●Message from the Director-General

National land and infrastructure in a time of low birth rates, aging and declining population

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(Keywords) National land management, social infrastructure, aging, population shrinkage

1. Population problems as a condition for national land management

When considering the management of national land and infrastructure, it is essential that we keep abreast of changes in various conditions in the background to prepare related technological policy.
However, they have been rapid of late, often moving into uncharted territory.

For example, the borderless international economy and rapid expansion of newly emerging countries have invalidated many conventional economic theories which were established regarding domestic matters.

The primary target of NILIM's research is to decide how we should manage national land and social infrastructure. Therefore I think that addressing not only international economic trends and long-term climate change but also rapid aging and population shrinkage are some of the major challenges we are facing. Here, I would like to consider trends in Japan's population shrinkage and what they signify, as well as stating my personal views on two or three remedial measures.

2. Views on demographics

On February 25th, the Statistics Bureau of the Ministry of Internal Affairs and Communications published its preliminary report on the 2010 National Census. In it, the population of Japan was said to have grown slightly by 288,000 or 0.2% compared to the previous survey in 2005. But I think a closer scrutiny will prove that the population is falling. According to the National Institute of Population and Social Security Research, Japan's population peaked in 2007 and is expected to fall below 100 million (around 80% of today's figure) four decades later in 2050. Judging from this prediction, the simple impression might be that Japan's population will gradually turn to a decline from now on.

However, a recent bestseller[1)] asserts that Japan's economic growth is related not to the total population but closely to the working population (people aged 15-64), as they are the main players in personal consumption, which accounts for 60% of GDP. The book also presents the shocking truth that this population in fact peaked in 1995 and has already decreased by around 9%. By 2050, moreover, it will have fallen to less than 50 million, a decline of 45% compared to the peak of 87 million. This can be interpreted as showing that, to maintain the nation's vitality, we need powerful economic policies that can reverse the tide of decline in the working population.

In this paper, I focus on the "advanced elderly" (those aged 75 or over), who account for the majority of personal assets among those over the pensionable age (65), with the prediction that their number will approach 24 million by 2050. While most people aged 75 or over are assumed to be in an age cohort requiring support in a variety of situations, this means that there will be no choice but for the rapidly declining working population (i.e. active generations) to support the rapidly increasing advanced elderly generation while attempting to sustain and energize the national vitality, particularly economically. This means, in turn, that we need to implement national land management designed to rebuild social infrastructure in ways this requires.

3. Scope of maintaining and energizing national vitality

To maintain high vitality under the shrinking population, it will be necessary to make the infrastructure produce added value efficiently in an effective state for users at all times. To this end, I would like to propose that the completion of expressways, currently under development, be pushed forward to keep them functioning as road networks. By so doing, we should establish a globally unique road infrastructure that harnesses leading-edge technology in Japan[2)].

There is a considerable expectation that electric vehicles (EV) can help to usher in a low-carbon society, with zero emissions (although depending on the power generation method). Recharging facilities are therefore already being built, and EVs are expected to be diffused rapidly. There are still many issues to be tackled for EVs to travel long distances; for example, high-performance batteries are expensive and limited in their capacity, and in addition, the recharging process is time-consuming. The batteries are also heavy, and this will cause difficulties in diffusing them for use in cargo haulage.

Nevertheless, the technology for supplying electric energy to moving EV from roads already exists as an infrastructure. There are several different technologies for non-contact transmission of electric energy, and if the method known as electromagnetic resonance (not induction) is used, it will be possible to supply energy

to vehicles some meters away by consecutively aligning coils on the road surface or in the median strip. In a case where energy is supplied from the road on expressways and vehicles on ordinary roads are powered by batteries, the EV systems will be diffused dramatically.

Systems of charging fees for the power consumed have already been developed to some extent, having been produced in conjunction with ITS technology. If these are combined with truck platooning technology for trucks, high-precision GPS using quasi-zenith satellites, and others, automatic transit of freight haulage vehicles might no longer be a pipe dream. While a contribution in environmental terms is assured, there is also potential for wave effects, such as solving manpower shortages in the distribution sector amid population shrinkage, reducing long working hours, and so on. Reducing costs in domestic haulage may even lead to increasing their competitiveness in national activities.

4. Scope of Quality of Life (QOL)

The aging society also means a long-living society. There is room for study, from the view of infrastructure, concerning ways to ensure that a longer life can also be a happier life. Decisive factors in QOL are, for example, whether or not a person can move about freely even in old age. Considering that many of the advanced elderly stop driving cars, it would be better for them to live convenient to public transport services.

Although much discussion has already been held on the rationale of compact cities, it is not easy to present a universal panacea, because cities all differ in their scales and existing transport infrastructures. But considering the simple maxim that "it should be the elderly who live in places where public transport services are convenient", society as a whole will be expected to gradually move in such a desirable direction.

And if you were to give up the preconceived notion that station plazas are places for busy shopping malls, and remodel the vacant shops on shuttered streets into old people's homes or other welfare facilities, the provision of public services would also be made more efficient. Moreover, a population of station front residents would make it easier for a certain level of commercial facilities, supermarket delivery services and others to become established. And if community buses and other local transport termini were established there, it would certainly attract regular users. Setting up nursery schools and other facilities at the same time might also be expected to have synergistic effects on these areas. Delivering such services in and around buildings located at large stations is also possible using the infrastructure.

5. Scope of mitigating natural disasters

In readiness for natural disasters, emphasis has long been placed on the concepts of self-help, mutual help and public help. Until now, these have been keywords for finely focused evacuation guidance, etc., at times of natural disasters. But when considering the sharp decline in the working population as bearers of mutual help for the rapidly increasing advanced elderly, we have to consider how we can reduce their burden. This kind of situation often pertains in mountainous regions that contain depopulated villages. While it is essential for advanced elderly who require evacuation support to live in places that are safe and easily accessed by support services, and collectively if possible, to achieve this, efforts are surely needed to inform people that reducing the burden of "mutual help" is an act that leads to "self-help".

6. Conclusion

We will never understand the essential meaning of the population shrinkage if we only consider total population. Most opinions on future population are the product of wishful thinking. However, the working age population in, say, 15 years' time will only be augmented by younger people who have already been born, and has therefore already reached its peak value. This means we have to think out various measures to deal with this matter, so our eyes must be firmly focused on the facts.

Finally I hope we will not forget that the future composition of our population not only consists of target recipients of welfare but is also a prerequisite for proposing policy.

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Challenges facing public procurement and perspectives of national land management

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(Keywords) Public procurement, Construction management, National land management

1. Introduction

The mission of the Research Center for Land and Construction Management ("the Center") is to support the planning and proposal of policy related to the development and management of housing and social infrastructure under the jurisdiction of the Ministry of Land, Infrastructure, Transport and Tourism (MLIT). The Center fulfils this mission through research activities focused on the key phrases of "national land management" and "construction management".

In the following report, I would like to introduce one of the main themes of research by the Center – the challenges currently facing the system of procurement in the public works sector and the status of initiatives aimed at solving them, including perspectives of national land management.

2. Challenges facing procurement in the public works sector

(1) Ensuring and improving the quality of public works

To steadily promote the development and management of social infrastructure that supports a safe, comfortable and energetic national lifestyle, it goes without saying that expanding public trust and support for public works is a major requirement. To that end, as well as ensuring the transparency and competitiveness of procurement processes, a system for ensuring a certain level of quality is seen as necessary.

The "Act on Promoting Quality Assurance in Public Works" enacted in April 2005 was an epoch-making revision of the public procurement system, in that it initiated a shift from the conventional "procurement by competition based only on price" to "procurement based on combined excellence in price and quality". The method of awarding bids based on overall evaluation, in which the winning bid is decided from a comprehensive evaluation of the content of the technical proposal combined with the bid price, has gradually been expanded in scope while its application has been continuously revised based on trials. This method was applied to almost all of about 11,100 works under the direct jurisdiction of MLIT in FY2009. Incidentally, the comprehensive evaluation method also became applicable to survey and design work in FY2007, and was applied to about 20% of 17,400 cases in FY2009. Adding about 34% decided under the proposal method, this meant that around 54% of contract partners were decided in a form not based solely on price.

Every year, the Center compiles and publishes annual reports on the implementation status of the comprehensive evaluation method in public works and construction consultancy, etc.[1) 2)].

We also carry out research aimed at making adaptive improvements, considering discussions at the "Informal Discussion Group on Ensuring the Quality of Public Works under Direct Jurisdiction of MLIT" (chairman: Professor Kazumasa Ozawa, University of Tokyo). The ultimate aim is to create a system of contract bidding that effectively encourages efforts to improve technical ability among the bidders.

(2) The role of construction industries in exhibiting local leadership

When considering the ideal shape of the construction industry in future, its role as a leader of regional society is also an important perspective. To appropriately maintain and repair aging social infrastructure stock and increase its longevity, the presence of construction companies with the necessary technical capability is essential. Undeniably, maintenance and repair works have until now tended to have a rather drab image compared to new works, including their budgetary treatment. However, considering that the weight of such works is inevitably going to increase in future, we need to form attractive markets in which companies with sufficient technical and business capabilities can continue corporate activities and reap the necessary profit to make further improvements to their technical capability. To this end, initiatives such as setting estimated prices based on small-scale, dispersed site conditions and flexible work processes, orders for combined maintenance inspection and repair works, continuous orders over several years for several works sites within a fixed area, and others have been started on a trial basis. Now, the time is right for efforts aimed at developing the market environment while ascertaining the effects of these measures.

The role of construction companies in the event of a

natural disaster should also not be forgotten, in that they take emergency measures and make other direct and indirect contributions, either autonomously or based on disaster response agreements with administrative bodies. In particular, locally-based companies often make tremendous contributions to their communities through swift emergency action using their own heavy equipment and materials, drawing on their close familiarity with the local terrain; they take responsibility for "protecting the nation" at grass roots level, as it were. To respond flexibly to disasters that could occur at any place and at any time, construction companies with business developments all over the country need to establish an environment in which they are always prepared for local disaster prevention activities.

(3) Harmonizing with international public procurement processes

Global strategies by industries aimed at harnessing the economic growth of newly emerging markets in Asia and elsewhere, as an energy that will revitalize Japan's economy, are cited as one mainstay of the Japanese government's new growth strategy.

In pursuing the global expansion strategies of the construction industry sector, where production-to-order is the norm, mastery of the procurement rules of the country in question is also a major challenge under present conditions, in addition to responding to normal market risks.

Preparations are currently in progress to start trial contracts based on the standard contractual terms determined by the International Federation of Consulting Engineers (FIDIC) in some works under direct MLIT jurisdiction. Part of the aim in doing so is to contribute to the training of engineers and experts in contractual practicalities who can be active in international projects, thereby aiding the international development of the construction industry. Of course, the national infrastructure, society and economic conditions in western countries differ from those in Japan, and there is no need to apply internationally standardized contractual terms mainly formulated by engineers from those countries unconditionally to Japan. Nevertheless, it is expected that this will provide positive lessons on the best aspects of works contract rules that have gradually been brushed up through application in various countries. At the same time, it may provide hints for improving Japan's system of construction production.

(4) Contributing to the creation of a recycling society

The construction industry, where various materials are invested on a massive scale, has the role of encouraging market formation and technology development and guiding the creation of a recycling society. It does so not only by recycling and reusing construction by-products generated in the process of works, but also, for example, by actively promoting the effective use of waste from other sectors where inside recycling is difficult.

Green procurement in the public works sector, based on the Law Concerning the Promotion of Procurement of Eco-Friendly Goods and Services by the State and Other Entities enacted in May 2000 (the "Green Purchasing Law"), has made steady progress over the last 8 years[3].

In the future, as well as further strengthening efforts from the design stage, it is hoped that the industry, by introducing life cycle assessment (LCA) and other related measures, will transmit information both in Japan and abroad as actual examples of the development of social infrastructure that can serve as models internationally, according to the demands of the times.

3. Summary

In the foregoing, I have cited the challenges facing procurement in the public works sector from a number of angles, and introduced directions for related research initiatives. These challenges are closely linked to each other. While making sure that in such cases the solution to one problem does not cause new problems or side effects (though this is by no means limited to public procurement), a holistic approach is required in order to find the best solutions for the problem as a whole[4]. It might be fair to say that the role and targets of the Center's activities lie in achieving this.

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Towards sustainable national land and urban environments to hand on to the next generation

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(Key words) National land and urban environments, sustainability, biodiversity, global environment

1. Introduction

Surrounded completely by the sea, Japan is blessed with abundant and beautiful nature throughout its changing seasons. On the other hand, it is exposed to harsh natural conditions and constantly faces the threat of disasters. For example, located on the main course of typhoons, Japan is susceptible to storm surges and frequent floods and sediment disasters. Moreover, located above tectonic plate boundaries, it is vulnerable to earthquakes and is frequently struck by tsunami and volcanic eruptions. Standing on national land with these conditions, we must find ways to manage our land as we face and seek harmony with an environment in which we coexist with nature.

On our small national land with its limited living space, a society has been formed which offers a population of approximately 130 million people the comfortable cultural life and efficient amenities we all now enjoy. However, the population has begun to fall and we are facing the steadily advancing aging of society. Therefore, to hand on a sound environment to the coming generation, we need methodologies to create a sustainable environment while we can, and to construct systems to develop these methodologies.

2. Directions in environment research

We face the urgent challenge of forming sustainable national land harmonized with nature under the limitation of the finitude of the environment.

Because today's environmental problems are, as shown by the global warming problem, becoming more complex and widespread, it is becoming more important for us to identify their position in the overall scope of the problems, and thus to implement comprehensive and strategic technical policies and research and development.

Environment Department considers environmental issues to be an important administrative challenge for the Ministry of Land, Infrastructure, Transport and Tourism and our research mission to be developing and managing public infrastructures such as roads, rivers, parks and green space, which directly contribute to livelihood and economic activities in Japan in the midst of fast-moving activities by others on the environment, by conserving, restoring, and improving quality of national land and urban environments.

Our research strategy is to target both global environmental issues such as "global warming", "sustainability", and "biodiversity" and immediate environmental issues such as "beautiful, abundant, and active livelihood" , and focus on research in these areas (see Fig. 1).

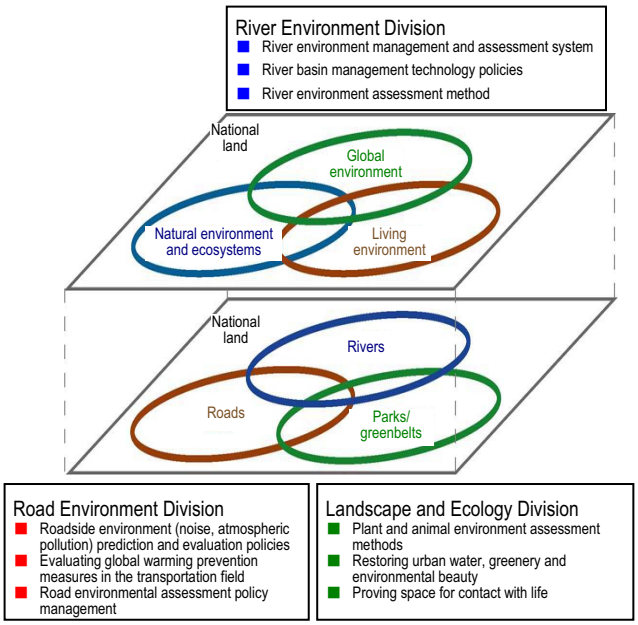

Figure 1. Outline of Research by the Environment Department

Our research is based on not only the natural science approach but the social sciences approach necessary for our policy research. It is also based on the empirical approach in corroboration with concerned organizations and local entities.

Our approach to research includes actively collaborating with concerned government ministries, independent administrative corporations, private corporations, universities and research institutes

including those overseas through coordination under a variety of circumstances, because environmental research encompasses a variety of interests and is very complicated.

3. Research principles

Environment Department has set the following three research principles.

The first is "visualization" of processes of environment research on infrastructures. For example, "research project on the conservation and restoration of brackish water area environments" puts emphasis on innovative ways to display the behavior of brackish water environments in an easily understood form, and on public symposiums. The "Research project on development of environmental assessment technologies for the life cycle of infrastructures" involves broad groups concerned with technological development. This visualization principle is applied to other research projects.

The second is harmonization of the natural sciences and social sciences. History tells us a great deal concerning the environment, so in the environmental field, it is particularly important to understand historical changes in society. The relationship of the change of coastlines with land use and social systems is also linked to the construction of the current comprehensive coast management[1]. Stronger partnership with social sciences will be increasingly needed.

The third is "data archive." Research is based on a large quantity of data, but once conclusions are delivered, data sometimes gathers dust and is unused. Through environmental studies, particularly complicated data are newly obtained, so data is much more significant than ones in other fields.

Some environmental research needs a trial and error process. Notwithstanding past common theory, Environment Department shall explore new technologies applicable to infrastructure management, and also be challenged by fundamental research.

4. Conclusions

Figure 2 shows change over time in the top three answers, "beautiful nature", "long history and tradition", and "superior culture and arts", given in response to the question, "What is the pride of Japan?" in a recent public opinion survey conducted by the Cabinet Office. The figure shows a gradual increase in the percentages for these answers. Environment Department shall make efforts to perform research and development to contribute to a splendid national land and urban environments where we will coexist with beautiful nature and enjoy traditions and culture, and once again a future generation will declare that these are "the pride of Japan.", although increased benefit from infrastructures related to rivers, roads, and parks become commonplace and may be unrecognizable to the public. In addition, modern society is flooded with a variety of information, but Environment Department shall stick to the research principles to achieve the missions through processes of trial and error and self-questioning, and closely watching environmental movement.

[Source]

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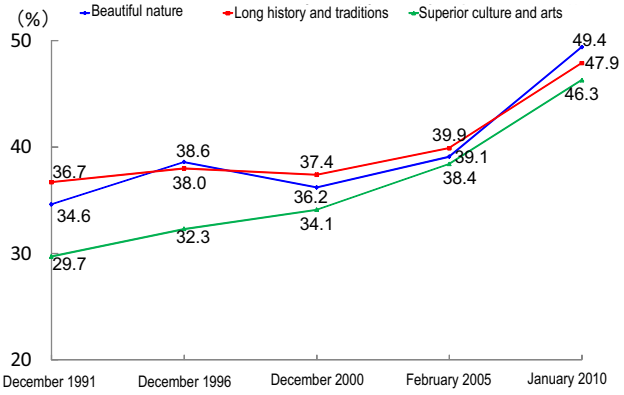

Reorganized by the author based on the results of an opinion survey by the Cabinet Office

Figure 2. Changes of the Top "Three Prides of Japan" in an Opinion Survey of Social Consciousness by the Cabinet Office

To operation of public infrastructure in the age of world unity

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(Key Words) Sewage system, energy, global warming, B-DASH, international standard

Introduction

Information from around the world is transmitted instantaneously not only by TV, but over the internet, most food products and miscellaneous day-to-day goods are imported and their share is growing, Japanese corporations are beginning to procure supplies overseas and place priority on hiring foreigners, and English is becoming an official language.

On the other hand, a prolonged economic slump has been accompanied by tightening financial restraints both at the national government and local level, and in regions where the population is declining and society aging, concern regarding the maintenance and renewal of the public infrastructure which supports daily life and economic activities has become a real problem.

This report introduces trends in sewage systems as their operators search for ways to contribute internationally such as through measures to counter global warming, and to encourage domestic growth while lowering the costs of constructing, operating, and renewing their facilities in modern society, which is now in the midst of a process of international unification.

1. For cheaper and faster improvement of pipelines

The cost of providing pipelines generally accounts for 60% to 70% of the total cost of a sewerage system, which consists of pipelines and treatment plants. Through the efforts of our predecessors, the nationwide sewered population has reached 73.7% (end of FY2009), and the sewered population plus the percentage which treats sanitary sewage using septic tanks etc. has risen to 85.7% (end of FY2009), but neither service is available in districts with a total population of 18 million people. So in FY2006, the Sewage System Quick Project, a social experiment regarding technologies to lay pipelines cheaply and quickly, was kicked off. The Wastewater Control Department of the NILIM is contributing to the selection of diverse technologies such as exposed pipelines, which are placed on the ground surface instead of underground (Fig. 1), through social experiments to test such technologies, and, reporting on their findings, by providing technical support for technology evaluations, and so on.

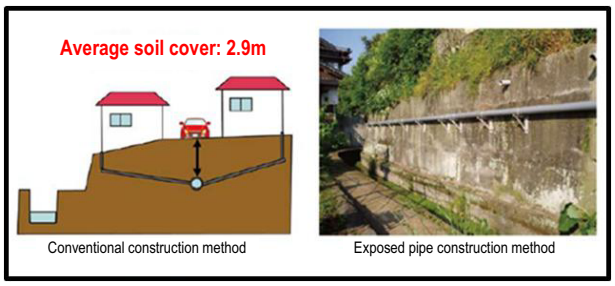

Figure 1. Exposed Pipes

2. Revolution in wastewater treatment technologies

More than half of the population of Japan discharges sanitary water into Tokyo Bay and other closed bodies of water, but the percentage of the population served by sewage systems performing advanced treatment of sewage is very low at only 16.9% (end of FY2008), and the percentage of treated sewage which is now reused stands at a mere 1.4% of all treated sewage.

The most common sewage treatment method in use is the activated sludge method which employs microorganisms, but replacing facilities to introduce more advanced facilities while continuing to operate treatment plants on narrow sites in urban districts is a daunting task. The revolutionary “membrane treatment technology”, which is not only compact, but can also easily obtain immediately reusable high water quality, is now spreading worldwide.

Japanese manufacturers supply a huge share of the world market for the membranes, but they are only used at about 10 small scale sewage plants in Japan. In order to make a big contribution to promoting the application of this method to deteriorated facility reconstruction and renewal projects in large cities and to satellite treatment in water demand regions, the Advance of Japan Ultimate Membranebioreactor technology Project (A-JUMP), a national government financed project to prepare guidelines to proving and introducing the method at large treatment plants was inaugurated in FY2009 with the cooperation of corporations and regional governments. To cut the energy used for aeration needed to prevent filter clogging and to tackle a variety of problems which arise when introducing the method at an existing plant, the NILIM is serving as a member of the project administrative office to revise existing guidelines in light of new knowledge which is being continually obtained. These efforts are counted on rapidly expanding its introduction to large-scale plants in Japan.

3. Using sewage sludge to create resources and energy and fight global warming

The next topic is sewage sludge formerly buried in landfill as industrial waste material. Through strenuous efforts of various kinds, the recycling rate of this sewage sludge has been increased to 78% (as of FY2008), but the rate of use as biomass taking advantage of its organic constituent has stopped at only 23% (as of FY2008). Treating wastewater consumes nearly 1% of all energy use in Japan, focusing national attention on this field of technologies because of the recent soaring cost of energy, project and maintenance costs, and the importance of measures to counter global warming.

The LOTUS (Lead to Outstanding Technology for Utilization of Sludge) Project, which was inaugurated in FY2004 to achieve two goals, (1) reuse is cheaper than disposal and (2) generating electricity is cheaper than buying electricity, is developing practical technologies such as technology to recover, dry, and carbonize biogas (methane) to form solid fuel briquettes by a digestion (fermentation) process. In FY2011, the project had selected and verified technology which has sharply cut the cost of construction and substantially lowered greenhouse effect gases through energy recovery, and led by the NILIM, is now preparing for the large scale guideline enactment project, B-DASH (Breakthrough by Dynamic Approach in Sewage High Technology Project).

These projects are counted on to develop sewage systems which function as urban infrastructure contributing to the environment in the areas of both resource recycling and of energy.

4. Maintaining and using existing systems

The era when infrastructure provided rapidly during the era of high speed economic growth and various other parts of our public capital must undergo full-scale renewal is near at hand. With limited finances and personnel, we are concerned with the need to decide how to make predictions and reach repair or reconstruction decisions in order to perform systematic stock management.

While facing problems such as road surfaces caving in above deteriorated water mains, the Sewage Pipeline Service Life Extension Support System was inaugurated in FY2008 as a national government subsidized project. Under this system, service lifetime extension plans enacted for sewage system projects nationwide are now in progress with their completion scheduled for FY2012. The NILIM has been collecting and analyzing nationwide data concerning pipelines, resulting in the completion in 2007 of the Basic Concepts of Stock Management in Sewage System Projects (Draft) and the preparation of the, still incomplete, Handbook of Stock Management of Sewage System Projects.

5. Aggressively responding to international standards

Table 1. Trends Related to International Standards

Name	International standard
TC224: Used for potable water supply and sewerage services	ISO24510-2
TC138: Plastic pipe for transporting fluids	ISO4435, 8773, etc.
PC253: To reuse treated waste water as irrigation water	Being prepared
TC255: Biogas	Being prepared
PC251: Asset management	Being prepared

The Water Quality Control Department took part in the first meeting of ISO/PC251 held in Melbourne from February 28 to March 4 to prepare proposed international standards for asset management including overall social infrastructure in various areas. Two working groups (WG) were established to discuss the contents at the same time as they agreed on a three-year standardization schedule. The next meeting will be held in October in Washington.

Public projects above a certain scale are already required to make procurements applying international rules under a WTO Agreement, but the international standards, ISO etc. which require compliance with domestic regulations and standards are being enacted one after another for various kinds of hard and soft public capital.

And in the public water supply and sewage system fields, the 2007 ISO/TC224 General Meeting (Tokyo), enacted international standards for drinking water and sewage services and decided to begin the task of enacting new international standards for assets and for crisis management, signaling the arrival of the age when the ISO has gained full-scale influence over domestic standards. Other related trends have begun as shown in Table 1.

With the ISO style, in which a core group formed through voluntary participation actually decides on proposals, if we do not detect trends and leap directly into discussions, we can be left in the position of having to comply with predetermined results. We advocate an aggressive response through the national government's intellectual property strategy.

Conclusions

In neighboring Asia, a population several tens as large as Japan's is continuing high speed economic growth. Private sector companies now play a major role in infrastructure projects in Japan. It is essential that while creating new procedures on one hand, we also reliably predict technologies etc. in order that public services, which must never cease to operate, continue to function at appropriate levels. We are determined to respond nimbly to high speed change around the world by appropriately determining regional needs and adopting a long-term perspective.

Promoting river projects that ensure safety and security

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(Key words) *Climate change, flood control, risk assessment, adaptation measures*

1. Change surrounding river administration

Extremely sharp changes of direction are facing flood control projects intended to ensure the safety and security of the people of Japan. One is abnormal weather occurring frequently throughout Japan and elsewhere around the world in recent years. Weather phenomena, which can be described as the source of flood disasters, are frequently taking abnormal form, resulting in expressions we use to describe them often including "the highest (or lowest) ever observed".

The severe impact on the world's grain markets of the serious damage to grain production in Australia in recent years inflicted by its severe droughts and unprecedented giant floods is still fresh in our memories. It is impossible to state positively that the causes of these abnormal weather phenomena is climate change. But we can conclude that some occur when climate changes, and that we must now begin considering how to respond to these changes.

The second change in the environment surrounding flood control projects is the arrival of the era when our priority has abruptly shifted to management. Generally, regarding the provision of public capital, in the beginning, Japan responded to a shortage of needed facilities by providing (constructing) more, increasing the quantity of facilities being managed, a process resulting in a shift of emphasis from provision to management. It has long been pointed out that an era dominated by facility management would eventually arrive, but spurred by financial restrictions, this process is abruptly accelerating. This is not a simple shift of emphasis from provision to management; we must not only manage existing facilities without errors, but must shift to appropriate management by advancing our methods in order to maximize our utilization of our facilities, requiring proposals for technical support measures for appropriate and efficient management.

In the midst of this recent change of both the climate and facility needs, a major challenge facing flood control projects which must be resolved is to decide the best measures to adapt to climate change. Another major challenge is the efficiency of river management. This report introduce some of the research which the River Department has undertaken in response to these two challenges.

2. Measures to adapt to climate change

Half of Japan's population and about three-quarters of its assets are concentrated on alluvial plains accounting for only about 10% of its national land. And the three large metropolitan regions, which serve as Japan's administrative and economic centers, are located beside three large bays (Tokyo Bay, Ise Bay, and Osaka Bay) on low "zero-meter" zones facing the sea. Japan's national land is also susceptible to floods, debris flows, and storm surge disasters at a location exposed to the threat of typhoons passing or crossing its land, and on the eastern end of the monsoon region of Asia, a zone of heavy rainfall unmatched by any other part of the world.

In an effort to overcome such national land conditions, Japan has worked strenuously to implement flood control measures by, for example, constructing uninterrupted lines of levees and building dams and other flood regulation structures, achieving a big improvement in the level of safety from floods. But the state of provision of flood control structures remains at a low level, at only about 60% of the present target levels. Already vulnerable to natural disasters in this way, finding ways to respond to this rise in external forces occurring in response to climate change is a major challenge facing future national land management.

Studies to develop measures to adapt to climate change are now guided by the following considerations.

(1) Evaluation of risk accompanying climate change.

The effects on society and the economy of flood disasters occurring under the impact of climate change are evaluated as disaster risk. Evaluating flood risk is important in the sense that it not only shows present vulnerabilities, but also permits the clarification of effectiveness of introducing adaptation measures.

(2) Proposed measures to minimize inundation damage

We study comprehensive measures combining facility provision—the excavation of river courses to increase rivers' flow capacity and the construction of retention facilities to supplement present inadequacy of flood control planning—with "drainage basin measures" (for example, setting flood control safety

levels according to land use, doubled levees, and other inundation prevention measures).

And to minimize the harm to residents, we conduct basic studies of non-structural measures outside river areas, the improvement of evacuation guidance systems or land use guidance, among them.

At the same time, we study the increase in rainfall plus ways to increase the precision of climate models. Recent analysis has obtained the results of calculating the relationship: increasing torrential rain → increasing flood flow rates → increasing river improvement works, but even if the torrential rain increases only 10% over present levels, the flow rate will rise 20%, and the quantity of works necessary to handle this increase in the flow rate, will rise 80%. Unable to define the extent of hypothesized climate change, we have to study adaptation measures resigned to the fact that they must be extremely extensive.

