Civil Engineering, JSCE 2003

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Overseas Expansion of the Japanese Construction Technology

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Overview of Overseas Activities of the Japanese Construction Industry

The Japanese construction market is steadily declining after reaching 83 trillion yen in FY 1996 and in FY 2000 was 70 trillion yen. Many would like to hope for expanding foreign market share but foreign orders for the Japanese construction industry reached a peak of 1.6 trillion yen in FY 1996 and after the Asian financial crisis and other influences declined to 0.73 trillion yen in FY 1999. In FY 2000, large projects such as the land reclamation works in Singapore and the high-speed rail in Taiwan contributed to figures of 1 trillion yen (Figure 1). Of this, ODA (Official Development Assistance) accounts for 11% (Figure 2). The foreign market is a tough environment for the Japanese construction industry considering the fact that the Asian construction market, accounting for around 70% of all foreign orders for the Japanese construction industry, is still recovering and highly cost-competitive construction companies are being fostered in China, Korea, and other Asian countries.

For civil engineering consultants, the domestic market is said to amount to around 1 trillion yen but after foreign orders exceeded 60 billion yen in FY 1994 the amount was around 65 billion yen for several recent years and reached 72.2 billion yen in FY 2000. Looking at the source of revenue, ODA accounts for 94% and this trend is relatively stable year after year. The Japan Bank for International Cooperation (JBIC) accounts for 46%, the Japan International Cooperation Agency (JICA) accounts for 33%, and international organizations such as the World Bank and the Asian Development Bank account for 6%.

For ODA, there is an international trend that doesn't give great importance to large-scale infrastructure development and for construction works and civil engineering consulting, there are growing pressures to untie the procurement of services to all countries. Also, domestically, budgetary constraints call for the reduction of ODA budgets.

Overseas Expansion Strategy for Construction Technology

Japan's construction industry is characterized by superb technology without sufficient international competitiveness. Not only are personnel costs higher than other countries but construction works are also structurally high cost. Also, when Japanese technical experts go overseas, not only are there language difficulties but the work culture is different so it makes them less effective and when engineers that are successful overseas return to Japan, they have a hard time adjusting back to the Japanese way of business. These difficulties make it hard to effectively mobilize human resources. Foreign orders for Japan's construction industry are limited to 8.9% (as of FY 1999) for the top 10 companies (Figure 3).

Domestically, cost reduction is being required and considering the fact that more competitiveness will be demanded in the future, we are coming to a point where we need to review the domestic way of doing business. This is not advocate the blind

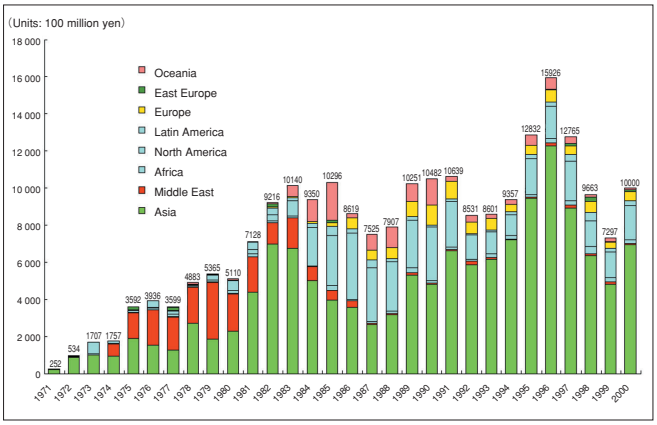

Figure-1: Levels of successful foreign bids (1971-2000) Source: OCAJI

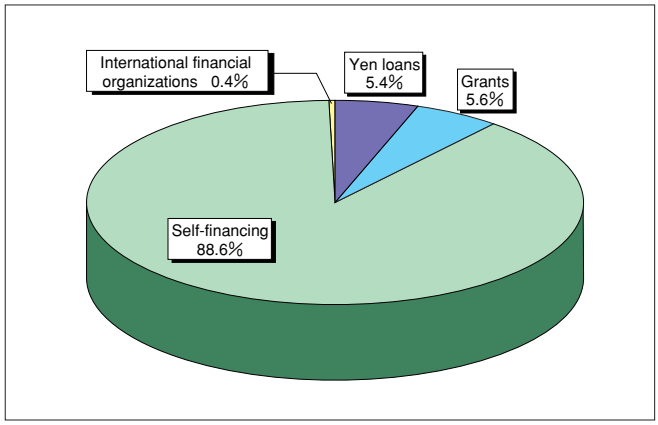

Figure-2: FY 2000 foreign construction bids (Source of funding and overall share)
Source: OCAJI

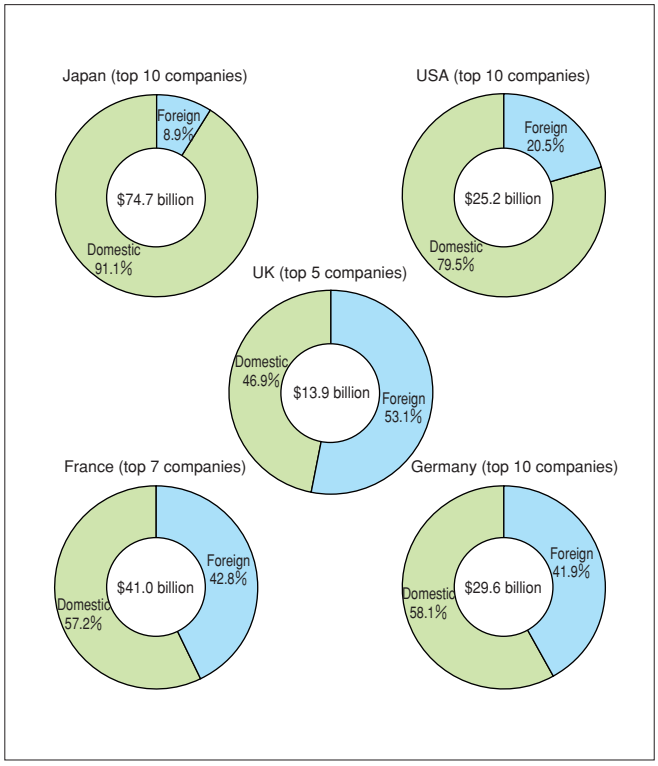

Figure-3: The proportion of international revenue for major corporations in Japan, USA, UK, France and Germany

Source:ENR,Engineering News-Record,August 14,2000.

adoption of western work practices in their entirety but there is a need to incorporate the best areas and combine them with the best from Japanese practices to create an optimal way of doing things.

Like the general consumer looking to build their own home, the behavior of the customer to procure the best at the cheapest is what reinforces the implementation of market principles. The issue is to greatly deregulate relevant accounting and procurement rules for the project owner to fulfill their responsibility to "procure the best quality at the lowest prices with respect to all fairness." Under such a market environment, it will be important for various companies to clarify business strategies and strengthen competitiveness.

Domestically, civil engineering consultants are usually positioned as assistants to the usual project owner but for the future it will be necessary to clarify its role as specialists that can manage the entire project against project owners without an adequate framework for a certain value. The fostering of human resources that can effectively utilize technical expertise on an international scale is a major issue. Not only will the international activity of civil engineering consultants play an important role in reflecting Japanese technological standards in international specifications or formulate good projects but will contribute to the expansion of international cooperation overall, including construction projects.

True internationalization not only involves the voracious absorption of good foreign practices but also the exporting of Japan's strengths, not just the blind acceptance of western standards but for Japan to collectively contribute to the creation of global standards.

For international standards such as the ISO 9000 series and ISO 14000 for quality and environment are completely western standards. There are many occasions where international standards that differ from Japanese practices are adopted for such aspects as design guidelines or material testing methods. Efforts are needed for Japan to internationally disseminate information on Japanese technology, actively create international standards, or work to reflect Japanese opinions when revising current standards. There are still no established standards for project management systems, a method that manage the aspects such as quality, cost, time, and risk. By using the initiative to reflect Japanese methods in international standards, efficient implementation methods should be promoted.

For the creation of the APEC engineer, an international standard that offers the opportunity for engineers to carry out wide international activities, Japan displayed great initiative along with Australia. The APEC engineer will one day become an international engineer. When that day comes, the qualifications that incorporate Japanese input will spread internationally.

Western methods are also the mainstream for bidding contract methods as well, but the good aspects of Japanese methods need to be promoted. Many of the countries such as the United States have trouble with frequent claims and defective construction because the open tendering is based only on cost. It is a typical problem for one shot business practice of a hunter-type contract society. Farming people create a society over trust that is fostered across many years and doing a good job makes it easier to get the next. The accumulation of past performance and evaluations are given great importance. Generally, Japanese companies have high bidding prices but carry out work within the agreed budget and deadline while doing quality work. When some international companies successfully get orders, even though the bid is low, they cut corners or make legal claims for budget overruns resulting in a high price for low quality work in many cases. In the west, a partnering method to reduce disputes between the project owner and tendering companies is being debated. The best of Japanese practices should be exported overseas and reflected in international standards.

In Japan, there are many cases where the national government,

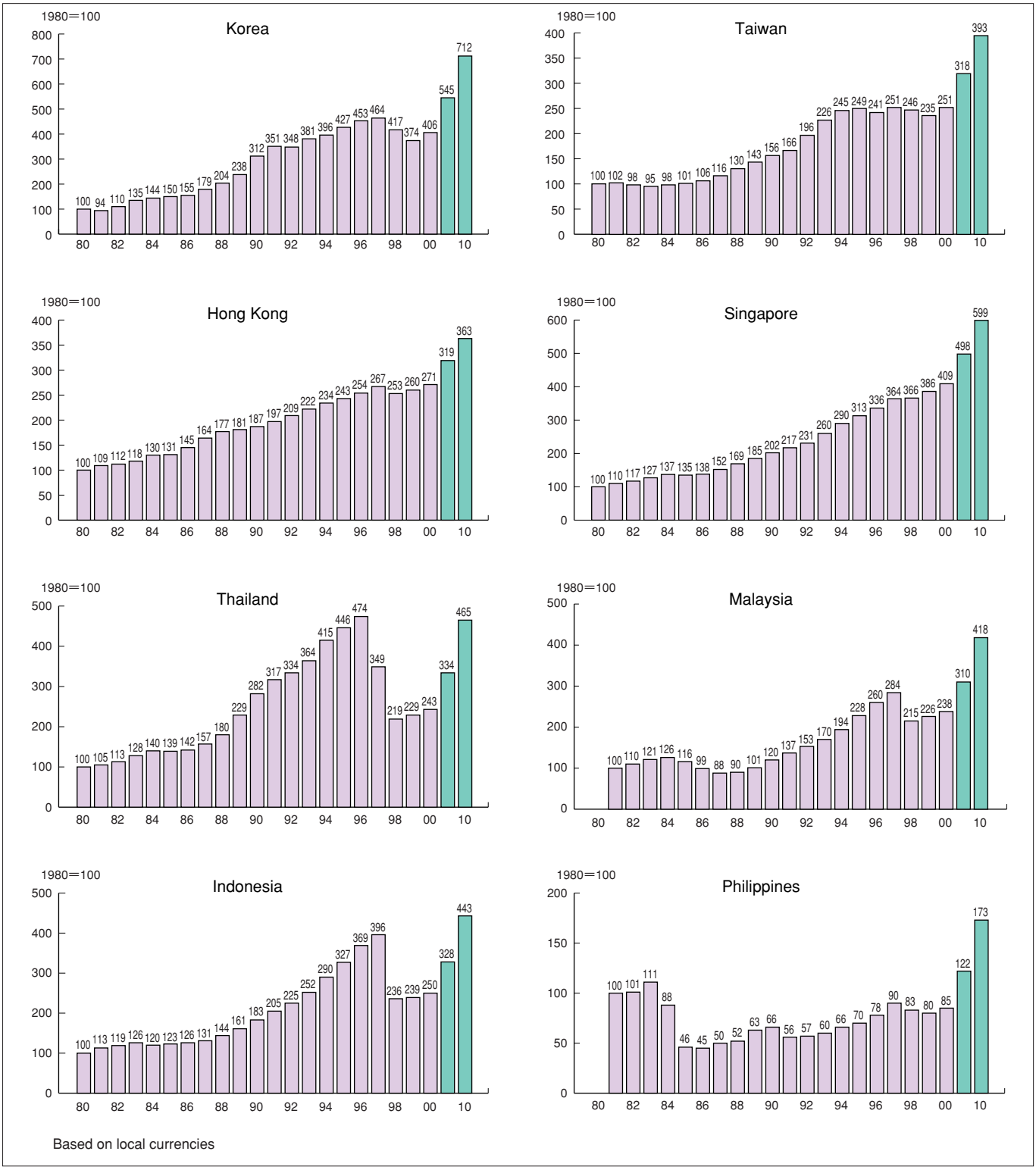

Figure-4: Trends in construction market scale based on growth rates in the Asia-Pacific Region

Source: CEIC database

public sector corporations, and local authorities own the expertise for planning such as the planning of projects and the creation of plans; and the management technology for public facilities such as the administration of roads and rivers; and the maintenance and management of sewerage and water supply as well as airports. It is necessary to effectively utilize such Japanese technology abroad from planning to maintenance and management.

Construction Projects by ODA

It is important to enhance the strategic quality Japanese ODA such as using it as an instrument of diplomacy among other things. Also, poverty eradication measures are frequently called for but for any given region to escape poverty on its own initiative, we need to emphasize the importance of infrastructure development to achieve this.

In infrastructure agencies such as the Ministry of Land, Infrastructure and Transport of Japan, it is important to

heighten the strategic value of infrastructure development. Knowledge needs to be vigorously promoted such as what kind of highway networks will contribute to regional development or how disasters can be reduced and water demand met through the placement of dams and water management. Yen loans, grants, and technical assistance needs to be promoted strategically with this in mind. It is important for infrastructure development specialists to get involved from the planning stages of a project to formulate them and in the examination for the approval of yen loans, the strategic points of infrastructure development need to be considered in addition to standard bank assessments as well as the point of national interest regarding whether the technology of the Japanese construction industry can be utilized. Also, it will be necessary for attaches in Japanese diplomatic missions abroad that specialize in infrastructure and JICA experts to step up their support of Japanese companies.

Infrastructure development is not just building but transferring technology, building capacity, and even leaving a cultural legacy. Such forms of "aids with a human face" will garner respect for Japan and appreciatively remain in the hearts of people.

Future Developments

Japan is making the transition from an era of new construction to one of maintenance, but developing countries including those in Asia are still in an era of new construction (Figure 4). Japan owns technology that is unprecedented in the world such as the great bridges connecting the mainland with other islands, large-scale tunnels such as the Seikan and Kan-etsu tunnels, underground shield tunnels and underground rivers in large cities, large-scale dams, high-rise buildings and earthquake resistance technology. The national government, public sector corporations and others in the public sector possess superior management and operation technology. The maintenance and development of such technologies through international contributions will not only provide benefits to the world but to Japan as well.

Audits for Government Development Assistance

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Overview of Accounting Audit Reports for Official Development Assistance

The Board of Audit of Japan is a constitutional organization independent from the Cabinet Office and its responsibilities include the auditing of national revenue accounts as well as account audits as proscribed by law and administer accounting, caution appropriateness, and promote improvements through the constant implementation of this and create audit reports that are submitted to the Diet through the Cabinet Office. The Ministry of Foreign Affairs (MOFA), the Japan Bank for International Cooperation (JBIC--formerly Overseas Economic Cooperation Fund of Japan before September 30, 1999), and the Japan International Cooperation Agency (JICA) are all organizations subject to audits and audits are carried out on the implementation and accounting of Official Development Assistance (ODA) carried out by these organizations and the results of these audits are reported. Accounting audit reports not only provide a confirmation of accounting but includes categories for budgetary violations and other transgressions, opinions as well as a call for improvement among other guidance. In addition to this, there is a category for the "auditing conditions regarding specific accounting subjects." This category includes auditing reports on various topics regarding issues of grate interest to the national citizens. ODA auditing results are included in this category.

Audit Methods

Creating Auditing Plans

Board of Audit of Japan stipulates the general policy for accounting audits. The general policy for audits in 2000 was to emphasize audits for certain policy areas with Japan's socioeconomic trends and budgetary conditions in mind. One of these was "economic and other cooperation in accordance with internationalization" and auditing was necessary from the point of whether such assistance was attaining objectives and if it was effective or not. In accordance with this basic policy, categories that required special emphasis was set by the implementing sections to create an appropriate auditing plan to carry out the audit efficiently and effectively.

Scope of Audits and Methods

The Board of Audit of Japan, audits were implemented against the cooperation implementation agencies including the MOFA, JBIC, and JICA as well as in diplomatic missions, JBIC's local offices, and JICA's overseas offices for locations abroad.

On the other hand, at developing countries receiving the assistance (recipient countries), there is no authority for the Board of Audit of Japan to audit these governments unlike Japanese official aid agencies. However, since the aid is to support the initiative of recipient countries, audits exclusively against Japanese agencies are inadequate to assess whether such aid is sufficiently effective or if projects are going as planned.

For this reason, the Board of Audit of Japan dispatched study missions to recipient countries with the presence of staff from the international cooperation agencies within the limits of cooperation offered from recipient countries.

Under these conditions, in projects that accepted the need for surveys, interviews were conducted with the recipient country's supervisor of project implementation as well as confirm the project site conditions. Also, for paperwork maintained by recipient countries needed for the survey, such materials were obtained through international cooperation agencies within the limits of cooperation offered by recipient countries.

