquake, due to serious damages caused by the large scale/extensive tsunami flooding on the urban disaster preparedness base facilities, which act as activity bases in times of disasters in the urban areas of the coast cities, difficulties arose for disaster emergency efforts in the disaster-struck city, as well as in the aid efforts of various agencies including external aid. Through this, however, various issues from the location and networks of the urban disaster preparedness facilities, to the individual measures taken at each facility, became clear.

In order to handle these issues, the Urban Planning Department has taken initiatives to secure the disaster preparedness functions for major tsunamis through disaster mitigation city planning in the "Research related with structured disaster prevention support technology of coastal cities" (fy 2012 to 2014). We inspected the actual conditions of the loss and recovery of the disaster preparedness base functions in the disaster-hit Tohoku cities, and implemented case studies for securing these urban disaster preparedness functions based on the creation of a disaster response flow chart/activity development chart of the Tokai - Nankai Trough coastal cities that will assumedly receive the the largest scale of tsunami damages, according to the Act on Regional Development in Tsunami Disaster. A guide plan for the examination was compiled based on the research results.

2. Regarding the creation of a guide plan

The guide plan is an examination procedure manual for the securing of urban disaster preparedness functions with regards to tsunami disaster mitigation city planning, and indicates the inspection method of the improvement plan for urban disaster preparedness facilities, as well as the direction of city planning of coastal cities, and compiles specific case studies, and technical references required for the inspections,

Its main purpose is so that the city planning bureaus of municipalities and or other bureaus with jurisdiction related to city planning/policies can reflect the examination procedures in the guide in their disaster mitigation city planning, tsunami disaster mitigation community plan and the national enhancement regional planning efforts. Even with regards to the disaster mitigation/crisis control bureau, the effects of the enhancement of the facilities' disaster preparedness function at urban disaster preparedness facilities in initiatives like the regional plan for disaster prevention, BCP, the community plan for disaster prevention, the tsunami evacuation plan, as well as designating hazard areas can be investigated. As well, the document regarding examinations can also be used as a springboard document for discussions on disaster mitigation measures by various related agencies examining scenarios of disaster mitigation drills and providing wide areas of support, to the facility managers themselves.

3. Releasing the guide

Regarding the created guide plan, it is scheduled for release in 2015 following adjustments with other related departments.

(Reference)

NILIM 2014 report "Deprivation/Recovery of coastal cities' disaster-prevention facilities functions by the Great East Japan Earthquake tsunami and the construction of disaster-prevention cities' lodgment functions and creation of disaster-prevention cities"

http://www.nilim.go.jp/english/annual/annual2014/4.pdf

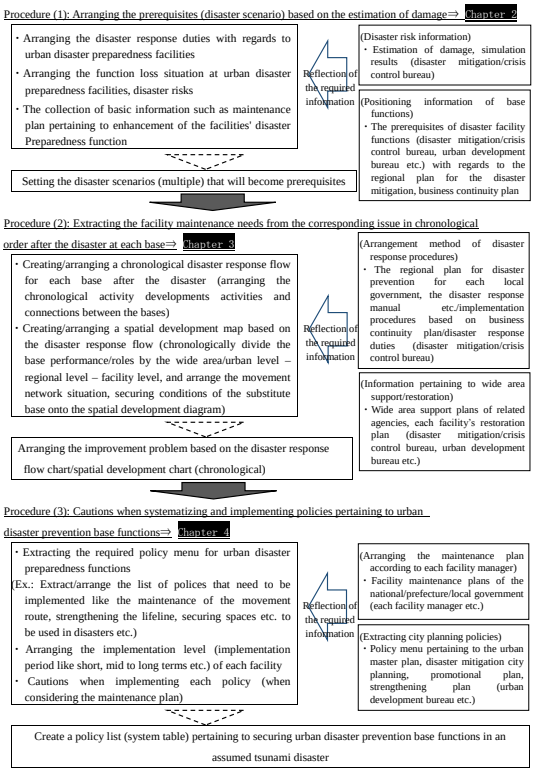

Figure: Flow of the examination regarding the guide plan structure and securing of urban disaster prevention base functions

Software development to support the creation of housing site liquefaction maps

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(Keywords) Great East Japan Earthquake, liquefaction, hazard maps, housing site disaster prevention

1. Foreword

Since the Great East Japan Earthquake caused liquefaction in a wide range of housing sites, causing serious damage to housing/social capital, NILIM, in its "Research related with structured disaster prevention support technology of coastal cities," created/provided a calculation sheet for evaluating a housing site's liquefaction damage in an urbanized area ("Calculation sheet for a housing site's liquefaction damage possibility evaluation") (July 2013) using boring survey data.

On the other hand, since the preparation work for the "liquefaction maps," which indicate housing site liquefaction risks, is slower compared to other hazard maps like those for floods, in order to support local public bodies involved in creating the housing liquefaction map, development began on a software that will support the creation of housing liquefaction maps.

By using boring survey data accumulated by each local public body, it became easier to create liquefaction maps based on the nation's "Technical guideline pertaining to the evaluation of a housing site's liquefaction damage possibility (April 2014)" (hereafter "technical guidelines"), and as the widespread use of liquefaction is now being promoted, there are greater expectations that in the future, prior measures can be made towards liquefaction on housing sites and that more information can be provided to its residents.

2. Overview of the software to support the creation of housing site liquefaction maps

The software to support the creation of housing site liquefaction maps inputs boring survey data and location information of the boring survey spots. Through this, the liquefaction risk of the investigation spot concerned is evaluated based on the aforementioned NILIM liquefaction evaluation sheet. Then, on a base map of the Geospatial Information Authority of Japan map, a 250m or 500m color-coded mesh is displayed (1), and at the same time, by clicking on the investigated spot concerned, the details of the liquid evaluation sheet at that spot is also indicated (3).

Although the prerequisite conditions of the evaluation

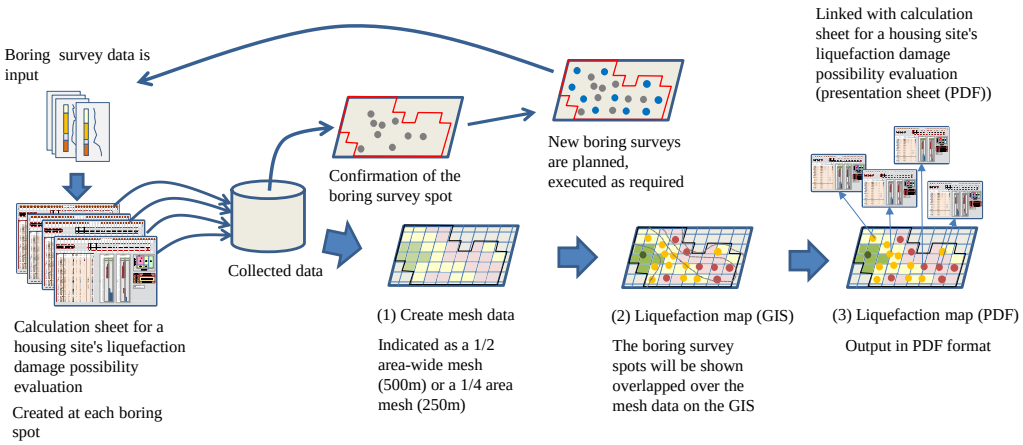

Figure: Vision of the software to support the creation of housing site liquefaction maps

is essentially the evaluation of a housing site's liquefaction damage possibility based on the seismic motion as predicted by the nation's technical guidelines, evaluations can also be conducted regarding the predicted seismic motion in each of the regions as required, which will allow even more detailed examinations through its use. As well, by adding more fresh boring survey data, the liquefaction evaluation information inside the mesh will increase, as well as the quality of the liquefaction map.

This software to support the creation of liquefaction maps is scheduled for release on the NILIM homepage in 2014.

(Reference) NILIM homepage (housing site disaster prevention)
http://www.nilim.go.jp/lab/jbg/takuti/takuti.html

Influence of Storm Surge Damage Due to Climate Change in Coastal Areas

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(Key words) Coastal Area, Climate Change, Global Warming, Sea Level Rise, Storm Surge Damage, Adaptation Measures

1. Influence of climate change on coastal areas

According to the Synthesis Report of the IPCC's Fifth Assessment Report (AR5), published in November 2014, there is no room for doubt concerning warming of the global climatic system; the atmosphere and oceans are warming, and sea levels are rising. Since around 1950, many changes in climate phenomena and related extreme events have been observed. These changes would include an increase in occurrence of extremely high tide levels. It is necessary to establish response measures for climate change in coastal areas. Therefore, it is important to assess the future risk of storm surge with consideration to sea level rise and the enlargement of typhoon scale.

2. Evaluation of future risk of storm surge damage

In order to enhance the knowledge of the response to storm surge damage in giant typhoons, we summarized the damage of ports [1)] and evacuation attitudes of residents [2)] based on a joint field survey in the damaged area of Typhoon 1330 (Haiyan) with the Port and Airport Research Institute (PARI) (**Photo-1**). In November 2013, Category 5 super typhoon 1330 (max. central pressure: 895hpa) passed over the islands of the southern Philippines, causing storm surge damage along the coast of the islands in its path. We also carried out a field survey of storm surge damage in and around the Port of Nemuro (Nemuro City, Hokkaido, Japan) due to low atmospheric pressure on December 17, 2014.

Future changes in the risk of damage by inundation due to storm surge were estimated, considering the effect of global warming[3)] (**Fig.-1**). It was shown that the risk of damage increased in Japan's three major bays (Tokyo, Osaka, Ise), the Seto Inland Sea and the Ariake and Yatsushiro coasts. For the three major bays, storm surge inundation was calculated to assess the future changes in the risk of inundation damage in the areas outside seawalls (**Fig-2**).

Photo-1 Damage of port in Philippines caused by Typhoon 1330 (Haiyan) (Port of Estacia) [1),2)]

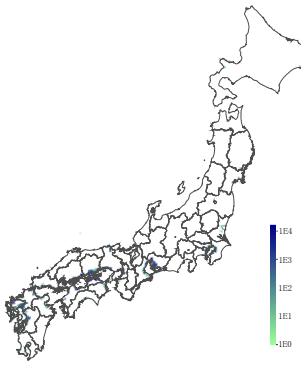

Fig.-1 Geographic distribution of inundated population [3)]

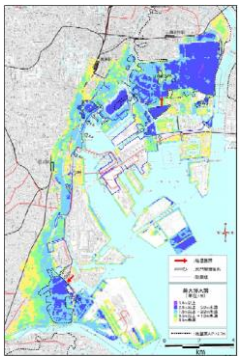

Fig.-2 Example of storm surge inundation calculation

3. Investigation of policies for climate change adaptation measures

To assess future the risk of climate change, including storm surge damage, and to investigate policies for its adaptation measures, the governmental agencies with

responsibility for coastal protection established a Study Committee on Future Risk of Climate Change in Coastal Areas and Policies for Its Adaptation Measures (Chair: Prof. Masahiko ISOBE, Vice President, Kochi University of Technology) [4]. As a member of the committee secretariat, the Coastal Disaster Prevention Division is supporting the development of policies for adaptation measures.

4. Toward the safety of coastal areas against storm surge damage

It is necessary to secure the safety of coastal areas against future changes in the risk of storm surge damage. Therefore, to evaluate the safety of coastal protection facilities, we are promoting researches on advanced observation technologies for sea level and waves, and on methods for assessing the risk of disaster in port and harbor areas.

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Verification of Aseismic Design Method for Mooring Facilities Based on Past Examples of Earthquake Disasters

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(Keywords) *Harbor Structure, Design Criteria, Aseismic Design*

1. Introduction

Aseismic design of port and harbor mooring facilities for Level 1 earthquake ground motion is performed by a method in which a reference seismic intensity (seismic coefficient) is calculated assuming that horizontal deformation of the quaywall is held to within an allowable value as a target, using the waveform of earthquake ground motion in the engineering bedrock, and the section dimensions are determined based on the calculated seismic coefficient. However, for quaywalls with water depths ≧7.5m, this seismic coefficient is constructed by calibration using numerical analysis and is not verified based on examples of disasters.

In this research, examples in which port and harbor quaywalls suffered/did not suffer disaster were collected from disaster reports, and the appropriateness of the existing design method was verified. Here, we report the results of verification of gravity-type quaywalls, which are a representative structural type of quaywall.

2. Disaster verification using limit seismic coefficient and acting seismic coefficient

As a large number of disaster reports for earthquakes have been compiled to date, the section dimensions, etc. of object facilities of verification were collected from this literature. The input seismic motion of each object facility was also estimated.

In disaster verification, the horizontal seismic coefficient of the design section of a facility is gradually increased, and the seismic intensity when the safety factor decreases to less than 1.0 due to any verification mode is defined as the limit seismic coefficient. The seismic coefficient (allowable deformation Da = 10cm) by the existing design method, which is calculated using the above-mentioned estimated earthquake ground motion, is defined as the acting seismic coefficient, and it is assumed that this ground motion acts on the object facility during an earthquake. In the disaster verifications, whether facilities suffer disaster or not was verified by judging whether damage was possible or not based on the magnitude correlation between the acting seismic coefficient and the limit seismic coefficient.

Figure 1 and **2** shows examples of the verification results. The ▲ symbol in the figures indicates that the facility suffered disaster, and the ▼ symbol indicates that the facility did not suffer disaster. When ▲ falls in the area where acting seismic coefficient > limit seismic coefficient (area within red lines), and when ▼ falls in the area where limit seismic coefficient > acting seismic coefficient, it can be said that consistency exists between the existing design method and the verification results.

Figure 1 shows the results when all the data for the object facilities of verification are plotted, whereas **Fig. 2** shows the results when the facilities with the water depth of <7.5m, which are not objects of calibration by the seismic coefficient calculation formula, are excluded from the plots in **Fig. 1**. In the water depth range which is the range of calibration by the seismic coefficient calculation formula, the results by the existing design method are generally consistent with the verification results. However, it is clear that seismic coefficients on the dangerous side will be calculated if the existing design method is applied in its present form to the range

of shallower water depths. Therefore, improvement of the existing design method is considered necessary.

3. Conclusion

With the aim of constructing a rational aseismic design method which is consistent with the realities of disasters and reflecting that method in technical standards, the authors will continue verification work related to the aseismic design method in the existing standards, using the results of a survey of past earthquake disasters.

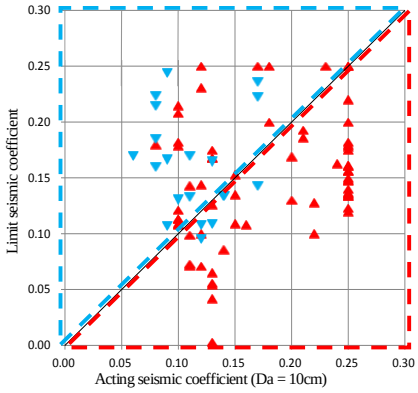

Fig. 1 Results of verification for full water depth range

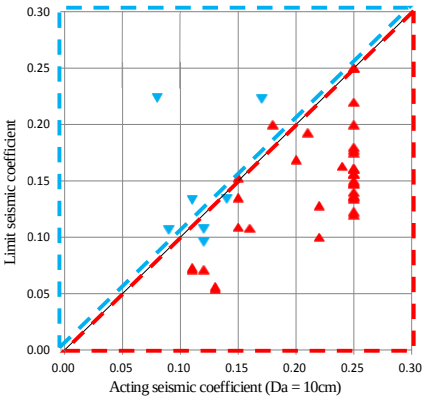

Fig. 2 Results for verification for water depths ≧7.5m
(excludes facilities with water depths of <7.5m from Fig. 1)

▲Acting seismic coefficient > limit seismic coefficient
▼Limit seismic coefficient > acting seismic coefficient

Earthquake Risk Management of Airport Concession Holders – Consideration of Insurance –

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(Key words) Concession, Insurance, Financial Impact Analysis, Loss Function, Financial Stress

1. Introduction

The privatization of public facilities by the concession system under the Act on Airport Management Utilizing Private-Sector Capabilities (2013, Law No. 61) was given a concrete form at Sendai Airport. In the concession agreement for that airport, the concession holder had agreed to undertake certain recovery/seismic retrofitting works on his own account. On the other hand, the concession holder bears the financial stress associated with earthquake disasters, and bankruptcy can also be supposed. In this case, the basis for recovery/seismic retrofitting works will also be lost. Therefore, the risk of bankruptcy was evaluated by an analysis of the financial impact on the concession holder, an insurance policy design for shifting the risk to the insurer was presented, and the effects of insurance were calculated.

2. Financial impact analysis for concession holder and policy design

Assuming the financial situation shown in Table 2 (PL, BS), which considers the assets/indebtedness of the concession holder, the financial impact of a group of scenario earthquakes (top 100) was analyzed based on an inventory of financial loss and system model of the period of business stoppage. Earthquake loss functions were calculated for each factor (removal damage, loss of income, rebuilding cost), and a risk list showing the cash, cash equivalents, liquid ratio, etc. of the BS (90% probability of nonexceedance) was obtained for the scenario earthquakes. (Table 1 shows the top 25/100 earthquakes.)

No.	①	M	PBA (cm/s²)	④	⑤	⑥	⑦	⑧	⑨
1	(130.45 , 33.55)	M7.0	521	0.00001	0.00001		0.20	−7,485	–
2	(130.55 , 33.55)	M7.0	484	0.00001	0.00001		0.17	−5,548	–
3	(130.45 , 33.65)	M7.0	472	0.00001	0.00002		0.16	−4,882	–
4	②	M7.2	465	0.00062	0.00064		0.16	−4,527	–
5	(130.45 , 33.55)	M6.5	454	0.00001	0.00066		0.15	−3,896	–
6	(130.55 , 33.65)	M7.0	446	0.00001	0.00066		0.15	−3,496	–
7	(130.35 , 33.55)	M7.0	422	0.00001	0.00067		0.13	−2,204	–
8	(130.55 , 33.55)	M6.5	393	0.00001	0.00068		0.11	−642	0.13
9	(130.45 , 33.45)	M7.0	383	0.00001	0.00069		0.10	−165	0.21
10	(130.35 , 33.65)	M7.0	383	0.00001	0.00070		0.10	−148	0.21
11	(130.45 , 33.55)	M6.0	368	0.00003	0.00072		0.09	625	0.34
12	(130.45 , 33.65)	M6.5	367	0.00001	0.00074		0.09	669	0.34
13	(130.55 , 33.45)	M7.0	360	0.00001	0.00075		0.09	1,011	0.40
14	(130.65 , 33.55)	M7.0	349	0.00001	0.00075		0.08	1,601	0.50
15	(130.65 , 33.65)	M7.0	323	0.00001	0.00076		0.07	2,843	0.70
16	(130.55 , 33.65)	M6.5	322	0.00001	0.00077		0.07	2,883	0.71
17	(130.35 , 33.45)	M7.0	319	0.00001	0.00078		0.07	3,014	0.73
18	(130.45 , 33.75)	M7.0	303	0.00001	0.00079		0.06	3,746	0.85
19	(130.35 , 33.55)	M6.5	295	0.00001	0.00080		0.05	4,096	0.91
20	(130.55 , 33.75)	M7.0	289	0.00001	0.00081		0.05	4,314	0.95
21	(130.55 , 33.55)	M6.0	285	0.00003	0.00083		0.05	4,481	0.97
22	③	M7.3	282	0.00010	0.00093		0.05	4,623	1.00
23	(130.25 , 33.55)	M7.0	281	0.00001	0.00094		0.05	4,673	1.01
24	(130.65 , 33.45)	M7.0	278	0.00001	0.00094		0.05	4,763	1.02
25	(130.25 , 33.65)	M7.0	265	0.00001	0.00095		0.04	5,346	1.12

Fig. 1 Risk list (top 25/100)

① Earthquake hypocenter
② Kego fault zone, southeastern part
③ Nishiyama fault zone
④ Probability of occurrence / year
⑤ Probability of exceedance / year
⑥ 90% nonexceedance value
⑦ Loss ratio (rebuilding cost)
⑧ Cash/cash equivalents (million yen)
⑨ Liquid ratio

In the policy design, assuming bankruptcy in case of a liquid ratio of less than 0.9, cash, cash equivalents, etc. (① ¥4,096 million) before and after the event are read, and this is treated as an insurance deductible (lower limit of coverage). The worst-case earthquakes (names of earthquake hypocenters are shown by hatching) are designated, considering the probability of occurrence, and the amount of cash, bank deposit, etc. (② - ¥4,527 million) is read. The difference between ① and ② is the necessary funding for the worst-case earthquake.

These amounts are divided by the current replacement

cost, and based on this loss rate conversion, the necessary funding is defined as a (=0.11), the payment limit as b (=0.16) and the deductible as d. Because insurance payments are determined by subtracting the insurance deductible from the actual loss, if the policy is designed so as to cover the necessary funding with the minimum insurance premium, the deductible d = b – a, and d can be decided as 0.05.

3. Calculation of effect by financial function stress

Fig. 2 shows the earthquake loss functions for various liquid ratios. This is defined as the financial stress function. When earthquake risk is not considered, the liquid ratio is 1.59, and when earthquake risk is considered, the liquid ratio decreases as the earthquake intensity increases. If the concession holder takes out insurance, the curve bends so as to maintain 0.9. In other words, the concession holder receives an insurance payment which is calculated by deducting the deductible from the actual loss, and management can be maintained satisfactorily. The point where the curve turns downward again is the worst-case earthquake, and after this point, the necessary funding exceeds the amount of the insurance payment. However, from the management viewpoint, this can be disregarded as a rare event. In this way, the effect of insurance can be measured by the financial stress function. Moreover, because the insurance premium is quite small in comparison with revenue, its effect on finances is not considered.

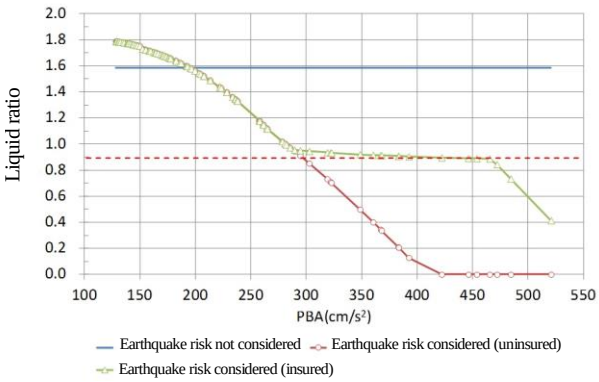

Fig. 2 Financial stress function

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Moving Processes and Conditions of Households under the Housing Lease Program for Disaster Victims in Iwate Prefecture due to the Great East Japan Earthquake

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(Keywords) Great East Japan Earthquake, temporary housing、private rental housing, lease

1. Foreword

In order to understand the reality of the "Housing Lease Program for Disaster Victims" (which supplied private rental houses as temporary housing) of which more units were provided than the temporary housing being newly built as emergency homes due to the Great East Japan Earthquake, a questionnaire survey was conducted on the tenant households and analyzed.

The research was conducted jointly with the Housing Section of Iwate Prefecture, targeting 3,458 cases of a total of 4,051 cases leased by the prefecture until October 2013, excluding those that left before October 2012, and was distributed by mail/collected in November 2013. Of these, 3247 cases were effectively forwarded/1658 cases effectively collected, with a collection rate of 51.1%.

2. The period for tenants moving into temporary leased housing

As Figure 1 indicates, there is a high concentration of people who began looking for homes in the middle of March, the end of March and the beginning of April, or a total of 807 cases (55.7% of the total) in less than a month after the disaster. Most people began living in the rented houses at the start of April (239 cases), and 597 cases (38.5%) began living in their new homes by the end of April. Approximately one month is required to secure the housing. As well, as 925 cases (57.0%) of the tenants found out about the housing lease program "after they rented," hence the majority secured their homes without knowing.

Regarding the reason of why they were searching for housing (multiple answer) most people chose "You can move in faster than prefab houses" (651 cases and 40.2% of the total answers). The answer ratio was higher than "You can choose your house and location" (selectivity 22.0%) "The quality of the housing and residential environment is good" (selectivity 21.6%), placing especial importance on the speed of moving in.

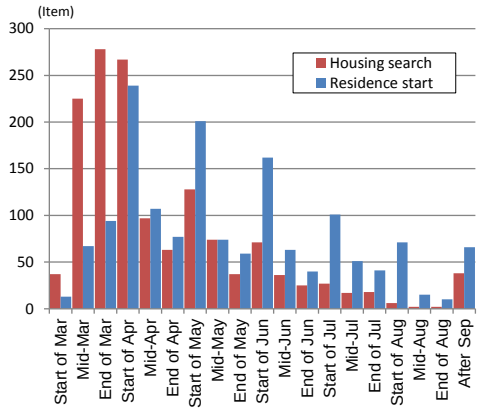

Figure 1: Period when people began searching for housing and moved in

3. Securing methods of property to move into

Regarding the search for housing (Figure 2 top), "1. I consulted with relatives and friends" took roughly 60% of the poll. Relatively few people replied: "2. I consulted with a real estate agent" or "3. I consulted with people at the municipal office." Regarding their relation with the owner (Figure 2 bottom) roughly 60% replied "3. No relation and not an acquaintance," and 20% replied "1. A relative related by blood" and "2. An acquaintance/friend" respectively. As 68.5% for those who replied "1.Relatives and acquaintances," were either relatives/acquaintances of the owner, it can be said

that in the aftermath and confusion of a disaster that securing methods center largely on human relations.

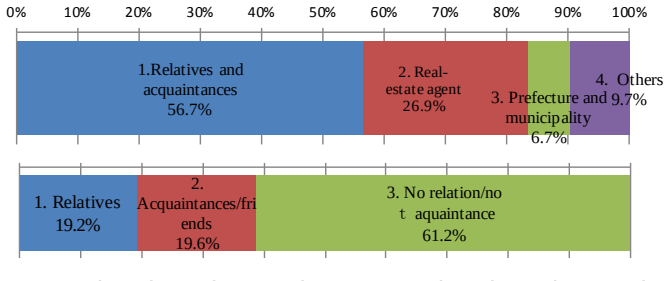

Figure 2 Search for housing (top) Relation with the owner (bottom)

4. The location and residential environment of the new home

When questioned if their housing was located in the same municipality as before, half replied "1. Same" and "2. Different" respectively, with a little less than half of the respondents who actually moved out (Figure 3 top). When asked the reasons for moving away (multiple answer), the most common answers were "There was a housing I could move into quickly" (selectivity 35.3%) and "There were relatives/friends I could depend on" (selectivity 32.3%), reflecting their moves were based on the need for housing and support.

Regarding their life in the rented housing, roughly 60% answered "1. Satisfied" and "2. A little dissatisfied but generally satisfied" (Figure 3 bottom). Regarding the reasons why they had "3. Some dissatisfaction" or "4. Much dissatisfaction" (multiple answer), the answers were, in order from the top down: "The building is old" (selectivity 50.2%), “The room is too small” (selectivity 44.0%) and "There are deficiencies and breakdowns in the facility" (selectivity 43.3%), showing greater dissatisfaction about the housing hardware rather than the residential environment.

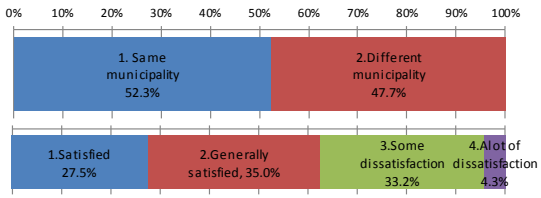

Figure 3: The location of the housing (top) and living satisfaction (bottom)

(Reference) Fumitake Meno: Moving Processes and Conditions of Households under the Housing Lease Program for Disaster Victims in Iwate Prefecture, Urban housing sciences No. 87, pp.133-138, 2014.10

Development of a Method of Building Disaster Occurrence Scenarios Considering Excess External Force

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(Key words) excess external force, large-scale disaster, disaster occurrence scenario, risk assessment, crisis management policy

1. Introduction

Since the Great East Japan Earthquake, it has become necessary to make flexible strong responses to even severe low frequency disasters. So the NILIM is conducting research and development to provide extremely tough core disaster prevention facilities that will not fail to function when a severe disaster strikes, and a method of contributing to crisis management that minimizes the impact of damage. This report introduces the results of this research and development organized as a disaster occurrence scenario building method.

2. Method of building disaster occurrence scenarios

A disaster occurrence scenario is built by first concretely setting external force, followed by participants divided into groups to deal with roads, rivers, etc. as appropriate conducting brainstorming while examining maps, to consider facility damage, obstacles to facility functioning, and obstacles to daily life and the economy and entering the results in obstacle conception sheets. Next, they organize the results into disaster occurrence scenarios. Then, they use excess external force focus cards to study phenomena that could be caused by unanticipated external force that was not initially set, and add these to the scenarios, so that they can portray disaster occurrence scenarios that consider large-scale disasters.

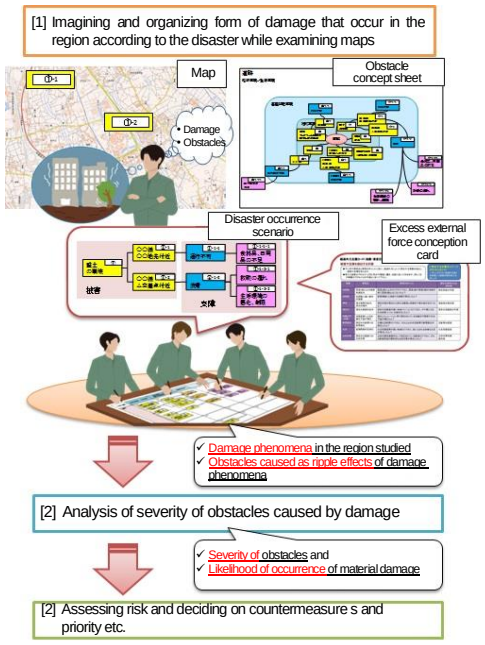
3. Characteristics of the method

This method permits efficient high quality study using study support tools that have also been developed.

The group of tools has been prepared based on past disasters and the results of case studies, and includes written procedures and entry formats to support the work during a study done in conformity with the procedure, a collection of printed phenomena labels to improve the quality of the study contents, collected cases and a checklist, etc.

And in addition to their use a method of building full-scale crisis management methods to study disaster countermeasures, these tools are also considered to be useful as training tools to teach or to remind disaster prevention officials and young staff of the forms of disaster.

Figure Image of Performance of a Disaster Risk Assessment



4. Future Development

Trial use at regional development bureaus that have cooperated with this initiative has yielded positive opinions concerning its usefulness. We plan to improve the completeness of the developed tools so that they will be of use in studying disaster countermeasures in the field.

Development of Technology to Instantaneously Estimate Large-scale, Wide-area Earthquake Damage

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(Key words) Earthquake motion distribution, facility damage estimation, support for decision-making, instantaneous earthquake damage estimation system

1. Introduction

Facilities of the Ministry of Land, Infrastructure, Transport and Tourism are managed when a disaster occurs by conducting inspections to clarify their condition, but after a large-scale earthquake, this requires many hours, possibly impeding decision making concerning the rapid first response.

Therefore, we have built the Instantaneous Earthquake Damage Estimation System (below, "the System") by developing technology to instantaneously estimate the damage caused by a large-scale wide-area earthquake in order to support decision making by facility managers at the stage when little information is available immediately after the earthquake.

2. Instantaneous Earthquake Damage Estimation System

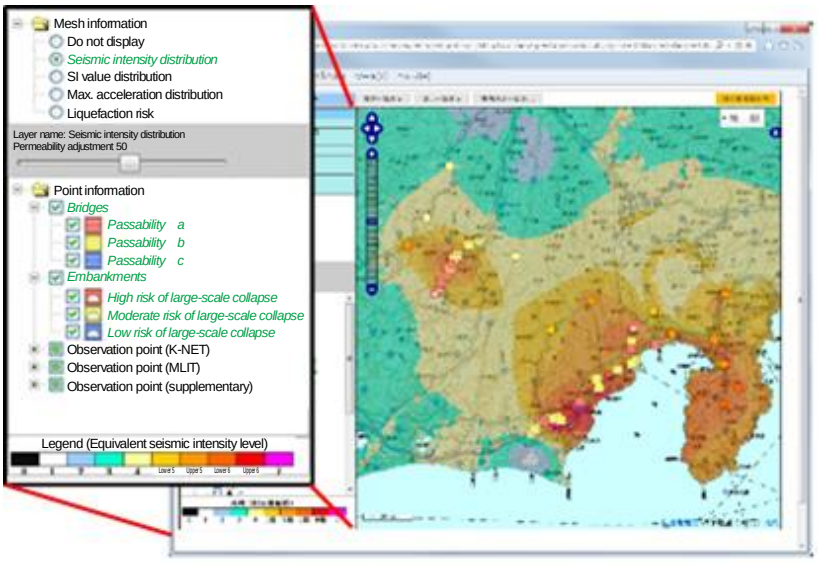
To estimate the facility damage caused by the shaking of an earthquake, it is necessary to know the earthquake motion strength at the location of the facility. This system estimates the spatial distribution of earthquake motion strength on the ground surface by considering amplitude based on earthquake motion strength at the ground surface according to the surface layer ground based on records from multiple observation points. The amplitude of the earthquake motion according to the surface ground is obtained by calculating the amplification factor using formulas etc. proposed by past research, based on the publicly announced average S-wave velocity of the surface ground. At the same time, for locations of high strength earthquake motion, the method was improved to consider the impact of liquefaction of the surface ground.

Damage to structures estimated by this system is done for viaducts and embankments. And the danger of liquefaction of ground that would highly impact facility damage is also estimated. Road embankments in particular, were analyzed based on cases of damage caused by the 2004 Niigata Prefecture Chuetsu Earthquake and by the Great East Japan Earthquake of 2011, clarifying that the foundation ground conditions, embankment structure, and embankment height are strongly correlated with the degree of damage, improving the precision of damage estimations.

A trial system built based on the achievements of the research is being operated, and the following figure shows an image of its screen.

A study is being conducted to achieve practical use of this system at disaster response sites, and a series of interviews and exchange of opinions have been carried

Figure Trial System Screen of the Instantaneous Earthquake Damage Estimation System



out in regional development bureaus. Following the opinions from the field, we have developed and equipped the trial system with functions to assess priority of road passibility and to permit use linked to a CCTV camera.

3. Looking ahead

As stated above, in response to opinions heard at regional development bureaus, a trial system will be built with, in addition to the basic functions such as displaying earthquake motion distribution and damage estimations, a number of functions to support decision-making in the event of a disaster.

In the future, based on the trial system, we plan to gather more spirited opinions from the field and to popularize its use for disaster response by regional development bureaus.

Development of Technology to Clarify State of Damage to Road Bridges by an Earthquake

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(Key words) Road bridge, road opening, earthquake damage clarification technology, real-time information

1. Introduction

As preparation for large-scale earthquakes such as the Tokyo Inland Earthquake or the Nankai Trough Earthquake, this research developed technology for real-time clarification of earthquake damage and obstruction of traffic on road bridges as areal information in order to be able to more quickly and efficiently open roads to traffic after a large-scale earthquake.

2. Analysis of disaster cases

Of results of emergency inspections by the Tohoku Regional Development Bureau after the 2011 Great East Japan Earthquake (1,504 bridges on government managed highways), results indicating the state of damage on 485 road bridges that suffered damage effecting their passibility or their bearing strength were analyzed. The results showed deformation near the end bearings (girder ends) of 80% of the bridges as shown in Figure 1, and clarifying this deformation (level difference etc.) of girder end bearings by this earthquake revealed obstacles to passability of almost all the bridges. And judging from the emergency restoration history, it is possible to presume that traffic will be blocked by a level difference of 100mm or more, and on road bridges with approach cushions placed to prevent a level difference on the approach behind their abutments, level differences of 100mm did not occur, confirming the level difference reduction effect of approach cushions.

3. Trial of earthquake damage clarification technology

Based on the results presented in 2., focusing on deformation near the end bearings (girder ends) of road bridges, in FY2013, full-size experiments and long-term observations were conducted on the NILIM grounds, to build a road bridge earthquake damage clarification technology system like that shown in Figure 2. In FY2014, with the cooperation of regional development bureaus, the system was installed and operated as a trial on five bridges with different structures, and its operability and state of its measurements are now being verified. Figure 3 shows how it was installed.

4. Future efforts

In the future, we wish to develop a highly trustworthy and reliable road bridge earthquake damage clarification technology by continuing to conduct trial observations and organize and analyze the state of measurements to improve the system.

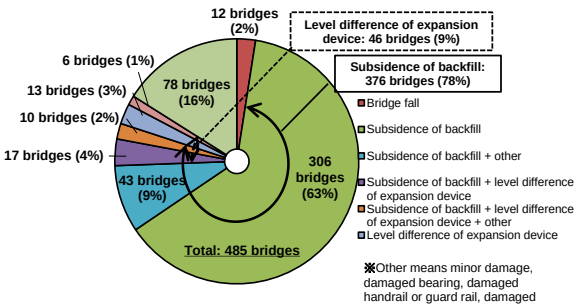

Figure 1 Factors causing earthquake damage to bridges

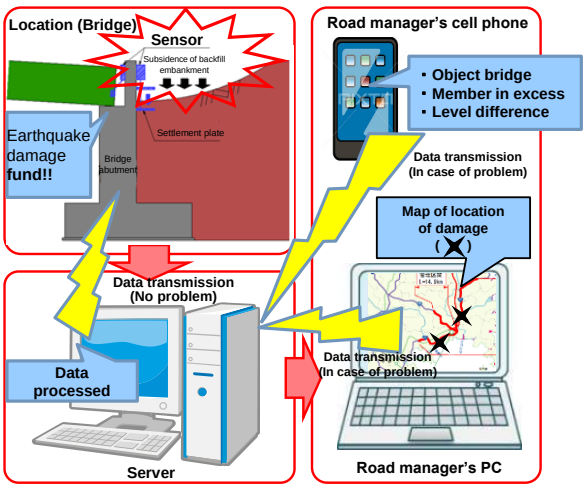

Figure 2 Outline of the Road Bridge Earthquake Damage Clarification Technology

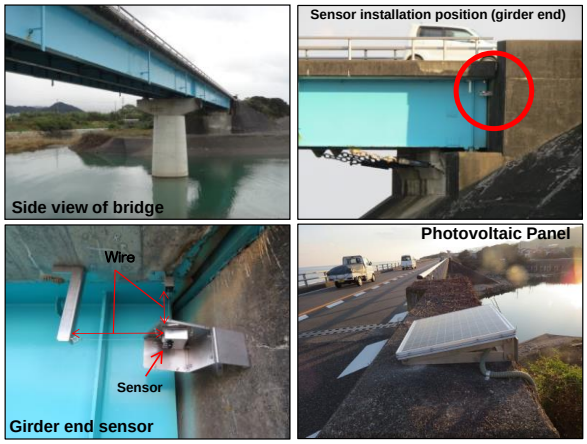

Figure 3　Installation case

Ground motion distribution of the 2011 off the Pacific coast of Tohoku earthquake estimated from strong motion records and ground condition

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(Key words) *the 2011 off the Pacific coast of Tohoku earthquake*、*ground motion distribution, nonlinear response*

1.Introduction

Ground motion intensity is an important factor in the analysis of earthquake damage to structures and the study of fragility functions. Most structures, however, are not near a strong motion station; it is necessary to estimate ground motion distributions when large number of structures are to be investigated.

Subjected to strong shaking, subsurface ground exhibits nonlinear response and accordingly, its ground motion amplification characteristics change. This nonlinear effect has not been taken into account in the estimation of ground motion distributions.

An improved procedure that can take account of the nonlinear effects was developed and employed for the estimation of the ground motion distributions of the 2011 off the Pacific coast of Tohoku earthquake.

2. Estimation of ground motion distributions

More than 2,000 strong motion records were collected from five organizations[1)] and ground motion intensity measures such as peak ground acceleration (PGA) were calculated. Ground motion amplification factors of subsurface ground were derived referring to previous studies using the average S-wave velocity[2)]. Spatial interpolation of ground motion intensity was then carried out based on the above-mentioned data to obtain ground motion distributions without taking account of the nonlinear effects.

Subsequently, average strain of subsurface ground was calculated from the ground motion intensity and the average S-wave velocity. The amplification factor taking account of the nonlinear effects was derived from the average strain and then used to re-estimate the ground motion intensity. Figure 1 shows the distribution of PGA estimated by the procedure.

3.Ongoing actions

Further research has been conducted to develop fragility functions based on the analysis of earthquake damage to structures considering the ground motion intensity.

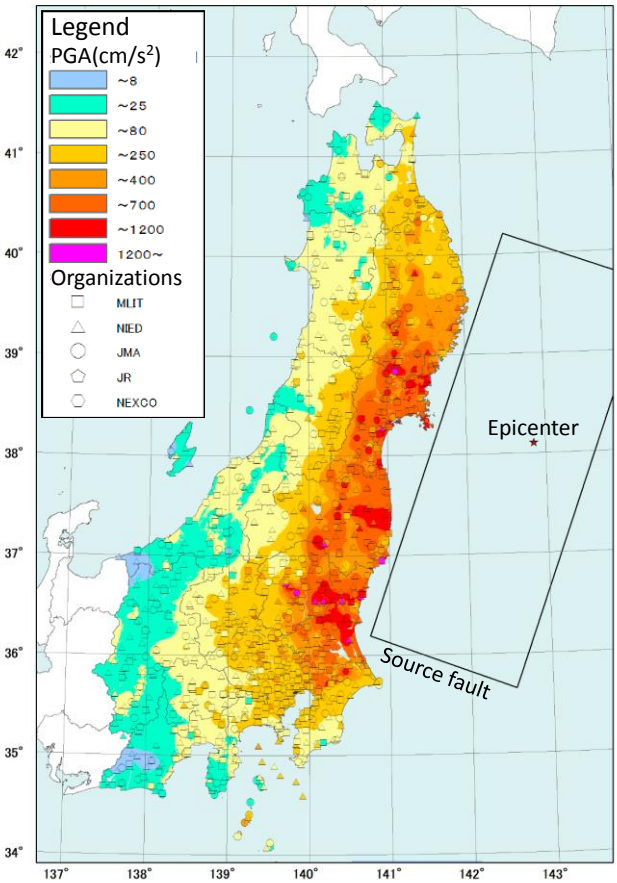

Figure 1 Estimated distribution of peak ground acceleration

The digital data of the ground motion distribution can be downloaded from our website[3)].