3. Performing more efficient maintenance

Ensuring the safety and security of the peoples' lives is an important policy target, and in order to deal with river damage such as the breaching of levees etc., we must continuously implement appropriate river management adapted to changes in the state of rivers such as runoff etc. and to changes in river management facilities which have been constructed. But there are limits to maintenance which river managers can perform with their limited budgets, manpower, and systems, so performing effective and efficient maintenance is an urgent challenge.

A predominant feature of river management is that levees, which are the major facilities managed, are extremely long linear structures which, when breached at even one point, result in the loss of the flood control functions of the entire patrol section. A characteristic of the soil used to build levees is, that as result of the frequent reconstruction and repair of the levees in the past, its quality is inconsistent, and it is also difficult to fully clarify the erosion resistance capability of the vegetation on the surface of the levees. Under these circumstances, the NILIM is currently undertaking the following research.

・Research to improve inspection and maintenance technologies to maintain the safety of levees

This is intended to propose the minimum necessary level of management by clarifying the quantitative relationship of deterioration of its functions such as change of the looseness of levees or of erosion resistance according to the level of levee vegetation maintenance.

・Improving maintenance technologies

This will allow managers to perform maintenance more efficiently and at less cost and will advance technologies used to analyze photographic and video data concerning levees by using the most advanced technologies such as IT technologies and non-destructive inspection technologies, and to evaluate these technologies.

・This will systematize data and analysis results related to patrols and inspections, maintenance and repair, and evaluation of rivers, to build a database of, and to evaluate the results, thereby contributing to appropriate maintenance in the future.

4. Aiming at river management which can ensure safety and security

It is essential that Japan, which is vulnerable to flood disasters, look back at its history to clearly evaluate risk posed by the impact of climate change and to propose appropriate and effective responses in order to recover from the many natural disasters which have been caused by violent wind and rain etc. and to prevent future disasters. And at the same time, Japan also has the duty of sharing its advanced technologies with countries around the world. At any rate, we have little time left to implement measures to adapt to the impacts of climate change, so we are determined to quickly undertake research needed to do so.

Reinforcing data collection, analysis, and application
Toward achievement evaluation of policy objectives

SATO Hiroshi,
Director of the Road Department

1. Introducing policy objective-oriented project evaluation

Immediately following the change in Japan's government, the Cabinet adopted a plan on "reform of budget compilation, etc." in October 2009. One of the main pillars of this plan is "introduction of a system for clear presentation of policy objectives." This system will clearly present the objectives of priority policies and provide for objective verification of their achievement based on established indices.

In response to this decision concerning all aspects of government, MLIT has decided to introduce policy objective-oriented project evaluation. By doing so, MLIT will strive to improve evaluation in the form of comparative evaluation that is based on concrete data after clarifying policy objectives and presenting alternative proposals. It will also implement comparative evaluation-based project evaluation beginning from the project planning stage. It began planning-stage evaluation on a trial basis for certain MLIT-controlled projects during FY2010, and in November 2010 it announced projects in the rivers, roads, and ports and harbors fields to be included in the trial.

2. Enhancement and application of increasingly important basic data

Given today's tight fiscal constraints, evaluation of the policy achievements and thorough explanation of the necessity and effects of projects and measures are demanded in all areas, not just the kind of project evaluation mentioned above. Thus, as part of this approach, MLIT will proceed with "management that leads to positive results" in the roads field. Such management will prioritize items through selection and concentration, and simultaneously seek to comprehensively explain priorities and expected effects based on objective indices.

More than ever before, this approach requires the resolution of various technical issues, among them "how to set objective evaluation indices" and "how to efficiently enhance data that will provide the basis for evaluation."

3. The 3 roles NILIM will be expected to play

NILIM's roles in supporting government administration through technical policy research toward addressing such policy needs can be largely classified into the following three areas:

(1) Establishment of efficient data collection methods

Questions that must be answered regarding basic data include how to efficiently collect "useable" data having the required accuracy, and how to appropriately supplement missing data. Although the work of providing answers here may not be very glamorous, it forms the foundation for everything thereafter and requires considerable effort. Another extremely important aspect is "arranging data to match application strategies." In cooperation with MLIT, regional development bureaus, local governments, and other concerned bodies, NILIM is moving forward with studies for envisioning application in actual operations—specifically road construction, construction, and policy management—from the data collection stage.

(2) Effective strategies for use of data by project implementers

If data are set, the next question becomes how to apply them to actual operations. In the same manner described above, NILIM is working with project implementers from the data collection stage to study and propose concrete application strategies and application templates.

(3) Technical policy research (policy support)

Finally, as a research institute engaged in technical policy research, NILIM is identifying new issues and illuminating phenomena in the road policy field based on scientific data analysis, and advancing research on its own function as an organization that provides policy support.

4. Specific approaches

Typical examples of specific approaches that NILIM is pursuing in accordance with its roles are summarized below.

(1) Efforts to realize smoother road traffic flow

By themselves, conventional road traffic censuses that are conducted every five years do not provide the data needed to carefully select locations having major traffic congestion or other problems and to implement priority countermeasures. To address this situation, NILIM is working to ascertain traffic conditions,

formulate relevant measures, and analyze the effectiveness of countermeasures based on data collected 24 hours a day, 365 days a year. Here, NILIM is focusing its attention on data obtained from constant traffic volume measurement using vehicle detectors and data concerning probe travel time using car navigation systems.

Thus far, NILIM has verified the density and precision of data gathering, and confirmed that the data have extremely high application potential. Accordingly, it is now beginning full-scale data gathering and application. Examples here include data application in efforts to ascertain effectiveness (e.g., improvement of travel time on ordinary roads, etc.) in a pilot project conducted to make expressways toll-free ,which started in June of last year, and to determine effects realized by the Daini Keihan Road, which was opened in March of last year. At the same time, NILIM is formulating various proposals. One involves the presentation of new performance indicators that are arrived at by contrasting periods of congestion with periods of no congestion and then calculating lost time. And another seeks to get a picture of lower speeds caused by snow and ice during winter and then apply the results to evaluations.

An example of policy support-related research by NILIM itself is development of methods for evaluating travel time reliability. Here, NILIM will develop methods that focus not only on average travel time, which is the conventional marker, but also on reliability (accuracy) of travel time by taking fluctuations in travel time into account. It also seeks to make permit estimation of travel time reliability impacts in order to evaluate individual projects.

(2) Road traffic safety

Countermeasures that focus on arterial road sections having high accident rates are effective. Thus, just as it is in seeking to realize smoother road traffic flow, NILIM recognizes that it must continuously accumulate data on traffic accidents and the implementation of safety measures, as it also simultaneously selects locations for countermeasure implementation, formulates countermeasures, and evaluates their results. Thus, it is accumulating accident data and safety measures data that will form the foundation for the above-mentioned activities with a fairly high degree of accuracy compared to the effort to realize smoother road traffic flow that was presented in (1) above.

By analyzing such accident data, NILIM is preparing methods for extracting zones deemed to have high urgency due to frequent accidents, and analyzing candidate countermeasures (i.e., a “countermeasures menu”) that may be effective in dealing with the characteristics of each zone. NILIM uses the results to provide road managers with tools that help them formulate traffic safety measures. NILIM recognizes that it must further fine-tune these tools based on continuing data accumulation.

At the same time, NILIM knows that ordinarily data must be accumulated for around four years in order to properly ascertain accident conditions for evaluation of countermeasure effectiveness. This makes the work of accumulating data a long-term endeavor. Thus, NILIM will study methods to enable evaluation of countermeasure effectiveness in a shorter period of time by grasping changes in traffic behavior (e.g., conditions that inhibit speed, vehicle convergence, etc.). Moreover, it will continue its studies on methods for scientific ascertainment and analysis by applying travel speed data, etc., obtained from video images (i.e., image processing technology) and car navigation systems. These methods will be in addition to ordinary onsite survey methods.

(3) Bridge maintenance

Regular inspections (taking place once every 5 years) of MLIT-controlled roads that are in accordance with a proposed bridge inspection standard prepared by NILIM began in 2004. Taking the results of these inspections, NILIM also proposed a standard for collection of road bridge inspection data that has greatly prioritized and simplified content for use by municipalities. This standard is already being applied by many municipalities. Moreover, by analyzing the characteristics and advancement of deterioration and damage, NILIM is drafting a standard for specific inspection of ancillary structures as well as for inspection and survey of fatigue in steel plate decks. These items are being used as reference materials in bridge management.

Given that a round of detailed regular inspections of MLIT-controlled roads has been concluded, NILIM is moving forward with an analysis of the accumulated data. It is using the results to revise the inspection standard in order to make it more efficient and rational, improve the accuracy of degradation predictions for concrete slabs and pre-stressed concrete structures, and formulate a new specific inspection standard for steel component fatigue and bridge pier scour. It is also reinforcing the foundation for appropriate response to the aging of road bridges, which is expected to accelerate in the future.

5. Conclusion

This article presented an outline, within the scope allowed by space limitations, of representative approaches being taken by NILIM. For details, please visit the website of the relevant NILIM department. In policy support-related research, reciprocal linkage with actual fields is essential. Specifically, such linkage involves trial application of the achievements of ongoing development to the front lines of actual operation, and then feeding

back the results to further research and development. The author wishes to thank MLIT, regional development bureaus and offices, local governments, expressway companies, and all else concerned for their consistently valuable cooperation, and humbly requests their continued support and guidance in the future.

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Thoughts on the debate over a Building Fundamental Law

– From a position of responsibility for technical standards related to structural safety –

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(Keywords) Building Fundamental Law, technical standards

1. Introduction

Recently, trade journals have been busy with talk of a "Building Fundamental Law".

The "Review Group on the Revision of the Building Standards Law" (hereinafter "Review Group"), set up in the Ministry of Land, Infrastructure, Transport and Tourism and chaired by Professor Seiichi Fukao of Tokyo Metropolitan University, met 11 times between March and October 2010. At those meetings, the Review Group discussed the system of judging compliance with structural calculations, statutory periods of building confirmation checks, and ways of imposing more rigorous penalties (Reference 1)). Based on the conclusions of this Review Group, a "Study Group on Building Legislation" (hereinafter "Study Group") (chaired by Professor Tetsuo Kubo, University of Tokyo)" first met on February 2nd, 2011. It immediately made a start on organizing the basic directions to be sought in building legislation as a whole, including the Building Standards Law, with a view to ensuring or improving the quality of buildings (Reference 2)).

While it is impossible to predict the future direction of this debate on the Building Fundamental Law, from a position of some responsibility for technical standards related to the structural safety of buildings, I would like to consider what bearing it will have on technical standards.

2. Proposal of a Building Fundamental Law Council

It was in August 2003 that a "Building Fundamental Law Council" (hereinafter "Council") was set up by around 30 volunteers involved in the construction business (now around 240 members). The first draft of a Building Fundamental Law (Reference 3, August 2010) has since then been proposed by the Council. The following is a brief summary of sections concerning the structural safety of buildings in the roles of the Building Fundamental Law as stated there.

(1) Basic minimum requirements are essential as minimum standards

(2) Satisfying safety should be entrusted to professional competence and private-sector standards

Technical standards on the structural safety of buildings set specific methods of achieving minimum standards determined in the Building Standards Law, but according to the above-mentioned proposal by the Council, these should be entrusted to professional competence and private-sector standards; national research institutions should not bear responsibility for them.

The essence here, however, is surely not who should create technical standards, but to specify whatever is necessary in order to achieve good buildings.

3. Debate by the Council for Social Infrastructure

Between September 2008 and February 2010, measures for developing high-quality buildings were debated by the Buildings Subcommittee of the Council for Social Infrastructure, and its opinions were summarized by the Basic System Working Group (Reference 4)). In this debate, opinions and proposals were voiced from a variety of angles, including the proposal of a Building Fundamental Law, and there was no uniform direction. This could be said to reflect the difficulty of this kind of basic debate. In this Study Group, the aim is for the debate to include the Building Standards Law and others as actual regulations, and I expect a more realistic debate to be pursued.

4. Formulation of building codes and standards (US example)

In February 2001, I attended a conference in San Francisco, where I had the opportunity to hear a presentation by the American construction engineer James Robert Harris. He was involved in formulating design load guidelines for buildings (ASCE 7), and his talk was entitled "The development and application of aseismic building codes and standards". The presentation was accompanied by 49 slides, and can be summarized very briefly as follows.

(1) It is not the federal government but State governments (and others) that decide architectural codes that have legal binding force. Normally, the IBC (International Building Code) is adopted as a model code, this being re-determined every 3 to 6 years.

(2) IBC is revised every 3 years by the ICC (International Code Council). Anyone can propose a draft amendment, and after receiving a hearing by ICC, the change is decided by a ballot. The ICC is made up of voluntary members including employees of State governments.

(3) The standards form part of the Building Code, in that the latter refer to them. There are 49 organizations

that provide standards referred to by the IBC. One of them is ASCE (the American Society of Civil Engineers), and ASCE 7 (standards) are formulated and revised every 6 years by volunteer members. There are about 55 members connected with earthquake resistance, and many of them are practicing engineers.
(4) NEHRP (the National Earthquake Hazards Reduction Program) is a federal organization established by Congress, and the NEHRP Provisions (standards) formulated by it are designed to be incorporated in revisions of ASCE 7.

5. Who should create technical standards?

As stated in section 4 above, in America, professional competence and private-sector standards are adopted for building codes; even national institutions prepare standards with the intention of incorporating them in professional competence and private-sector standards. This is also consistent with the system envisaged in the proposal by the Council mentioned in section 2.

What should not be forgotten here, however, is that in the USA the standards are revised by volunteers, and many of them are practicing engineers. Also, it is the State government that ultimately decides whether or not to adopt a building code. In contrast, if we think of private-sector standards in Japan's building sector, the various design criteria and guidelines of the Architectural Institution of Japan spring to mind. However, the members involved in formulating these are almost all academics (university). This is completely different to the situation in the USA.

In other words, the important point is how to create the technical standards necessary for achieving good quality buildings within an objective, impartial system.

6. What is expected of the Building Fundamental Law?

One trade journal conducted a questionnaire under the title "What sort of topics do you expect to be discussed with a view to enacting a Building Fundamental Law?" (Reference 5)).

Among the replies, the following were particularly well supported: More rational and efficient application procedures / Simplification of the Building Standards Law / Clarification of the roles and responsibilities of works commissioners, the administration and experts / Revision of remuneration standards and other improvements to the working environment / Creation of a system of thorough quality checks all the way from design to installation.

It is difficult to agree with a simplification of the Building Standards Law if it would mean diluting the content of technical standards. To achieve structural safety in buildings, it goes without saying that safety needs to be properly confirmed, and to this end, issues that need to be studied must be studied properly. If there is anything that could be simplified (omitted), it would merely be to determine specifications in advance so that structural safety is automatically assured, and to create buildings in a way that satisfies these.

Even with private-sector standards, there should be no thought of reducing the topics for which safety needs to be confirmed (content remains undiluted).

7. Comprehensive approval (Article 38 of the old law)

With the amendment of the Building Standards Law in 1998, the regulation of performance was promoted and various verification routes were highlighted. On the other hand, the provisions for comprehensive approval under the former law (hereinafter "old Article 38") were removed.

The fact that base-isolated buildings have become so diffused in Japan well ahead of other countries could result from the system of ministerial approval under old Article 38. The same is true of concrete-filled steel tubular structures. In other countries, I hear that it took a long time before building codes could be adopted.

Although old Article 38 used the phrase "recognize as being equivalent", it was often the case that the performance requirements in provisions subject to comparison were not specified, and the performance requirements to be ensured for buildings as a whole were not clear. On the other hand, when new materials, construction methods and others are adopted for a specific building, one may imagine a situation in which they would be difficult to handle with the present combination of individual verification routes. In that sense, I can understand why the Review Group proposed the creation of a system of comprehensive technical approval similar to the Ministerial approval based on the provisions of old Article 38.

8. Conclusion

The future direction of the debate on Japan's Building Fundamental Law remains unclear, but it goes without saying that its objective should lie in raising the quality of buildings. With the recent amendment to the Act on Architects and Building Engineers, ethical provisions were explicitly stated; but in a sense, it should be a matter of course that anyone claiming to be an expert in building, including ourselves, must constantly strive to improve the quality of buildings provided for the daily lives of many people, without this having to be expressly stated in law.

From the standpoint of the safety of buildings, as well as steadily pursuing technical reviews with a view to promoting such objectives in future, I would like to banish unpreparedness so that we can respond appropriately, whatever the outcome of the review, by firmly grasping the situations pertaining in other countries, etc.

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Reconstructing residential spaces for an aging society with a low birth rate and declining population

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(Key words) Prolonging service lifetime of housing, existing stock renewal, environmental adaptation, stable housing for the elderly

1. Population decline, falling birth rate, aging, and housing

Population decline, the falling birth rate, and aging have brought Japanese society to a major turning point as the twentieth century gives way to the twenty-first century. Of course, these problems existed at the end of the previous century, but they are accelerating in the new century, when their impact on housing problems will be massive. Housing responds to its occupants, and the housing situation is greatly impacted by trends in population and household numbers. The falling birth rate and aging of society force us to respond to the shortage of housing suited for households with children and for elderly people. We must take action to deal with a society which has taken a sharp turn in a new direction since the twentieth century.

To begin with population decline, the challenge facing housing policies in the last half of the twentieth century was how to tackle a soaring population and its concentration in the large metropolitan regions. And to ensure that the required quantity of housing was constructed, a Five Year Plan for Housing Construction was enacted eight times under the Housing Construction Planning Law. In a society with a falling population which we are approaching, it will be necessary to effectively utilize the existing housing stock rather than construct new housing (the number of new housing starts peaked in 1972 at 1.85 million, but last year was down to 775,000). So the challenge is to effectively use the growing number of empty homes (13% of all dwellings in 2008) instead of abandoning them.

With regard to the falling birth rate, regardless of the improvement of the housing situation, the level of housing for families with children remains low (the targeted housing floor area level achievement rate is an average of 57% for all households, while it is 40% for households with children.) Welfare facilities for elderly people have been extensively provided, but the supply of housing adapted for occupancy by elderly people is still low, and far behind the levels in Europe and North America (The percentage of all elderly living in housing adapted to their needs is 8% in Britain and in Denmark, but only 1% in Japan). As these figures show, shortages of housing for families with children and elderly people are now conspicuous.

And the falling birth rate and aging of society have revealed problems with services necessary to support people's daily lives. The swing to nuclear family households continues as single-person households and small households are still rising, and the ability of families to provide mutual support for all their members as they did in the three-generation households of the past has reached its limit. At the same time, communities have been diluted, making it difficult for people to satisfy their needs in their neighborhoods. The mobility of elderly is now restricted. In residential areas, not only housing, but all functions and services needed for daily life must be ensured.

2. Recent trends in housing measures

Housing policies have been transformed in response to growing awareness of such circumstances which appeared about 10 years ago. The Eighth Five Year Plan for Housing Construction which started in 2001 prioritized the stock and adopted a posture emphasizing the market place, in response to the transition from a growing society to a mature society. This has long been called the "switch from quantity to quality", but in the past it promoted a good quality flow. It has now switched to the formation of a full-scale housing stock. And to encourage effective use through the smooth cycling of the housing stock, the provision of an environment for the housing market was considered necessary.

In 2006, the Basic Act for Housing was enacted, changing the planning system from the Five Year Plan for Housing Construction to Basic Plan for Residential Life, further clarifying the policy of omitting new housing construction from our targets. In 2001, the Elderly Housing Law was enacted, positioning the supply of elderly housing, and then revised in 2009, establishing the Plan for Stable Housing for Elderly People.

Now, more than ten years into the twentieth century, the population has begun to decline, bringing us face-to-face with brand new circumstances. Housing policies must include measures to deal fully with these problems. The revision to the Basic Plan for Residential Life enacted by the Cabinet in March of this year incorporates the following points.

① A percentage of approved long-term superior

housing was set as a goal to form a good quality stock which can be used into the future.
②Expanding the scale of used home distribution and the renovation market was set as a goal to effectively use the existing stock.
③"The provision of services to support security" in living environments was announced and a percentage of homes for elderly was set as a goal.

3. Initiatives by the National Institute for Land and Infrastructure Management

In response to new trends under such a housing policy, the NILIM is undertaking research activities to tackle challenges necessary to support the enactment of plans under this policy.
(1) Prolonging service lifetime of housing and improving its performance

The service lifetimes of houses in Japan are short. In recent years, the average age of demolished houses has been only 27 years. A long-term superior housing system to build good housing, maintain it scrupulously, and use it carefully for a long time has established, and in response to this, the NILIM has undertaken "Development of Multi-Generation Use Super Long-Term Housing and Housing Land Formation/Management Technologies" (from 2009 to 2011).

To ensure conditions necessary to maintain soundness of housing for a long period of time, some successes have been achieved including a method of evaluating the variability of divisions between dwellings in apartment buildings, a method of planning long-term management of condominium apartment buildings, a collaboration method to ensure good living environments, guidelines to the use of health monitoring technologies to improve management, guidelines to the design and maintenance of wooden detached houses, safety measure technologies for housing ground, and a method of evaluating the performance of the body in order to improve existing apartment buildings.
(2) Recreating and cycling the existing stock

Japan's used housing distribution and renovation markets are not as mature as they are in Europe and North America. Used housing accounts for only 13.5 of housing distributed, and the percentage of funds invested in housing directed to finance renovations is only 27.2% (both are more than half of the levels in the U.S. and Europe). In order to overcome one problem behind this, namely people's greater uncertainty about their performance than about newly built housing, a performance evaluation system and defect insurance system for existing houses has been established, and in response, we have begun "Development of Performance Evaluation Technologies for Existing Houses for Used Housing Distribution and Stock Reuse" (2011 to 2014). An efficient performance evaluation method for existing housing, including clarification of state of deterioration, has been established and is being reflected in present inspection standards, etc.
(3) Adapting to the environment surrounding the existing housing stock

As global environment measures, it is necessary to stop and reverse the increase of the cost of resident use energy, which tends to rise faster than in other areas. The environmental performance of new housing is steadily improving, but measures directed at the soaring existing stock is needed. Thus, "Development of an Energy Consumption Evaluation Method According to Category Of Housing" is in progress (2010 to 2012). The existing housing stock is categorized by years since construction and the energy consumption of each is evaluated, verifying the effectiveness of measures taken to use less energy, and this is reflected in energy saving standards for existing houses.
(4) Ensuring safe housing for elderly people

In order to deal with the soaring number of one-occupant elderly households and married couple households (predicted to be 24.7% of all households in 2020) and shortage of houses for elderly people, the supply of housing with services linked to nursing and medical care to support the lives of elderly people will be encouraged. In response, the NILIM is undertaking "Research on Methods of Providing New Housing to Increase Residential Security for Elderly People" (2011 to 2013). The aim is to establish guidelines to planning housing for elderly people according to the diverse physical and emotional states of residents, and guidelines to the reduction of barriers in resident-owned homes according to the diverse physical and mental states of the elderly, and measures to deal with dementia.

4. Future challenges

As we face an unprecedented age of declining population, falling birth rates, and aging of society, there are many challenges which should be the object of future research: reducing the scale of urban neighborhoods, planning better residential districts, and the role of the local community in child-rearing and nursing care.

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Data that supports urban planning and their application
Toward building new urban visions

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Keywords: Urban planning basic survey, geographical information system, geospatial data, aging society

1. Introduction

In a sense, urban planning is the work of creating a future vision for a particular region. Thus, the conventional approach to urban planning involves predicting the future based on vast amounts of data, and then forming plans with the intention of promoting or controlling urban and social conditions that are drawn from this prediction.

So then, what kinds of data are required? Article 6 of the City Planning Act sets forth stipulations concerning urban planning basic surveys. The act establishes that prefectures must conduct basic surveys for urban planning every five years or so. These surveys must cover current conditions and future estimations of population size, employed workforce, urban area, land use, and traffic volume among other items. Conducting such surveys requires the collection of vast amounts of data. However, because such data are usually available only in paper form, their application can be problematic.

2. Maintaining and applying geospatial data

In urban planning, it is important to consider how to link numerical information (e.g., number of enterprises, number of households, etc.) with spatial information (e.g., topography, roads, administrative boundaries, etc.). It is here that recent advancements in the geographical information system (GIS) deserve attention. A survey on how past geospatial data are maintained revealed that less than 40% of prefectures and municipalities operate GIS, and of these, only approximately 50% maintain geospatial data that are linked to urban planning[1].

This situation makes promoting the maintenance of urban data (geospatial data) using GIS an urgent issue. Particularly important in making geospatial data applicable to various aspects of urban planning is the incorporation of building attributes and land use attributes. Building attributes include use, structure, number of stories, and total floor area. Currently, these items must be inputted individually on the basis of onsite surveys. Land use attributes are land use classifications. They are categorized as public land, commercial land, residential land, industrial land, and agricultural land among others.

3. Steps toward realization of urban simulation

Even if population, traffic volume, and other information are maintained as geospatial data, it remains unclear how this alone can contribute to policy. Data must be further processed and developed to serve policy objectives. The following presents examples of geospatial data application that are taken from the various research themes being tackled by the Urban Planning Department. The results are in themselves urban data, and can be described as "secondary data" resulting from the processing of so-called "primary data" to meet policy objectives.

(1) Simulation of fire spread in an urban area[2]

A simulation program developed by a General Technology Development Project titled "Development of Assessment and Countermeasure Technologies for. Disaster Prevention in Town Planning" (1998 to 2002) predicts the spread of fire in buildings during a major post-earthquake fire in an urban area (Figure 1). Fundamentally required data are buildings' locations, sizes, and structures as pertain to fire resistance. In addition, the program can add data that infer the locations and shapes of openings that are needed to predict fire spread from general examples.

Once building data are established, the program can easily conduct simulations that consider higher fire resistance resulting from partial redevelopment of the relevant region or the effect that building of roads or parks has. The program can present the effects of urban development in both quantitative and visual forms.

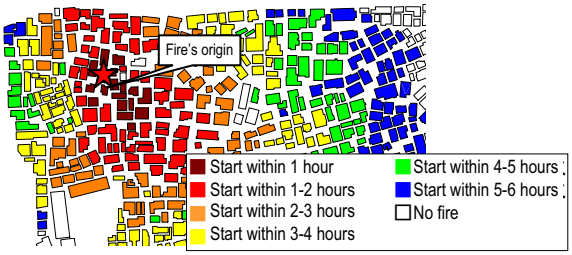

Figure 1: Fire spread by time of fire start in areas around the fire's origin

(2) Heat island simulation[2]

This simulation program was developed through a General Technology Development Project titled "Development of Synthetic Evaluation Technologies for Improving Urban Thermal Environments" (2004 to 2006). It presents temperature and wind direction and speed in external spaces that are influenced by the urban heat island phenomenon in the form of a map (Figure 2). Data required here are building location and size as well as building purpose and traffic flow, which are needed to input exhaust heat volume.

Like the fire spread simulation, once building data are established, the program can calculate changes in heat island effect that arise from redevelopment, road construction, or other activity with relative ease. It is being used in studies of redevelopment near Tokyo Station and construction of an urban plan-authorized road (Kanjo Route No. 2) near the Shimbashi district.

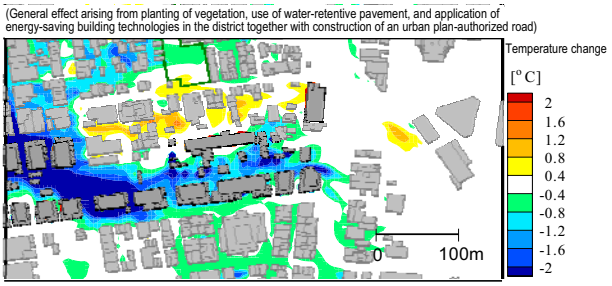

Figure 2: Temperature differences caused by execution of heat island countermeasures (estimation of effects arising from construction of an urban plan-authorized road, etc.)

4. New directions for data maintenance

The above-mentioned simulation programs are effective in tackling individual concerns, such as fire prevention in urban areas and urban environments. However, today the question of how cities should function for Japan's aging society is taking on increasing importance. Given this, there is a need for comprehensive data to help in formulating an accurate vision of how cities will look in the future and studying necessary policies.

The Urban Planning Department is developing a program for predicting urban structures from the standpoints of population, traffic, land use, and other factors in a project titled "Research on Assessing the Future of Urban and Outlying Regions during a Period of Population Decline" (2008 to 2010). This program will perform simulations predicating population distribution in individual municipality zones (in general, neighborhood districts) by treating various forms of data (traffic data, etc.) as variables. As a result, a number of outputs—including costs that correspond to urban policies—will be produced in visual form.

We are also about to start a study on methods for data maintenance that will allow land use oriented toward more compact urban areas as well as on methods for its evaluation. This effort will part of a new research topic to start in FY2011 called "Research on Technologies for Land Suitability Evaluation for Strategic Land Use Management in Urban Planning." Here, we will be seeking to develop a method for indicating latent land-use suitability as quantitative data and, further, to conduct evaluations of this suitability in line with policy objectives, based on various forms of land attribute data.

5. Conclusion

Returning to the topic of urban planning basic surveys, MLIT is proceeding with a review toward improving these surveys. The review is being conducted with focus on linkage with personal information, use of geospatial information, current conditions surrounding overseas urban databases, and other related items. We know that great amounts of time and labor are required to maintain data pertaining to urban areas. Nonetheless, we believe that an important mission of the Urban Planning Department is to clarify the process from data maintenance to data application in response to policy objectives through research, as this represents a step forward in creating urban visions that will satisfy the demands of the times.

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New Era in Oceans and Wide-area Coastal Zone Management

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Coast and Marine Department

(Key words) EEZ, ocean, coastal zone management, disaster, ocean debris

1. Introduction

Perhaps because Japan is surrounded by the ocean on four sides, we have not been particularly conscious of its importance. Conflict over undersea gas field development in the East China Sea and the Senkaku Island dispute are problems which have sounded a loud alarm concerning Japan's present situation. It is impossible to ignore the contributing role in these problems of Japan's exclusive economic zones (EEZ) which now spread across the ocean east of the continent.