The Focus of Audits

At the Board of Audit of Japan the appropriateness of implementation and accounting for grants, yen loans, project-based technical cooperation and other categories were audited in addition audits to assess whether such assistance proved effective in improving the economic development and social welfare of the recipient countries as well as examining whether the systematic framework or methods of assistance could be improved. The specifics of such audits toward Japan's international cooperation agencies and study missions abroad are listed separately as follows.

Audits of Japan's International Cooperation Agencies

1) Does Japan's international cooperation agencies adequately assess whether the projects are suitable to the actual conditions of recipient countries in preliminary surveys and assessments?
2) Does the assistance follow exchanged official documents, yen loan contracts and other documents as well as if the provision of funds follows relevant laws and budgets among other matters?
3) Does Japan's international cooperation agencies appropriately assess the progress of the overall project including the cooperation project and take appropriate measures to ensure that the effects of the cooperation are realized as early as possible?
4) Does Japan's international cooperation agencies appropriately assess, evaluate and provide for additional measures for the overall project's progress in accordance with needs?

Study Missions in Recipient Countries

1) Is the project going smoothly and as planned?
2) If assistance projects are closely related to other development projects are there adequate provisions to adjust any setbacks involving related projects?
3) Are the facilities, equipment and transferred technology provided through assistance being adequately utilized?
4) Is the project achieving expected goals and proving effective?
5) Is the project being adequately management by the recipient country after the implementation of assistance?

Audit Results

At the Board of Audit of Japan, after implementing audits along the above points and methods noted cases where the assistance is not providing adequate results in the auditing report. Some of these cases are illustrated below.

Water Supply Development Project

This case involves the assistance to a recipient country to provide necessary materials for the implementation of construction, but due to design changes the construction did not progress and the facilities provided for through assistance were not used and did not prove adequately effective.

This project was for the construction of water intake and purification facilities to improve the conditions for living water as well as creation of a water supply network. The digging of wells, the construction of water intake pumps and the procurement of piping for water distribution networks and equipment such as water meters were obtained through aid and the construction of water supply piping was to be carried out with funds from the recipient country.

Figure-1: Comparison of planned and actual water supply volume and supplied population

Category	Planned	Realized	Ratio of Attainment
Supply Volume (m3/day)	18,132	990	5.5%
Supplied Population	109,200	11,000	10.1%

According to the dispatched survey team, since the recipient country changed the design for the water supply pipe works, a shortage occurred for a specific diameter pipes and the implementation of pipe laying was halted and the water supply pipes were unable to reach the very end of various households. In addition, since the development of water supply will require fees for water services, some of the residents against paying user fees refuse to use the water supply system. From this condition, only a handful of water intake pumps for wells are being used and the water supply volume as well as the water supply population is greatly under the planned volumes as shown in Figure 1.

For this case, the above situation is mainly due to domestic conditions of the recipient country, but it was also noted that the Japanese international cooperation organization in charge should make efforts to make sure that the aid is proving effective by providing necessary advice so that the facilities constructed with aid will realize its potential effectiveness.

Irrigation Project

In this case, the recipient country's project is mostly complete but since the project implemented with aid is not completed, the irrigation project is not implemented and is not realizing its desired effect.

This project involves the construction of a dam with a holding capacity of 5 million m3 and a 28km long arterial waterway for the purpose of increasing agricultural productivity and also develop a 4,960 ha plot of farmland. The dam and arterial waterway was to be constructed with aid while the creation of farmland was to be created with the recipient country's funds.

According to the study mission, tendering for the construction of the dam and arterial waterway that was to receive aid funding was interrupted due to a change in administration and the contractor was changed due to a lack of project implementation for the project, creating a great delay for the construction. So, since the aid-funded facilities were still not completed the created farmland was without an accompanying irrigation project.

Figure-2: Comparison of passenger and other figures before and after the project

Category	Before Project	After Project
Passengers (people)	Around 1 million	Around 580,000
Number of trains (per day)	4	4
Travel Time (hours)	(Regular) 15	(Regular) 11
	(Express) 10	Not running
Freight transport (t/year)	6.3	No longer handling

On this matter, the above situation was mainly due to circumstances but an opinion was noted that measures such as providing further timely and appropriate advice as necessary to prevent such discrepancies for the overall aid-funded project including the domestic projects of the recipient countries.

Vitalization Project for the South Line of National Railways

This case involves the lack of maintenance and repairs following the implementation of an aid-funded project negating any expected improvements in transport capacity.

This project involved the reconstruction of rail and bridges and the procurement of railcars and railcar parts to enable the existing railway to conduct high-speed and reliable operations. For this project, the rail track in bad condition was improved and the travel time of rail was shortened and the number of trains increased to enhance the capacity of total passengers and freight volume. However, after beginning the rehabilitation of the rail track the price of construction materials and personnel costs shot up, creating a great increase in overhead costs, making it impossible to implement the project in its entirety. Therefore, for the areas that could not be helped with the planned aid, funds from other aid organizations were used to complete the project.

According to the study mission, there was a lack of funds for the recipient country's national railways and an insufficiency of regular maintenance and repair activities for the railcars and other areas.

For this matter, the above situation was mainly due to the domestic affairs of the recipient country but it was noted that the Japanese international cooperation organization should appropriately assess the usage conditions of the facilities and other areas subject to aid funding to mitigate any factors in the way of the project realizing its full capabilities.

Figure-3: Comparison of freight handling volumes and revenue growth before and after project implementation

Category	Before Project	After Project
Freight Handling Volume (TEU)	106,000	1,687,000
Revenue (million Rupees)	454	2,778

There are other cases where aid is not effective aside from the above that are noted in the accounting audit report. On the other hand, the auditing results for ODA indicate that the effectiveness of aid is being realized and projects are progressing well and these are noted in the report as well. Below is one such example.

Port Development and Port Expansion Project

These projects aim to procure foreign currency through the provision of port services and to contribute to the development of domestic industry; a container berth was constructed and necessary cargo handling machinery was also installed as well. Of these projects, the construction of the container berth and the procumbent of the cargo handling machinery was to be carried out with aid.

According to the study mission, the handling volume of container freight is as noted in Figure 3 below and the numbers exceeded the planned volume of 1.606 million TEU. Also, the revenues of the Port Authority from the increase in the container freight handling volume of the recipient country are as shown in Figure 3 and is contributing to the procurement of foreign currency. For this case, the project supported by aid was constructed and developed in a timely and appropriate manner and the management and operations by the recipient country was appropriate and from what was observed at the project site, it was noted that Japan's assistance was adequately effective.

Watershed /Urban Regeneration in Accord With Nature

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Ministry of land, Infrastructure and Transportation

As National Strategy for Scientific Technology

The scientific technology development policy of the nation was debated at the Council for Science and Technology Policy (Chaired by the Prime Minister and part of the Cabinet Office). Here the prioritization of the strategic importance of the 8 additional areas including 1) life science, 2) information technology, 3) environment, 4) nano-technology and materials were established as sectors of importance and also 5) energy, 6) manufacturing industry, 7) social infrastructure, and 8) frontiers.

For "Environment," one of the 4 priority sectors, 3 research programs under the coordination of various government agencies cutting across many sectors were started for "global warming research," "zero waste-type resource recycling technology research," and "technology research for nature coexistent basin areas and urban regeneration." Also after this "technology research of integrated risk management for chemical substances" and "research of global water cycle changes" were added for 5 priority research projects.

The "technology research for nature coexistent basin areas and urban regeneration" includes the national land management of basin areas including urban areas and is an intensive research and development initiative and is closely related to the infrastructure development sector. Below I will detail the background of this initiative, the contents and thoughts on this undertaking.

The Concept of Basin Areas and Urban Areas

Around 25 years from now when economic growth was vigorous, the "3rd Comprehensive National Development Plan (3CNDP-1977)" was adopted. The 3CNDP was a "post-island overhaul" plan and the theme was making the transition from high economic growth to stable economic growth as well as the concept of garden cities and habitation areas. Habitation area concepts focused on river systems ad was a so-called river basin area concept.

The river basin area concept was aimed to counter cowboy development and high economic growth. However, the continued economic development and general development as well as the development of infrastructure such as transport and information networks limited the implementation of this concept to areas in select regions such as the Yahagi river basin in the midland region and the Gokase river upstream area in Miyazaki Prefecture.

In the 4CNDP (1987) the theme was to establish a dispersed national land to respond to more advanced urbanization and agglomeration to Tokyo but there was no discussion on river basin areas.

In the 5CNDP the bubble burst and the era was one of declining population levels and it was no longer a comprehensive development plan but a plan was created and called the "grand design of national land (1997). The grand design served as a plan for the management and administration of national land and in addition to the concept of participation and coordination, the renovation of large cities, living with diverse nature, and creating a regional coordination axis, the river basin area concept was once again promoted.

The Past Age and Coming Age

Let us look at national land and living as well as the changes of river basin areas and cities over a long period of time. Figure 1 shows changes in Japan's population over a 1000-year span of time. Looking at the past 400 years that formed an age of urbanization, at the beginning of the Edo Period, the

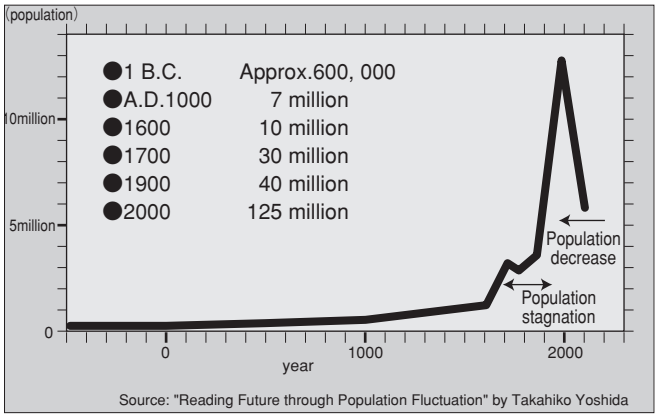

Figure -1: Japan's population part one: On a 1000-year time scale

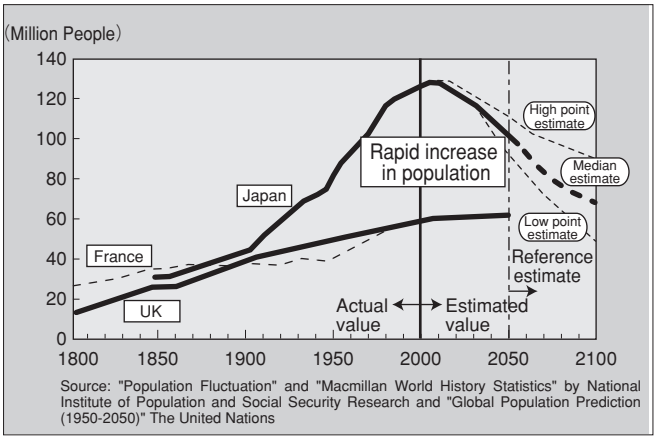

Figure-2: Japan's population part two: On a 100-year time scale

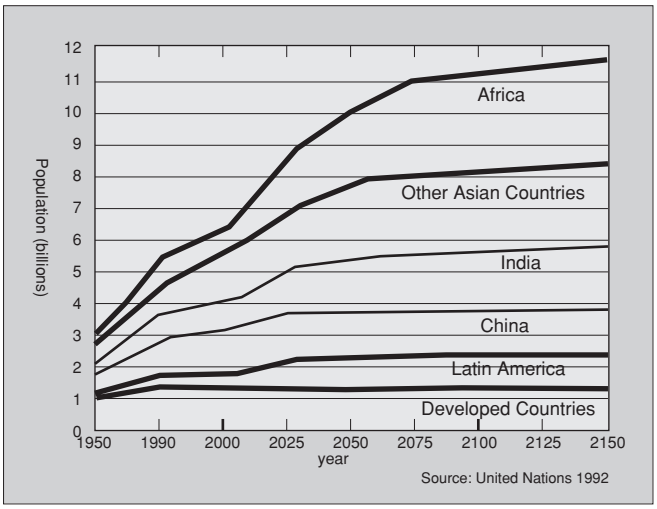

Figure-3: The world population

population went from around 10 million people to roughly 30 million (roughly 3 times in the 1600s). For the following 200 years, the population fluctuated at the 30 million level for the whole Edo Period and in the Meiji Period (around 130 years before). After the Meiji Period, the population exploded and roughly 100 years ago the population was around 40 million and currently it is roughly 3 times that (roughly 4 times the early Meiji Period) or under 130 million. Also, most of the increased population settled on plains such as flood plains and ranges between the mountains and the ocean.

Figure 2 shows the change of Japan's population on a 100-year scale. To take a comparative approach to the changes experienced by Japan, the population of France and England is also shown. The population growth of Japan following the Meiji Period was explosive compared to that of France and England. Urbanization also progressed in accordance with population growth and various problems associated with cities and environment arose, requiring various measures that lead us to this day. If you look at Figure 3, which shows a global forecast of the "3 billion population explosion," the increase of Japan's population was an explosion that preceded the population explosion expected in developing countries such as countries in Asia where population will rapidly increase. In the future, Japan will precede other developed countries in a rapid decrease of population and in roughly 100 years the population is expected to decrease by half (median estimate).

Keeping the relationship with population in mind, let us explore the past ages and the future of river basin areas and cities. In the Edo Period, the population was roughly 30 million and in cities including Edo (modern Tokyo), it was a river system society that co-existed with nature and a river basin area was formed. In regions that were grouped in units of river systems, there were roughly 300 domains within them (around the number of single-seat electoral districts). The grouping by river system continued from the Meiji Period into the pre-World War II period. The Edo Period was a complete self-sufficient society. By the time the population surpassed 70 million in the pre-war period, the settlement of Manchuria and other movements indicate that the limits of this self-sufficiency were being reached, but it was still a self-sufficient society.

Around 60 years ago after the war when population was around 72 million and Japan entered a period of rapid economic growth and population approached 100 million, there were still strong vestiges of the river system society and the river basin areas. This was rapidly lost in the recent 30 or so years.

For the future, taking measures with a longer time frame, there is a great possibility that the creation of national land, cities, and river basin areas will differ from the period when economic efficiency and convenience were pursued. Regaining what was lost in this roughly 30 ears will also be a theme. For example, an urban regeneration based on river systems and river basin areas that coexist symbiotically with nature, coexistence with the natural aspects of disaster, transition of land use involving the withdrawal from regions with a high danger of disasters such as water disasters to a safer location, and also restoring the coastal area, sea areas of Tokyo Bay and other areas as well as the restoration of lakes and ponds will also be considered as well.

Nature Coexistent Basin Areas and Urban Regeneration Initiative

The loss of natural environment, human environmental pollution, urban landscape and other problems that we currently see in river basin areas and cities, especially in prosperous areas, is burden legacy of the 20th century and the

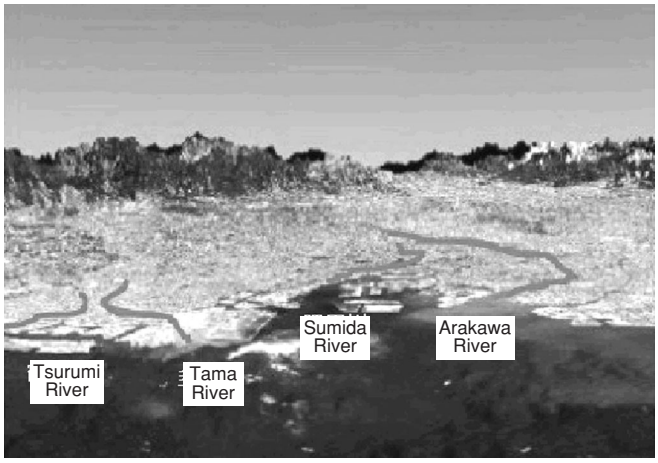

Figure- 4: Example of a river basin area and urban area (looking at the capital)

last half of the century in particular. For example, Figure 4 is a view of the capital's river basin area and cities.

In a society where the population is decreasing and becoming aged with low birth rates, the issue will be to reduce or relieve the burden legacy while maintaining the vitality of the country and its regions. Also, considering the coexistence of cities and nature or urban areas that live off of nature, making amends with nature in a sustainable manner will be an important global theme considering the international developments such as Asia-Monsoon region where the population will grow explosively and urbanization will progress.

Many of the regional activities regarding environment, not only for within Japan but over the world are interrelated with the river basin (river system) approach in many cases. An advanced example is the Mersey river basin campaign which flows through England's Manchester and Liverpool as well as the international activities of the Rhine River or activities in the United States for various river basin approaches or the Tsurumi river basin activities in Japan where government, industry, and citizen groups carry out activities in a coordinated manner for environmental activities.

The "nature coexistent basin areas and urban regeneration" initiative looks at the river basin area as an integrated whole consisting of the cycle of water and other resources as well as the ecosystem and also gives importance to the view of cities supported by the river basin area in addition to the research and development for undertakings for the renovation of river basin areas and urban areas in the field of environment.

The need for this initiative can be seen in the fact that: 1) in Japan, cities were established and developed on a foundation of nature with the river basin as a basic unit, 3) the resulting concentration of population and economy created environmental burdens for the river basin area, and 3) foundation of nature for river basin areas that make the cities viable is disintegrating and it requires the preservation and rehabilitation of the natural environment for the entire river basin area. Also, the compromise between urban areas and nature (i.e. the independence of cities and creating an orderly boundary between cities and surrounding regions among others) is also covered. The details of the initiative include: 1) the environmental monitoring of the urban areas and river basin areas, 2) the development of a management model for urban areas and river basin management areas, 3) development of nature coexistent technologies, and 4) the creation and implementation of a scenario to create an nature coexistent society as well as the research and development of various related programs.