[Sources]
1) Strong-motion records from the 2011 off the Pacific coast of Tohoku earthquake, Technical Note of NILIM, http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0726.htm
2) National Research Institute for Earth Science and Disaster Prevention: Japan Seismic Hazard Station, http://www.j-shis.bosai.go.jp/
3) Disaster Prevention Division, NILIM: http://www.nilim.go.jp/lab/rdg/index.htm

Study of the Assessment of the Priority of Removing Rubble from Roads during a Disaster

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(Key words) Earthquake, disaster response, ,removing rubble from roads (cutting the way) to disaster area

1. Introduction

To rescue and assist the victims of an earthquake, a variety of activities including first aid and rescue, fire-fighting, medical treatment, and supplying water, food, and medical supplies etc. (disaster response activities) are done by many organizations. The first 72 hours after the disaster has a particularly great impact on the survival rate of the victims, so it is necessary to quickly ensure a road network by removing rubble from roads (cutting the way) to the disaster area.

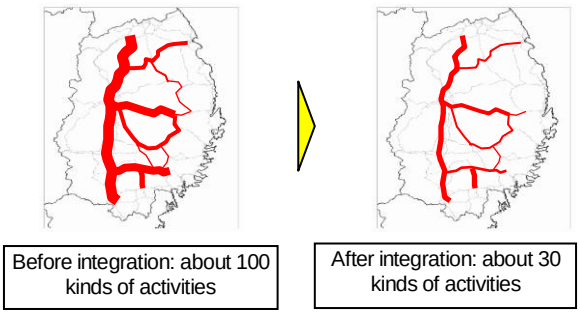
This research assessed the priority of cutting the way to the disaster area through the fastest routes for disaster response activities during the first 72 hours after the disaster happened. This research was based on research conducted last year[1)] (below, "Document 1") to study a method of identifying the route which is given priority.

2. Assessing road networks focusing on disaster response activities

Document 1 describes the trial of a method of using GIS software on the market to superimpose and display the fastest routes to carry out part of disaster response activities to assess these routes as the road required for the disaster response activities according to the thickness of the lines on the display.

Cutting the way to the disaster area is an activity that places top priority on ensuring rescue routes to save human lives immediately after a disaster, so this research focused on important kinds of disaster response activities that must be carried out by 72 hours after a disaster and superimposed the shortest routes on a map of Iwate Prefecture as the model in the same way as previous research. And because a vast number of routes equaling the number of departure and destination points are displayed for even one type of disaster response activity, in order to simplify the work, an effort was made to integrate disaster response activities within a range where the overlapping of shortest routes remained largely unchanged.

Figure 1 Integration image

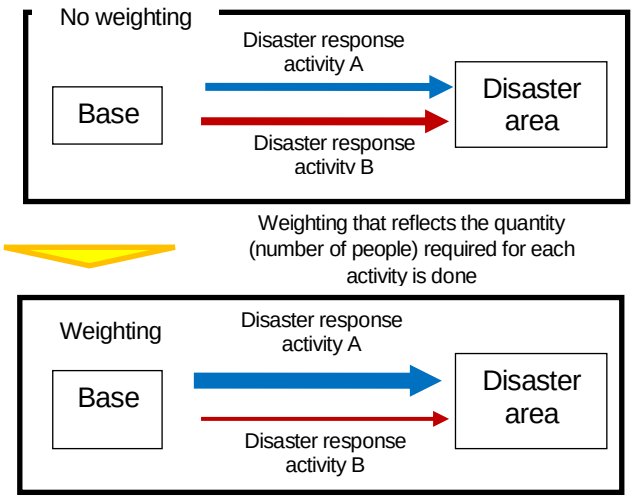


3. Weighting disaster response activities

In the previous section, all types of disaster response activities were represented by lines of the same thickness, and the road network was assessed based on the thickness of the superimposed lines (in other words, number of types of disaster response activities).

So a weighted assessment was done by reflecting the "quantity" necessary for disaster response activities. As typical representations of "quantity", there are many such as "number of injured persons" that are related to people, so an attempt to assess the road network was made by weighting according to the disaster response activities integrated in the previous section based on the population of the disaster area.

Figure 2 Image of road network assessment in a case with weighting of disaster response activities



4. Summing up

This research was a trial of a method of visualizing an assessment as a method of identifying the route on which cutting the way to the disaster area should be prioritized.

This research approached an assessment of priority of cutting the way to the disaster area according to the need for disaster response activities.

On the other hand, there are many problems in each process of removing rubble from roads. For example, it is necessary to clarify damage to roads (they are different

from assumptions), and to manage work teams efficiently.

So, it is necessary to conduct future research that deals with these problems.

[Sources]
1) NILIM Report 2014, pp. 41.
http://www.nilim.go.jp/lab/bcg/siryou/2014report/2014nilim022.pdf

Cost and Labor Saving in Maintenance of Sewer Pipeline Facilities

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Key words: Sewer pipeline survey, sewerage electronic ledger, survey priority determination, traveling performance improvement, cost reduction

1. Introduction

Of the sewer pipeline laid across the country with a total length of about 460,000 km, aged pipeline that has passed 50 years after installation amounts to about 10,000 km in length, and is expected to increase to about 4 times in 10 years, and 12 times in 20 years. About 3,000 to 4,000 cases of road subsidence due to deteriorated sewage pipes, etc. occur every year, and concerns are arising according to progress in deterioration about increase in road subsidence and other accidents and financial burden for alteration / replacement of pipes, etc. There is also a concern about decrease in personnel engaging in the construction industry due to the decrease in labor force according to the aging population and declining birth rate, etc. In view of the situations described above, the National Institute for Land and Infrastructure Management (NILIM) has been studying both structural and non-structural measures from the viewpoint of saving cost and labor in maintenance of sewer pipeline facilities

2. Establishment of pipeline survey priority determination system (non-structural field)

For appropriate maintenance of sewer pipeline, it is essential to detect abnormal spots before road subsidence or other accident occurs. In addition, it is necessary to survey the inside of pipeline efficiently in order to address the expected rapid increase of deteriorated pipeline. Accordingly, it is effective to determine the priority of surveys by identifying the pipeline where abnormality is likely to occur, or that suffers serious damage in case of an accident, etc. based on the data on year of installation, pipe type, location, etc.

NILIM is establishing a system for enhancing the efficiency of surveys, including optimization of survey frequency, etc. and reduction of the risk of abnormality, by identifying the areas expected to deteriorate and determining priority of survey areas, etc. based on the ledge information collected from local governments. In this fiscal year, we plan to analyze the risk of abnormality with degradation effect factors such as corrosive environment and soil conditions and develop an approach to determine the priority of surveys. In next fiscal year, we study establishment / improvement of system (draft) and linkage with a large database.

3. Upgrading of pipeline survey technologies (structural field)

To prepare for the coming of times of full-scale maintenance, it is required to develop technologies and equipment that enable pipeline survey more quickly, cheaply, and accurately than existing survey technologies. NILIM conducted an empirical study in fiscal 2013 concerning a survey method using the screening survey technology, and developed guidelines based on results of the study. [1)]

In this fiscal year, we are promoting activities for further upgrade of technologies, the basic concept of which is provided in Figure 1. For example, since the conventional TV camera cannot climb over the level difference at manhole, the investigator has to enter the manhole each time to install TV camera equipment, which has been inhibiting the growth of daily progress (possible extension of per-day survey). In this research, we are organizing the specifications (traveling performance etc.) required for equipment in order to enable the survey equipment to climb on the level difference at manhole by improving traveling performance and to improve daily progress and reduce cost. In next fiscal year and thereafter, we plan to prepare a road map for commercialization of new technologies, and examine how development system should be, etc.

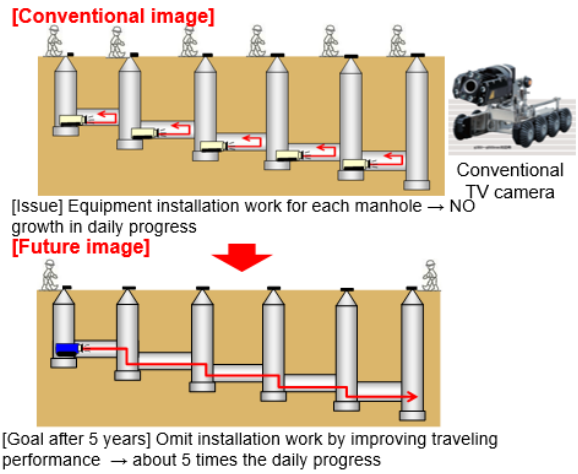

Figure 1. Image of Improvement in Pipeline Survey Equipment

[Reference]

1) http://www.nilim.go.jp/lab/ebg/b-dash.html

Preparation of Sound Ratio Curve for PVC Pipes (Proposal)

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SUEHISA Masaki, Researcher
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Key words: Sewer pipe, maintenance guideline, PVC pipe, visual inspection standards, urgency diagnosis, sound ratio curve

1. Introduction

The function ("sound ratio curve") available for determination of the deterioration of sewer pipes and forecast for reconstruction demand was often used in the past and developed mainly for rigid pipes such as reinforced concrete pipes that need to be reconstructed.

However, since PVC pipes, which are flexible pipes, now account for about 50 percent of all the pipes laid across the country with a total length of 460,000 km, it is necessary to grasp the deterioration of PVC pipes correctly and forecast reconstruction demand to prepare for reconstruction expected to expand in the future.

National Institute for Land and Infrastructure Management (NILIM) has prepared visual inspection standards (proposal) and urgency diagnosis standards (proposal) for examination of deterioration in PVC pipes. Further, as a study in the current fiscal year, we examined the sound ratio curve in order to prepare an appropriate reconstruction scenario for PVC pipes and to level maintenance cost.

2. Outline of sound ratio curve

"Sound ratio" represents the ratio of sound pipelines to all the pipelines, and the curve drawn based on the sound ratio and the function expression of elapsed years is called "sound ratio curve." Sound ratio curve represents the progress in the (macroscopic) deterioration of the whole pipeline with statistical approach using the probability prediction model. In the sewer pipeline, all the pipes laid between two manholes are counted as one unit ("span"), and pipes are diagnosed to grasp the urgency for reconstruction for each span by classifying the levels of deterioration into four categories: I, II, III, and "No deterioration." The sound ratio curve in Figure 1 shows the time series trend of generation ratio according to elapsed years for each level of urgency.

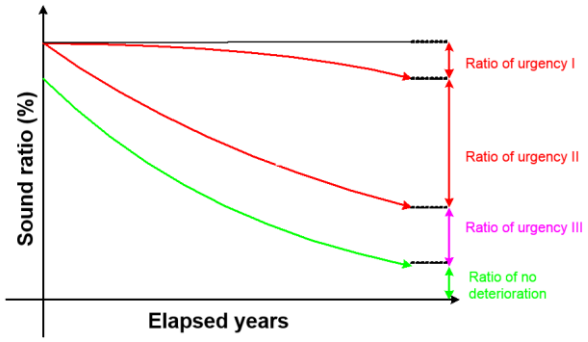

Figure 1. Concept of Sound Ratio Curve

3. Preparation of sound ratio curve for PVC pipes

In preparation of the sound ratio curve for PVC pipes, there are three main issues. The first is that there is little survey data on deterioration since PVC pipes have recently begun to be used. The second is that there are few samples of PVC pipes showing deterioration. The third is that the time series trend of the sound ratio is not a monotonic increase trend. In consideration of all of these issues, we made examination by dividing into four steps as shown in Figure 2. As the result, the validity of the sound ratio curve for PVC pipes was evaluated from the clarification of the functions and variables of sound ratio curve and comparison with the percentage of correct answers of sound ratio curve for rigid pipes. When more accurate sound ratio curve is required, it is necessary to consider the regional difference of age-dependent changes in the trend of deterioration occurrence. We plan to publish the sound ratio curve for PVC pipes.

1) "Manual for formulation of sewer life extension plan based on stock management method (proposal)", Sep. 2013, Sewerage and Sewage Purification Department, Water and Disaster Management Bureau, MLIT http://www.mlit.go.jp/mizukokudo/sewerage/crd_sewerage_tk_000135.html

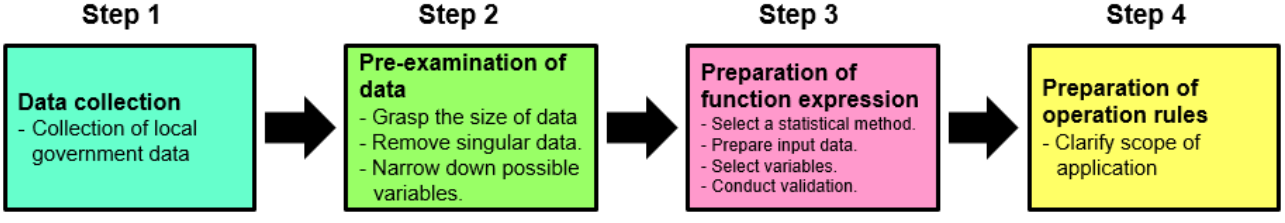

Figure 2. Examination Steps for Sound Ratio Curve

Promotion of Smart Sediment Management

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SAKURAI Toshiyuki, Senior Researcher
Large-scale Hydraulic Structure Division

Key words: Sediment discharge technology, river channel / biological environmental impact assessment, water flow and sediment discharge

1. Introduction

In order to accelerate the trend of adopting comprehensive sediment management across the country, the National Institute for Land and Infrastructure Management (NILIM) has started the development of activities consisting of (i) development of typical activity as a flagship of comprehensive sediment management in Japan, (ii) generalization of the results of accumulation of individual cases and experiences in technical standards, etc., and (iii) application of generalized results to other cases. The contents of these activities are as follows.

2. Points and systems of activities

"Comprehensive sediment management" is based on the concept of managing sediment-related issues arising in various forms according to the areas of mountain / foot of mountain, alluvial fan, plain, and river mouth / coast in accordance with "flow of sediment," such as sediment transport system, without confining issues to each area.

Of these issues, with focus on maintenance / recovery of the functions of dams where sediment accumulated, we are studying in this fiscal year with the theme of "Smart discharge of sediment from the dam to downstream" by reasonable combination of all possible measures, including (i) sediment discharge with a flood, (ii) excavation of the upstream river channel of the dam to reduce incoming sediments, and (iii) moving sediments by mechanical power, such as a belt conveyor.

Comprehensive sediment management is a significant issue that the MLIT should solve with all its energy and take the initiative to address without merely providing "technical support." We are studying in close cooperation mainly with the Chubu Regional Development Bureau, which controls the Yahagi River and is addressing the urgent issue of sediment discharge from the dam.

3. Breakthrough in promotion

For appropriate sediment discharge / supply from a dam, main breakthroughs are the following two points.

One is development of technology for discharging the sediment already accumulated in the dam or technology for reducing the sediment that will accumulate in the dam in the future. We study the development of such technologies considering various conditions, such as actual flow regime of the river, topography of the site, and operation of the dam.

The second is the grasp of behavior of sediment supplied downstream. Sediment discharge without particular purpose may result in excessive accumulation of sediment on river bed, which impairs the function of river channel to discharge flood to the downstream, and in affecting the areas of inhabitation / growth for fishes and other living things in the river. Therefore, we are studying how sediment accumulates on the river bottom according to the ways of sediment discharge and what measures are required to discharge sediment without excessive accumulation. And we found that this issue can be solved by controlling the amount of sediment to be discharged when flow rate is small.

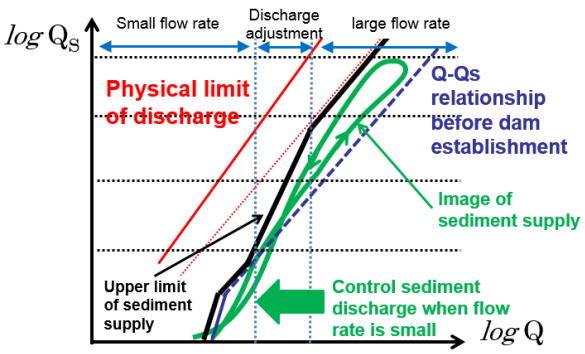

Figure. Relation between Water Flow (Q) and Sediment Discharge (Qs)

These two issues have often been discussed separately as the issue of "Dam area" and the issue of "Channel area," but it is important to address them comprehensively as a series of phenomena by introducing the relation of "water flow and sediment discharge" and grasping sediment behavior in respective areas.

4. Conclusion

We consider that dissemination of research findings is a significant role of the NILIM. In the process of developing study cases, we intend to share information and disseminate findings as appropriate.

Topics

Efforts for Efficiency Increase / Upgrading of River Structure Maintenance

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MORI Hirotoshi, Senior Researches (Dr. Eng.), FUKUHARA Naoki, Researcher
River Division

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

1. River Structure Management Research Task Force

The National Institute for Land and Infrastructure Management (NILIM) established the River Structure Management Research Task Force ("River Structure TF") in April 2012 jointly with the Public Works Research Institute (PWRI) as a group of researchers who follows up the structure management technologies suitable for rivers, and is developing activities including (i) research and technical support aiming to upgrade (develop) river maintenance management in both technology and management, and (ii) holding of technical consultation events and seminars aiming for introduction and establishment of advanced technologies for effective and efficient river maintenance management.

2. Activities in 2014

River Structure TF developed its activities with focus on commitment to the preparation of standards for technical development and assessment for efficiency increase / upgrading with respect to inspection and monitoring, which constitute the basis of river structure maintenance. The Ministry of Land, Infrastructure and Transport (MLIT) is considering introduction of new technologies including robot technology for efficiency increase / upgrading of inspection and monitoring. Particularly, in the river and dam areas, we have set up as a goal development / introduction of the equipment etc. that can substitute visual inspection of underwater areas and practical use of river levee monitoring technology. River Structure TF aims for matching of needs for maintenance with seeds for technical development and provides technical advice to ensure effective use of developed technologies on the site. In addition, in order to develop inspection / diagnosis techniques that can be utilized by field engineers, we progressed the study by contracting out to the PWRI, as in last fiscal year, for clarification of cavity in the levees near sluice or other structures, deterioration etc. in concrete components and sheet-pile revetment, and grasp of applicability of nondestructive testing techniques. Further, based on the examination of the inspection manual and subsequent trials conducted last year, we provided technical support for examination about preparation of standards and procedures for evaluation of inspection results. In order to use as reference in this examination, we collected information concerning infrastructure maintenance methods in foreign countries including Britain and analyzed the difference from the maintenance methods in Japan. For technical consultation, we also received nine requests from local governments. On February 27, 2014, we held a seminar of river structure management research with the theme of "Overseas maintenance methods and database," which served as an opportunity for exchange of the latest information on maintenance in collaboration between industry, government, and academia. The seminar was attended by a total of about 100 persons and all engaged in enthusiastic discussions. For detailed activities of River Structure TF, access the HP. [1)]

Figure. River Structure Management Research Seminar

3. Future development

River Structure TF will actively develop activities for the efficiency increase and upgrading of river maintenance management in close cooperation with the MLIT and Regional Development Bureaus, including encouragement of information exchange etc. between industry, government, and academia.

[Reference]

1) Homepage of River Structure TF
http://www.nilim.go.jp/lab/fag/index.html

Protect River Levees from "Progressive Failure"

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Key words: river levee, foundation ground, seepage flow, progressive failure

1. Introduction

In July 2012, the levee of the Yabe River in Kyushu was breached and caused enormous damage to the hinterland. As a result of surveys, the cause of the levee breach was attributed to river water seeping into the foundation ground under the levee and causing the loss of soil due to seepage flow out to the landside (housing land, cultivated land, etc.). However, there are still many unclear issues including the process that led to the levee breach, external forces, and ground conditions. Moreover, levee failures from such permeable ground were also observed in the Koyoshi River, etc. in the Tohoku Region.

The River Division is researching ways to improve investigations, assessments, and countermeasures for levees so as to enhance the safety of levees. As part of this study, we are examining how to identify weak areas in levees that lead to so-called "progressive failure," i.e. the process of failure to breach in a one-time flood, as in the Yabe River.

2. Present issues and efforts for solutions

Main issues concerning progressive failure are the following three items.

Issue 1: Mechanism of progressive failure based on the foundation ground and external force conditions.

Issue 2: Development of methods of numerical analysis and evaluation that enable the mechanism to be appropriately identified and rated.

Issue 3: Development of method for identifying weak areas.

In the joint research with the Public Works Research Institute ("PWRI"), we have conducted experiments on levees simulating various ground conditions to examine the conditions causing progressive failure resulting in breach (Issue 1). We plan to start technical development next year including numerical analysis techniques in collaboration with academics and private sectors (Issue 2). For utilization of such techniques, it is necessary to grasp ground conditions fully, but it is not practical to conduct such ground investigation across the country. Then, we examine methods for identifying weak areas based on the results of Issue 1 with referring to results of the past surveys, water level history, etc. (issue 3).

3. For the evaluation of progressive failure

In fiscal 2014, we carried out model experiments for river levees. As a result, we observed that the breach was caused from the toe of the levee due to the seepage flow into the foundation ground (Fig. 1) and the process leading up to the breach vary according to ground conditions. Based on the results, in the next and subsequent fiscal years, we plan to pursue techniques for determining failure progress from the viewpoint of both ground and external force conditions, and study ways to identify weak areas in levees.

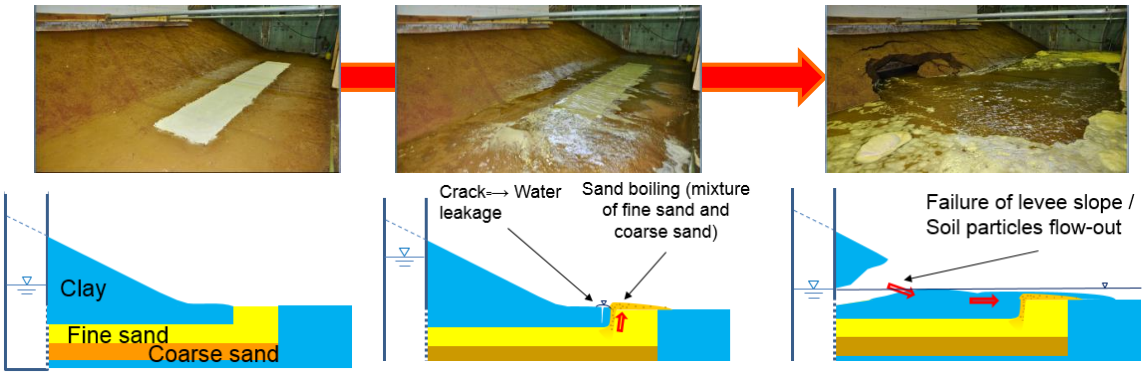

Figure 1. An Example of Process to Levee Breach in Experiment

Upgrading of Method for Setting Large-scale Earthquake Ground Motion that Acts on Dam Foundation

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Key words: *Level 2 earthquake ground motion, attenuation formula (empirical approach), semi-empirical approach*

1. Introduction

For the earthquake ground motion to be set in evaluation of the earthquake resistant performance of dams, the distance attenuation formula [1)] (empirical approach), which was prepared based on the record of earthquake motions measured on the dam foundation, has often been used. Meanwhile, due mainly to the accumulation of new findings obtained from fault investigations by government institutions, semi-empirical approach has been also used considering more detailed information on epicenter, etc. Then, by conducting detailed analysis on correspondences between estimated values obtained by empirical and semi-empirical approaches and measured values, we refer to the applicability of both approaches and aim to improve the accuracy of design external force.

2. Method of setting earthquake ground motion in dam

Generally, the nature of earthquake ground motion at a certain point is expressed in the combination of three elements: source characteristics, propagation path characteristics, and site amplification characteristics (see Figure 1).

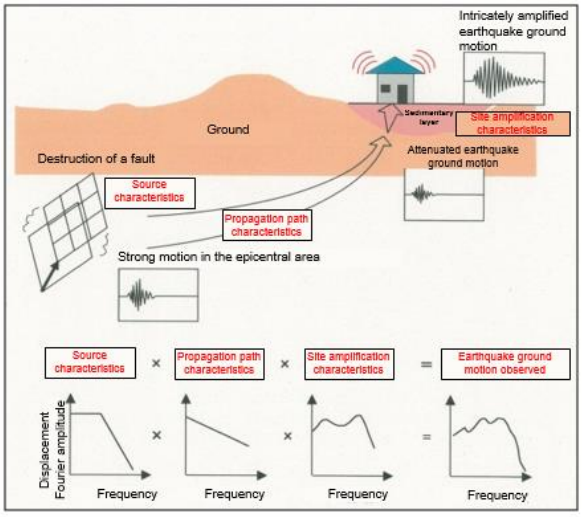

Figure 1. Three Elements of Earthquake Ground Motion

Methods for forecasting earthquake ground motion are classified into empirical approach, semi-empirical approach, and theoretical approach. Characteristics in setting earthquake ground motion by each approach are shown in Table.

Table. Characteristics of Approaches for Earthquake Ground Motion

Approach	Characteristics
Empirical approach	Prepare a regression equation with parameters of earthquake scale and distance based on the past earthquake records, and estimate the maximum ground acceleration and response spectrum of the earthquake.
Semi-empirical approach	Classified into empirical Green function method, which synthesizes earthquake ground motions of a big earthquake by overlapping the record of small-and-medium earthquakes in the same epicentral area as of a big earthquake in accordance with the destructive process of fault so as to conform to the law of similarity applicable between a big earthquake and small earthquakes, and statistical Green function method, which uses small earthquakes prepared artificially.
Theoretical approach	A theoretical method based on the assumption of source model and underground structural model for estimating earthquake ground motions by evaluating the three elements (characteristics) of earthquake ground motions theoretically with a formula.

3. Issues on empirical approach

Since it is being found that values calculated in the attenuation formula to be used for dams may be considerably different from measured values depending on the specific types of earthquakes and characteristics of the location of earthquake (as shown in Figure 2), it is necessary to organize the points of attention when using empirical approach.

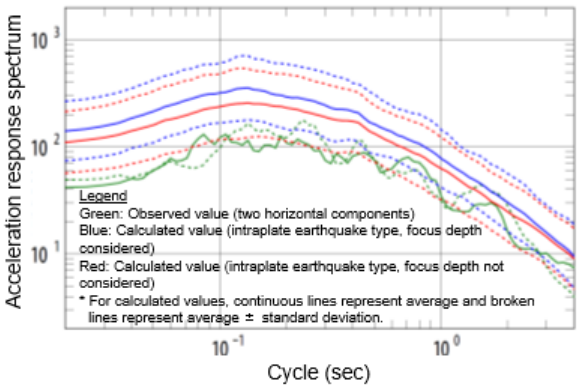

Figure 2. Comparison of Empirical Approach and Measured Values (Spectrum)

4. Future schedule

We examine points of attention in setting earthquake ground motion using attenuation formula by comparing with data of past earthquake ground motions in dams and considering the scope of data collection for earthquake ground motions, etc. We also compare with earthquake ground motions calculated by semi-empirical approach and organize matters concerning the applicability of empirical and semi-empirical approaches in setting up earthquake ground motions for dam foundation.

[Reference]

1) Civil Engineering Journal, Vol. 56, No. 11, pp.38-41

For Appropriate Maintenance of Anchors in Dams

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Key words: Anchor, prestressing of rocks, maintenance

1. Introduction

Of the dams under the administration of the Ministry of Land, Infrastructure and Transport (MLIT), those that have passed over 30 years since the start of operation account for about 40%, and many anchors have been installed to date. Maintenance of dam facilities has been appropriately performed in accordance with the dam maintenance standards prepared in each dam and safety and functions of dams have never been affected by deterioration of anchor, etc. However, deterioration of anchors has become apparent in some of them.

In maintenance of anchors in existing dams, there are such issues that main structures are located in invisible areas and that the inspection procedure for ground anchors is referred to but inspection procedures and frequency greatly differ according to each dam site. Then, we are studying methods for desirable inspection in order to maintain anchors appropriately and keep their functions.

2. Points of attention in maintenance of anchors in dams

The subject of this study is what is essential for safety and functions of dams, such as anchors, etc. used in the fixed part for transmitting the load acting on dam gate, etc. to the dam body concrete etc. or constructed to reinforce the dam foundation rock.

We also organized the results of surveys on the literature concerning anchor maintenance in and outside the country and on the cases of deterioration / repair of anchors used in domestic dams and the results of field trial inspections. Main points of attention in maintenance obtained as a result of such work are as follows.

(1) Appearance and anchor head: More than half of the past cases of anchor fracture occurred in the anchor head. Therefore, maintenance of the head part is the most important. Attention should also be paid to corrosion in the back of the head and ensuring the waterproof function. A method of checking the back of the head with an industrial endoscope is being developed.

Figure 1. Example of Anchor Used to Reinforce the Dam Foundation Rock

Figure 2. Lift-off Test Conducted in Trial Inspection

(2) Prestressing / anchoring: For unbond-type anchors, which do not fix tendon area with grout, periodically check the residual prestressing force with lift-off test, etc. For bond-type anchors, which fix tendon with grout, it is difficult to measure prestressing force but there is an approach for checking prestressing force with a survey method using supersonic waves.

(3) Corrosion / rust prevention: Attention to corrosion is required for the old type anchor (not covered by the Guidelines of Japanese Geotechnical Society revised in 1988), which is inferior in corrosion protection function. For tendon, attention should also be paid to "delayed fracture" a phenomenon that a minor damage suddenly expands to a major fracture, which occurs even when it seems sound in appearance.

3. Future schedule

We plan to organize the results of literature survey, case studies, and actual condition surveys as "Inspection Manual for Anchors Used in Dams" for the purpose of more appropriate and reasonable maintenance and ensure that it will be utilized in practical operation of dam maintenance.

Topics

Guidelines for Periodic Road Structure Inspections

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(Key words) Road structure, Principal inspections, Maintenance

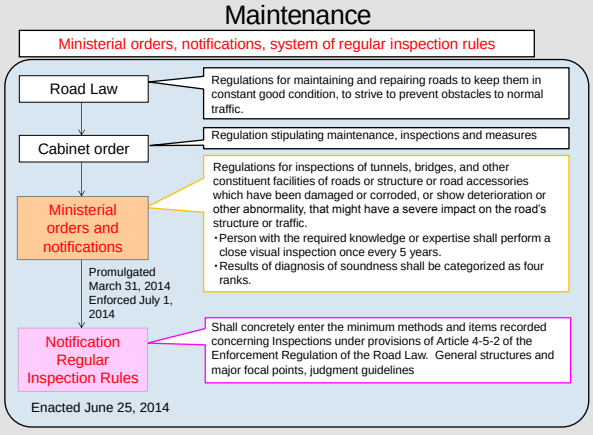
1. Introduction

With the increasing recognition of the need for appropriate management of road structures and given the aging of existing structures or the possibility of hazardous situations, the Road Law was amended in 2013. Article 42 paragraph 2 of the Road Law stipulates that a Government Ordinance shall be set out to describe the technical norms for maintenance and repair, including periodic inspections. Accordingly, MLIT had an obligation to establish the technical norms for periodic inspections for road structures.

2. Technical Standards for Principal Inspections

The Ministerial Orders for periodic inspections for road bridges and tunnels were promulgated on March 31, 2014 and came into force on July 1, 2014. There are approximately 700,000 bridges and 10,000 tunnels in Japan and the Ministerial Orders stipulate that close visual inspections of all components be conducted at five-year intervals. Technical Guidelines for the legally-binded periodic inspections were notified announced on June 25, 2014, setting out minimum requirements for inspection methods, recordings, and references for typical structural components, inspection focal points, and remedial action urgency ratings.

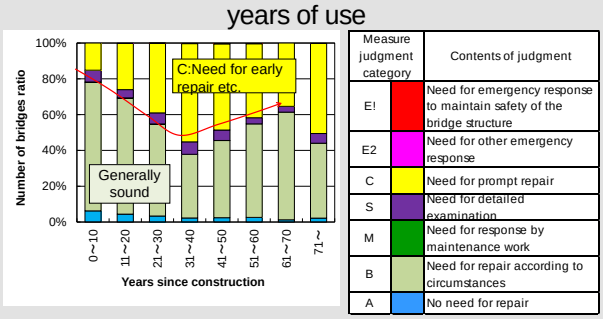
Figure 1 Legal System of Technical Standards for Maintenance



3. Background study in NILIM

The NILIM has conducted studies for road administrative agencies to improve management of inspections, planning and actions, and analysis of inspection data and modeling deterioration behavior for bridges, tunnels, and other road structures that are owned by MLIT, the largest road owner in Japan operating designated sections of the national highway system. One of the highlighted results is shown in Fig. 2[1)], where the ratios of remedial work urgency ratings are classified at different age groups for road bridges. The ratio of C-rating, in which repair is required, increases with age up to the age group of 31-40, while this increasing tendency is reversed for the ages groups of 41-50 or older. This may be attributed to the fact that older bridges are supposed to be maintained or repaired and indicates that earlier preventive maintenance would reverse the worsening tendency with age at an earlier time. Segmental condition records, were analyzed and the results were considered when establishing the technical guidance for periodic inspections. In addition, NILIM also prepared the official textbook for bridge inspector training courses that are provided by Regional Bureau of MLIT.

Figure 2 Changing remedical work argency ratings for government managed road bridges based on years of use



4. Remarks

The periodic inspection described herein is now implemented nationwide. The enactment of the technical

guidance for inspections will lead to a better management system. NILIM continues to analyze inspection data records to establish more reasonable and reliable inspection protocols and seek a better management methodology to extend their service lifetimes.

[Sources]
1) TECHNICAL NOTE of NILIM NO. 748
2) TECHNICAL NOTE of NILIM NO. 294
3) TECHNICAL NOTE of NILIM NO. 381
4) TECHNICAL NOTE of NILIM NO. 471
5) TECHNICAL NOTE of NILIM NO. 685
6) TECHNICAL NOTE of NILIM NO. 748

Division web site:
http://www.nilim.go.jp/lab/ubg/index.htm

Concrete Pavement: Applicability and Maintenance Methods

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(Key words) Road, concrete pavement, life cycle costs, maintenance

1. State of concrete pavement

Cement concrete pavement (hereinafter referred to as "concrete pavement") in Japan, covered about 30% of all paved roads during the period of high economic growth in the 1950s and 1960s. But the percentage of concrete pavement has fallen steadily over the years, and in recent years, has been flat at about 5% of all road pavement. This is a rate lower than in other countries (Fig. 1).

Figure 1. Percentages of Road Pavements in Various Countries

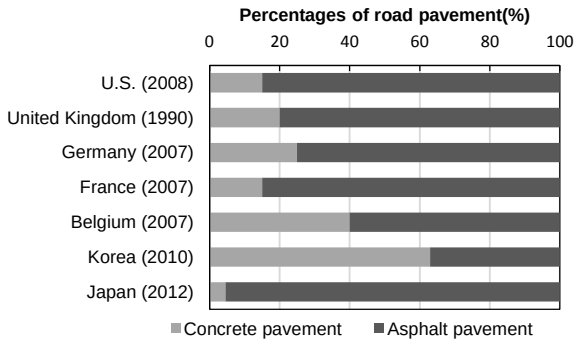

Photo 1. Concrete pavement on National Highway No. 20 in Hachioji City in Tokyo (In service since 1957. Photo taken in February 2014)

Reasons why concrete pavement has not been used in Japan in recent years are thought to be its initial cost that is higher than that of asphalt pavement, the fact that it is difficult to repair it when it is damaged and it is difficult to tear it up to perform work under a road, and problems with riding comfort and noise in cars traveling on it.

But concrete pavement is more durable than asphalt pavement, with some concrete pavement still in use more than 50 years after construction (Photo 1), and in some cases, it fully displays its strong points through use at appropriate places and suitable maintenance.

2. Study of applicability of concrete pavement

One way to lower the life cycle cost of pavement would be to use concrete pavement, so we are working to identify conditions that make its use appropriate.

In FY2014, we surveyed the state of damage to concrete pavement visually at about 20 locations throughout Japan, and also surveyed road conditions (work method used, pavement configuration, traffic volume, percentage of large vehicles, road structure conditions, alignment and so on), and by organizing the correlations between the two results, we identified conditions suitable (and not suitable) for concrete pavement.

3. Study of Concrete Pavement Maintenance Methods

Concrete pavement differs from asphalt pavement structurally and in the way it is damaged, so it is also necessary to study appropriate inspection and diagnosis procedures, and methods of selecting maintenance work methods. We have studied inspection methods since FY2013, and based on the results, are now actually performing inspections on existing roads to discover problem points. We are also studying methods of appropriately selecting repair methods by surveying repair methods used, state of damage at repaired locations, years passed since repair work, and deterioration or further damage to repaired locations at locations where existing concrete pavement has been repaired.

Photo 2.Characteristic Joint Damage on Concrete Pavement and State of Repair

4. Future efforts

Based on these studies, we wish to summarize technical documents and release them in the field so that concrete pavement will be used on for road construction.

[Sources]

1) Technical Note of NILIM No. 747, Technical documents concerning deformation of concrete pavement, July 2013
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0747.htm

The actual conditions and issues regarding maintenance and renewals of facility plumbing for the long-term use of apartment houses

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(Keywords) apartment house, facility plumbing, maintenance, renewals

1. Introduction

As resource and environmental issues become more urgent, the construction of quality housing and its inheritance is becoming increasingly important. Measures for the maintenance and renewals of facility piping is essential for maintaining the standard of living in apartment houses, and is also an evaluating item in housing performance indications.

This study is aimed to provide technical data for rationalization of the evaluation criteria for the maintenance performance of the facility piping. This year, we have surveyed the actual conditions of the maintenance and renewals of facility piping, and organized the issues to rationalize them.

2. The actual conditions of the maintenance and renewals of facility piping

(1) The specifications and construction method of facility piping etc. of apartment houses

Implementation of the maintenance and renewals of facility piping is affected by the building form, floor height and floor plan etc., in addition to the specifications and construction method of the facility piping. The table shows the specifications and construction method of apartment houses arranged and exemplified according to its construction age.

(2) The actual conditions and issues of the maintenance and renewals of facility piping

The actual conditions and issues of the maintenance and renewals regarding water supply and drainage pipes were investigated. In recent years, the following cases of renewals have been confirmed.

1) The drainage piping joints are pulled out from the concrete floor slabs and renewed using hydraulic jacks to suppress vibration and noise during the work.

2) The facility piping under the floor slabs of dwelling units are renewed and piped above the floor slabs.

On the other hand, the increase in cost compared to standard construction methods, and the allocation of these costs between the home-owner's associations and unit owners (individual households) are becoming issues.

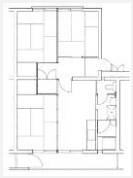
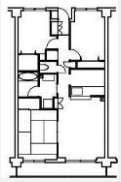
(3) The building design data of authorized long-life quality housing

For the purpose of grasping the planning technology, the specifications and construction methods of facility piping etc. for newly built apartment houses for long-term use, case studies of authorized long-life quality housing (apartment houses) were conducted and the building design data was arranged. Even in these cases, the ratio of common drainage stacks being placed inside the dwelling units was high, which can be pointed out as an issue in terms of maintenance and renewal.

3. Future works

The evaluation standards of the maintenance and renewal measures of facility plumbing pertaining to housing performance indications are being continuously reviewed and rationalized. We will continue to grasp the actual conditions and arrange the issues of the maintenance and renewals, in order to arrange the technical references and reflect it in future technical standards reviews.

Table: Example of the specifications and construction method of the apartment houses according to its construction age

Specification model	1960s model Pre-1970	1970s model		1980s model		1990s model 1991 - 2000	2000s model Post 2001
		A: 1971 - 1980	B: 1971 - 1980	A: 1981 - 1990	B: 1981 - 1990		
Structure/scale/ access	RC box frame/mid-rise/ Staircase	RC box frame/mid-rise/ Staircase	RC rigid frame/ Mid/high rise/corridor	RC box frame/mid-rise/ Staircase	RC rigid frame/ Mid/high rise/corridor	RC rigid frame/ Mid/high rise/corridor	RC rigid frame/ Mid/high rise/corridor
Example of dwelling unit plan	Housing corporation/3DK 	Housing corporation/3DK 	Private sale/3LDK 	Housing corporation/3LDK 	Private sale/3LDK 	Private sale/3LDK 	Private sale/2LDK 
Story height	About 2,550mm	About 2,600mm	About 2,600mm	About 2,650mm	About 2,650mm	About 2,700mm	About 3,000mm
Floor slab thickness	About 110mm	About 130mm	About 130mm	About 150mm	About 150mm	About 180mm	About 260 - 320mm
Seismic resistance	Old seismic standards (Note)	Old seismic standards (Note)	Old seismic standards	Current seismic standards	Current seismic standards	Current seismic standards	Current seismic standards
Water supply pipe	Hot dip galvanized steel pipe/Screwed joint	Rigid polyvinyl chloride lined steel pipe /Resin coating coupling		Rigid polyvinyl chloride lined steel pipe /Resin coating coupling		Rigid polyvinyl chloride lined steel pipe /Pipe edge corrosion protective coupling /Stainless steel pipe/Mechanical joint	
Drain pipe	Cast iron pipe, Carbon steel tube /Drainage fitting	Cast iron pipe, Carbon steel tube /Drainage fitting		Cast iron pipe, Tar epoxy lined steel pipe, Rigid polyvinyl chloride lined steel pipe /Mechanical joint		Cast iron pipe, Fire resistant double layer tube, Tar epoxy lined steel pipe, Rigid polyvinyl chloride lined steel pipe /Mechanical joint	
Bathroom/ piping	Conventional /under the slab	Conventional /under the slab	Conventional /under the slab	UB/above the slab	UB/above the slab	UB/above the slab	UB/above the slab
Floor level difference in dwelling unit	Yes	Yes	Yes	Yes	Yes	None	None
Hot-water supply apparatus	BF Bath boiler	BF Bath boiler with Hot water supply/shower function	BF Bath boiler with Hot water supply/shower function	Hot water supply heating machine No.13/No.16	Hot water supply heating machine No.13/No.16	Hot water supply heating machine No.24	Latent heat recovery type hot water supply heating machine No.24
Energy conservation	–	–	–	1980 Standards	1980 Standards	1992 Standards	1999 Standards

(Note): RC box frame structure even designed based on the old seismic standards, is often meet the current seismic standards.