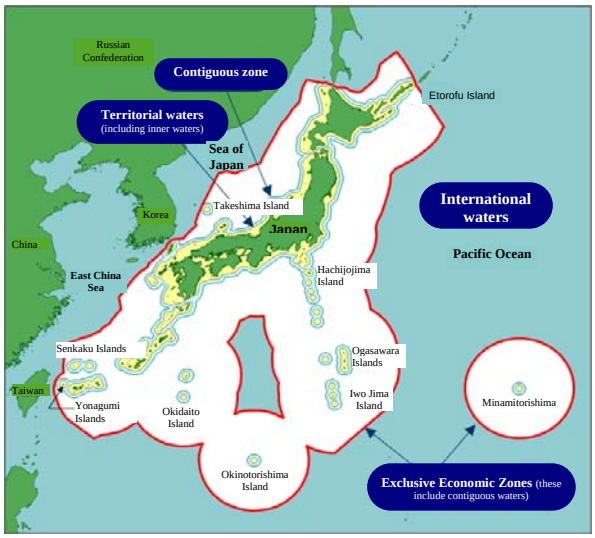


Figure 1. Map Showing Japan's Territorial Waters Etc.
(Source: Web site of the Japan Coast Guard)

The EEZ are designated as ocean areas extending Japan's economic sovereignty for 200 nautical miles from our coastline under the United Nations Convention on the Law of the Sea, but the ocean area over which the EEZ extend Japan's economic sovereignty (EEZ + territorial waters) is the fourth largest in the world at about 4.47 million km^2, and the area of these waters combined with our national land is the ninth largest in the world, making Japan one of the world's giant nations in fact as well as name.

As the great potential of the ocean as a frontier region with growing unknown possibilities broadens along with Japan's predicted expansion on the continental shelf, Japan is counted on to resolve to develop the ocean as a marine nation and to fulfill its responsibility to apply the benefits of this development to benefit the world. Until now, only a few politicians, academics, and administrators have shared such consciousness. But in 2007, the Basic Act on Ocean Policy was enacted and enforced, then last year, the Law Concerning Conservation of Low Tide Lines and Provision of Base Facilities in order to Promote the Conservation and Utilization of the Exclusive Economic Zone and the Continental Shelf, was enacted in order to position the role of the ocean in the new growth strategy of 2010, and to conserve the remote islands, which are vital for the maintenance of the EEZ and the development of the continental shelf. And as a result of low-profile enlightenment activities, an awareness of Japan as a marine nation has slowly spread among the people, a process which the above-mentioned incidents are now spurring.

2. Various potentials of the ocean

It is said the following are direct or indirect potentials of the oceans.

- Food resources: fish, benthic organisms, vegetation, etc.
- Energy resources: wind power, ocean currents, tides, gas hydrates, biomass, etc.
- Mineral resources: hydrothermal ore deposits, cobalt rich crusts, etc.
- Environmental improvement: fixing CO_2, biodiversity, etc.
- Other uses: disaster information (seismograph networks), etc.
- New technology development: oceanographic survey technologies, undersea construction equipment, undersea transport vessels, meteorological and hydrographical prediction technologies, etc.
- New education: developing new human resources, etc.

3. Need for wide-area coastal zone management

The ocean possess many potentialities of these kinds, but on the other hand, this also may create a variety of interests. Until now Japan has expended

considerable time and effort to harmonize conflict between parties with interests in the use of coastal zones.

And such clashes of interests, confrontations between large public projects and the fishing industry for example, have occasionally been reported and assessed incorrectly as totally emotional disputes.

The benefits of the oceans must provide the maximum benefits for the people as a whole, and for this reason, priority is not placed entirely on a specific field. In order to maximize benefits by harmonizing interests, we must conduct discussions through scientific analysis based on objective data, develop and agree on a rational process which can create the maximum benefits, and weight efficient investment.

And the oceans are not only the sources of blessings, they are also the origin of typhoons, tsunami, storm surges, earthquakes and other disasters. We also presume that if ocean development continues in the future, its bases will spread throughout coastal regions vulnerable to such disasters, but even under such conditions, ensuring an adequate level of safety is indispensable. And the EEZ etc. bear the duty to conserve ocean environments.

In fact, a perspective such as the above is incorporated in the Basic Act on Ocean Policy, the NILIM is conducting research permitting its actual use, and part of this research is introduced below.

4. Related initiatives by the NILIM

(1) Under the Basic Act on Ocean Policy, we must comprehensively manage coastal zone development, biodiversity, fisheries, recreation, and other conflicting uses in coastal regions. To do so, we have to find ways for various interests to share goals. With the environment selected from a variety of elements as its key word, the NILIM is now conducting research on the development of a process for policy setting by diverse interests for Tokyo Bay and elsewhere, unification or visualization of environmental data, and studying easy-to-understand project evaluation indices. We have to deepen the course of and the achievements of studies possible in the future, at the same time as we consider if it will be possible to widely apply these to harmonizing various uses of the ocean by replacing the key word or bringing concerned together.

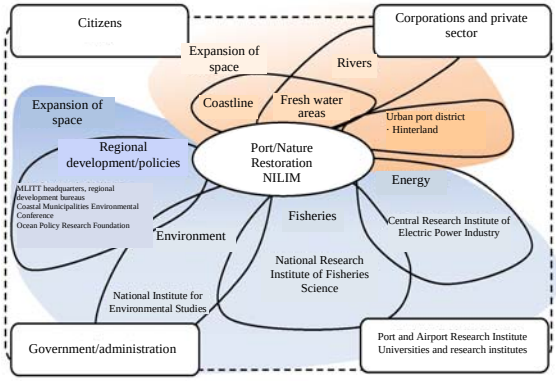


Figure 2. Coastal Region Management System Outline Chart

(2) On new coastal bases, preserving the safety of human lives from disasters is one indispensable condition, and to quickly develop bases, we have to effectively take advantage of disaster reduction, not only that based on physical structures which are extremely expensive facilities, but also on evacuation methods and other non-structural measures. We must back up disaster reduction measures by providing results of setting evacuation routes based on the results of inundation simulations or research on the effective positioning of evacuation sites.

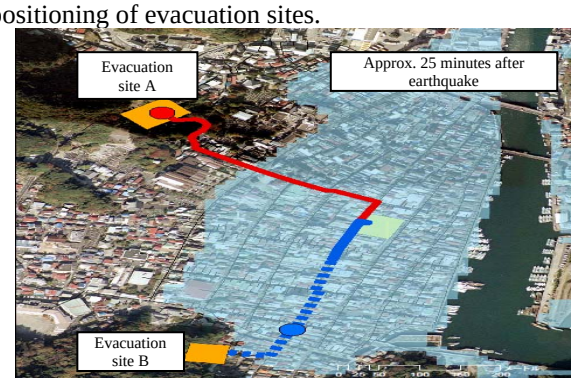


Figure 3. Occurrence/non-occurrence of Damage According to Evacuation Route for Inundation by a Tsunami

(3) Measures to deal with ocean debris are taken up by coastal nations as a response to protect the ocean environment. As a nation managing vast EEZ, Japan must encourage measures including those governing its own disposal of debris accompanied by measures to recover ocean debris and specify countries producing debris. The NILIM is now conducting research on methods of analyzing the drifting debris – beached debris balance, drift routes, and origins of debris in Tokyo Bay and in the East China Sea, and must expand its perspective to include ocean waters near Japan.

5. Conclusion

In order to develop the ocean which is Japan's remaining frontier, we want to continue our research with our eyes fixed on the future, so that we can widely and effectively apply the achievements of research nurtured with the Japanese ~~coastline~~ coastal zone as its field.

Asian economic growth and Japan's ports

SUZUKI Takeshi,
Director of the Port and Harbor Department

Keywords: Asia, trade trends, international logistics, international ports, Japan's economic growth

1. Asian economic growth and Japan's ports

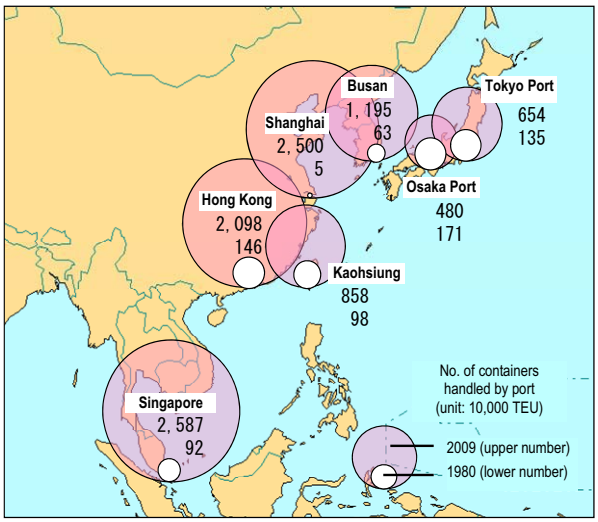
During the 10 years from 1999 to 2009, the world's GDP expanded by 1.85 times. During this same period, the GDP of North America grew by 1.55 times and that of Western Europe grew by 1.71 times. In contrast, however, Japan's GDP grew by only 1.16 times, indicating that Japan's economy remained stagnant even as the global economy grew. On the other hand, Japan's neighbors, China among them, expanded their economies significantly during this time. They also formulated various strategies leading to bold investments and institutional reforms, and thereby expanded the influence of their ports. Looking at handled container volume, Japan's top port in 1980 (Kobe Port) ranked fifth in the world in handled volume; however, by 2009, Japan's top port (Tokyo Port) ranked just 26th. Conversely, East Asian ports dominate the top positions in terms of handled volume, as eight of the top ten ports are located in East Asia.

2. Increasing size of international cargo vessels

Container vessels are being built larger and larger in order to efficiently transport a growing amount of container goods and to ensure that companies survive in market competition. In the 1970s, container ships had a carrying capacity of about 2,000 TEU; however, in the 1980s, 4,000-TEU Panamax vessels—the largest vessels capable of passing through the Panama Canal—made their appearance. In the 1990s, "over-Panamax" vessels that are incapable of traversing the Panama Canal began to be built, with some attaining a capacity of 6,000 TEU. Given the growing size of these vessels, construction to expand the Panama Canal is underway. And looking at the current state of ship construction, it is anticipated that size of container ships that ply the world's oceans will suddenly grow even larger in response to the canal's expanded capacity. At the same time, however, there are some shipbuilders that are not waiting for the canal's expansion, and thus there are expectations that container ships capable of carrying some 15,000 TEU—exceeding the canal's post-construction capacity—will be seen.

Bulk carriers that transport coal, iron ore, and grain are also expected to grow larger. One reason for this is expanding long-distance transport amid rapidly growing demand for resources by newly developing countries. Until now, 70,000-ton class Panamax vessels have been the major mode of grain transport, while 170,000-ton class

[Number of containers handled by major Asian ports]



* "Tokyo Port" includes Tokyo Port and Yokohama Port. "Osaka Port" includes Osaka Port and Kobe Port. However, the figure for Osaka Port is for 2008.

TEU (twenty-foot equivalent unit): An International Organization for Standardization standard (ISO standard) unit that calculates a 20-foot container as "1" and a 40-foot container as "2".

[World ranking of number of containers handled by port]

(Unit: 10,000 TEU)

1980 :

	Port	Handled volume
1	New York/New Jersey	195
2	Rotterdam	190
3	Hong Kong	146
4	Kobe	146
5	Kaohsiung	98
6	Singapore	92
7	San Juan	85
8	Long Beach	83
9	Hamburg	78
10	Oakland	78
⋮		
12	Yokohama	72
⋮		
16	Busan	63
⋮		
18	Tokyo	63
39	Osaka	25
46	Nagoya	21

2009 (preliminary values)

	Port	Handled volume
1 (1)	Singapore	2,587
2 (2)	Shanghai	2,500
3 (3)	Hong Kong	2,098
4 (4)	Shenzhen	1,825
5 (5)	Busan	1,195
6 (8)	Guangzhou	1,119
7 (6)	Dubai	1,112
8 (7)	Ningbo	1,050
9 (10)	Qingdao	1,026
10 (9)	Rotterdam	974
26(24)	Tokyo	374
36(29)	Yokohama	280
(39)	Nagoya	※282
(44)	Kobe	※256
(50)	Osaka	※224

Source: Prepared by the Ports and Harbors Bureau, MLIT, based on Containerisation International Yearbook 1982 and 2010 and March 2010 Containerisation International

Note: Figures include both domestic and overseas trade. Figures in parenthesis show rank in 2008. Handled volume figures marked with an asterisk (*) are for 2008.

Capesize vessels have been the main player in iron ore transport. However, more and more vessels that are even larger than these ships are coming into service. Transport by 300,000-ton class VLOC (Very Large Ore Carrier) is beginning between ironworks in China and Brazil. And a major Brazilian iron ore company is reportedly building a 400,000-ton Chinamax vessel.

3. Response to changing international cargo demand and larger vessels

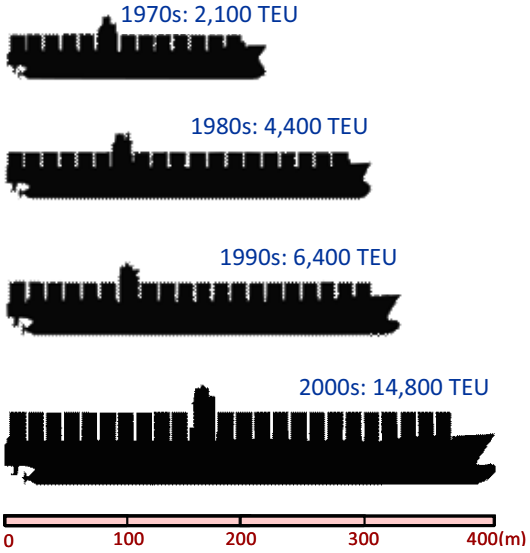
Domestically, Japan faces severe economic, financial, and employment circumstances brought about by its aging society, declining population, the strong yen, and shifting of businesses to overseas locations. Moreover, antigovernment protests in the Middle East and Africa from the end of last year present the danger of rising petroleum prices. On the other hand, other Asian countries quickly bounced back from the Lehman Brothers' crisis and are now enjoying strong economic growth.

As other East Asian ports prosper and vessel sizes grow larger, Japan's ports are falling behind in responding to the larger vessels and could even lose major container routes as a result. Moreover, companies are leaving Japan in search of lower production costs and strong foreign demand.

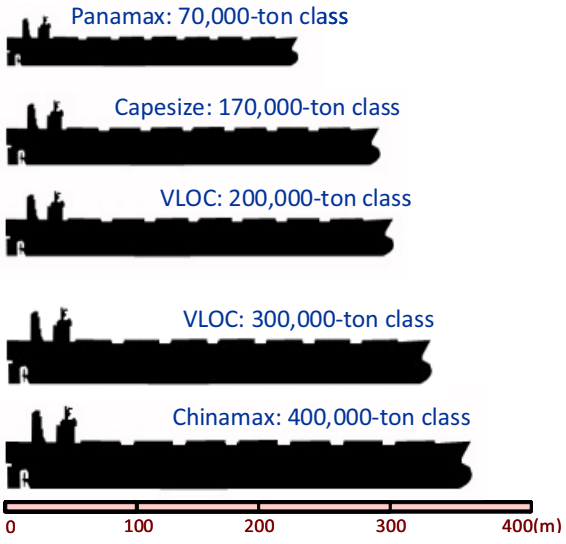
Japan must raise the competitiveness of its ports and, by doing so, raise its domestic economic competitiveness and lower import costs for consumer goods. At the same time, it must link Asia's vitality to revitalization of its domestic economy. Achieving these goals will require immediate steps to give ports the ability to handle larger vessels and improve corresponding services. In light of Japan's severe financial situation, it will be necessary to carefully select ports having high potential here and then to pour intensive investment into them. It is with these objectives in mind that the Ministry of Land, Infrastructure, Transport and Tourism selected two regions as "international container strategic ports" in August 2010. MLIT is also taking steps toward selecting "international bulk strategic ports."

To formulate such practical and highly effective port policies and then to effectively implement them, it will be necessary to analyze and draw up forecasts concerning how flow of goods between ports, vessel size and function, frequency of port calls, and volume of cargo handled by each port change in response to economic conditions in concerned countries, barriers to international transport and trade, fuel costs, the management strategies of shipping companies, vessel specifications and performance, and conditions surrounding the development of port, land, and marine infrastructure. Such analyses and forecast must also focus on the kinds of facilities and equipment needed to respond to the above-mentioned conditions as well as the size, structure, and function they must have. Taking these steps will require continuous accumulation and analysis of various forms of information, including data on trade, transport, vessels, and port development. Then, survey research on model theory, survey analysis techniques, statistical theory, and other fields must take place, followed by the creation of a highly reliable international marine logistics model capable of evaluating the various elements that influence trade and logistics. Moreover, this model must be constantly upgraded to ensure that it has maximum practicality. On top of this, survey analyses must take place that cover not only results obtained from the international marine logistics model but also operation of vessels, cargo-handling equipment, and storage facilities as well as structure function, usability, durability, energy efficiency, and technical development trends. From here, it will be necessary to establish methods for setting the specifications, use conditions, and other factors for port facilities and equipment that will be needed as conditions require.

As the policy for establishing international container strategic ports and international bulk strategic ports moves forward based on the activities described above, the Port and Harbor Department intends to help evaluate various measures within the policy and to contribute to forecasts and analyses for the planning and formulation of new measures.



Changes in lengths of container ships



Changes in the lengths of bulk carriers

Support by the infrastructure for aviation growth strategies

HASEGAWA Kou,
Director of the Airport Department

(Key words) growth strategies, policy simulation, regional stimulation by an airport, stock management

1. State of and growth strategies for aviation and airports

On October 2010, at Haneda Airport, the fourth runway and new international terminal building began service, initiating full-scale service on international routes. At almost the same time, local approval for increasing the number of flights at Narita Airport was obtained, greatly expanding the airport capacity of the Tokyo region. It has been assumed that the long period when both Narita and Haneda were operated at full capacity, and hence, unable to satisfy airport demand, had a severe impact on the economy of Japan. With nearby Asian countries completing large international airports and vigorously ensuring their competitive strength, resolving this problem has been an urgent challenge. But we believe that we must prepare for the time when, as a consequence of the size of Japan's economy and the further growth predicted to occur in Asia, capacity again exceeds demand, by studying the further expansion of our aviation capacity by all possible means. On the other hand, critics have pointed out that we have many unprofitable regional airports.

In May, the growth strategy of the Ministry of Land, Infrastructure, Transport and Tourism was completed and released. Aviation is included among growth strategy fields, including (1) promoting a thoroughgoing open-sky policy, (2) strengthening Haneda and Narita to increase the inter-city competitiveness of the Tokyo region, (3) taking radical measures to achieve more efficient airport operation by taking advantage of the wisdom and capital of the private sector, (4) aggressively strengthening airports by improving their balance sheets, (5) promoting truly necessary aviation networks, and (6) expanding benefits for users by encouraging participation in LCC.

In this regard, the proposed budget for 2011 was prepared incorporating the reduction of the aviation fuel tax and introducing measures to unify the management of the Kansai Airport and Osaka International Airport. At the same time, project costs were sharply cut and maintenance regulations stiffened. And in parallel, we have conducted open sky negotiations with the member countries of the ASEAN, and have formed a committee to study ways to improve airport operation and proposed specific methods such as integrating airport management (runways and other basic facilities, terminal buildings and other related facilities which are now separately managed in airports managed by the national government,) and privatizing airports.

Our mission is to use the infrastructure to support aviation growth strategies. In the infrastructure field, the age of priority on new infrastructure has given away to an era when operation of infrastructure is emphasized, so we now focus on developing methods which we can apply throughout the aviation field to tackle challenges such as finding ways to effectively use existing airports or to effectively maintain existing facilities. An outline of these follows.

2. To expand benefits for users by promoting open skies and LCC and enhancing the competitiveness of cities

—Improving precision of demand simulation methods—

The advance of open skies is counted on to promote frequent flights by smaller aircraft at airports in Japan's large metropolitan regions and also to strengthen hub functions of multiple airports in a region, but the problem is to decide how to use multiple airports to maximize convenience for users. Cost reductions achieved by promoting LCC now offer the possibility of creating brand new regional routes. There is also a growing need for policy simulations capable of showing what demand will emerge under what kinds of rules and policies. Our department has been developing and improving a method of predicting demand for air transport, and is now working to improve this method by accounting for the actions of airlines, and we are counting on these playing roles as policy simulation tools. We hope that developing these technologies will result in open skies and in concrete measures to promote LCC based on open skies, providing benefits for users.

We are also conducting research on ways to quickly ensure an alternate route when an international airport transport center or domestic trunk aviation route center cannot function as a result of an earthquake or volcanic eruption. When there are shortcomings in actual circumstances, an immediate response is necessary. To ensure international competitiveness, it is very important to resolve this problem.

3. To maintain aviation networks which are truly necessary

—Aiming to create airports that stimulate regions and to measure their stimulation effects—

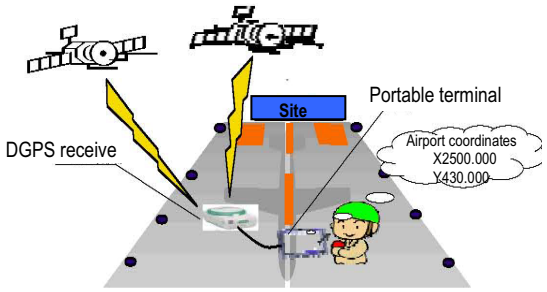
This concerns regional routes which seem to have been maintained with internal support by the airline, but judging that regions should take the lead in ensuring air transport services, efforts should be made to maintain services, develop tourism, or stimulate the region, through cooperation, including grants, etc., with airlines. Our department is conducting research to clarify characteristics of use in order to be able to obtain support taking advantage of the properties of airports to introduce measures to stimulate the region through tourism etc. And transparency is needed to obtain the understanding of the local residents regarding support measures by the region. It is also necessary to quantify the impact of airports on local economies, and to clarify other non-economic effects. We are studying methods of measuring effects which are not accounted for in past cost-effects manuals. We hope these will contribute to the maintenance of aviation networks.

4. Towards radically more efficient airport management

—Stock management of airport facilities—

Integrating the management of airports and privatizing airports in order to benefit from the wisdom and capital of the private sector has been suggested, but there are many airports which failed to become profitable even after unification. Overall strategies must be studied, but more efficient maintenance and operation are also required. As facilities have aged, increasing the need for repairs and reconstruction, the questions we must answer are how should we conduct day-to-day management to minimize these tasks, or how can we carry them out using the least possible labor. It is essential to improve efficiency, while ensuring safety and security, which are issues with priority over growth strategies.

One characteristic of an airport is that it possesses a vast paved area without obstacles, or in other words, without any targets. We have developed a maintenance inspection system using GPS supplemented with information from a multifunctional transport satellite in order to quickly identify defective locations, repair them, and manage them continually.



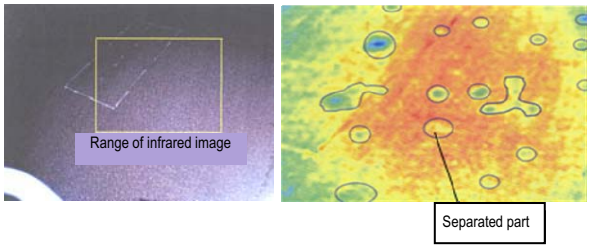
One challenge is improving the efficiency of grass cutting, a task which accounts for a large part of maintenance costs.

Specialized technologies are skillfully used and provided because in Japan, it has been necessary to construct hub airports in particular on locations with poor ground conditions and to expand their paved areas. In addition to enacting design standards for new facilities as we already have, we have prepared draft instructions for repair work, which will be the major issue in the future. It incorporates measures to strengthen the weak points, which are joints and edges, and which have been studied experimentally.

To perform design according to the way paving is used, we have established a theoretical design method based on the degree of fatigue of facilities, and also studied a design method based on probability in response to the trend towards performance design.

It is necessary to fly aircraft according to schedule, and to maintain and repair facilities without impacting this activity. Non-destructive inspection methods are one way to achieve this, so we have applied the FWD based inspection method to a new design method, and have developed an infrared beam based separation detection method. We are also studying the possibility of using optical fibers as sensors.

Example of monitoring using infrared beam images



On the subject of probe data

FUJIMOTO Satoshi,
Director of the Research Center for Advanced Information Technology

(Key words) Probe, probe data, ITS spots

1. Introduction

Recently, we often hear talk of "probes". The dictionary definition of a "probe" is "a slender, flexible surgical instrument used to explore a wound or body cavity", or "a vehicle equipped to obtain scientific information (space probe) " (extracts from Collins English Dictionary). In the field of electronic devices, meanwhile, a probe can also be a lead connecting to or containing a measuring or monitoring circuit used for testing.

In the field of road traffic, a traveling vehicle fitted with sensors is called a "probe car", and the data collected by those sensors are called "probe data". Moves are afoot to take these data and subject them to processing and analysis, making them available for broad use in services in the road traffic sector.

2. What is a probe?

While the term "probe" is still somewhat unfamiliar in the field of civil engineering, it has long been in common use in other fields. To quote a recent case, for example, when the unmanned spacecraft Hayabusa returned to earth with microparticles from the asteroid Itokawa, the BBC reported the news with the headline "Japan probe collected particles from Itokawa asteroid". It is also used with frequency in a social or political sense, and is often seen in English-language news (for example, in connection with 'spy probes' or investigations of contagious diseases).

In the road traffic sector, the use of probe data was first considered in the second half of the 1990s. In 1999, for example, the Japan Automobile Research Institute (JARI) led an initiative for a "Feasibility study on the development of an ITS probe car system", while at around the same time the Ministry of Land, Infrastructure, Transport and Tourism started studying the use of probe cars in highway administration. An example of this was a study on the creation of a probe car system by the Chugoku Regional Development Bureau. Monitoring devices fitted with functions for obtaining positional and other data using GPS (global positioning systems) and functions for communication were attached to vehicles constantly in use, such as official vehicles and buses. Existing communication networks were then used to gather positional data from each vehicle with the passage of time.

3. Probe data

Probe data that can be obtained from a motor vehicle include data obtainable from navigation systems, such as the time and position (longitude and latitude), i.e. data on the vehicle's running history, and front-rear acceleration or right-left acceleration, i.e. data on the vehicle's performance history. Since these probe data can be obtained continuously over time from each single vehicle, if a system could be constructed whereby data could be acquired from a considerable number of vehicles, it would allow us to monitor the state of road traffic at any chosen location or point in time.

Probe data on the running history mentioned above is obtained by aggregating compound technologies consisting of GPS technology, map matching technology, and digital road maps. Of these, positional measurement by GPS can take two forms, namely single point measurement and relative positional measurement, the former of which is used for car navigation systems. With this method, the position of one's own vehicle and the time of that position are obtained by calculating the longitude, latitude, elevation and time (i.e. the time on a nuclear clock mounted on GPS satellites) by receiving transmission signal data from four GPS satellites. The data received here, however, are inconsistent in their precision, owing to ionospheric delay in the radiowave propagation pathway, the state of the earth's atmosphere, and other factors. GPS receivers in common use are set to a standard allowing them to receive positional identification to within 10 meters from the correct longitude and latitude to a probability of 95%. In future, this inconsistency is expected to be vastly improved through the use of quasi-zenith satellites. However, it will probably be some time before quasi-zenith satellites are operating 24 hours a day over Japan; only one ("Michibiki") is in orbit at the moment, and two more are still needed.

Map matching technology is a corrective method whereby, since cars basically only drive on roads, the longitude and latitude obtained by GPS positional measurement are plotted on the links on a digital road map. While this method has been used by various navigation system manufacturers to improve precision using their own technology, there are some complications with patents. As a result, each manufacturer uses a different specific technique producing a different level of precision, and the method is not yet in the public domain.

As shown above, probe data on a vehicle's running

history obtained from car navigation systems currently present some problems over the inconsistency of precision when in use.

4. Verification of probe data

With a view to starting a nationwide service using ITS spots between January and March 2011, the Ministry of Land, Infrastructure, Transport and Tourism has installed about 1,600 ITS spots, mainly on expressways all over the country, in a public-private collaboration. The spot communication used in these ITS spot services has the characteristic of facilitating large-volume communication in both directions.

Car navigation systems compatible with ITS spots are fitted with GPS receivers, acceleration sensors, gyrosensors and other devices, allowing them to obtain and accumulate the vehicle's running history data and performance history data. The probe data accumulated here are up-linked every time the vehicle passes an ITS spot, and are also aggregated in the probe server. The data thus gathered are called "road probe data", to distinguish them from other probe data.

The use of road probe data is being considered in a variety of situations, but for the time being, the aim is to process them into average traveling time and average traveling speed per unit of links on digital road maps. This will make it possible to capture the daily changing state of road traffic at any time.

However, while a variety of devices are being developed and gradually starting to be used to gather road probe data, before that, as stated in the previous section, I think the gathered data will need to be verified. Specifically, this system has been given parameters that can be set as appropriate by the administrator (for example, when calculating average traveling time and producing data on a given vehicle traveling significantly faster or slower than the average, the threshold value for removing or retaining those data). Nevertheless, I think it will be necessary to tune these to appropriate values, having verified the relevance of these parameter values using actual data. Also, it will be essential to verify whether or not the data are being processed in the sequence specified in the equipment specifications, or whether or not the data are being uplinked in accordance with the format of road probe data determined in advance.

5. Conclusion

In this modern age of advanced car electronics, many other types of data exist as probe data related to motor vehicles, besides those mentioned here. One direction for research in the ITS field in future could be to study how effective use can be made of these probe data, but verifying the data themselves will be indispensable as a prerequisite to that.

Reference

Traffic Engineering 2003 No.4 Vol.38 Japan Society of Traffic Engineers

Actions which should be taken to reduce the damage caused by natural disasters

YAMASHITA Masaru,
Director of the Research Center for Disaster Risk Management

(Key words) Natural disaster, disaster risk, warning and evacuation, technical guidance, Sediment Disaster Prevention Act

1. Introduction

The history of the postwar growth of Japan has also been a history of a battle with natural disasters. An examination of changing numbers of fatalities and missing from natural disasters [1)] shows that from 1945 to 1960, earthquake disasters such as the Fukui Earthquake and wind and flood disasters such as the Ise Bay Typhoon struck the national land while core disaster facilities were being constructed, claiming between about a thousand to several thousand victims each year.