The promotion of the initiative is being undertaken with the coordination of the Ministry of Environment; the Ministry of Agriculture, Forestry and Fisheries; the Ministry of Health, Labour and Welfare; the Ministry of Education, Culture, Sports, Science and Technology; and the Ministry of Land, Infrastructure and Transport among others. It involves the management of national land with a focus on river basin areas and urban areas and it is a theme that should not only involve the Ministry of Land, Infrastructure and Transport but also a wide range of academics, researchers, relevant academic societies, NPOs and others in a coordinated and active manner.

The 5 ministries involved expect the achievement of the following research and development as well as goals. For research and development, the above mentioned 4 programs are broken down into 6 areas for: 1) the monitoring and clarification of various phenomenon, 2) development of a river basin area management model, 3) development of an analysis and evaluation system from a humanities and social science perspective, 4) development of nature restoration technology, 5) developing an information technology foundation, and 6) the creation and implementation of a regeneration program.

This initiative not only involves research and development but also is a grand social experiment to renovate river basin areas and urban areas and the relevant ministries are agreed that the implementation program must integrate the whole. The targeted goal is to create policy tools in the first 3 years and apply it to pilot river basin areas and urban areas in 5 years, and in 10 years apply it to all the major river basin areas and urban areas across the nation.

Participating in the Initiative

The river basin area and urban area concept must be suited to the needs of the times as seen in the progress under 3CNDP. However, with decreasing populations and a graying society,

the proposal of a new and wider river basin area and urban area concept including the regeneration of urban areas is welcome. The "nature coexistent basin areas and urban regeneration" initiative is becoming a national initiative that is considered equal to global warming and other initiatives due to the background of urban area regeneration that is becoming an urgent and important issue in itself.

This initiative allows government, industry, civil society groups, and residents to start with their surroundings (river basin areas and river systems) to be engaged in environmental problems including global environmental problems. The symbiotic coexistence of urban areas and nature or the compromise between urban areas and nature is a global theme as noted before and will also lead to dealing with global warming and global water cycle changes.

In promoting this initiative, it will be necessary to engage broad participation in creating a promotional framework. It is expected that many will participate from various fields including researchers, research institutes, universities, academic societies, industry, citizens, citizen groups and others for research activities ad sharing the fruits of the effort to join together in action and implementation and we would like to make efforts for this to be possible.

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Transition of City Planning

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Ushering into a new century, various circumstances related to Japanese cities are rapidly changing. Some of them have even turned around 180 degrees.

Firstly, the growth of the population and the economy is shifting from an increase to a decrease. The working age population has already been decreasing from the 1990s and the overall population will begin to decrease in a few years. If the current conditions continue, the population will be reduced to half in 100 years from now. The age of economic growth has come to an end. Although it barely retains zero growth on account of the issuance of government bonds, the economy is substantially declining.

Secondly, centralization has shifted to decentralization. Shifting to centralization under the Meiji government from decentralization under the Tokugawa Shogunate administration created the population concentration in the megalopolises like Tokyo and Osaka. However, the collapse of the bubble economy caused people to disperse to local districts, and enforcement of a decentralization system is accelerating this movement.

Thirdly, the values of the residents who constitute a city have shifted from work to leisure, office to home. Various surveys show that the people who had been sacrificing their free time and family lives have realized it as a falsehood and are coming back to their homes and their own time. A transition of consciousness has also taken place.

Fourthly, "the development-first" principle has shifted to "the preservation-first" principle. Like the River Yoshino Tenth Dam Project and the Fujimae Tideland Reclamation Project, a series of development projects which had easily been implemented before have come to a deadlock because of the residents' opposition. Nowadays it is a common phenomena that development plans of small forests, lakes and marshes near big cities are very difficult to be carried out because of the counter movements. Quite the contrary, public works which restore a once developed area to its original state have begun to be conducted.

The fifth is the shift from the industrial society to the information society. The ratio of the workers in the tertiary industry which was less than 30% just after the war has recently increased to more than 60%. The industrial society found every product equally valuable as symbolized by mass production and mass consumption, however, in the case of the tertiary industry, what is really valuable lies in the uniqueness of the information it provides. The emergence of a society which aims at this diversity is also a great change.

Based upon these almost 180 degree turnarounds represented by the above-mentioned examples, I would like to consider what a future city should aim at.

Firstly, it should be a city in which our life is centered. Most of the beaches along the big cities like Tokyo are now industrial areas. The residents must travel several dozens of (few score) kilometers away from the cities in order to experience the beach. Most of the canals in Tokyo and Osaka have been converted into highways. They are the examples of the use of space for production, but we have to regain them for our lives.

Secondly, we have to construct diversified cities by means of original area planning. Like Technopolis and Teletopia, it has been the job of a local district to carry out as a subcontractor the plan made by the metropolis. As symbolized by "XX Ginza", imitation of the megalopolis improved the status of the local cities. However, we have to plot cities which are characterized by the natural and cultural background of the local areas from now on.

Thirdly, we have to regard maintenance as an important job. While the public investment is declining on account of the economic growth standstill, the maintenance cost for the infrastructure already established is rising. An extreme estimation suggests that we need to appropriate the whole amount of the public investment for maintenance a half-century later. It will become a major role of a city to consider measures to maintain and preserve the present city environment at a certain standard.

Fourthly, it is necessary to develop a new urban industry. The information industry which is relatively simple, like call centers and data centers, are rapidly scattering into local districts. A city has to create fresh new information, that is, a

creation of culture, and launch a system to make it link directly with the urban economic activities. Repayment is needed from a time when economic surpluses activate cultures to a time when accumulated cultures activate the economy.

The fifth is to create a city in which the inhabitants are at the core. A mentality of dependence on the governmental authorities has been cultivated under the strong preponderance of the governmental power since the Meiji era. From now on, on the contrary, with a preponderance of civil power, that is the people's sovereignty, shall take the lead. Information disclosure will be the prerequisite measure in order to realize it.

Viewing things in this way makes it quite clear that today we are facing a great transition from the period when the central authority had been planning, constructing and maintaining cities since they were born.

The Urban Revitalization Policy as a Structural Reform

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A core issue for urban policy concerns is how to harmonize the market mechanism and the regulations.

Throughout the post-war era, people have migrated to large cities, in particular to central business districts. This phenomenon has undermined the economic foundation of rural economies and threatened the interests of rural politicians. To counteract this trend, national urban policies were formed, based on the principles of "balanced development of the nation's land" and "urban growth management", which encouraged the return of resources from cities to rural areas.

Rather than introducing policies that minimize the benefits of urban agglomeration, Japan could have allowed market forces to allocate resources while taking specific measures against congestion and other possible external diseconomies that such forces might cause.

In this paper, we explain how the policies of "balanced development of the nation's land" and "urban growth management" were introduced and why they distorted resource allocation. Then, we discuss how laws and regulations must be revised so that efficient resource allocation is attained. Last, we examine the urban regeneration policy of the city of Osaka as an example.

Analytical Focus

The market re-allocates labor, capital and other resources from low-productivity areas to high-productivity areas. Removal of the various institutional factors that impede market forces is called "structural reform". In other words, structural reform facilitates the flow of resources from low-productivity areas to high-productivity areas.

The most successful structural reform implemented in Japan has been the abandonment of the coal protection policy in the early 1960s, which was accompanied by support measures for displaced coalminers. In late 1950s technological innovation in oil tankers made it possible to import oil from the Middle East at low cost. At that time, the Japanese government opted to abandon the protection policy for the coal industry and allow free importation of oil. At the same time, the government founded the Employment Promotion Corporation to facilitate the displaced coalminers to migrate into large cities and seek new employment. The corporation subsidized the companies that employed the ex-coalminers, and even provided housing in Osaka and Tokyo. The government spent money in the cities where the ex-coalminers moved to rather than in the coal-mining towns. Japan experienced rapid economic growth soon after this policy was introduced. The policy may be regarded as an ideal example of structural reform.

The "Balanced Development of the Nation's Land" and the End of Japan's High Economic Growth

Since the 1970s, however, policies have been implemented that have impeded the free flow of resources into high-productivity areas, especially the central business districts of large cities. These could be called "counter-structural reform policies".

The first step of counter-structural reform was the introduction of the policy that blocked the flow of resources from rural to urban areas.

Japan's economic growth of the 1960s was based on a demographic shift from rural areas to large cities such as Osaka and Tokyo. The average worker was able to double his wage rate by this migration, while Japan as a whole achieved significant economic growth.

Nevertheless, near the end of 1960s some people started to argue that the rural areas were under-populated whereas the urban areas were over-populated. As a result, the guidelines of "balanced development of national land" were proposed. Since rural voters are over-represented in the parliament, many politicians supported policy guidelines that introduced measures to impede the flow of resources from rural to urban areas.

These measures distorted the market mechanism and the efficient resource allocation that supported Japan's economic growth in the 1960s. This may be a major factor that halted Japan's economic growth.

The past policy measures that restricted the inter-regional resource allocation can be classified into the following two categories:

1. Redistribution of financial funds obtained through tax imposition in large cities to rural areas. The Comprehensive National Development Plan (Zensou) is an example. The dramatic increase in the Local Allocation Taxes also gave incentives to local governments to engage in lavish spending.

2. Regulations aimed at restricting urban growth. A typical example is the "Regulatory Law on Factories and Other Facilities". Enacted in 1964, this law restricts new construction of, or additions to, factories, universities, colleges, and technical schools with a certain floor space in specified districts in the Tokyo and Osaka areas.

The official purpose of this law was to eliminate the concentration of population and to remove the disadvantages of over-populated urban areas. However, its real purpose was to relocate factories and universities to rural areas for the economic benefit of rural areas.

Indeed, the share of factory workers in these restricted districts dropped from 26% to 14% over the 25 years from 1970 to 1995. The number of university students in Osaka decreased by almost 50% from 51,000 to 26,000, whereas the total number in Japan increased from 1.4 million to 2.7 million from 1970 to 2000.

The decentralization policy, which was based on the "balanced development of the nation's land" policy during the 1970s and later, retained resources in the low-productive areas. This brought about Japan's low economic growth.

Thus, it is necessary to abolish the Regulatory Law on Factories and Other Facilities, as well as to drastically cut down the Local Distribution Tax and the tax revenues allocated to local governments.

Efficient Use of Land in Urban Centers

The second step of counter-structural reform was the policy that prevented efficient use of land in urban centers. This policy was later named "urban growth management".

For a metropolis, the more concentrated are the businesses in the central districts, the more productive they become. Thus, it is essential to ensure efficient land use in the central business districts in order to achieve urban revitalization.

However, Japan has not recognized the importance of maximizing the benefits of efficient land use in the urban centers. An example is the regulation on floor area ratio (FAR). In Manhattan, New York, the maximum floor area ratio is set at 20, whereas in Tokyo, it is set at just slightly over 10. Since this regulation restrains the supply of floorage, the rent per floorage becomes more expensive in Tokyo.

One seemingly legitimate reason for the FAR regulation on buildings is that the FAR contains the growth of offices in the city centers, which may cause unreasonable congestion of commuters on trains.[1] There are other measures, however, to curb congestion of commuter trains that causes less loss in the benefit of urban allocation.For example, it is possible to give incentives to railroad companies to adopt a peak-load fare system by allowing flexibility in the regulation of fares. The aim of the FAR regulation should be clarified, and the regulation should be set at a minimum level to achieve the aim.

The most significant side effect of the FAR regulations is that it severely limited the residential floor space in city centers. Because the FAR regulation was applied not only to office buildings but also to residential buildings, the floor space of residential buildings became limited. This drove people into the suburbs, thereby decreasing the number of residents living in city centers, and increasing the number of commuters into the cities; the FAR regulation caused the opposite effect of its initial purpose. Indeed, the nighttime population density at Tokyo's center is one-seventh that of Manhattan. Residential buildings in the city center, therefore, should be exempted from the FAR regulation. This would lower the rent per floor area, and increase the number of people living at the urban center, which would alleviate congestion during rush hours.

A Prescription for the Revitalization of Osaka

Some specific measures for urban revitalization are now proposed, taking Osaka as an example.

The raison d'etre of a large city lies in the ease of face-to-face contact. From this viewpoint, some policy failures impair the urban functions of Osaka. The key to the revitalization of Osaka lies in redesigning the city so that a greater amount of face-to-face contact is possible.

Because of traffic congestion it currently takes too much time to travel between the traditional city center (which begins at Osaka Station and stretches along Midosuji) and the newly established sub-centers at Nanko and Osaka Business Park. Unlike Tokyo, it is rare for suburban trains and subway lines to share tracks. Moreover, Osaka Station is not on the Shinkansen (bullet train) Line. The airport and the city center are quite near in geographical distance, but the airport cannot be reached from the city center without transferring to another line.

There are four specific measures to improve this situation.

The first measure is to concentrate the urban functions along the Midosuji Line, starting at Osaka Station. It is necessary to ease the FAR regulations along this strip of land. This will allow the floor areas of both office and residential buildings to be significantly increased.

The second measure is to double the tracks of the Midosuji Line, Osaka's main subway line, into quadruple tracks. The time distance between each station can be shortened by running the express trains along the local trains, as is the case with the Chuo and Sobu Lines in Tokyo.

The third measure is to shorten the traveling time between Kyoto, Kobe, and Osaka. For this purpose, the number of tracks shared between the suburban trains and the subway lines should be increased to allow passengers from Kobe and Kyoto to reach Tenoji directly without transferring at Osaka Station. Most suburban trains do not share tracks with subway lines because of the differences in the track specifications. Therefore, the New Midosuji Subway Line, the express subway line, should be constructed with track specifications consistent with suburban trains, but not with the existing Midousuji Line.

The fourth measure is to shorten the traveling time between Osaka and other cities in the nation by improving train connections. For this purpose: 1) a new Osaka Shinkansen Station should be built on the vacant lot to the north of the present Osaka Station, a space which was once used for a freight station. The present Shin Osaka Station should be closed as a Shinkansen station. This will enable direct transfer to the Shinkansen Line not only from the JR Lines, but also from the Hankyu Lines, Hanshin Lines and other subway lines. 2) An underground track of about one kilometer should be laid to connect Osaka Airport and Hotarugaike Station on the Hankyu Takarazuka Line, allowing direct access from Osaka Station to Osaka Airport. If this can further interconnect with the New Midosuji Line, access to other cities in the nation from any station at the traditional city center of Osaka will be drastically improved.

These improvements of the subway networks can be financed through the introduction of a peak-load congestion fare. An increase in the charge during peak hours will provide significant funds for traffic investment.

National Policy for Urban Development

The benefits of urban agglomeration are immense. Concentration of offices is the key to the existence of a city. In case of Osaka, however, the office hubs were scattered in a very disorderly way. This weakness is now about to prove fatal to Osaka.

Fortunately, it is possible to remedy this situation through an urban concentration policy. The most efficient way to regenerate Osaka is to improve office accommodation by concentrating such development in the city centers.

Japan achieved its rapid economic growth by implementing structural reforms at the transition stage from primary to secondary industry, taking the measures that supported displaced coalminers to find re-employment in cities like Tokyo and Osaka. Nevertheless, Japan now faces difficulties in shifting from a secondary to tertiary industry because of the decentralization policy that has been in place for 30 years. This is an underlying reason for Japan's sluggish growth. Now that international competition has begun among such cities as Shanghai, Hong Kong, and Singapore, structural reform in the form of urban revitalization needs to be carried out as the highest priority in Japan today.

Reference:

Masuda Etsusuke: "New Era for Urban Development" "HSBC Security Business Report" March 29, 2001. It has been pointed out that the decentralization policy represented by the Comprehensive National Development Plan (Zensou) has been lowering Japanese productivity; e.g., Hatta Tatsuo: "Overconcentration in Tokyo: A Measure through Price Structure", Uzawa Hirobumi / Horiuchi Kyouzou: "Considering the Optimum City" 1992, Tokyo University Press.

Dr. Masuda was the first to claim that the Zensou Policy is the major reason for the low economic growth of Japan since 1970. To support this, he proved that giving high priority to local districts in the allocation of public investment narrowed the income gaps between the big cities and local districts.

[1] Another reason given for suppressing the FAR at a low level is the low proportion of road area to total land area in the Japanese cities. This reason, however, cannot explain why the FAR is also low in Sapporo. In addition, the subways in Tokyo are so well developed as to defy comparison with those of New York. People can go almost anywhere without getting into a car.

Town Planning & District Planning in the Age of Decentralization
-Experience from the Post-Quake Reconstruction -

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Town & District Planning Under Decentralization

The time for decentralization has arrived. Until now, all matters were determined by the central government and local bodies have generally submitted to those decisions. There are many cases where the policies appointed by the central government on a nationwide scale may not necessarily be applicable to a local district, but still, though unwillingly, we have given it our reluctant consent. On the other hand, even if a problem broke out in the local district, we had to think twice before taking any action, because there were no supporting systems or subsidies to back it up. Hitherto, the local administration has followed the convoy system. Although a "self-government," it would not be an exaggeration to say that we have lodged the most important part of decision-making and policy options with the national government. This custom has deeply filtrated into town planning and district planning as well.