An examination into the durability evaluation standards of existing concrete structures based on research data of actual buildings

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(Keywords) Concrete, carbonation , durability, corrosion of steel bar probability

1. Foreword

In order to appropriately evaluate the effect of deterioration prediction and deterioration measures of concrete structures, it is essential to examine it from the data of an actual building built under different conditions, such as location environments.

The purpose of this research is to collect the actual building data regarding deterioration like the carbonation depth from the concrete structures surface to the inside etc. based on the investigation diagnosis report into earthquake-resistance and planned maintenance of condominium apartments, and examining the evaluating method/standards of concrete structures using the corrosion of steel bar probability according to the measured carbonation value and age of a building, for the sake of arranging an index of deterioration progress predictions of concrete structures. Here we will report our findings.

2. The collected actual building data

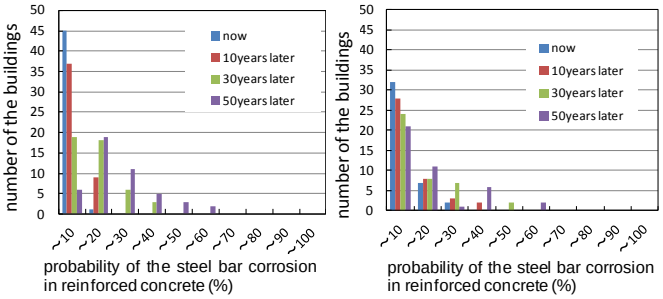
The collected data was acquired from the seismic diagnosis report, as well as the report for the investigation of planned maintenance, and the report of the renewal construction. The collected data items were basic items required for deterioration evaluations like carbonation depth, age of the building, as well as construction site, a type of finishing materials and its thickness etc. Here, the collected data was the seismic diagnosis report for roughly 900, the planned maintenance reports for roughly 160, and the data from the reports of renewal constructions for roughly 3000. Regarding the seismic diagnosis report, the data measurements included the carbonation depth etc. on the parts of various places in one building. Furthermore, the collected data used data from completed surveys and therefore, collecting of test specimens was not conducted for the research.

3. Results and discussion

The corrosion of steel bar probability, the index of durability for concrete structures, which takes into account the constant unevenness of material quality and construction accuracy, was calculated. Using data from the seismic diagnosis report, an example (carbonation measurement points) of the results from the carbonation suppression examination into various finishing materials, is shown in the figure. The number of data collected varies depending on the type of finishing materials, however, in the case of mortar + thin finishing materials, the current corrosion of steel bar probability in most 30-40 year-old buildings is less than 10%, and less than 10% for 80% of buildings with thin finishing materials . According to the calculations, roughly half of the buildings with thin finishing materials had a corrosion of steel bar probability less than 10%, even 50 years later compared to those coated with mortar. We are scheduled to examine this point in more detail along with the collection position etc. of the test specimens .

As well, after evaluating the unevenness of the carbonation speed coefficient based on the analysis of the seismic diagnosis report, gathering evidence from the test specimens of multiple points per building, it was found that it tends to become smaller in points where the finishing is of mortar types. As well, in exposed concrete points indoors, not only was the carbonation speed coefficient large, but the possibility that unevenness at every collecting point of test specimens grows, was

suggested from the prominent effects of environmental conditions. It was therefore confirmed that evaluations including the collection position etc. of the test specimens is required for more accurate deterioration evaluations.



(a) finishing materials ; mortar+lyshin (b) finishing materials ; lyshin

Figure: probability of the steel bar corrosion in reinforced concrete (actual building 30-40 years after construction)

4. Conclusion

The results of this research will become the backbone data for the validation of durability evaluation standards of concrete skeletons in existing buildings, and are scheduled to be reflected in the basic standards in the future.

Efforts for Effective and Efficient Maintenance Management of Port and Harbor Facilities

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(Key words) Life Cycle Cost, Inspection, Database, Cavity Inside Quaywall

1. Introduction

In order to hold down the cost of future improvements and renovations of port and harbor facilities while continuing to maintain necessary functions, a changeover to preventive maintenance-based maintenance management is demanded. NILIM is engaged in efforts to realize effective and efficient maintenance management, as outlined in this article.

2. Development of program for estimation of life cycle cost of port and harbor facilities

NILIM developed a program for estimation of the life cycle cost of port and harbor facilities (LCC calculation program). NILIM made this program available on its website, and is providing it to port administrators, etc. We are currently working to improve the program.

The LCC calculation program enables simple calculation of operation/maintenance management costs (rough calculation of repair costs) of port and harbor facilities based on the results of inspection and diagnosis of facilities and the number of years since construction, and is expected to contribute to drafting of systematic repair plans by administrators.

3. Study of form of inspection/diagnosis guidelines and maintenance management information database

"Guideline for Inspection and Diagnosis of Port and Harbor Facilities" was published in July 2014 to promote effective and efficient maintenance management of port and harbor facilities. This Guideline provides methods for efficient and effective inspection and diagnosis, etc. and is prepared in an easy-to-understand form using photographs. In the future, it will be used as a reference when establishing inspection and diagnosis plans.

To ensure that inspections, repairs, and other maintenance management work are performed accurately on an ongoing basis, a continuous grasp/accumulation of information on deterioration of facilities and utilization of that information are important. Therefore, in FY2013, a "Study Group on the Proper Form of Maintenance Management Information on Port and Harbor Facilities" was held, and a system for providing maintenance management information on port and harbor facilities to port administrators was studied. Based on the results, and also referring to the opinions of port administrators, in FY2014, a concrete study was conducted on a more user-friendly database of effective maintenance management information for maintenance management of port and harbor facilities.

4. Analysis of cavities in gravity mooring wharves

Due to the heightened importance of maintenance management, etc., we arranged/analyzed the condition of cavities inside the quaywall, etc. at aging port and harbor facilities throughout Japan based on a nationwide survey of facilities carried out in FY2013. Regarding the position of cavities, it was found that many cavities occurred near the quaywall normal line. In the future, the results of this analysis will be used to conduct more efficient surveys of cavities inside quaywalls.

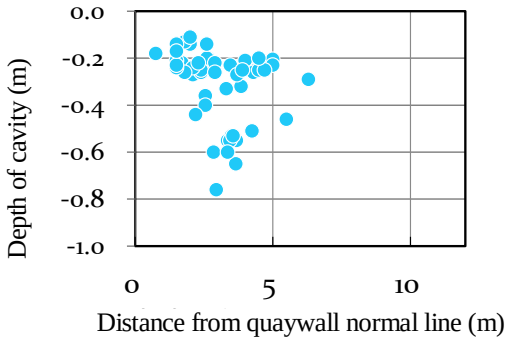

Fig. Position of cavity occurrence

5. Conclusion

In the future, we will continue the efforts described here with the aim of contributing to labor-saving and rationalization of maintenance management work.

【Reference For more information concerning the maintenance management (LCC) calculation program, see:

http://mailsv.ysk.nilim.go.jp/kakubu/kouwan/sekou/lcc.htm

Technology for Efficient, Short Time Repair of Airport Pavement

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(Key Words) Airport, Operation and Maintenance, Cold Mix Asphalt

1. Introduction

When an abnormality is discovered in an airport runway or taxiway and emergency repair is performed, it is desirable to carry out the repair with hot mix asphalt. However, due to material procurement or time restrictions, repairs must sometimes be made using cold mix asphalt. Cold mix asphalt is easy for airport administrators to keep on hand at all times as an emergency repair material. On the other hand, there are some issues such as its initial stability after paving, durability. As cold mixtures with improved performance have become available in the market in recent years, we conducted various types of tests to grasp their properties.

2. Outline of tests

As sample materials, we prepared four types of cold mix asphalt (A: cutback, B: cutback (water reaction curing type), C: resin (acryl), D: resin (epoxy)), together with a hot mix asphalt (dense grade asphalt concrete (20)) as a comparison material, and conducted various laboratory tests (Marshall stability test, wheel tracking test, Cantabro test, tensile adhesion test, unconfined compression test, simple pothole test) to confirm their initial stability, durability during use, etc.

3. Test results

An example of the test results is presented below. As can be understood from both the standard Marshall stability test and the standard pothole test, the initial stability and durability of the cutback type and resin type differ greatly. However, when using resin-based materials, it is necessary to mix the main solvent and curing agent and knead this mixture with the aggregate. In addition to the fact that these operations are considered handling of hazardous materials, surface leveling with a metal trowel is also necessary. Thus, the workability of the resin-based materials also differs greatly from that of cutback asphalt, which requires only spreading, leveling and compaction by rolling.

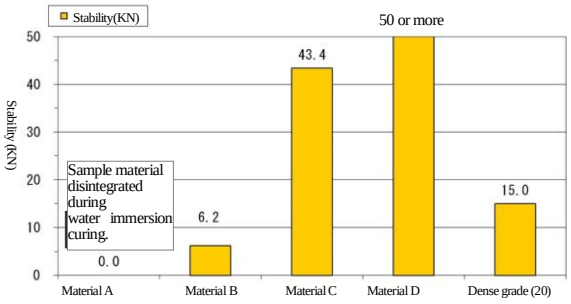

Fig.-1 Results of standard Marshall stability test

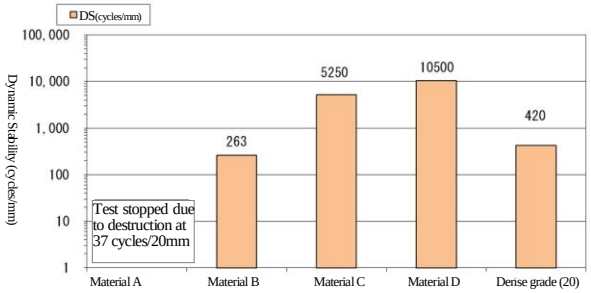

Fig.-2 Results of standard wheel tracking test

4. Future efforts

Basically, airport pavement can only be inspected and repaired at night-time outside of airport operating hours.

On the other hand, the environment for airport operation and maintenance is increasingly difficult due to the increasing loads of aircraft and longer airport operating hours. In the future, we plan to carry out research with the aim of proposing efficient inspection and repair methods for airport pavement, including a further investigation of the properties of cold mix asphalts.

Improving Sustainable Maintenance Methods Considering Risk Management

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(Key words) Maintenance, risk management, sustainability

1. Introduction

Aware that the deterioration of public infrastructure is now a serious problem, we are enacting plans to extend the service lifetimes of all types of public infrastructure, and carrying out concrete studies of management methods including inspections, measures, and databases. In the future, management techniques to determine how to incorporate execution methods in maintenance work, how to sustainably conduct the PDCA cycle, and how to prevent fatal risk to managed facilities must be found. The NILIM started "Research on methods of improving the sustainability of maintenance incorporating the perspective of risk management": a two year project started in 2014 to incorporate this resolution method. Beginning in April 2014, to horizontally integrate research activities, the Maintenance Research Promotion Headquarters was inaugurated with four missions. This research is being undertaken positioned as one of these missions: "Clarifying problems obstructing the maintenance PDCA cycle and resolution derivation methods".

2. Method of conducting the research

This research will be conducted in the following steps [1] to [5].

[1] Categorizing the present state of and problems with maintenance in the public capital field.

[2] Understanding the essentially different characteristics of each field (purpose of installing objects of maintenance, maintenance systems, reliability of technologies used, etc.) to compare their problem points.

[3] Sharing maintenance work between fields and setting evaluation axes thought to aim for the essential character of problems.

[4] Improving the completeness of evaluation axes that are insufficient or thought to need improvement while referring to private sector infrastructure field or overseas efforts.

[5] Performing verifications using case studies and evaluating methods of conducting maintenance (management) to propose a framework useful in proposing improvement measures.

3. Evaluation axis common to maintenance in various fields

In order to build an evaluation framework enabling managing bodies to conduct self inspections of their management method and obtain suggestions for improvement measures, we visited four managers of road bridges, river levees and revetments, and sewage mains (road and river offices of the Ministry of Land, Infrastructure, Transport and Tourism, sewage bureaus of ordinance-designated cities), six private sector companies (railway, gas, manufacturing, plants, housing) and countries overseas (road and river managers in England and France) to conduct interviews about problems they face and episodes they have experienced. Based on these, we considered evaluation axes from the following perspectives.

1) Being confronted with regular accidents, troubles, and natural disasters endangers management of deterioration of facilities. Attitudes to response measure according to characteristics of risk (prolonging lifetime by renewal or repair?, prediction or post-trouble response?, priority on disaster prevention or safety measure?, prioritizing precision or speed?).

2) Problems obstructing sustainability are encountered in all processes: inspecting, evaluating soundness, predicting deterioration, taking countermeasures or using databases. Ideas for linking with other tasks to draw out effectiveness of improvements to problems from their interrelationships (for example, cleaning and inspections, earthquake damage investigations and soundness evaluations, disaster prevention measures work and repair measures work, etc.)

3) Converting and developing concepts, such as searching for clues to resolution of problems in each process in other processes (for example, finding methods of using databases to screen the efficiency of inspections, finding knowledge of deterioration prediction in dismantled works.

4. Future Plans

In FY2015, we will move ahead to [4] and [5] in "2. How to proceed with research" and summarize the results.

Empirical Study on B-DASH Project (Technology for Power Generation from Sewage Sludge Biomass)

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(Key words: Power generation from incineration waste heat, energy saving, energy creation, sludge disposal, innovative technology

1. Introduction

Sewerage is essential social capital for the life of citizens, and as response to the global warming and tight supply of resources / energy, further effective use of the energy contained in sewage sludge is sought in addition to the greenhouse gas reduction measures.

To response to such social request and administrative needs, new technologies are being developed but are less used in practice and many sewerage service providers are cautious about introduction. For this reason, the Sewerage and Wastewater Management Department of the Ministry of Land, Infrastructure and Transport (MLIT) launched the "Breakthrough by Dynamic Approach in Sewage High Technology" (B-DASH) Project in fiscal 2011, and the Water Quality Control Department of the National Institute for Land and Infrastructure Management (NILIM) has been conducting empirical study for the Project. The objective of B-DASH Project is to realize cost reduction in sewerage projects and creation of renewable energy through the demonstration and dissemination of excellent innovative technologies and to support the overseas development of the water business by Japanese enterprises.

Of such activities, this paper introduces the outline of two empirical studies concerning the technology for power generation from sewage sludge biomass, which was adopted in fiscal 2013.

2. Outline of the technology for power generation from sewage sludge biomass

This technology is a combination of 1) technology to lower water content in sludge, 2) technology for energy-saving incineration, and 3) technology for power generation from incineration. The technology eliminates the need for supplemental fuel for incinerators by reducing water content in sludge and enables the creation of energy with power generation using waste heat in the incinerating process, which has been seldom used. Characteristics of these two empirical studies are as follows.

In the empirical study on the innovative sewage sludge energy conversion system with total optimization of dewatering, combustion, and power generation (Metawater-Ikeda City Joint Research Organization), the binary power generation technology was adopted as power generation technology since it has been in practical use in geothermal power generation and power generation is possible with low temperature difference, and cooperative control of the operation of each facility aiming for the efficient operation of the whole system enables further energy and cost saving (Figure 1).

In the empirical study on the system for power generation from sewage biomass (Joint Research Organization of Wakayama City, Japan Sewage Works Agency, Kyoto University, Nishihara Environment Co., Ltd., and Takuma Co., Ltd.), it is possible for even small facilities to secure a sufficient amount of power generation by adopting the low-power consuming stoker furnace as incineration technology and the small steam and binary power generation as power generation technology.

3. Future development

NILIM will continue to lead the empirical study and formulate guidelines based on study findings for sewerage service providers to consider introduction, and promote the dissemination of guidelines.

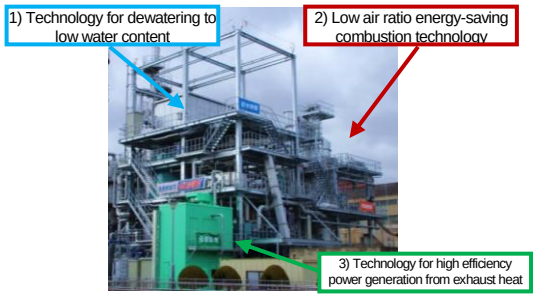

Figure 1. Demonstration Facility (Ikeda Sewage Treatment Plant)

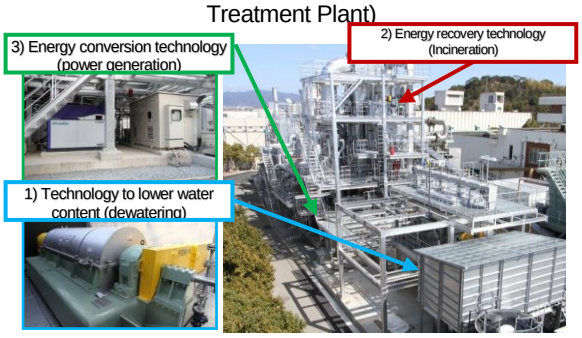

Figure 2. Demonstration Facility (Wakayama Central SewageTreatment Plant)

[Reference]

http://www.nilim.go.jp/lab/ecg/bdash/bdash.htm

Formulation of Guidelines for B-DASH Project (Solid fuel forming, sewage heat utilization, nitrogen removal, phosphorus removal / recovery)

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Key words: Sewerage, energy saving, resource saving, cost reduction, greenhouse gas, innovative technology

1. Introduction

In order to achieve cost reduction, creation of renewable energy, etc. in the sewerage service by accelerating the research and development and practical use of new technologies, the Water Quality Control Department of the National Institute for Land and Infrastructure Management (NILIM) has been implementing the Breakthrough by Dynamic Approach in Sewage High Technology Project (B-DASH Project) since fiscal 2011 in collaboration with the Sewerage and Sewage Purification Department of the Ministry of Land, Infrastructure and Transport (MLIT).

Under B-DASH Project, in response to the research contracted out by the NILIM, the research organization (contractor) constructs a full-scale plant to verify cost reduction, decrease in greenhouse gas emissions, energy saving effect, etc. resulting from the introduction of innovative technology, etc. Based on the results of such verification, the NILIM formulates guidelines for sewerage service providers to consider introduction of the technology with the aim to disseminate the technology.

Based on the findings of the research on the four innovative technologies, i.e. technology for converting sewage sludge into solid fuel, technology for utilizing unprocessed sewage heat, technology for removing / recovering phosphorus derived from sludge treatment, and technology for removing nitrogen, which had been continuously demonstrated since fiscal 2012, we formulated the guidelines for technology introduction in August 2014.

2. Outline of demonstrated technologies

(1) Technology for converting sewage sludge into solid fuel using waste heat

The technology uses the low-temperature waste heat (250-350 ℃) from the existing incinerator in the treatment facility, such as white smoke prevention air, as heat source for drying sewage sludge to manufacture sludge solid fuel saving cost and energy. The effect of reducing the usage of supplemental fuel can also be expected from the use of this solid fuel as alteration of supplemental fuel for the incinerator (Figure 1).

(2) Sewage heat recovery technology for installation in pipeline

As compared with air, sewage is warm in winter and cool in summer, and is present stably and abundantly in urban areas.

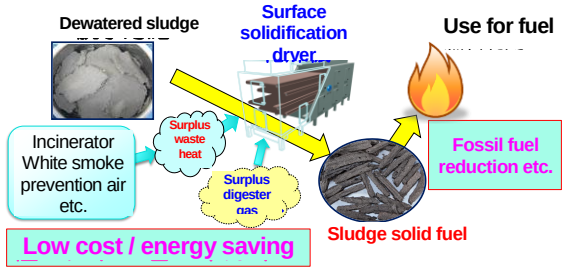

Figure 1. Technology for converting sewage sludge into solid fuel using waste heat

Therefore, effective use of sewage heat for air-conditioning, hot water supply, etc. leads to expectation for energy saving effect. This technology requires installation of heat recovery pipes in sewer pipeline at the time of pipe regeneration work and eliminates the necessity for sewage-dedicated intake facility and heat exchanger (Figure 2).

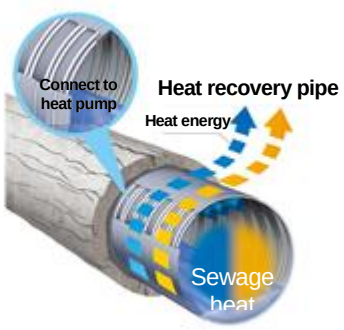

Figure 2. Sewage Heat Recovery Technology for Installation in Pipeline

(3) Technology for removing / recovering phosphorus derived from digested sludge

Technology for removing phosphorus from digested sludge before dewatering and recovering as $MgNH_4PO_4 \cdot 6H_2O$ (MAP). Using the complete mixing reactor with mechanical stirring, this technology enables efficient and stable phosphorus recovery even for digested sludge, which is more viscous than dewatered filtrate, and this leads to expectation for increase in phosphorus recovery as compared with the conventional method of removing phosphorus from dewatered filtrate (Figure 3).

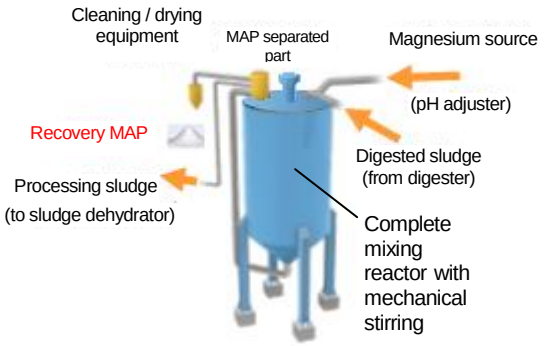

Figure 3. Technology for Removing / Recovering Phosphorus from Digested Sludge

(4) Technology for highly efficient nitrogen removal with fixed bed type anammox process

Anammox process is a biological response that converts ammonia nitrogen and nitrite nitrogen into nitrogen gas under anaerobic conditions. This technology has adopted a biofilm reactor, which uses a fixed bed type carrier for holding cells to be used in the nitritation process and anammox process, and is expected to bring such effects as reduction in aeration power, no need for addition of organic matter, and smaller space for installation of the equipment, in comparison with the conventional nitrogen removal method (Figure 4).

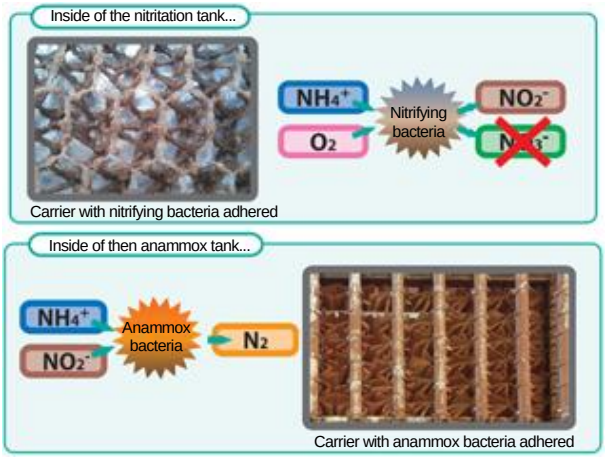

Figure 4. Technology for Nitrogen Removal with Fixed Bed Type Anammox Process

3. Outline of the guidelines

Based on the findings of the empirical study and opinions of local governments, we formulated guidelines according to each technology and had experts reviewed them.

Table shows the composition of the guideline (draft) formulated. Chapter 2 describes the characteristics, performance, etc. of the technology, and Chapter 3 estimates the effect of the technology when introduced in a treatment facility. Based on the results of estimation, possibility of introduction is discussed, and Chapter 4 examines basic planning, equipment design, etc. for introduction. Chapter 5 describes the items and frequency of check, etc. that will be required when the technology is introduced.

Table. Composition of Guideline (draft)

Chapter I. General Provisions	Objective, scope of application, definitions of terms
Chapter 2. Outline of the Technology	Characteristics of the technologies, conditions of application, evaluation results
Chapter 3. Examination for Introduction	Introduction examination method, examples for examination of introduction effect
Chapter 4. Planning and Design	Introduction plan, design
Chapter 5. Maintenance	Check items, frequency, etc.
Reference Data	Verification results, case study, etc.

4. Utilization of findings and future development

In order to introduce the guideline to local governments, sewerage-related companies, etc., the NILIM held a guideline presentation seminar in Intex Osaka in July 2014, attended by more than 100 persons.

We will continue to introduce the guidelines actively through such presentation seminars, etc. to promote utilization of sewage energy and secure phosphorus, which is a scarce resource.

Photo: Guideline Presentation Hall

[Reference]

1) Technical Note of NILIM, No. 802
Guideline for introducing the technology for highly efficient nitrogen removal with fixed bed type anammox process (Draft)
2) NILIM Document No. 803
Guideline for introducing the technology for converting sewage sludge into low-cost solid fuel using waste heat
3) Technical Note of NILIM, No. 804
Guideline for introducing sewage heat utilization using the sewage heat recovery technology for installation in pipeline (Draft)
4) Technical Note of NILIM, No.805
Guideline for introducing the technology for removing / recovering phosphorus from digested sludge (Draft)
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn000.htm

Early Verification of Effectiveness of Traffic Safety Countermeasures Based on Traffic Behavior

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(Key words) Traffic behavior, early verification of effectiveness of countermeasures

1. Introduction

The widely used method of verifying the effectiveness of a traffic safety countermeasure is to compare the number of accidents before and after the countermeasure is taken using traffic accident data, but because traffic accidents occur very rarely at individual locations such as intersections, it takes a long time, many years in fact, to collect the traffic accident data necessary to verify the effectiveness of countermeasures. So there are cases where the effectiveness of a countermeasure is quickly verified by, in addition to referring to traffic accident data, analyzing traffic behavior to efficiently manage traffic safety.

The Road Division has, based on a number of trials of countermeasure effectiveness evaluations done based on analysis of traffic behavior, organized concepts guiding this approach to prepare a guideline on evaluating effectiveness based on traffic behavior analysis.

2. Preparing the guideline

The handbook organizes the traffic behavior analysis procedure, outlines and methods of obtaining and using evaluation indexes, and analysis method, and case studies of the use of the method at individual locations. It introduces a variety of evaluation indexes including traveling speed and collision area entrance time difference, etc. Here "collision area entrance time difference" means the difference between the times that potential victims of an accident, a pedestrian walking in a pedestrian crossing and a car turning left or right, or a car turning right and a car coming from the opposite direction for example, each enter the area where they may collide, and is an index of the danger of an accident based on the rule: the smaller the difference, the greater the danger. Figure 1 is a schematic figure showing the collision area entrance time difference of a pedestrian walking in a pedestrian crossing and a car turning left.

3. Example of analysis of effectiveness of a countermeasure based on traffic behavior

As a countermeasure for a place where cars turning left have collided with pedestrians crossing in a pedestrian crossing zone, the corner radius was reduced to slow the left turn speed, and a video camera was used to measure and analyze a number of evaluation indexes based on traffic behavior before and after the countermeasure.

Figure 2 shows change of the collision area entrance time difference after the countermeasure. After the countermeasure was taken, the collision area entrance time difference was larger and the particularly dangerous phenomenon of less than 2 seconds was observed less often.

Figure 3 shows the change of the traveling speed during left turning after the countermeasure was taken. The percentage of cars turning left at the high speed of 30km/h or more fell after the countermeasure.

The results of collecting accident data for several years and comparing the number of accidents before and after the countermeasure was taken after evaluating the effectiveness of the countermeasure by analyzing traffic behavior at the location, show that accidents fell from 1.75/year to 0.75/year, showing that it is possible to estimate the effectiveness of a traffic safety countermeasure by evaluating the effectiveness of countermeasures based on traffic behavior.

4. In Conclusion

The guideline is counted on being used as reference material by regional development bureaus to quickly evaluate the effectiveness of countermeasures based on traffic behavior analyses.

Figure 1. Schematic Figure of Evaluation Indexes

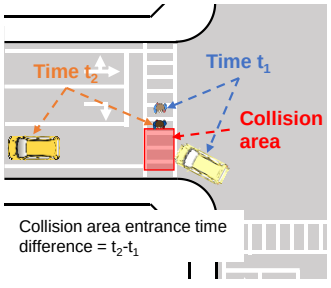


Figure 2. Comparison of Collision Area Entrance Times Before and after Measure

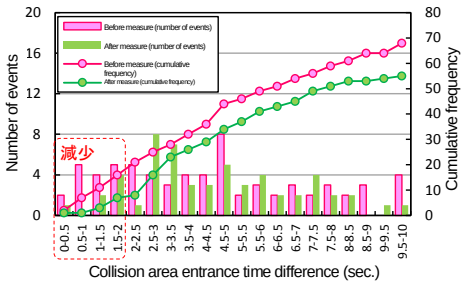
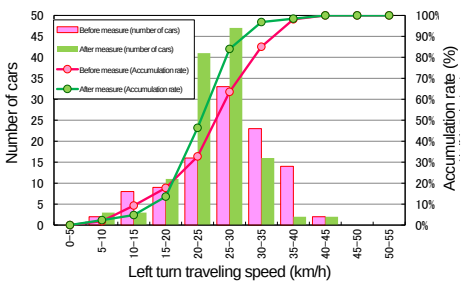


Figure 3. Comparison of Left-turn Traveling Speed Before and after Measure



Promoting Traffic Safety Measures on School routes and Residential Roads

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(Key words) Residential road, school route, traffic safety

1. Present and future of efforts in each region

In the field of traffic safety for residential roads, in 2012, the Ministry of Education, Culture, Sports, Science and Technology, the National Police Agency, and the Ministry of Land, Infrastructure, Transport and Tourism conducted emergency joint inspections of school routes throughout Japan and have taken necessary measures and other actions. Examining measures taken in each region shows that they have mainly been measures that can be implemented relatively quickly, such as installing signs or coloring shoulders. But at locations where it is assumed that emergency measures have not ensured adequate safety, more effective measures are demanded.

2. Research to promote initiatives

NILIM is conducting research to support the specific selection of measures in each district by indicating the effectiveness of installing speed humps or curb extensions.

Concerning vehicle speed reduction structures in particular, standards governing their installation are not set at this time, so our survey and analysis has been focused primarily on gathering existing knowledge and at the same time verifying the effectiveness of measures that can be installed on the side of arterial roads. Surveys of measures from the sides of arterial roads have shown that narrowing intersections (Photo 1) or smoothing sidewalks (Photo 2) where cars enter residential roads achieve a wide range of effects such as lowering the speed of cars, boosting safety consciousness, and increasing the visibility of pedestrians. (Figure)

Photo 1 Intersection curb extension (extending sidewalks at an intersection to narrow the space for cars to enter the residential road)

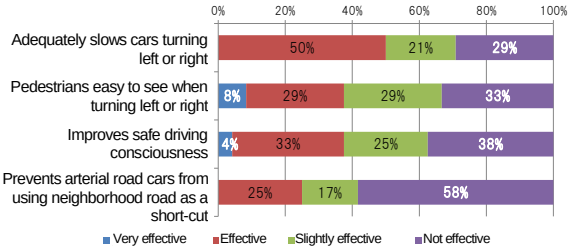
Photo 2 Smooth sidewalk (Raising the sidewalk across the intersection to form a level difference in the traffic lanes)

In addition, we are conducting research to develop methods of proposing effective measures for residential roads based on social experiments of school route safety measures conducted in cooperation with Tsukuba City.

3. Future Developments

The Council for Social Infrastructure, Road Committee has specified eliminating through traffic and restricting speed as basic policies for traffic safety measures on residential roads, and plans to summarize and announce technical knowledge to promote future measures on actual roads.

Figure Questionnaire survey of drivers concerning extended curbs at intersections



[Sources]
Road Division
http://www.nilim.go.jp/lab/gbg/index.htm

Method of Using Probe Data to Specify Congestion Occurrence Locations and Range of their Impact

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(Key words) Road traffic survey, probe data, traffic smoothing, congestion occurrence locations

1. Introduction

Congestion is a major challenge facing road traffic in Japan. To effectively take congestion countermeasures, we have to specify locations for priority countermeasures by specifying where intersections that cause congestion are located, and clarify the range of the impact of this congestion. This report introduces a method of using probe data to specify congestion occurrence locations and the range of their impact.

2. Method of specifying congestion occurrence locations and the range of their impact

Specifying congestion occurrence locations and the range of their impact is done using the bottleneck index that indexes combinations of congestion and non-congestion between adjoining road sections (Fig. 1).

First, probe data is used to compute the average speed in a section in a particular 1-hour period, then with 20km/h as the threshold value, judging whether congestion has or has not occurred. Next, when the section to be analyzed is "congested", computing the bottleneck index by giving a +1 point if the downstream side section is non-congested and giving a－1 point if the downstream section is congested, then dividing the resulting score by the number of days data is received. If the absolute value of the (+) bottleneck index is large, there is a high possibility that the section analyzed is the start of congestion, and if the absolute value of the (-) bottleneck index is large, there is a high possibility that it is influenced by congestion in the downstream section.

3. Confirming effectiveness of the specification method

The effectiveness of this method was confirmed near the Taisho intersection on National Highway No. 2, that is a major congestion location in Hiroshima Prefecture (Fig. 2). The analysis was done between 7:00 and 8:00 in the morning on 247 weekdays during 2011 and the percentage of days of congestion out of all 247 days (congestion rate) and the bottleneck indexes were computed for each section on a digital road map. Data was obtained for more than 90% of the days for almost all sections. In section 2, "congestion" occurred at a percentage of 0.8 or more between 7:00 and 8:00 a.m. and the absolute value of the bottleneck index (+) was large at 0.7 or higher, so it was judged to be highly probable that the Taisho Intersection is a congestion occurrence location. In sections 3 and 4, the absolute value of the bottleneck index (-) was high at above 0.6, so it was determined that there is a high probability of these sections being influenced by downstream section congestion.

4. In conclusion

In the future, more verifications of the method will be done, confirming its effectiveness, and the specification method will be improved.

Figure 1. Concept of bottleneck index computation

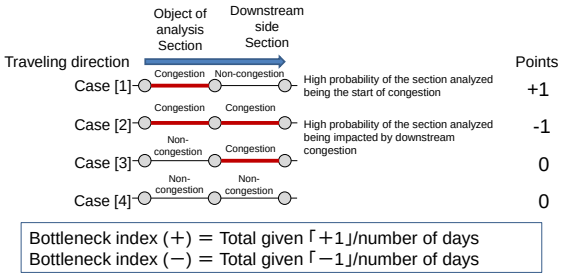
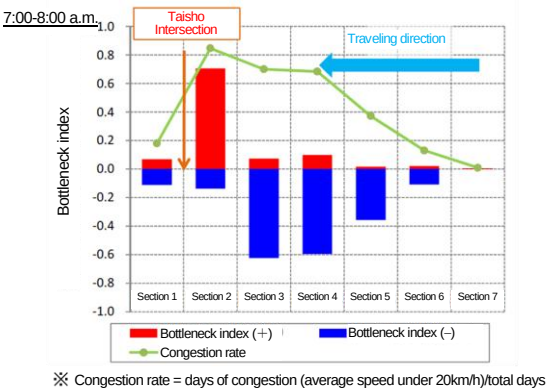


Figure 2. Bottleneck index near the Taisho Intersection (7:00 - 8:00 a.m.)



※ Congestion rate = days of congestion (average speed under 20km/h)/total days

A Case of Utilizing Results

Desirable Roundabout Structures Issued

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(Key words) Roundabout, traffic volume, geometric design

1. Introduction

On August 8, 2014, Desirable Roundabout Structures (Notification by the Heads of the Planning, National Highway and Risk Management, Environment and Safety, and Expressway Divisions of the Road Bureau)[1] (below referred to as, "Division Heads Notification) was issued to road managers (roads administered by the national and regional governments). The Division Heads Notification summarized immediate application conditions and precautions necessary for a road manager to plan and design a roundabout as the basic concepts for a desirable roundabout.

The NILIM has conducted surveys and research on roundabouts, and participated in the preparation of the immediate application conditions and precautions in the Division Heads Notification.

This report introduces an outline of the surveys done by the NILIM and the contents of the Division Heads Notification regarding the applicable traffic volumes and applicable geometric design that are the major items in the Division Heads Notification.

2. Applicable traffic volume

We surveyed overseas traffic capacity setting methods, simulated traffic flow, and measured the characteristics of driving on actual roads in Japan to organize traffic capacity that can be accommodated. As a result, the Division Heads Notification indicated that traffic handling capability is confirmed in two stages. At the first stage, even though a detailed study is not done, as the traffic volume that can be accommodated, less than 10,000 (vehicles/day) that enter a roundabout was set,

Figure 1 Relationship of Entry Roadway Traffic with Circular Roadway Traffic

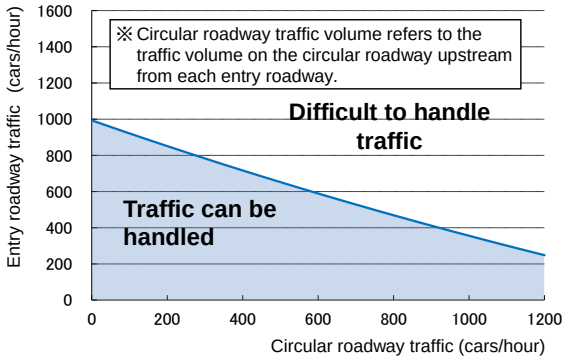
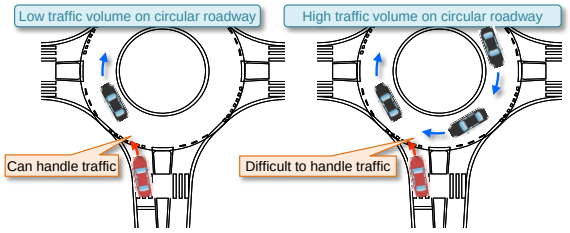


Figure 2 Image of traffic handling

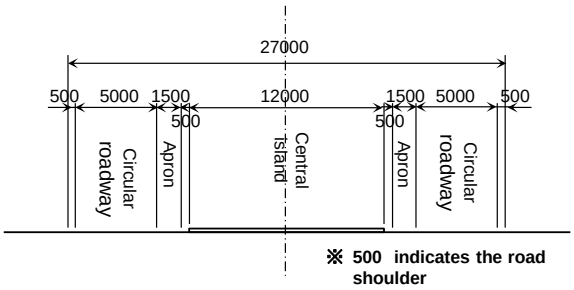


and in this case, it was assumed that a roundabout can be applied. At the second stage, as a verification method requiring a relatively detailed study, its applicability was judged by using Figure 1 to confirm whether or not a total number of incoming traffic of 10,000 (vehicles/day) or more is or is not in a range that can be accommodated by each incoming road. And Figure 2 shows an image of traffic handling by a roundabout.

3. Applicable geometric design

A driving survey based on various widths (circular roadway, apron, etc.) was performed to organize appropriate geometric designs. As a result, the Division Heads Notification considered the width of the roundabout to be the constituent that can ensure safe and smooth traffic flow, to stipulate external diameter of 27m and four roads as the criteria.

Figure 3 Criteria for width configuration (external diameter 27m, 4 roads, design vehicles are ordinary vehicles)



[Sources]
1) Ministry of Land, Infrastructure and Transport web site: http://www.mlit.go.jp/road/sign/kijyun/pdf/20140901tuuti.pdf

Analyzthe Effects of a Road Opening Using ETC2.0 Probe Data

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(Key words) ETC2.0, probe data, road management

1. Introduction

The Ministry of Land, Infrastructure, Transport and Tourism has developed a system that collects the longitude and latitude, time, acceleration, etc. of cars from ETC2.0 onboard units through roadside devices, and since April 2011, has been collecting data about users (ETC2.0 probe information) who have agreed to the collection of these data. This report introduces the result of analysis using ETC2.0 probe information of change of selected routes (Fig. 1) between the Tomei Expressway and Kanetsu Expressways caused by the opening of the Sagamihara-Aikawa IC to Takaosan IC (14.8km) section of the Metropolitan Inter-city Expressway (below, "Kenodo") from that was opened for use on June 28, 2014.

2. Analysis results

Based on the ETC2.0 probe data, the analysis confirmed changes in the selected route after opening of the Kenodo by vehicles that passed through the Kanetsu Expressway Tsurugashima JTC within 6 hours after passing through the Tomei Expressway Ebina Junction and vehicles traveling in the opposite direction. Similar route selection trends were revealed in both directions between the Tomei Expressway - Kanestsu Expressway, showing that the opening of the Kenodo increased traffic using the Kenodo about 20%. The ETC2.0 probe data confirmed that the opening of the ring road transformed route selections by through traffic that did not begin traveling in the center of Tokyo.

3. In Conclusion

In the future, we will endeavor to realize a world in which roads are used "intelligently" by appropriately evaluating the reliability of roads on which ETC2.0 probe information is used "intelligently and by taking appropriate measures.