After later progress in the construction of levees on major rivers, by about 1983, the numbers of fatalities and missing was down to a few hundred each year. During this period, damage caused by large-scale flooding fell, while a relative increase was seen in the percentage of fatalities and missing as a result of sediment disasters caused by torrential rainfall, volcanic eruptions, and earthquakes.

Since that time, the numbers of fatalities and missing persons has fluctuated between several tens of people to between 100 and 200 as a result of aggressive implementation of non-structural measures such as the establishment of warning and evacuation systems in addition to the construction of disaster prevention structures. But, during the same years, the Hokkaido Southwest Offshore Earthquake, the Kobe Earthquake, and the Niigata-Chuetsu Earthquake and other sudden large-scale disasters caused severe damage, while responding to disasters caused by guerilla type concentrated torrential rainfall triggered by climate change and supporting elderly people and others requiring protection during a disaster are now urgent challenges.

2. Natural disasters and their changing environments

As stated above, natural disasters and the environment surrounding them are changing constantly.

Sediment disasters which occurred in July 2010 in Shobara City in Hiroshima Prefecture caused severe damage including one fatality in a range limited to about 5km square where rainfall was concentrated in an extremely short time. A rainfall gauge at the site recorded 173mm in 3 hours, but it is assumed that even heavier rainfall fell at the actual disaster location. In recent years, floods and sediment disasters caused by such extreme climate phenomena have tended to increase, and it is vital that in the future, we take action in response to rising disaster risk accompanying the decline of regional disaster prevention capabilities caused by depopulation and aging etc. in addition to this climate change.

When the Central Chili Coastal Earthquake occurred on February 27, 2010, tsunami warnings were issued over a wide area centered on the Pacific coastline. More than 24 hours passed between the announcement of a warning at 9:33 a.m. on February 28, and the cancellation of all precautionary warnings, while on trunk highways along the Pacific Ocean coastline, travel restrictions were enforced over long distances for long periods, causing confusion including severe congestion.

Evacuation advisories were issued to about 1.69 million people living in a total of 189 cities, towns, and villages throughout Chili, but fewer than about 40% of the people actually evacuated, even in regions warned of a large tsunami [2)], leaving problems concerning the people's evacuation awareness and information dissemination including that performed at normal times.

On January 26, 2011, full-scale volcanic activity began after about 300 years of inactivity at Mt. Kirishima (Shinmoedake), spewing vast quantities of volcanic ash during repeated eruptions. In regions where ash fell heavily, the danger that future rainfall will trigger debris flows has increased, so in addition to physical measures such as emergency removal of rock from existing sabo dams, it is vital to clarify and to provide information directly relevant to the evacuation of the residents: critical rainfall for warnings and evacuation, hypothetical debris flow inundation areas and so on.

3. Initiatives by the Research Center for Disaster Risk Management

Below, characteristics of natural disasters in recent years and initiatives taken to resolve challenges are introduced.

(1) Response to rising risk of disasters accompanying climate change

It is difficult for conventional observation systems to clarify the actual state of recent guerilla type

concentrated torrential rainfall, posing a major obstacle to implementing measures. So in upstream regions where this has delayed river improvements and the installation of observation equipment, and in cities where severe disasters are predicted, X-band radar will be used to boost the precision of rainfall forecasts and water level predictions.

And technologies to provide real time information revealing the state of inundation of cities by both outer waters and inner waters is being developed as the construction of a framework for the sharing of information among concerned organizations is being studied.

(2) Support for damage mitigation by reliable warnings and evacuation

At the same time as public investment falls and social infrastructure facilities deteriorate, the establishment of reliable warning and evacuation systems is an important pillar of disaster prevention and mitigation measures.

A review of proper procedures for restricting traffic in anticipation of tsunami has been initiated in response to the earthquake tsunami which struck Chile, but technical knowledge related to traffic restriction measures to prepare for tsunami which should be included in this review, and general knowledge necessary for employees to take appropriate action in the field will be compiled to ensure road users' safety and improve their response.

In order to urge appropriate evacuation activities to prevent human loss when runoff or other disasters occur, the most appropriate evacuation methods for each form of residence and disaster situation will be studied along with methods of transmitting information based on residents' acceptance of disaster prevention information.

And by focusing on social capital in each region, methods of continually improving regional disaster prevention capacity according to its characteristics are being studied.

(3) Technical guidance at disaster scenes

Technical guidance on the sites of large-scale disasters is one of the major roles of the National Institute for Land and Infrastructure Management. The NILIM dispatched an employee as a member of TEC-FORCE, an emergency disaster countermeasure team, to Shobara City in Hiroshima Prefecture in response to the torrential rainfall disaster of July 16, 2010 caused by the early summer seasonal rain front, and another employee as a member of the same team to Amami in Kagoshima Prefecture in response to the rainfall disaster of October 18, to survey the state of damage and provide technical support and advice concerning restoration policies, etc.

The NILIM sent one more employee as part of a government support team to the eruption of Mt. Kirishima (Shinmoedake) which started in January 2011 to provide technical advice concerning the preparation of measures which need to be taken quickly, the enactment of an evacuation plan in anticipation of predicted debris flows for example.

4. Conclusions

The Sediment Disaster Prevention Act (Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas) was revised and enforced in May 1, 2011. Under this revision, when a large scale sediment disaster is imminent, the national government or prefecture provides information about districts and time periods when a disaster is predicted to cities, towns, and villages in order that their officials can make correct judgments concerning the issuance of evacuation orders appropriate to their residents.

Providing information which is directly linked to the lives of residents requires advanced technical skills and superior judgment at the same time as it is a heavy responsibility.

The Research Center for Disaster Risk Management has, in order to prevent or lighten natural disasters, helped promote facility provision under the revision of the standards, develop disaster mitigation support technologies for use during disasters, and research disaster information which will contribute to appropriate evacuation and methods of providing this information. In the future, we must accompany these activities by actively working to improve technical capabilities so that employees of the Ministry of Land, Infrastructure, Transport and Tourism can make suitable judgments at disaster sites and to do all in their power to respond to increasingly diverse and severe natural disasters.

[Sources]

1) 2010 White Paper on Disasters: Cabinet Office
2) Emergency questionnaire survey of residents concerning tsunami evacuation following the earthquake with its hypocenter on the coast of central Chile: Cabinet Office, Fire and Disaster Management Agency

Levee Management Project

—To clarify effectiveness of vegetation management in maintaining flood control functions of levees and reflect the findings in levee management—

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(Key words) Levee vegetation management, flood control functions of levees

1. Introduction

To more effectively and efficiently manage river levees in the future, it will probably be important to set the maintenance level according to external force conditions, conditions of the hinterland, etc. While the effectiveness of mowing, inspections, river patrols and other maintenance activities in maintaining the levee's flood control functions have been partly studied [1], their effectiveness is still inadequately clarified, so completing technologies to assess the relationship of maintenance activities with maintaining flood control functions remains a challenge.

2. Levee Management Project

The Levee Management Project is a framework for the joint surveying of levees and development of technologies by the head office of the Ministry of Land, Infrastructure, Transport and Tourism, National Institute for Land and Infrastructure Management, the Public Works Institute, and the regional development bureaus in order to clarify the effects of levee slope vegetation management on erosion resistance to flood flow and on slip stability under seepage, and to propose necessary maintenance levels and maintenance intervals.

The project was planned to meet the following three challenges.

Challenge 1: Clarifying change over time of vegetation transition (flourishing of tall herbaceous plants), thickness of the loose layer of the surface soil, and strength or permeability inside the loose layer of levee slopes according to mowing frequency

Challenge 2: Quantitatively clarifying the bearing strength (erosion resistance, seepage resistance, resistance to slope sliding) of levees according to the quality of the levee (loose level, types of vegetation flourishing)

Challenge 3: Setting the management level at the minimum necessary based on the above.

Studying the frequency of mowing and removing and replacing the loose soil layer of the slope in order to maintain flood control functions by quantitatively evaluating the levee's bearing strength (challenge 2) according to change over time (challenge 1) of a levee according to differences in the management level (frequency of mowing). And also studying how to reflect the indices for plant communities or loose layer thickness etc. in levee inspection items (Challenge 3).

3. Towards reflection in the field

As an example of the project, the following are interim results of a large-scale water channel experiment using specimens taken in undisturbed state from an actual levee (Challenge 2). Assuming that erosion resistance capacity is mainly impacted by root hairs on roots of vegetation, the roots were classified as "vegetation consisting mainly of root hairs (Japanese lawn grass, cogon grass)", "vegetation consisting mainly of tap roots (thick roots) (tall goldenrod)", "vegetation consisting of mixed root hairs and tap roots (nezasa (*Pleioblastus chino* var. *viridis*.))" and then compared, and based on the results, it was concluded that the erosion resistance capacity of "vegetation consisting mainly of root hairs" was greater than that of the other types [2].

The achievements of this project will be reflected in setting the maintenance level, and we wish to continue this study in order to contribute to more efficient maintenance and to the improvement of the quality of river levees.

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2) S. Ochiai, A. Hattori, H. Nobutsune, N. Fukuhara: Test of erosion resistance according to differences in vegetation, No. 65 Proceedings of annual conference of the Japan Society of Civil Engineers, 2010

Systematic initiatives to link disaster case studies to the improvement of river technologies

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(Key words) Disaster case study, technological improvement, database

1.Maintaining technologies

Needless to say, river improvement and river course management play a role in maintaining and improving safety from flooding, but recent large-scale disasters have been sharp reminders of the importance of maintaining the technologies which support these activities [1)]. A Levee Research Committee and River Structure Technology Council established by the River Bureau last year have presented a framework for performing field surveys of disaster cases to accumulate technical knowledge and revise technical standards etc. Under this framework, the NILIM is conducting the following three research projects related to the above technological maintenance.

2. Analysis information concerning disaster cases are the touchstone of river technologies

A disaster case survey diverges from the conventional perspective by, based on a variety of actually measured values, connecting the processes resulting in damage one at a time to mechanically verify the appropriateness of its findings. Based on knowledge obtained from such meticulous analyses, reviews and improvements of design methods are made continually. In order to put the above ideas into practice, the NILIM conducts disaster case studies jointly with regional development bureaus, and taking the disaster study of the weir and its adjoining levees on the Angagawa River System [2)] as an example, the impact of the previous year's fluctuation of the river course downstream from the weir on the water level and on riverbed scouring near the disaster location was analyzed.

3. Discovering technological information in inspection and patrol records

Records of inspections and patrols of levees and past disasters and repairs are checked to abstract the types of deformation, members deformed, and degree of their deformation which are linked to decline of functions at the same time as all conditions for inspections and patrols done to accurately grasp such deformations (walking, driving or other traveling method, implementation frequency, state of vegetation, etc.) are clarified. To establish such an analysis method, records of inspections and patrols, etc. performed during the previous five years are used to analyze data. Even initial organization by superimposing locations where deformation is confirmed and locations repaired on a plane map of the river course provide clues drawing out information of use for inspections by, for example, permitting sections where deformation was concentrated and confirmed to be distinguished.

4. Need for mechanisms to continue disaster case studies

For the NILIM and regional development bureaus to continue to jointly survey disaster cases etc. in such detail, considerable labor is required and the number of surveys performed each year is probably naturally limited. Consequently, it is important to also provide a mechanism to strengthen motivation to continue studies. The NILIM is constructing a database as a means for river managers to share cases in which they have been involved with river managers throughout Japan, and to obtain hints for solutions to challenges they face. The River Bureau has established an implementation system to contact the NILIM after a disaster, to perform joint studies to obtain more detailed results, and to record the results in the database. The NILIM intends to take initiatives in order to apply information which has been accumulated in the database to improve technologies.

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http://www.nilim.go.jp/lab/bbg/saigai-gaikoku/asce.pdf
2) Survey of Causes of Levee Disaster on the Agagawa River and Future Policies: Journal, River, February, 2013

Concept and specific methods for management which provides a flow capacity margin

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(Key words) River course change, flow capacity, river course management, fine soil sedimentation, river narrowing, high water channel formation

1. Management of flow capacity anticipating river course change

The enactment of basic policies for river improvement and river improvement plans is accompanied by the planning and implementation of river course excavation and tree cutting etc. to expand flow capacity. When doing this, it is important to carefully watch for change of river courses to study the optimization of the management labor, but sufficient knowledge is not always obtained. As one method of ensuring the specified flow capacity in river course sections prone to sedimentation, in addition to the river cross-section necessary to transport a flood flow, installing cross-section space for sedimentation (a margin) is also considered. This means that flow capacity is managed by (1) as part of river course design, predicting fluctuation of future flow capacity according to sedimentation and, for example, setting the optimum margin to balance the annual average quantity of soil re-excavated and the maintenance labor force, and (2) as part of river course management, observing the state of sedimentation by sectional surveying to set judgment standards to reliably implement maintenance excavation before the margin is filled in by deposited sediment.

2. Incorporating the optimum margin in river course design

On a river course with a gravel riverbed, if the low-water channel is widened across a series of sections, in areas where vegetation flourishes on slight elevations of the riverbed, every time fine sediment, which is almost non-existent in the riverbed material, is deposited by a run-off, a high water channel forms, returning the low-water channel to its original width[1)], and cases where this occurred in the relatively short period of less than 10 years [2)] are known. A river course design which provides a margin was tested for a case where it is necessary to devise a way to quickly reduce the size of the river section to maintain flow capacity in this way. First, we constructed a simple prediction model for high water channel reformation radically simplified to a range where the essential mechanism of fine soil deposition in flourishing vegetation areas is not harmed [2)]. This model was applied to the Sendaigawa River, confirming that the model provides a certain degree of reproducibility of the form and height of sedimentation, and that it can predict and evaluate the river cross-section reduction. This model can be used to study the form of excavation or margin of the river section, etc. which slow the river section reduction rate to optimize the maintenance labor.

3. Inspection technologies to more reliably manage flow capacity

We proposed the Basic River Course Management Sheet as a tool to inspect flow capacity in cooperation with the Kyushu Regional Development Bureau's River Management Research Committee. It was prepared by organizing data of various categories in order to be able to longitudinally compare change over years of the water level calculated for the time when the management target flow rate is flowing (two versions: present situation and when the trees have been cut) and the average riverbed height. Sections where, for example, the calculated water level approximates the design high water level (eliminating leeway in the flow capacity) and the average riverbed height has tended to rise in recent years, are reorganized so that they can be interpreted as sections where there is danger of the flow rate being insufficient. Using this sheet, it is possible to evaluate the degree of reduction of the margin of the designed river section in the present river course and to more reliably manage the flow capacity by, for example, performing maintenance excavation before the margin is filled by deposited sediment.

We are counting on rational river course design and flow capacity maintenance being implemented in the

field in this way, further improving the level of river course management technology.

[Sources]
1) Fujita et al.: Collected Reports of the Japan Society of Civil Engineers, No. 551/II-37, pp. 47-62, 1996
2) Takeuchi et al.: Civil Engineering Journal, Vol. 52, No. 7, pp. 26-29, 2010

Tsunami Inundation Estimation System to Improve Reliability of Evacuation Information

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(Key words) Tsunami, inundation prediction, disaster response, evacuation

1. Introduction

When the Chilean earthquake tsunami struck Japan at the end of February 2010, many residents did not evacuate despite the tsunami warnings, evacuation directives and recommendations which were issued, and the tsunami formed tidal bores which flowed upstream in several rivers, forcing the long-term closure of roads along the coastline, which was the region targeted by the tsunami warning. In order that from immediately after an earthquake until the danger of inundation by a tsunami has ended, river managers and other facility managers make appropriate decisions to send out patrols and to set the range of these patrols and take other disaster response measures such as restricting access to areas at risk, it is essential to predict the range and depth of inundation according to the predicted tsunami height announced in tsunami warnings instead of the largest predicted inundation range of tsunami shown on tsunami hazard maps.

This research is intended to improve facility managers' disaster response to tsunami warnings by building the Tsunami Inundation Database, which can reflect the most recent progress in the seismic retrofitting of coastal dikes etc. to rapidly estimate the range and depth of a tsunami inundation according to the predicted tsunami height announced in a tsunami warning, and at the same time, the Tsunami Inundation Calculation System, which can accurately revise the inundation estimation range at an appropriate time by reflecting the state of opening/closing of sluice gates, and the Tsunami Inundation Attenuation Prediction Model, which can predict the duration of the tsunami inundation.

2. Outline of the systems

The Tsunami Inundation Database is a database of inundation estimations calculated in advance by tsunami height in line with the state of seismic retrofitting of coastal dikes etc. In the case of a near-field earthquake, the predicted tsunami height announced immediately after the earthquake is entered to the database, which can then confirm the range and depth of inundation estimated according to the tsunami height. If it is later confirmed that the sluice gates are closed and the dikes are not damaged, the inundation estimated by the Tsunami Inundation Database might be too high. It is now possible to improve the precision of inundation estimations by entering the state of opening/closing of sluice gates to the Tsunami Inundation Calculation System to perform an inundation calculation. This system can even be used in the case of a far-field earthquake, when tsunamis arrive a long time after the earthquake. The Tsunami Inundation Estimation System formed by supplementing these with the Tsunami Inundation Attenuation Prediction Model has the potential for application not only to disaster responses by facility managers, but also to the evacuation of residents.

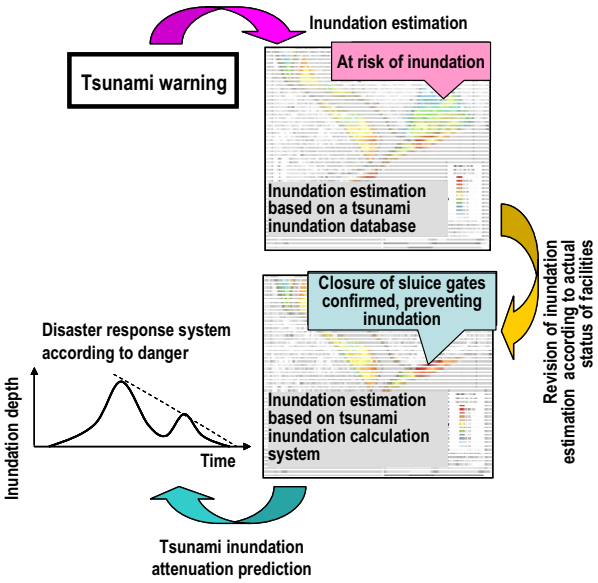

Figure 1. Outline of the Tsunami Inundation Estimation System

3. Future plans

This research is scheduled to continue for three years beginning in 2011.

[Reference]
F. Kato, Y. Suwa: Survey of evacuation from the Chilean Tsunami of 2010, Technical Note of NILIM 622

Simple method of Identifying Sources of Supply of Beach Sand by Chemical Analysis of Sand Grains

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(Key words) Beach sand, sand supply, mineral analysis, whole-rock analysis

1. Where did this sand come from?

"Tiny particles were discovered in the capsule!" The world swung from joy to despair over a few grains of sand carried from the Itokawa Asteroid by the Hayabusa spacecraft. The question, "where did this sand come from?" is an important challenge for the Coast Division.

Beach sand is maintained by a balance between sand washed away by the action of waves and wind and newly supplied sand. At locations where insufficient sand is supplied, coastline erosion occurs, exposing the hinterland to danger, so identifying the sources of sand is indispensable for coastline management.

The Coast Division is working cooperatively with Tokyo City University to develop methods of identifying the supply sources of sand. This report introduces research carried out along Kujukurihama Beach.

2. How is the source of supply of sand identified?

There are cases where coastal sand consists of a variety of different minerals, permitting researchers to hypothesize the sources of its supply by examining its mineral constituents under a microscope. But identifying minerals requires experience, and identifying minerals in more than 100 grains in a single sample is a labor-intensive task. One method of more easily identifying the constituents of sand is to use fluorescent X ray analysis to perform whole-rock analysis which quantifies the 10 major elements and 9 trace elements found in all sand.

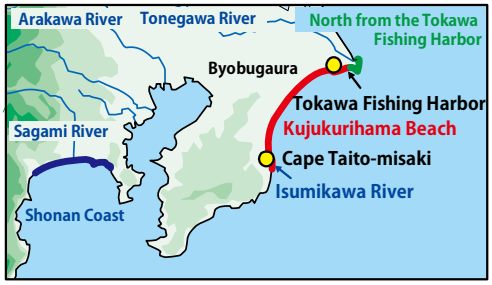

Figure 1. Coast where Whole-rock Analysis of Sand was Performed

3. Differences of sand supply sources revealed by chemical analysis

The results of analysis of sand and rock sampled from Kujukurihama Beach, the nearby coastline, inflowing rivers, and sea cliffs (Fig. 1) confirm that the quantities of Nb in the minerals (Nb/TiO_2) are completely different on the coastline north of the Tokawa Fishing Port and on Kujukurihama Beach, with Byobugaura as the northern boundary (Fig. 2).

Most of the Nb/TiO_2 on Kujukurihama Beach is almost equal to that at Byobugaura, and there are also points with low Nb/TiO_2 on Chojagahama Beach at the mouth of the Isumikawa River, suggesting that sand is also supplied from south of Cape Taito-misaki.

According to the results of analysis of other elements, origins vary according to minerals, and pyroxene on Kujukurihama Beach for example, originated in the same Kanto Loam as that on the Shonan Coast.

This reveals that it is possible to clarify differences in the origins of sand on coastlines by examining their chemical composition. In the future, more sand samples will be obtained from the hinterland and inflowing rivers, bringing us closer to finding the origins of the sand on Kujukurihama Beach.

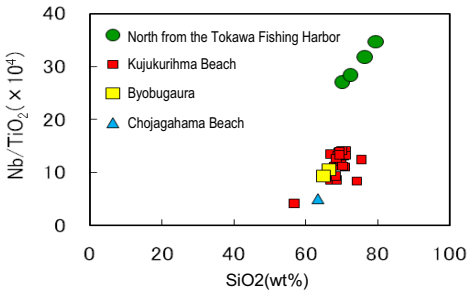

Figure 2. Example of the Results of Whole-rock Analysis of Coastline Sand

[Source]
A. Ishii, H. Hagiya, K. Watanabe (2010): Study of the origin of beach sediment based on the chemical composition of beach sand on the Kujukuri Coast, Annual Journal of Civil Engineering in the Ocean, JSCE, Vol. 26, 1125-1130

Evaluation of degree of toleration of drought by a social experiment

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(Key words) Water stoppage social experiment, drought disaster, drought toleration level

1. Introduction

In Japan, normal responses in drought periods are restrictions on water intake according to river flow rate or dam reservoir storage percentage from the standpoint of managers, but responses from the perspective of water users considering their tolerance of droughts are rare. Therefore, the author's performed a water stoppage social experiment to survey and analyze drought damage to clarify tolerance of drought in order to more rationally perform drought adjustments including the perspective of the water users in the future.

2. Outline of the water stoppage social experiment

The water stoppage social experiment was performed with the cooperation of Hirakata City in Osaka Prefecture. Artificial water stoppages to deliberately prevent water use by 60 households with 153 members were performed for a total of 8 days, with the water stopped for 6 hours for 3 days, 9 hours for 3 days, and 12 hours for 2 days. The water stoppage social experiment was short, so a questionnaire survey based on the premise the drought continued for a long period was carried out.

3. Analysis of the results of the survey

The results of the survey were analyzed in order to specify the attributes with high impact on drought tolerance and to abstract attributes of weak tolerance of droughts. This analysis was performed using quantification II type as the statistical method in order to handle data which cannot be quantified, which is the level of tolerance. Tolerance/non-tolerance was set as the objective variable and the attribute as the explanatory variable and a model formula shown as formula (1) was prepared by stoppage time and by restricted period.

$$Y=a_1X_{11}+b_1X_{12}+c_1X_{21}+d_1X_{22}+e_1X_{23}+f_1X_{24}+\cdots(1)$$

Y: objective variable (tolerance/non-tolerance)
X_{ij}: explanatory variable (each attribute)
X_{1i}: sex, X_{2i}: family constitution
a_i, b_i, c_i ---: category score (degree of impact on objective variable)

A relational formula was prepared by treating the objective variable Y as tolerance/non-tolerance, and the explanatory variable X_{ij} as monitor attribute, and setting 1 in a case where each corresponds, and 0 in a case where each does not correspond. A simultaneous equation was solved to maximize the correlation ratio, and if the category score obtained was positive it was judged to be a factor working tolerably, and if it was negative, a factor working intolerably. As a result of the analysis, "household with many members" and "household with all members 65 or older" were seen to be factors acting intolerably.

4. Drought tolerance level

Next, in order to evaluate the level of tolerance for droughts, water stoppage period and water stoppage hours were organized based on a matrix. In responses to the questionnaire survey, a regression curve on which the percentage of "harsh" and the percentage of "harsh" and "a little harsh" are over 50% was obtained based on the interpolation method, and set as the boundary of each tolerance level. Figure 1 shows the tolerance level curve.

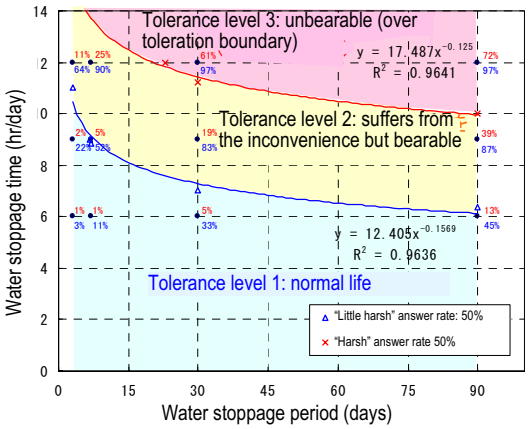

Figure 1. Tolerance Level Curve

5. Conclusion

Based on the results of analysis performed in this research, persons requiring protection during a disaster caused by a drought were specified, and tolerance levels for droughts were set. We are counting on the facts learned from this research being the basis for a proposal for a study of a drought adjustment method

including the perspective of water users to be applied when future droughts occur.
http://www.nilim.go.jp/lab/fdg/index.htm (Water Management and Dam Division)

Using rainfall predictions to improve dam flood control methods

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(Key words) Rainfall prediction, flood control, prior discharge

1. Introduction

It has been pointed out that under the effects of global warming, it is highly probable that extreme rainfall phenomena will continue to occur with increasing frequency. On the other hand, the Ministry of Land, Infrastructure, Transport and Tourism has been constructing fewer dams in Japan in recent years, so it must enhance the functions of its existing stock of dams in the future.

This research project was undertaken in order to minimize flood damage downstream from dams by predicting rainfall with high spatial resolution suitable to manage dams in dam catchment areas where large-scale flooding has occurred in the past, by studying a more effective flood control method (Fig. 1) which maximizes the full capacity of dams, and by verifying the applicability of this new method under actual floods including super large floods.

2. Rainfall prediction and rational dam operating methods

Rainfall was predicted by performing prediction calculations in 2km meshes through down-scaling by a meteorological model developed and released in the United States, and based on predictions by the Meteorological Agency (20km meshes) at the time of actual floods with reference to the occurrence of local torrential rainfall and the dam's catchment basin area. The predicted inflow was obtained by calculating the initial loss in the area upstream from the dam, the primary runoff, and rainfall loss based on the maximum underground water holding capacity and its reduction curve, then finding the effective rainfall by reducing the hourly rainfall by the rainfall loss, and then obtaining the product of this value and the catchment area.

The total inflow during the predicted period which has been calculated and the dam's free capacity at the time of the prediction were compared to perform a flood control simulation which performs operating judgments every hour.

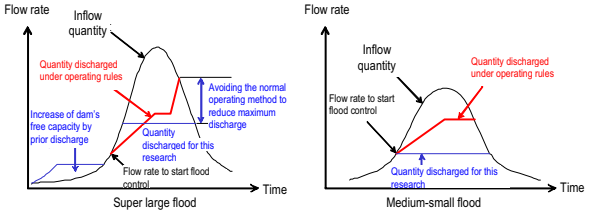

Figure 1. Comparison of Flood Control Effectiveness

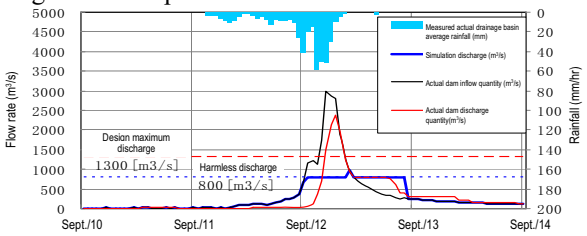

Figure 2. Results of Simulation of the Flood of September 2000 at the Yahagi Dam

3. Simulation results

Even when a super large flood has occurred, as shown in Figure 2., prompt adjustment operations sharply reduce the maximum discharge more than when normal operation based on the operating rules is performed, and it is possible to restrict inundation damage by many floods. And damage to downstream regions by many medium and small floods can be prevented by holding the discharge below the harmless discharge level.

4. Conclusion

While flood control effectiveness can be enhanced by using rainfall predictions, prediction errors may endanger flood control or water use. In the future, the Division will conduct research to accurately clarify characteristics including errors in rainfall predictions and reflect them in flood control operation judgments in order to minimize these risks.

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A method of using rubber poles to control speed on residential roads

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(Key words) Residential road, speed control, rubber poles, chicane, narrowing

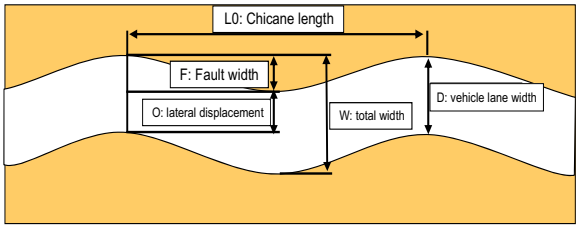
1. Introduction

As a traffic safety measure for residential roads, speed control measures have been taken using humps, narrowings, or other structures which control the traveling speed of automobiles (below called, “devices”). But, many humps or narrowings executed in the past are expensive, because they often require road reconstruction. So while many people are calling for traffic safety measures on nearby residential roads, with the finances of local governments restricted, they wish to implement simpler measures at many locations, even though these may be somewhat less effective.