The quintessence of the local autonomy originally lies in the virtue that it enables settlement of local issues in the most appropriate and agreeable way for the local residents. Therefore, decisions regarding local issues should not be left to the discretion of central government nor should it require its consultation. The clue to the solution will always be found nearby within the district. We need to identify the problems that exist at the local level and take them into our policies, decide for ourselves what's best, and carry them into effect. Issues and assignments should not be passed down from the central government to the localities, but should be conveyed from the localities to the center authorities through actions by the local government. This the most desirable future policy-making mechanism in the age of decentralization

Town planning or district planning is the basic starting point for the local government. The residents should have the right to ponder over and decide what to do with their town or district. The decision-making process itself is what makes "self-government" a "self-government." Whereas, town planning by local governments across the nation have not quite been carried out along this ideal. As long as Japan is a law-abiding country, it is inevitable that to follow the regulations under the affiliated laws. However, the fact that much of powers have been assigned, not to the local governments but to the central government, has hampered with the independent town planning of the local authorities.

At the same time, as various back-up measures and support systems for town planning are prepared by the central government, local municipal bodies that are chronically suffering from money shortages have no other choice but to rely on those subsidies. As a result, it gives way to a rather prominent dilemma where town planning will take place only where the money is offered, and remain untouched where there is none, regardless of the need for the planning. Moreover, it is common for the subsidy system or the contents of the system to not necessarily fit in with the needs of the local residents. Rather, it is usually quite different from what is anticipated by those who have sufficient knowledge of the local situation. It is a result of each central ministry and agency being caught up in a vertical alignment, growing ignorant of the actual situation. I have once been made painfully aware of this fact. That was through an experience with the post-quake reconstruction of the Western Tottori Prefecture Earthquake.

Post-Disaster Reconstruction - Site-Based Town Reconstruction

There was a big earthquake of magnitude 7.3, with a seismic intensity of 4, whose epicenter was in the western part of Tottori Prefecture. It caused great damage in the area, destroying a great number of houses, towns and villages. The quake-stricken area was rapidly aging and under populated, so consequently, most of the disaster victims were the elderly people. Most of the aged victims with damaged homes had no spiritual energy or financial funds to re-build or repair their beloved homes.

"The elderly people come and seek my advice but I can't give them even the slightest hope. I can only feel sorry for them, and it makes me so miserable. Please, Governor, help them," sobbed a female clerk at the consultation counter of the town

office in the quake-stricken area. I can never forget how she cried out to me of her distress. So many of the elderly shed tears in front of me saying, "I wish I could continue my life here, but it's impossible now when my house is like this. My son who lives in the city invited me to come join him, so I'm thinking of leaving this district. Not that I really want to, of course..." The tears generate a chain reaction. "If you're leaving, I guess I'll have to go to my son's, too. I'm really going to miss you." One's anxiety leads to another's. I asked myself, "What would I do if I found myself in the same situation as these elderly people?" My conclusion: There would be no other choice but to leave the village, since there was no longer a place for me to live in.

The more the people leave the district, the larger the damage incurred to those who stay behind. In this district, all have helped and supported each other until this day. If the community members decreased one after another, the remaining members will not be able to sustain each other for long. "The community will collapse if nothing is done. A true reconstruction can never be achieved without rebuilding the houses." This was the immediate impression I had when I stood face to face with the victims on the disaster site, soon after the earthquake.

Photo-1: Over 17,000 homes were damaged and roofs were covered by blue protective sheets (Nihonkai Newspaper)

Photo-2: The residents of earthquake stricken area are given encouragement.

Various types of policies are prepared by the national government in order to reconstruct the afflicted area. There are hospitable subsidy systems for the reconstruction of public facilities, such as severed roads and bridges. Fortunately, the government does not begrudge money for this kind of matter. Nevertheless, there is no subsidy system at all for rebuilding and repairing houses. There is, of course, the low-interest loan from the Housing Loan Corporation, but it exists only for those capable of receiving the loans, and holds no meaning to others who are screened out during the process in the first place.

Why does the government provide such generous assistance for the reconstruction of roads while it is indifferent to rebuilding individual houses? The answer is because roads are "public" and houses are "private." Taxes can only be spent for public goods. This is the traditional rule of public finance and I do not dare to challenge it. However, no matter how much we invest in an attempt to reconstruct the public goods, would the investment have any meaning if there were no residents to serve? It will be reduced to a mere joke if we say, "We stood by the rule of public finance, but failed to stand by our district."

Temporary houses are provided to the disaster victims who lost their houses, which cost approximately ¥3-4 million per house, but there is also a generous subsidy provided by the government. However, a temporary house is a temporary house, and it must be pulled down after a several years. It is out of the question for an individual to continue using the house. As long as the house is temporary, it remains a public good, but once the ownership changes hands to an individual, it becomes a private good. As I stood there on the disaster site, to find that there are generous subsidies for goods to be broken down, whereas there is no subsidy at all for goods to be used over a long period of time, I must admit, I found the situation downright bizarre.

Though a rule is a rule, I made up my mind to support housing reconstruction, even if I had to bend those rules a little. I judged that the true restoration of the district could never be achieved without the reconstruction of houses. However well the roads may be reconstructed, the elderly people will not remain in this district unless their homes are rebuilt, and this district will collapse. It may mean that the money invested for the reconstruction of public roads and bridges may end up going down the drain. On the other hand, offering financial support to rebuild individual houses will surely mean spending taxes for a private matter. Still, if investment of tax money into this seemingly private purpose can protect the district as

a whole, then the ultimate purpose achieved in this case is no other than a public purpose. It is about time that the government realized the equivocality of the traditional rule in public finance.

When I conveyed my decision in advance to provide support for housing reconstruction, the bureaucrats at Kasumigaseki criticized me for "violating the Constitution." I asked, " Then exactly which article does it violate?" to which obviously, I received no reply. As it turns out, what the Kasumigaseki bureaucrats have primitively believed in and insisted all along as the "rule of financial policy," was nothing more than a long-established illusion lacking any legal basis.

The First Support Plan for Housing Reconstruction in Japan - For True Restoration of Town & District

Tottori Prefecture decided to supply, uniformly, 3 million yen to a disaster victim who wishes to rebuild his house damaged by this earthquake. In so doing, we determined that we would not rate the damages as "total collapse", "half" or "partial collapse". This was to avoid unwarrantable unfairness through the differences created by the administrative handling process. No income restrictions were introduced, which typically accompany this kind of support plan. There may be a certain extent of legitimacy in placing income restrictions, but it is will be irrational for a person to be denied support during such emergency on grounds that he has been paying his taxes regularly. It will discourage the taxpayer from paying his taxes, if his payments prevent him from receiving support when he is truly in need. Upon consideration of the above factors, the only prerequisite for claiming subsidy was for the resident to rebuild his house within the same community as his previous house, in which he lived.

The subsidy amount of 3 million yen was derived from the cost required for constructing a temporary house. It was first estimated that a considerable number of temporary houses needed to be built, although not quite as many as was the case for the Hanshin Awaji Earthquake. It turned out, however, that the actual number was only 28, surprisingly small. The reason was because most of the victims were able to secure temporarily shelters with their neighbors or relatives. This serves as verification for the existence of a strong sense of community within this quake-stricken area. Thanks to this bond or this sense of community, we were able to stave off the otherwise immense financial expense for building temporary houses, allowing us to reserve a considerable amount of money. If we utilize a part of that reserve to implement a support plan for house reconstruction to preserve the community, it should not strain the financial balance. With such reasoning, we set the house-rebuilding subsidy at 3 million yen, the same amount needed to build a temporary house.

Photo-3: A newly built home.

Aside from subsidies for house reconstruction, we decided to provide subsidies for alterations or repairs of houses as well. The grant rate in this case was 2/3, and the ceiling was set at 1.5 million yen. Although there were opinions claiming that subsidies for repairs were unnecessary, in reality, many of the elderly disaster victims could not even scrape up money for a simple repair work. If nothing is done, a house may be needlessly abandoned, where it may still serve its purpose with a little retouch. Then, public housing will need to be offered to those who abandoned their homes. I feel it is much more rational and economical to assist people to repair their own houses instead.

There were several characteristics in the damage caused to the houses in the Western Tottori Prefecture Earthquake that are not found in other earthquakes. One is that, for houses built on the mountainside slopes, significant damage was caused to the ground itself or to the stone foundations of the house. Considering the potential risk of those houses on the slopes, there were persistent opinions recommending they move the houses to the level ground. However, I adopted the stance to honor the inhabitant's choice if he wished to continue living on the same sloped grounds. In doing so, it would cost a considerable amount of money to rebuild the damaged stone foundations. Hence, I decided to provide subsidies for the cost of repairing the stone foundations as well, with a cap of 1.5 million yen.

Another characteristic is that, in certain regions, the so-called liquefaction phenomenon occurred. In such cases, it was typical for a house damaged by liquefaction to have also damages caused to its foundation and ground. Therefore,

restoration or reconstruction will necessitate a far greater cost than others. It will also become necessary to apply special countermeasures against liquefaction when reconstructing the house to alleviate the resident's concerns for the future. In one new residential area, it was anticipated that many would give up rebuilding their houses due to the burdens of housing loans. If it turned out so, the new residential area would be abandoned to turn into a ghost town, which would be a tremendous waste. Therefore, we encouraged reconstruction/repair of houses and ground improvement, and offered a maximum of 1.5 million yen as an additional project expense to subsidize for ground reinforcement against liquefaction.

It was on October 17th, 11 days after the earthquake, that the above support measures were announced. Admittedly, when the press conference was over, I was overwhelmed by extreme fatigue. It was caused by a feeling of loneliness and anxiety that I had stepped into an unprecedented territory in our country to implement support measures for rebuilding houses in the post-quake reconstruction.

Would the system operate successfully on the site? Would approvals for subsidy applications be carried out smoothly? Countless uncertainties crossed my mind, but above all, I was worried that I had no idea how much the total expense would amount to in implementing all the support measures. It was only 11 days after the earthquake, and the whole extent of the damages had not yet come out to the open. Besides, the prefecture did not have much to spare financially to begin with, and the subsidies from the national government could not possibly be expected because they were standing in direct opposition to us. It takes considerable courage to step into new territory, equipped only with financial anxiety, where there are no precedents or support from the national government,.

Town or District Planning Lessons from the Post-Disaster Reconstruction.

I learned many things about town planning and district planning from this post-quake reconstruction experience of the Western Tottori Prefecture Earthquake. One was the importance of visiting the actual site and getting an understanding of the real situation. It is also important to maintain an unswerving attitude and speed to carry out the necessary measures, regardless of whether there is a subsidy system from the national government or not.

Viewing the situation from the victims' standpoint is also essential. If I were a victim, the most important issue would be how to stabilize my own living and to eliminate my anxieties. The basic starting point for town planning or district planning in the reconstruction phase is to restore things the way they used to be before the disaster as much as possible. The area and the neighborhood where you've lived in for many years, your house that serves as the base of your daily activities, association with your neighbors, the scenery which surrounds you, and even the songs of the birds you are accustomed to hearing, these things which were taken for granted and paid very little attention to are, in fact, the essential constituent elements for your life and the basic infrastructure that enable you to lead a secure and comfortable life. It may have far greater meaning to the elderly people, especially.

When a disaster occurs, it is typical for the idea to emerge to take advantage of the opportunity to convert the town into a better one. It seems that the central government is very generous in providing subsidies for that purpose. This idea may be good for town planning if seen in a 100-year perspective, but holds no meaning to those who are distressed and steeped in anxieties at that very instant. We should adopt the 100-year perspective in the peacetime, but in post-disaster reconstruction, the existing victims should be considered as the first priority.

Almost a year has passed since the occurrence of the Western Tottori Prefecture Earthquake. Although there are still problems yet to be solved, the restoration project, including house reconstruction, is going smoothly. What pleases me the most is the fact that there were hardly any disaster victims that left the area. Most of them are cheerfully engaging in reconstruction work. Needless to say, there has not been even one solitary death. They will most likely continue to support one another to protect their towns or districts. Some people have said to me, "We found courage to recover, because the local administration was so quick in hammering out a house

Photo-4: An old lady smiling after the completion of her new home, the first one to be rebuilt with the government subsidy.

reconstruction plan." Their words in return have given me much courage, and I cannot help feeling thankful to them.

When I look back, I'm always glad that I've courageously taken up the challenge to realize what I felt was necessary from my own viewpoint when we stood at the actual disaster site, that I did not simply follow the orders from the central government which I felt lacked awareness of the actual situation. Also, I am truly glad that we did not choose measures from the national government's subsidy menus, and instead, actively carried out the necessary reconstruction measures on our own. I took this opportunity to introduce my experience, because I feel that the same idea may be applied not only in disaster reconstruction projects, but also in town planning or district planning in broader perspective.

Can We Save the World from the Water Crisis?

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The 21st century is called the "Water Century". It is because the spatio-temporal water demand in quality and quantity is getting more and more stringent worldwide, which aggravates poverty, plague and conflicts, and as control over foreign water resources is also keenly sought among nations through trading commodities, it has become an international strategic matter. Millions of people are dying due to the deficiency of clean water every year. Thousands of people are dying due to floods every year. Behind the heated conflict between Israel and the Arabs, there is also the dispute over Golan Heights, the water source of the River Jordan. Desertification and salinization have been changing the whole map of habitats, farming and cattle breeding in Africa and Central Asia. The water crisis has already started.

In order to cope with this matter, many nations are competing for their political leadership and various kinds of water conferences have been held. More than 100 nations sent their ministers to the 2nd World Water Forum in The Hague. The United Nations, considering freshwater management as the key to sustainable development, designated Year 2003 as the International Year of Freshwater and started the World Water Assessment Project (WWAP) to monitor the development of the program designed in Chapter 18 of the Agenda 21. In these initiatives, Japan is showing significant political presence such as organizing the 3rd World Water Forum, launching the World Water Assessment Project, and Director General Koichiro Matsuura of UNESCO designating the freshwater and ecological sciences as a priority area of UNESCO's science program. The whole world is keeping its eye on Japanese leadership.

The root of the water problem lies in the population increase and the desire for a higher quality of life. However, seeing the fact that there is enough water in absolute amount and there is the technology to make use of it, it must be said that the true water problem lies in its management. The limit of development is not absolute but depends on the technological level and the social system and the organization of society, thus, management is the most important aspect of the definition of sustainable development

Then, what kind of concrete solutions have been proposed? As a matter of fact, the only guideline we have is the approach of the integrated water resource management (IWRM) indicated in Agenda 21. This approach is intended to solve the problem by integrating policies, institutional systems, organizations, education, the economy, scientific technology and others, and having them function as an integrated system to secure and preserve the water resources, and avoid conflicts. Above all, what is particularly emphasized is the importance of demand management. It promotes efficient water use by introducing water pricing, priority rating of water allocation and distribution, promotion of reuse and recycling, effective irrigation for reduction of agricultural water use, which amounts to 80% of all water consumption, introduction of drought-resistant breeds of crops, utilization of brackish water for irrigation and many others. As a premise for ensuring that these items be efficiently carried out, there must be a consistent policy of equity and fairness. The equity should extend not only to rich/poor, men/women, all the interested parties, users and the inhabitants at the headwaters, but also to the generations in the future and to all other living things as members of the ecosystem. Fairness means participation by all the people concerned at any level of the democratic process of decision-making and societal consensus, and as a base for it, information disclosure. These are actually political issues and also issues of the economy, the institutional system and the priority orders. Scientific technology can only assist.

Let us go back to the original question. Can we save the world from a water crisis? The water issue is not about the absolute amount, but the issue of spatio-temporal balance of quantity and quality. There is an engineering technology for adjustment. Ultimately it is a political issue, a matter of policy and its execution. Unfortunately it is making little progress. What is the role of scientific technology in that? The world policy priorities are decided according to the historical course of international agreements, scientific knowledge, persuasive principles, and so forth. Above all, scientific knowledge, in other words, technology, logics and experiences have substantial power. That is because there cannot be

administration without science in this modern age. Conversely, scientific knowledge is just a useless sophistication if it cannot move politics. In order to give appropriate guidelines to politics, not to have a wrong decision made, and also lead the citizens' decision making in selecting political issues in the right direction, the responsibility of the experts is immense. The expert in water science and water management, as a torchbearer and a translator of the scientific facts and their potentiality, has a responsibility to talk to politicians and citizens in a visible way.

Can we save the world from a water crisis? It totally depends on how far we can make water a political issue and reflect science in politics.

Roundtable Discussion:
What We Should Do About the Worldwide Water Issues

Participants
Taikan OKI
Associate Professor, University of Tokyo
Takeshi OKUTANI
Tetsuo MIZUTA
Kimihito MUKOYAMA
Editorial Committee Members
Hiromi SEO
MC

Photo-1: During the roundtable discussion

Several voluntary members of the editorial staff who were in charge of the feature articles of this edition held a roundtable discussion, reflecting back on those articles. The theme was "What we, civil engineers, should do about the global water issues." Dr. OKI Taikan, who is researching the global water cycles and water resources assessments, joined us as our commentator.

Japan depends on 'Overseas' Water

SEO: We featured articles on global water issues from various viewpoints. Living in Japan, much abundant in water, I myself was surprised to find that realities beyond our imagination currently exist in various parts of the world. What article did you find the most interesting?

MIZUTA: What surprised me the most was the passage, "more than 4 million children die every year (one every 8 seconds) due to water shortage and other water-related diseases." This is WHO's data. Do you know this fact, Dr. Oki?