[Sources]
1) Y. Tanaka, H. Kanoshima, H. Saji, H. Makino: Analysis of effects of opening of the Metropolitan Inter-city Expressway (Kenodo) by road probe data, 12th ITS Symposium 2014,1-2A-05,Dec. 2014.
2) Ministry of Land, Infrastructure, Transport and To urism, Road Bureau: From ETC to ETC2.0, http://w ww.mlit.go.jp/road/ITS/j-html/etc2/index.html

Figure 1. Selected Routes between the Tomei Expressway and Kanetsu Expressway

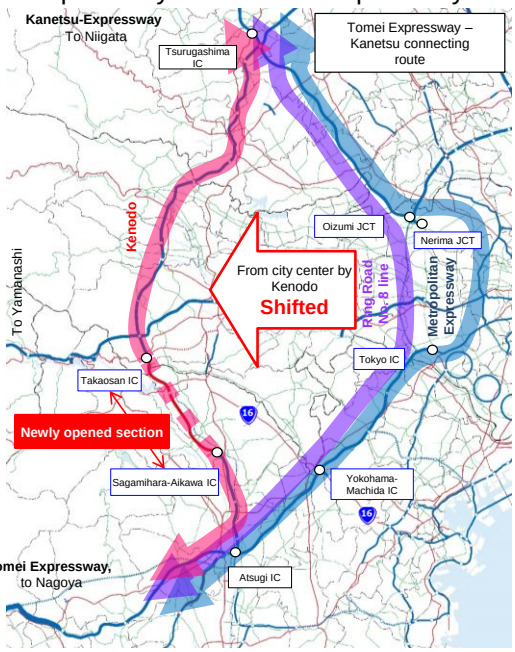
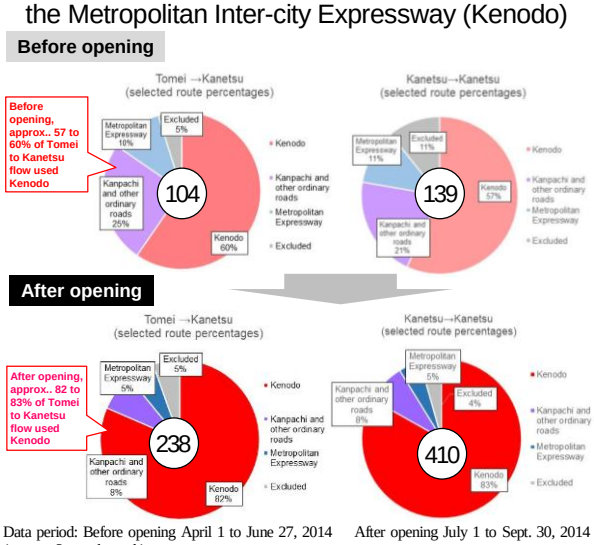


Figure 2. Change of selected route after opening of the Metropolitan Inter-city Expressway (Kenodo)



Data period: Before opening April 1 to June 27, 2014 After opening July 1 to Sept. 30, 2014 (approx. 3 months each)
Object extracted and analyzed: The study confirmed the routes traveled by vehicles that entered the Tomei Expressway Ebina JCT within 6 hours after passing through the Kanetsu Expressway Tsurugashima JCT (and in the opposite direction) (Kenodo/Kanpachi or other ordinary road/Metropolitan Expressway). Excluding vehicles that stopped midway

Initiatives to Realize Simple ITS Spots

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(Key words) Simple ITS Spot, ETC2.0, electric field strength

1. Introduction

The Ministry of Land, Infrastructure, Transport and Tourism has installed road-vehicle communication use radio antennae (ITS Spots) to provide ETC2.0 service, mainly on major expressways throughout Japan, in order to mitigate congestion and improve traffic safety. ITS Spots can be used not only to supply road traffic information, but also to abstract and collect traveling history and related information (uplink information), to be used for road traffic related analyses.

The NILIM is studying policies to develop and popularize services that will link industry, academia and government using uplink information in order to broaden the use of ETC2.0 compatible car navigation systems and widen the collection of uplink information. This report introduces a proving test done to study machine specifications for simple ITS Spots intended for installation at off-road facilities such as ports, harbors and logistics bases (below referred to as, "Simple ITS Spots").

2. Characteristics of Simple ITS Spots

Unlike conventional ITS Spots that communicate with vehicles traveling non-stop, these will contract the radio communication area to that occupied by one vehicle assuming that they will communicate with vehicles that will either stop temporarily or move slowly past the ITS Spot. The goal is to lower the conventional radio output of 70mW to about 5mW in order to simplify the radio base station application requirements.

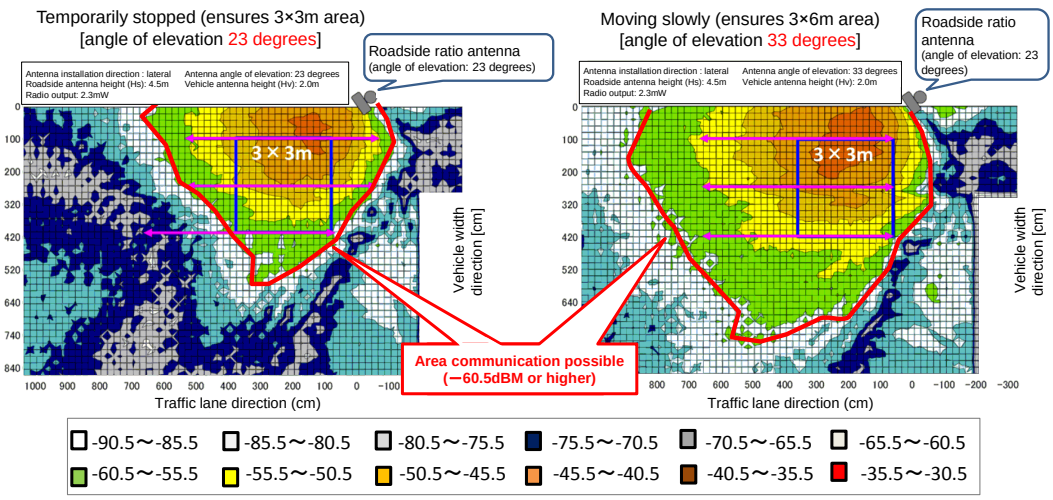
3. Measurement results

The radio wave output and installation height etc. of the ITS Spots were varied on the NILIM test track to measure the electric field strength distribution. The figure shows the measured electric field strength distribution. It shows that even when the output was lowered to 2.3mW, if the antenna's angle of elevation is 23 degrees, it is possible to obtain a communication area of 3×3m that is assumed to equal the area of one vehicle, confirming that service is possible when the vehicle stops temporarily. And assuming that when a vehicle moves slowly at 20km/h, ETC2.0 service communication processing time is 1 second, a communication area of about 6m in the direction of progress will be necessary. The figure confirms that if the antenna's angle of elevation is 33 degrees, output of 2.3mW will ensure a 3×6m communication area, permitting the provision of services to vehicles traveling slowly.

4. In Conclusion

This proving test performed measurements by lowering the radio wave output of the conventional ITS Spots. In the future, in order to also simplify operating conditions, we must abstract necessary functions, make a simple ITS Spot prototype, and perform function and performance proving testing.

Figure Electric Field Strength Distribution (Unit: dBm)



A Case of Utilizing Results

Revising ITS Spot Technical Specifications, and Expanding them to Ordinary Roads Throughout Japan

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(Key words) *ITS SPOT、ETC2.0、DSRC、Probe*

1. Introduction

In FY 2011, about 1,600 ITS Spots (road side devices for radio communication in the 5.8GHz frequency band) installed on expressways throughout Japan by the Ministry of Land, Infrastructure and Transport and Tourism were surveyed and studied by the National Institute for Land and Infrastructure Management (below,"NILIM") to provide and improve the ITS Spot services. And as a summary of the findings, the NILIM revised the Specifications (Draft) for Spot Communication Services (DSRC (Dedicated Short Range Communication) services) (Below, "the Specifications (Draft)).

This is a report on the revision of the Specifications (Draft) done so that when services using route information, which the Ministry of Land, Infrastructure, Transport and Tourism is now promoting, are implemented and when ITS Spots are installed at about 1,500 locations on ordinary roads, the services will be implemented smoothly and the installed equipment will be adapted to conditions on ordinary roads.

2. Outline of services that use route information

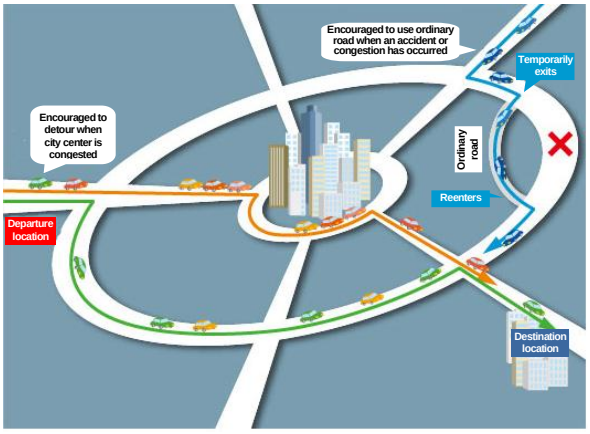
Services that use route information is a concept that will result in effective use of overall road networks in the future, because in large cities, the construction or ring roads is sharply increasing the range of route selections, and ETC2.0 and ITS Spots that gather and aggregate route information will permit preferential measures for drivers who select routes intelligently according to congestion, accidents, and other conditions.

3. Outline of the revision of the Specification (Draft)

It is necessary to appropriately clarify the routes that vehicles travel to operate ETC2.0 services etc. so ITS Spots must provide highly reliable communications. Therefore, it will be essential to quickly detect and repair roadside equipment that is damaged or malfunctions.

Under such circumstances, in addition to collecting probe data (traveling history, behavior history and similar data) as done until now, collecting ASL-ID probe data (ITS Spot compatible car-mounted equipment individual number data) was incorporated into the Specifications for ITS Spots newly installed in FY2014 (a total of about 1,500 at major points on ordinary roads nationwide).

Figure 1 Services that utilize route information



ASL-ID probe data is data collected shortly after the start of communication, and which is characterized by small data volume, so it permits the collection of data relatively stably, even when the car equipped with the car-mounted equipment passes an ITS Spot's communication area at a speed of several tens of kilometers per hour. Therefore, by calculating the reception rate of probe data with the number of these data received as the denominator and the number of probe data received as the enumerator, it is possible to detect roadside devices that may be damaged or malfunctioning.

And when installing ITS Spots on ordinary roads, incorporating the definition of communication area where communication is possible with one ITS Spot on each of the inbound and outbound lanes of a 2-lane 2-way road, is counted on to increase the variation of installations of ITS Spots on ordinary roads and to help lower costs because a small number of ITS Spots will be able to communicate over a wide area.

4. In Conclusion

Based on the newly revised Specifications (Draft) 1,500 ITS Spots will be newly installed on ordinary roads in FY2014, and functions specified in the revisions to the Specifications (Draft) will be gradually added to the 1,600 ITS Spots already installed in expressways. In the

future, based on knowledge obtained through operations in the field, a study will be done to further expand ETC2.0.

Topics

Awarded the Minister of Land, Infrastructure, Transport and Tourism Award at the Twelfth Industry, Academia, and Government Cooperation Awards

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(Key words) ITS, Expressway sags, congestion countermeasure, industry, academia, and government cooperation

1. Introduction

The Minister of Land, Infrastructure, Transport and Tourism Award of the Twelfth Industry, Academia, and Government Cooperation Awards has been awarded to the National Institute for Land and Infrastructure Management, Prof. Oguchi of the Institute of Industrial Science, the University of Tokyo, and to the Research Consortium for Smart Traffic Flow Control System, for developing Traffic Smoothing System at Expressway Sag Sections, which the Intelligent Transport Systems Division of the Road Traffic Department has been developing as part of an Industry, Academia and Government Project (Photo). These awards have been given since 2003 to contribute to the further development of cooperation between industry, academia, and government in Japan by honoring the achievement of individuals or groups whose outstanding achievements have made a superior contribution to the promotion of cooperative activities between industry, academia, and government [1].

2. Outline of the award

About 60% of congestion on intercity expressways occurs at places where the gradient changes called sags, making countermeasures for such locations an urgent challenge. The National Institute for Land and Infrastructure Management established the Study Group for Traffic Smoothing at Expressway Sag Sections in FY 2010, which under the leadership of Prof. Oguchi of the University of Tokyo, who acted as group chairperson, and with the cooperation of five auto makers (Toyota, Nissan, Honda, Mazda, and Fuji Heavy Industries) that are the members of the Research Consortium for Smart Traffic Flow Control System, carried out research and development of the Traffic Smoothing System at Expressway Sag Sections that unites road with vehicles. This system, which is based on academic knowledge of Prof. Oguchi and others who have clarified the basic causes of congestion at expressway sag sections, provides information on information signboards and to car navigation terminals at the same time as it provides drivers with services that use ACC (function that keeps heading distance and traveling speed of automobiles constant) for congestion countermeasures (Figure).

Photo Industry, academia, and government

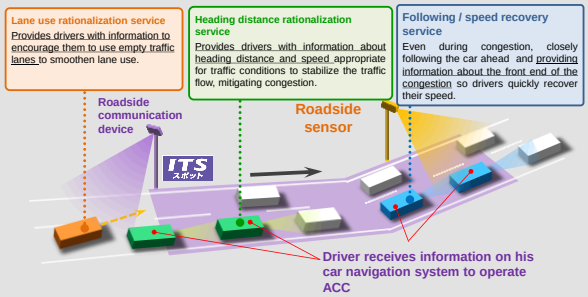

Figure Image of a Service the System Provides

3. Future Development

In the future, the development goals and the nationwide level congestion mitigation effectiveness will be clarified through various driving tests and computer simulations in order to strengthen links between industry, academia, and government and to bring the services to the public.

[Sources]
1) Cabinet Office web page: Industry, Academia, and

Government Cooperation Awards
http://www8.cao.go.jp/cstp/sangakukan/index2.html
2) NILIM, ITS Division web page: Research on ITS "Research on Smoothing Traffic at Expressway Sags by Linking Roads and Vehicles".
￥ http://www.nilim.go.jp/lab/qcg/japanese/2reserch/1field/36smoothingsag/index.htm

Developing the grasping methods of existing wooden detached housing specifications whose design drawings at the time of construction have dissipated

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(Keywords) Existing houses, Wooden detached housing, Building method

1. Foreword

As it is difficult to grasp the design specifications at the time of investigations on present conditions and preliminary investigations of renovation plans, since documents like design drawings at the time of construction for many existing houses have dissipated, NILIM has structured a support system that can be used in the duties of site investigations, and developed an effective grasping method of the design specifications. .

2. Acquiring, arranging data related to design specifications

In order to arrange the data according to each regional and building generation's design specifications, design specification investigations were carried out for existing houses whose documents such as drawings were available. And through the help of home builders with roughly 30 years experience providing municipal finance housing etc., data regarding housing structure and the materials and construction methods used by generation, was recorded/acquired from a total of 55 builders and 1,247 cases from Hokkaido and the Tohoku, Kanto, Chubu and Kyushu areas.

3. Developing effective grasping methods for design specifications

In order to support site survey work carried out by contractors and architect offices, a support system called "Materials/construction method database system" was developed to secure information in line with workflow like site surveys, by presuming basic information and specification data for building survey subjects, and through site surveys. The main functions are the inputting of building specification information of building survey subjects, the inputting of deformed items and the outputting of survey results as a report. Taking into consideration its use on tablet devices carried onto the site, it is expected to run in ASP format. The partition editing of building data was enabled, taking into consideration the actual duties pertaining to surveys distributed among multiple individuals. As well, a standalone use function was also prepared in the case that the communication environment at the location is bad. As well a records arrangement function, a function that registers photos, which are extremely important survey records, taken at the site for each part, was also included. Furthermore, taking into consideration the linked use with the "Housing history" management system, extensibility using a common ID is also being considered.

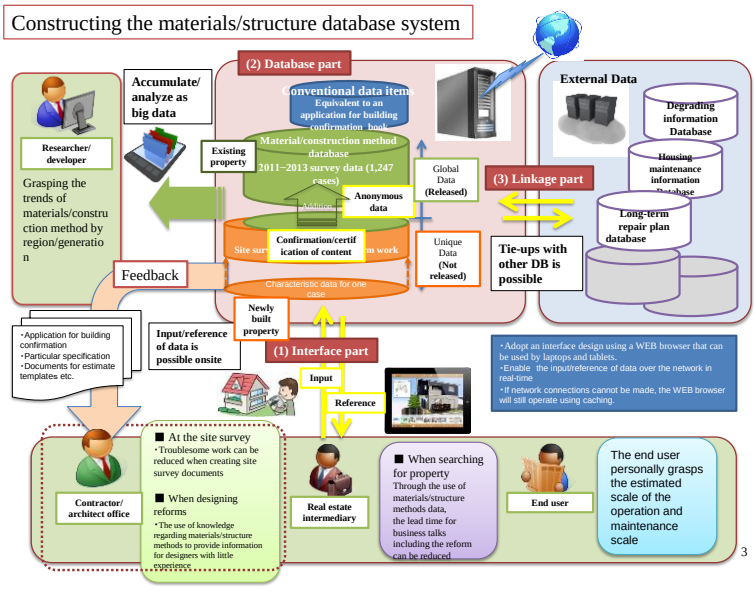

Figure 1:Constructing the materials/structure database

4. Conclusion

The materials/structure method database system, from a business support standpoint, is scheduled for a test operation after user registrations have been received. In the future, through feedback of actual data of the materials/structure method for each part acquired from site surveys, the information aims to be used as a shared knowledge base.

(Reference)

1) Comprehensive Technology Development Projects
"Development on performance evaluation technologies for home inspection to reduce uncertainty of existing houses (2011-2014)"
http://www.mlit.go.jp/tec/gijutu/kaihatu/pdf/soupro011.pdf

Developing evaluation tools for the simulation of sunshine, lighting levels pertaining to existing houses

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(Keywords) Distribtuion of existing houses, sunshine, simulation, evaluation tool

1. Foreword

Sunshine and lighting are important items that are considered when consumers select homes, however, the mechanism and technology to quantitatively evaluate those levels as housing performances have not been established. As well, after selecting a home, the levels of sunshine and lighting change due to the influence of surrounding buildings. As a result, for the purpose of spreading the use of good sunshine/lighting levels at housing distribution sites, a simulation evaluation tool was developed.

2. Overview of the simulation evaluation tool

The developed tool possesses the following functions.

Function (1): The evaluation of the sunshine/lighting levels based on the point of measure of each building under the building circumstances of the present condition of the block and each site inside the block.

Function (2): The evaluation of sunshine/lighting levels on the point of measure of each building in cases where each site was crowded with houses allowed to the maximum limit under current laws, or cases with a constant building control.

The overview of the simulation evaluation tool is shown below.

(1) Create a model for the possible building range

Condtions like the the collective default conditions of the target block, reverse light calculations and diagonal clearance, as well as the retraction distance from the boundary line of the adjacent land and boundary line of the street will be set, and a three-dimensional range of the maximum crowding of houses allowed under current laws will be created.

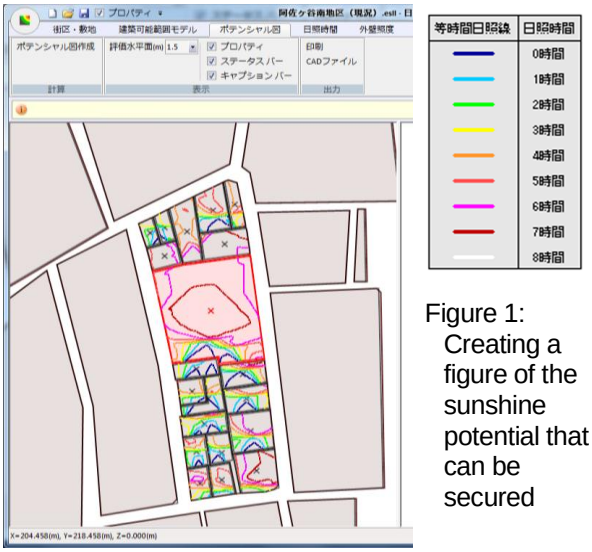

Figure 1: Creating a figure of the sunshine potential that can be secured

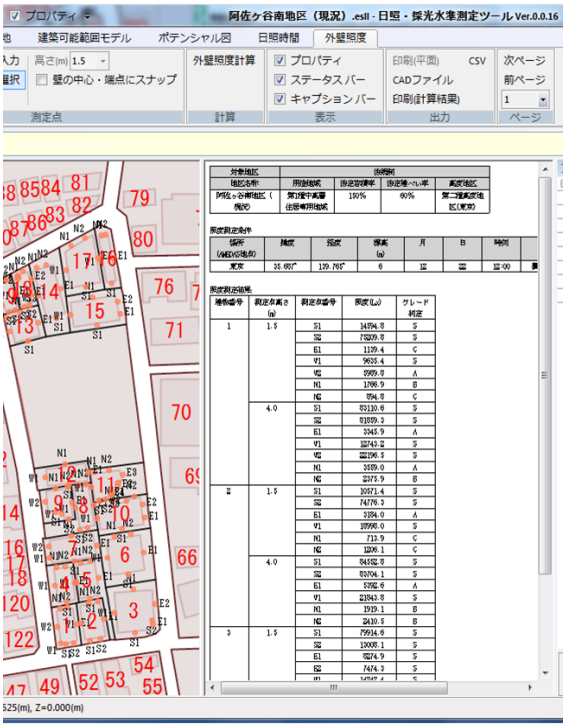

Figure 2: Simulation example of sunshine hours at each measurement point

(2) Creating a figure of the sunshine potential that can be secured

For buildings with a constant capacity of usage

placed on each site in the block, a "figure of sunshine securing potential" of isochronous sunshine projections on a horizontal plane with constant height at each site will be created, taking compound shade into consideration (Figure 1).

(3) Simulation measurement of the sunshine and lighting standard

Measurement conditions like latitude/longitude, the position and height of the building and capacity use will be designated, and simulation measurements of sunshine hours and lighting levels (outer wall surface illumination) will be made. Sunshine will be measured from 8:00 to 16:00 on the day of the winter solstice (Figure 2). The surface illumination will be measured with a CIE standard sky (overcast sky 15,0001x etc.).

3. Releasing and using the results

The developed tools are scheduled for released on the NILIM homepage. As well, further examinations will be made regarding mechanisms to position sunshine/lighting levels in the housing performance indication system.

Promotion of Countermeasures in Sewerage against Global Warming

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KAWASUMI Ryota, Researcher
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Key words: Global warming, sewerage, water treatment process, nitrous oxide

1. Introduction

In order to promote global warming countermeasures in sewerage, this Division has been studying factual surveys and emission reduction methods for nitrous oxide ("N_2O"), a greenhouse gas ("GHG") emitted from water treatment process.

2. Reduction of GHG emissions from water treatment process

It is known that N_2O gas is generated from biological wastewater treatment systems, but there are still unclear matters concerning the contributing conditions, and sufficient measures have not been taken to control the generation of N_2O gas from water treatment process. Therefore, this Division first conducted a field survey of several sewage treatment systems in municipal sewage treatment plants in order to grasp the actual status of N_2O emissions. Past surveys indicated that treatment with nitrogen removal showed lower emissions than the methods without nitrogen removal. Further, in order to investigate the difference in emission according to treatment methods, we examined changes in N_2O gas emissions using a pilot plant by switching from operation in the conventional process (CAS method) to anaerobic-aerobic process, (AO method) (RUN1), which is advanced treatment, or to pseudo-anaerobic-aerobic process, which is staged advanced treatment, (pseudo AO method) (RUN2). As the result, N_2O gas emissions reduced 80% or more as compared with operation in the CAS method after changing the operation method both in RUN1 and RUN2 (Figure 1). As the result of examining N_2O emissions from each reactor, in the AO method and pseudo-AO method, emissions from the front of the aeration tank were lower than the CAS method (Figure 2). In addition, as compared with the CAS method, pseudo AO method and AO method improved the ratio of the nitrogen removal by approx. 10 percent, which suggests the effect of microorganisms causing nitrogen metabolism on N_2O emissions.

3. Conclusion

The interim results of the study show that N_2O emissions can be reduced by conducting the treatment method that improves the ratio of nitrogen removal, which also suggests that advanced treatment can lead to reduction of N_2O emissions as well as quality improvement in treated water. Accordingly, introduction of the advanced treatment method is expected to control N_2O emissions.

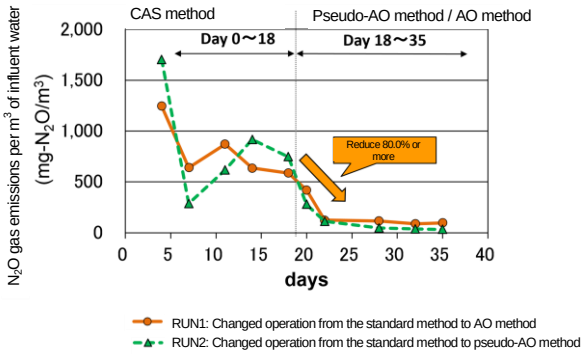

Figure 1. Comparing N_2O Gas Emissions by Changing Treatment Method

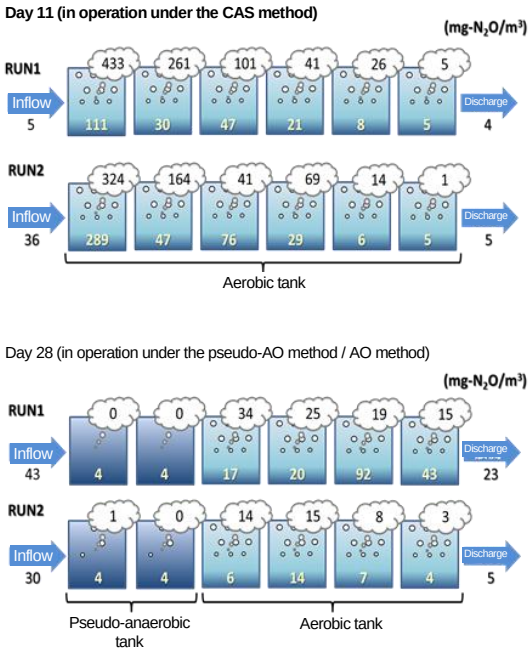

Figure 2. Difference of N_2O Emissions in CAS Method and Pseudo AO Method (Changes in Reactor)

Promotion of Water Treatment Technology Considering Energy Optimization and Risk Control

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Key words: Nitrogen removal, energy consumption, reclaimed wastewater, carbon-dioxide emissions, hygienic risk

1. Introduction

Sewerage greatly contributes to maintenance of good water environment, and for that purpose, removal of harmful microorganisms in sewage is important as well as removal of organic matter and nutrient salt. Moreover, effort to reduce energy consumption related to water treatment is important for achieving sustainable environment. This Division is conducting research and study from various viewpoints for conservation of good water environment by sewerage.

2. Study on energy optimization in drainage basin

Because the energy efficiency of nitrogen removal in small-scale wastewater treatment plants is low, we studied whether energy consumption could be reduced in the whole drainage basin by integrating the pollution load removal and associated energy consumption of multiple wastewater treatment plants into large-scale wastewater treatment plants.

We made a simple design of treatment facility and estimated based on capacity calculation the amount of nitrogen to be removed and the necessary capacity of water treatment facility, and defined the water treatment facility according to the estimated capacity. Then, we estimated energy consumption by adding up electricity usage using the rated power of this facility. Based on the results of this estimation, we created a relational expression on energy consumption and removal of nitrogen according to water treatment methods. With this expression, we studied the energy reduction effect of five small and large wastewater treatment plants by concentrating nitrogen removal on large-scale wastewater treatment plants, while ensuring the required amount of nitrogen reduction in the model drainage basin. As the result, it was estimated to be able to reduce about 21% of energy consumption required for water treatment in the whole basin.

In addition, a similar relational expression created with the performance values of statistical data suggested a possibility of inefficient operation in small treatment facilities due mainly to influent load fluctuation since energy consumption in such facilities was higher.

3. Evaluation of carbon-dioxide emissions in reclaimed wastewater utilization

Reclaimed wastewater is valuable as a water resource available even at the time of drought, but energy consumption should be considered in using reclaimed wastewater.

Accordingly, we estimated energy consumption in the supply of reclaimed wastewater using a wastewater reclamation process that includes the membrane filtration treatment, for which development is advancing in recent years. In this estimation, we evaluated energy consumption as carbon-dioxide emissions ($LCCO_2$) since we considered not only power consumption for wastewater reclamation but also the energy used for manufacturing, etc. chemicals consumed in wastewater reclamation. The figure shows an example of such evaluation. As a result, emissions of $LCCO_2$ were smaller in the wastewater reclamation process consisting of "Ultrafiltration membrane (UF membrane) treatment + Ultraviolet (UV) disinfection" than in the conventional wastewater reclamation process consisting of "Prechlorination + Coagulation sedimentation + Sand filtration + UV disinfection," which uses many chemicals. This result also suggests superiority in terms of energy consumption and applicability of the wastewater reclamation by membrane filtration treatment, which had been said to consume much energy.

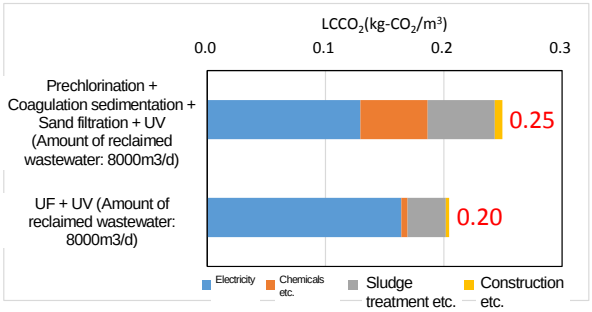

Figure. Example for Comparison of $LCCO_2$ in Wastewater Reclamation

4. Evaluation of hygienic risk control technology for treated wastewater / reclaimed wastewater

We have been studying typical technologies for disinfection and reclamation of treated wastewater in order to evaluate optimal treatment technologies from the two viewpoints of hygienic risk (infection risk) of treated wastewater / reclaimed wastewater and the cost and

energy consumption of treatment technologies. We aim to utilize findings of this study mainly for proposal of treatment technology that controls cost and energy consumption while reducing hygienic risk.

Activities for Practical Environmental Management of Rivers

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KAI Takashi, Guest Research Engineer
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Key words: River environment, environmental management, environmental target

1. Introduction

Building a society that lives in harmony with nature by conserving biodiversity is a goal of social infrastructure. For rivers, this goal should be achieved through environmental management, but practical environmental management has not been established in many river systems due mainly to the difficulty of setting environmental targets. To improve the environmental management of rivers, we try to provide insight into solving this issue based on a review and discussion of practical activities conducted to date. [1)]

2. Environmental management under basic principles

In environmental management, it is desirable to set specific targets and manage the environment toward those targets. However, any attempt to set environmental targets is inevitably accompanied by difficulties in building consensus and converting qualitative targets into practice, even if established. These issues already have been discussed in the River Environmental Target Review Committee, but no conclusion has been reached.

Therefore, the authors are proposing an approach to setting "basic principles," without environmental targets, and applying them to practical environmental management. Considering that "basic principles" for environmental management could more easily obtain a consensus and could be commonly applied to all rivers if defined as "preserving in principle the existing environment and possibly improving it," we discussed specific measures as follows in accordance with this approach.

3. Practical measures for environmental management

As a specific measure of environmental management under the "basic principles," we propose a method of conservation in which areas with a relatively good environment are designated as "good sites" in each longitudinal river category (e.g. "sub-segment"), while the environments of other sites in the same segment are improved in relation to the "good sites." The advantage of designating "good sites" is that the river managers can feel and touch the site because it actually exists. Furthermore, as shown in the figure, we prepared three sheets necessary for selecting "good sites" and environmental management activities. Thus, we are devising measures that enable us to "comprehend / assess the conditions" of a river environment in a quantitative and easy-to-understand manner using already existing data. We are still improving this method and identifying issues by applying it to some rivers. This method is already applicable in part to actual operations, but there are issues to solve in the future, including how to designate "good sites" in rivers with severely deteriorated environments, establish appropriate habitat indicators for each segment, and devise appropriate scales for that purpose.

Furthermore, we are constructing a database system for enhancing our efficiency to "comprehend and assess conditions" of river environments. Utilizing this system, we aim to increase the findings useful for the environmental management of rivers and to be able to refer to cases in other rivers with similar environments.

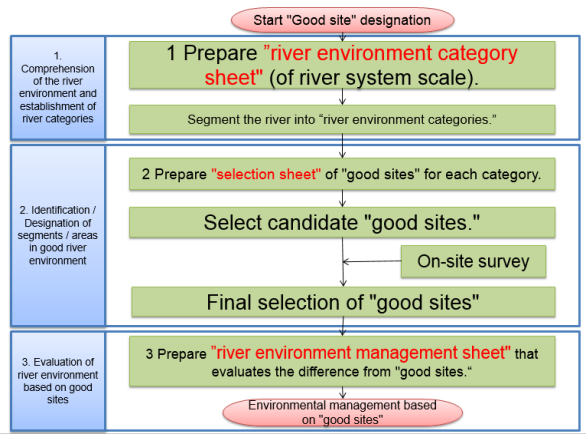

Figure. Selection of Good Sites and Sheets Required

[Reference]

1) NAKAMURA Keigo, HATTORI Atsushi, FUKUHAMA Masaya: "Approaches and Problems for Practical River Environment Management" Civil Engineering Journal, Vol. 57(2), pp. 10-13, 2015

For Establishment of Groundwater Management Contributing to Sound Hydrological Cycle --- Utilization of Hydrological Cycle Analysis for Groundwater Management ---

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Key words: Hydrological cycle, hydrological cycle analysis, ground water, groundwater management

1. Introduction

The Basic Law on the Water Cycle was established and enforced in fiscal 2014. This Law focuses on the public nature of water, providing that "Since water is a valuable common asset of the nation and a highly public resource, it shall be used properly and it shall be ensured that all the people can enjoy the benefits of water."

Conventional groundwater management in Japan has been developed in a limited way due to the restriction arising from its nature as private right related to land, centering on areas where public use of underground water, such as tap water, has advanced or areas where the ground remarkably subsided in the past. In the future, it is necessary to manage ground water in accordance with the purpose of the Basic Law on the Water Cycle and actual conditions of local areas. Aiming for contribution to this end, the Water Cycle Division of the National Institute for Land and Infrastructure Management (NILIM) is studying about hydrological cycle analysis.

2. Utilization of hydrological cycle analysis for groundwater management

Hydrological cycle analysis is a technique that couples hydrologic processes such as surface water and ground water to analyze them physically and integrally in terms of wide-area hydrological cycle systems, such as whole or part of basin, and is expected to be utilized widely for groundwater management.

In the first place, it is expected to grasp "basic information," such as flow characteristics of ground water and water balance in the basin, by interpolating discrete observation information. In order to promote management of ground water, consensus building among local residents and adjustment with the organizations concerned are essential, and as the first step for that purpose, it would be necessary to clarify and share such "basic information." In addition, grasp of flow characteristics can serve to examine observation wells for new construction and establishment of standards for appropriate water level, etc.

Further, it is possible to convert the information into "visual information" as shown in the streamline chart of Figure 1 using a plotting program. This will serve to foster the recognition that ground water is not indigenous to the land but one of the elements constituting a water cycle. Moreover, it is possible to use as a tool to "evaluate policies," such as groundwater increment policies for paddy field cultivation or rain water infiltration, control of groundwater pumping. These information is expected to serve as important information in determining propriety of a policy or gaining understanding of a policy.

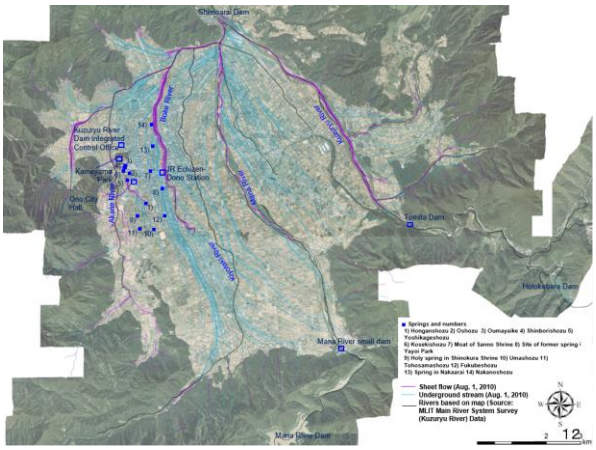

Figure 1. Streamline Chart in Oono Basin, Fukui

3. Trend of research

The Water Cycle Division of the NILIM has been conducting case studies on hydrological cycle analysis in the basin of Sendai River (alluvial plain in Tottori) and Oono Basin (alluvial fan in Fukui). Particularly in the Oono Basin, while collecting opinions from Oono City about specific needs for findings from the analysis, we are discussing effective position of paddy field cultivation and analyzing various cases in order to clarify the hydrogeological characteristics of the Oono Basin, including sensitivity analysis under various topographical / geological conditions. [1)]

We plan to document the know-how obtained through these studies as a manual or otherwise for local governments and expect it to contribute to further utilization of hydrological cycle analysis for groundwater management.

[Reference]

1) Journal "Rivers", August 2014 issue "Utilization of Hydrological Cycle Analysis for Maintenance / Improvement of Sound Hydrological Cycle"

Proposed Method of Using Existing Survey Results to Assess People with Mobility Difficulties

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(Key words) People with mobility difficulties, regions where public transportation is difficult to use, person trip (PT) survey

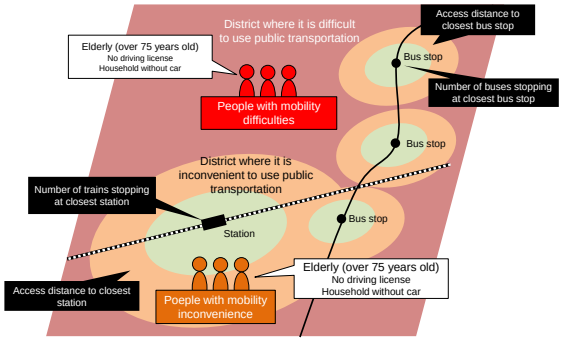
1. Introduction

It is predicted that in Japan, the future decline of public transportation services and the increase in the population of elderly people who will not be able to drive easily, mainly in regional cities, will cause severe challenges to people who must move to lead their daily lives. This research proposed a method of identifying and assessing people with mobility difficulties (or inconvenience), based on the state of daily movement as revealed by past surveys.

2. Concept of people with mobility difficulties (or inconvenience)

The concept of people with mobility difficulties and people with mobility inconvenience considers public transportation (railways and buses) and automobile usage environments, and specifically, as shown in Figure 1, defines people who live in regions where it is difficult (or inconvenient) to use public transportation and whose ability to use an automobile on a daily basis is restricted as people with mobility difficulties and people with mobility inconvenience respectively. Regions where public transportation is difficult to use are regions where the nearest railway station or bus stop is so far away, daily use is impossible, and inconvenient regions are regions where the nearest railway station or bus stop is far away so daily use of them is unpleasant (residents do not feel like using them) or regions where there is a nearby station, but so few trains serve the station that daily use of the station is unpleasant.

Figure 1 Definition of concept of people with mobility difficulties (or inconvenience)



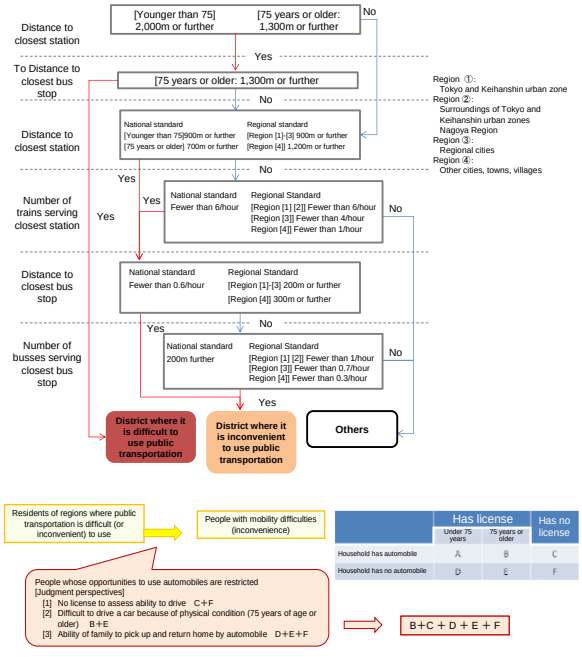
3. Identifying regions where public transportation is difficult (or inconvenient) to use

The division has judged regions where it is difficult (or inconvenient) to use public transportation based on person trip (PT) survey data and the results of analysis of its relationship with the public transportation usage environment (distance, number of trains) (Fig. 2). The concept governing the analysis is judging the distance where, if the distance is longer than a specified distance (limit distance), almost no trips are taken using this transportation method in this region (difficulty: 95 percentile, inconvenience: 80 percentile). Persons with mobility difficulty (inconvenience) were identified as persons living in a region where it is difficult (inconvenient) to use public transportation and whose opportunities to drive an automobile are restricted.

4. Future challenges

Regarding set values and setting conditions etc., because they are set as tentative values by analyzing

Figure 2 Procedure for identifying people with mobility difficulties (or inconvenience)



existing materials, it is necessary to improve precision and explanatory power according to the increase of future survey data.

Studying CO_2 Balance through the Life Cycle of Infrastructure

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NAGAHAMA Yosuke, Researcher
KANDA Mayumi, Researcher
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(Key words) Infrastructure LCA, CO_2 emissions by road work, Carbonation of concrete

1. Introduction

The NILIM has developed a calculation method and carbon dioxide (CO_2) emission basic unit to be applied at each decision-making stage including design, construction, and materials selection to calculate the quantity of CO_2 emitted from the materials manufacturing stage through transport and construction on site, as a technology to appropriately evaluate CO_2 emission reduction technologies in the provision of public capital. [1)]

This report introduces the state of research on quantity of CO_2 emitted at the planning stage (before the design stage) and quantity of CO_2 fixed by use and recycling (after the construction stage on site), which is a remaining challenge facing infrastructure LCA.

2. Study of CO_2 emissions at the planning stage

It is assumed that at the planning stage, there are no quantitative data for each category of work beginning at the design stage, so it is necessary to compute CO_2 emissions based on length for each type of road structure (earthwork, bridges, tunnels) work. So we obtained design documents for road projects on government managed roads (total of 172 works) and based on quantitative data for each work category, aggregated the quantity of CO_2 emitted by each category of work using the infrastructure LCA method, to calculate the quantity of CO_2 emitted by type of road structure per 1km of each traffic lane. The results revealed great scattering between earthwork, bridges, and tunnels as shown in Table 1. The study analyzed the relationship of filling and cutting (earthwork) and width (bridges or tunnels) with CO_2 emissions, but wide scattering remained, and it was not possible to directly discover a correlation that would permit its adoption as the CO_2 emission basic unit.

The planning stage is divided into the concept stage (general route and structures etc. study stage) and the detailed planning stage (specific route and structure etc. in a city plan etc. study stage) of an actual road project. In the future, we will study the CO_2 emission calculation method in order to be able to use it as an evaluation item for each decision based on data obtainable at each stage.