This research included a survey to clarify the degree of speed control effectiveness of constructing chicanes or narrowings using simple devices (rubber poles) on actual roads and a study of effective and simple speed control measures.

2. Implementing a social experiment using rubber poles

In 2009, at the locations of 15 narrowings, 10 chicanes, and 5 slaloms, the relationships of their shapes with the speeds of automobiles traveling through them were surveyed and analyzed. The results show that in order to lower the 85th percentile speed to below 30km/h, the slowing effects of the chicane is greater than that of the narrowing, and that regarding the shape of the chicane, the relationship F/W≦0.37 should be established between vehicle lane width W and fault width F.



But, the chicane is LO (chicane length) = L1 (curve length) + L2 (Fault length)

Figure: Example of the Shape of a Chicane (Slalom)

And in 2010, in cooperation with Kumagaya City in Saitama Prefecture, the division used rubber poles to construct a chicane (fault width of about 2m) which maintained the above F/W≦0.37 relationship on a one-way street with vehicle lane width of about 5.5m, and performed a social experiment with a total of three patterns of chicanes and narrowings with varying intervals and measured automobile traveling speed to clarify whether or not speed reduction effects were obtained and to undertake simple measures while maintaining this effectiveness.

Photo View of the Social Experiment (Chicane)

The 85th percentile speed which was about 39km/h without the rubber poles, fell to about 35km/h in two patterns with chicane interval of 35m and 50m, which was speed reduction effects of about 4km/h. At the same time, about half of the automobiles traveled at speeds of 30km/h or less in a section of about 100m or more in an observation section of 180m.

At narrowings at 50m intervals, the 85th percentile speed fell only slightly, by about 2km/h to approximately 36km/h, with benefits obtained by all patterns. And among these, as imagined, the chicanes were more effective, and in the chicane cases, some pedestrians complained that they feel they are dangerous, revealing that it is necessary to separately study ways to improve the feeling of security they provide.

3. Future developments

We are considering summarizing the results of this social experiment and precautions concerning the installation of existing devices (installation interval, distance required from frontage, etc.) as a technical document, and to give support enabling local governments to introduce speed control measures a little more easily.

Method of making an early verification of the effectiveness of a traffic accident measure using video image data etc.

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(Key words) Conflict phenomenon, video image, traffic accident measure effectiveness

1. Introduction

Traffic safety measure projects should be implemented based on the PDCA cycle, which includes the steps—analyze causes of accidents, study countermeasures, implement them, evaluate their effectiveness, and study and implement supplementary countermeasures—in order to carry out more effective countermeasures. And in order to quickly discover their effectiveness, this PDCA cycle must be implemented as efficiently as possible. And the effectiveness evaluation step in the PDCA cycle has been done by collecting accident data before and after the countermeasure. But to perform an accurate evaluation based on accidents, it is necessary to collect data representing several years, so it takes a long time to make a reliable evaluation.

So the NILIM has developed a method of evaluating the effectiveness of a countermeasure based on speed data obtained from video images etc. and conflict behavior of automobiles to supplement methods of evaluating effectiveness based on accident data.

2. Effectiveness evaluations by analyzing vehicle behavior images

Figure 1 shows the distributions of speeds of automobiles passing the experiment locations before and after taking temporary countermeasures. The speed is interpreted from video images. The temporary countermeasures taken for this experiment were laying a simple Mat with a level difference on the road in order to alert drivers to the road ahead and slow them down, and at the same time, installing attention-getting signs to warn drivers to control their speed and alert them to the danger of rear-end collisions if they change lanes.

It is confirmed that the temporary countermeasures reduced speed. Although it will be necessary to continue to verify the relationship between speed and accidents, it is possible to evaluate the degree of achievement of the targets of the countermeasures (for this experiment, reducing speed) based on the countermeasure work methods which we selected (for the experiment, simple Mat, etc.).

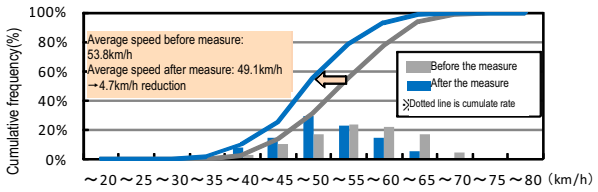

Figure 1. Change of Driving Speed Distribution After Countermeasure

Table 1. Change of Conflict Phenomena Occurrence Frequency After Measure

Conflict phenomenon pattern	Occurrence frequency (times/24 hours)	
	Before measure	After measure
Abruptly changes lanes	21	1
Rapidly nears leading vehicle	1	0
Total	22	1

Table 1 organizes changes of the frequency of conflict phenomena. It treats dangerous phenomena accompanying avoidance actions such as emergency braking or emergency steering as conflict phenomena. The frequency of conflict phenomena is totaled by the same survey personnel visually confirming video images both before and after temporary measures are taken.

It revealed that conflict phenomena fell sharply after the measure. But with the correlation of accidents with conflict phenomena not fully confirmed, in order to apply this method to verify the effectiveness of countermeasures, it is still necessary to analyze the accident – conflict phenomena correlation. At the experiment locations, 17 rear-end collisions occurred during the four years that was the criterion for accident data collection periods. If correlation with accident data is confirmed, it will be possible to perform evaluations using the same quantity of data as accident data based on 24 hour video image data.

3. Summing up and future challenges

As explained above, by interpreting speed and other

aspects of vehicle behavior based on image data obtained before and after countermeasures, it will be possible to confirm whether or not the selected countermeasure works are fully effective. And by organizing the correlation of accidents and conflict phenomena it will be possible to quickly evaluate the effectiveness of traffic safety measures.

For measures against massive disasters exceeding the design force

—Research on low- frequency/mega-risk coastal disasters—

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(Key words) Storm surge and tsunami, design external force, non-regret policy

1. Introduction

Interest in low-frequency/mega-risk coastal disasters (below called "mega-risk disasters"), which cause massive disasters when they do occur has been increasing, because of large-scale disasters such as the Indian Ocean Tsunami disaster and Hurricane Katrina which have occurred in succession around the world. The National Institute for Land and Infrastructure Management has studied how to deal with such disasters, defining "mega-risk disasters" as "massive disasters exceeding the design force".

2. Study of disaster reduction effects of structures other than shore protection facilities and a method of evaluating their effectiveness

A simple simulation model constructed considering its use for administrative purposes is proposed as a method of evaluating disaster reduction effects of buildings etc. against tsunamis and storm surges. This model uses a simple "combined ground height model" which can be prepared using a residential map when aerial survey photographs are not available.

Accounting for effectiveness at normal times, adding to the conventional B/C (cost-benefits) analysis reveals that there are cases where it is possible to enlarge the investment limit several times. This means that there are cases where accounting for effectiveness at normal times ensures B/C in projects with a scale many times larger, even among cases where B/C are not obtained only from effectiveness during disasters.

3. Study of consensus formation methods

However, counting on disaster reduction performance of buildings, parks, etc. against seawater overflowing dikes means that a certain amount of damage should be accepted. It is vital to form a consensus regarding to what extent it is acceptable. And in addition to ordinary residents, there are also business offices, factories, and numerous lifelines, thus the quantity of entities located in a coastal area limits an administrative body's authority. So a consensus formation process model is proposed for cases adapted for "mega-risk disasters", and the need for an integrated management system incorporating infrastructure information other than shore protection facilities is pointed out.

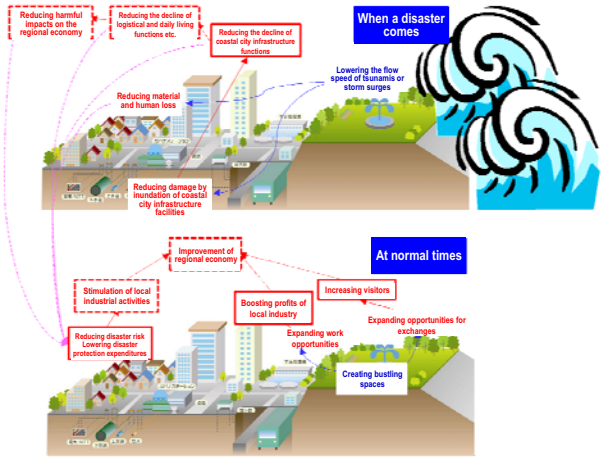

Figure. Effectiveness of Facilities (During Disasters and at Normal Time)

4. Conclusion

This research proposes a policy of preparing for "mega-risk disasters", specifically countermeasures while providing facilities with social benefits, because they not only reduce damage during a disaster, but provide benefits at normal times, or in other words, the "No-Regret Policy".

This survey was worked out to the extent of creating the basic conceptual material to discuss a policy of avoiding catastrophic destruction while accepting a certain degree of damage, but in the future, initiatives to show the way to reach a consensus will be required.

Trial distribution of X-band MP radar rainfall information

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(Key words) Guerilla rainfall, flood disaster, X-band MP radar

1. Introduction

Flood disasters caused by so-called guerrilla rainfall, the 2008 flood on the Togagawa River in Kobe City, Hyogo Prefecture, or the water accident on the main line of the Zoshigaya Sewer System in Toshima Ward in Tokyo for example, have occurred frequently in recent years. The River Bureau of the Ministry of Land, Infrastructure, Transport and Tourism is introducing X-band Multi-Parameter radar (below called X-MP radar), a type with high special and temporal resolution, in order to perform refined observations and monitoring of guerrilla radar.

2. Characteristics of conventional radar and newly-installed X-MP radar

The conventional MLIT C-band radar (radius of quantitative observation range: 120km, 1km mesh), which provides wide observation range and is installed to cover the entire nation, is a large river flood-management tool useful in observing the seasonal rain front or typhoons, but its observation mesh is too large to allow its use for precise observation of local and sudden guerrilla rainfall. In contrast, the newly installed X-MP radar (radius of quantitative observation range: 60km, 250m mesh) uses small observation meshes which permit high resolution rainfall observations, allowing users to temporospatially clarify the constantly changing state of rainfall (Fig. 1).

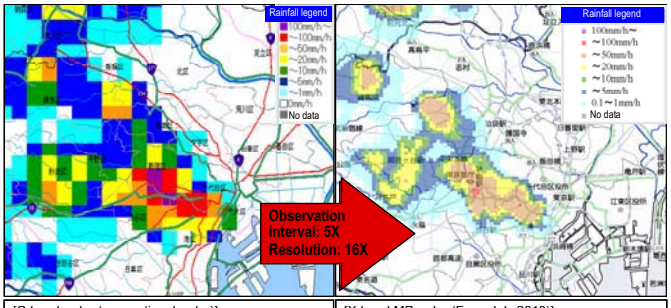

Figure 1. Images of C Band Radar and X-MP Radar

3. Trial operation of X-MP radar

The River Bureau of the MLIT installed 11 X-MP radar bases in the three large metropolitan regions (Kanto, Chubu, Kinki, Hokuriku) in 2009, then conducted trial transmissions beginning in July 2010. The NILIM provided technical support for the introduction of X-MP radar by, for example, building the rainfall information transmission system.

Because the quality of radar observations is reduced by, for example, noise signals etc. received as a result of mountains, buildings, and other obstructions in the observation direction, to mitigate this problem, the NILIM set appropriate observation methods for X-MP radar and adjusted patterns, improving the precision and quality of rainfall observations. Considering that guerrilla rainfall occurs unexpectedly, we also constructed an integrated system able to rapidly collect data from rainfall observations, process the information, and transmit it to a web site in order to meet the challenge of real-time information provision.

For these reasons, on the X-band MP radar rainfall information web site published by the Ministry of Land, Infrastructure, Transport and Tourism, users can view images of rainfall distribution occurring from 30 minutes earlier to the present moment (updated at 1 minute intervals).

4. Future initiatives

Plans for X-MP radar installations in 2010 call for 4 bases in Chugoku, 5 in Kyushu, 3 in Chubu, 2 in Tohoku, and 1 in Hokuriku. Beginning in 2011, trial operations intended to improve observation precision and advance torrential rainfall observations of a total of 26 X-MP radar installations will begin, with full-scale operation scheduled to begin in 2013.

[X-band MP radar rainfall information web site]
http://www.river.go.jp/xbandradar/

Inspecting road accessories (road signs, lighting facilities, etc.)

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(Key words) Inspection, road sign, lighting facilities, corrosion, crack

1. Introduction

Road signs, lighting facilities, and other column-shaped accessories installed on roadsides have been damaged in various ways including broken columns, fallen bolts or lamps, and so on. These may harm third parties such as passing pedestrians or vehicles, so it is vital that these problems are reliably found by inspections. Many defects are generated at places where they are difficult to see such as corrosion at invisible locations, underground for example (Photo 1), or loose bolts high on the structure or cracked welds, etc. In addition there are a huge number of these column-shaped accessories, so it is now necessary to introduce a rational easy inspection method which prevents overlooking of defects. The Bridge and Structures Division has, with the cooperation of the regional development bureaus, conducted research on the actual state of maintenance of these accessories and analyzed the results, to propose a draft of a periodical inspection manual for column-shaped accessories equipment.

Photo 1. Column Base Corrosion Covered by Paving

Photo 2. Match-mark

2. Outline of accessory inspection

The research results clearly show that among accessories with relatively simple structures, a severe accident such as collapse of the structure or a bolt falling to the ground or similar accident which threatens harm to third parties, can be limited to welds, joints, or specified members, and that corrosion or cracks of such specified parts can develop extremely rapidly in some installation conditions. On the other hand, a characteristic of column-shaped accessories is that it is possible to set patterns of typical structural details and forms of joints since many of them have the same or similar structures. Based on the above,an inspection manual has been proposed. This manual provides for general visual inspection and checking and recording of abnormalities at all specified locations which are known in advance as relatively weak points in every structure. In order to accurately detect whether or not there are corrosion or cracks which can deteriorate extremely rapidly, and to find any loose bolts or other problems, it is usually essential to closely inspect welds, bolts, etc. using a mobile lift or similar device. To reduce the labor requirements of inspections, bolted joints can also be inspected visually from a distance by placing match-marks, which are marks made on each bolt (Photo 2), so that any abnormality of the joint can be accurately identified. By clarifying the level of certainty which should be achieved by inspections in the inspection manual in this way, inspections by a method appropriate to conditions can be ensured. In addition, by taking care to minimize weak points in advance when setting or replacing structures, reliable and economical inspections, and the reduction of future maintenance cost can be counted on.

Methods of inspecting for corrosion of column foundations include non-destructive residual thickness inspections using the ultrasonic pulse reflection method and a safety evaluation method based on its results. To look for corrosion of invisible parts under the road surface, based on research on the actual state of maintenance, priority inspections in cases of such corrosion which can be visually confirmed near the boundary of the road surface and parts buried in asphalt pavement for more than 20 years since installation have been suggested.

3. Conclusions

The results of this research were reported to each regional development bureau by the National Highway and Risk Management Division of the MLIT as Inspection Manual for Accessories (Road Signs, Lighting Facilities, etc.) (Draft)" in December 2010. In the future, studies of the rationalization of maintenance, including analysis of inspection data which is collected will be conducted.

Use of draft technical specifications for the mobility support system

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(Keywords) Mobility support, ubiquitous, technical specifications, pedestrian space network data

1. NILIM's role in the mobility support system

By developing ubiquitous information infrastructure using IC tags, etc., the Ministry of Land, Infrastructure, Transport and Tourism is promoting a project for mobility support. The aim of this is to build an environment in which anyone, at any time and in any place, can access information needed in various situations (e.g. transit routes, means of transport, destinations, nearby facilities, etc). Following demonstration trials all over the country since FY2004, a model project has been in progress since FY2009, the ultimate goal being a transition to a permanent service.

To achieve this transition, it will be important to ensure the compatibility of equipment between different districts, and to set rules for uniformly gathering and accumulating the data needed for services. The National Institute for Land and Infrastructure Management (NILIM) is responsible for studying various technical issues in this project, in collaboration with a variety of members including academic and professional experts, private companies, NPOs, the central government and local authorities. In May 2008 NILIM published its findings in the form of "Technical specifications for the mobility support system (draft)".

2. Outline of the mobility support system

The mobility support system consists of equipment fitted with geopositional identification codes and communication functions installed in various places, configured so that users can use mobile terminals to access information managed separately by a server, etc. The system is characterized by the speed with which it updates constantly changing information, since the information is managed separately by a server, etc.

3. Development of pedestrian network data and implementation of monitor survey

From FY2010, we started developing pedestrian network data including information on barriers in pedestrian spaces, an indispensable element of the mobility support system, in the centers of the three big urban spheres (Tokyo, Osaka and Nagoya). Data were developed by the various regional development bureaus in line with technical specifications prescribed for the basic data composition, content, etc.

At the same time, based on user opinions of the data actually produced, we constantly need to update the data content while confirming the usefulness of the data, reflecting user needs in the data content, ranking the information provided in order of priority, and so on.

To this end, we conducted a monitor survey in which we enlisted the help of wheelchair users, visually impaired and other volunteers in the area around Ueno Station, where the development of data was at a more advanced stage. We provided the monitors with network data on the pedestrian area as they actually made their way around it, and asked them to complete a questionnaire during and after their tour.

Based on the results, we identified issues in the draft technical specifications, while also proposing data content that would allow more useful information for the users to be provided at low cost. We plan to refer to these survey results to produce even more advanced technical specifications in future.

Table: Examples of Data items that should be added, based on the survey results

Level of pedestrian traffic	Taxi stands
Level of obstacles on road	Information boards
Number of dropped kerbs	Time duration of green traffic signals
Structural format of sidewalks	Length of sections with long gradient of 5% or more

(References)
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Nationwide deployment of ITS Spots

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(Keywords) Intelligent transport systems (ITS), ITS Spot services

1. Background

Since 2005, the National Institute for Land and Infrastructure Management (NILIM) has been conducting cross-sector joint research and other R&D aimed at achieving in-car environments in which VICS, ETC and other services provided individually until now, as well as diverse other services, can be provided by a single on-board-unit. Demonstration trials on expressways were held in FY2007 and large-scale demonstration trials by a group of related ministries in FY2008. In January 2010, based on the results to that point, NILIM published "Technical Specification for the Spot Communications Services (DSRC Services)" concerning roadside units, the Center's devices, interfaces between devices, and so on.

2. Developing ITS Spots

In line with these trials and publication of specifications, the Ministry of Land, Infrastructure, Transport and Tourism gradually installed roadside equipment (ITS Spots) in about 1,600 locations in FY2010, mainly on expressways throughout Japan. In advance of this, from autumn 2009 private manufacturers started marketing car navigation systems corresponding to ITS Spots that can use services provided by ITS Spots.

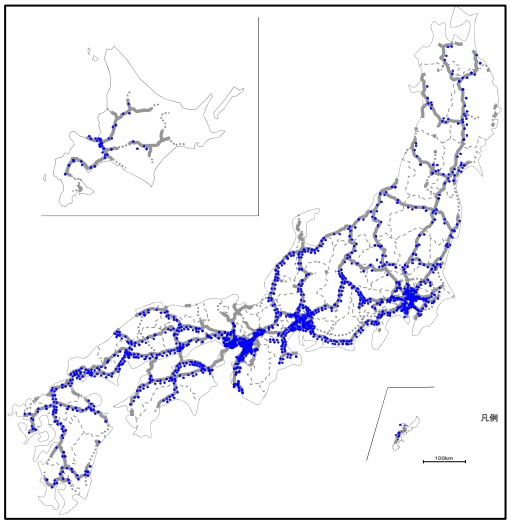

Fig. 1 Scheduled locations of ITS Spots

3. ITS Spot services

Between January and March 2011, the provision of the following basic services and Internet connection services (available with some models only) will start nationwide. The collection of probe data will also start.

(1) Dynamic route guidance

A service using new high-speed, large-capacity road-vehicle communications to distribute wide-area road traffic information exceeding prefectural boundaries (maximum about 1,000km in extended road length) in real time, enabling car navigation systems to choose the optimum route.

(2) Assisting safe driving

A service providing caution in emergencies, using ITS Spots that provide road traffic information in normal circumstances. The service can alert drivers by notifying them not only of fallen obstacles ahead but also traffic jams beyond curves, in other words, at blind spots on the road ahead, preventing them from being startled, causing accidents.

Fig. 2 Example of assisting safety driving

4. Future challenges

In the future, it is expected that the development and expansion of services using ITS Spots will continue to be promoted through collaboration between the public and private sectors.

(Reference: URL of related website)
http://www.mlit.go.jp/road/ITS/j-html/spot_dsrc/index.html

Topics

Field Survey of earthquake and tsunami of Sumatra Mentawai Islands in 2010

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(Key words) Tsunami, Field survey, Indonesia, Mentawai Islands, Remote island

1. Introduction

On October 25, 2010, at 23:42 JST (21:42 on the same day in local time), an M7.7 earthquake occurred under the seabed, west of Sumatra Island in Indonesia. It caused a tsunami disaster centered on the Mentawai Islands (Fig. 1). From November 10 to 13, 2010, a joint survey team of NILIM and the Port and Airport Research Institute (PARI) conducted a field survey of the damage of the earthquake and tsunami in cooperation with the Ministry of Maritime Affairs and Fisheries (MMAF) of Indonesia.

2. Outline of the survey

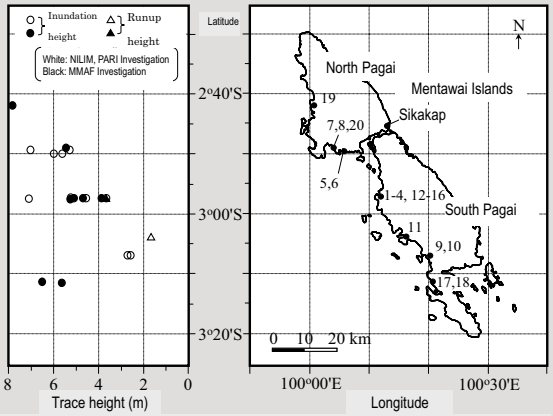
Measurements of trace heights of the tsunami clarified the tsunami height on North Pagai and South Pagai Islands, which are part of Mentawai Islands. And interviews with residents clarified the state of inundation and the way the residents evacuated. The only way to reach Mentawai Island is a ferry service and it takes 10 hours under the normal conditions. The ferry service, however, was suspended because of the disaster. The team was able to access Pagai Islands with the help of MMAF. There were difficult conditions not only the ferry service but also the mobile phone service.

Tsunami with height of about 6m above sea level struck North Pagai and South Pagai Islands, and damaged buildings. Brick houses were completely destroyed. At several villages, the tsunami reached between 7 and 8m in height (Fig. 2).

The human damage varied greatly between communities. For example, no human damage occurred at one village of the South Pagai, because one villager, who is the first witness of tsunami in the village, instructed the other residents to evacuate to the safe place by screaming in loud voice.

Figure 1. Location of the Mentawai Islands

Photo 1. Measuring trace height (white line shows trace height)



1-4, 12-16: Malakopa 5, 6: Muntebarubaru 7, 8, 20: Sabeugunkgung 9,10: Saumang, 11: Bake, 17, 18: Bulasat, 19: Silabu

Figure 2. Distribution of Trace Height of Tsunami

3. Supplement

The region surveyed was a remote island, isolated from the country's major land areas. Performing the survey in circumstances in which the transportation and communication services were almost suspended, it was found to be difficult to supply materials and transmit information to restore disaster damage in the remote islands. Risks similar to the remote island disaster will be found in case an earthquake disaster strikes Japanese remote islands. We wish to thank everyone who helped us with this survey.

[Sources]
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Management of Sewers

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(Key words) Sewers, stock management, Survival Ratio, LCA

1. Introduction

At the end of 2009, the sewerage coverage ratio reached about 73%, and the vast stock of pipes providing this coverage reached approximately 420,000km. It is predicted that sewerage facilities will deteriorate, pushing up the cost of their maintenance in the future, resulting in the need for systematic and efficient facility management to ensure that these facilities continuously provide their specified functions. One way to achieve this is stock management (SM).

To develop and implement the SM method, rational operation plans must be drawn up based on the prediction of the medium to long term quantity of work considering the soundness of the facilities. This will permit maintenance of good quality sewerage services under harsh financial restraints.

And a sewerage service contributes to improving the living environment and conserving water quality in public bodies of water. At the same time, the consumption of energy resources and emission of green house gases by the construction and operation of its facilities create a variety of environmental loads. Therefore, to operate a service, it is necessary to evaluate its environmental load from the medium to long term perspectives.

The NILIM is contributing to the promotion and development of the SM by carrying out research on a variety of basic technologies such as facility soundness (survival) evaluation and prediction, standardization of future works volume, and the evaluation of the impact of sewerage system operation on the global environment as Life Cycle Assessment (LCA).

2. Predicting Survival Ratio of sewers

To predict future works volume in the medium to long term, it is necessary to have a survival ratio prediction formula to predict change over years of the percentage of pipes which are reconstructed. Survival ratio is a value obtained by dividing total length at each deterioration rank by total surveyed length of pipes surveyed after any number of years of service. The survival ratio prediction formula indicates this with an approximate line.

The NILIM improves the precision of the survival ratio prediction formula by conducting a nationwide survey of pipe length by year of installation. And the NILIM updates the soundness prediction formula annually (Fig. 1).

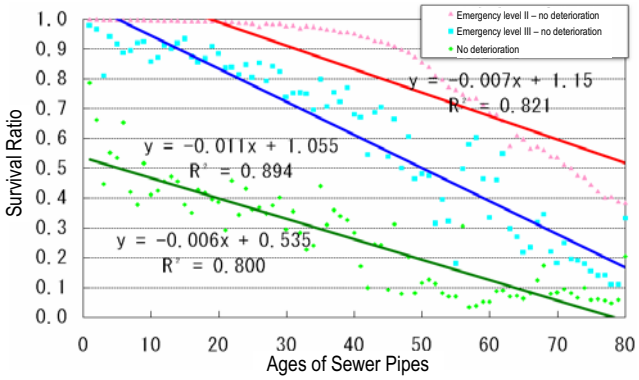

Figure 1.Survival ratio prediction formula

3. Application of LCA to sewers

To establish concepts to guide cases where LCA is applied to calculate the environmental load of sewers, we collected information about environmental load basic units by pipe material and by work method, etc. at each stage—pipe manufacture and installation, operation, and disposal—to prepare an environmental load calculation function (Fig. 2). This simplifies environmental load calculations, permitting its use as material to select work methods when installing new pipes or reconstructing existing pipes.

4. Conclusion

Initiatives to develop SM in the sewerage field have barely begun, and even local governments are at the trial and error stage. Under such circumstances, we hope that the SM method established by the NILIM will further promote the introduction of SM.

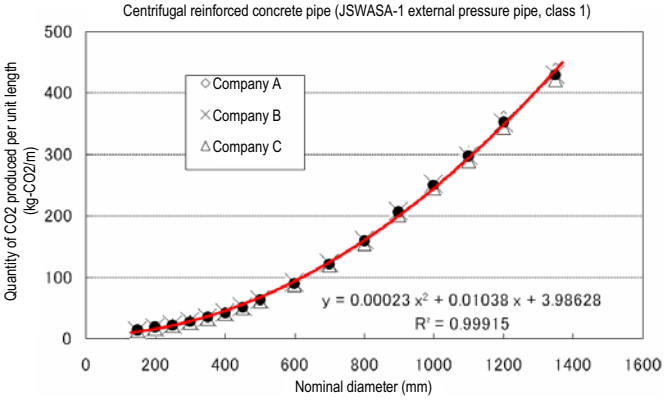

Figure 2. Environmental Load Calculation Function Graph (Example)

Towards the Establishment of Asset Management Methods for Road Bridges

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(Key words) road bridge, periodic inspection, inspection system, asset management

1. Introduction

During this period when road structures are steadily aging, considering the degree of damage and the predicted decline of investment capacity, maintenance must become more efficient, requiring the creation of data based scientific maintenance to advance road asset management. Road bridges managed by the national government are, under the provisions of Manual for Periodic Inspections of Bridges (Draft) (March 2004), given a direct visual inspection for the first time within 2 years after the beginning of service and periodically every five years afterwards. The second inspections will soon be carried out. The NILIM is conducting research based on detailed and multi-faceted analysis using vast data which has been accumulated from these inspections.

2. Optimization of the inspection system

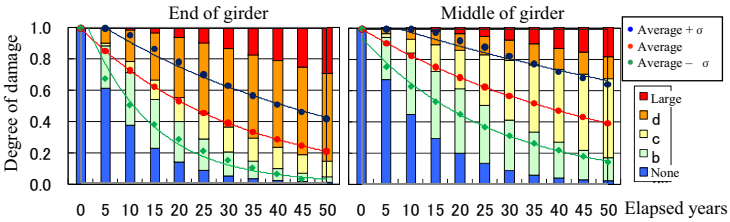
Periodic inspections are performed by directly examining the entire bridge and all of its members every five years. If the correlation of the characteristics of the occurrence and progress of damage and related factors can be clarified, it will be possible to do these inspections more efficiently by optimally combining inspection items and frequency for the bridge and each of its members. Changes of two inspection results performed on the same location of the same bridge will be analyzed by damage, by member, by type of bridge, and by bridge erection environment in order to achieve this greater efficiency.

Inspections are primarily visual, so the state inside members cannot be clarified unless symptoms appear on the surface. Specified inspections including non-destructive inspection methods are required to compensate for this weakness. In order to narrow the locations and the time of the specified inspections, the correlation between the characteristics of steel member fatigue cracking etc. and related factors and the relationship between the damage and the bridge's performance are being researched.

Inspections are intermittent and there are limits to their ability to catch sudden malfunctions, so the department is studying methods of detecting fatal damage by constant monitoring of change of position and risk management methods to introduce these into inspection systems.

3. Establishing road bridge management methods

The foundation of management is reducing the life cycle costs (below, "LCC") by clarifying the present state of a bridge by the above inspections, predicting its future condition, and repairing damage or retrofitting at appropriate times. The deterioration of a bridge encompasses a wide variety of forms of deterioration or damage according to the condition of each bridge, so the results of deterioration prediction are always scattered. This is an important point to remember when trial calculating LCC, so the department is developing deterioration prediction equations which provide LCC matched to the degree of reliability (see Fig. 1).