OKI: When we discuss global water issues, we always come across this same kind of figures, which may be 4 million or sometimes 5 million. The world population is now about 6 billion and the birth rate is greater than the death rate, of course, but roughly speaking, about 100 million people are born every year and almost the same numbers of people die every year. Within that perspective, the figure does not seem to be that big.

However, those are borrowed figures from the US and European nations. I feel a bit sad that Japan disseminates so little foresighted information on water-related issues.

MIZUTA: At the same time, what impressed me the most is the passage bringing up, "the import of virtual water." I admire the cleverness of such unique perception, but I also concerned about distortion of the world water balance made by Japanese trade.

OKI: Japan imports grain from all over the world. Suppose we grow all the major grain such as wheat, soybeans, corn and rice, domestically in Japan through irrigation. How much water would we need? After some calculation, we find that Japan is largely dependent on USA, next Canada, then Australia, Argentina and Brazil. Japan imports a total of about 40 km3/y of water indirectly every year. Since the annual water usage of Japan, on intake basis, amounts to about 90 km3/y, we find that Japan is largely dependent on overseas water.

It was common to assume that "industrialization" mean "becoming a member of the developed countries." However, when we look at other countries around the world, we see that most developed countries other than Japan are those that are able to export agricultural products. Japan is practically the only country which unilaterally imports agricultural products on a massive scale.

MUKOYAMA: During summer in Japan, drought always becomes an issue. I felt that we must treat the water pollution and water depletion issues as our immediate problems, and not regard them as another's concerns. In regards to water quality, the water must clear 100 check items on water quality standards provided by the Water Works Law in Japan before it can pass as drinking water. That is how everybody is able to drink water from the faucet without care..

However in Japan, demand calls for water not only to be simply potable, but good-tasting as well, which goes one step beyond the safety requirement. We must take measures to answer to those demands. At the same time, I think that issue such as endocrine disturbing chemicals, so-called

Mr. Oki

environmental hormones, which are said to have harmful effects on living organisms, should also be addressed by developed countries.

Adjustment between the water necessary for ecological system and the existing water service is important

SEO: Is there anything that we should mention besides the topics that were taken up in the featured articles?

OKI: There is the issue of "ecosystem." How much water would we need for preserving the ecosystem? Although it has been started to be considered through the "intimate river works for nature conservation" in Japan as well, I believe what is really important is how we should establish the process of decision making as to how much water we should reserve for preserving the ecosystem in respective places from the global viewpoint.

People who are suffering from hunger wish to have water just in order to grow crops. On the other hand, there are people who claim that the ecosystem must be preserved. How can we harmonize the needs of those people? Also, in the urban areas, water sometimes becomes too short to maintain the cultural life, and the residents may complain of having water stopped for many hours per day in the dry season. To them, irrigation for farming and preserving the ecosystem are secondary issues. How can we compromise these conflicting demands? The problem is becoming a worldwide issue now.

MIZUTA: Who is in the position to make a decision on the rights of agricultural water use and adjustment with the water supply for the cities?

OKI: Actually, I think there is a global trend for someone in the central government or a local government with a keen sense for the issue to exert leadership and call on stakeholders concerned to find a way to decide how to make a decision on this issue.

I believe it is important to collect and accumulate information and know-how, and to share a common awareness through case studies: A certain adjustment of this way has worked out well enough here; or, a certain method had led to problems 10 years later, etc. The framework of consensus forming would become another issue.

A Global Perspective to Identify Problems

SEO: Why is there a need to take up the global water issue here in Japan?

OKUTANI: I also think that is an important point. The water issues may seem like local problems if we focus on the respective places where the problems are arising. However, in order to solve the problems, local efforts are not enough and they have to be dealt on a broader scale. I understand the word "global" is used in that sense. However, we need to identify the problem in a global sense as well, or else we cannot call the water issues global.

For example, the problem of global warming is easy to understand in that the temperature of the earth is rising as a whole, whereas, the water issues are merely accumulations of local problems. Could you add some more explanation to it?

OKI: To contribute to the global water issues is an expression of our awareness that Japan exists as a part of the international society, and that we are not simply wishing good for ourselves, but wishing good for the entire world as well.

Otherwise, what will happen? For example, the world population will grow. It will grow up to around 9 billion, though it was previously said that it would increase to 10 billion. It would keep on growing at least in the first half of this century. As the living standard rises, more food will be consumed, which means that we will eat more livestock feed grain indirectly through meat, and that we will need higher grain production per person than now. Consequently, we will need more water. As for Japan, we can manage to survive by importing food from overseas through money gained from exporting marketable goods such as automobiles and electronic products.

However, from a global point of view, food is not sufficiently distributed and there will be more people who will not be able to have enough food particularly in poor areas and countries with increasing population. Eventually, they will suffer from hunger. The question is, under such circumstances, is it possible to claim it as our rightful economic activity to buy food from ourselves?

OKUTANI: I understand quite well the concept that we must do something to contribute internationally, since Japan is a country that depends on trade. However, if all the people in this world desired to lead the same life as ours, it is obvious that all the water resources would dry up due to excess demand. Nevertheless, if we drew a certain line in offering assistance, I'm afraid that it might turn out that Japan would be the one to determine which living standard is appropriate for other countries. In addition, extending half-hearted assistance might mean that we are putting off the problems, or worse yet, we may even aggravate the situation.

OKI: Let's take up this issue of whether we should extend our assistance or not at a later stage. I think it is necessary for us to be fully aware of what is really happening in the world. At least academic pursuits should not have to be limited to domestic issues, and it is important that someone is always keeping a watchful eye on the world. In the industrial world, I don't see a bright future for civil engineers who only target the Japanese domestic market. The market exists in the world. If so, it would be the natural to find out what kind of water demands exist where and by whom.

OKUTANI: Wouldn't that mean adopting a noninterference policy, to leave everything up to the market, namely, commercial activities by the private sector? On the other hand, it may be possible to introduce public funds in order to make it a non-profit project. In such a case, the research itself may surely be of great value. However, I'm afraid it wouldn't be really meaningful if it would be studied only to satisfy the researcher's personal curiosity.

OKI: I think there are two sides. One is the standpoint not to seek direct benefit domestically in Japan. What is the water crisis, to begin with? We must come up with our own figures and our own data, instead of relying on those offered from other countries. On the other hand, another standpoint may allow some domestic benefit for Japan in an indirect way. If we can invest in Africa or Southeast Asia by identifying beforehand where the water crisis will escalate in the near future, and by determining what kind of assistance would be most effective in the next stage, then it may serve to stabilize the economy of those nations and pacify the peoples' minds, and eventually their market may grow to buy Japanese products.

OKUTANI: Referring to our civil engineering field, there are opinions that it is no longer necessary to build roads in the local districts. Looking back into our history, investments have been concentrated in Tokyo while investments to the local districts have been held down. The idea was to first make Tokyo a developed city, and then disperse the nation's wealth nationwide, including that of Tokyo. This way, the entire nation may enjoy its wealth. However, as a result of the concentration of investments in Tokyo, human resources and the know-how have concentrated in Tokyo, causing the cost-effectiveness of the same investments to local districts to decline.

Mr. Mizuta

Mr. Mukoyama

Under such circumstances, when it comes to discussing how the precious financial resources should be used, what is commonly said is this: "Stop the public investment to local districts." Obviously, it is spoken only from an economic viewpoint, and I can't completely agree with it, but I'm afraid that same kind of opinion will be posed before long in the case of using public funds for research purposes.

OKI: Let's take for example, sports. Why do we spend money for sports promotion? It is because we feel happy and proud when a Japanese athlete plays an active role in the international arena, isn't it? We should apply that same concept to academic pursuits. We should feel proud that "a Japanese made this such discovery," or "a Japanese pointed out this new water crisis issue to the world," and that "there is a solution to this issue as such," etc. Even if it does not make the front pages of the newspaper, I think a lot of people would understand its value and appreciate it.

SEO: I would prefer to think that way as well.

OKI: I'm often asked, "What kind of role does the research on global water issue play in the reconstruction of the Japanese economy?" The value of academic research will be found either by having economic benefits or feeling proud of its excellent achievements. The water issue is a public issue, so I think the latter would apply in this case.

OKUTANI: In terms of economic benefits, the idea of the Straits of Malacca-Singapore in marine transportation may be used as a reference. Japan has made a substantial amount of investment in it. The strait contributes greatly to the

stability of the area as a cornerstone of Southeast Asian trade, and at the same time, it is of significance to Japan itself. The Strait of Malacca is virtually the only strait through which oil tankers from the Middle East can sail. Without it, we would have to make a detour to the Sunda Strait or Lombok in which case we would not be able to receive the supply on time, and the crude oil prices would rise because of the cost increase in transportation. We may need to come up with this kind of easy-to-understand explanation.

Starting with Water Conservation in Households

SEO: What can we do about the water issue, in practical terms, through our present civil engineering technologies?

MUKOYAMA: It was pointed out in the featured article that the absolute amount of water will remain the same, while the population will keep growing. We will be fighting over the limited water resources. The Japanese living standard has been rising and we have come to utilize a lot of water. Water conservation will become important, and each of us will have to be careful not to waste water on an individual level.

I actually thought about what ways of water conservation there are. What we surely can do is to put a water saving tip on every faucet at home. I believe accumulation of such a small effort is the only way to enable all of us to make equal use of what is limited.

Next, considering water cycles, there is the issue of utilization of recycled water. However, plant investment will be required in this case, which would turn out to be quite costly. If spending money for preservation of water resources becomes a public consensus, the supporting technologies will start to develop. However, since there is little consensus yet in the market, the cost associated with water recycling technologies will not be easily reduced. In my opinion, we must first resolve this matter before we can turn the water conservation issues into a larger project.

At the same time, I think agricultural water use is the largest in foreign countries as well as in Japan. What kind of technologies do we have for water conservation in agriculture?

OKI: The drip irrigation is widely known. It is used to grow vegetables in the Middle East where they have little water. Nevertheless, there are quite a few technical problems that need to be taken care of such as temperature adjustment or weeding in addition to the water for plants, so it is not an all mighty solution. Also, there will be many pipes running in all directions over the field, and I'm afraid the scene can't be described as sound or sustainable.

MUKOYAMA: In industrial use, water is used for cleaning and cooling. The users will require technologies for more effective use of cooling water or for higher pressure cleaning water. However, if the users are unable to earn profits as a result of making investments for water conservation, I don't think it is very practical.

OKI: Since water is taken to be almost free in Japan, if the present water rate was, say, doubled, I think the cost-consciousness of individual households would increase. Or, it might be effective to implement a policy that induces a water saving effect.

Given that real water shortage occurs only twice or three times a year, it may be valid to figure out a method to cope with the problem specifically under those situations. If we try to conserve water all the time, water won't sell. So I think it is more practical and effective in Japan if we allowed people to use as much water as they like under normal conditions, and ask for their water saving cooperation only when there is a significant shortage of water, such as during droughts in the summer. Or, it might be a good idea to raise the water rate only for that period.

Flood Issues and Drought Issues

SEO: Do you have any preventative soft measures?

MIZUTA: The River Law has changed and was decided that the water of a river basin should be managed comprehensively. According to the circumstances, I would say that there are some benefits to be gained from floods. We certainly don't want to have a big flood that occurs once every 100 or 200 years. However, I heard opinions in various places that claim it might be better to have a flood that occurs once every 20 or 30 years so that we can pass on our experience and know-how on how to cope with floods to the next generation. Considering what can be done for that purpose, in parallel with efforts to construct continuous levees and other flood-preventing hardware, I think we must consider a variety of soft measures, as well. In such a case, we may allow a flood to take place, with preparation such as an introduction of flood insurance system to enable financial coverage of damages. I take it that the River Law's amendment gives us such themes.

OKI: In addition to what you pointed out, I think we have to consider changing our way of living. In order to allow a drought to take place only once every five years, it may be

necessary to disclose the forecasts as to the limits to the population that can be sustained in the area, or as to the costs associated with increasing the possible number of inhabitants. For example, water will be continuously supplied to the earlier developed area. On the contrary, it will be delivered by water tank trucks to the new residents. These are examples of soft measures that can be considered. If we were truly cost-conscious, that would be much cheaper, but the residents certainly wouldn't like it, I'm sure. If we consider the situation of an equal basis, the old residents may have less water due to the arrival of new residents. I wonder if it is fair. I hear there are some communities in the U.S. that restrict the number of inhabitants. That is not only because of water but also because of public safety concerns, but I think it's one way to cope with the problem. Japan as a whole will not have such a problem because the Japanese population is decreasing. However, population is still concentrating in local core cities and such an issue is coming to the forefront in some of those areas. We can neither be optimistic nor pessimistic.

SEO: In a global sense, is water deficiency more serious than floods? When it comes to flood issues, I believe Japan has much to offer to the world from previous experiences.

OKI: Since Japan is influenced by the Asian monsoon climate both in summer and winter, we have almost as much rainfall as in the tropical zones and we have an affluent stream flow and consequently, a lot of floods. In developed countries around Europe and the USA, however, water deficiency for food production is much more of interest.

SEO: That may be an issue that is difficult for the Japanese to recognize and comprehend.

OKI: I think there is a gap like that. Actually, drought is not really a serious problem for us in Japan at present as we rarely have a problem of poor yield due to lack of water, in general.

Civil Engineers are Expected to Play an Active Role

SEO: Then, what can we do for the future as young Japanese civil engineers? In what direction should we proceed?

OKI: The first of the anticipated academic pursuits is to provide reliable information concerning the global hydrological cycles from the past to the present. The second is to improve the accuracy of the near-real time forecasts, like heavy rain, and forecasts concerning natural climate changes influenced by El Nino, La Nina, and others from seasonal to inter annual time scales. It may lead to the prevention of disasters, and in the long-term scale, we may be able to get economic benefits by changing the agricultural crop breeds or changing the time of planting.

The third is to provide a reliable forecast of water cycles under climate changes conditions, such as global warming. Although we do not yet have precise forecasts at present, I'm afraid it will be too late to wait around. We need to think 30 years ahead to construct a dam, so we must start preparing now. We start out by investigating, working out plans, purchasing the land and then set about constructing. That is why we need to know what the climate will be in 30 years from now. Global warming will take place everywhere, regardless of whether it is a developed country or a developing country. We need to know whether we will be having heavier or lighter rains in Japan, or whether we will have more droughts or less, and we should immediately start preparing appropriate measures.

The fourth is to make a quantitative estimation as to how much water is at present available for human beings and how it will change in the future. How much of the river water are human beings allowed to use? If we were to preserve the ecosystem, how much water should we reserve, and how much can we distribute among us humans? Quantitative analyses for the present and the future should be made. If it becomes clear that water shortage will occur, the fifth is to present alternatives on what kind of measures can be taken in order to secure enough water to meet the present and future demands. The sixth is to grasp the realities of virtual water imports / exports and indirect water consumption, and to present the framework of the "water resource security." I believe it is better to collect reliable data by ourselves, which will serve as data for basic diplomatic policies.

Item 1 to 3 above, are within the framework of natural

Mr. Okutani

Ms. Seo

science, while items 4 to 6 are issues that are related to human engineering and the legal system, and, to my understanding, it is the field where we civil engineers must play active roles since civil engineering covers both physical science and human science. Therefore, I believe we should deal with the above-mentioned issues including its management and organizations, not just the simply supplying the infrastructures.

OKUTANI: I feel the same way in that the data we use must be those we can totally trust. There are all sorts of numbers used in this world. There can be many different numbers describing one phenomenon, and they may vary a great deal depending on what angle you choose to adopt. Unless we know what type of numbers is being used, Japan will not be able to determine which course of action it should take in response. That is something I have keenly felt.

MUKOYAMA: Even if we pose an opinion about the global water resource issue, it would not be taken seriously by the world unless our comprehension of the issue is sufficient and we can make our position very clear.

OKUTANI: How can we make ordinary people understand the new perspective that "water resource" is a global issue? I think we should present what many different explanations and interpretations there are from the viewpoint of a civil engineer, whose job is to build infrastructure, the foundations of everyday life.

In addition, I personally felt that in some cases more deliberate handling would be necessary. As discussed before, in terms of soft measures, we propose a kind of new life style and we expect it to be accepted. I'm afraid it may be considered as a one-sided imposition. Each culture in each nation has value. We must be very careful to provide aid in a way as not to destroy each nation's culture. That's an approach I took from a different perspective.

SEO: In association with the preventive diplomatic policy mentioned by Mr. Okutani, Professor Takeuchi says in the opening article that what is important is to recognize the water issue as a political matter. Japanese engineers have been given few opportunities to say anything in political scenes, but I think young engineers should actively make remarks in the international arena as well from now on. What do you think?

OKI: The global water issue is a political matter, indeed. I think what is really important is for an engineer to actively suggest, without hesitating, to realize those things he believes will help save more people at a lower cost, that is, what will be good for the society. If a public fund were invested in vain, it would be necessary to make a more efficient proposal, or, if a certain country were peddling influence, it would be necessary to offer an alternative plan. If there is a good chance of succeeding, then it is one's duty to make appropriate suggestions to materialize the plan. One must speak out constructively with such strong beliefs and alternative plans.

Civil Engineering Makes a Sustainable Society

SEO: In conclusion of this discussion, I would like to ask each of you to express your opinion as to what specifically you think we should do.

If you will allow me to speak first, being a consultant, I felt I should first gather accurate information as to what kind of issues are developing in the world and next to convey to the public on what needs to be done. What are your opinions?