Table 1 Results of Calculation of Quantity of CO_2 Emissions by Road Work

	Emission basic unit of CO_2 per vehicle-km [t-CO_2/km/vehicle lane]						
	Average value					Max.	Min.
	Material	Transport	Moving construction machines	Wear on construction machines	Totals		
Earthwork (106 works)	491	69	113	47	697	3,394	100
Tunnels (23 works)	4,850	174	302	179	5,390	6,642	4,098
Briges (43 works)	12,085	360	382	288	13,116	45,547	5,320

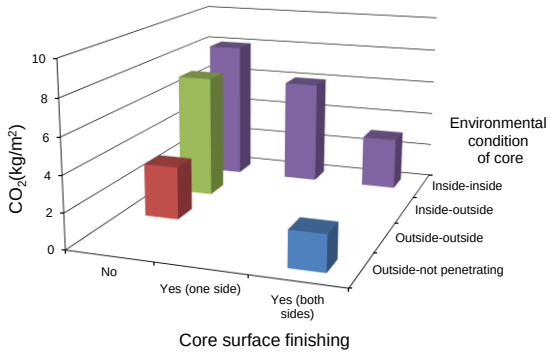
3. Fixing CO_2 in concrete through use and recycling

Decarboxylation during cement manufacture emits CO_2, but part of this is recovered by use and recycling of structures through so-called carbonation of concrete. We consider the carbonation of concrete to be a CO_2 absorption action, and believe it is appropriate to incorporate its effects in evaluations of CO_2 emissions during use and recycling of concrete structures. (But, carbonation of a reinforced concrete structure is a major deterioration mechanism, so it is necessary to be careful to definitely not recommend this process).

Little is known about using the carbonation of concrete as a CO_2 absorption action, and the quantity of CO_2 fixed is unknown.

So assuming that it is important to first clarify approximate impacts of CO_2 fixing, the quantity of CO_2 fixed in a concrete core taken from an actual structure and

Figure 1 Quantity of CO_2 fixed by wall members estimated from concrete cores taken from wall surfaces of concrete structures between 26 and 50 years old
(Approximately 5kgCO_2/m^2 of CO_2 fixed by wall member materials.)



The following is a categorization of conditions
- ■ Finished
- • No: Both surfaces of the core are planed or lightly finished with cloth or by spraying
- • One side: One side is heavily finished with mortar tile etc. and one side is lightly finished
- • Both sides: Both surfaces of the core are heavily finished (non-penetrated surface categorized as heavy finishing)
- ■ Environmental conditions
- • Inside: indoors, Outside: outdoors

in a concrete specimen prepared simulating recycling was measured, (Fig. 1, Table 2).

In the future, we will study life cycle CO_2 balance considering the CO_2 emissions from the construction to the recycling stage of a structure.

Table 2 Quantity of CO_2 fixed per 1 ton of concrete estimated based on a concrete sample prepared to simulate recycling
(The more cement and smaller its particle diameter, the larger the quantities of CO_2 fixed by each recycled product)

Product	Fixed quantity (kg CO/ton)
Recycled aggregate H (mechanical method)	30.0
Recycled aggregate H (thermal method)	24.7
Recycled aggregate M	26.1
Recycled aggregate L	15.2
RC40	10.0

※ Case where the samples were exposed to the atmosphere for 28 days under alternate dry-wet conditions
※ CO_2 was not measured in tiny particles of recycled aggregate M and L, so tiny particles of recycled aggregate H (mechanical method) were substituted during production.

[Sources]

1) NILIM Project Research Report 36, Development of Life Cycle Assessment Methodology on Sustainability of Infrastructures
http://www.nilim.go.jp/lab/bcg/siryou/kpr/prn0036.htm

How Does Constructing a New Road Change Emissions of Carbon Dioxide from Automobiles?

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(Key words) Road construction, automobile, carbon dioxide, road traffic data

1. Introduction

In preparation for COP21 scheduled for November 2015, the government is now enacting a new greenhouse effect gas reduction plan for Japan as a successor to the Kyoto Protocol Target Achievement Plan. The Road Environment Division is conducting research and development of a method of monitoring carbon dioxide (below, "CO_2") emission from automobiles and a method of predicting changes in CO_2 emissions from automobiles accompany the opening of a newly constructed road.

2. Study method

In order to quantitatively clarify the CO_2 emission reduction effects of constructing a new road, Road Traffic Data (traffic volume, traveling speed) collected by private sector probe cars or traffic counters was used to calculate change of CO_2 caused by the completion of an individual road project.

3. Study results

The quantity of CO_2 emissions by regional block computed based on road traffic data conformed generally with CO_2 emissions computed based on inventory data (greenhouse effect gas emission data caused by fuel consumption). (See Figure 1)

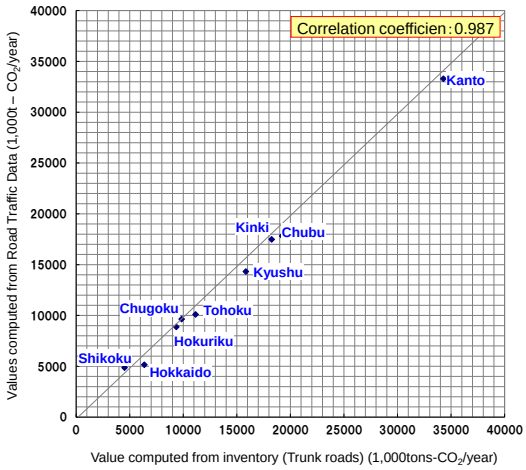
And road traffic data for the same month of the year before and year after opening of the road was used to calculate and compare change of CO_2 emissions by the opening of a new road. (See Figure 2)

The results clarified the average traveling speed improvement effects of constructing the new road at the same time as they confirmed that improvement of average traveling speed did not increase CO_2 emissions, even in sections where the traffic volume increased.

4. Future Plans

Based on the results and knowledge obtained by this study, we will perform further verifications to build a method of monitoring CO_2 emissions by automobiles and a method of predicting changes in CO_2 emissions from automobiles resulting from the construction of a new road.

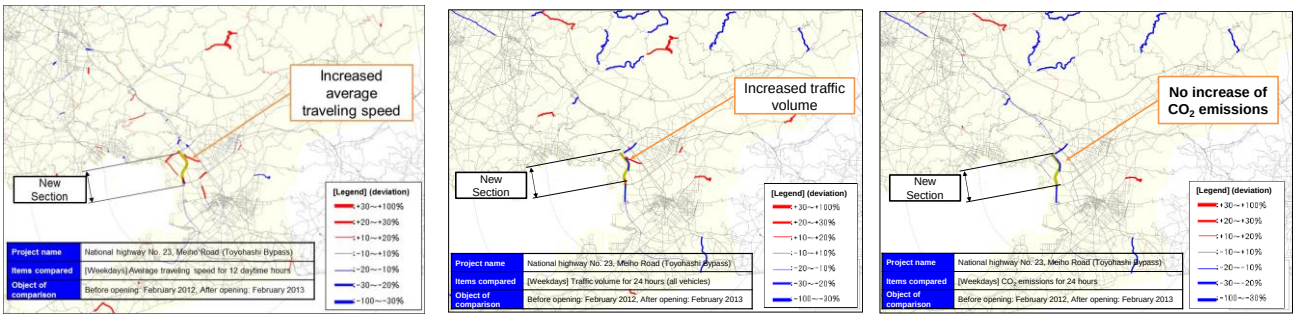
Figure 1 Results of Comparison of Calculated CO_2 Emissions



[Sources]

1) TECHNICAL NOTE of NILIM No. 671
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0671.htm

Figure 2 Changes of Average Traveling Speed, Traffic Volume, and CO_2 Emissions by the Construction of a New Road Obtained Using Road Traffic Data (National Highway 23, Toyohashi BP)



Study of Directions to Achieve Lower Energy Consumption by Road Facilities and Sustainable Energy Use

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(Key words) Road facility, energy conservation, sustainable energy, sustainability, environmental load reduction

1. Introduction

In the intermediate collection of proposals by the Road Committee of the Council for Social Infrastructure (June 2012), specific proposals included "Actions to Promote the Widespread Use of Low Carbon Mobility: Towards Green Road Space", and as one action to achieve a low carbon society that is a present goal, it presented, "Reducing Energy Use by Road Facilities (aggressive use of LED lighting, use of sustainable energy generating facilities)".

The Ministry of Land, Infrastructure, Transport and Tourism's Basic Technology Plan (December 2012) positions effectively using energy and minimizing energy consumption as challenges that must be considered to undertake technology policies, in particular, technology R&D.

So the NILIM has collected required information and studied activities to fulfill the roles demanded of road managers by organizing future technology development programs in order to promote energy conservation by road facilities and to introduce sustainable energies.

2. Survey of electric power demand

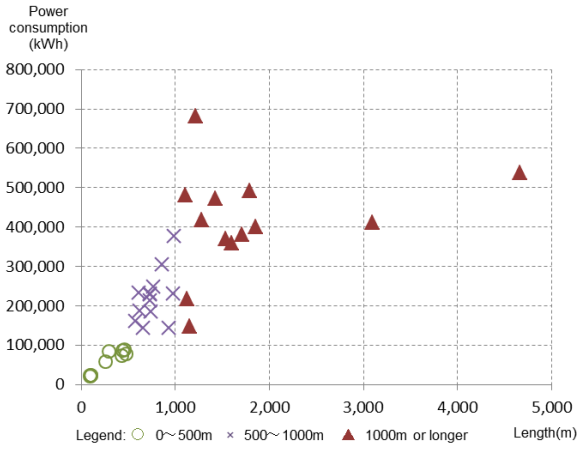
The division surveyed quantities of electric power consumed by road offices throughout Japan in order to clarify characteristics of electric power use (fluctuation by time) and electric power demand of road facilities in Japan.

The results of the survey indicated that road facilities with heavy electric power loads are road lighting, tunnels (lighting and ventilation systems) and snow melting systems (road heating, etc.). The results of an estimation of electric power demand throughout Japan based on the results of the survey show that electric power consumption by government managed roads breaks down as road lighting 35%, tunnels 32%, snow melting systems 15%, drainage equipment, relay points and signboards etc. 10%, and road stations 8%.

About 76.6% of tunnels (locations) in Japan are shorter than 500m, and based on the characteristic installation conditions of tunnel lighting and ventilation equipment, electric power consumption of the tunnels surveyed were organized by tunnel length class (Fig.).

3. Study of directions of technology development

Figure: Electric power consumption of tunnels



Based on characteristics of energy demand by road facilities and directions of Japan's energy policies, we organized challenges and categorized the following five themes (proposals) concerning the desirable directions of the promotion of future developments.

[1] Research and development to build energy systems adapted to demand characteristics

[2] Research and development to improve the infrastructure to adapt to the spread of next-generation automobiles

[3] Research and development to build energy systems for bases to strengthen disaster-prevention functions

[4] Research and development to build energy systems for entire roads to toughen the national land

[5] Research and development to build integrated infrastructure

4. Use of the results

Further verification of the electric power consumption values obtained by this research will be carried out and applied to promote research and development of technologies that will further reduce energy consumption by road facilities and sustainable energy technologies.

Topics

Verification Testing and Overseas Research to Promote Further Utility Pole Removal

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(Key words) Utility pole removal, underground installation, road function

1. Introduction

To improve the disaster prevention properties of roads, ensure safe and pleasant traffic space, form beautiful scenery, and encourage tourism, we have, for a long time, promoted the removal of more utility poles from roads by placing electrical power lines underground. However, utility pole removal in Japan lags behind that in major overseas cities (see Fig.). The NILIM works to more aggressively promote the removal of utility poles by clarifying trends in related systems and technologies in foreign countries, in addition to conducting verification testing to reduce costs by resolving technical problems. This report outlines these activities.

2. Overseas research of legal systems and technology trends in utility pole removal

We are examining research literature and sending fact-finding missions regarding legal systems and technology trends in foreign cities where utility pole removal is nearly 100% complete: London, Paris, and Singapore. In particular, while interviewing road administrators and electric utility operators etc. in each city, we collected information about undergrounding policy and technical standards such as cable depths and horizontal position, and undergrounding methods that offset distance from communication lines, cable specifications, and safety measures.

3. Verification testing of low cost utility pole removal methods

As methods of removing utility poles that are less costly than the multipurpose electric cable method that has been used in Japan until now, we are considering adopting methods of underground installation such as burying electric cables etc. at more shallow levels or directly under the road pavement, or a laying method using compact boxes. So a technical study committee[1)] was formed to study technical challenges to introducing such new utility pole removal methods, and it has been working in cooperation with the Ministry of Internal Affairs and Communications, Ministry of Economy, Trade and Industry, electric utilities, electric communication companies, and other concerned organizations.

So this year, we conducted accelerated loading tests to verify the impact on road functions and on electric supply and communication functions, in a case where the road is subjected to cyclic loading equivalent to 10 years of use, which is the design service lifetime of pavement (see Photo). We constructed tests of roads with light traffic (fewer than 250 large vehicles per day) where electric power cables and communication cables are placed inside pavement, either directly or in pipes or where compact boxes were constructed to protect the electric cables. The results show that electric cables etc. can be placed at a more shallow level than stipulated in the current technical standards.

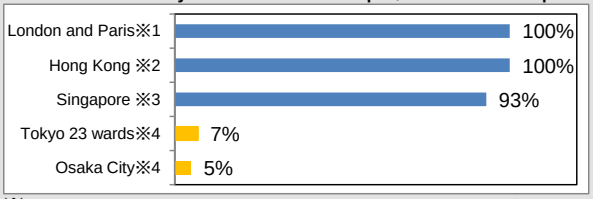
4. Future efforts

We will continue to investigate technical studies to introduce low cost utility pole removal methods in the field, and will revise technical standards etc.

[Sources]

1) State of Deliberations by the Low Cost Utility Pole Removal Methods Technology Study Committee, http://www.nilim.go.jp/lab/ucg/koho/index.html

Figure: Information about the progress of Utility Pole Removal in Major Cities of Europe, Asia and Japan



※1 Conditions in 2004 provided by Japan Electric Power Information Center (cable length based)
※2 Conditions in 2004 provided by Infrastructure Development Institute-Japan Investigation (cable length based)
※3 Conditions in 1998 provided by Overseas Electric Power Industry Statistics (cable length based)
※4 State at end of FY2013 provided by Ministry of Land, Infrastructure, Transport and Tourism investigation (road length based)

(http://www.mlit.go.jp/road/road/traffic/chicyuka/genjo_01.htm)

Photo : Accelerated loading tests for pavement and underground cables

The development and verification of energy consumption performance prediction tools inducing the energy-saving design of non-residential buildings

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(Keywords) Non-residential buildings, energy-saving, low carbonization, performance evaluation, design support tool

1. Foreword

Saving energy is an urgent issue as approximately 30% of our nation's energy consumption comes from housing/buildings. In order to attain effective energy saving, it is important that energy consumption performance is predicted/evaluated in the design phase and the most suitable design is induced. At NILIM, the development of a tool (Web program) that precisely predict energy consumption performance during design stages was conducted towards non-residential buildings whose energy use is especially difficult to predict (Figure 1).

2. Developing energy consumption calculation logic

This tool evaluates the performance of the envelope and facilities as an index of the building's primary energy consumption. The logic behind the calculation of primary energy consumption was structured based on factual surveys[1)].

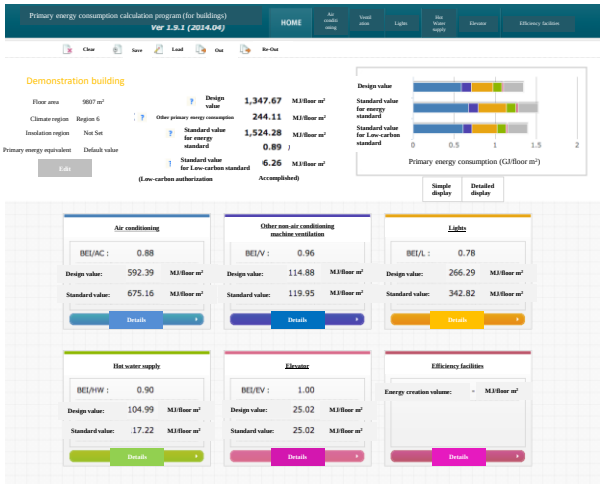

Figure 1: Energy consumption performance

3. Validation of the actual building

Because various energy-saving technologies will be evaluated in line with this tool, its high standards of equity and reliability are also in demand. In order to validate the estimated accuracy of this tool, evaluations were made using this program for multiple actual buildings and a comparison of the actual energy consumption was conducted (Figure 2). Based on these results, improvements were made on the calculation logic and adjustments were conducted on the calculation conditions.

4. Application in actual design processes

Since the information required to execute this tool can be easily created from design documents, evaluations can be easily conducted without much effort. As well, since it can be commonly used to report on various regulations/support/guidance measures like energy-saving reports (the energy-saving standard revised in April 2013) and performance indication system (BELS), appropriate evaluations can be made while reducing the burdens on designers, and promote energy-saving promotions (Figure 3).

(Reference)

1) NILIM reference No.762, 2013 energy-saving standards (promulgated January 2013) etc./related technical references - primary energy consumption calculation program explanation (non-residential buildings issue) -

2) Miyata, others: Evaluations on the validity of the primary energy consumption calculation Web programs based on actual values, Soc. of Heating, Air -Conditioning and Sanitary Engineering meeting scientific lecture papers, vol. 9, p105-108, 2014.9

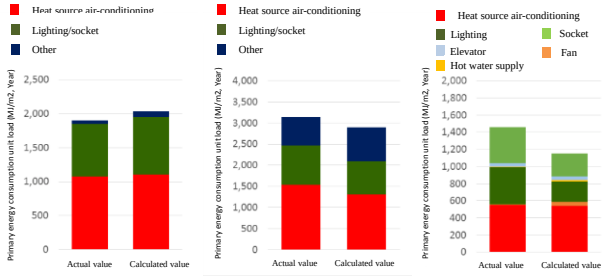

Figure 2: Example of tool verification results
(Left: School A, Middle: Hospital A, Right: Office

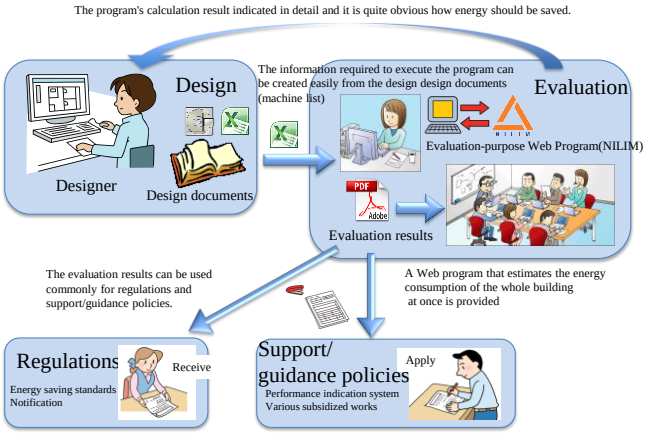

Figure 3: Construction of the design process to promote

Surveys and analysis regarding the evaluation structure of living satisfaction for the attainment of prosperous living

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Research Coordinator for Housing Performance ,Housing Department

(Keywords) Living, satisfaction, living resources, web investigations

1. Foreword

Policies are being promoted for the "Attainment of a prosperous living" based on the Basic plan for housing (National Plan/2011 to 2020), however, in light of recent financial conditions, it is essential that effective housing measures be carried out effectively. Because of this, we have been taking initiatives to investigate the evaluation structure of each household's living satisfaction (hereafter "living satisfaction") in a three-year plan since 2014. Based on a web survey, basic data was collected and analyzed in 2014.

2. Setting the living resource items

Assuming living satisfaction is defined as the quantity and quality of "living resources" possessed by each household, the "living resources," believed to define living satisfaction, was set. Items were temporarily set by consolidating relevant literature and conducting expert hearings, and through pre-investigations on the Web, a total of 34 items were set from the standpoint of residential environment, housing, community and ease of residential improvement.

3. Extracting living resource items that affect living satisfaction

Based on this Web investigation, a survey was conducted regarding the total evaluation of living satisfaction, as well as the importance and satisfaction of each living resource item. All 6,138 samples were attained by securing the number of samples that could be analyzed for separate household types (elderly single/married couples, singles other than elderlies/married couples other than elderlies,

Table 1: The results of the living resource items affecting the total evaluation of living satisfaction

	Metropolitan area/city center		Provincial area/suburbs	
	Elderly singles 457 samples	Child-rearing 758 samples	Elderly singles 412 samples	Child-rearing 1,051 samples
Residential envrionment	・Safety from traffic accidents (0.06) ・good peace and order (0.16) ・Distance to bus stop (0.12) ・Convenience of the supermarket (0.14)	・Safety from traffic accidents (0.08) ・Good peace and order (0.06) ・No facilities that negatively affect residential environment (0.11) ・Distance/convenience to railway station (0.13) ・Convenience of the supermarket (0.07) ・Convenience of the bank/post office (0.13)	・Good peace and order (0.06) ・Abundance of nature and greenery (0.06) ・Distance to bus stop (0.07) ・Convenience of the supermarket (0.15)	・Abundance of nature and greenery (010) ・Ease of car movement (0.10) ・Convenience of the supermarket (0.16)
Housing	・Airtightness, insulation characteristics (0.14) ・Spaciousness and layout (0.20)	・Seismic resistance (0.07) ・Spaciousness and layout (0.16) ・Ease of housework (0.15)	・Seismic resistance (0.14) ・Airtightness, insulation characteristics (0.11) ・Spaciousness and layout (0.23)	・Exposure to the sun and ventilation (0.12) ・Sound insulation (0.12) ・Spaciousness and layout (0.21)
Community	・Close to a child's residence (0.13) ・There are people one can greet and converse with (0.20)	・Close to a parent's residence (0.11)	・The residents' association is solid (0.19)	・Close to a friend's residence (0.08) ・The residents' association is solid (0.13)

* Inside the parenthesis is a standard partial regression coefficient and the relative influence is shown for each item. Items with larger numbers increase in proportion to the effect on the total evaluation of living satisfaction.

child-rearing) in each of the four region types (metropolitan area center/suburbs, provincial area center/suburbs).

A multiple regression analysis was conducted with the total evaluation of living satisfaction as the response variable, and the satisfaction of each living resource item as the explanatory variable for each household type in each region. Based on the standard partial regression coefficient of each explanatory variable, the items that affect the total evaluation of living satisfaction were extracted. As well, the living resource items affecting the total evaluation of living satisfaction of single elderly households and child-rearing households in the metropolitan area center/suburbs, provincial area/suburbs was extracted, as indicated in Table 1. We were able to find specific items that influence the total evaluation of living satisfaction regardless of one's place of residence and household type, as well as items that differ among one's place of residence and household type.

4. Future works

We will continue to specifically analyze the data attained and at the same time, conduct surveys and analysis of specific regions and work on clarifying the evaluation structure of living satisfaction.

Planning method proposal for elderly housing with supportive services for the living security of elderly people.

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Research Coordinator for Housing Performance, Housing Department

(Keywords) Elderly, elderly housing with supportive services, building/facility design, living support services, service management

1. Overview of registration regulations for elderly housing with supportive services

As our super-aging society rapidly progresses, households comprised of elderly singles and couples have increased. Because of this, the "Housing with home-care services provided" registration system was established (October 20, 2011) for prefectural governors planning the stabilization of residence for elderlies. This regulation registers housing that satisfied a certain degree of standards pertaining to the hardware of the housing (a housing area, in principle of over 25㎡, toilet/washroom facilities, barrier-free) and services (staff are stationed in the daytime to offer safety checks and life consultation services), obligating businesses to optimize the tenant contracts, and government to supervise housing management and services, while service promotions are supported by the nation's aid/taxation system/funds.

2. The purpose of examining the plan method

The registration standards for elderly housing with supportive services are the minimum standards that must be secured in registrations. In order to secure the stabilization of long term residences for elderly people, various schemes in terms of planning apart from the registration standards are required, regarding the provision of life support services and hardware plans to support the psychosomatic state and living needs of the elderly.

Because of this, examinations regarding plan methods will be conducted from both a hardware and software perspective, presenting the basic concept of the plan, points and cautions, and the advisable integrated/systematic technical information.

3. Points on examining the plan method

The major characteristic of senior citizen housing with home-care services is shown in Table 1. Placing the most importance on "risk management" and "supporting changes in the psychosomatic state of the tenant," examinations of the plan method were coordinated from the perspective of "buildings/facility designs with a high level of safety," "high stability life support services" and "service management duties based on risk management" (Figure 1).

4. Releasing and making the results widespread

We will release the results in NILIM research reports to plan its widespread use by holding lectures for businesses etc.

Table 1: Characteristic of senior citizen housing with home-care services（Singularity）

(1) The tenant is an elderly person whose bodily functions have decreased	・Aging after moving in, the nursing care level and medical dependence changed, with an increase in accident risks in daily living.	⇒ Support of hardware/software to changes
(2) Services and housing is integrated	・It is easy to be affected by the external environment like system revisions or the labor market.	⇒ The preparation of the business plan

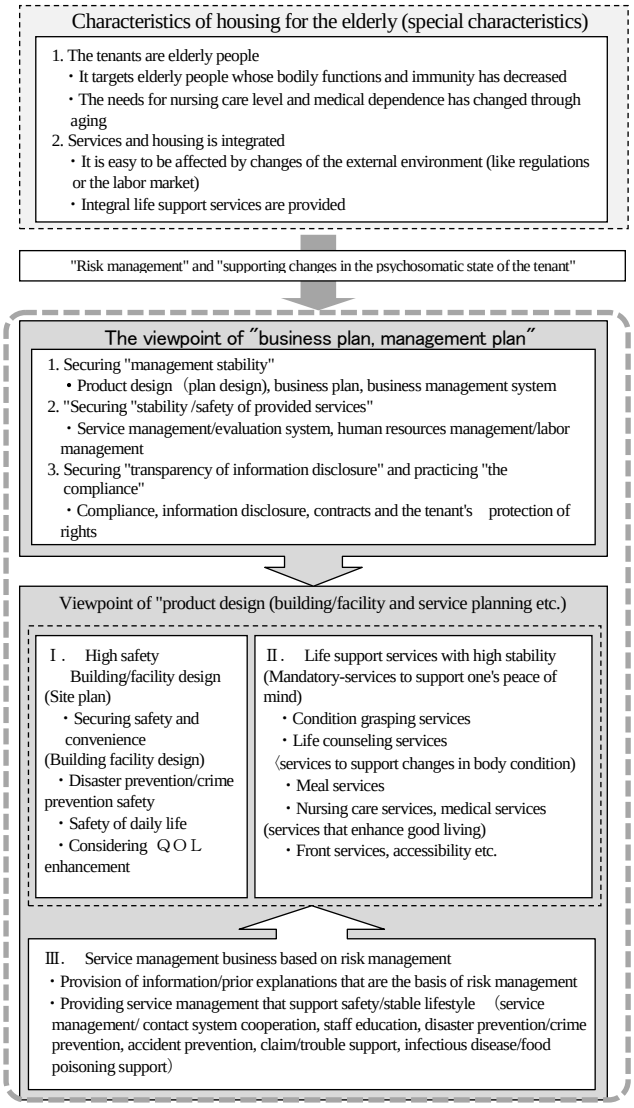

Figure 1: Structure of the senior citizen housing with home-care services plan method

Creating a knowledge base of effective barrier-free housing repairs for the living security of elderly people

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(Keywords) Elderly people, barrier-free housing repairs, plan method, repair effects, knowledge base

1. Foreword

As the dawning of a super-aging society approaches, housing reforms like barrier-free repairs will be required in order for elderly people to continue to live in the homes that they are used to living in. After the establishment of the nursing-care insurance system, barrier-free repairs have become more common, however, it cannot be said that appropriate housing repairs that fuse building expertise with experts in care has become sufficiently widespread.

Because of this, a knowledge base of planning technology information for effective barrier-free housing repairs was created, implementing survey research of housing repair methods supporting the various psychosomatic conditions and planning conditions of elderly people.

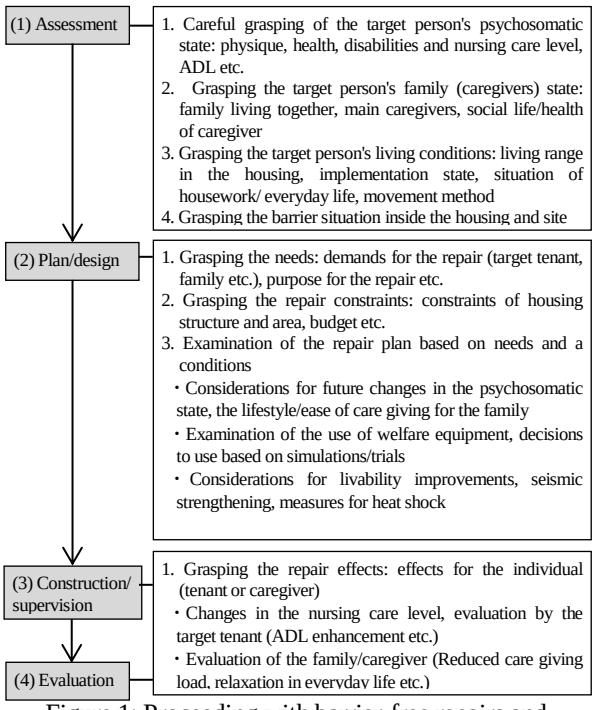
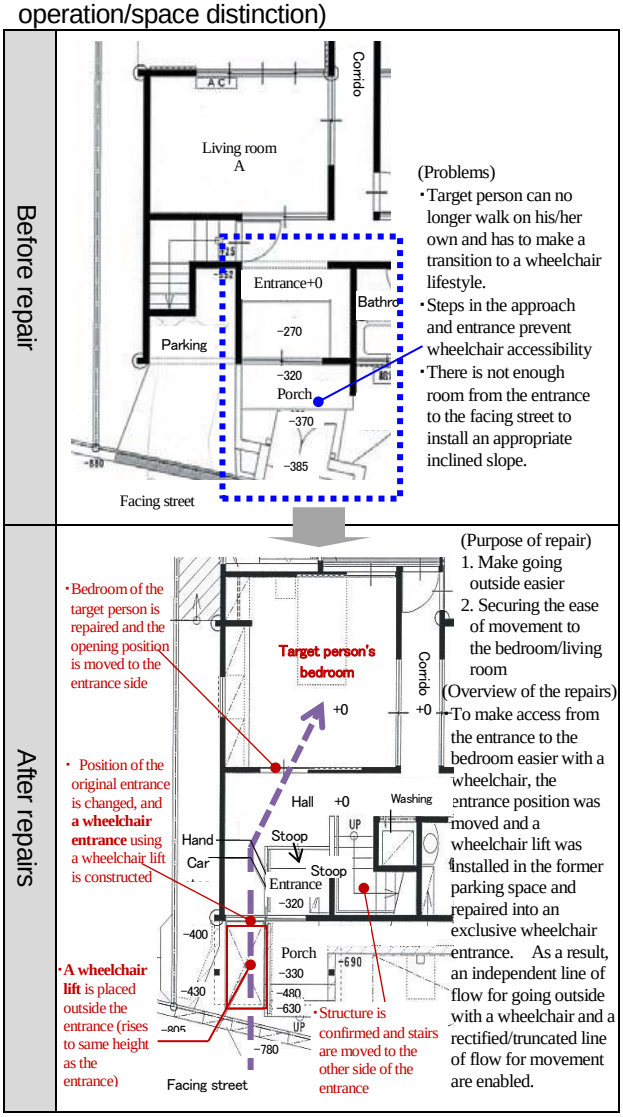


Figure 1: Proceeding with barrier-free repairs and viewpoints

2. The standardization of proceeding with barrier-free repairs

The procedure as shown from the viewpoint of Figure 1 is desirable regarding effective barrier-free repairs. Through collaborations with qualified architects and care experts, plans based on required conditions is necessary by conducting precise assessments of the target tenant and housing. As well, after the repair or a fixed period time, an evaluation of the repair effects (targeting the tenant or the caregiver) is required.

Table 1: Knowledge base examples (basic operation/space distinction)



3. Creating a knowledge base of barrier-free housing repairs

Investigations regarding the planning process and repair effects of barrier-free repair examples (31 examples) of

building and care expert collaborations were conducted, and a knowledge base was created for technical information pertaining to effective housing barrier-free repairs.

4. Releasing and making the results widespread

We will release the results in NILIM research reports and plan its widespread use by holding lectures for businesses etc.

The new evaluation index for envelope performance of commercial buildings

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(Keywords) Non-residential buildings, energy saving standards, envelope performance, PAL ＊

1. Revision of the Energy Efficiency Standard

The Energy Efficiency Standard was revised in January 2013. With regards to commercial buildings, "envelope performance" and "facility efficiency (air conditioning, ventilation, hot water supply systems, lighting and elevators)" were evaluated up to the present. Regarding the latter, each facility was evaluated by old standard indexes like the CEC (energy consumption coefficient), however, by indexing the total primary energy consumption of all facilities after the revision, it became easier to objectively compare the energy saving function of the entire building. On the other hand, envelope performances continue to be indexed by old standards like PAL (perimeter annual load), and conditions that were partially different from the calculation of the primary energy consumption (for example, regional divisions and the physical property of materials) were used in the calculation process.

NILIM, and the Building Research Institute, collectively joined their respective practitioners and people of learning and experience to create a new envelope performance index (PAL*, Palstar), which was included in the Energy Efficiency Standard in September 2013. This standard was enforced in April 2014, while the old PAL standard will be abolished in April 2015. Indexes before and after the revision are shown in Figure 1.

2. The new envelope performance index PAL*

The definition of the new envelope performance index PAL* is the same as the old standard PAL, and represents the value of the annual heating and cooling load of the building's outer periphery divided by the area of the outer periphery. The main points that were changed include: (1) regional divisions (2) the physical property of materials, (3) presumptions on how the room is used, (4) how the outer periphery area is defined and (5) consideration of latent heat load. As well, the standard values are of equal value to the old standard, and the standard value of PAL* was established from the correlation of the PAL and PAL* calculated for each building's use.

3. Releasing the calculation tool and transmitting information

For the purpose of rationalizing/labor saving calculations and examinations in the operations for the energy efficiency standard, this Internet-based calculation tool (Web program, Figure 2) has been released to the public for free use by anyone. As well, a homepage[1)] has been opened regarding technical information pertaining to energy saving standards, and each type of Web program, its explanation, and references regarding the calculation methods and prerequisite conditions of the calculation have been released.

4. Future developments

PAL* is an index established from the standpoint of annual heating and cooling load, however, we would like to enhance our information pertaining to energy efficiency by examining the required envelope performance from the viewpoint of the quality of inner thermal environments.

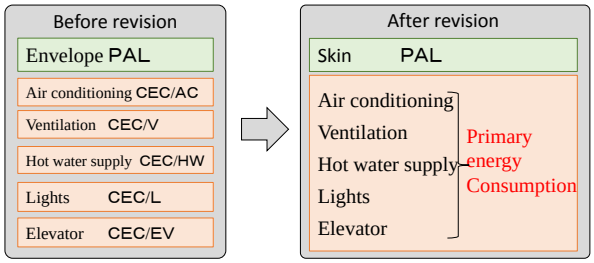

Figure 1: Index prior to the energy efficient standard revision (commercial buildings)

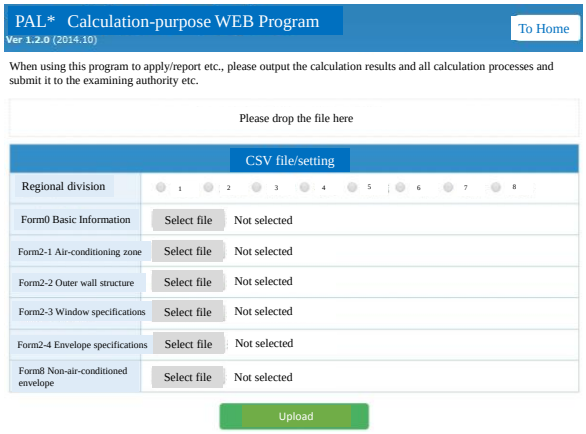

Figure 2: PAL* Calculation Web Program Screen

(Reference)

1) Technical information regarding the authorized standards in the order of energy efficiency and low-carbon buildings (Building Research Institute (cooperation: NILIM)) http://www.kenken.go.jp/becc/index.html

Development of land aptitude evaluation programs for strategic land use management

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(Keywords) city, compact, population decline, land aptitude evaluation

1. Foreword

Compacting cities is an important issue currently facing cities, and with the current population decline, there is a pressing need for an effective switchover in urban structures to effectively compact suburban districts that were expanded during the economic growth of the past.

In this case, local public bodies must for the sake of locating appropriate sites for life services functions, indicate areas that these functions should be guiding. As well, regarding its setting in the regions concerned, information should be provided in an understandable manner to the local residents, and it is also an extremely important issue that consensus building be promoted among its residents.

Because of this, a land aptitude evaluation program was developed by NILIM as a technical support measure to provide an objective basis for regional settings of local public bodies involved with urban planning duties.

2. Overview of the land aptitude evaluation program

The land aptitude evaluation program uses geospatial data like the nation's numerical land information and base map information arranged by the country that can easily be obtained by local public bodies as its basic information, and using data such as the basic city planning surveys possessed by each local public body, ianalysis and evaluations based on the land, are enabled.

The data in geospatial data from which land aptitude evaluations are based upon (for example topographic conditions, the present land use situation, road conditions, the distribution of public interest facilities, hazard maps etc.) have various spatial units, forms and scales, however, in order to enable their comparative evaluation in the same spatial units, we are developing a method to convert them into quantified evaluation values using the unified spatial units (mesh).

In this program, urban land use is largely divided into five categories (1) Residence systems, (2) Customer collecting systems, (3) Industrial/physical distribution systems, (4) Agricultural systems and (5) Natural systems. From this, the large number of spatial elements which influence land aptitude (topography incline, integration degree of land use, road conditions, accessibility etc.) can be indexed, measured in 10m mesh units and scored for an overall evaluation. As well, in order to attain the results of operations suitable for use in urban planning administrations, indications can be shown in 10m mesh (building site scale equivalency) as well as zonally integrated 100m mesh and block units.

The land aptitude evaluation values that have been quantized using this program are expected to provide an objective basis to support administrative judgments and contribute to the promotion of urban consolidation efforts by local public bodies.

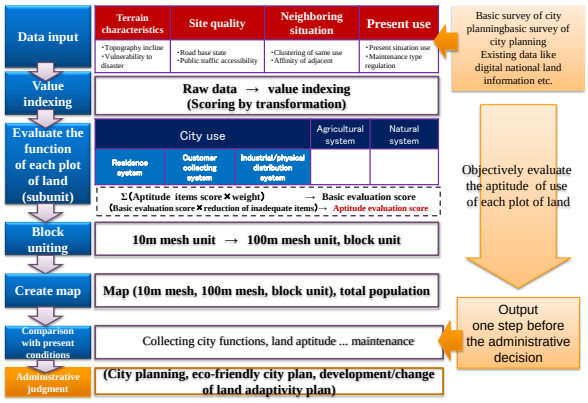

Figure 1: Land aptitude evaluation flow chart

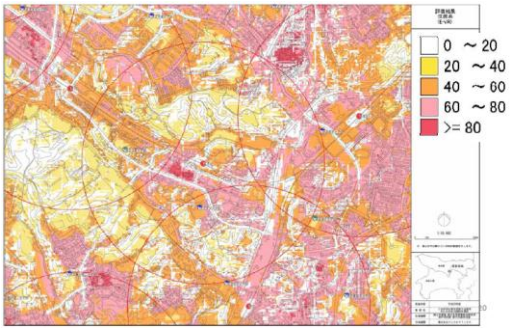

Figure 2: Example of a land aptitude evaluation of a residence system

Developing an "accessibility calculation index" to evaluate public transportation convenience in cities

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(Keywords) Public transportation, accessibility, administrative evaluations

1. Overview of the accessibility index

At NILIM, an "accessibility index" was developed and an "accessibility index utilization guide (plan)" was issued indicating its calculation procedures on May 2014. The "accessibility index" indicates the ease of access by public transport from one's place of residence to the site where administrative services facilities are located. A characteristic of this index is that it includes not just the amount of time required for the movement, but wait times affected by the frequency of the public transport system. As well, the amount of time in the calculation results are indicated in "minutes," and is devised so that the calculation method and results can be understood easily without expert knowledge.

2. Overview of the accessibility index calculation program

Recently at NILIM, an "accessibility index calculation program" that automatically calculates numerical values of all mesh (100m mesh) of subjected survey areas, where data regarding public transportation operations were input, was created and is scheduled for release in the near future.

The data input in the program generally uses data that has been released. For example, position coordinates of facilities like bus stops are acquired from the digital national land information of the Ministry of Land, Infrastructure and Transport, while basic map information is acquired from the Geographical Survey Institute of Japan and timetable data is attained from the homepages of various transportation projects. While each data is essentially input one by one using the interface as shown in Figure 1, it is also possible to collectively input data that has been arranged as text files. Regarding input methods, a separate guide is scheduled for release.

Furthermore, regarding the separate GIS software and data management software required to operate this program, all applications used are freely available to the public.

In this way, local public bodies etc. can easily perform calculations without purchasing additional accessories to input the data or run the software.

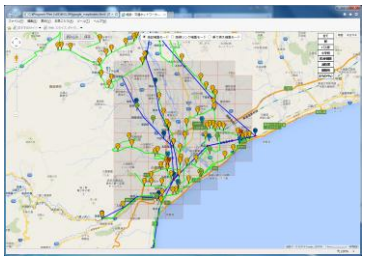

Figure 1: Inputting route data using the interface

3. Regarding the application of the calculated results

The index-calculation results are indicated in color-coded mesh as seen in Figure 2 in a manner that is easy to understand.

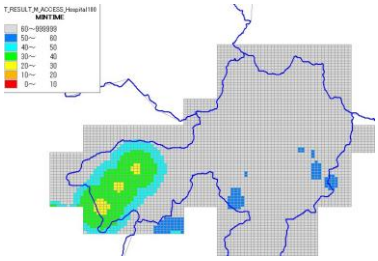

Figure 2: Output results (access to a hospital) image

While the indexed target facilities are presumably hospitals, city centers etc., it is also possible to set multiple points for various facilities. As well, any "transport hub that allows transfers" can also be set.

As a result, its application for developing placement plans for the locations of public service facilities such as hospitals, as well as land adaptability plans and examinations into reorganizing public transportation networks is anticipated.