The Markov transition probability is obtained and degree of damage weighted based on changes of the results between two inspection (none 1.0 to large 0.0), and the mean value and standard deviation are calculated for each number of elapsed years (tentative value by damaged member).

Figure 1. Example of Deterioration Curve of Main Girder Corrosion on a Steel Girder Bridge

4. Future research policies

The department will link a variety of research activities with related organizations in order that engineers skillfully employ information processing technologies and other most advanced scientific methods to perform inspections optimized for each bridge, that smart maintenance systems capable of

minimizing the LCC of overall road resources and minimizing risk to road users are created, and that required performances are established for new bridges to control durability and reduce scattering in order to enhance maintainability.

[Reference] Web site of the Bridge and Structures Division (with access to related reports)
http://www.nilim.go.jp/lab/gcg/index.htm

Release of CommonMP

(Common Modeling Platform for water-material circulation analysis)

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HATTORI Atsushi, Head of River Div. YAMAMOTO Akira, Director of River Dept.

(Keywords) *Hydraulic and hydrological analysis, software, consortium*

1. Introduction

River Dept. has been developing the *CommonMP*, general-purpose platform for hydraulic and hydrological analysis since 2007. The *CommonMP* (Common Modeling Platform for water-material circulation analysis) is a software platform for analysis models such as river channel models and rain runoff models established to analyze water-material circulation in river basins and permit plural analysis models to mutually interact. CommonMP Ver1.0 was released in March 2010.

2. Utilization of CommonMP

The purpose of *CommonMP* is to stimulate R&D of hydraulic and hydrological analysis models. It is also intended to improve the skills of river engineers as they personally use it for flood forecasting in order to upgrade river management. Regional development bureaus and the Japan Civil Engineering Consultants Association jointly hold training sessions to learn to disseminate *CommonMP*, while RDBs develop analysis models of the *CommonMP*. Handout documents are provided on the CommonMP web site for your reference. Regarding university activities, books[*1] for lectures in universities were issued in March 2011.

3. Future Activities

River sectors and sewage sector organizations established the industry-government-academia consortium in July 2009. The consortium will promote all future *CommonMP* development and dissemination activities.

(Reference)

*1 Michiharu SHIIBA, Yasuto TACHIKAWA, Introduction of the CommonMP
CommonMP HP: http://framework.nilim.go.jp

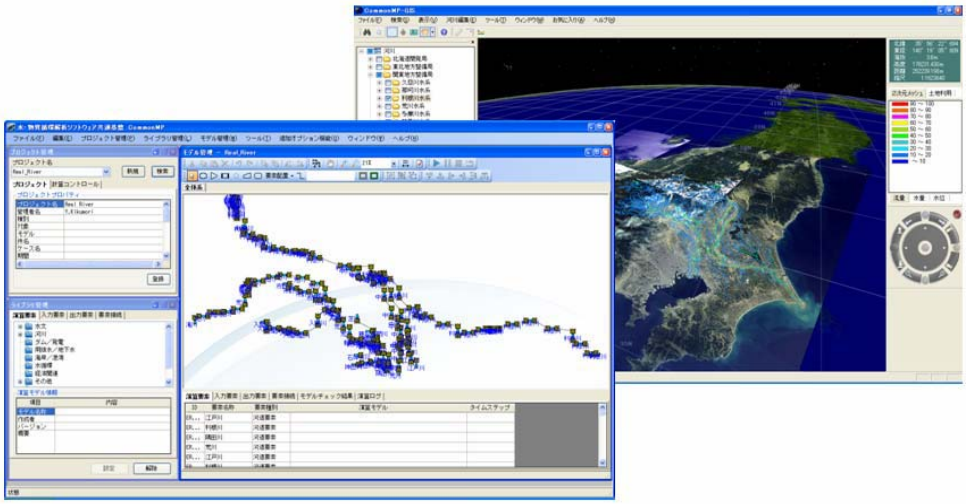

Image of a CommonMP screen

Characteristics of roads traveled by international marine container trucks

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MATSUMOTO Shunsuke, Researcher　FURUKAWA Makoto, Guest Researcher
Traffic Engineering Division, Road Department

(Keyword) International logistics, international marine container, truck, route selection

1. Introduction

Our division conducts survey research on the characteristics of actual routes traveled and of route selection activity by international marine container trucks in order to accumulate knowledge of use in studying measures to smooth international logistics. Below, an outline of the survey and analysis and part of the knowledge already obtained are introduced.

2. Outline of survey and analysis of routes actually traveled

(1) Surveyors visited 83 container transport companies in the Kanto Region to survey the transport routes they usually use (routes actually traveled), departure/arrival times, and whether or not arrival times are designated. As a result, we obtained information regarding 890 container truck routes and 112 ordinary truck routes.

(2) Road network data was built with information such as road widths or intersection standards etc. which are included in the Road Information Manual as its link attributes.

(3) The routes actually traveled information obtained in (1) was applied to the road network data obtained in (2) and various analyses are performed.

3. Knowledge concerning routes traveled by container trucks

The following is knowledge we obtained from the analysis.

○ The percentage distance traveled on national highways and higher level roads is 88% for container trucks 54% for passenger cars, showing that a high percentage of container trucks travel on high standard roads (Fig. 1).

○ The turning percentage at the highest standard Rank A intersection (a vehicle less than 20m in length can turn without intruding on the opposing vehicle lane) is 77% for container trucks and 65% for small trucks, showing that a high percentage of container trucks turn at high standard intersections (Fig. 2).

○ A comparison of the outward run (transport route for loaded containers from the container terminal to the shipper) and return run (transport route of empty containers from the shipper to the container terminal) of the import container transport (first transport run of the day) (Fig. 3) shows that a higher percentage travel on expressways for their return run than their outward runs (1% is significant, t-value =4.3). The reasons were confirmed as follows by interviews with transport companies. On the outward runs, departure times are adjusted so that they can arrive at the designated time, and more economical routes are used. Its merit is that on the return runs, it is possible to increase the quantity of work done in a single day by shortening the transport time (the next transport is performed or the next days' loaded containers are picked up in advance, etc.). So, on return runs, there is a stronger incentive to shorten the time than on outward runs which means a high percentage use expressways for return runs.

4. Conclusion

In the future, we want to model container truck route selection actions based on knowledge obtained in the past and apply it to study international logistics smoothing measures etc.

Related research is available on the Traffic Engineering Division web site　http://www.nilim.go.jp/lab/gbg/index.htm

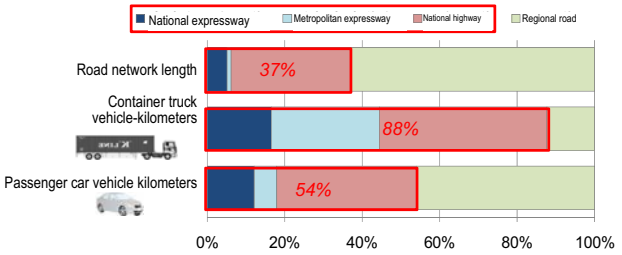

Figure 1. Vehicle-kilometer Percentage

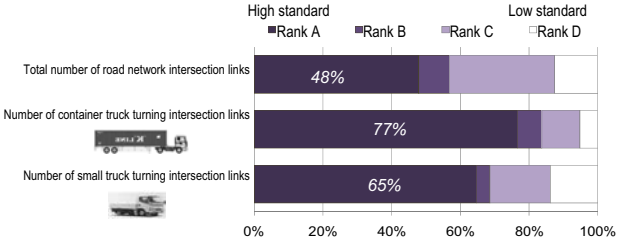

Figure 2. Standards for turning Intersections

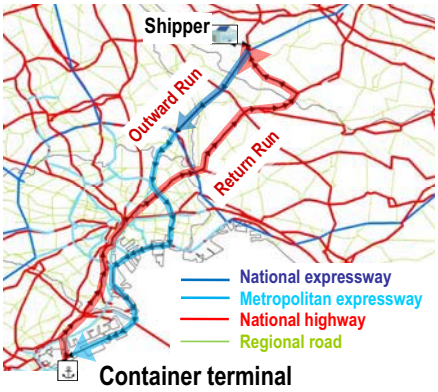

Figure 3. Outward Run and Return Run Routes of Import Containers (Example)

Do container ships cruising between East Asia and North America cruise through the Japan Sea or the Pacific Ocean?

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(Key words) Container ship, North-American shipping route, AIS, Tsugaru Strait, Osumi Peninsula

1. Introduction

In recent years, the rapid growth of the Asian economies has increased the number of container ships traveling between East Asia and North America. Japan is located on this shipping route, but the circumstances governing whether they travel on the Japan Sea side or Pacific Ocean side of Japan have not been analyzed. So we combined Lloyd's ship movement data with AIS data to analyze the passage of these ships.

2. Analyzed data

Past analysis of the movement of ships has been done using Lloyd's ship movement data, but these data are ships' port clearance data, which can not clarify ocean waters where ships cruise. So for this research, we performed analysis combining Lloyd's data with AIS data obtained at the Hakodate and Moji receiving stations. AIS stands for Automatic Identification System which, since the 9/11 terrorist incident, all ships above a certain size are obligated to carry.

3. Analysis of ocean areas used by the shipping

Figure 1 shows the results of analysis of the passage data for the single year, 2009.

Overall, 3,140 ships traveled eastward and 2,972 ships traveled westward, almost identical quantities traveling in the two directions, but when the results are viewed by ocean area cruised by the ships, eastbound, 1/3 used the Tsugaru Strait and 2/3 cruised offshore from Osumi Peninsula, while westbound, more than 70% of the ships cruised in the water offshore from Osumi Peninsula. These numbers reflect the fact that in many cases, container ships stopped at ports on the Pacific side of Japan.

4. Change of numbers of ships over time

Assuming that judgment standards for selecting passage through each ocean area are constant, 1999 and 2004 were estimated based on the results obtained for 2009. In the Tsugaru Strait (Sea of Japan), eastbound ships have doubled, while westbound ships have declined in number slightly since 2004.

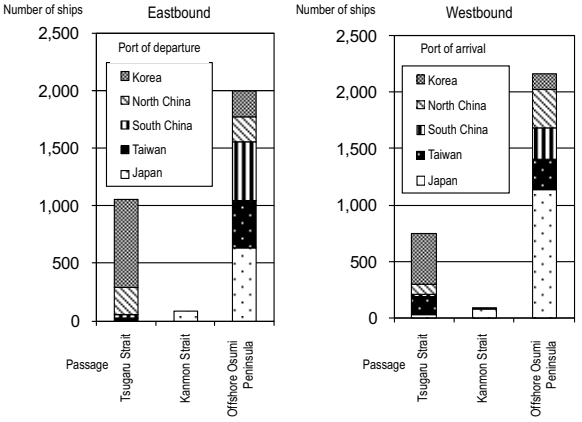

Figure 1. Number of Ships by Ocean Area

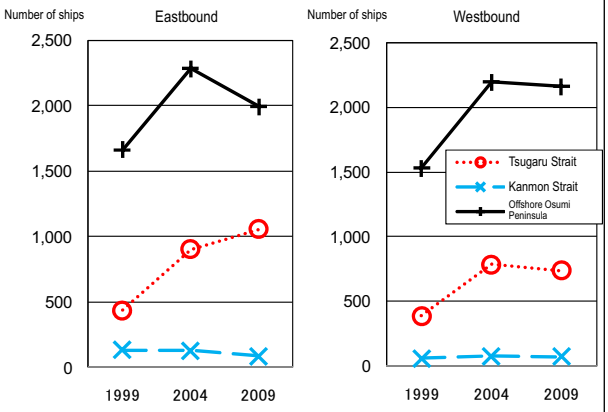

Figure 2. Time Series Change (Estimated) of Ship Numbers

5. Conclusion

These results will be basic materials for the study of port facilities including ports on the Japan Sea side, and we wish to continue this analysis.

[References]
NILIM document NO. 610 http://www.nilim.go.jp/

Analysis of impact of the cooperation policy between ports on container ship callings

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(Key words) Cooperation between ports, percentage of ships calling successively at multiple ports, container ship

1. Introduction

In December 2007, the ports of Osaka Bay, which had been divided into three ports, were integrated as the Hanshin Port, and for foreign trading ships that call at two or more of these ports, the tonnage dues charged for each port call were reduced to an amount for one port call. And prior to the unification of the ports, a policy of halving the port dues for container ships calling successively at 2 or more ports in the bay was introduced in April of the same year. And in April 2009, Keihin Port also reduced the port dues for container ships calling successively at 2 or more ports within the bay to the dues for one port call.

This research calculated and analyzed the percentage of ships calling successively at multiple ports in a single bay in order to clarify the effectiveness of the cooperation policy between ports.

2. Calculation of the percentage of ships calling successively at multiple ports

This analysis used Lloyd's data for port calls around the world throughout the year to calculate the percentage of ships which called successively at multiple ports from among all ships visiting the bays studied. Figure 1 shows changes of the percentage of ships calling successively at multiple ports from 2003 to 2009. The objects of the analysis were Osaka Bay and Tokyo Bay, where the cooperation policy had been implemented, and for comparison purposes, Ise Bay and Northern Kyushu. Three of the bays with the exemption of Ise Bay had tended to grow to 2006. Between 2006 and 2008, there was no increase in Tokyo Bay and Northern Kyushu, but Osaka Bay, where the cooperation policy between ports had been adopted, increased, and passing Tokyo Bay in 2008 to take first place.

To clarify the effectiveness of cooperation between ports in greater detail for Osaka Bay and Tokyo Bay, the percentages of ships calling successively at multiple ports before and after the policy was introduced, are shown in Table 1 by type of route. The three route categories were all routes, routes in East Asia (EA), and near-sea routes (calling only at ports in Japan, Korea, and Northern China (from Zhejiang Province north)). In Osaka Bay, only ships on the near-sea routes increased after the reduction of port dues, but after the unification, ships on all routes increased, then in 2009, the percentages on all routes began to decline. It is assumed that this was caused by the world economic slump in the last half of 2008, but in Tokyo Bay, the percentage of ships calling successively at multiple ports was maintained after the reduction of port dues.

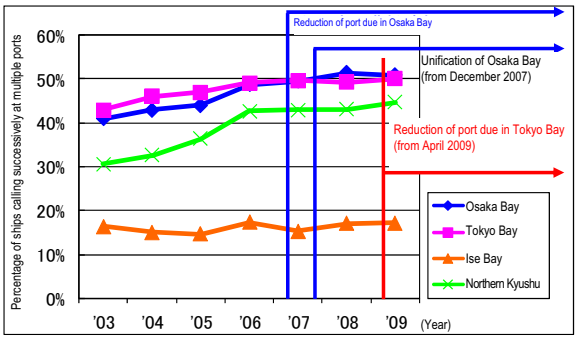

Figure 1. Changes of Percentage of Ships Calling Successively at Multiple Ports

Table 1. Percentage of Ships Calling Successively at Multiple Ports Before and after Wide Area Cooperation Policy

		No policy at Osaka Bay 06.04～07.03	Reduction of port due in Osaka Bay 07.04～07.11	Unification of Osaka Bay 07.12～09.03	Reduction of port due in Tokyo Bay 09.04～09.12
All routes	Osaka Bay	49.3%	49.4%	51.5%	50.7%
	Tokyo Bay	49.3%	49.7%	49.2%	50.5%
EA area	Osaka Bay	71.4%	71.2%	73.3%	69.5%
	Tokyo Bay	82.8%	83.7%	83.9%	83.2%
Near-sea routes	Osaka Bay	78.9%	81.8%	83.7%	72.0%
	Tokyo Bay	73.0%	78.2%	77.6%	78.0%

3. Closing Remark

In the future, we want to continue the analysis to calculate the results of the reduction of port costs by the cooperation policy between ports.

[Source]
Japan Society of Civil Engineers 2010 Annual Meeting Proceedings, IV-068, September 2010

Construction of an APEC edition of a Trade and Logistics Prediction System

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Port and Harbor Department

(keywords) Trade prediction, international logistics model, APEC

1. Outline of research

The authors have entered future social and economic variables and international economic and transport policies to construct the Trade and Logistics Prediction System, which predicts the future value of international trade and quantity of cargo logistics in countries around the world. Last year, we constructed the APEC (Asia-Pacific Economic Cooperation) edition model, which is an expanded and modified version of this system, and expect that we will receive approval very soon from the Transportation Working Group Maritime Security Experts Group (TPTWG-MEG) of APEC. This report present an outline of this system.

2. The model

Figure 1 is an overall image of the system. This system is broadly divided into two parts, the Trade Prediction Model and the Cargo Logistics Model (International Logistics Model). To apply the trade model, social and economic variables such as population, capital, etc. plus future values of tariff rates and other international economy and trade policies are input to separate scenarios based on the authors' own surveys, and the future values of trade by commodity in participating countries and regions are estimated based on the GTAP (Global Trade Analysis Project) model. Using the International Logistics Model, a trade statistics database etc. is used to convert future values of trade in various countries obtained above to cargo transport demand by zones more detailed than countries, then the multi-mode balanced allocation model which permits simultaneous consideration of marine and land transport networks, which the authors independently constructed, is applied to obtain the quantity of cargo transport by transportation systems under future international transport infrastructure policies.

3. Examples of results of estimation

As examples of results of estimation, results of trade value predictions by scenario in 21 nations and regions participating in APEC (specific names omitted due to space limitations) are shown in Figure 2, and results of the allotment by international trade models based on trade prediction amounts of the 2015 middle case from among these (including numbers of containers and transshipments handled by major ports, but excluding containers carried by air) are shown in Figure 3.

The final report presents not only results of such future predictions, but the results of changes of future numbers of containers handled depending on whether or not future investment is made in ports and of a simulation of the impacts of detouring when the Strait of Malacca is closed.

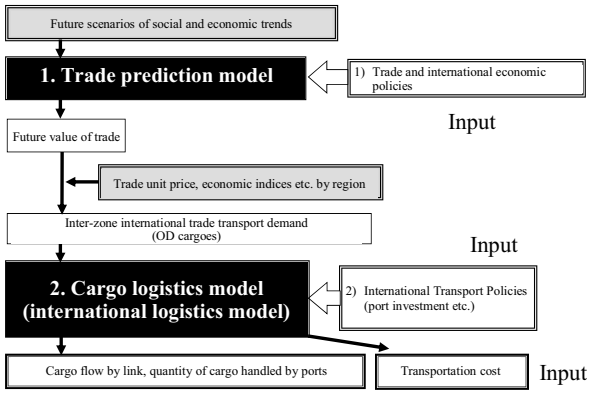

Figure 1. Overall Structure of the Trade and Logistics Prediction System

[Reference documents]
NILIM, MLIT, Japan Impacts of Trade and Transport Policy on International Cargo Shipping and Economic Activities (Final Report), Asia-Pacific Economic Cooperation, Transportation Working Group

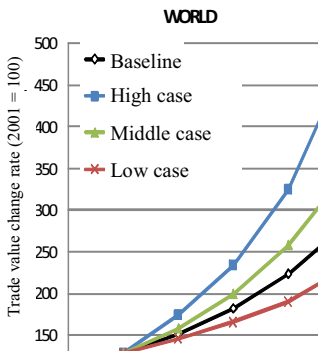

Figure 2. Results of Predictions of Future Trade by Scenario

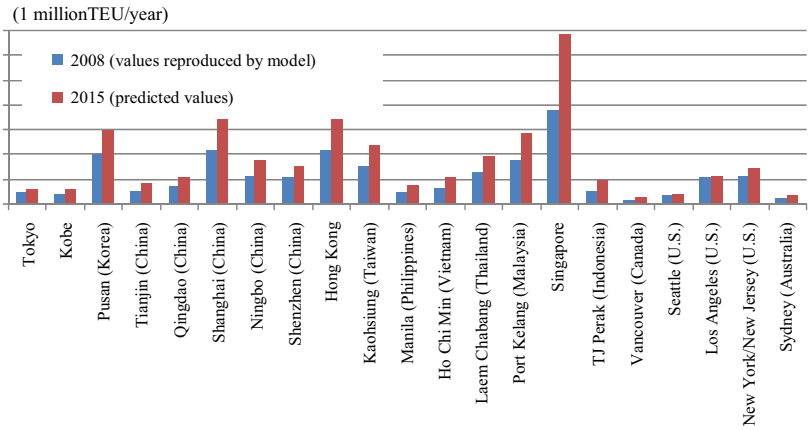

Figure 3. Predicted Quantities of Cargo Handled in Major Ports in the 2015 Middle Case

EMV Payment in Vehicle: New Type of Cashless Payment Using ITS SPOT

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MOTOMIZU Shota, Researcher
MAEDA Takeyori, Guest Researcher
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(Key words) EMV, joint research, ITS

1. Introduction

The NILIM conducted Research on "Systems to Provide Next-Generation Road Services" in March 2006, and has been developing information provision services, an internet connection service, and a payment service. This report introduces an outline of the cashless payment service.

2. EMV Payment in Vehicle

The NILIM promotes the research and development of a cashless payment system called "EMV Payment in Vehicle". It will allow drivers to make cashless payments through ITS SPOTs from within their cars by using an IC credit card in the car's On-Board Equipment (OBE). EMV is an international standard for IC credit card settlements.

Figure 1 shows the system configuration. The system manages vehicles' parking period through ITS Spots installed at both the entrance gate and exit gate of a parking lot, while settlement is done at the exit.

Joint Research on "EMV Payment in Vehicle Using DSRC Communications" was organized to conduct this research by five private companies and the NILIM in November 2009. Each company developed its corresponding devices and interfaces, then the group installed and tested the whole system.

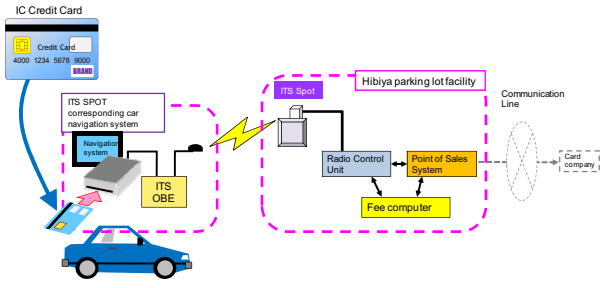

Figure 1. System Configuration

3. Proving test

A proving test was conducted at the Hibiya Parking Lot in Chiyoda Ward, Tokyo, from October 2010 to February 2011. The operation of the system was tested.

The whole system and each device operated as expected, confirming that each device and interface is appropriate in terms of its technical aspects.

Vehicles passed smoothly through the entrance gate, confirming that the entrance gate system is operationally feasible. But it takes longer to pass the exit gate than the entrance gate because the of the long time needed to settle the parking charge . To deploy the system operationally, it is necessary to shorten the settlement time at the exit gate.

Figure 2. View of the Test and Car Navigation Operating Screen

4. Conclusion

The EMV Payment in Vehicle system is expected to reduce traffic congestion on roads caused by vehicles queuing to enter parking lots. It is also expected to contribute to removing barriers to taking parking tickets at entrance gates and paying parking fees at exit gates, especially for elderly and handicapped drivers whose numbers have been recently increasing.

Effects of Cutting Transport Costs by Enlarging Bulk Carriers —Promoting International Strategic Bulk Port Policies—

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Port Planning Division, Part and Harbor Department

(Keywords) Bulk carrier, iron ore, coal, grains, international strategic bulk port

1. Enlarging bulk carriers

Strong demand for resources by China and India and the expanded Panama Canal scheduled to begin service in 2014 are spurring the enlargement of bulk carriers which transport coal, iron ore, grains, etc. Many ultra large bulk carriers capable of transporting from 300,000 to 400,000 tons of iron ore or 90,000 to 120,000 tons of grain or steam coal to power thermal electric generation plants are scheduled to go into service.

Many of the facilities constructed to handle bulk cargoes in Japan's ports were constructed during the period of high speed growth so that because of shallow depth etc., their capacity is now inadequate. For example, comparisons of the allowed draught of berths for ships handling steam coal in Japan and the fully loaded draught of coal carriers (PMX: Panamax (70,000 to 80,000 tons), and NPX (New Panamax (90,000 to 120,000 tons)) are shown in Figure 1, showing clearly that the depth at these berths is insufficient. Korea and Taiwan are transporting steam coal by even larger Capesize (170,000 to 180,000 tons) ships, showing that international gaps in transport efficiency are now extremely wide.

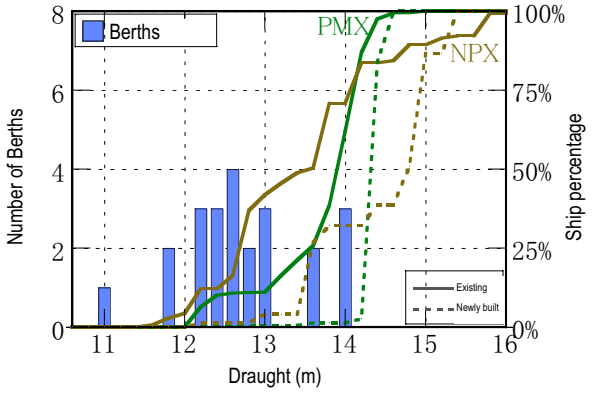

Figure 1. Draught of Steam Coal Berths in Japan and Coal Carriers

2. Clarifying and analyzing the transport cost reduction effects

In order to quantify the cost reduction effects of using ultra large bulk carriers which will enter service in the future, a method of calculating transport costs based on ship costs, fuel costs, and port costs incurred running ships has been established. Figure 2 shows the results of the applying this method to calculate the effects of using ultra large bulk carriers to transport coal. The figure shows the results of the calculation for three cases: Case 0: ships are simply enlarged, Case 1: a new open yard is required in order to increase the quantity of cargo transported each time, and Case 2: feeder transport is necessary because the water depth in the berth in the second port is insufficient. But in all three cases, transport costs fall from the present shipping cost (PMX) as a result of the enlargement of ships (NPX/CPS: Casesize).

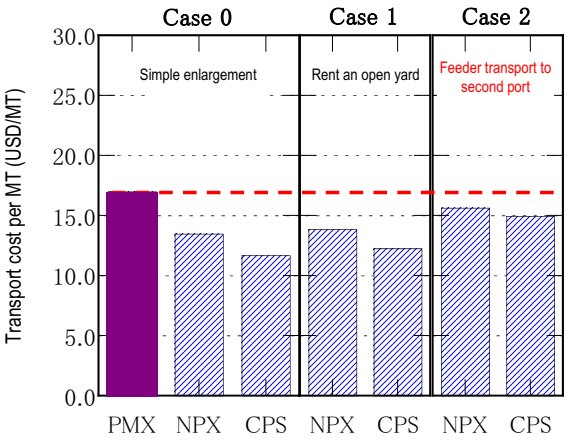

Figure 2. Example of the Results of Cost Calculation by Enlarging Coal Carriers

3. Application of results

The Ports and Harbours Bureau of the Ministry of Land, Infrastructure, Transport and Tourism has formed the International Strategic Bulk Port Study Committee which is conducting deliberations in order to strengthen the international competitiveness of ports which handle bulk cargoes through selection and concentration of development. The results of this research have been prepared as study documents to be

used by the committee for its deliberations.

[Source]
Technical Note of the National Institute for Land and Infrastructure Management, No. 560
Journal of the Japan Society of Civil Engineers: Vol. 66, No. 3, pp. 369-382

Trial of riverine estuary environment classification on first class rivers throughout Japan

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ONUMA Katsuhiro, Senior Researcher
ENDO Maremi, Researcher
River Environment Division, Environment Department

(Key words) Riverine estuary, environment, classification

1. Aims of the research

At river mouths where rivers reach the ocean, riverine estuaries are formed by the mixing of fresh water with salt water. In riverine estuaries, complex physical and chemical phenomena occur as a result of external forces including tides, waves, floods, sediment supply, and addition of pollutants from both the sea and from the river, and the combinations of these external forces produce diverse environmental properties. Living organisms adapted to this environment inhabit these waters.

These complex and diverse riverine estuary environments are often strongly impacted by man-made disruptions, so it is difficult to set goals when planning the conservation of their environments. If riverine estuaries can be classified according to environmental properties, it will be possible to evaluate the environmental impacts of specified man-made changes by selecting and comparing rivers with different degrees of man-made change from among multiple rivers in the same classification. And if we select a river where relatively little man-made change occurs as a reference, it might be possible to set environmental conservation goals for riverine estuaries on rivers in the same class with considerable objectivity. For these motivates, we classified riverine estuaries on rivers nationwide by abstracting natural environment elements presumed to determine the properties of riverine estuary environments.

2. Physical environment classification of riverine estuaries on 109 first class river systems throughout Japan

Riverine estuary environments were classified using the river flow rate, riverbed gradient, tidal range, and wave height, as the physical environmental indices which determine riverine estuary environments. For the concept guiding the selection of indices, we referred to a past report [1]. Riverine estuaries were classified by performing principal component analysis of the above indices, obtaining the principal components and principal component scores, then performing cluster analysis of principal component scores for principal components with an eigenvalue of 1 or more.

Figure 1 shows the distribution of riverine estuaries classified into five classes based on indices values at normal time. It established five classifications: a group where the tidal range is a little large distributed widely on the Pacific Ocean side (Tide Class I), Flow Rate Class I where the river flow rate is a little high distributed widely throughout Japan, Tide Class II where the tidal range is extremely large and which is distributed on part of the Ariake and Seto Inland Seas, Gradient Class where the riverbed gradient is steep distributed on the Hokuriku Tokai coast, and Flow Rate Class II where the gradient is mild and flow rate is high located mainly at large rivers on the Japan Sea side.

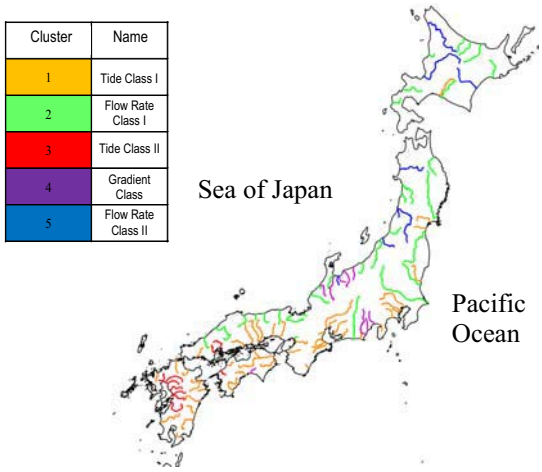

Figure 1. National Distribution of Classification Based on Indices at Normal Time

3. Summary

This classification clearly demonstrated for the first time relationships showing that in tidal type riverine estuaries strongly impacted by the sea, salt-water and brackish water fish species are numerous, and that in flow rate type riverine estuaries strongly impacted by rivers, fresh water fish species are numerous [1]. In the future, we will do further study of environmental classifications and their properties to contribute to the conservation of riverine estuary environments.