OKUTANI: I thought the first thing I must do is to enhance my ability to digest a problem as if it were my own. The global water issues are truly striking in its concept when explained. I can understand the logic, but at the same time, I feel kind of frustrated that I can't really grasp the issues as my own. I think I should deepen my knowledge, looking for any answers as to how I can cope with the issues.

MUKOYAMA: Talking about young civil engineers, I think a lot of people in the civil engineering field have been working because they want to construct things, or construct things that will last longer. However, the future playing fields for the young civil engineers are those where they cannot proceed with the job unless there is proper management. Even more, to cope with the global water issues, researches in terms of "soft measures," including management techniques, will become necessary. For that purpose, the six approaches that Dr. Oki has mentioned will be a great hint. To collect information, to digest it, and to offer feedback; it is important to become an engineer with such application ability.

MIZUTA: I'm thinking that there is a way of thinking not from a viewpoint of someone who constructs things, which is common concept in civil engineering, but from the viewpoint of someone who does not construct things. However, I would like to continue my research always reminding myself that a plan, including an option not to construct something, will be only as a vain doctrinarism or lack of reality if I don't make it clear what is really acceptable in the people's minds.

OKI: One of the significance of working globally is that we

can learn different management know-how from different regions. If we look around the world, there are very ancient water facilities that are still used at present, and I think it is a magnificent thing. The Dujiangyan in Szechuan, China, has been used for 2,300 years and it still continues to supply irrigation water in the Szechuan Basin. The Dujiangyan is a facility that takes in water, without using machinery, and taking in as little dirt as possible into the irrigation system. It is made so that it does not use much energy except human power. It may not have been constructed to make it last for 1000 or even 2000 years from the beginning, however, I think that the future infrastructure should be constructed with such high level vision. What is sought now is not "sustainable development", which is often referred to in the discussions of global environmental issues, but the "development of sustainability" or "sustainability development." I would like to propose that the establishment of a sustainable society be set as a big goal of civil engineering.

Mino Bridge-The oldest existing modern suspension bridge in Japan

Kei SUZUKI
Kajima Corporation

The Investigation of a historic civil engineering structure can be, in a sense, compared to a detective's job to delve into a mysterious incident. Who designed and constructed what, where, when, why and how are deducted based on various assumptions. When these 5Ws1H become clear, then we can reveal the truth like Sherlock Holmes. This time, for "civil engineering travel", I focus on the Mino Bridge in Gifu Prefecture, which was certified to be the oldest existing modern suspension bridge and designated as a civil engineering heritage by Japan Society of Civil Engineers in 2001. The construction of the Mino Bridge, with a length of 114.2 m and a width of 2.3 m, was started in August 1915 by Nagoya Tekkoujo (or "Nagoya Iron & Steel Company") and completed in August 1916. (Photo-1) According to the "History of Mino City"i, how the bridge was constructed is clear, but the designer is unknown. Hence, I detect the 5Ws1H of the bridge as Sherlock Holmes, making various assumptions. The excitement of the civil engineering history lies in this very point, but I will leave the judgment of the deduction up to the future discovery of the historical documents and the further study of the readers who are interested.

Mino City and crossing ferries

Mino City in Gifu Prefecture is located on the Nagara River and the Itadori River, which is a tributary river of the Nagara River, carrying clear water that is an essential element to produce Mino washi(Japanese paper). It commands a beautiful view of the rivers with the background of green mountains. Sir Osaomi Kanamori, who had become a feudal lord of this district since the Battle of Sekigahara, built a castle at the top of Mt. Ogura and constructed a new flood-proof castle town. The streets of Udatsu have a somewhat historical taste and attract a lot of people from other prefectures. Kouzuchi Port flourished as the doorway for cargo shipments and thrived as a base for ship transportation heading downstream on the Nagara River. The Sumiyoshi-type Lighthouse, which is 9 m high standing on the bank and one of the rare structures in our country, is presumed to have been built at the end of Edo Era, and the area around the lighthouse is designated as a prefecturally-designated historical siteii. Since the Edo Era, Kouzuchi was the hub from where roads stretched out to various places. There were ferry crossings where the roads crossed the Nagara and the Itadori rivers. The Maeno crossing on the Makitani Road, the Tachibana Crossing and the Nagase Crossing on the Gujou Road, and the Simo Crossing on the Bugei Road were the main crossings busied with much passengers. At the time of heavy snow or floods, however, the river was closed and the traffic was often stopped. The people strongly requested a bridge at the Maeno Crossing since the end of Meiji Era, and the Mino Town Congress submitted a petition for bridge construction to the prefecture in 1912 (Meiji 45), but it was rejected then. The petition was submitted again in 1914 (Taisho 3) and the construction was approved.

Photo-1: Overlooking the characteristic main tower of Mino Bridge from the riverbed.

Models for the Mino Bridge

The characteristic of the Mino Bridge is its unique, heavy-looking main tower form made of concrete. It's the only remaining part since the completion of the bridge. The lateral beam of the tower with a height of 4.5m was determined not from a structural viewpoint but from a designing viewpoint, considering that the "Manual for Reinforced Concrete Bridge Design", the first manual for reinforced concrete bridge construction in our country, was established by the Tetsudo-

In (predecessor of Railway Ministry) in the year of 1914. There exists a model for the historical bridge and it may give us some clues. In 1809, a suspension bridge was completed over the River Merrimack at Newberry Port, Massachusettsiii. This bridge was designed by James Finley (1756-1828), who was the inventor of modern suspension bridges. The main tower, which was made of bricks, looks very similar to that of Mino Bridge. According to the patent on the suspension bridge that Finley obtained in 1828, it is stated that the sag ratio of the cable to the span is 1:7iv, that the angles of the cable of the main tower should be the same, to hang the hanger from the cables and to attach truss stiffening girders to it, and hereby the load was transformed to hangers, which would restrain excessive deformation of the cable. This last characteristic is the one representing the structural characteristic of a modern suspension bridgev (Note-5). The Jacob's Creek Bridge, which was completed in Union Town, Pennsylvania, was used in the design for the patent obtained in 1808vi (Figure-1). The wooden pony truss was used, similar to that of the Mino Bridge. Suspension bridges of this type spread all over Europe in time and, in France, the Seguin Brothers adopted the same type for the Saint-Vallier Bridge which was completed in 1824.

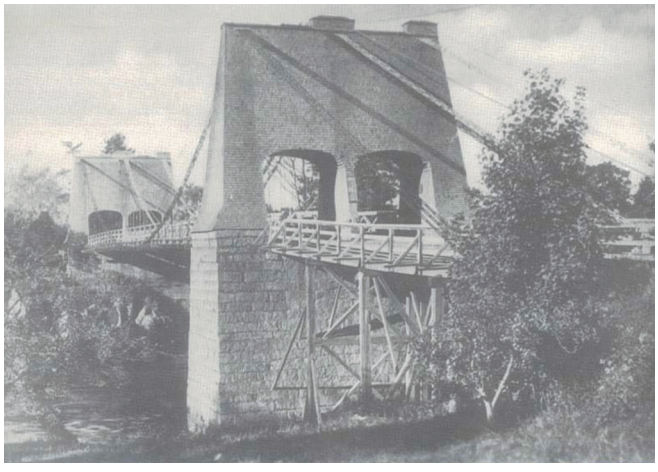

Photo-2: Newberry Port Bridge: This could be the model for Mino Bridge.

Was the designer SEKIBA Shigeki?

It is thought to be quite feasible that the designer of the Mino Bridge was an engineer of Nagoya Tekkojo (or "Nagoya Iron and Steel Company") but since Nagoya Tekkojo was merged with Ishikawajima-Harima Heavy Industry Co., Ltd., no documents pertaining to the Mino Bridge have been found. If we focus our attention on engineers who had studied in America before 1914 as designers, and those who had the latest information on bridge design technology at that time, there were KABASHIMA Masayoshi and SEKIBA Shigeki, who worked actively as bridge designers after the Kanto Earthquake Disaster. Both of them studied bridge design business at Waddell & Hedrick. KABASHIMA Masayoshi went abroad in 1901 (Meiji 34) and came home in 1906 (Meiji 39) and took a post at the Bridge Section of Tokyo Metropolitan Government. SEKIBA Shigeki came home in 1908 (Meiji 41) and became the first Engineering Manger of the Yokogawa Bridge Corporationvii. According to the corporate history of Yokogawa Bridge, "the company was appointed as the designated steel girder manufacturing factory of the Tetsudo-In and drew up "The Standard Bridge Specifications" in 1914 (Taisho 3), which was the first standard of bridge design and construction in our country. There having existed no unified standard until then, indicated the guidelines on usage of steel material for public roads and bridges, and it had been used as the standard until the middle of Showa Era." This passage supports the idea that there was influence by Sekiba who studied bridge design and technology in America and we may well assume that the high technology level of Yokogawa Bridge Corporation was known to Gifu Prefecture. Kabashima, on the other hand, having taken a post in the Tokyo Metropolitan Government, the probability seems quite low that he might have taken a job of designing a bridge for another prefecture. Considering these points, we can assume that Gifu Prefecture requested Yokogawa Bridge Corporation for the design of the Mino Bridge, and SEKIBA

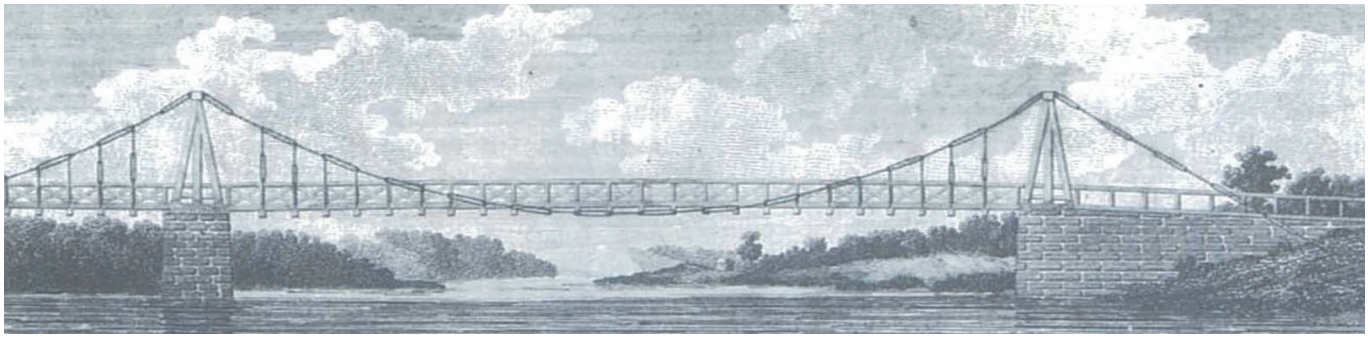

Figure-1: Patent James Finley: With the added stiffening girders, this bridge is an early model of modern suspension bridges.

Shigeki took charge of it. In addition, it is assumed that the model of the bridge was the suspension bridge invented by Finley, who was the founder of modern suspension bridges, and that cast iron or wrought iron was used for the stiffening girder (Photo-3).

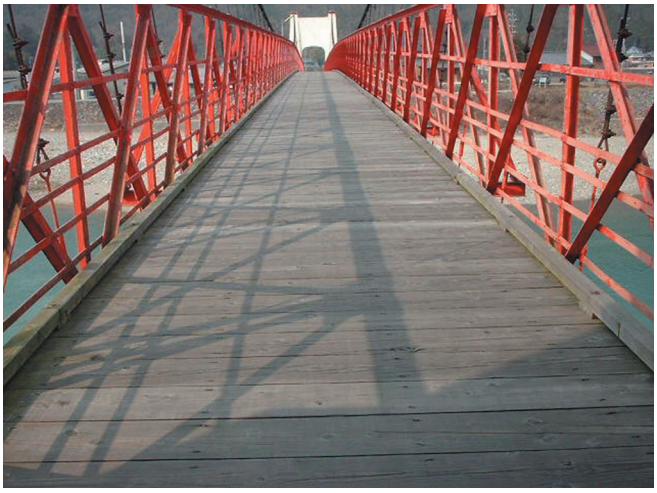

Photo-3: Observing the stiffening girder from on top of the bridge.

References:
i The History of Mino City
ii Mino City Website
iii Wagner, R. und Egermann, R.: Die ersten Drahtkabelbruecken, 1987
iv Ernst Haeseler: Eisernen Bruecken, 1908
v KAWADA Tadaki: The Cultural History of Suspension Bridges, 1981
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The Urban Space Renewal Project that Incorporates Roads and Railways
The Successive Multi-level Crossing Project in Tokyo, and the Odakyu Trial

Ryoji HIROKI
Construction Bureau
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The effect of the successive multi-level crossing project

There are about 1,200 railway crossings in the Metropolis of Tokyo. The Japanese railway operation is maintaining a split-second, every two-minute run, which in fact has no parallel in the world. Because of this, there exist a lot of so-called "unopened crossing gates" that is, crossing gates which seldom open in rush hours in the morning and in the evening.

This not only causes congestion of people and cars but also hinders the emergency operations of police and fire stations. The fact that the area along the railway is divided by the railway itself is having great adverse effects on the community's daily activities and the social and economic activities. In addition, accidents at the crossings are the Achilles' heel for the railway operation, and in order to solve this problem, building multi-level crossings of railway and road is necessary. Above all, the necessity and the urgency of the "successive multi-level crossing project", which is to build overhead crossings successively for a certain section, are coming to the front.

This is a project with a government subsidy provided by the Ministry of Land, Infrastructure and Transport as one of the road improvement projects, based on the financial resource from the gasoline tax, automobile weight tax, etc., and is implemented by the Metropolis, prefectures and ordinance-designated cities according to the "Agreement on building successive multi-level crossings of railways and roads in urban areas" concluded between the Construction Ministry and the Transportation Ministry in September, 1969 (Showa 44) (revised in March, 1992 (Heisei 4) and the 'Itemized agreement". At present, getting rid of crossings is re-recognized as an important political issue and this project, which is going to make use of the urban space restricted in many ways in terms of space and environment using various technologies, is the last card for urban regeneration.

The effects of the successive multi-level crossing project can be summarized as follows:

(1) Because a lot of crossings are taken away at the same time, it is expected that traffic congestion and accidents at crossings will be greatly reduced.
(2) Unification of the communities separated by the railways will be promoted and it will have a strong impact on urban degeneration and activation by implementing the town redeveloping plans and the land readjustment plan together with this project.
(3) The space newly generated under the overpass can be utilized multi-purposely, for instance, for a bicycle parking lot or a contact window for administrative services, in accordance with the overall town planning of the area.
(4) It will contribute a great deal to safety increase of railway transportation, saving the cost for crossing maintenance and reinforcement of transportation. It is becoming a leading project to carry forward the integrated overall town planning.

Problems in Tokyo and addressing them

While the above-mentioned effects are expected, there are problems in implementing the project as follows;

(1) Building multi-level crossings will incur a huge expense and will impose a big burden on the wards and cities along the railway.
(2) It will take a long time until completion since it is a large-scale project and must be carried out without stopping trains in the city area.
(3) Such being the case, it can't fully respond to the district's request for clearing crossings as soon as possible.
(4) It becomes necessary to acquire or rent the land along the rail track for a certain section in the case of adopting and implementing the temporary track method in order to utilize the existing railroads.
(5) Since the temporary rail track comes close to private houses, it is necessary to ask for the inhabitants' cooperation to solve environmental issues.

To cope with those issues, we are carrying forward our project, putting our ideas together and trying various measures at respective sites.

Especially, the following two approaches turned out to be very effective in order to make further progress in the project.

One is: if the land that is going to be rented for building a temporary track is farmland that has been exempt from inheritance tax, it is necessary to improve the situation in which the inheritance tax is imposed retrospectively, which obligates the landowner to pay a far larger amount of tax than the land rent fee, therefore, makes it impossible for him/her to cooperate with the project. To cope with this problem, together with the Mayors of Kunitachi City and Koganei City, we submitted a request to the government asking for the amendment of the special taxation measures law. As a result, it was decided that the farmland in question should be continued to be tax exempt by being designated by the Minister as a site for the temporary track.

The other is; in order to avoid suspension of the construction work due to failure of obtaining cooperation with the land offer, we went through a procedure pertaining to the land acquisition on the following two points.

Firstly, since the land, which was necessary for the temporary track, was outside of the area that was given a project permit based on the City-Planning Law, we filed an application for a project permit as stipulated in the Compulsory Purchase of Land Law.

Second, since we came to have the belief that it would be impossible to have the consent from everyone who has a sectional ownership as to the land acquisition of a large-scale collective housing, we asked the management union for a vote to decide on the land sectional disposal and made an equity purchasing contract and a land ownership registration transfer with the majority of the people who agreed on the land sale after the right deletion registration of a subdivision-of-a-lot site, and only against the people who disagreed on the land sale, we followed the procedure of condemnation of the land.

It is our intention to make utmost the effort in order to obtain understanding toward the project and to meet the expectation of many people who extended their cooperation to the project.