(Reference)

1). Accessibility index utilization guide (plan)
http://www.nilim.go.jp/lab/jcg/index.files/accessibility.pdf

The plan and evaluation of planned degeneration scenarios for suburban city areas with declining populations

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(Keywords) Population reduction, urban reorganization, planned degeneration, cost analysis

1. Foreword

Taking into account the predicted population decrease in local cities and rigorous fiscal and environmental restrictions in the future, the introduction of "systematic shrinkage of urban areas" seems inevitable in restructuring urban areas, as well as realizing a "compact city type urban structure". Thus the Urban Planning Department has been deliberating expected urban features, enforcement requirements, effective steps to carryout and so forth, when implementing such measures. Based on deliberations from the year 2011 for examples of relocations of the residents, and the examination of its implementation scenarios in the year 2012, we have conducted a quantitative evaluation study focused mainly on expenses of the model urban area.

2. Configured conditions of the model study

The target district was set as a model urban area with an area of 1.7ha, 100 lots (74 households/136 inhabitants) as shown in Figure 1. Using actual urban neighborhoods as references, population was also set according to age hierarchies.

The following scenario was established, forecasting the population changes of 25 years based on cohorts. (1) Scenario 1: Regardless of the population decline, the operation and maintenance of the infrastructure will be conducted in the same manner in the future. (2) Scenario 2: The infrastructure will be reduced according to the population decline in five years time. (3) Scenario 3-1: A planned degeneration scenario that promotes the move of inhabitants out of the district (with assisted expenses), to be withdrawn within 10 years (40 replacement housings will be built). (4) Scenario 3-2: A planned degeneration scenario that will transfer all households 15 years later, with 20 replacement housings to be built.

The administrative costs set for the target calculation were: (1) regular costs required for the standard operation and maintenance of facilities such as district

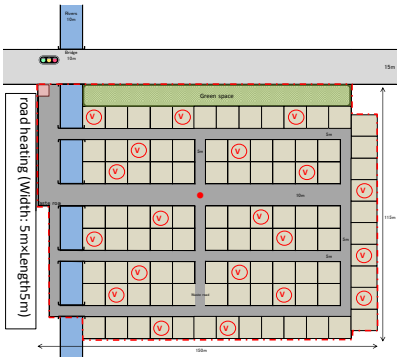

Figure 1: Overview of the model urban area

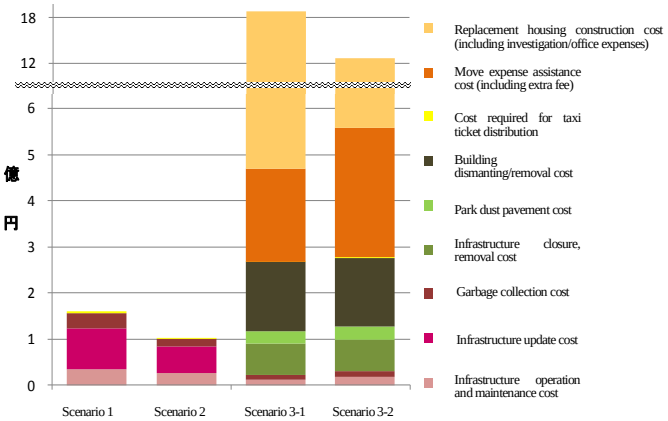

Figure 2: Comparison of accumulated costs up to 20 years later

hundreds of millions of yen

infrastructures and subsequent updates after their service life has expired, and human public services, (2) costs that will arise in the case of guided degenerations, whereby residents are moved and facilities like infrastructures are gradually abolished/prepared, as well as required public service fees etc. Calculations were derived through the unit expenditure method approach, while referencing the values of surveys etc. calculating the average values of many cities. Renewal expenses were calculated by adding up the annual fees divided by the service years and the cost of removing the infrastructure and stopping the pipeline was set at half price of the renewal expense.

4. Calculated results and summary

A comparison of the calculated results of accumulated costs over 20 years is shown in Figure 2. While costs for the planned degeneration case greatly exceeded the others, the following examinations are required to raise the feasibility of the costs. (1) Substitute measures such as utilizing unoccupied housing, as the construction fees for the replacement housing is considerably large. (2) Expenses pertaining to the maintenance of the ruins and the shut down/removal costs of the infrastructure may be covered through the long-term use of solar generation etc. on the vacant lots. (3) Costs for assisting the movement of residents could be balanced by expense reductions in a wide area of administrative services, as well as higher measure effects by activating the city centers etc.

Needless to say, total considerations must be given to factors outside of costs, including the willingness of the residents and improving their quality of life.

(Reference)

1) NILIM report 2013 "Research on How the Systematic Shrinking of Urban Areas in Depopulating Cities should be "
http://www.nilim.go.jp/english/annual/annual2013/44.pdf
2) NILIM report 2014 "Configuration of Draft Scenario for Systematic Urban Shrinkage of Urban Areas in Depopulating Cities "
http://www.nilim.go.jp/english/annual/annual12014/73.pdf

Easy forecast methods of future district images to prepare for the well-planned downsizing or restructuring of cities

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(Keywords) Population decline, aging, centralized urban structure, suburban built-up areas, future forecasts

1. Foreword

Regardless of whether one lives in a provincial city or the greater metropolitan area, population decline and aging is progressing rapidly in suburban built-up areas outside the city core, and with it, a rise of even more serious urban issues can be seen, like an increase in empty houses and vacant lots, and a drop in the quality of living due to withdrawing living convenience facilities. The switch to a centralized urban structure is therefore a large issue in urban planning today. In this report, we will provide an overview of easy forecast methods of future district images in suburban built-up areas that are currently being developed by NILIM to support initiatives regarding the well-planned downsizing or restructuring of suburban built-up areas, which are directly linked with the centralization of living functions and urban service functions in the city core.

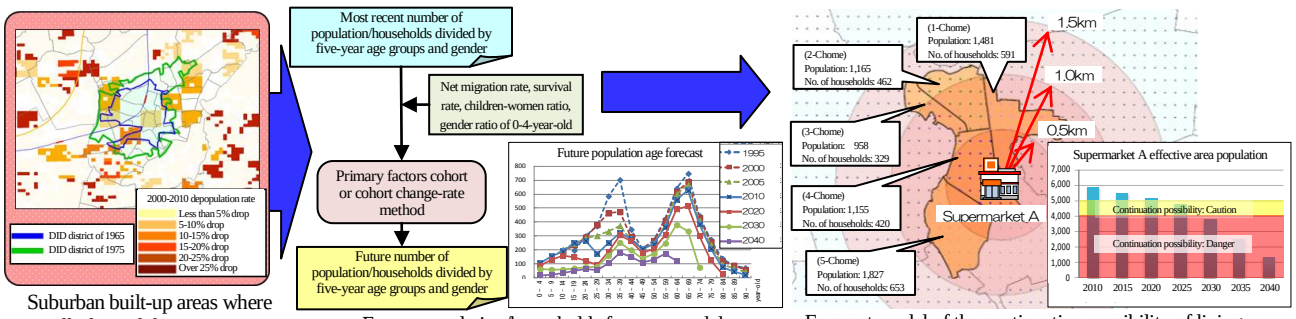
2. Easy forecast methods of future district images of suburban built-up areas

The easy forecast method of future district images in suburban built-up areas is a fundamental analysis for selecting candidate districts for well-planned downsizing or restructuring, and is structured upon the future population/households forecast model, and forecast model of the continuation possibility of living convenience facilities.

(1) Future population/households forecast model

The future population/households forecast model is set in district units (small areas in the national census), and by inputting the most recent number of population/households divided by five-year age groups and gender, the future number of population/households divided by five-year age groups and gender can be predicted in chronological order. Two kinds of predictive methods can be selected: a primary factors cohort, or a cohort change-rate method, and in the former case, settings for the net migration rate (social mobility rate) reflecting regional attributes, can also be set. The program, which allows easy operations by local government officers, will be developed on a Microsoft Excel-based platform.

(2) Forecast model of the continuation possibility of



Suburban built-up areas where well-planned downsizing or restructuring can be examined

Future population/households forecast model

Forecast model of the continuation possibility of living convenience facilities etc.

Figure: The schematic of the easy forecast methods for the future district image of a suburban built-up area

living convenience facilities etc.

With progressing declines in population/households, there is a concern that living convenience facilities like shops and medical facilities located inside or around the district facing severe running costs will be forced to close, thereby creating a drop in the residents' quality of living, and accelerating the population decline even further. The forecast model of the continuation possibility of living convenience facilities etc. predicts the continuation possibility of facilities like shops and medical facilities, by analyzing the location, the effective area, the management viability population conditions of each facility, and chronological forecast results based on the future population/households forecast model. The facility access possibility rate of the residents can also be calculated. This model, which will allow easy operations by local government officers, will also be developed on a Microsoft Excel-based platform.

3. Conclusion

We would like to expand on the easy forecast methods of the future district image of suburban built-up areas introduced in this report by adding other functions like infrastructure operation/maintenance cost evaluation methods etc., as a way to contribute to the selection of candidate districts for well-planned downsizing or restructuring initiatives.

(Reference)

1) Development of the techniques of maintenance suburban built-up areas and the techniques of site planning review for well-planned downsizing or restructuring of cities.
http://www.nilim.go.jp/lab/bcg/mailmag/pdf/ml177_1.pdf

Developing a preliminary evaluation tool to monitor neighboring noise effects from a manufacturing establishment inside the city

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(Keywords) Manufacturing establishment inside the city, noise, evaluation tool

1. Foreword

As collection-type city plans are being pushed ahead, the establishment of technology to evaluate its major external effects beforehand are in demand, for the swift and accurate rating and evaluation of new forms of production/services that will be introduced into abandoned sites in the city and suburbs by the local public body of the site.

Among the various external effect factors, we focused on noise that is generated from manufacturing establishments, and implemented surveys of noise generated by actual manufacturing factories. As well, we developed a calculation sheet that calculates noise levels from any evaluation position outdoors, with regards to generated noise from the manufacturing devices inside the manufacturing establishments.

2. Generated noise surveys of a manufacturing establishment inside the city

Regarding the manufacturing machinery in manufacturing establishments from general purpose types/compact/low-pollution types, we implemented a listing/analysis of typical devices used in various processes, based on catalogs and hearings etc. with regards to the typical machine's size, capacity and generated noise, however, in terms of specific numerical values, the results were not always as clear.

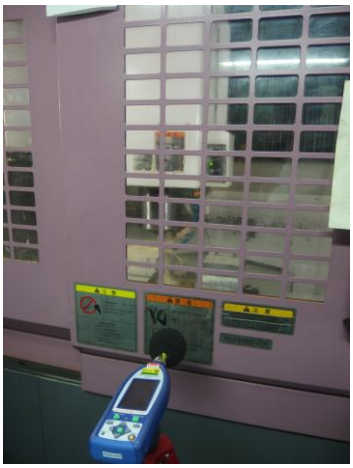

Photo: Noise survey conditions of a manufacturing establishment inside the city

Therefore, we conducted measurements of generated noise during operations at manufacturing establishments inside the city, including a metalworking factory, a foundry and a printing plant (photo).

3. Developing a forecast calculation software regarding the external effects of generated noise from a manufacturing establishment inside the city

Regarding the noise generated from production equipment from the manufacturing establishment inside the city, a Microsoft Excel-based calculation sheet was created to calculate noise levels from any evaluation point outdoors (Figure).

Test conditions was building placement, sound power levels of the machines, sound insulation performance, and the calculation formula used for the forecast method was a geometrical acoustics method using the "Practical noise measures guidance (Edition 2)" (Architectural Institute of Japan, 1984) for reference.

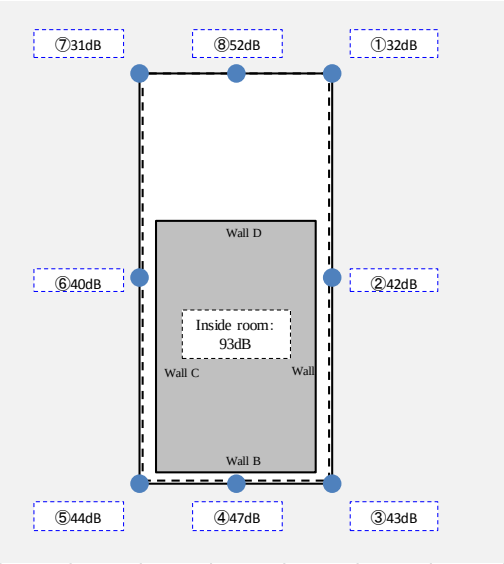

Figure: Output results of the calculation sheet under development (image)

4. Future works

To examine the validity of the calculation sheet, comparisons will be made between the actually measured generated noise and the calculated result, whereupon further reviews will be made to the calculation conditions. Apart from our noise studies, we also plan on

implementing examinations pertaining to the evaluation technology of safe storages for hazardous materials and the incoming and outgoing traffic of small recycling industries.

Research collaborations with the Korea Research Institute for Human Settlements in dealing with population decline/aging society and urban renewal initiatives

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(Keywords) Population decline, aging society, urban renewal, South Korea

1. Foreword

As democratic nations located adjacently to one another in the same East Asian region, Japan and South Korea share a relationship based on a sense of harmony and competition. However, in terms of urban planning, both countries face common issues like over-concentration in the metropolitan area, decreasing birthrates, aging and declining populations. Yet, there are some initiatives such as the integration of land-use planning systems, in which South Korea is believed to have taken the lead. On November 2012, the Korea Research Institute for Human Settlements, the nation's representative research institute in land-related fields, joined in an ongoing collaborative research agreement with NILIM.

2. Actions taken to date

Both bodies decided on focusing their collaborative research on urban-related fields, of which the following initiatives have been implemented.

①During the research exchange discussions, both counties disclosed and discussed conditions surrounding their respective initiatives towards city planning and urban renewal etc. (meetings held four times).

②Field work pertaining to city conditions and the relocation of central ministries and agencies was implemented with regards to South Korea's government function relocation plan for the new administrative city of Sejong, which is still under construction.

③Research information about issues/content regarding the implementation of specific research topics like land-aptitude evaluations was exchanged.

Photo 1: First research exchange conference (at NILIM)

Photo 2: Joint investigations into the urban renewal efforts of Gunsan, which utilized modernization-related assets

3. Initiatives regarding urban renewal support in provincial cities

Through this collaborative research work, a deeper understanding regarding the conditions and issues facing both countries' urban polices of recent years was attained, as well as a more human exchange, integral to the implementation of true collaborative research. Under the theme "Urban renewal support in provincial cities," we will be taking measures to further develop and deepen our joint research through the following activities starting this fiscal year.

①Joint investigations in case study initiatives for the urban renewal of provincial cities where population decline, aging societies and the impoverishment of city centers progress (Japan: Fukui, Toyama, South Korea: Jeonju, Gunsan).

② Provide a lecture and exchange views with lecturers from each country at an international seminar held by the Korea Research Institute for Human Settlements on the effects that our country's fluctuating population structure has had on urban space, and future initiatives for the formation of centralized cities in the face of further declining populations.

Photo 3: Lecture regarding population decline and spatial planning at the international seminar

Through these activities, the common points (participation by local management organizations in planning support etc.) and the differences (suburban development and maintenance situations etc.) between the two countries in terms of the declining populations/aging society issue and urban renewal initiatives, is becoming more distinct. In the future, we would like to focus our studies on these very points.

Possibility of Creating Habitats Utilizing Shallows Existing in Port and Harbor Areas

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Head, D.Eng. Tomonari Okada

(Key words) Shallow Water, Habitat, Bathymetry, Canal

1. Introduction

In recent years, coast areas around ports and harbors have been expected to provide a high level of ecosystem services to residents and others by redevelopment of housing, etc., beginning with high-rise condominiums. If canals and harbor basins are observed in detail, shallows (water depth ≦ 3m) created by natural accumulation of sand can be found in various places where they do not impede ship navigation and berthing, and these shallows are functioning effectively as habitats for aquatic life. Therefore, the purpose of this research was to measure the detailed topography from the land areas, including tidal zones, to water areas and determine the abundance and spatial distribution features of shallows.

2. Method

Data acquisition was carried out at canal in the Port of Tokyo. [1)] In underwater measurements, a wide swath bathymetry system (interferometric echo sounder; C3D, manufactured by Benthos; depth measurement resolution: 5.5cm) was used. In measurements on land, a ground laser (LMS-Z420, manufactured by RIEGL; heading, pitch and roll accuracy: ±0.01°) installed on shipboard was used. The measurement results were arranged as 3-dimensional information, enabling calculation of the area of arbitrary water depth zones (Fig.-1).

3. Results

In canals in the Port of Tokyo, which were the object of this investigation, shallow waters with depths of 3m or less occupied about 18.0% of the total water area. Their area was approximately 7.1×10^5 m^2, which was equivalent to about 70% of the Tamagawa river mouth tidal flats and about 50% of the Sanbanze tidal flats in Chiba Prefecture. While this area may be small in comparison with Tokyo Bay as a whole, considering the fact that it is equivalent to 4% of the 16.4×10^6 m^2 area of the existing tide flats around Tokyo Bay, these can be considered valuable shallow areas.

Furthermore, these shallow areas are not distributed disproportionately in only some locations, but existed widely (Fig.-2). This suggests the possibility that an ecosystem network can be created efficiently and is considered to contribute to effective restoration of nature.

4. Conclusion

Shallows with an area of approximately 7.1×10^5 m^2 existed in canals in the Port of Tokyo. These shallows are distributed widely, suggesting the possibility of creating habitat spaces where the ecosystem network functions efficiently. However, as shallows where the bottom sediments have become sludgy also exist, study of appropriate measures, such as sediment remediation, etc., is considered necessary for these shallows to demonstrate their full functions.

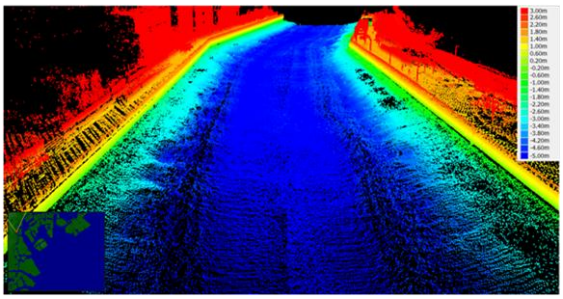

Fig.-1 Display of detailed topographical measurement data

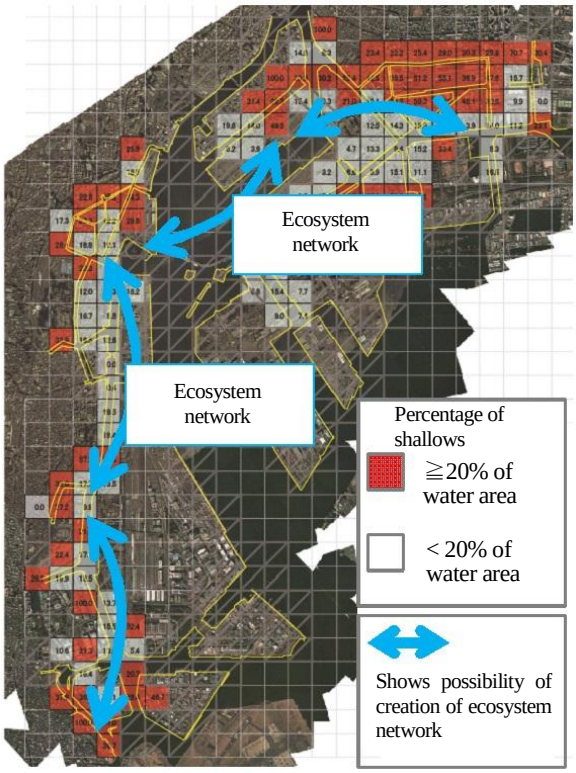

Fig.-2 Distribution of shallows

【Reference】

1) Tomonari Okada, 3 others (2014), Effective utilization of shallow water habitats in Port and Harbor Regions, Journal of Coastal Zone Studies, 27, 1, 61-69.

Measurement of Residence Time of Marine Plastics on Beaches and its Application in Beach Cleanup

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Researcher, D.Eng Tomoya Kataoka Head Yasushi Matsunaga

(Key words) Marine Plastics, Average Residence Time, Mark-Recapture Experiment, Beach Cleanup Effect, Linear System Analysis

1. Introduction

Marine plastics which wash up on beaches undergo remarkable deterioration, ultimately leading to fragmentation, due to the heat of the beach surface and the intense ultraviolet radiation while on the beach. Fragmentation also rapidly increases the environmental risks caused by marine plastics (e.g., chemical contamination of the marine ecosystem by marine plastics). Accordingly, measurement of the residence time from wash-up on a beach until return to the sea is necessary and indispensable for study of measures to mitigate the environmental risks associated with marine plastics. This article introduces an example of measurement of the residence time of marine plastics which wash up on beaches and a method for quantifying the environmental risk mitigation effect of beach cleanup based thereon.

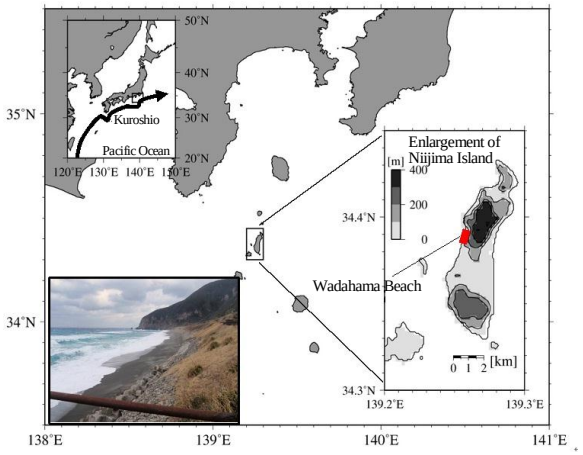

Fig. 1 Location and photograph of Wadahama Beach, Niijima Village, Tokyo.

2. Measurement of residence time at Wadahama Beach, Niijima Village, Tokyo

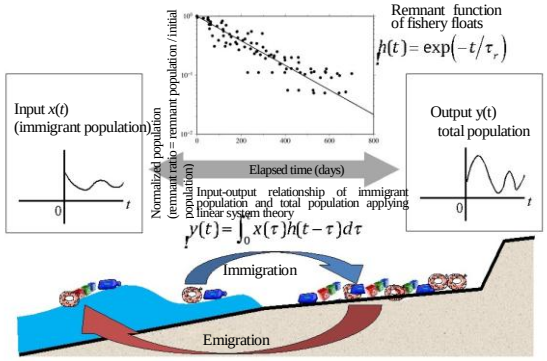

Fig. 2 Input-output relationship of immigrant population $x(t)$ and total population $y(t)$ applying linear system theory.
$h(t)$ is the remnant function (unit impulse response) of fishery floats, and τ_r is the average residence time. The total population $y(t)$ can be expressed by convolutional integration of the immigrant population $x(t)$ and the unit impulse response $h(t)$.

The decrease process (remnant function) of plastic fishery floats relative to the time of the remnant population was measured at intervals of 1-3 months over a 2 year period from September 2011 to August 2013 at Wadahama Beach (Fig. 1, total length: 1km, beach width: 30-50m) in Niijima Village, Tokyo, and the average residence time was calculated. The remnant function of the fishery floats could be approximated with extremely high accuracy by an exponential function which was determined solely by the average residence time. The average residence time of fishery floats on the same beach, as

estimated from the remnant function, was 224 days (95% confidence period: 208-224 days).

3. Quantitative evaluation of beach cleanup effect

Because the remnant function of fishery floats can be approximated by an exponential function, a beach can be regarded as a time-invariant linear system having a unit impulse response of the exponential function type (Fig. 2). Based on linear system analysis, we devised a formula for evaluating the amount of generation of plastic fragments, which are one serious environmental risk associated with marine plastics, and developed a method for evaluating the effect of beach cleanup in mitigating these environmental risks.

4. Conclusion

As a result of this research, it is now possible to make quantitative evaluations of the effect of beach cleanup in mitigating environmental risks originating from marine plastics, which could only be evaluated qualitatively in the past. In the future, if measurement of average residence time progresses at other beaches, it will become possible to select beaches with high priority for cleanup (i.e., beaches with long average residence times) and establish strategic beach cleanup plans.

【References】

1) Kataoka and Hinata (2015): *Mar. Pollut Bull.* (in press). http://dx.doi.org/10.1016/j.marpolbul.2014.12.026.

2) Kataoka (2014): Research Report of National Institute for Land and Infrastructure Management, No. 54 http://www.nilim.go.jp/lab/bcg/siryou/rpn/rpn0054.htm

Analysis of Port Logistics and Development of Predictive Model for Strengthening of International Competitiveness

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(Key words) Port Cargo, Container, Ferry, Predictive Model

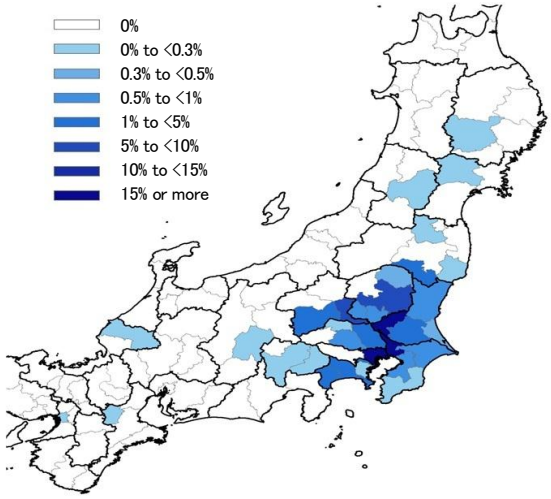
1. Introduction

The environment surrounding marine transportation is undergoing great changes, including increasing use of ultra-large container ships, construction of the new Panama Canal and expansion of international container/ ferry traffic with neighboring countries. Amid these changes, Japan is deploying an international container strategic port policy, etc. to strengthen the international competitiveness of Japanese ports and industry.

Based on this background, we carried out an analysis of port logistics and developed a model for prediction of international container/ferry cargo flows which will be useful in the planning, drafting and execution of Japan's port policies. The following presents an outline.

2. Analysis of port logistics

An analysis of cargo flows was performed using data from the National Survey on Import/Export Container Cargo Flow (date: Nov. 2013), which made it possible to grasp the transportation routes for international marine container cargos between producing/consuming regions in Japan and destination/origin countries by net flows as a series of movements. Fig.-1 shows an example of an analysis of the distribution of consuming regions for import cargos into Japan for international RORO ship routes linking ports in Korea and the Kanto region. The differences between RORO ships and ferries, etc. are shown in Table-1. Fig.-2 shows an analysis of the regional ports used in the United States for export cargos from Japan to the US by four regions.



Source: Analysis of shares of Korea→Kanto ports by consuming region, based on data in text

Fig.-1 Example of analysis of cargo flows of international RORO ship cargos

Table-1 Features of ferry, RORO and container ships

	Ferry	RORO ship	Container ship
			
①	Roll-on/Roll-off (self-propelled)	Roll-on/Roll-off (self-propelled)	LOLO (Lift-on/Lift-off using crane)
②	· Passengers · Cargos (containers, trucks/cars, chasses)	· Passengers · Cargos (containers, trucks/cars, chasses)	·Cargos (containers)

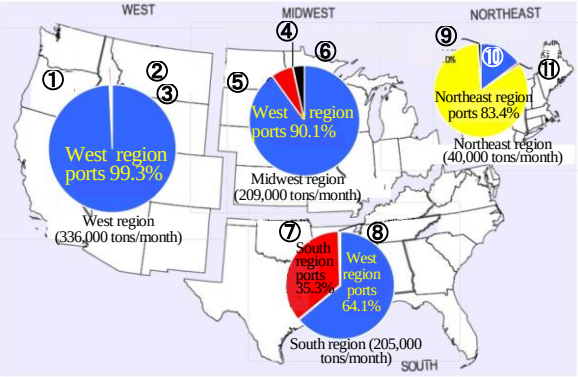


Fig.-2 Ports used for export cargos from Japan to various regions of United States

WEST
①South region ports 0.5%
②Northeast region ports 0.1%
③Other (non-US) ports, 0.1%

MIDWEST
④Northeast region ports 0.1%
⑤South region ports 6.5%
⑥Other (non-US) ports 3.3%

SOUTH
⑦Other (non-US) ports 0.4%
⑧Northeast region ports 0.1%

NORTHEAST
⑨Other (non-US) ports 1.0%
⑩West region ports 14.8%
⑪South region ports 0.8%

3. Development of international container/ferry cargo flow model

Using the data from the above-mentioned National Survey on Import/Export Container Cargo Flow, etc., we developed a cargo flow model [1)] which makes it possible to analyze changes in the cargo volume by port, effect on the hinterland, etc. depending on changes in the service levels of international container/ferry routes, etc. by a sacrifice model, in which routes are selected to minimize the total sacrifice S of transportation routes (S=transport cost C + required time T x cargo time value α). Using the developed model, we also performed an impact analysis to evaluate the changes in cargo flows on international ferry routes (i.e., volume of cargos, regions from which cargos are collected) depending on the opening of new international ferry routes and progress of mutual traffic of chasses on international ferry routes with Korea, and related issues. [1)]

【Reference】

1) Technical Note of National Institute of Land and Infrastructure Management, No. 801
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0801.htm

Support for Aviation Policy Formulation by Enhancement of Aviation Demand Forecasting Method

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(Key Words) Aviation Demand Forecasting, Low Cost Carrier(LCC)

1. Introduction

In order to provide a basis for a technical review aimed at further enhancement of the capability of airports in the Tokyo metropolitan area, the Civil Aviation Bureau publicized prediction of demand at the Transportation Policy Council on September 26, 2013 (see Figure-1). The predictive model was developed and improved by the NILIM Airport Planning Division. We also provided technical advice to the Ministry of Land, Infrastructure, Transport and Tourism on application of the model.

Furthermore, using a stated-choice survey, we are examining air transport demand changes when low cost carriers (LCCs) enter domestic aviation service between Tokyo International Airport and Kansai International Airport and the Linear Chuo Shinkansen (high-speed railway) begins the operation.

2. Estimation of Impact of Entry of LCCs on Domestic Aviation Service

(1) Overview

A revealed-preference survey is not suitable when presently nonexistent modes of transportation such as LCCs from/to HND or the Linear Chuo Shinkansen should be considered in predictions of transportation demand. In such cases, a stated-preference survey is used instead, since it can assess the inter-regional movement of passengers even when several presently-nonexistent modes of transportation are included as alternative means of transportation, whereas a revealed-preference survey can assess the movement of passengers only by existing alternatives. In order to advance the examination, we are collecting data by stated-choice surveys and developing a prototype for a mode choice model that can treat LCCs as an independent transport mode.

(2) Results

Figure-2 shows the simulation results for the route between the Tokyo metropolitan area and Kinki area. The share of airlines is boosted by about 10% by the entry of LCCs with 50% off the Line-Whole Fare, even when the Chuo Linear Shinkansen begins operation. In this case, the total share of FSCs decreases by about half.

(3) Future Prospects

In this paper, we adopted a two-tiered transition transportation choice model for simplification in place of the three-tiered civil aviation demand forecast model officially adopted by the government. We plan to elaborate a stated-preference choice model encompassing a route choice model and an access/egress choice model, corresponding to the official civil aviation demand forecast model, in order to conduct more detailed analyses.

[Source]
TECHNICAL NOTE of NILIM No. 784
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0784.htm
Transportation Policy Council on September 26, 2013.
http://www.mlit.go.jp/common/001018977.pdf

Fig. 1 Prediction of aviation demand in Tokyo metropolitan area
Fig. 2 Simulation results

Figure-1 Prediction of Aviation Demand in the Tokyo metropolitan area

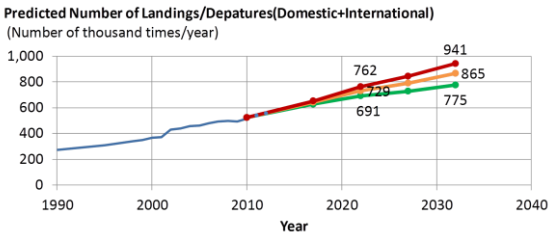
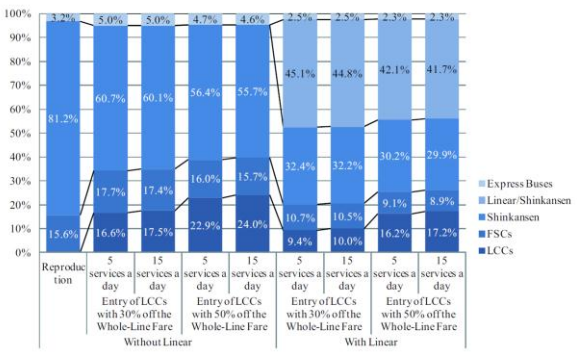


Figure-2 Simulation Result



Developing technologies for habitat evaluation and a method of efficiently monitoring rare raptors

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(Key words) *Environmental impact assessment, Raptors, Habitat evaluation, Monitoring, GIS*

1. Foreword

As part of the environmental assessment of public works (e.g., road, dam, rail, and power plant construction projects), raptors are often surveyed and evaluated as an environmental-indicator species. However, their evaluation requires a lot of time and work, because an efficient method of habitat evaluation and monitoring of raptors has not been established. Thus, we conduct research to find and develop an efficient method.

2. Developing habitat evaluation methods

We try to construct and validate prediction models based on a statistical approach to evaluating habitat quality (i.e., species distribution model: SDM). SDM is derived from the relational expression between the pattern of species location (occurrence/absence data) and environmental factors calculated using GIS (e.g., land use and features) in landscape scale (Fig. 1).

We assembled a database by extracting the location of raptors' 1800 nests from over 500 reports of biological surveys in nationwide road projects during 2009-2012. At present, we are trying to validate SDMs with high prediction accuracy, and estimate the environmental factors important for the conservation of rare raptors (Fig. 1). In addition, we predicted the potential maps of raptors' nesting habitats using SDMs (ex. Fig.2).

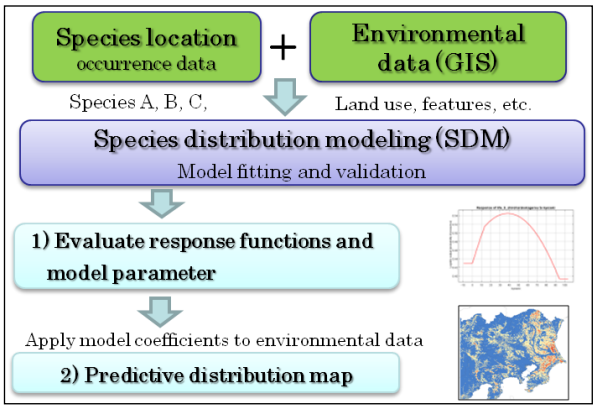

Fig. 1: The steps in SDM and predictive mapping.

3. Future development: efficient monitoring

In recent years, new monitoring techniques for aerial animals are rapidly developing (e.g., Radar, Full spectrum camera, bio-loging technologies). Thus, we will try to efficiently monitor raptors using these techniques and SDMs.

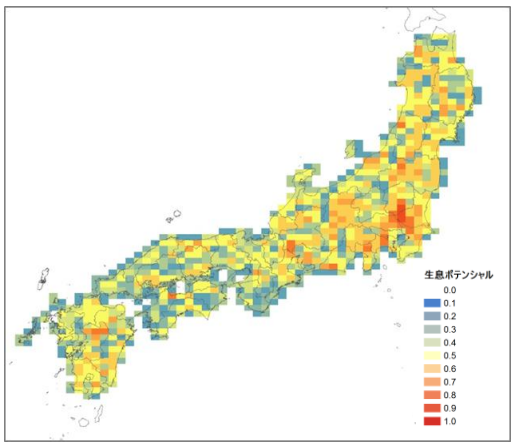

Fig. 2: Potential map of Goshawk nesting site predicted using SDM. (Red: high quality site, Yellow: medium, Blue: low)

Research on Control of Distribution Expansion of Alien Plants using Soil Seed Bank in Rivers

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Key words: Invasive alien species (plants), soil seed bank, countermeasure technologies against *alien species*

1. Introduction

"The National Biodiversity Strategy of Japan 2012-2020" (Sep. 2012) established the country-specific goal of Japan to achieve the "Aichi Target," and as one of the specific measures in countermeasures against alien species, it is planned to promote countermeasures against alien species, considering the rapid expansion of alien species in rivers, survey and study alien vegetation etc., and examine effective countermeasures against alien species.

In addition, the Ministry of the Environment (Conference for Formulation of Action Plan to Prevent Adverse Effects on Ecosystems Caused by Alien Species) has placed focus on the early stage of invasion in the countermeasures against alien species to prevent spread. For that purpose, it is considered important to grasp seed supply source and formation of soil seed bank as well as vegetation on the ground in the countermeasures against alien plants in order to clarify the stage of invasion of alien plants and expected changes in vegetation including distribution expansion of alien plants.

2. Soil seed bank survey in rivers

In the above-mentioned circumstances, the Landscape and Ecology Division has been conducting research on the prevention of distribution expansion of alien plants using soil seed bank in rivers since fiscal 2014. In fiscal 2014, we conducted the survey of vegetation on the ground and soil sampling around the areas of six domestic rivers where alien including invasive alien species(plants) such as lanceleaf tickseed and bur cucumber has grown. We also conducted germination experiment in a greenhouse on the premises of the National Institute for Land and Infrastructure Management (NILIM) using part of the soil samples collected in the fall. Note: Seedlings and sprouting were confirmed in many species including lanceleaf tickseed as an invasive alien species (plant). We are analyzing the data obtained from our research, and plan to analyze the distribution characteristics of soil seed bank in river space with the data such as flood frequency estimated from soil texture and water levels in the surveyed areas.

In addition, realization of the effective and efficient countermeasures against alien invasive species is considered to need "adaptive action" that feeds back the results of continuous monitoring to be conducted after implementation of countermeasures to next countermeasures as well as publication and sharing of the information.[1)] Accordingly, the information on the countermeasure technologies against alien species has been being disclosed on the website, etc. In response, in order to grasp the present state of countermeasure technologies against alien species, we conducted web research and document search on countermeasure technologies against alien species being implemented in main domestic rivers with focus on six species of alien plants including lanceleaf tickseed and bur cucumber.

lanceleaf tickseed bur cucumber

Photo. Example of seedlings that sprouted in the germination experiment

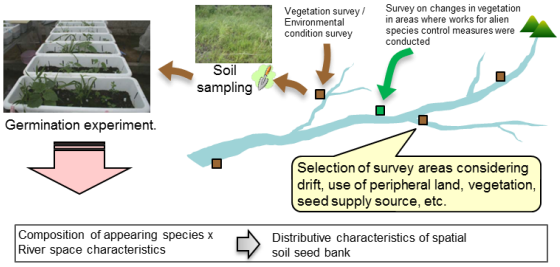

Figure. Image of Soil Seed Bank Survey in River

3. Conclusion

Based on the findings of this research, we intend to establish indicators for grasping the trend of invasion of alien plants from the species composition of soil seed bank and organize efficient countermeasure method against invasive alien species(plants) etc. using such indicators.

[Reference]

1) Manual for Countermeasures against Alien Species in Rivers (River Environment Division, MLIT, Dec. 2013)
http://www.mlit.go.jp/river/shishin_guideline/kankyo/gairai/tebiki.html

Note: To conduct carrying and planting of soil containing the seeds and their organs like roots(which are stipulated by the Cabinet Ordinance according to invasive alien species (plants)) of invasive alien species (plants) for the purpose of academic research, etc., permission granted by the competent ministers is required under Article 5 of the Invasive Alien Species Act.

Study on Greening Method with Native Grass Species

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(Key words): Native species, local ecosystem, greening

1. Introduction

For bare ground formed in public works in roads, parks, rivers, etc., early greening of the ground is required due to prevention of corrosion, consideration for peripheral environment and landscape, etc., and exotic grass is mainly used for greening because of reasonable cost and ease of procurement.

Under the Invasive Alien Species Law and other relevant laws, consideration is also required for local ecosystem when using greening plants in public works. In recent years, native plants, such as Japanese pampas grass, are used in part, but native plants of foreign origin (Chinese silver grass, etc.) are actually used, and there is a concern about genetic disturbance with the group of plants growing in Japan.

		Local origin	Genotype domestic origin	Foreign origin
Natural distribution	Domestic only or abroad	Local greening plants	Native greening plants	Native greening plants (of foreign origin)
	Only overseas	-		Exotic greening plants

Figure. Positioning of Greening Plants
(Fiscal 2006 Investigation Report by the Ministry of the Environment, the Ministry of Agriculture, Forestry, and Fishery, and the Ministry of Land, Infrastructure and Transport)

2. Purpose of Research

The National Institute for Land and Infrastructure Management (NILIM) has been studying greening methods considering for the maintenance of local ecosystem, such as works for using surface soil, promoting natural invasion, and using local seeds and seedlings, and one of the issues in conducting such works is how to procure local greening plants. Therefore, we have prepared a list of local greening plants for selecting desirable species and aim to develop methods for project owners to collect / produce species that are hard to be supplied by market production, in a simple and easy manner independence or in cooperation with local community.

3. List of local greening plants

We identified appearing grass species in the secondary glassfields (Japanese pampas grass type grassland, zoysia-type grassland, etc.) and the communities of floor in secondary forests, which constitute good vegetation in the Kanto Region, and prepared a list of local greening plants by organizing the information on whether listed in the Red List, admirability such as beauty of flowers, cultural values such as season words, growth characteristic, and appearance record in works for promoting natural invasion, as well as basic information including classification, natural distribution, form, reproductive ecology, flowering period, and fruiting season.

4. Seed sampling and germination test

We picked up 50 species out of the list that are confirmed in terms of appearance in multiple plant communities and are considered promising greening plants with excellence in cultural value, admirability, settlement, etc. and examined the place, timing, and method of sampling for them, and sampled seeds for 20 species out of them in the current fiscal year.

We conducted the germination test for the seeds sampled through careful selection including removal of downs and no treatment or germination treatment according to species (cold stratification).

5. Results and future development

As the result of germination test, no sprout was observed with 7 species and germination rates of the others were 1 to 63%. We plan to conduct scattering test on the seeds that sprouted to examine the possibility of seed production. In the following fiscal years, we plan to sample seeds for the remaining 30 species to conduct germination test and scattering test.

Although there are few findings about the sprout characteristics etc. of native grass species, we will accumulate data and promote use thereof for greening.