[Reference]

1) Kishida, Amano, Onuma, Endo: Riverine estuary classification for the sake of environmental conservation, Journal of Hydraulic Engineering, JSCE, Vol. 55, 2011. (in Japanese with English abstract)

Field Research to Evaluate the Environment of Rivers Downstream from Dams

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HARANO Takashi, Senior Researcher
ENDO Maremi, Researcher
ITO Kanako, Researcher
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(Key words) Dam, environment, field survey

1. Introduction

Little past progress has been made in the evaluation of the impact of dams on the environments of the rivers downstream from the dams, because the impact manifestation mechanisms are complex and the impacts themselves are not easy to abstract.

This research was undertaken to evaluate the impact of a dam on the riverbed of the river downstream from the dam. The impact of a dam on the riverbed downstream from the dam is assumed to be a result of the dam varying the downstream river's flow regime and the change of the flux of materials flowing downstream, typified by the flux of sediment transport, so dam quantities related to these were collected and evaluated at 79 dams nationwide. The riverbed materials (soil forming the riverbed) and the benthic organisms which inhabit this material were selected as the indices used to evaluate the manifest impacts, and a field survey of these was carried out.

2. Survey of dams nationwide and their surrounding rivers

In order to evaluate the quantities of sediment transport at 79 dams selected from all dams managed by the national government throughout Japan, the annual average specific sedimentation was calculated by dividing the annual average dam sedimentation by its drainage basin area, and at the same time, to evaluate the degree that dams change flow regimes, the annual average maximum cut rate was calculated by dividing the annual maximum difference between the dam inflow and discharge by the annual maximum inflow, and using these two indices, the dams were classified (Fig. 1; dams not suitable for the purpose, those constructed separately upstream for example, were omitted.)

In rivers downstream from dams with large specific sedimentation (Group 2), the supply of sediment ought to be sharply reduced. And downstream from dams with small annual average maximum cut rate (Group 1 and 3), the sediment flushing force is not reduced very much. Therefore, it is hypothesized that in rivers downstream from dams in these groups (on the left side of Fig. 1), the riverbed material will be coarser grained or the riverbed will be degraded, and that inversely, in downstream rivers in Group 4 where the flood cut is large, according to circumstances, the riverbed material can be fine-grained.

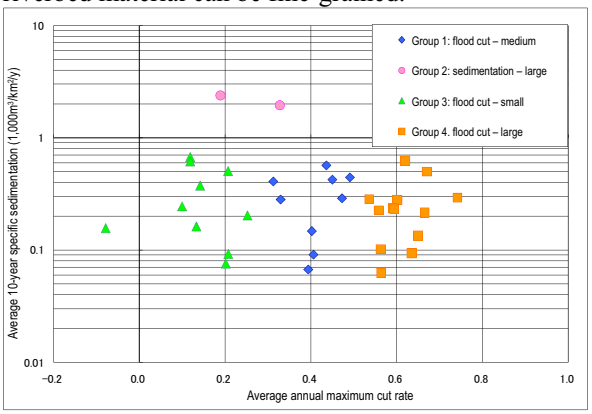

Figure 1. Classification Based on Specific Sedimentation Rate and Peak Cut

A field survey was carried out longitudinally on rivers upstream and downstream from dams. A comparison of the 60% grain size of the riverbed material and the shear stress at the riverbed calculated based on the flow regime and shape of the river channel revealed that in all groups, the 60% grain size was relatively larger just downstream than it was in the river upstream from the dams. This result suggests that just downstream from many dams, the possibility of the riverbed becoming coarse-grained is high.

The examination of results of the survey of benthic organisms has confirmed that in addition to the dams in Groups 1 and 3, where it is assumed there is a strong tendency for the riverbed material of the downstream river to be coarse-grained material, at dams in Group 2, downstream from the dams, species which prefer a stable environment with riverbed material somewhat larger than that upstream are increasing.

3. Summary

In the future, we plan to interpret the data obtained by a quantitative method such as hydraulic analysis to study revealed patterns of the environment impact on rivers downstream from dams according to the properties of the dams and countermeasure methods.

Simple method of investigating CO_2 emissions from vehicles on actual roads

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(Key words) CO_2 emissions, road traffic, road survey

1. Background and purpose of the research

CO_2 emissions by the transportation sector have shown a falling trend in recent years, but account for about 20% of all CO_2 emissions in Japan. To reduce these emissions, it is essential to take an integrated approach applying measures in many areas including improving fuel performance of individual automobiles and using alternative energy, eco-driving, switching to public transportation, smoothing road traffic flow, and transforming the structures of cities.

In order to accurately clarify the effectiveness of these measures, it is necessary to make a detailed assessment of CO_2 emitted from automobiles traveling on actual roads, but because a rational survey method to do so is not fully established, traffic volume and average driving speed data and CO_2 emission coefficients by speed are used to estimate CO_2 emissions from road traffic in specified sections.

Under such circumstances, a method using store-bought fuel gauges to perform simple and detailed surveys of CO_2 emissions by an automobile traveling on an actual road was established.

2. Outline of the simple CO_2 emission survey method using fuel gauges

The fuel gauges used for this survey were connected to the diagnosis use connector in each automobile as shown in Photo 1, permitting the date and time, vehicle speed, engine revolutions, fuel injection time, GPS, and other data stored in the vehicle's ECU to be recorded on a memory card. Based on the data collected by this instrument, the instantaneous fuel consumption per second and CO_2 emissions were estimated.

The instantaneous fuel consumption is proportional to the engine revolutions and fuel injection time. The total fuel consumption, which is the total of the instantaneous fuel consumptions, was corrected using the quantity of actual fuel supplied to each automobile's fuel tank before and after the survey as the positive value. The CO_2 emissions were converted from the quantity of fuel consumption, a technique identical to the method used to calculate the greenhouse effect gas national inventory.

Figure 1 shows an example of survey results. This survey method can clarify behavior of automobile CO_2 emission behavior before and after an intersection. In this case, the CO_2 emissions were high during idling while the vehicle was stopped in front of the intersection and during acceleration after passing through the intersection.

We aim to continue to accumulate results of surveys using various vehicles and under various driving conditions to provide this survey method for general use.

Photo 1. View of Installation of Fuel Gauge in an Automobile
Connected to the diagnosis use connector at the driver's seat to collect vehicle data

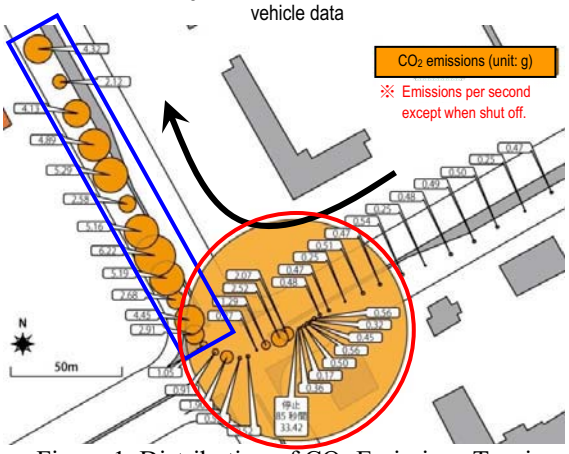

Figure 1. Distribution of CO_2 Emissions Turning Right at an Intersection
CO_2 emissions are large during idling and while accelerating after a right turn

[Sources]
M. Dohi, S. Sone, M. Takimoto: Simple investigation of CO_2 emissions from road traffic and its variation according to differences of road structure, Selected Papers on Environmental Systems Research, vol. 38, 2010

Fully considering the care of the natural environment at the road project concept stage

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(Key words) Environmental impact assessment technology, road project, animals, plants, ecosystem

1. Background and Purpose

Under the recently revised Environmental Impact Assessment Law (refer to, Topics: "Proposed Amendment of Environmental Assessment Law and Response to the SEA (Strategic Environmental Assessment)" for an outline of the revision proposal), the Strategic Environmental Assessment (below, "SEA") which considers care for the environment from the earliest stage before the project begins, is stipulated. SEA was established in response to the insistence that it was needed to prevent loss of the natural environment, and in response to its codification, early concern for the natural environment may attract attention in the future.

From the practical perspective, presumably, there will many restrictions on the study of ways to care for the environment, because it is predicted that at the stage where the location and scale etc. of a project to which SEA will be applied (below, "concept stage") is decided, the project plan will still be in preliminary form, and information concerning the local natural environment will be limited.

This research is intended to establish methods of effectively and efficiently caring for the natural environment at the road project concept stage.

2. Conservation effectiveness according to differences in route and road structure

—For future discussion which must be considered at the road project concept stage—

Road projects, as shown by *Eco-roads* [1] for example, have included bridges, tunnels, and other structures, and initiatives to install facilities allowing animals to cross roads, in order to select routes which are in harmony and compatible with nature and to minimize change to the topography and vegetation. These often permit concrete studies at the stage where road structures are designed. To apply SEA, it is necessary to not only simply speed up the study period, but to also clarify the study range, conduct surveys according to the study stage, and search for effective ways to care for the environment.

In 2010, which was the first year of the project, to prepare for future discussion of "items which must be considered at the concept stage", we conducted a basic case study of the relationship between the effectiveness of conserving the environment and construction costs according to differences in route location and road structures. Five proposals for the road studied were hypothesized (Fig. 1), and existing documents were used to classify the degree to which each one would change vegetation and divide routes traveled by animals. The results have shown that the impact of each would vary according to differences in the location of route several hundred meters in length and selection of the road structure (Table 1), and suggested that it is possible to obtain various measures to care for environment.

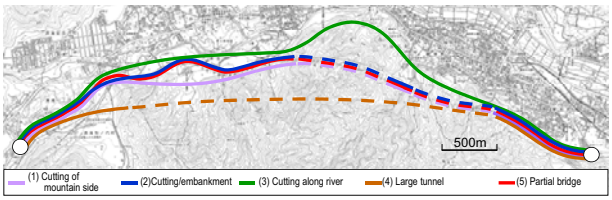

Figure 1. Hypothetical Proposals

Table1. Conservation Effects of each Proposal and Construction Cost

	(1) Cutting of mountain side	(2) Cutting/ embankment	(3) Cutting along river	(4) Large tunnel	(5) Partial bridge
Degree of alteration of existing vegetation	△	○	×		◎
Degree of change of growth of valuable species and their habitat environments	△	○	×		○
Degree of division of routes traveled by animals	○	△	×		◎
Construction cost (rough calculation)	×	○	◎	×	△

Note) ◎, ○, △, × beginning with smallest degree of impact and construction costs.

3. Contents of future studies

The following studies are planned in response to the amendment of the law and trends in later discussions of the amendment of related cabinet orders and ministerial orders.

(1) Clarification of the range of studies under SEA based on past cases

Past cases considering environment are analyzed to classify effective ways to care for environment which should be studied according to the stage of the project.

(2) Collecting information about the natural environment and studying the evaluation method

Effectively implementing SEA depends to a great extent on the quantity and quality of information concerning the natural environment of a region. Survey and research on animals and plants and the advance of IT are accompanied by the provision of various kinds of information, so methods of using SEA in a road project and methods of evaluating conservation effects are studied.

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CO_2 Uptake through Recycling of Concrete Rubbles

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(Key words) Construction byproducts, concrete rubble (demolished and crushed concrete), recycled concrete aggregate, recycling, CO_2 uptake

1. Introduction

The recycling level of concrete rubbles following demolition of civil engineering structures has been kept at about 98 percent in Japan, since the "Construction Material Recycling Law" came into effect. Almost all the concrete rubbles are recycled as aggregates. Recently, some researchers report that CO_2 uptake to concrete structures during their life cycle is not negligible. The process of CO_2 uptake is known as carbonation (or neutralization), the reaction of Ca ions in cement (pH is high) with carbonate ions in the atmosphere. The uptake rate probably becomes higher in a recycling process because the surface area of the cement is increased by the demolition and crushing processes.

The amount of the CO_2 uptake should be subtracted from the amount of CO_2 emissions due to the energy consumption etc. in the calculation of the net CO_2 emission during the recycling process. In the present paper, we introduce our nation-wide investigation to determine the amount of the CO_2 uptake through recycling of concrete rubbles.

2. Mechanism of CO_2 uptake

Limestone is a main raw material of cement, which is decomposed into CaO and CO_2 in the calcination process. During the hydrate process, CaO in cement paste transmutes into $Ca(OH)_2$ which absorbs the atmospheric CO_2. The CO_2 behavior through life cycle of concrete structure can be written as follows. In addition to $Ca(OH)_2$, calcium silicate hydrate (C-S-H) also absorbs CO_2.

(i) Cement manufacturing: $CaCO_3 \rightarrow CaO+CO_2$
(ii) Hydration (concrete mixing): $CaO+H_2O \rightarrow Ca(OH)_2$
(iii) Use (service)-: $Ca(OH)_2+CO_2 \rightarrow CaCO_3+H_2O$

3. Overview of nation-wide investigation

We collected 46 specimens of concrete rubbles around the nation. Each specimen was divided into two parts. The amount of CO_2 was measured immediately for one part (denoting uptake during service period of concrete structures), and after 28-day exposure to the environment for the other. Figure 1 shows the result. The amount of CO_2 in the immediately analyzed specimens was 14kg- CO_2/t on average. That increased to 23 kg- CO_2/t after 28-day exposure. The amount of CO_2 uptake through recycling was about 9kg- CO_2/t on average (minimum: 3, maximum 17), calculated as the increment between 28-day exposures. The smaller the grain size was, the more CO_2 the specimen absorbed. This amount is comparable with the amount emitted to produce the recycled concrete aggregates.

4. Future work

We will determine the amount of CO_2 uptake which should be considered in the calculation of the net CO_2 emission due to manufacturing of recycled concrete aggregates. We will identify the influential factors on the CO_2 uptake to propose easy and effective techniques for increasing the amount of CO_2 uptake.

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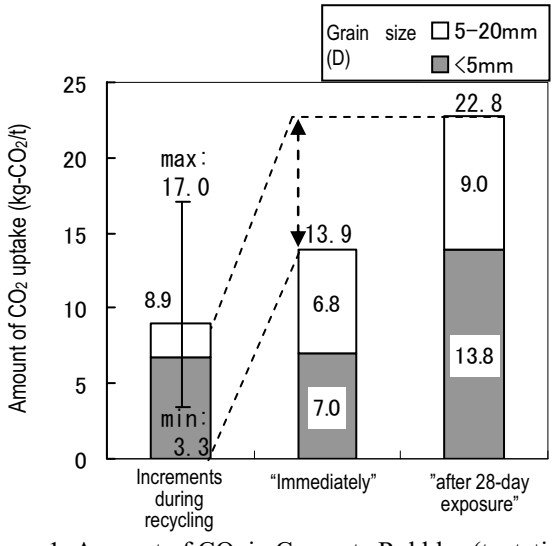

Figure 1. Amount of CO_2 in Concrete Rubbles (tentative)

3) T. Kanda, S. Sone, H. Kishida: *Meeting of The Institute of Life Cycle Assessment* (in Japanese), vol. 6, 2011

Developing environmental load factors for construction materials used in social infrastructure LCA

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(Keywords) Life cycle assessment, environmental load factor, construction materials

1. Background

If we are to introduce life cycle assessment (LCA) into the development of social infrastructure, we will need to establish a method of calculating environmental load arising throughout all processes from the extraction of resources to the manufacture, installation, commissioning, demolition and disposal of materials. Since environmental load is calculated as the volume of a material multiplied by its environmental load factor, we will need to develop environmental load factors covering all construction materials and energies, etc., used when developing social infrastructure.

We have prepared environmental load factors concerning CO_2 emissions and others for both general products and individual products. The aim is that these should enable construction industry operators to compare ordinary products (ordinary construction materials as pre-manufactured products) with individual products (specific products produced by individual factories and companies, special products), and to choose materials with a lower load by introducing LCA to social infrastructure.

2. Developing a list of environmental load factors for ordinary products

We calculated the environmental load factors of ordinary products using a method that combines the summation method with the input-output method. That is, we used the summation method to calculate load factors for "principal construction materials", based on official statistics and others from which physical data can be obtained in categories of specific commodities. For other items, we complemented this with the input-output method. We selected steel, cement, asphalt blend, rubble, and others as elasticity markers for "principal construction materials"[1]. We then calculated their load factors and arranged them in a list (Fig. 1)[2].

By complementing this with the input-output method, we standardized system parameters (the range for calculating environmental load) into a range based on domestic economic activity. This enabled us to calculate load factors for different materials under the same conditions. For principal construction materials, meanwhile, load factors can easily be updated by inputting the latest aggregated data.

3. Method of creating environmental load factors for individual products

We calculate environmental load factors for individual products using the summation method, which aggregates environmental load in individual manufacturing processes. To do this, we need to set a method of distributing system parameters and environmental loads common to materials. For principal construction materials, we studied and set system parameter and environmental load distribution methods, together with academics and professional experts in the field of materials and the environment (Fig. 2)[3].

Also, since the summation method involves an element of discretion in setting system parameters, for loads other than those subject to aggregated calculation, we made it possible to compare them with ordinary products by adding sector input-output tables and headings as "Estimates of unaggregated values".

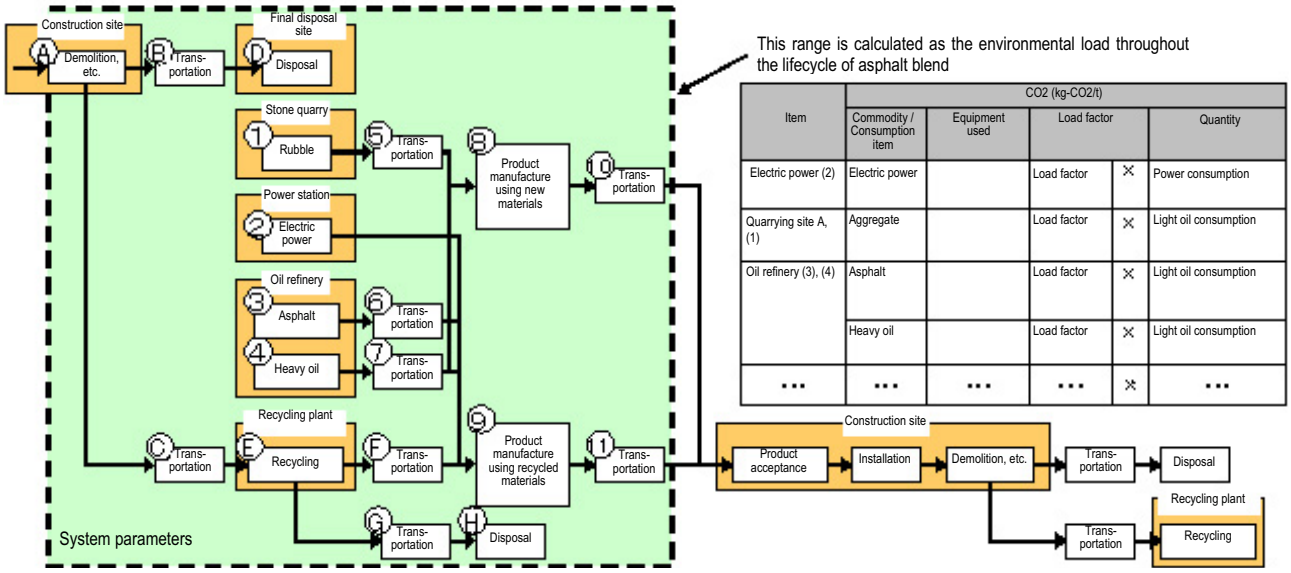
Name of commodity	Unit	CO_2 emissions load factor			
		Total	Production	Shipment	Fuel used
Freshly mixed concrete, ordinary	m3				
Freshly mixed concrete, early strength	m3				
Freshly mixed concrete, blast furnace	m3				
Concrete products	t				
Asphalt blend or mixture	t				
Recycled asphalt blend or mixture	t				
Rubble	t				
Recycled rubble	t				

Fig. 1 Example of commodities on an ordinary product environmental load factor list

Name of commodity	Unit	CO_2 emissions load factor			
		Total	Production	Shipment	Fuel used
Light oil	m3				
Blast furnace slag	m3				
Steel plate	m3				
Steel sheet pile	t				
Portland cement, ordinary	t				
Portland cement, early strength	t				
Blast furnace cement	t				
Fly ash cement	t				

Fig. 2 Example of system parameters

• System parameters of asphalt blend



Item	CO2 (kg-CO2/t)				
	Commodity / Consumption item	Equipment used	Load factor		Quantity
Electric power (2)	Electric power		Load factor	×	Power consumption
Quarrying site A, (1)	Aggregate		Load factor	×	Light oil consumption
Oil refinery (3), (4)	Asphalt		Load factor	×	Light oil consumption
	Heavy oil		Load factor	×	Light oil consumption
・・・	・・・	・・・	・・・	×	・・・

4. Publication of results

The environmental load factors of construction materials used in social infrastructure will first be examined and verified by academic experts in the fields of materials and the environment, in a committee set up within the Japan Society of Civil Engineers. They will then be compiled into a Comprehensive Technical Development Project Report.

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Noise by Vehicle Type

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(Key words) Road traffic noise, hybrid vehicle, low-pollution vehicle

1. Purpose

Various supplementary noise abatement measures have been taken in the past, according to the following documents and trends, (1) to (4), the spread of automobiles with little or no engine noise can be counted on to reduce noise. (1) The number of hybrid vehicles is soaring(Fig. 1), and (2) the noise inside highway busses is about 5dB lower than that of normal public busses[2]. (3) The noise reduction which would result from the conversion of all automobiles to low noise vehicles is estimated at about 6dB[3]. (4) The operation of fuel-cell powered busses (Photo 1) is another example. This report presents the results of measurements of quantity of sound generated by low-pollution cars etc. during test runs (dense asphalt concrete pavement) at the test track in NILIM

2. Measurement results

Coasting passenger cars and electric vehicles produced noise approximately 5dB below that of an ordinary passenger car measured on a public road[4] (Fig. 2). And a medium size low-pollution heavy vehicle produced about 5dB less than ordinary medium heavy vehicles measured on a public road[4] (Fig. 3).

3. The future

We presume that clarifying the reasons for these 5dB differences would contribute to further lowering of noise. On the other hand, over 10 years have passed since the measurements which obtained data representing quantities of noise produced by vehicle type used to predict noise (heavy vehicles, medium heavy vehicles, small trucks, passenger car). The results of confirmation of their appropriateness will be reported in the future.

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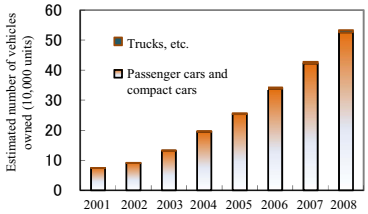

Figure 1. Number of Hybrid Automobiles Owned (in Japan)[1]

Photo 1. Fuel Cell Powered Bus
(Haneda Airport Limousine Bus)

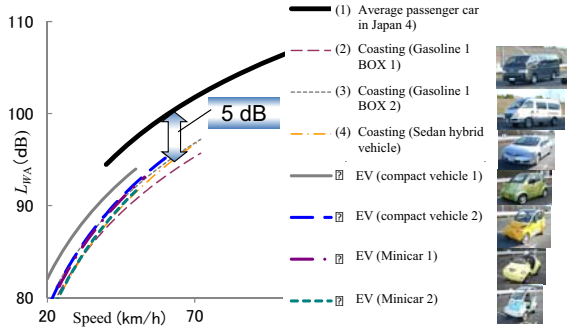

Figure 2. Results of Measurements During Steady Running of Passenger Cars

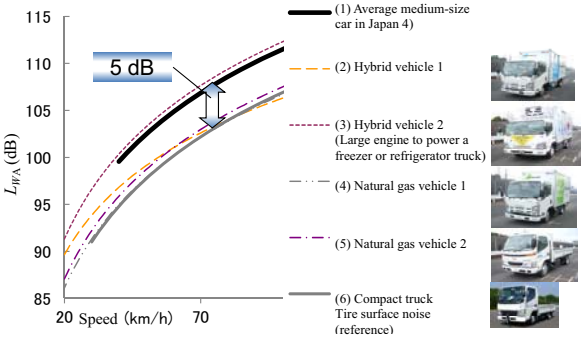

Figure 3. Results of Measurements During Steady Running of Medium heavy vehicles

Links with overseas research institutes regarding conservation of the Northwest Pacific marine environment

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(Key words) Ocean environment, pollution load, simulation, sewerage system

1. Introduction

In countries near Japan, rapid population growth and industrial growth seen in recent years have not been accompanied by adequate development of their sewage systems and other infrastructures, resulting in an increasingly serious problem of water pollution in major rivers and Northwest Pacific. The Wastewater System Division has studied methods of conserving the future marine environment in Northwest Pacific (Bohai Sea, Yellow Sea, East China Sea, Japan Sea), and in particular, has attempted to clarify the pollutant load runoff reduction effects of providing sewerage systems in neighboring countries. And because we often cannot obtain overseas data or documents inside Japan in sufficient quantities for our survey, we have undertaken survey research in cooperation with researchers in the concerned countries (Japan, China, Korea, Russia).

2. Contents of recent surveys and challenges

In order to clarify the future effectiveness of measures to reduce pollutant loads in Northwest Pacific achieved as a result of the construction of sewerage systems in neighboring countries, the Wastewater System Division built a simulation model of the runoff of pollutant loads from watersheds in concerned countries and set future economic growth (increasing pollutant loads) scenarios and sewerage system installation scenarios (reducing pollutant loads), verifying the effectiveness of pollutant loads reduction measures. We also built a hydrodynamic and water quality model, and entering the results of calculations by a pollutant load model, used it to perform flow and water quality model calculations, clarifying the way that the pollutant load (COD, T-N, T-P) behaves on the surface of Northwest Pacific (Fig. 1).

On the other hand, it was extremely difficult to collect water quality data from each country in order to perform the above simulation calculations. We think that in the future, as one challenge to be overcome to take marine environment conservation measures in Northwest pacific, it will be vital that each country continues sustained monitoring of water quality in major rivers and in Northwest pacific.

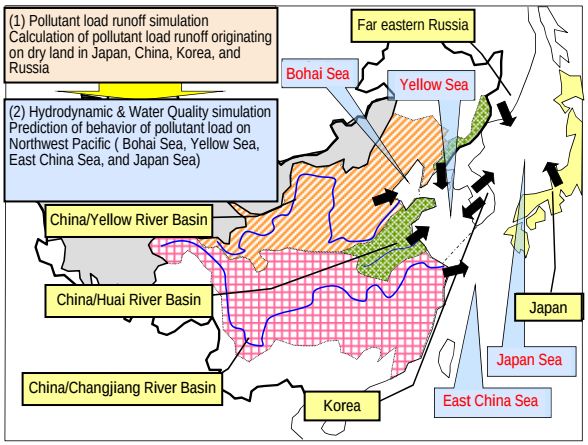

Figure 1. Outline of Contents of Surveys in Previous Years

Figure 2. The International Conference with Overseas Researchers and Signing the Agreement

3. Future links with overseas research institutes

In February 2011, we held an international meeting for researchers invited to Tokyo from Japan, China, Korea, and Russia, countries which had already been cooperating with our survey research (Fig. 2 left). At the conference venue, reports were given on the results of the past surveys, confirming the importance of continuing relationships with research institutes and sharing water quality monitoring data possessed by each country. At the same time, the participants signed an agreement stating that researchers from Japan, China, Korea, and Russia would share water quality monitoring data for major rivers in the various countries and for Northwest Pacific (Fig. 2 – right). In the future, based on the knowledge already obtained, we will continue to collect information concerning pollutant unit load etc. and water quality monitoring data from each country, and also actively provide such

information to them.
http://www.nilim.go.jp/lab/ebg/
(Wastewater System Division)

Study on light environments in LCCM housing and lighting energy reduction effects

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(Keywords) LCCM housing, daylighting, artificial lighting

1. Introduction

LCCM housing ("Life Cycle Carbon Minus" housing) has been proposed as "housing that creates a negative ("minus") CO_2 balance throughout its long lifetime, including CO_2 emissions during construction, by striving to reduce CO_2 as much as possible during construction, use and demolition, and by creating renewable energy using solar panels and the like" [1)]. To study this LCCM housing, a joint research organization called "Research on Zero Energy Housing" has been established under an initiative by the Building Research Institute, and the National Institute for Land and Infrastructure Management is taking part in this. The author has compiled a report on light environments in this housing as well as its lighting energy reduction effects, and gives a brief outline of the content here.

2. Study on the light environment of LCCM housing

When studying the light environments of LCCM housing, the author first proposed a concept[2)] based on knowledge of light environments obtained from low energy housing with validated efficiency (a type of energy-saving housing), among others, then enlisted the collaboration of academic and professional experts in simulating daylight lighting and lighting designers for artificial lighting. Bearing in mind that daylighting could conversely cause an increase in lighting consumption, since the introduction of daylight causes glare or the room interior is felt to be dark in contrast to the brightness around the windows, we used the highly precise daylight environment simulation software "Radiance" in our study. We mainly studied the impact of south-opening louvers at different time and seasons, and taking account of the daylighting simulation results, compared the results to the initially drafted plan and incorporated them in later versions of the plan (Fig. 1). As for artificial lighting, the study was based on the rationale of distributed multiple-light arrangement harnessing the characteristics of LEDs, i.e. compactness and long life[2)]. We obtained a working brightness in accordance with specific domestic activity by using distributed light, even if the average luminosity was low, and planned balanced lighting with less contrast and no sense of discomfort.