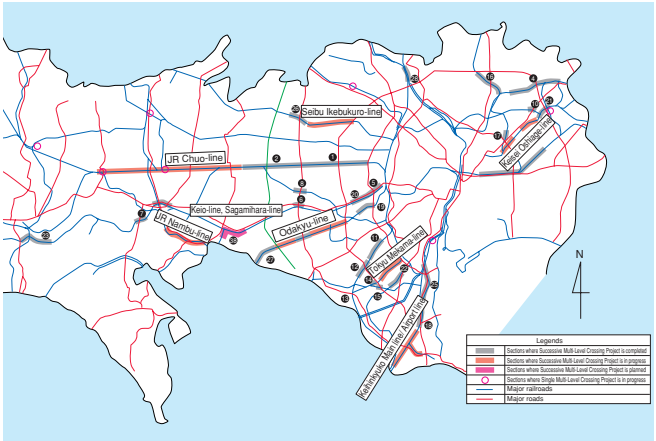

Figure-1: Successive multi-level crossing project in Tokyo (As of March 2001)

The rail tracks under the project in Tokyo

The Metropolis of Tokyo started this project in 1962(Showa 36) and has already completed this project for 67.8 km at 29 spots on 17 lines such as Odakyu Odawara Line (Yoyogi-Hachiman ~ Higashi-Kitazawa, Seijogakuen ~ Noborito) and Keio Line (Hatsuda ~ Daitabshi, in the neighborhood of Fuchu), removing 246 crossings.

Presently the lines under the project are eight lines at nine spots, which are Seibu-Ikebukuro Line (Nerima ~ Nerima Takanodai), Odakyu Odawara Line (Setagaya-daita ~ Kitami), JR Nambu Line (Inadazutsumi ~ Fuchu-Honcho), JR Chuo Line (Mitaka ~ Tachikawa), Tokyu Mekama Line (Meguro ~ Senzoku), Keihin Kyuko Honsen Kuko Line (in the neighborhood of Keikyu Kamata Station), Keisei Oshiage Line (Oshiage ~ Yahiro, Yotsugi ~ Aoto), and Keio Line (in the neighborhood of Chofu Station).

Among them, in March 2000 (Heisei 12), at the intersection of the Radial No.7 Road (Mejiro Blvd) and Seibu Ikebukuro Line, we undertook a construction of reverse-multi-level crossing, which crossed a road beneath the elevated railroad, doing away with the only crossing which had been left in the section under the project on Seibu Ikebukuro Line. In addition, the down line of Odakyu Line between Setagaya-daita and Kitami was made multi-leveled by the end of 2001 (Heisei 13), and the rest of the existing line was made multi-level by the end of 2002 (Heisei 14).

In addition, construction of the successive multi-level crossings on the quadruple track in the neighborhood of Shimo-kitazawa on Odakyu Line was decided to go under preparation for the construction work and a city planning change was made in January 2003 (Heisei 15).

The petition for revocation of the project permit for constructing successive multi-level crossings on Odakyu Line and the judgment by the Tokyo District Court

There was a very unprecedented judgment that rescinded the project permit that had already commenced, made by the Tokyo District Court on October 3, 2001 (Heisei 13). It was to revoke the project in which 70% of the viaduct construction had already been completed and seven out of the seventeen bottleneck crossings already removed, and with the filing in court of the petition we see that great stress was caused to all the parties that had been involved in the project. The national government, upon hearing our opinions, that is of the Tokyo Metropolitan Government, appealed the verdict on October

Photo-1: Reverse-multi-level crossings construction for the Seibu Ikebukuro Line.

12, 2001.

The Tokyo Metropolitan Government has been participating in this suit as an observer in the place of a city planning decider. While we will keep asserting the legitimacy of city planning and the project permit at the appeal hearing, let me take this opportunity to explain about some issues at stake.

The outline of the project and the court decision

The outline of the project is as follows: The project of building successive quadruple multi-level crossings for the 6.4 km section between Seijogakuenmae Station and Umegaoka Station on Odakyu Line was given a project permit in June 1994 (Heisei 6), and the construction work was started in December that year and is scheduled to be completed in 2004 (Heisei 16). The total project cost is approximately 190 billion yen. This project was decided on based on the No. 9 Line City Planning made in 1964 (Showa 29) with some partial revisions such as the change from the surface method to the half underground method in the neighborhood of Seijogakuenmae Station.

The outline of the suit is as follows: 123 residents along the line filed a suit against the Construction Minister at that time in June, 1994 (Heisei 6) appealing for revocation of the project permit demanding a change from the viaduct method to the underground method.

The decision by the Tokyo District Court is as follows: It admitted the eligibility of 9 people among the plaintiffs and declared the permit illegal stating that the permit "made a decision as to the suitability of the project execution duration without good grounds", "overlooked a discrepancy between the city planning decision and the site marking in the drawing of project permit application" and the city planning decision "overlooked the possibility of generating illegal noise damage in a considerably large area in the case of adopting the viaduct method", "was wrong in making a plan on the premise that the neighboring Shimokitazawa zone is on the surface", "if the underground method was adopted, it can't be said to be inferior in terms of geographical condition" and "there was a good possibility that the conclusion as to which, the viaduct method or the underground method, was superior in comparison of the project costs might have been reversed or the difference might have been very small."

Impact on the environment

The Tokyo Metropolitan Government has been implementing the environmental impact assessment based on the bylaws so that appropriate consideration may be given to the preservation of the natural environment and the prevention of pollution since 1981. This system will help a great deal in carrying out city planning that gives the top priority to the environment and is very advanced compared with other local government administrations in this country. Since the successive multi-level crossing construction project is to utilize the existing lines, most of them are to be discussed and as for Odakyu Line, we heard the opinions from the citizens, wards, cities, towns, villages and the Governor of Tokyo by holding explanatory meetings and deliberation committees, and implemented the environmental impact assessment so as to have as little impact as possible and made a modification in the city planning following a series of procedures. We could not have overlooked the possibility of noise damage generation in a considerably large area.

In the "Guidelines for the noise control measures in the case of new construction on an existing rail track or a large-scale reformation" established in 1995, it is mandatory that the noise level must be improved in the case of a large-scale reformation, and it had been already achieved in the construction of successive multi-level crossings in the neighboring zone on Odakyu Line between Izumi-tamagawa Station and Kitami Station, which was proven in the investigation after the completion of construction. In addition, we adopted 60 kilo rail and we are carrying on installing acoustical panels and interference soundproof devices inside the sound insulating wall. On account of that, it is considered that the zone under the construction area will get much lower noise of trains running than the zone between Izumi-tamagawa Station and Kitami Station and we have actually heard the voice of the residents along the track that has already been completed, saying that the noise has changed in its quality and become quieter.

City planning should be decided from a comprehensive standpoint considering and comparing everything totally as to what is necessary in order to achieve the city's sound development and orderly maintenance, and it is requested that enough consideration be given to environment measures, after judging there is little influence by the environment assessment. It is quite a pity that the fact that the project executors had taken these things into full account and tried to make the best use of the latest technical knowledge was totally neglected.

The project cost

As for the project cost, the actual results of the multi-level crossing construction of the existing lines are 360.6 km using the viaduct method versus 16.8 km using the underground method. The number of the viaduct method construction is overwhelmingly larger than the other one. This shows that the construction cost of the viaduct method is lower and more advantageous in order to get rid of as many crossings as possible within limited financial resources.

In recent years, in constructing subways, they are being constructed very deep underground. The construction cost per 1 km comes to over 20 billion yen. If we are going to conduct the successive multi-level crossing construction underground utilizing the existing lines, we come across various difficulties, such as we have to construct while maintaining the stations and rail tracks, and the cost is getting higher and higher. On the other hand, in the case of the viaduct method, construction work is simpler and it is an utter truism that the construction costs become lower compared with an underground cut-and-cover method of tunnel or shield tunnel.

Also, on the main artery road in Tokyo, the so-called Kanpachi Road (8th Circular Road) in this project area, about 800 m of viaduct has already been constructed and it is quite natural to make a plan utilizing it.

It is quite hard to understand what it was really meant in the judgment by pointing out that there was a possibility that the costs of the viaduct method and the underground method might be reversed or almost the same, but if it meant to value the site above the track in the case of making it underground and deduct it from the construction cost, as the plaintiff asserted, a witness on the plaintiff's side admitted that "there was no such precedent that the necessary costs had been budgeted that way.. They calculated that they needed a certain amount of money to cover expenses. There had never been a case where this money was itemized as "business expenses", but they claim they did this to create a buffer."

How the Odakyu Railway procured the necessary funds for the project is one thing and to figure out the project costs necessary for city planning is quite another. In other words, it is obvious that, even if Odakyu procured the funds by selling their own land, it should not be deducted from the project costs necessary to implement city planning.

Toward the appeal hearing

Apart from the above, the judgment pointed out a number of points that were not disputed in the trial hearing.

For example, the appropriateness of the construction period, the conflict between the city planning and the notice of the project permit, and so on. However, are there any problems in carrying out city planning under plural projects? Having the viaduct construction as the successive multi-level crossing project and the rail track increase as the quadruple line track construction project, we regard it as a matter of course from a practical view point to cooperate and collaborate with each other in order to carry on the construction. We don't see any reason in it to judge the project permit as illegal.

Now, The Tokyo Metropolitan Government is taking part in the appeal hearing to make more detailed assertions, together with the national government.

Also, we aim for the earliest possible completion of the project in order to meet the requests of a great many people who are looking forward to the dissolution of crossings and who are using the Odakyu Line every day commuting to/from work and school waiting for the quadruple track completion. Fortunately, we have been able to obtain the citizens' cooperation regarding the acquisition of the sites for the railroad project. The three parties involve in the project, the Tokyo Metropolitan Government, Setagaya Ward and Odakyu Electric Railway, will continue to work on with the aim of the completion of the quadruple line track in the year of 2004 (Heisei 16).

Picture-2: Soshigaya Okura station on the Odakyu-Odawara line.

Picture-3: Advertisement for the multi-level crossing construction project.

City planning for the future

Apart from the above case, various lawsuits were filed pertaining to this project. The construction ban claim, ban claim of the expenses for the third sector in order to introduce the NTT-A type fund to the multi-level crossing construction project, and the compensation claim, revocation claim of fare raise, nullification claim of the project permit by the land appropriation law, and so on. In all of the cases, the plaintiff's appeal was rejected, the ruling was finalized at the Supreme Court, or the plaintiffs themselves withdrew their appeal. This is the first case in which the judgment was given against the defendant and we consider it necessary to probe why this case became entangled this far despite the fact that it was the project supported by many people's requests.

In deciding on city planning, the Tokyo Metropolitan Government makes it a rule to hear opinions of the district inhabitants from the beginning stage of the rough idea of the planning, and we consider we can take pride in it as part of an open administration. However, for the people against the plan it can be regarded as an indulgence for the city planning decision, and it cannot be denied that they appealed to their forces to block the explanatory meetings and filed various suits.

The Tokyo Metropolitan Government is now trying to find a new way to carry on city planning with full flexibility and practicability, such as improvement of transparency of the city planning process, so that various bodies can participate in the city planning in the process of deciding on plans and implementation. Moreover, various trials and examinations are carried out as to how the so-called "strategic assessment" should be. From now on, it is our assumption that various discussions will be had as to how to develop consensus-building systems and improvements, meeting the needs of the times, based on past matters.

Toward the future promotion of the successive multi-level crossing project

For the multi-level crossing project, it is very important to go along with the overall city planning including the land readjustment project, the urban redevelopment project in the neighborhood of a station and the area along the rail track and the improvement plan of the roads and the station square. Thus cooperation with the municipal bodies along the rail track is essential.

It may well be assessed as the epitome of urban civil engineering, since it is being carried on exercising our ingenuity in collecting the latest technologies from various fields other than civil engineering in conducting a large-scale construction on narrow city streets.

Also, since this project is being implemented while the existing lines continue being operated, what is the most important is the cooperation and understanding of the inhabitants along the track, to say nothing of the cooperation from the contractors and the railway companies involved. The Tokyo Metropolitan Government is going to promote this project actively trying to obtain the citizens' understanding faithfully.

Look and Listen to the Movement of Civil Engineering
A Panorama of a Mysterious World: Calcareous Cave in Tosa City

Masaaki YOSHIKAWA
Earthquake Prevention Laboratory
Construction System Engineering Department, Kochi Technical College

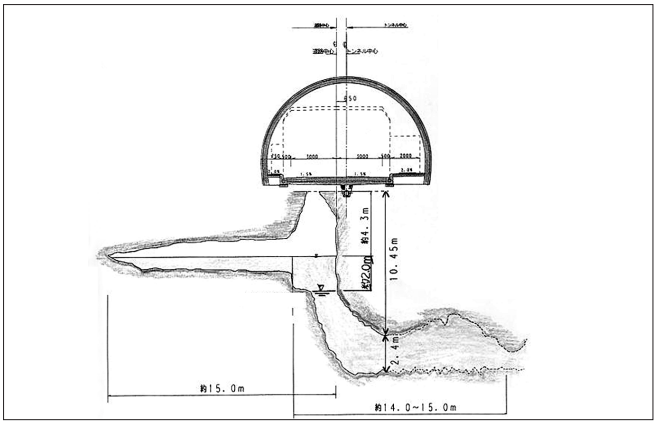

Diagram of the cross section


Inside the calcareous cave

In November, 2001, at the construction site of the Tenzaki Tunnel (approximately 11m in diameter, length 110m) on the prefectural road of the Tosa Ino Line in Tosa City, Kochi Prefecture, a calcareous cave of 40m from east to west, 6m from north to south, and 15m in depth was discovered during an excavation activity about 40 meters from the tunnel entrance at the present area for the prefectural road. In Kochi Prefecture, limestone has been exposed since 270 million years ago and there exists another calcareous cave, designated as a national natural treasure at a place 50 km away to the east from this limestone zone.

When you crawl down on the temporary steel ladders from the hole inside the tunnel, there is a terrace made of limestone on which a man can stand. There, stalactites of up to 1.5 meters are hanging down from the ceiling in their reddish tinge and a forest of stalagmites as tall as a man grows from the cave floor. And below this, a pool of milky emerald-green water with a perfectly calm surface lies, creating a world of tranquility and fantasy.

As part of the by-pass construction work of the prefectural road, the tunnel, which would pass under the limestone hill of approximately 40m in height, was excavated by a machine without blasting because there are a lot of houses in the neighborhood. If the tunnel had been excavated 50 cm higher, the calcareous cave would have remained undiscovered. On the other hand, if it had been excavated 50 cm lower or blasting method had been used in excavation, the ceiling of the cave would have collapsed and the whole cave would have been destroyed. Thanks to a series of miraculous coincidences, the cave narrowly avoided the destruction and appeared in front of us.

Soon the "Investigation Committee of Tenzaki Tunnel Calcareous Cave (tentative name)"consisting of experts in geology and tunnels and representatives of the district, was organized at the Civil Engineering Department of the Kochi Prefectural Government and the construction was suspended for a short period of time. The author made a suggestion, from the point of view of earthquake engineering, about the method of bridge construction from the ceiling of the cave inside the tunnel in order to conserve the cave and control the vibration due to the traffic using TMD. In this area, there is a concern for the possibility of the Nankai Earthquake, which is said to happen once every hundred years. If the growing speed of a stalagmite is calculated to be 1 mm in 1,000 years, the cave is estimated to be about 1 million years old. Those stalactites and stalagmites have probably survived hundreds of earthquake incidents without leaving any indication of fall or collapse. This fact convinced me that the interior of the stone (P wave speed about 3 km/s) has an anti-earthquake structure. Since this calcareous cave which, is filled with mystery and adventure appeared in front of us in a moment of luck, we would like to investigate it using sufficient fund and time and we would like to hand it down to our descendants.

"Founders of Modern Japanese Civil Engineering" Crowns the First Place in the 2001 Cultural Film Ranking of the Cinema Report

Tadao KAWAMURA
Chuo Fukken Consultants Co,Ltd

"Cinema Report Top Ten", the highest authority in Japanese film scene has awarded the first place of their 2001 cultural film genre to "Founders of Modern Japanese Civil Engineering", a movie conceived by Taisei Corporation, directed by the acclaimed Junsei TANABE, and produced jointly by Nippon Eiga Shinsha Co. and Nichiei Kikaku Seisaku Co. This is the second honor that the work receives, following the "Grand Prize for Japanese Industrial Films and Videos".

Since many of our readers might have already seen it, I will not go into the details of the plot. However, the film (which is also available in video) recounts in 58 minutes, the lives and works of five forerunners in Japanese civil engineering, who in the beginning of the Meiji era (A.D.1868-1912), have left great footprints on the education of civil engineers following them and created from nothing, the foundation of the national land management. The film is also a chronicle of our country during the time that these five personalities, INOUE Masaru, TANABE Sakuro, FURICHI Kimitake, OKINO Tadao, and HIROI Isamu have lived.

The prize winning is even more meaningful as Mr. Tanabe, a fine and eminent filmmaker who has created masterpieces like "Ishi o Tsumu (Stacking stones)", "Kozui o Nadameru Hitobito (Those who sooth the flood)" acknowledged it as a hurdle and commented "Cinema Report's top prize was really my dream as a film maker". The prestigious award is also the first achievement by films related to construction.

The construction field has been comparatively enthusiastic about film creation and has been producing numerous works so far but most of them focused on project records and technical explanations. There has been no powerful portrayal of the forerunners' footprints or records of public utility of civil engineering and thus the impression has been that the works were a step short from public recognition. I hope that the Cinema Report prize would be the first step in public re-recognition of civil engineering.

Although I heard that a considerable number of the videotapes of this film were sent to educational institutions and libraries, the Taisei Corporation will provide the videos free of charge to those who are in positions to provide public good and are interested in showing the film. Please contact the company's PR department (TEL: +81-3-5381-5009, FAX: +81-3-3345-1386).