Photo 1. Bagging and seed sampling

Photo 2. Germination test

Creating Pleasanter Road Space by Restoring Street Trees

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(Key words) Street trees, conservation, redevelopment, road revegetation

1. Introduction

Street trees have been planted aggressively in road space in order to improve road scenery, conserve street environments, and ensure pleasant and safe road traffic. Although this has raised the total number throughout Japan to about 6.74 million trees (2012), looking at trends in recent years (past 10 years beginning in 2002) shows that the increase has halted and large diameter trees that have matured from newly planted young trees over the years have increased in numbers. Under such circumstances, street trees that have grown to become large diameter trees obstruct visibility, cause unevenness of pavement, topple weakened street trees and produce fallen branches.

To resolve these problems, it is essential to take measures to narrow the shapes of street trees, restore their vigor, and to counter lodging and exposure or roots. It is also important to consider the emotional attachment to Street trees of neighborhood residents when taking such measures.

The NILIM has verified a street tree restoration method that permits reaching an agreement with surrounding residences while maintaining pleasant road space by surveying methods of surveying the state of Street trees, greening technologies for street tree conservation or redevelopment, and methods of cooperating with residents in cases where conservation and redevelopment projects were done to counter problems with street trees.

2. Street tree restoration procedure and method

The figure shows desirable street tree restoration methods compiled based on the survey results. First, accurately clarifying and evaluating the problem, then deciding response guidelines and proposed plan while, as necessary, gaining the agreement of the residents. When the study prioritizes conservation in order to save street trees considering local residents emotional attachment to them so it is difficult to resolve the problems, cutting them down and replanting new trees as necessary is studied.

Countermeasures should be taken by expert technologists according to the contents of the measures, then later, the site should be checked until its effects are manifest. Whenever possible, it is necessary to build a system based on cooperation with local residents.

Effective restoration methods include conserving the trees by restoring their shapes by pruning and thinning, improving the tree planting infrastructure, or taking pest countermeasures. If these measures cannot resolve the problems, redevelopment is done by felling the trees then replanting the same species or a new species (Photo).

Figure Street tree restoration procedure

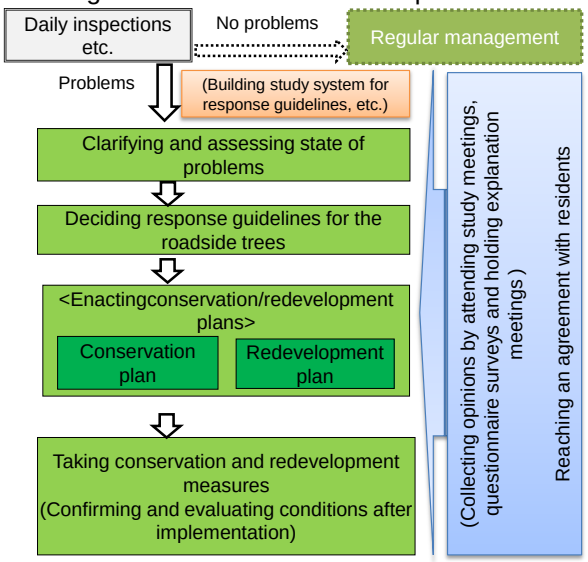

Photo Examples of Restoration of Street Tree

3. In Conclusion

The achievements of this research will be summarized in "Technical Documents Concerning Methods of Restoring Street Trees", that can be used by local managers.

Technologies to preserve biological diversity in the city

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(Keywords) Biological diversity, urban ecology, parks and greenery, urban planning

1. Research background and purpose

As was witnessed with the resolutions of treaties at the Convention on Biological Diversity COP10 held in Nagoya in 2010, the importance placed on biodiversity preservation in cities is increasing. However, the definition of "city" is not exactly clear-cut, as can be ascertained by the various degrees of urbanization found in the city centers of large cities and its suburbs, to provincial cities etc. As well, with the forecast of population decline facing most cities in Japan, examinations into the implementation of compact cities are currently being conducted. Up to the present, the administrative stance towards parks and greenery was centered on how to secure greenery in the midst of a growing population and development constraints. In the future, however, in order to effectively pursue even further, the preservation of biodiversity in cities, an optimal preservation/creation plan for greenery that includes "quality" and "placement" factors will be required.

The purpose of this research is to analyze the effects that the scale of greenery, vegetation structure and surrounding environment etc. has on biodiversity over a wide range of urbanization levels (high population density, fewer green space areas etc.), and to clarify the most effective greenery preservation/creation measures, according to the various city situations and visions.

2. Research Overview

An investigation was conducted over a wide area from the city center to the suburbs, covering city parks, green roofs and roadside planting etc., where environmental conditions like the habitation situation of birds and insects, the vegetation structure inside each green tract, and the presence of water was monitored (see figure). Presently, we are analyzing the results of this investigation concurrently with investigations on site conditions like land use and the topography around the target site, in order to clarify the factors affecting biodiversity in cities and its degree of affectation. For example, the following observations have been made clear through this research.

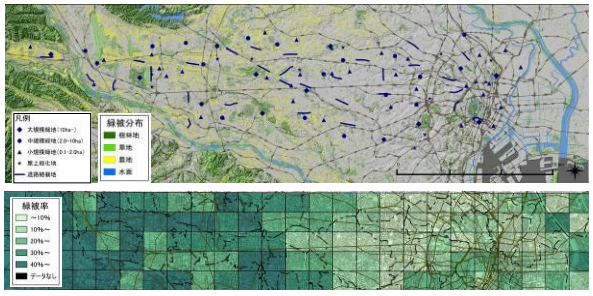

Figure: Distribution of the survey area (top) and the green coverage ratio range (bottom)

1) The relation with the degree of urbanization

As a general trend, as the degree of urbanization increased, conversely fewer varieties of birds and insects were found. However, since the degree of this effect fluctuates depending on the movement ability of each species, this trend may serve as an index reference to comprehend the nature of biodiversity and its changes.

2) Biodiversity preservation functions in urban green spaces

While the amount of time spent investigating at each green space was limited, with a focus on large-scale parks, a wide variety of species including those listed in the Red Data Book of Tokyo could be found. It can be said that urban green spaces contribute to biodiversity conservation in cities.

3. Future works

In the future, we will continue to analyze our investigation results, and compile a technical guide that can be utilized in Park and Green Space policies for the preservation of biodiversity in the city.

(Reference)

1) Yusuke Uneo/Naoyuki Sone/Masao Kurihara (2014): The effects of urbanization on biodiversity - interaction among urbanization, patch area, and the taxonomic group - : Japan Association for Landscape Ecology, 24th Kanazawa Meeting, meeting program and lecture notes, p64
http://jale.sblo.jp/article/102731331.html

Photo: Example of creatures found in the investigation of urban green spaces

Greenery planning technology targeting population decline and degenerating cities

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(Keywords) Population reduction, degenerating cities, compact city, greenry plan, basic greenery plan

1. Research Overview

Urban greenery provides a source for fun and relaxation, improves the heat environment through its shade, prevents the spread of fire in fire emergencies, and is an infrastructure with invaluable functions for the safety and wellbeing of urban life. Up to now, administrative policies towards parks and greenery were based on and pushed forward by the Master Plan For Parks And Open Spaces whose general notion was to "secure a green of open space inside the expanding metropolis." However, with the oncoming population decline and degeneration of cities, we must now strive to "attain a quality of living for people through the urban planning of greenery even though our society is no longer based on the premise of expansion." In other words, we are required to shift our ideas regarding our greenery plans and park policies to a much wider viewpoint (Figure 1). For example, although the functionality of a park which was maintained at the time of development becomes obsolete as a result of fluctuations in the population structure, by putting this unplanned plot of vacant land to good use, there are cases where it can become a contributing factor to the allure of a region (Photo).

At the Landscape and Ecology Division, we are conducting a "Research regarding the basic planning technology of greenery targeting cities facing population decline and degeneration (research period: 2013 to 2015)" with the above issues in mind. In the fiscal year 2014, we conducted an analysis regarding the response status towards population decline, targeting advanced examples of domestic master plans for parks and open spaces. As well, we set up a research society with the help of experienced academic personnel and conducted discussions regarding new roles and directions required for future master plans for parks and spaces.

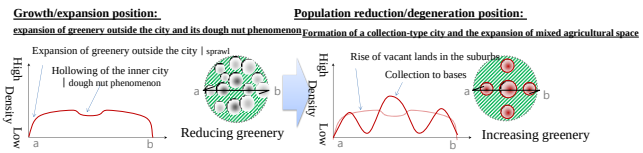

Figure 1: Image of urban degeneration and a green

Photo (left): A park whose usage has dropped
Photo (right): A vacant lot that is used by the region for child-rearing etc.

2. The new role of the master plans for parks and spaces

In advanced cases, not only are the quantitative sufficiency of parks and greenery being planned, but at the same time, experiments and examinations are also starting to understand how to increase a region's allure and sustainability through the use of greenery and natural resources. In future master plans for parks and spaces, apart from the environmental protection/problem solving approaches that indicate polices evaluating a region's natural environment potential to utilize a natural plot of land, positioning and development technology will also be required for planning the utilization of greenery from the viewpoint of regional operations.

3. Future works

At the research society, ideas that were discussed included greenery and its role in solving societal problems, the improvement of sustainability through the use of natural resources and presenting new values/lifestyles through greenery management. We will continue to follow these new directions so that our examinations can help shape the master plans for parks and spaces.

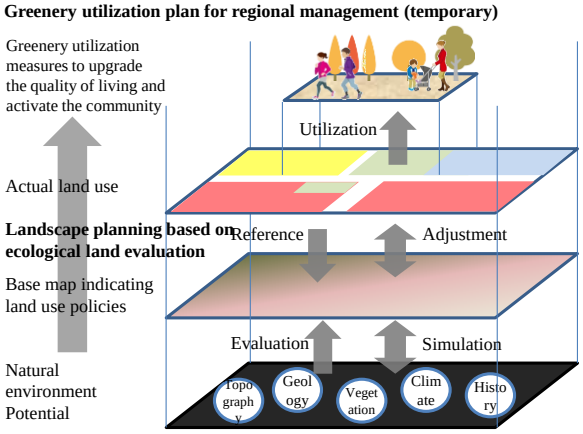

Figure 2: Image of the new role for master plans regarding greenery

Practical Use of Traditional Civil Engineering Construction Methods in Preservation and Improvement of Historic Landscape

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(Keywords) Historical town planning, historical urban development, traditional construction methods, infrastructure facilities , database

1. Introduction

The Ministry of Land, Infrastructure, Transport and Tourism has been supporting the initiatives in the historical town planning across the nation, since the "Law on the Preservation and Improvement of Historic Landscape in a Region" (abbrev: Historical Town Planning Law) was approved in 2008. At NILIM, in order to further technical support in the operative improvement of the Historical Town Planning Law, the Landscape and Ecology Division has been involved in 1) design of the progress management/evaluation system of the Plan for the Preservation and Improvement of Historic Landscape, 2) technical guidance about the preservation and improvement of historic landscape and 3) study on the preservation of historic landscape in disaster-stricken areas.

In recent years, while infrastructure facilities of historic interest have been evaluated from various points of view including community development, their maintenance and utilization have been left as an outstanding issue. As well, even with regards to ordinary infrastructure facilities which are not cultural assets in the narrow sense of the word, there is a need for the appropriate construction method to be selected according to their own historic value and that of their surroundings, in order for it to be effectively tied into the community development. Concerning urban infrastructure facilities in historic districts, efforts are being made to compile information about the historical and regional developments of traditional civil engineering construction methods. At the same time, we try to grasp the actual situation of their application in the restoration/reconstruction works in the cities authorized by the Historical Town Planning Law.

2. Study on traditional construction methods

We compiled information pertaining to the historical and regional developments of traditional civil engineering construction methods used in pavement, masonry, walls, fences, irrigation canals and brick structure through document study, expert interviews and field works that took place in West Japan fiscal 2013, and East Japan 2014 respectively. Regarding the distinct regional construction methods dependent to climate properties and local materials, we are accumulating/arranging the basic information about their technical characteristics and their change with the times that will provide reference points for the authenticity of present day restoration/reconstruction works.

At the same time, we are also investigating/analyzing means to implement restoration/reconstruction of these infrastructure facilities that take into account not only modern and practical needs, but also their locality. For restoration/reconstruction of infrastructure facilities of historic interest in the cities authorized by the Historical Town Planning Law, we are analyzing the selection process of construction methods, the characteristics of the adopted construction method and the effect of restoration/reconstruction works on historic value of the city. Furthermore, to support the inheritance of the skills which form the basis of traditional construction methods, we are investigating/analyzing public schools such as the Kanazawa Institute of Traditional Crafts, and other private learning places.

Photo (left): Stone wall restoration of Sendai Castle, (right): Clay wall restoration with straw matting by students of the Kanazawa Institute of Traditional Crafts

3. Establishment of a database

As we continue our investigation research into traditional civil engineering construction methods, we are simultaneously establishing a database to store various information related to historical town planning initiatives of the authorized cities. We aim to utilize the database to make the historic town planning widely known by the general public and to provide useful information to tourism-related businesses, as well as to share the

information amongst the authorized cities' officials. We will release it on the NILIM homepage so that the information may be attainable to both the historic town planning personnel and the public.

(Reference)
Yusuke Kimura, others: Utilization method of traditional techniques on historical infrastructure: municipalities' efforts based on approved plans for the maintenance and improvement of historic landscape - Civil Engineering Journal, Vol. 57, No. 1, pp. 42-45, 2015.

Improvement in the Quality of Space by Road Reconstruction in Urban Districts

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(Key words) Road reconstruction, landscape formation, urban redevelopment, public space, urban districts and suburbs

1. Introduction

In recent years, it has become necessary for the role of roads as public space to be improved together with roadside facilities and public transportation services in order to further landscape formation and area redevelopment. In response to these requirements, a variety of services and local activities have been introduced to road spaces as a result of interventions such as remodeling of road surfaces and/or renovation of roadside buildings.

Accordingly, specific studies are needed to establish a planning method that facilitates the collaboration between multiple projects under different jurisdictions, as well as a project framework that effectively utilizes local activities to form landscapes. In addition, it is necessary to investigate the effects which a road reconstruction project can have on landscape formation, environmental improvement and area redevelopment. Therefore we have worked on the analysis of methods and effects of road reconstruction projects according to the diversified needs for present road space.

2. Collection and Classification of Case Studies

In FY2014, we selected 80 projects throughout Japan and gathered information about each one. To select the projects, we sought recent projects including some at the planning/construction stage (60 out of 80 projects were completed less than 10 years ago). We also tried to find good examples which are not yet widely known, rather than projects which have already earned public approval. According to the characteristics of urban road spaces, we classified the case studies into the following groups: a) landmarks of tourist sites, b) catalysis of urban regeneration, c) axis of urban structure, d) pedestrian and/or cycle network, e) basis of new transportation systems, f) incubator of greenery and waterside and g) main streets of redevelopment areas.

As the result of the analysis, we have learned that the effective use of urban road spaces had been enabled due to innovative methods such as land-use conversion of railway lines, road replacement/abolishment by alteration of land-use registrations, and vertical use of space led by construction of underground passages and/or pedestrian decks.

As for design, we found new inventions such as pillar-like installation for utility pole removal, innovative use of paving materials/patterns to demarcate footpaths and traffic lanes, and temporary installation and roof structures that can transform road spaces into public squares. We also analyzed various public-private cooperative initiatives to promote urban regeneration and environmental improvement through road reconstruction projects, including management of open-air cafes and events under the exceptional application of the Act on Special Measures concerning Urban Reconstruction or the special agreements between distinct authorities, as well as construction of large roadside complex facilities.

3. Future Development

We are now preparing for the publication of a Case Study Collection which explains the outlines of the 80 projects that we selected. It will be released on the NILIM web site in order for it to be widely used by authorities, research institutes and consultants.

Figure: Sample Pages of the Case Study Collection (Example: Shinmon Street in Izumo)

Wireless Power Supply Technology for Running Vehicles

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(Key words) electric vehicle, wireless power supply, electricity supply in running state

1. Wireless power supply technology

Wireless power supply is already in use by cell phone terminals, some home appliances, and industrial equipment, etc. There are two types of wireless power supply technology: the electromagnetic induction method and magnetic resonance method. Many systems now in practical use are based on the electromagnetic induction method. And among wireless power supply technologies used around the world, the greatest efforts are directed to adopting the magnetic resonance method because of its characteristics, which include the ability to lengthen the distance from the supplier side to the supplied side, and the high degree of freedom of positioning it permits. Research is now being done to expand the distance between supplier and supplied sides and to transmit more power.

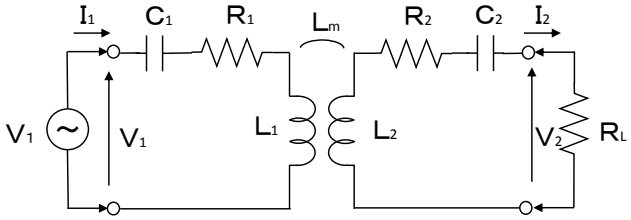
The NILIM has been cooperating with the University of Tokyo to develop and verify magnetic resonance technology that can supply electric power to and charge an electric automobile while it is running, and has confirmed that it is possible to stably supply power while running at the model level. A power transmission/reception unit with diameter of 35cm was used, successfully transmitting electric power on an actual road over the hypothetical gap of about 80cm.

2. Equivalent circuits of wireless power supply technology

The magnetic resonance method consists of series resonance circuits on both the power transmitting and receiving sides to transmit power in resonant state. The equivalent circuit of the magnetic resonance method consists of RLC series circuit configuration on both the primary side (power transmitting side) and the secondary side (power receiving side) as shown in Figure 1. L_1 and L_2 represent reactance of the coils, C_1 and C_2 represent the resonance use capacitance, R_1 and R_2 represent line resistance, and L_m is the mutual impedance between the coils on the power transmitting side and power receiving side, and these vary according to the positional relationship of the transmitting side coil and the receiving side coil (automobile). And because the magnetic field is caused to resonate on the power transmitting side and power receiving side, the resonance frequencies on both sides conform, establishing the following formula.

Figure 1 Equivalent Circuits of the Magnetic Resonance Method

$$\omega_0 = \frac{1}{\sqrt{L_1 C_1}} = \frac{1}{\sqrt{L_2 C_2}}$$



The magnetic resonance method can transmit power even when the axis of each coil on the power transmitting and receiving sides are not straight. This is related to the mutual inductance L_m in Figure 1. And it was shown that during wireless power supply while running, when L_m varied continually, even if the values of voltage and current transmitted to the power receiving side change, the phase itself does not change.

3. Supplying electricity for running vehicles

Wireless power supply now in use is done with the positions of the power transmitting side and power receiving side fixed, so the circuit should be turned on or off after making sure that the power transmitting side and power receiving side are in their preset positions. Using wireless power supply technology of an electric vehicle, while it is running on the other hand, it is necessary to perform switching only when the vehicle being supplied is in a place where power can be transmitted, and it consists of a circuit that is a parallel resonance circuit with infinitely high impedance when there is no vehicle, and is a series resonance circuit with impedance of zero when there is a vehicle, and it is necessary to confirm or verify electric power at or above a certain degree.

Cost Cap Sewerage Plan for Almost Completion of Sewage Treatment Facilities in Ten Years

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Key words: Sewerage planning, low-cost development method, cost cap, solution for non-dissemination

1. Early almost completion of sewage treatment facilities

The percentage of population connected to public sewerage (sewerage, combined household wastewater treatment facility, community sewerage, community plant) at the end of fiscal 2013 is about 89% (of these, about 76% are under the control of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT)), and the population not using sewage treatment facilities (population not connected to any sewerage) or sanitation system amounts to about 14 million.

The Ministry of the Environment, the Ministry of Agriculture, Forestry, and Fisheries, and the MLIT, responsible ministries for sewage treatment facilities, revised the "Manual for Prefectural Planning of Sewerage system" in their joint names (April 2014) in order to solve the issue of non-dissemination of sewage and launched the objective of "Almost completion of development of sewage treatment facilities in 10 years" in the Manual.

2. Introduction of cost cap sewerage

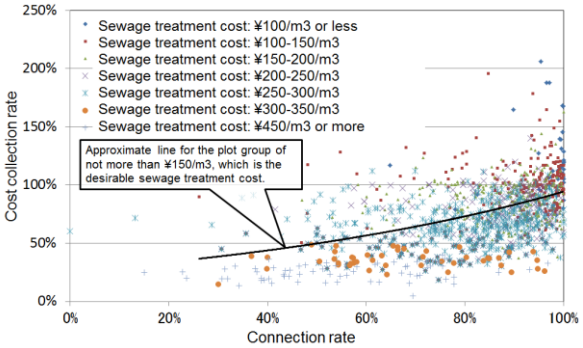
Insufficient on-site survey or examination of technologies to introduce due to urgency of sewerage development may lead to adoption of expensive construction method, construction of excessive facilities, etc. and may result in burden of excessive service charge or aggregation of sewerage management. For this reason, we have proposed "cost cap sewerage plan," which aims at sustainable management within investable budget considering severe financial conditions of local governments as a planning method different from the conventional sewerage plan, which accumulates necessary facility sizes and costs after determining sewerage development area. We chose as a model area, Mihama Town in Aichi Prefecture, where no sewerage project has been undertaken, and published the results of estimation in the past year that can considerably reduce cost and development period after examining existing planning, development, and maintenance methods. [1)]

3. Examination of measures to improve sewerage connection ratio

Cost cap sewerage not only performs sewerage development at low cost but aims to achieve appropriate sewerage management after development. To achieve this aim, it is indispensable for citizens to connect to sewers without delay, but the connection ratio at the start is generally low, which contributes to the low level of user charge and rise in treatment cost. Accordingly, in order to contribute to achievement of the aforementioned objective, we conducted analysis of the factors of delay in connection to sewers, organization of information concerning measures to improve connection ratio, and examination of effects.

As the result of investigation, we estimated that the dissemination of household wastewater treatment facility before starting, aging, number of household members, etc. affect the connection ratio. As measures to improve connection ratio, typical cases include door-to-door visit by municipal personnel or special promotion members, campaign and other awareness raising activities, and subsidies for installation of connection pipes. Since no quantitative assessment has been conducted for the effect of these measures, analysis of relevant data should be conducted in the future.

Figure 1. Relation between Sewerage Connection Ratio and Cost Collection Ratio



4. Dissemination development of cost cap sewerage

In order to disseminate the introduction of cost cap sewerage plan across the country, we advanced the documentation of findings of the research in Mihama Town as a manual (to be published in fiscal 2015) and held presentation meetings on introduction method in all parts of the country

5. Conclusion

Local governments aiming to solve the issue of no access to sewage treatment facilities are faced with various issues, such as finance, organization, terrain, and declining birthrate and aging population, and methods of solving such issues are also various. In the future, we intend to distribute information useful for many local governments facing similar issues so as to realize low-cost development considering for regional characteristics.

[Reference] Document of Press Release on Sep. 4, 2013
http://www.nilim.go.jp/lab/bcg/kisya/journal/kisya20130904.pdf

Topics

Promotion of Dissemination of Hydraulic / Hydrologic Analysis Software Platform

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Key words: Platform, hydraulic / hydrologic analysis, element model

1. Introduction

Since April 2007, the River Department has been developing a platform (CommonMP : Common Modeling Platform for water-material circulation analysis) for analysis model that simulates complicated hydraulic / hydrologic phenomena in river basins on the PC by connecting multiple hydraulic / hydrologic analysis models (river channel model, outflow model, etc., collectively "element models"). After releasing this platform on the website [1)] in March 2010, we upgraded its version every year for consistent improvement seeking better convenience and operability, while promoting the disclosure, etc. of its element model to the public.

The River Department, in collaboration with the main office of the Ministry of Land, Infrastructure and Transport (MLIT), has been actively holding open seminars, training seminars, etc. in order to promote full-scale introduction of CommonMP it developed into river management practice.

2. Seminars in Regional Development Bureaus

We have been holding seminars in Regional Development Bureaus to provide an opportunity to learn skills for CommonMP. In fiscal 2014, we held CommonMP seminars in 8 Regional Development Bureaus, targeting not only the personnel of the Bureaus but personnel, students, etc. of universities and technical colleges.

Considering such seminar as an opportunity to learn the basics of CommonMP, such as installation of element model, project implementation, and delivery of project, we provided introductory lectures and operational practice, such as outline and basic operation of CommonMP, reproduction of flood, and calculation of flood control effect in dams.

3. Training in the College of Land, Infrastructure, Transport and Tourism

CommonMP practice time is included in "Channel planning and environmental training" (from fiscal 2012) and "Social capital GIS [River] training" (from fiscal 2010), both held by the College of Land, Infrastructure, Transport and Tourism. Particularly, in "Social capital GIS [River] training," 4 days out of the total period of 5 days were allocated to practice for CommonMP in a concentrated manner.

Considering such training as an opportunity to learn applied operation of CommonMP, such as establishment and alteration of project and parameter sensitivity analysis, we mainly allocate the time to practice assuming the use of CommonMP in practical operation. In fiscal 2014, we examined river planning by calculating flood runoff using the storage function method and channel tree management by calculating quasi-two-dimensional non-uniform flow, using CommonMP.

4. Future activities

In reference to the opinions, etc. of attendees to training and seminars, we will discuss how to improve the contents, such as provision of training courses according to proficiency, introduction of means to check proficiency, such as practice problems or issue presentation, and improvement of teaching material, and reflect results in activities of next and subsequent fiscal years.

[Reference] 1) CommonMP Website:
http://framework.nilim.go.jp

Table. Curriculum in Regional Development Bureau

Seminar 1	Outline of CommonMP	Purpose and objective of CommonMP and points of attention in use.
Operation practice 1	Basic matters and basic operation practice	Explanation of terms and management of element models, simulation project, etc.
Seminar 2	Utilization in river operation	Merits of use for river management operation Calculation of flood effects for dams
Operation practice 2	Practice for data acquisition tools and runoff calculation	Data acquisition by hydraulic / hydrologic data acquisition tool Reproduction of recent floods and sensitivity analysis using the multithread function
Operation practice 3	Editing of channel cross section using CommonMP-GIS	Calculating of quasi-two-dimensional non-uniform flow Calculation of water level reduction effect by cutting trees and excavation in river channel.

Development of a Transportation Mode Identification Method Using Smart Phone Movement History Information

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(Key words) Smart phone, traffic behavior survey, transportation mode identification

1. Introduction

The spread of smart phones permits traffic behavior surveys based on smart phone applications (below "smart-phone surveys") to be performed more easily with the agreement of survey participants, and it is now possible to efficiently obtain movement history information. At the data utilization stage, it is necessary to analyze traffic behavior by transportation mode, so a method of identifying transportation mode based on movement history information has been developed.

2. Outline of the transportation mode identification method

This report introduces a method of identifying transportation mode using latitude/longitude and acceleration from among movement history information (GPS etc. sensor information) automatically obtainable by a smart-phone survey.

First, latitude/longitude and acceleration data during movement are resolved in units of 10 seconds. Walking and driving are identified focusing on the characteristics of the acceleration waveform of each unit. As shown by Figure 1, in the case of a high amplitude cyclic waveform, the unit is identified as walking (pedometer mechanism). In a case not identified as walking, but where relatively high frequency shaking is detected, it is identified as cycling.

Next, continuous units that were not identified as walking or cycling are integrated to focus on characteristics of movement path. Based on the degree of turning and conformity with the bus route network or the railway route network, the units are identified as either bus or railway travel (Figure 2 is an example of movement identified as bus travel). If units could not be identified as bus or railway travel, they are identified as driving.

3. Verification using results of a smart phone survey in Tsukuba City

In November 2013, the method was applied to data from the results of a smart phone survey done in cooperation with Tsukuba city and Tsukuba University (history of one day's movement of 1,400 people (workers and students) living in Tsukuba City). As a result, as shown in Table 1, the accuracy rate in the transportation mode identification results based on transportation mode recorded by the participants was about 80%.

4. In Conclusion

We developed a transportation mode identification method and confirmed its usefulness. If it is possible to automatically identify transportation mode, participants in smart-phone surveys do not have to record their transportation mode, contributing to more frequent larger scale surveys. In the future, we will conduct research to improve smart phone surveys by applying the transportation mode identification method for its practical use.

Figure 1 Walking acceleration waveform

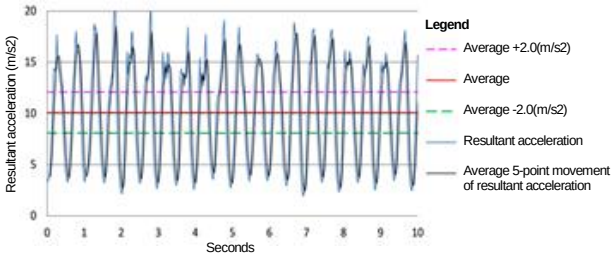

Figure 2 Example of movement identified as bus travel

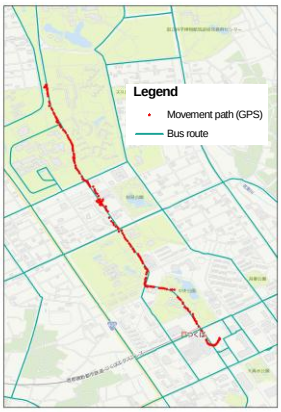

Table 1 Accuracy rate of transportation mode identification

Rate (%)		Movement means identification results					
		Walking	Cycling	Driving	Bus travel	Railway travel	Total
Participants response	Walking	87.4	4.2	3.9	2.1	2.4	100.0
	Cycling	10.1	76.1	11.7	1.9	0.2	100.0
	Driving	3.5	1.0	82.8	12.4	0.4	100.0
	Bus travel	7.4	1.3	34.3	55.7	1.4	100.0
	Railway travel	7.7	0.1	10.9	2.9	78.4	100.0

Initiatives on creating the original plan for building-related technical standards

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1. History

Technical standards pertaining to the securing of safety in buildings are established in the Building Standard Act, however, based on the progress in investigative research and technology development and the lesson imparted by disasters etc., it is also necessary to appropriately review these building-related technical standards when required.

As a result, to push forward standardization systems based on the result of the research and building standards maintenance promotion businesses at NILIM (Ministry of Land, Infrastructure, Transport and Tourism Housing Bureau subsidized project: the nation sets the investigative issues related to the maintenance of building standards, projects whose investigation costs are subsidized to the business entities selected from a public offer), the Building Structure Standards Committee (Chairman: Tetsuo Kubo, Professor emeritus at Tokyo University, fiscal 2011 -) and the Building Fire Prevention Standards Committee (Chairman: Makoto Tsujimoto, Professor at Science University of Tokyo, 2012-) will be installed inside NILIM, and with the input from outside expert opinions, a system to create the original plan for technical standards will be structured.

As well, by setting up "contact points" through collaborations with related organizations, we will support proposals for the maintenance/review of standards from the wider public sector with the aim of advancing/rationalizing the technical standards.

2. Building Structure Standards Committee/Building Fire Prevention Standards Committee

Based on the lessons learned from the Great East Japan Earthquake, the Building Structure Standards Committee has been involved in creating original plans of technical standards pertaining to the structural standards of tsunami evacuation buildings and ceiling collapse countermeasures, and in fiscal 2014, conducted examinations into the countermeasures of long-period earthquakes.

The Building Fire Prevention Standards Committee, based on the results of full-scale fire tests implemented on three-story wooden schools during fiscal 2011 to 2013, has been examining the reviews of fire-prevention standards pertaining to wooden buildings, and on June 2014, conducted related revisions to the Building Standard Act. In fiscal 2014, examinations of the original plan for the following standards (government ordinances/notifications) were conducted towards the enforcement of the revised laws in June 2015.

(1) Standards related to large-scale wooden buildings whose total area exceeds 3,000㎡ (Law Article 21 Clause 2)

(2) Standards related to three-story wooden schools etc.

3. Contact point

Contact points are communication points where proposals are received from private businesses etc. regarding reviews for technical standards based on the Building Standard Act (simple regulations) and the preparation of new standards,※ and regarding the accepted proposals, NILIM will conduct examinations from a technical standpoint with assistance from the Building Research Institute (Figure). In fiscal 2014, replies for the examination reports of nine proposals including the positioning of ETFE film as a designated construction material, and the expansion of applicable steel materials pertaining to fire-resistance structure authorizations were sent out (as of the end of January 2015).

※ Opened on (General Incorporation Foundation) the Information Center for Building Administration homepage: http://www.icba.or.jp/cp/cp_top.html

4. Future works

Taking into consideration trends in the Panel on Infrastructure Development, we will continue to examine maintenance/reviews of technical standards according to progress in investigative research and technology development.

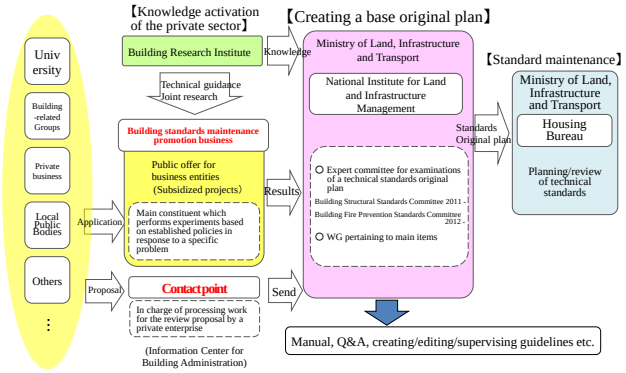

Figure: Examination system of building-related technical standards

Guideline proposal on how to create building information models that indicate the present situation of existing houses

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(Keywords) Existing houses, housing Records, BIM

1. Foreword

At NILIM, to support the storing and utilizing of housing records [*1], an examination called the "Guideline on how to create building information models that indicate the present situation of existing houses (Draft, Japanese version only)" (hereafter "guideline (draft)") was coordinated, pertaining to rational methods of accumulating/managing information like detailed design, embodied materials, building methods and inspection records using information technology like BIM[*2] etc.

2. Examination of the accumulation/utilization of housing history information

It is required to continuously implement appropriate maintenance and renovation for the life-extension of housing, and it is equally desirable that the utilization methods used to rationally accumulate/manage the housing records distributed in the various drawings, documents and data be established. Especially with existing houses, current conditions require information preparations to be rearranged from reproductions of drawings, as many documents have been lost since their construction. Because of this, we have begun initiatives in BIM, whose usage in the design phase of new projects is becoming widespread, and using 3D CAD etc. to create form models of building elements (wall, floors, roofs etc.) and using them to index the information management, we studied a method to arrange/accumulate records like materials and construction methods, techniques, and inspection/repair information etc. (Figure 1).

3. Content of the guideline (draft)

The guideline (draft) maps out a technical reference to explain the technical content to practitioners involved in the distribution and renovation of existing houses in an easy to understand manner. This volume (Chapter 1 and 2) lists the duty flow regarding information maintenance of existing houses, the concept of the consolidated building information model, creation procedures of the models using CAD, items related to data saving methods, and explanations pertaining to the diagnosis/surveys of buildings in a manner that can be understood by architectural engineers, with figures and model data examples. As well, the technical volume (Chapter 3) collects documents like detail standards when inputting

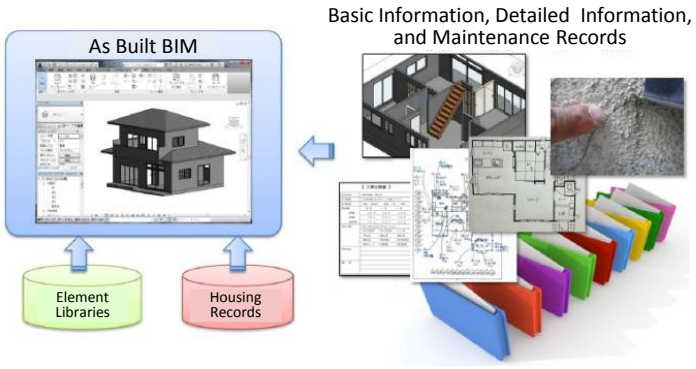

Figure 1: Conception diagram of housing records management using the building information model

form models of building elements, and reference methods of external data regarding attribute information. Furthermore, information templates and libraries etc. that can be used commonly by general CAD software are being created and collected in the reference volume.

4. Summary

The guideline (draft) is anticipated to be used as a guidebook in actual technical duties, and along with the library and database produced as experiments, is intended to be released through our homepage.

*1 A history of each household recording how the design, construction operation/maintenance was conducted, as well as drawings, specifications, a catalog of materials/machines, photos, inspection/diagnosis reports will be stored and utilized as information during reforms and purchases.

*2 Abbreviation for Building Information Modeling. Various information from the building's plan/planning, design, construction and operation/maintenance will be consolidated/managed focusing on parts and 3D models of parts, and used as shared information and consensus building method among related personnel.

(Reference)

1) Comprehensive Technology Development Projects
"Development on performance evaluation technologies for home inspection to reduce uncertainty of existing houses (2011-2014)"
http://www.mlit.go.jp/tec/gijutu/kaihatu/pdf/soupro011.pdf

Research on Person-trip Surveys Using the Web

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(Key words) Person-trip survey, WEB interface, response rate

1. Present state of and challenges to person-trip surveys

Person-trip surveys (below, "PT surveys") have been regularly conducted in all parts of Japan since a large-scale PT survey was conducted in the Hiroshima City region in 1967. When PT surveys were first introduced, the surveyors visited the people surveyed, explained the purpose of the survey then gave them questionnaires, but in recent years, they have mainly mailed the questionnaires to survey subjects to lower costs.

But as distribution by mail was done, response rates fell, questionnaires were incorrectly completed and questions not answered, also the samples were biased in many cases, so attention has turned to surveying on the WEB, an approach that will simplify entry and collect samples inexpensively. So the NILIM has proposed and announced new WEB interface use questionnaire survey formats.

2. Aim of developing the WEB Interface

Questionnaires using a WEB interface have already been used for some surveys, but in many cases, the configuration of the paper questionnaire is maintained as it is displayed on the screen, and it cannot be claimed that this has ended the complexity of filling them in. The NILIM has, therefore, taken advantage of the strong points of PC entry to develop questionnaires so that even elderly people and other respondents unaccustomed to using PCs can easily enter their answers and recall past behaviour. It has developed two types of questionnaires: (1) Destination Advance Entry Type organized so that it is basically easy to enter answers on an existing questionnaire, and (2) Diary Type that have reset the entry method so that it is easy for the respondents to recall their behaviour on a certain day.

3. Outline of the development of the WEB Interface

Both forms of interface were designed so that screens open successively for each entry item. To enter traveling behaviour, first every destination of travel and length of time spent at each destination throughout the entire day are entered, followed by entry of information about means of movement etc., but (1) using the Destination Advance Entry Type, in cases where ???is seen for each entry item, the questionnaire can be filled in the same way as past paper questionnaires, but (2) using the Dairy Type, the respondents first enter daily life activities and time of the activities just as if they are entering their schedule in a memo pad, and then enter detailed information about their movement between activities (locations means of movement, etc.).

Using both formats, messages pointing out contradictory entered contents and missing entries concerning the context of time, are displayed as needed, reducing the number of invalid questionnaires. And they are devised so that information about places visited can not only be entered as written addresses; but can also be designated on a map so that it is easy for the respondent to visualize the places.

Figure Entry of destination on a map

4. Future challenges

This research developed a method of replacing paper questionnaires with a method of answering through a WEB interface, but it has been pointed out that changing to a new survey method will impact response rate for each attribute and the trip numbers that are recalled while responding. In the future, it will be necessary to fully clarify differences in data characteristics caused by differences in survey methods in order to compare PT surveys over time and to compare regions. It will be advisable to pay close attention to the above points with regard to the Diary Type that differs greatly from the conventional questionnaire.

[Sources]

NILIM, Urban Planning Department, Urban Facilities Division web site
http://www.nilim.go.jp/lab/jcg/index.htm

Study on Relationship between Layer Thickness and Mat Density of Airport Asphalt Pavement Surface Layer for Higher Efficiency of Construction

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(Key Words) Airport Asphalt Pavement, Layer Thickness, Mat Density, Temperature Descending Time

1. Introduction

In airport asphalt pavements, Standard Specifications for Airport Civil Works (referred to hereinafter as Standard Specifications) specifies that the layer thickness of the surface layer and base layer shall be 8cm or less. Increasing the layer thickness is considered effective for increasing construction efficiency. In summary, however, two issues exist in connection with increasing the layer thickness.

The first one is the problem of securing the mat density. As a specification limit for asphalt mixtures, Standard Specifications specifies that the mat density of Marshall specimens shall be 98% or more.

The second one is the problem of temperature descending time (time required for the asphalt surface temperature to fall from the temperature at the time of laydown of the mixture to the temperature provided at the time of opening to traffic). To prevent rutting after opening to traffic, Standard Specifications specifies that the pavement surface temperature at traffic opening shall be 50°C or less in case straight asphalt is used. However, as the layer thickness increases, longer temperature descending time can be expected.

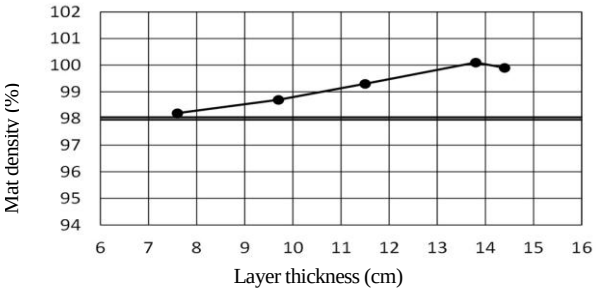
2. Study results

Test pavements were constructed by varying the layer thickness from 7 to 15 cm, on two types of base, i.e., an asphalt stabilized base and a granular base, and the relationship between the layer thickness and both mat density and temperature descending time was studied.

With the surface layers constructed on an asphalt stabilized base, the specification limit of 98% or more was obtained regardless of the thickness, and a tendency in which the mat density increased as the layer thickness increased could be seen. The higher stiffness of the base, this is attributed to high compaction due to the use of large-scale construction machinery. Moreover, the fact that heat transfer time became longer as the layer thickness increased, and as a result, a sufficiently high temperature could be maintained in the pavement, is also considered to be a cause.