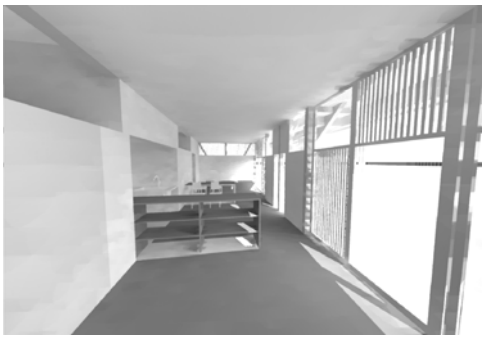

Fig. 1 Daylighting simulation example

3. Study on the lighting energy reduction effect of LCCM housing

The total energy consumption by artificial lighting in LCCM housing was around 480W, and the annual lighting power consumption was around 530kWh (primary energy consumption around 5.1GJ). Bearing in mind that, with LED, CO_2 emissions when in use account for almost the whole of the life cycle, it should be possible to reduce environmental load while adequately forming light environments including lighting effects.

4. Conclusion

A demonstration version of LCCM housing reflecting the results of this study will be built inside the Building Research Institute. It will be completed in February 2011, and after completion, verification trials reproducing the living conditions of residents will be held. In future, we plan to measure artificial lighting consumption volumes and take actual measurements of light environments.

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Use of ITS technology to implement traffic smoothing measures at expressway sags

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(Key words) Sag, traffic congestion, ACC (adaptive cruise control), traffic simulator

1. Introduction

The National Institute for Land and Infrastructure Management has conducted research to develop a vehicle lane utilization rate optimization service based on the use if ITS SPOT etc. to provide information. Considering linkages between in-car systems such as ACC (Adaptive Cruise Control), which controls distance between vehicles, and services which provide information from roadside systems, the NILIM is performing research to develop a service to mitigate congestion at sags (places where the gradient changes gently from descending to ascending). In FY2010, it built a micro-traffic simulator capable of reproducing the impact on traffic flow of the introduction of these services on a computer, and trial calculated the congestion mitigation effectiveness of including vehicles equipped with the vehicle lane utilization rate optimization service or ACC in the traffic flow.

2. Vehicle lane utilization rate optimization service

The vehicle lane utilization rate optimization service provides information to drivers in three stages in order to correct imbalanced use of passing lanes resulting from heavy traffic approaching the location of congestion. Just in advance of a sag, a “change-lane request message” urges drivers to change from the passing lane to the nearside lane, then near the bottom of the sag, a “keep lane request message” urges drivers to stay in the lane they are using, and finally, a “service end message” informs drivers that they are leaving the service section.

3. Expectations of congestion mitigation at sags by connecting with vehicle control technology

Recent dazzling progress in vehicle control technologies has brought ACC and many other such technologies into practical use. This use of ACC, which has a function which maintains vehicle speed and the distance between vehicles at constant values, is counted on to mitigate congestion by restricting drivers’ unintentional deceleration, which is one cause of congestion at sags.

4. Construction of a micro-traffic simulator to trial calculate congestion mitigation effects

Data (traffic volume, cruising speed by vehicle lane and lane change behavior etc.) obtained from instruments installed in the past at the Yamato Sag on the Tomei Expressway (outbound) was used to construct a micro-traffic simulator capable of reproducing traffic flow before and after the occurrence of congestion at the Yamato Sag (outbound) and before and after the elimination of this congestion. When the system was built, in order to that it could simulate the vehicle lane utilization rate optimization service, parameters at two stages—service awareness rate (percentage of drivers who noticed the information provision) and the acceptability (percentage of the drivers who noticed the information provision who also responded to it)—were considered. The system could also simulate vehicle passing behavior, lane changing behavior, speed reduction characteristic of vehicles in sags, and ACC vehicle behavior.

5. Trial calculation of congestion mitigation effectiveness

The simulator which was built was used to trial calculate the congestion mitigation effects of the following services. As a result of these trial calculations, their usefulness as traffic smoothing measures were summarized during FY2010.

1) Congestion mitigation effects of the vehicle lane utilization rate optimization service
2) Congestion mitigation effects of mixing in ACC vehicles
3) Congestion mitigation effects of considering the vehicle lane utilization rate optimization service and mixing in ACC vehicles

[Sources]
Intelligent Transport System Division web site: Services to realize AHS/aiming to mitigate congestion at sags and tunnels
http://www.nilim.go.jp/japanese/its/0frame/under/02ahs/index_02_05.htm

Enacting the Handbook for Measures to Prevent Typhoon Damage to Planted Trees in Cities

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(Key words) Planted trees in cities, typhoon damage, tree planting method, maintenance, Okinawa

1. Introduction

Planted trees in cities, beside roads and in parks for example, are damaged, even falling over, under the impact of powerful wind during typhoons. In addition to damaging surrounding structures or blocking traffic, they can even injure people.

So in order to mitigate typhoon damage to trees planted in cities, we have taken Okinawa, which is struck by more typhoons than other parts of Japan, as an example to perform a fact-finding survey of typhoon damage to clarify the causes of this damage, and based on the results, establish tree planting methods to nurture trees highly resistance to typhoon damage.

2. Outline of the Handbook for Measures to Prevent Typhoon Damage

This handbook consists of the following four chapters

(1) Factors causing typhoon damage

Typhoon damage is broadly categorized as fallen trees, bent trees, broken trunks, and broken branches, and the causes of these types of damage are ① typhoon exceeding a specific scale (Fig. 1), ② selection of species unsuited for conditions at the location, ③ insufficient planting base, ④ low quality planting, and ⑤ low quality maintenance

(2) Basic typhoon damage prevention measures

In order to mitigate typhoon damage to trees planted in cities, it is important to correctly plan, design, and execute the tree planting. Specifically, it is necessary to give full consideration to ① selecting species, ② layout, ③ providing the planting base (Fig. 2), and ④ installing support columns.

(3) Measures taken when a typhoon arrives

Before a typhoon arrives, a tree management system is quickly established, the soundness of the trees confirmed, and preventive measures taken at trees which are vulnerable to damage (pruning, installing a wind blocking net, etc.). When a typhoon arrives, emergency measures are taken to deal with damaged trees (cutting down and removing, etc.), and after the typhoon has passed, full-scale measures to deal with damaged trees (standing the trees or replacing the support columns, etc.) are taken and the causes of the damage are clarified.

(4) Daily maintenance

In order to nurture highly typhoon resistant trees planted in cities, it is important to regularly check the soundness of trees, and to do so, necessary to ① perform daily inspections ~~and~~ (,) ② soundness surveys and ③ appropriately manage all trees.

3. Announcement of the results

The results are explained based on trees and the tree planting environment of Okinawa, but the basic typhoon damage prevention measures can be applied in all regions of Japan, so the results have been

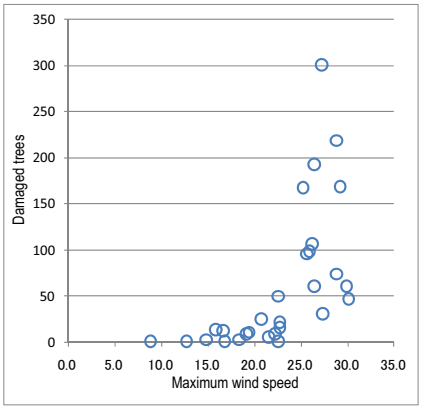

Figure 1. Maximum Wind Speed and Number of Damaged Trees

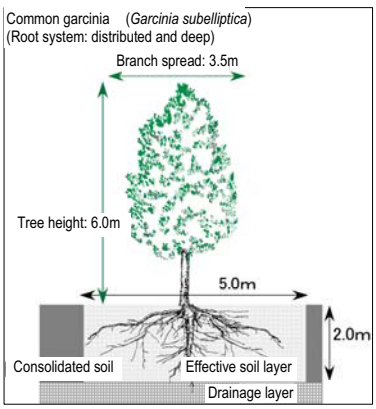

Figure 2. Example of Provision of the Tree Planting Base

published as Technical Note of NILIM No. 621.

We look forward to this handbook being used as a basic document to be applied to improve tree planting technologies in Okinawa and throughout Japan, contributing to the conservation of rich green living environments.

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

Preparation of a Manual of Road Crossing Structures for Wild Animals (Draft)

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(Key words) Road crossing structure, biodiversity, road kill

1. Need for road crossings for wild animals

The construction of a road directly and indirectly impacts the ecosystems where the road is built. Direct impacts of road construction include automobiles running over wild animals (road kill)[1)], loss or division of wild animal habitat environments, and decline of the quality of the ecosystem. Road kill not only impacts the wild animals, it is reported that in some cases, collisions with animals have injured drivers or other people. Under these circumstances, road crossings for wild animals are effective compensation measures which mitigate the impact of dividing habitats of wild animals, and also an effective way to prevent injuries to humans involved in road kill incidents.

2. Road Crossing Installation Manual (Draft)

Technical Methods for Evaluating Road Environment Impact[2)] is used to study environmental conservation measures with reference to Scientific Knowledge and Similar Cases, to install road crossings for wild animals.

The Landscape and Ecology Division of the Environment Department of the National Institute for Land and Infrastructure Management corroborated the effects of installing road crossings by organizing cases of measures taken to deal with the division of habitats of wild animals and by conducting a monitoring survey from 2007 to 2009. It also performed a fact finding survey of the use of road crossings by wild animals for a three year period to prepare the Road Crossing Installation Manual (Draft) based on scientific knowledge. This manual provides a comprehensive corroboration of the usefulness of road crossings and organizes the process of work done to install and maintain road crossings based on knowledge obtained from past surveys and other existing knowledge. An outline of the structure of the manual is shown in Figure 1.

The manual summarizes the basic concepts and reference cases applied to study every step from planning and design to maintenance and management of road crossings and their auxiliary structures provided for use by wild mammals on new and existing roads, and at the same time, presents a detailed explanation of monitoring methods using infrared cameras as a road crossing post-survey method.

The manual will be used by persons in charge of road projects of regional development bureaus and regional governments after it is published as an NILIM report, and it will be revised in response to the opinions of its users so it is easier to apply in the field.

[References]
1) N. Fujiwara, Y. Kaneko, Y. Iizuka (2004): Research on methods of providing ecological corridors for medium to small size wild mammals, Report by the Landscape and Ecology Division of the National Institute for Land and Infrastructure Management, 147, 55-118
2) Highway Environment Research Institute (2007): Technical methods for evaluating road environment impact, Vol. 3, p. 423

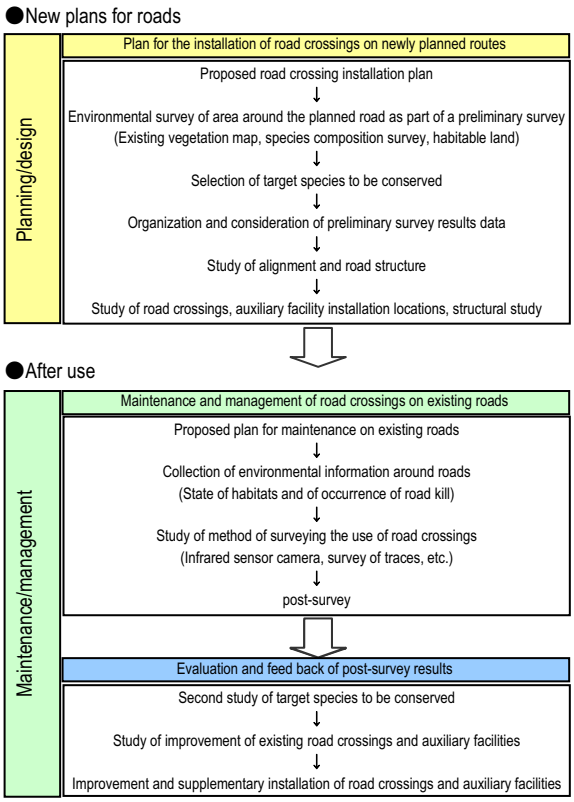

Figure 1. Road Crossing Structure Installation Planning Flow Chart

Designated invasive alien species, lanceleaf coreopsis (*Coreopsis lanceolata*) removal and control manual

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(Key words) Designated invasive alien species, lanceleaf coreopsis (*Coreopsis lanceolata), removal*

1. Background to the preparation of the manual

Lanceleaf coreopsis (*Coreopsis lanceolata)* was designated an invasive alien species in February 2006, placing restrictions on its cultivation, storage, transport, import, etc., and requiring that it be exterminated whenever considered necessary. Attempts are being made to exterminate it from rivers and roads with the cooperation of residents, but lanceleaf coreopsis (Photo 1), a perennial herb of the composite family originating in North America, is extremely fertile. Many seeds are fructified and fall to the ground where large numbers of the seeds sprout. It is plant with a powerful constitution; any which survive control activities quickly recover. For these reasons, the effects of control efforts are insufficient.

Very little research on lanceleaf coreopsis has been done in Japan, so it is necessary to collect more information to develop effective methods of controlling it.

Since 2006, three methods, uprooting, cutting, and topsoil removal, have been used for a vegetation control experiment in Kasada Park at the government operated Kisosansen Park Center, verifying the control method and its effectiveness. The Removal and Control Manual was prepared based on knowledge obtained as a result of this experiment.

2. Outline of the Lanceleaf Coreopsis Removal and Control Manual

To consider a control method, it is necessary to set achievable goals based on a clear understanding of present circumstances. To do so, it is important to decide what kinds of vegetation to aim for after exterminating the lanceleaf coreopsis. After this goal has been set, a management method adapted to achieve it is selected and implemented at the site. Then it is important to clarify effectiveness through monitoring, and when it is impossible to confirm sufficient effectiveness, the goal and method must be revised.

Figure 1 is the removal and control flow chart. The manual presents the goal setting concept, management method and its effectiveness, method of selecting the control method according to the goal, method of performing the management work, and implementation precautions. As stated above, lanceleaf coreopsis possesses powerful resilience, requiring years of continued control until it is completely exterminated. And measures are necessary to prevent it from returning after it has been removed. The manual is counted on to support measures to defeat the lanceleaf coreopsis in the field.

Photo 1. Flowering lanceleaf coreopsis (top) and fallen seeds (bottom)

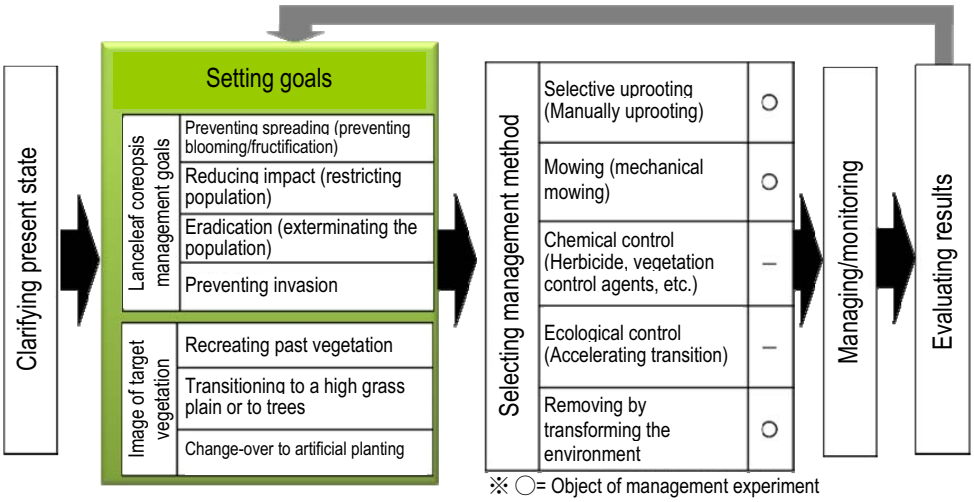

Figure 1. Setting Lanceleaf Coreopsis Management Goals and Management Methods

TOPICS

Trends in Considering Integrated Countermeasures to Automobile Exhaust Gas in the Future

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(Key words) Automobile exhaust gas, exhaust gas regulations, total NOx emissions

The Automobile Exhaust Gas Comprehensive Measures Subcommittee of the Atmospheric Environment Committee of the Central Environmental Council (below, "CEC") is revising and considering the Automobile NOx/PM Law and basic policy to reduce them. Its interim report released in January 2011 presents appropriate revisions of goals and policies to support the use of priority measure districts and support the further use of low-polluting automobiles to ensure environmental standards in all countermeasure regions by 2020. The CEC will continue to study the overall systems. But it is predicted that when changes of the automobile total NOx emissions are organized according to the CEC report and the results of surveys by the Ministry of the Environment, the level will be sharply reduced to about 30% of the 2010 level by 2020, and to about 20% by 2030. These reductions are presumed to be a result of the strengthening of exhaust gas regulations and the spreading use of automobiles in compliance with stricter exhaust gas regulations.

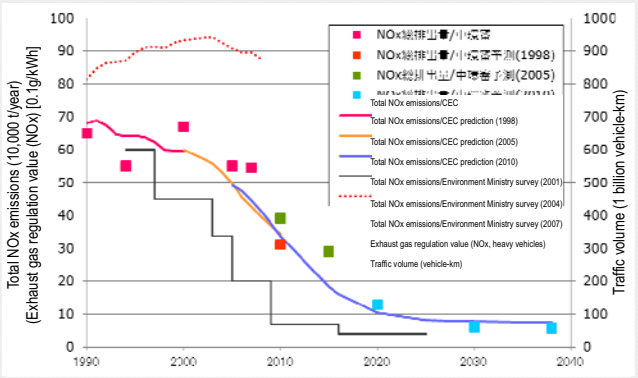

Figure Predicted Future Change of Total NOx Emissions etc. from Automobiles

Prepared using data from Future Effective Automobile Exhaust Gas Reduction Measures, second, third, eighth, ninth, and tenth reports by the Automobile Exhaust Gas Experts Subcommittee, Atmospheric Environment Committee, Central Environmental Council, the survey reports, Survey of Automobile Exhaust Gas Basic Units and Total Emissions (2001) and Automobile Exhaust Gas Basic Unit and Total Emission Calculation and Study Survey (2004, 2007) of the Ministry of the Environment, and Annual Statistical Report on Automobile Transportation of the Ministry of Land, Infrastructure, Transport and Tourism.

Source: CEC: Future Comprehensive Automobile Exhaust Gas Measures (Interim Report), CEC web site, January 2011

TOPICS

Proposed Amendment of Environmental Assessment Law and Response to the SEA (Strategic Environmental Assessment)

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(Key words) Environmental Impact Assessment Law, Strategic Environmental Assessment (SEA), concept stage PI, post-survey

1. Proposed amendment of the Environmental Impact Assessment Law

The Environmental Impact Assessment Law came into force (June 1999) over 10 years ago, and under Supplementary Provision Article 7, its revision has been discussed, and the results submitted by the Central Environmental Council (February 2010). The proposed amendment of the law is still under consideration in the Diet (as of February 2011), but the following are the points of revision requiring new actions. (Fig. 1)

① Legalization of the Strategic Environmental Assessments (SEA)
② Preparation and public release of post survey reports
③ Electronic inspection of Environmental impact statements etc.
④ Holding explanatory meetings for scoping documents

Of these, ② post-survey reports are intended to reflect assessment results in projects, while ③ electronic inspection and ④ meetings to explain scoping documents are intended to encourage understanding by residents. A detailed explanation of ① SEA follows.

2. Implementation of SEA during the concept stage PI and related challenges

SEA, which is a study of the protection of the environment performed at a stage earlier than the Environmental Impact Assessment (EIA) already performed at the project implementation stage, is reflected in the project plan.

Road development and other public projects are already taking actions equivalent to SEA at the public involvement (PI) phase of the stage when the approximate location and scale of the project are decided (concept stage). Through the concept stage PI, it is important to comprehensively make judgments from the environmental, social, economic, and various other perspectives, and to flexibly communicate smoothly with the residents and other concerned parties.

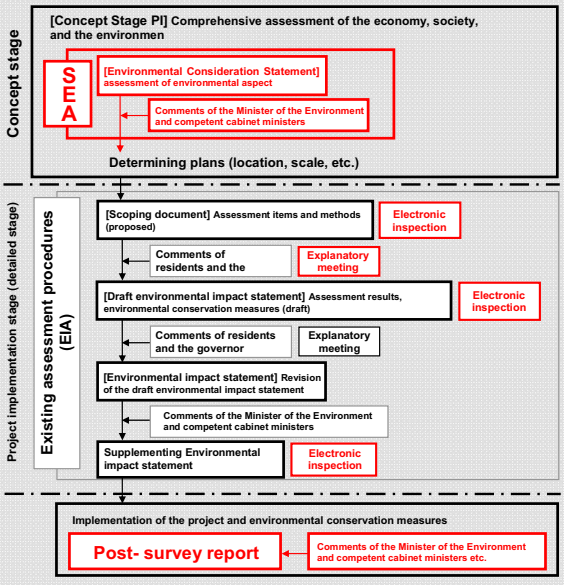

Figure 1. Flow Chart After Revision of the Environmental Impact Assessment Law (New steps shown in red)

Based on actual status of the above public projects, SEA under the proposed revision of the law is only an evaluation of the environmental aspect without comprehensive judgments, and establishes an obligation limited to procedures less sweeping than those of an EIA (preparation of an Environmental Consideration Statement, etc.). But the following questions remain to be answered in order to implement SEA under the law at the concept stage PI.

(1) PI processes vary from project to project, so in which process will the SEA procedure be implemented?

(2) PI remains an optional process, so how can standing out of the environmental aspect by legally prescribed SEA be avoided?

(3) What is the specific method of preparing the Environmental Consideration Statement?

(4) Considering that the need for SEA was argued partly to conserve biodiversity, how is the protection of the natural environment considered at the concept stage?

(See Research Trends and Results, Fully considering the care of the natural environment at the road project concept stage)

3. Future schedule

Following the enactment of the Revised Environmental Impact Assessment Law, technical guidelines applying to all categories of projects (basic guidelines) will be issued after one year, technical guidelines by project category (by competent cabinet ministers) will be issued after one year and a half, and the revised law will come into full force after two years. The NILIM intends to study the challenges referred to above and to revise “Technical Methods for Road Environment Impact Assessment” (see below).

http://www.nilim.go.jp/lab/dcg/introduction/kadai5/kadai5.htm

Application of Probe Data to the Evaluation of Traffic Smoothness

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(Key words) Probe data, traffic smoothing, lost time

1. Application to the front line of policy planning

(1) Preparing a common nationwide traffic smoothing evaluation index

The Ministry of Land, Infrastructure, Transport and Tourism has announced the results of a trial calculation of total lost time nationwide performed at the 12th session of the Road Subcommittee (August 3, 2010) of the Panel on Infrastructure Development (Fig. 1).

This trial calculation was performed applying a lost time calculation method using probe data (driving record data) obtained by ordinary automobiles which is the object of research by the NILIM.

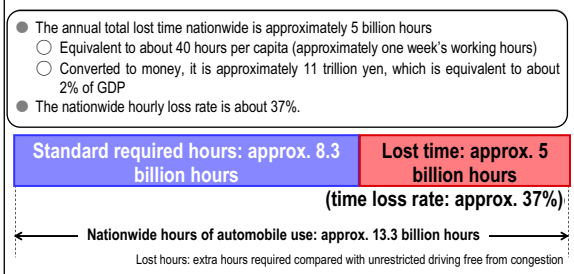

Figure 1. Results of Trial Calculation of Total Lost Time Nationwide

(2) Clarifying the results of implementing measures nationwide

Research findings obtained from the Public Test of Toll-free Operation of Expressways in 2010 have been used to clarify the traffic smoothing effects of wide-area change of the traffic flow (Fig. 2).

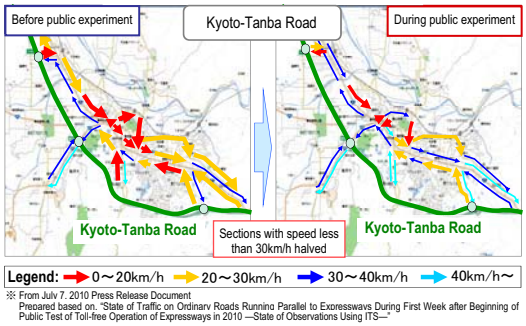

Figure 2. Example of Application to a Public Test of Toll-Free Operation of Expressways

2. Application to the front line of project implementation

(1) Diagnosis of state of congestion before and after a new road begins service

Figure 3 shows the temporal and spatial distribution of traveling speed on National Highway No. 1 (section with length of about 17km), which runs parallel to the Daini-Keihin Expressway (from the Hirakata-Higashi IC to the Kadoma Junction) which was prepared using probe data obtained on this section of National Highway No. 1 during two periods of about 1 month before and 1 month after this section of the Daini-Keihin Expressway opened for service on March 20, 2010.

The distribution before the start of service has shown that (1) taking the bottleneck intersection as the start point of congestion, (2) congestion occurs from after 6:00 a.m. to 7:00 p.m. and (3) the longest congestion occurs after 6:00 p.m.

The distribution after the start of service has shown that almost all the congestion which occurred before the start of service ended after service started, improving traffic smoothness.

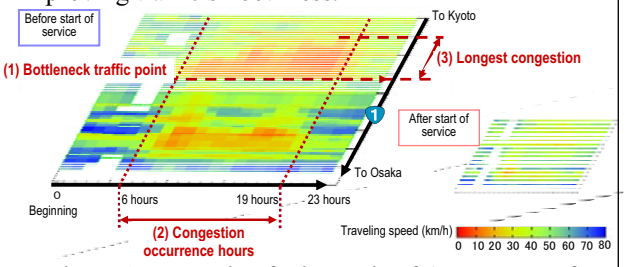

Figure 3. Example of Diagnosis of Occurrence of Traffic Congestion

3. Application to the front line of technical policy research

The NILIM is using probe data not only to support the work cited above, but also for technical policy research from the medium-term perspective, such as research and development on time reliability evaluation methods to achieve the final goal of calculating convenience in order to evaluate projects (Fig. 4).

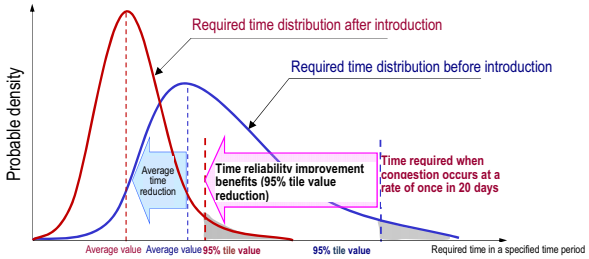

Figure 4. Image of Time Reliability Improvement Benefits

(Traffic Engineering Division) HP: http://www.nilim.go.jp/lab/gbg/index.htm】

Major disaster surveys

1. Field survey of damage to the Sugawa Bridge on Route 246 due to Typhoon 9

The Sugawa Bridge (steel deck arch bridge) on Route 246 spanning the Sugawa River is located in Shizuoka Prefecture. Due to Typhoon 9 on September 8, 2010, the supporting soils around the bridge were eroded and collapsed as retaining walls were washed away. The Bridge and Structures Division conducted a field survey to provide technical support for the evaluation of the structural safety of the bridge and the study of emergency measures. Results found no damage to the superstructure, but confirmed the collapse of the ground around the foundation, which is important for safety of the overall bridge, and the existence of an unconsolidated sediment layer on the exposed surface. They indicated that it requires priority implementation of measures such as natural ground stability work based on protection of the surface of the collapse and embankment construction, and erosion prevention measures to deal with future rainfall and increases in the river level.

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Major International Conferences

1. 26th US-Japan Bridge Engineering Workshop and the 14th MLIT/FHWA Bridge Engineering Meeting (US: September 20 to 22, 2010)

The US-Japan Bridge Engineering Workshop and the MLIT/FHWA Bridge Engineering Meeting are held annually, alternately by the U.S. and by Japan, (held in New Orleans, United States, at this time), as an activity of Working Committee G (traffic systems) established under the US-Japan Panel on Wind and Seismic Effects , making up the United States-Japan Cooperative Program in Natural Resources (UJNR).

At this workshop, , participants presented papers concerning performance evaluations of bridges, seismic retrofitting, accelerated construction, and maintenance and inspections (15 by Japanese delegates and 20 by American delegates), and discussed and exchanged views concerning the papers.

The MLIT/FHWA intergovernmental conference is a meeting with the US Federal Highway Administration concerning bridge structures, which is a cooperation theme under the US–Japan Agreement on Cooperation in Research and Development in Science and Technology. At the 14th meeting, the participants exchanged views concerning data which should be obtained by bridge inspections to rationalize and optimize maintenance systems and methods of using these data, and based on experience of the Chili earthquake which occurred in February, the impact of long duration earthquake motion and the behavior of skewed bridges and curved bridges during earthquakes. They also confirmed that both sides would carry out continued exchanges of information and surveyresearch in the future.

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NAKASU Keita, Senior Researcher
Bridge and Structures Division, Road Department

Major International Conferences

1. 6th Japan-Sweden Workshop on Road Science and Technology

The 6th Japan-Sweden Workshop on Road Science and Technology was held at the National Institute for Land and Infrastructure Management (NILIM) in October 2010. This Workshop was the sixth in a series held approximately every two years under an agreement between the NILIM and the Swedish Transport Administration. The first was held in December 2000. At technical sessions held on October 6 and 7, the participants discussed ITS, tunnel technology, winter road maintenance, and traffic safety. On October 8, a technical tour was held, giving participants the opportunity to experience a mobility support system using pedestrian space network data and visit the Ohashi Junction.

KANEKO Masahiro, Head
Advanced Road Design and Safety Division, Road Bureau

Major International Conferences

1. **The 3rd International Conference on Transport and Logistics (3rd T-LOG)**

This conference, attended mainly by researchers and administrators in the field of international and urban logistics mainly from Asia and including Japan, was held in the Nishijin Plaza at the University of Kyushu in Fukuoka City from September 6 to 8, 2010. At the general session, reports on advanced research and reports on the most recent state of logistics infrastructures were presented under the themes: logistics policies and statistics, model development and predictions, logistics in developing countries, inter-modal transportation, environment and risk, ITS, and supply chain management, etc. From the NILIM, members of the Port and Harbor Department and the Road Department gave a total of seven presentations as well as helping prepare for the conference by serving as members and as head of the preparatory committee. The next conference will be held in Korea in 2012.
Conference website: http://www.t-log.info/3rd-Tlog/index.html

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