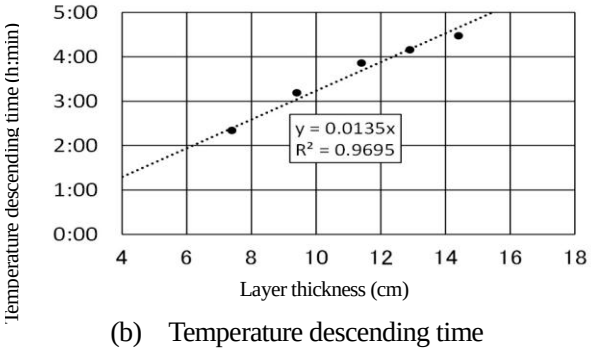
Regarding temperature descending time, in the range of layer thicknesses in this experiment, a proportional relationship was observed between the layer thickness and the temperature descending time.

In the future, the authors plan to construct a test pavement with a 10cm layer thickness on an asphalt stabilized base, which is considered to have a comparatively high potential for realizing an increase in the layer thickness, and conduct a further study.



(a) Mat density

Fig. Relationship between mat density and layer thickness.



(b) Temperature descending time

Fig. Relationship between temperature descending time and layer thickness.

【Reference】
Technical Note of National Institute for Land and Infrastructure Management No. 818
http://www.nilim.go.jp/lab/bcg/siryou/tnn/tnn0818.htm

Long-term Planning and Budgeting for Transport Related Public Works Projects in the Industrialized Countries of Europe and America

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(Key words) Public works projects, transport related public works project, long-term planning, budget, United Kingdom, United States, France, Germany

1. Introduction

The NILIM is conducting a survey focused on interrelationships between public works project planning systems, decision-making methods and project evaluations in the industrialized countries of Europe and America in order to improve Japanese public works project evaluation methods. We are now researching the policy systems, planning and individual projects, the individual project evaluation procedures, the relationships between budget systems and project evaluations, and the project progress management systems in the United Kingdom, theUnited States, France, and Germany. This report introduces the most recent state of long-term planning and budget systems for transport related public works projects in each country based on the results of the research.

2. United Kingdom

Since 2010, HM Treasury has enacted the National Infrastructure Plan as a long-term plan for transportation (roads, railways, ports/harbors, and airports), information and communication, flood control and so on. This plan has been enacted to present nationwide infrastructure investment and to explain its importance. Though it is a 5-6 year plan, it is renewed every year. In regards to this, concerning road projects, the Parliament has introduced the Infrastructure Bill, a bill concerning the construction of Strategic Highways to be operated by the Highway Agency between 2015 and 2021. The previously enacted Road Investment Strategy has been also incorporated in this Bill to measure the cost-benefit ratio (B/C) in individual route units.

3. United States

Map-21 is the latest long-term planning law related to land transportation (started as a two-year plan, it is being extended). MAP-21 stipulates the federal government's budget scale for each category, and the federal budget is divided between the states mainly according to criteria such as state size, but the federal government does not determine priority of individual projects. In the MAP-21, individual projects scheduled for the next 20 years in the long-range plan (LRP) in each state are confirmed based on 5-year cycles and the Transportation Improvement Program (TIP) sets priorities and funding plans for prioritized projects scheduled for the next four years.

4. France

The Transportation Public Capital Improvement Plan, which stipulates major national projects concerning railways, ports, canals, urban public transport, roads and airports for between 20 and 30 years in the future, was enacted in 2010. This plan includes individual route names, estimated project cost, and project section length for each category—railways, ports, and roads—and prioritizes projects and provides annual budgets for each year in individual project units.

5. Germany

The Federal Transport Infrastructure Plan that is a long-term plan in 10 to 15 year units concerning railways, roads, and inland shipping has been enacted by the Federal Ministry of Transport, Building and Urban Affairs, and the latest is the 2003 plan and the 2015 plan is being enacted. The Federal Transport Infrastructure Plan stipulates locations, outlines, and project costs of major projects by field and order of priority. When the Federal Transport Infrastructure Plan was enacted, the projects were evaluated, and were prioritized in three ranks. The Demand Plan is enacted every 5 years based on the views of states by extracting projects from the Federal Transport Infrastructure Plan, forming the basis of the distribution of budgets to individual projects in five year units.

6. In Conclusion

Japan has the Act on Priority Plan for Social Infrastructure Development, but this is not a plan linked directly to budgeting. In the United Kingdom, the United States, France, and Germany on the other hand, procedures from the enactment of long-term plans to budgeting individual projects are interrelated, establishing such systems that ensure long-term stable project implementation.

In the future, we will continue to research project evaluations in industrialized countries of Europe and America in order to obtain further reference for improving the Japanese project evaluation system.

Working on the application to transportation planning of a platform of movement of people

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(Key words) movement of people, trail data, map, road network

1. Introduction

Transportation planning takes advantage of the results of statistical surveys of human movement information obtained by person-trip survey and road traffic censuses, etc. In recent years, we have been counting on utilizing information that can grasp the state of people and automobile movement (trail data) which has been collected from cell phones, car navigation systems, and so on.

The NILIM researches the potential application of diverse movement of people to transportation planning by providing a platform capable of collection and analysis. This report describes the results of a trial of combinational analysis of diverse movement of people, the state of research on an analysis and visualization platform that can be used to uniformly and efficiently process movement of people, and future prospects.

2. Trial of combinational analysis

Figure 1 shows the results of superposing number of passengers on buses (Tsukubus) and taxis (Tsukutaku) that are public transportation systems in Tsukuba City on a map divided into 500m meshes. From this map, it is possible to grasp that the state of use has complementary relationships between each usage area. Also, detailed analysis of departure and arrival points and usage time slots of passengers in overlapping areas of use can be counted on to be used for transportation planning such as abstracting candidate locations of transfer encouragement.

Figure 1 Superposing Tsukubus and Tsukutaku usage areas

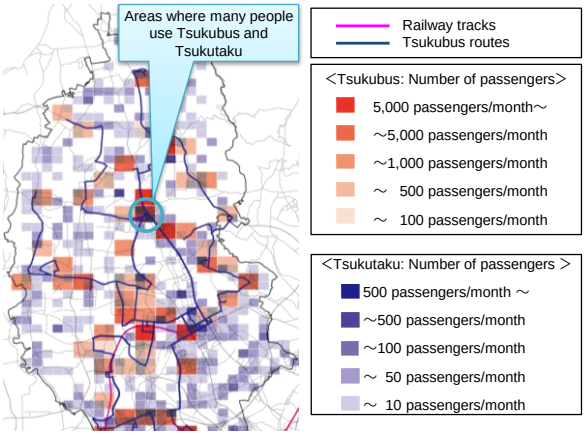
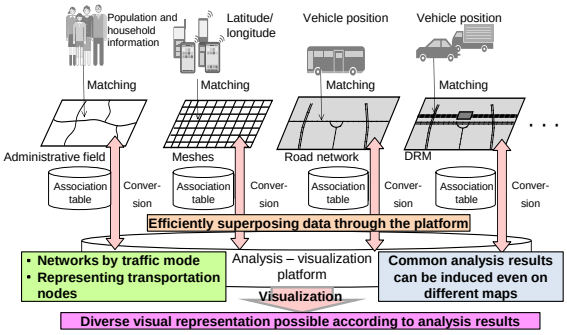


Figure 2 Image of Achievement of the analysis and visualization platform



3. Studying the analysis and visualization platform

Considering present conditions, under which it is possible to diversify and increase the quantity and perform combinational analysis of movement of people, it is important to provide a analysis and visualization platform such as that shown in Figure 2, to achieve more efficient information superpositioning, conversion and analysis and to diversify visualization expression. This research considered a data model of analysis and visualization platform. And we confirm the usability by using a private maker's map to trial manufacture the platform and perform information conversion testing[2].

4. Future prospects

The achievements of the research were obtained as part of the activities of the Tsukuba Mobility and Traffic Research Committee[3], etc.

We will continue to verify analysis methods using diverse movement of people and to conduct case studies using the analysis and visualization platform and apply it to transportation planning in the future.

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Movement of people, information infrastructure and Working on the application of transportation planning <http://www.nilim.go.jp/lab/qbg/bunya/gis/idoujyouhou.html>
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3) City of Tsukuba: Clarifying Movement of people (Urban Activities) in Tsukuba City, Tsukuba Mobility Traffic Research Committee
http://www.city.tsukuba.ibaraki.jp/dbps_data/_material_/_files/000/000/015/445/No77.pdf

More Efficient Civil Engineering Structure Management Using 3D Models

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(Key words) CIM, 3D model, maintenance, level of detail

1. What is CIM

The Ministry of Land, Infrastructure, Transport and Tourism is building and widely introducing a construction production system using a 3D model and an information integration platform (CIM). CIM stands for Construction Information Modeling, a method that introduces a 3D model from the surveying and design stage, develops it by linking it to the construction and maintenance management, thereby permitting various studies using the 3D model and increasing the efficiency of the construction production system.

2. Use for maintenance

The effectiveness of the use of the 3D model at the design and construction stage has been confirmed, but its use for maintenance has not been fully verified. So we are studying the use of the 3D model for maintenance.

There are two benefits of using the 3D model: three-dimensional visualization and gathering and integrating information in the 3D Model. Three-dimensional visualization is applied to prepare a 3D model of the structure including the topography, arrange vehicles and scaffolding for high lift works in the inspection and repair plans, clarify inspection routes, confirm work space, and so on (Fig. 1). Gathering and integrating information is done to perform integrated management of information associating information of use in maintenance in the 3D model, and managing inspection results that are displayed on the 3D model. [1)]

3. 3D model for maintenance

If a 3D model is prepared in detail, it is highly effective, but on the other hand, this increases the preparation cost. So one challenge is to describe the level of detail adequate for the 3D model according to purpose of use. So we studied the level of detail that will maximize the cost-effectiveness of a 3D model provided for maintenance. Figure 2 shows the results of a study of a 3D model for the area around girder end bearing supports carried out to confirm the work space during the preparation of an inspection and repair plan. In order to clarify a stereoscopic image of the girder ends and clarify the work space in detail, a detailed model including cross beams, lateral bracing, bearings, displacement limiters, bridge fall prevention devices and other small members was prepared, otherwise, only the external shapes of major members were accurately modeled.

4. Future Plans

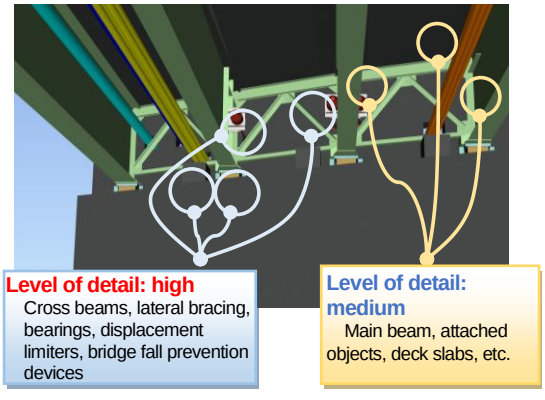
To advance use for maintenance, we will continue to study the level of detail of the 3D model and to develop standards for the delivery of 3D models.

[Sources]

1) Ministry of Land, Infrastructure, Transport and Tourism, National Institute for Land and Infrastructure Management: Guidebook to Bridge Maintenance Using 3D Models
http://www.nilim.go.jp/lab/qbg/bunya/cals/pdf/guidebook_bridge_cim.pdf

Figure 1 Example of Use of a 3D-model to Plan Inspections

Figure 2 Setting the Level of Detail for a 3D Model around Girder Ends



Expanding Work Categories Applying Completed Work Dimensional Control Using TS

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(Key words) Total station, completed work dimensional control, Information Integrated Construction, revetment work, retaining wall work, earth retaining work

1. Introduction

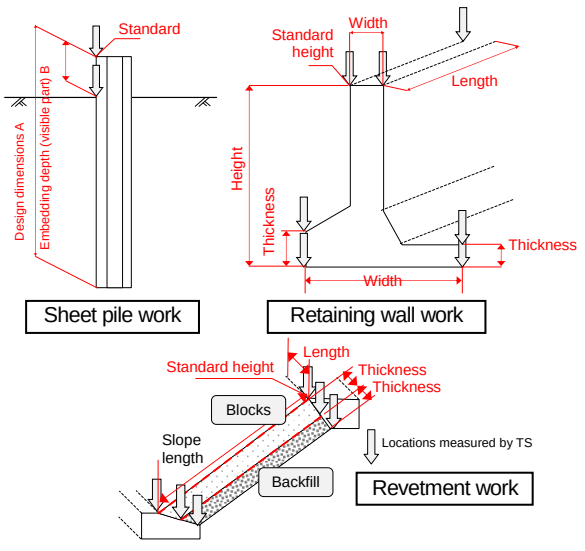
One program in the Second Stage Information Integrated Construction Promotion Strategy established by the Ministry of Land, Infrastructure, Transport and Tourism is the expansion of work categories performed applying "completed work dimensional control using a Total Station (TS)". The following introduces efforts to expand completed work dimensional control using TS, which is already applied to earthwork and paving work, to include peripheral works, and to develop measurement methods that will achieve overall labor saving.

2. Targeted peripheral works

The work categories where we intend to apply TS to completed work dimensional control are 1) revetment work (placing and pitching concrete) and 2) earth retaining work (sheet pile work) and 3) retaining wall work (cast-in-place and precast). These were selected considering frequency of use and ability to divert earthwork measurement work to other purposes. Figure 1 shows the relationship between dimensional control standards for these works with the measurement locations when using TS.

The Euclidean distance (length of width etc.) between two end points is calculated according to the coordinates obtained by TS.

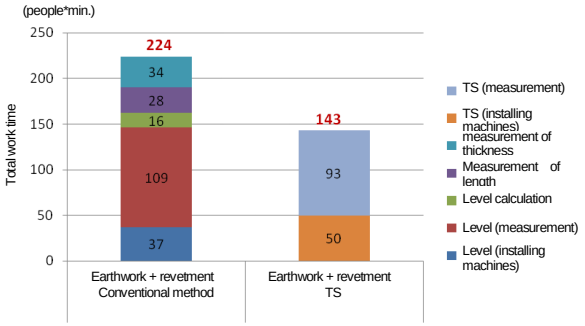
Figure 1 Dimensional Control Standards and TS Measurement Locations



3. Verification of time reduction effects

Figure 2 shows an example (concrete pitching) of the results of comparing total work time required to perform an on-site trial of TS completed work control on new work categories and measure the completed work for a case doing everything using conventional methods and a case applying TS completely to completed work control. In this way, time reduction effects were shown for revetment work and earth retaining work. It reveals that in the case of revetment work, although it took a little longer to install the machinery than when using the conventional method, later measurement work was performed much more efficiently.

Figure 2 Example of time reduction effects



On the other hand, the time reduction effects were limited in the case of retaining wall work. One reason considered is that completed work dimensional control of a concrete structure is work often done by installing scaffolding, and it is difficult to ensure visibility of the prism.

4. In Conclusion

Our Division is undertaking a variety of measures to contribute to reducing labor requirements at construction sites using ICT. In the future, we will try to gradually apply the method by clarifying the feasibility through field trials.

[Sources]

1) Proceedings of the Twenty-sixth Construction Machinery and Construction Symposium (p33-36)
2) Second Information Integrated Construction Promotion Strategy (Ministry of Land, Infrastructure, Transport and Tourism)
(http://www.mlit.go.jp/common/000993270.pdf)

A study on large-scale road map preparation methods using digital maps and point cloud data

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(Key words) fundamental geospatial data of road, digital map, point cloud data

1. Introduction

Since 2006, Ministry of Land, Infrastructure and Transport and Tourism (MLIT) has been promoting provision of "fundamental geospatial data of road" for large scale road maps. The fundamental geospatial data of road represents road structure data about 30 types of features that are highly serviceable in road administration or automated driving [1)]. The fundamental geospatial data of road have already been provided for about 30% of government-managed national roads. It is necessary to provide the fundamental geospatial data of road about the government-managed national roads exhaustively in order to use it as a common base for the government-private sector[2)]. So the NILIM began to implement "Joint Research on Providing and Updating Large Scale Road Map by government-private sector" (FY2013-2014).

This joint research has proposed methods of providing the fundamental geospatial data using existing resources such as digital maps or point cloud data of government-private sector. This paper reporst on results of the trial preparation of the fundamental geospatial data using the proposed methods and future prospects for these approaches.

2. Concept of the provision method

The following three methods were proposed as methods of providing the fundamental geospatial data of road using existing resources.

Method 1: Provision method using digital maps

Method 2: Provision method using point cloud data

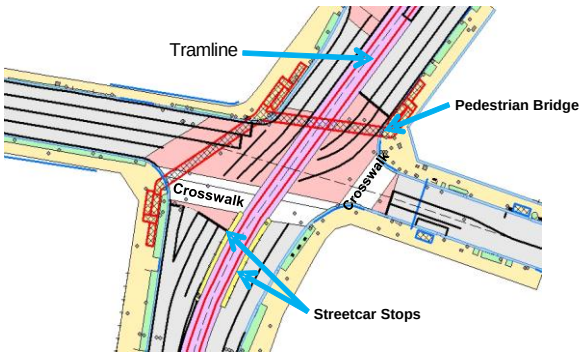
Method 3: Provision method using multiple existing resources

3. Evaluating usefulness of provision methods by trial preparation of maps

This joint research trial prepared maps in conformity with the three methods and confirmed their usefulness. This is a report on the results of the trial preparation of the fundamental geospatial data for Chiba City (road including road intersections and underground crosswalks, etc.) and Kumamoto City (roads including intersections with Prefectural and City roads with tramline or streetcar stops) using method 3 that can provide the most features.

The figure shows an example of the fundamental geospatial data that was trial prepared. It shows that crosswalks and streetcar stops and similar road structures can be represented in detail. As a result of the trial preparation, it was possible to provide about 60% of features in Chiba City and about 90% of features in Kumamoto City.

Figure. The fundamental geospatial data that was trial prepared by Method 3 (Kumamoto City)



4. Summary and future prospects

The results of trial preparation using the three methods revealed that it is possible to provide many features on the fundamental geospatial data of road. Based on the results, Collected Rules for provision methods proposed by the joint research were prepared. In the future, we will work hard to promote the provision of road infrastructure map information based on the Collected Rules and to create a sustained operation model.

[References]

1) Ministry of Land, Infrastructure, Transport and Tourism (MLIT): Product Specification of the Fundamental Geospatial Data of Road (Beta version) (Japanese only), 2008

2) R. Imai, M. Fukada, K. Shigetaka, A study of a method of creating and updating large scale road maps by public and private sectors (Japanese only), *the GIS Association of Japan* , Vol. 22., 2013

3) R. Imai, S. Matsui, M. Fukada, A. Kimura, K. Shigetaka, A Study of a method of creating large scale road maps by public-private partnerships (Japanese only), *the GIS Association of Japan* , Vol. 23., 2014

Dispatch of TEC-FORCE and other Experts to Disasters, and State of Technical Support Activities

1. Introduction

As shown by the example of the announcement by the Ministry of Land, Infrastructure, Transport and Tourism in January 2015 of "Effective Ways to Prevent or Mitigate Disaster Damage at the New Stage", we are already conscious of the localization, intensification, and increasing severity of the impacts of nature seen in recent years, and have been working harder than ever to promote efforts to integrate "structural" and "non-structural" measures to minimize disaster damage. As one effective method to achieve these goals, the Ministry of Land, Infrastructure, Transport and Tourism established TEC-FORCE (Technical Emergency Control FORCE)) in 2008, which has acted many times to prevent the occurrence or spread of damage or to carry out early restoration after a disaster.

2. Technical Support Activities of the NILIM

TEC-FORCE, which is based at the NILIM, acts as an Advanced Technology Guidance Team which, backed up by accumulated day-to-day research, deals primarily with phenomena or disaster damage that are difficult or complex to assess. Its major roles are, in addition to surveying damage conditions and evaluating the safety of facilities, providing advice based on its authoritative judgments to prevent secondary disasters.

When sediment disasters struck Hiroshima City in August, 2014, a few hours after the early morning occurrence, TEC-FORCE began to travel to the site to conduct a survey on the same day. Later, its members gave technical advice to support decisions concerning whether or not it was possible for the Self-Defense Forces, police and fire-fighters to enter the disaster region to conduct rescue activities, and also responded proactively as experts to requests for advice from local residents and governments, and from regional development bureaus.

The NILIM responded by, in addition to the activities of TEC-FORCE in the disaster region, aggressively continuing activities similar to those undertaken by TEC-FORCE when requested to do so by local governments or regional development bureaus in the region. And without requests or instructions to do so, it also voluntarily sent personnel to survey phenomena that must be handled considering the design of structures and to conduct other activities to improve technical capabilities concerning the prevention of damage to public capital.

Table 1　Despatch of Experts in FY2014 (Dec. 2014)

Disaster	Day dispatched	Location dispatched	Positioning of the dispatch	Personnel dispatched
Torrential rainfall on June 7	June 12	Kanagawa Pref. Yokosuka City Highland 1-chome	Request by Kanagawa Pref.	Sabo Dept., Sabo Risk-Management Div. Senior Researcher Matsushita Kazuki Sabo Dept., Sabo Planning Div. Chief Official Kado Takeshi
Typhoon 8	July 10 to July 11	Nagano Pref., Nagiso-machi	Request by Chubu RDB	Sabo Dept., Sabo Planning Div. Head Kanbara Junichi
Typhoon 11 (Torrential rains of Aug. 2014)	Aug. 10 to Aug. 11	Nara Pref. Gojo City Totsukara Town, Akatani District Kurihira district	Request by Kinki RDB	Sabo Dept., Sabo Risk-Management Div. Head: Kunitomo Masaru Sabo Dept., Sabo Planning Div. Chief Official Hirosawa Motohiko
Typhoon 12 (Torrential rains of Aug. 2014)	Aug. 8	Yamaguchi Pref., Iwakuni City, Shinminato and Tada Districts	Request from Yamaguchi Pref.	Sabo Dept., Sabo Planning Div. Senior Researcher Uchida Taro Chief Official Oochi Hisanori
Torrential rains of Aug. 2014	Aug. 20 to Aug. 22	Kyoto Pref. Fukuchiyama City Hyogo Pref. Tanba City	Voluntary survey	River Dept. Flood Disaster Prevention Div. Head Ito Hiroyuki Researcher Hosoda Satoshi
Continuous heavy rain from Aug. 16 (Torrential rains of Aug. 2014)	Aug. 20 to Sept. 8 Sept. 12 to Sept. 17	Hiroshima Pref. Hiroshima City, Asaminami Ward, Yagi Dist. And others	Request by Chugoku RDB TEC-FORCE	Sabo Dept. Head Watari Masaaki Research Coordinator for Sediment Disaster Prevention Nagai Yoshiki Sabo Dept., Sabo Planning Div. Head Kanbara Junichi Senior Researcher Uchida Taro Researcher Matsumoto Naoki Researcher Tanaka Yasutaka Chief Official Sakou Shunsuke Chief Official Uchida Takuji Sabo Dept., Sabo Risk-Management Div. Head: Kunitomo Masaru Senior Researcher Matsushita Kazuki

Disaster	Day dispatched	Location dispatched	Positioning of the dispatch	Personnel dispatched
				Researcher Kamiyama Joko River Dept., River Div. Head Hattori Atsushi
Continuous heavy rain from Aug. 16 (Torrential rains of Aug. 2014)	Sept. 16	Hiroshima Pref. Hiroshima City, Asaminami Ward, Yagi Dist.	Voluntary survey	Building Dept. Research Coordinator for Disaster Mitigation of Building Okuda Yasuo Building Dept., Standards and Accreditation System Div. Head Ando Koji
Heavy rainfall brought by low pressure on Sept. 11, 2014	Sept. 18 to Sept. 19	Hokkaido, Chitose City	Voluntary survey	Road Structures Dept., Pavement and Earthworks Div. Head Yabu Masayuki Researcher Enomoto Tadao Road Structures Dept., Foundation, Tunnel and Substructures Div. Senior Researcher Nishida Hideaki
Eruption of Mt. Ontake	Sept. 27 to Sept. 29	Nagano Pref., Kiso-gun, Kiso Town, Otaki Town	Emergency survey under the Sediment Disasters Prevention Act	Sabo Dept., Sabo Risk-Management Div. Head Kunitomo Masaru
	Oct. 2 to Oct. 3	Nagano Pref., Kiso-gun, Kiso Town, Otaki Town	Emergency survey under the Sediment Disasters Prevention Act	Sabo Dept. Head Watari Masaaki
	Oct. 5 to Oct. 7	Nagano Pref., Kiso-gun, Kiso Town Otaki Town	Emergency survey under the Sediment Disasters Prevention Act	Sabo Dept., Sabo Risk-Management Div. Head: Kunitomo Masaru
	Oct. 13 to Oct. 15	Nagano Pref., Kiso-gun, Kiso Town Otaki Town	Emergency survey under the Sediment Disasters Prevention Act	Sabo Dept. Research Coordinator for Sediment Disaster Prevention Nagai Yoshiki
Typhoon 18	Oct. 7	Ibaraki Pref., Chikusei City (Kokai River)	Voluntary survey	River Dept., River Div. Senior Researcher Mori Hirotoshi Researcher Fukuhara Naoki Researcher Takenaka Yuki River Dept. Flood Disaster Prevention Div. Researcher Hosoda Satoshi
Kinki Jurisdiction, Yuragawa-Okawa District, levee subsidence accident	Nov. 24 to Nov. 25	Kyoto Pref., Maizuru City (Yuragawa-Okawa District)	Request by Kinki RDB	River Dept., River Div., Head Hattori Atsushi Senior Researcher Mori Hirotoshi Researcher Fukuhara Naoki
Nagano Pref. Northern Earthquake	Nov. 23	Nagano Pref., Otari Town	Request by Hokuriku RDB	Sabo Dept., Sabo Planning Div. Researcher Matsumoto Naoki
	Nov. 24	Nagano Pref., Hakuba Town Kamishiro District etc.	Request by MLITT Headquarters	Housing Dept., Housing Production Div. Senior Researcher Nakagawa Takafumi
	Nov. 26	Nagano Pref., Hakuba Town Kamishiro District	Request by MLITT Headquarters	Building Dept., Structural Standards Div. Senior Researcher Arai Hiroshi
	Nov. 26	Nagano Pref., Nagano City (Susobana Dam and Okususobana Dam)	Voluntary survey	River Dept., Large-scale Hydraulic Structure Div. Researcher Ito Takeshi
	Nov. 29 to Nov. 30	Nagano Pref., Hakuba Town Kamishiro District.	Voluntary survey	Housing Dept., Housing Production Div. Senior Researcher Nakagawa Takafumi
Damage by heavy snow starting Dec. 12	Dec. 19 to Dec. 20	Hokkaido, Nemuro City	Voluntary survey	Coastal, Marine and Disaster Prevention Dept. Senior Researcher Kumagai Kentaro

※ This table contains only immediate post-disaster emergency response. Technological support for emergency restoration and reconstruction that continued after this stage is omitted.

※ The personnel dispatched column is limited to employees of the NILIM (affiliation and office when dispatched)

Technical Support in Comprehensive Dam Inspection

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Large-scale Hydraulic Structure Division, River Department

Key words: Dam management, Comprehensive Dam Inspection

1. Introduction

The number of dams that have been standing for many years since the start of management is increasing rapidly in Japan. For the dams under control of the Ministry of Land, Infrastructure and Transport (MLIT), they have been managed appropriately for maintenance of the required functions, including daily inspection by dam managers and periodic inspection by experts, etc. in principle for every three years. In addition to these, from a viewpoint of ensuring maintenance of the safety and functions of dams for longer time, the Comprehensive Dam Inspection [1], which is required to be implemented at the interval of about 30 years, was institutionalized.

2. Technical support by the National Institute for Land and Infrastructure Management (NILIM) and Public Works Research Institute (PWRI) for Comprehensive Dam Inspection

In the Comprehensive Dam Inspection, all the dam components, including civil engineering structures, machines and equipment, telecommunication equipment, and other dam facilities are covered and their soundness is surveyed and evaluated, and results are organized and documented comprehensively as "maintenance policy." The content of this maintenance policy is reflected in subsequent daily management, periodic inspections, etc. Figure below shows the basic flow of Comprehensive Dam Inspection.

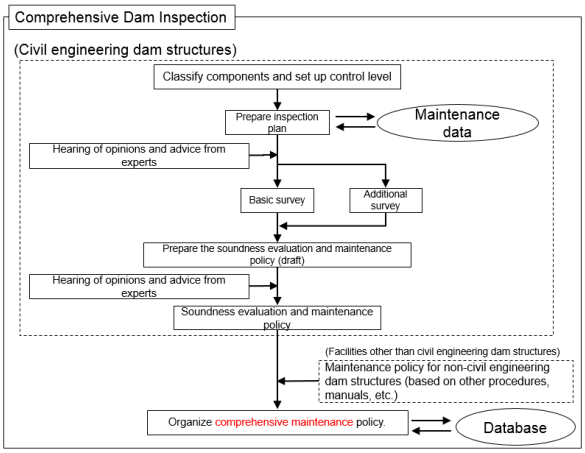

Figure. Basic Flow of Comprehensive Dam Inspection [1]

Photo. A Scene of Comprehensive Dam Inspection (On-site check by experts)

There are about 70 dams in Japan that have been operating more than 30 years since the start of management by the MLIT and the Japan Water Agency (JWA), and they have been undergoing the Comprehensive Dan Inspection in turn since October 2013. As shown in Figure, "experts" give comments / advice when "preparing inspection plan" and "preparing the soundness and maintenance policy (draft)" for civil engineering dam structures. The personnel of NILIM and PWRI responsible for dam structures and dam geology have been providing technical support in the position of "experts" to ensure effective implementation of Comprehensive Dam Inspection. The number of dams involved until the current fiscal year amounts to 46, including 5 dams under control of local governments.

3. Conclusion

Under the Comprehensive Dam Inspection, overall inspection of dams under control is scheduled for next year and thereafter. In order to ensure the implementation of PDCA cycle for dam facility management including Comprehensive Dam Inspection, the NILIM plans to continue to provide technical support for dam sites in collaboration with the PWRI.

[Reference]

1) River Environment Division, Water and Disaster Management Bureau, MLIT: "Comprehensive Dam Inspection Procedure / Commentary", October 2013 http://www.mlit.go.jp/river/shishin_guideline/dam/pdf/03.pdf

Building damage investigations regarding landslide disasters that occurred in Hiroshima on August 20

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(Keywords) Landslide, building damage

1.History

Regarding the landslide disasters that occurred in Hiroshima on August 20, 2014, landslides and the resulting avalanche of mud and debris struck various areas causing serious human casualties and damages to buildings.

NILIM, through joint efforts with the Building Research Institute, conducted field work investigations into the damage situation of a reinforced concrete building (Kenei Midorigaoka Jutaku) that, although were among those buildings damaged by the landslide disaster and received considerable earth load and impact from the debris flow, did not collapse.

As well, in the Building Standard Act, regarding buildings with living rooms inside a landslide disaster special warning zone, the outer wall that is expected to receive impacts from the debris flow of landslides, and its principle structural resistant parts must be of a certain construction method according to the type of natural phenomenon, or is required to have a gate or wall installed with an equal or greater withstanding strength (this region was outside the bounds of the zone concerned).

2. Investigation overview

(1) Investigation date: Tuesday September 16, 2014 (PM)

(2) Overview of Kenei Midorigaoka Jutaku

Location: 3 Chome Yagi, Asaminami-ku, Hiroshima

Construction period: 1982 to 1983 (completed)

Facility overview: Three-story wall type RC building, 9 buildings/total 120 homes

(3) Building No.5

Part of the tiles on the eaves of the housing unit's west side was out of position, making it likely that the debris (with a strong possibility that flowing rubble from houses upstream were in this debris as well) reached the height of the eaves (Photo 1). It is likely that a massive rock collided with the side facing the mountain as well, causing a cantilever retaining wall (both ends open) on the second story terrace on the mountain side to be greatly deformed in the off plate direction (Photo 2).

Photo 1

Photo 2

(4) Meeting place

Although it was a single story house wall type RC building, due to the sloping land, a portion of the side facing the mountain lay underground (Photo 3). Since the parapet was damaged considerably and rock remains were on the roof, the avalanche of earth and rocks is believed to have flooded over the building, however, large damage was not found on the building's structure. There was also hardly any detectable off -plate deformation of the retaining wall on the dry area along the road (Photo 4).

Photo 3

Photo 4

(4) Propane storage

The storage was a single story wall type RC building (10㎡), with driftwood remains still left on the roof. Although it is assumed that the flood of mud and rocks reached the top of the wall, no considerable damage was found (Photo 5).

Photo 5

(5) Others

Apart from the surveys conducted on the Kenei Midorigaoka Jutaku building in the 3 Chome Yagi, Asaminami-ku district, damage situation investigations were also conducted on the building's upstream and downstream sides, as well as the 6 Chome Kabehigashi, Asakita-ku district, where landslides occurred from multiple directions.

(Reference)

NILIM, Building Research Institute "Building damage investigations regarding landslide disasters that occurred in Hiroshima on August 20, 2014"
http://www.nilim.go.jp/lab/bbg/saigai/h26/140916hiroshima_kenchiku.pdf

Field surveys of damage to buildings and foundations from the 2014 northern Nagano earthquake

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(Keywords) damage investigation, wooden house, foundation, Kamishiro, the 2014 northern Nagano earthquake

1. Foreword

The department conducted two surveys of damage to buildings, mainly wooden houses, by the November 22, 2014 earthquake in Northern Nagano Prefecture, and a survey of the surrounding ground and foundations. For details, refer to literature 1.

2. Damage to buildings focused on wooden houses

In order to clarify the state of damage to wooden houses and other types of buildings from the earthquake that struck northern Nagano prefecture at 22:08 on November 22, 2014, in cooperation with the Building Research Institute, the department conducted surveys centered on the Kamishiro part of Hakuba Town. The primary survey confirmed many houses that collapsed or showed severe residual deformation in the Horinouchi district of that region. Judging from such conditions, it is thought that earthquake motion higher than upper 5 on the Japanese seismic intensity scale might have occurred in Hokujo in Hakuba Town, which is the location of the nearest earthquake observation station. And damage to mud-plastered wall houses, damage to houses in which the column and brace end joints were not connected adequately, displacement of houses in which the column ends or sills were not fixed to their foundations, and damage to houses with block foundations or non-reinforced foundations were found at many places. The secondary survey was a detailed survey of the state of damage including a visual inspection of the interiors of houses. The results of the surveys will be analyzed and summarized in technical documents to be used to study the causes of damage to buildings.

Photo 1: Collapsed houses

In the future, we intend on compiling technical documents for the evaluation of damage factors to the buildings.

3. Ground deformations at building sites

The survey of ground and foundations has revealed that a number of stone and retaining walls were heavily damaged or overturned in the Horinouchi district, which is a south-facing slope terrace. Many power poles were also shifted about 5-30 cm and inclined southward in the district. These indicate that strong ground motions could have been predominant in the north-south direction during the main shock.

Some documents reported that this district was placed near the shore of a large lake before, suggesting that the surface strata consist of soft soils and their geophysical conditions could vary with locations on the slope in the district. And by surveying soil investigation data, we will study the relationship between the structural damage and ground characteristics in the district.

Photo 2: Stone walls and power poles damaged southward

(Reference) Literature 1: Investigation report HP
http://www.nilim.go.jp/lab/bcg/kisya/journal/kisya20141127.pdf（Wooden building primary investigation report）
http://www.nilim.go.jp/lab/bbg/saigai/h26/141126nagano_kenchiku.pdf（Basic foundation investigation report）
http://www.nilim.go.jp/lab/bbg/saigai/h26/141129nagano_juutaku2.pdf（Wooden building secondary investigation report）

International Activities

1. International Research Activities at the NILIM

International research activities of the NILIM in fiscal 2014 were collecting advanced cases from overseas, sharing information within Japan, promoting international standardization of Japan's standards and forming multilateral and bilateral links and undertaking the following specific activities.

・Collecting advanced cases from overseas and sharing information within Japan (exchanging technology on large-scale sediment disaster countermeasures etc., EU - Japan - U.S. Trilateral ITS Working Group Conference, Japan-U.K. Workshop on Road Science and Technology, Inter-jurisdiction Regulatory Collaboration Committee (IRCC), etc.)

・Promoting international standardization of Japan's standards (supporting the international standardization of Japan's sewage treatment technologies, dam facilities design and construction technologies, erosion and sediment control technologies, and ITS technologies, contributing to the international harmonization of building regulations through participation in the in ISO etc. concerning housing and building construction)

・Forming multilateral and bilateral links (joint research with the Korean Research Institute for Human Settlements, Japan-Indonesia research cooperation, Japan-Vietnam research cooperation, etc.)

The following are results of major international conferences (international conferences held by the NILIM).

2 Holding major international conferences

2.1 EU - Japan - U.S. Trilateral ITS Working Group Conference (U.S. July 18 to 19, 2014)

This conference was held in San Francisco in the United States under a memorandum of cooperation between Japan and the U.S. in ITS signed in 2010 by the Road Bureau of the Ministry of Land, Infrastructure, Transport and Tourism and the U.S. Research and Innovative Technology Administration (RITA) of the United States Department of Transportation, and under a memorandum of cooperation between Japan and Europe in ITS signed in June 2011 by the Road Bureau of the Ministry of Land, Infrastructure, Transport and Tourism and the European Commission Directorate General for Communications Networks, Content and Technology (DG Connect). This conference consisted of three working groups: "Automated Driving", "Probe data", and "Evaluation tools and methods". At each working group session, each country exchanged information, reported on the progress of work alloted to it, and confirmed the contents of future tasks.

2.2 The 21st ITS World Congress, Japan-EU-US Trilateral Steering Group Meeting, Bilateral Meeting, ITF-VHA, FOT-Net Data (U.S., September 6 to 12, 2014)

The ITS World Congress, the largest international conference on ITS, has been held every year since 1994. In 2014, it was held in Detroit, Michigan, USA. The Intelligent Transport Systems Division attended it and gave 6 presentations at special sessions including the ITF-VHA, FOT-Net Data International Workshops held at the same time in addition to 4 presentations of papers. Through the Japan-EU-US Trilateral Steering Group Meeting and the Japan-Amsterdam Group, Japan-China and Japan-Korea Bilateral Meetings, we exchanged information and discussed future research and development of ITS with concerned authorities of each country.

Photo 1 Image of the Japan-EU-US Trilateral Steering Group Meeting

2.3 The 13th Japan - Indonesia Joint Research Workshop (Indonesia, October 5 to 10, 2014)

This workshop was held in Jakarta, Indonesia under a memorandum concerning the cooperation activities between the NILIM and the Indonesian Institute of Road Engineering（IRE) signed in 2009 by. This workshop was an open seminar for technologists from throughout Indonesia on tunnel technology guidelines, a matter now being studied in Indonesia. It was accompanied by the exchange of views between concerned parties from Japan and Indonesia concerning the guidelines.

2.4 High level conference with the U.S. Federal Highway Administration (U.S.: October 14 - 19, 2014)

This high-level meeting was held in Washington, D.C. in the U.S. so Japan and the U.S. could exchange views on road administration. Director General Tokuyama, Ministry of Land, Infrastructure, Transport and Tourism and Director-General Iwasaki of the NILIM represented Japan. At the meeting, views were exchanged concerning the financial state of road administration in both countries, PPP, measures to counter the deterioration of road facilities, and efficient road management, and particularly lively discussions dealt with advanced cases such as

bridge reconstruction projects in the U.S.

Photo 2 View of the High level conference with the U.S. Federal Highway Administration

2.5 The 30th U.S.-Japan Bridge Engineering Workshop (U.S.: October 20 - 23, 2014) and the 18th MLIT/FHWA Intergovernmental Conference (U.S.: October 23, 2014)

The U.S.-Japan Bridge Engineering Workshop is held alternately in Japan and the United States every year as an activity of the Panel on Wind and Seismic Effects Task Committee G (Transportation Systems) of U.S. - Japan Conference on Development and Utilization of Natural Resources (UJNR). This year it was held in Washington in the United States with its main themes: durability design, inspections, preventive maintenance, seismic design, and seismic retrofitting.

The MLIT/FHWA intergovernmental conference is held alternately in the United States and in Japan once every year under the US–Japan Agreement on Cooperation in Research and Development in Science and Technology (an agreement concerning cooperation by the Ministry of Land, Infrastructure, Transport and Tourism of Japan and the Department of Transport of the United States concerning Transportation Science). The state of the art on technology policy and standards and future development plans were shared with each other concerning preventive maintenance and remedial measures, element-level bridge inspection, seismic retrofitting, and risk management.

2.6 Japan - U.K. Workshop on Road Science and Technology (England: November 4 to 5, 2014)

This workshop has been held alternately in Japan and the United Kingdom since 1998 under an Understanding on Japan - U.K. Road Science Technologies signed in 1997. At this, the eleventh workshop in the series, participants from both Japan and the U.K. gave presentations on the themes—traffic safety (mainly expressway traffic safety) and ITS—and asked and answered questions and exchanged views about the state of traffic accidents, and future directions in traffic safety countermeasures in their two countries.

2.7 14th Japan - Indonesia Joint Workshop (Indonesia, November 16 to 21, 2014)

This workshop was held in Bali and elsewhere in Indonesia under a memorandum concerning research cooperation signed in 2009 by the NILIM and the Institute of Road Engineering (IRE) of the Ministry of Public Works & Public Housing of Indonesia. At the meeting, participants presented papers, exchanged views, and conducted a field survey on road environments and road stations in both countries.

Photo 3. View of the workshop with the IRE

2.8 9th Japan - Vietnam Research Cooperation Workshop (Japan: November 18-19, 2014)

This workshop was held in Tsukuba under a memorandum concerning research cooperation signed in 2010 by the NILIM and the Institute of Transport Science and Technology (ITST) of the Ministry of Transport of Vietnam. At this workshop, participants confirmed the state of road environments in the two countries and also confirmed the need for environmental standards considering differences in traffic conditions in the two countries.

2.9 4th Japan - Korea Research Exchange Meeting on Urban Affairs (Korea: February 11, 2015)

This meeting was held in Anyang City in Korea under a memorandum of cooperation between the NILIM and the Korea Research Institute for Human Settlement (KRIHS) signed in 2012 by. At this meeting, reports were presented from both countries on challenges to and policy directions concerning urban renewal introduced cases of specific cities. Later, the participants joined a field survey of the cities of Jeonju and Gunsan, two cities where urban renewal has been done taking advantage of historical streetscapes.