I hear a lot about the shortage of texts and supplementary materials for the education of ethics in construction, which has recently begun. Although this is my personal view, I would like to add that this work could serve as supplementary material for this field. (1/29/03)

新しい課題へのチャレンジ

2001年度キネマ旬報文化映画大賞を受賞した

田部 純正さん

Left: From the archive of the Kensetu Tushin Newspaper (Feb. 20, 2002)
Right: From the archive of Cinema Report, No. 1350, Feb. 2002

Development of Risk Management Technology for Rock/Slope Failure

Hiroshi MIKI
Director of Construction Technology Research Department
Public Works Research Institute

In order to efficiently and effectively manage the enormous number of road slopes in our country for disaster prevention along with current budgetary constraints, it is essential to develop a technique of rational risk assessment and management for rock and slope failure. The Road Bureau of the MLIT (Ministry of Land Infrastructure and Transport) and the Public Works Research Institute have been intensively working on the technology development in this field and trying to explore new technologies for disaster prevention of road slope failure under the "Five-year Project on New Road Technology".

Background and Direction

Since the accident of a bus falling at the Hida River in August 1968, MLIT has been implementing traffic regulatory actions, with the greatest priority on human life, designating road sections with a high potentiality for accidents during heavy rainfall as sections for "disaster-preventive" traffic regulations during unusual weather. Also, comprehensive inspections for disaster prevention are carried out every five years and disaster prevention works are implemented on areas requiring countermeasures in accordance with the plans.

Thirty years have passed since then and the number of road slope failures has decreased remarkably due to the progress of disaster prevention works. As a matter of fact, the number of disasters on national roads under the direct jurisdiction of MLIT is almost one-fifth of what it was 20 years ago for which data is available.

On the other hand, amid the increasing importance of roads as infrastructure of industry and people's everyday life, the public is growing weary of closed disaster-preventive traffic sections hampering the convenience and reliability of roads, and of the non-decreasing budget for disaster prevention.

However, looking at the actual situation of the present Japanese roads, where three-fourths of the national land is mountainous and weather conditions are also severe, there are a lot of roads that are winding through the steep mountainous areas of fragile geological features and despite progress with countermeasures implemented on the road site, there are a lot of places still left with a possibility of large rock falls or secondary disasters from the natural slopes above, where a sufficient countermeasure is difficult to implement and the investment is too large in proportion to the benefits.

Research Significance and Summary

From the background mentioned above, the development of a rational technique for the risk evaluation and management for rock and slope failure is now required in order to effectively and efficiently work out the disaster prevention management of the road slopes under current budgetary restrictions.

It is necessary to develop hazard evaluation technology utilizing high-tech solutions like GIS, develop slope monitoring technology, and an improvement of disaster-preventive traffic regulations are required. Also, to enhance the accountability of countermeasures for road slope disaster prevention, it is necessary to present an appropriate assessment of slope failure risk and to clarify the investment effect and prioritize various disaster prevention countermeasures.

Hence this R&D team approached the road slope disaster measures from the following four aspects; (1) Hazard evaluation technology (sampling) (2) Influence mitigation technology (management) (3) Prediction technology (surveillance) (4) Risk management technology (accountability) and carrying out R&D on the component technologies necessary for each aspect.

Table-1 shows a summary of individual component

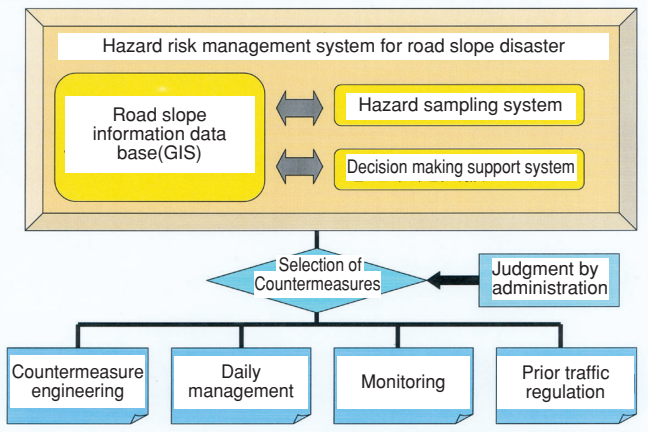

Figure-1: Illustration of the research system

Technology development items		Element technology development and the final results	
Hazard evaluation technology (Sampling)	Investigation of rock/slope inside structure, Stability evaluation technology	A. Technology Development of, simplification and Efficiency of slope stability investigation	·Proposal of a simple investigation technique for slope stability ·Development of cutting edge investigation techniques such as a laser pro filer and technology for simple measurement of soil layer depth.
		B. Development of investigation technique for rock bed interior structure	·Creation of the measurement and evaluation manual for unstable rock bed slope using the investigation technique for rock bed interior structure
Influence mitigation technology (Management)	Technology for efficiency and advancement of slope disaster management	C. Development of CIS utilization technology	·Creation of the abstracts of maintenance and utilization of the road slope data by GIS. ·Establishment of algorithm for a hazard map creation and the trial on the model routs. ·Improvement of the road disaster checking techniques
		D. Advancement of prior traffic regulation technique	·Creation and trial of "The guideline plan of the prior traffic regulation technique using the "equivalent continued rainfall method (effective rainfall method)"
		E. Examination of software measures for coordination techniques among road users or the local districts, etc.	·Establishment and trial of the "local disaster prevention partnership"
		F. Upgrading of daily management	·Creation and trial of the "Disaster prevention Figure operation manual (plan)" and the "Basic manual for checking using the disaster prevention Figure (plan)"
Prediction technology (surveillance)	Monitoring technology for slope surface failure	G. Development of monitoring technique for the rainfall infiltration	·Proposal of a technique for the rainfall limit prediction based on the rainfall infiltration monitoring.
		H. Establishment of monitoring technique for slope surface failure	·Proposal of a technique for the rainfall limit prediction based on the rainfall infiltration monitoring.
	Monitoring technology for rock bed failure	I. Instrument observations of rock bed slope	
		J. Establishment of possibility and limitation of the site adaptability of the rock bed monitoring	·Creation and partial practical application of the "Rock bed failure monitoring summary (Plan)" and the "AE measurement manual for rock bed failure monitoring (plan)"
		K. Establishment and evaluation of rock bed failure prediction and monitoring	
Risk management Technology (Accountability)	Rational risk evaluation and management technology	L. Introduction of rational risk evaluation and management technique	·Creation of the "Risk evaluation for road slope disaster and management support manual (plan)" and trial on the model routes.

Table-1: Summary of each element technology

technologies (A-L). These technologies are effectively linked to each other and as the Figure-1 shows, we focused on the development of the hazard sampling support system and the decision-making support system and aimed to advance action programs such as daily management, strengthening of surveillance, the disaster-preventive traffic regulation at the time of rainfall, according to the disaster prevention records being accumulated.

Interim Results

The results we have obtained so far are as follows:

1. Hazard evaluation technology

For hazard evaluation technology, we have proposed a technique for simple investigation of slope stability, established an internal rock bed structure investigation technique (air tracer test, etc.) and tried a slope hazard map-drawing technique utilizing GIS (Geographic Information System).

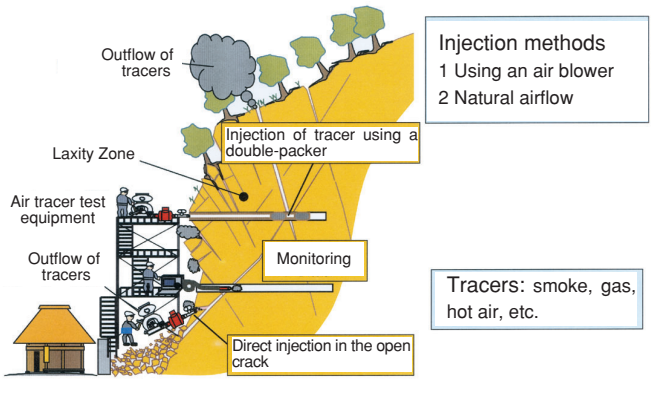

Figure-2: Air tracer test

(1) Development of an air tracer test

For the hazard evaluation of the rock slopes, it is necessary to properly grasp the distribution of cracks on the rock bed.

For that purpose, this R&D team developed an air tracer test as a means to clarify the continuity of open cracks. (Figure-2) This test is carried out by injecting the air mixed with tracers (e.g., smoke or gas) into the open cracks using an air blower (or the natural air flow), to measure the air pressure and the volume at the point of air injection and the air outflow distribution, movement time, outflow volume and density at the outflow point, which will clarify the continuity of cracks inside the rock slope and help extrapolate the mechanism of slope failure by identifying the loose area.

We have so far conducted experimental tests on the rock bed at eleven places nationwide and confirmed its effectiveness. (Figure-3)

(2) Development of a slope hazard map-drawing technique utilizing GIS

The aim of this R&D is to efficiently manage and utilize the enormous volume of data, such as the disaster prevention records being accumulated, for the enhancement of sampling accuracy of dangerous spots and hazard map-drawing, as well as to efficiently obtain the basic micro topographical data, etc. utilizing the aircraft laser measuring method, etc.

By working on case studies on some model routes, what we are trying to do is to develop a technique to create a GIS base map (inventory map) and a hazard map (map of possible disaster areas) and establish an algorithm for hazard evaluation and risk evaluation. (Figure-4) Furthermore, we are going to propose a technique to create a fragility map (a map showing the instability distribution of various factors) and a risk map (map showing areas with disaster risk).

Figure-4 Example of GIS base map (inventory map)

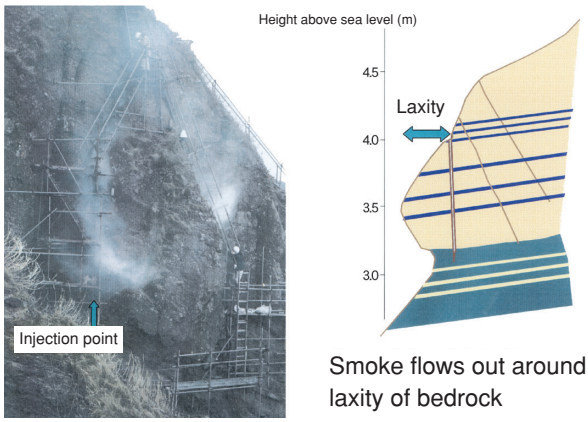

Figure-3: Example of an air tracer

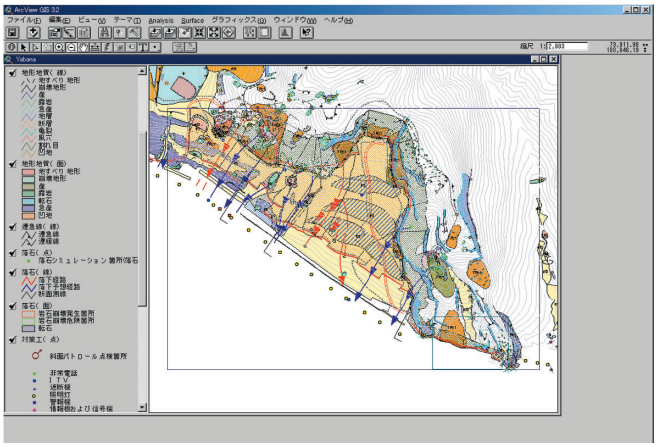

Figure-4: Example of GIS base map (inventory map)

2. Influence mitigation technology

Upgrading of disaster-preventive traffic regulation techniques

We worked out a new guideline for the disaster-preventive traffic regulations by the Continued Rainfall Conversion Method (Effective Rainfall Method) reflecting the past rainfall and started introducing the test to actual road sites. By using this technique, in relation to the continued rainfall data, the number of "wide swings", indicating a situation where there is no accident occurrence despite the disaster-avert traffic regulation, and "overlooking", where a disaster occurred before the regulation was announced, have both decreased in sections with a high potentiality of failure occurring due to rainfall, and it was confirmed that the regulated time can also be shortened greatly from the enormous amount of case study analysis in the past.

However, 124 sections out of 193 sections are designated as disaster-preventive traffic regulated sections among the national roads under the direct jurisdiction of MLIT and they are now in a situation where there is no likelihood of a disaster occurring even if they go under the disaster-preventive traffic regulation, thanks to the progress of disaster measures. We intend to keep proposing methodologies for rainfall standard mitigation on the disaster-avert traffic regulated sections based on the effects of the disaster prevention measures.

3. Prediction technology

As to the prediction technology, we have made a proposal for a rain osmosis monitoring technique, confirmation of the adaptability possibility of optical fiber sensors to the wide area slope surveillance system, and examination of the possibility and limits to the adaptation of rock bed monitoring techniques at the sites.

(1) Development of slope surface failure monitoring technology using optical fiber sensors

Slope surface failures caused by rainfall are diverse in form and the prediction of failure occurring is very difficult. For this reason, we are focusing our attention on the optical fiber sensor as a system to be able to comprehensively and specifically survey the slopes that are continuing extensively, and we have been working on joint research with 14 private companies.

We installed a slope monitoring system using optical fiber sensors on six slopes in the country and conducted adaptability evaluations. We are going to make system improvements and assess adaptability based on the evaluation results of observed data and costs from now on.

(2) Development of the slope failure monitoring technology

In response to the rock failure that occurred inside the Toyohama Tunnel in Hokkaido in September 1996, we have implemented monitoring at 15 spots in the country since 1997 and examined the adaptability and limits of all kinds of measuring equipment, the noise and its periodic change, arrangement and installation method, failure prediction technique, and so on. (Figure-5)

A failure actually occurred at one of the spots under observation, and we were able to observe how displacement was accelerated with repeated cycles of high speed and low speed until it came to failure, and also that it showed a movement similar to Saito's 3rd Creep Failure Curve.

It is our future plan to draw up the "Rock Failure Monitoring Summary (Draft)", summarizing the knowledge we have obtained, to accumulate examples applied to the actual cases and try to upgrade the methods such as for setting up a management criterion.

4. Risk management technology

We have been working out a method to apply to risk management, quantifying the risk of road slope failure using the risk curve as a tool to support the decision making by a road administrator, and we have been carrying it out in the four sections on the model routes in the country.

- Extensometer
- Displacement meter
- Inclionmeter
- Steel measure
- AE sensor
- Digital camera(image measurement)
- ITV
- Thermomerter
- Rainfall meter

An example of instrument installment
(Western area of the Amadori Bridge)

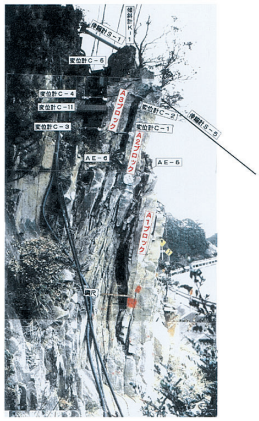

Figure-5: Example of slope monitoring

The risk curve indicates the annual overrun probability of the causes that may trigger disasters along a vertical axis, and the estimated amount of damages generated by disasters triggered by the causes along a horizontal axis. The area surrounded by the risk curve is the annual assumed amount of damage.

Making up a risk curve is done by the following procedure. (1) Calculation of the annual overrun probability of rainfall, (2) Making up of the fragility curve: Calculation of the fragility curve (the curve indicating the ratio of slope failure to the volume), using the road disaster prevention check results and the disaster history data, then classifying the slope failure nature applying the quantification II type, etc. (3) Estimation of the amount of collapsed soil by the slope failure, (4) Calculation of the damage amount at the time of the slope failure (loss of human lives, cost for road restoration, loss caused by detour, etc.), (5) Making up a risk curve: To seek a risk curve of the whole route section by calculating risks on individual slopes and adding them up from the above four items.

We are planning to make proposals for new methodologies showing that, by using the risk curve, we can make more rational explanations about the selection of the spots for pro-active countermeasures and the effects of investments on disaster preventions.

Conclusions and Future Tasks

Lastly I would like to introduce the summary of the interim evaluations given by the three members of the External Assessment Committee (General Manager, Dr. (Mr.) IMAMURA Ryohei, Technical Advisor, Asia Air Survey Co., Ltd., Committee Member, Dr. (Mr.) KUWAHARA Hajime, Manager, Marketing Section, Yokogawa Electric Corporation, and Dr. (Mr.) KOMATA Shinjuro, Manager, Integrated Technical Center, Nippon Koei Co., Ltd.) as a summary of this paper and future tasks.

(1) MLIT is aiming at the efficient implementation of limited budgets and support to the road administration and better service for road users. However, costs expanded for countermeasures taken against road slope and rock bed failures. It is of immense significance that we quantify the effect by the results from our R&D, reevaluate it using a new technique like risk management and GIS, which will lead to the enhancement of our accountability of road slope failure prevention measures.

(2) In order to carry out the road disaster measures according to the plan from a wider viewpoint, we need to actively address upgrading the database including improvement of fundamental topographical maps, and development and practical use of the hazard sampling support system based on the database and also the decision making support system according to the risk assessment.

(3) It is essential that we predict the risk against the hazard vulnerability of road slopes using GIS and develop a technique to evaluate it in order to decide the priority order of disaster measures for a great number of road/rock slopes nationwide and to make ourselves ready for the time of a disaster occurrence. The development of a technique using GIS is technically most appropriate at present and is expected to utilize practically since it is a technique able to assess a huge number of slopes in a short time and serve for the daily road management.

(4) When we aim at the safe road maintenance and management utilizing the limited resources, a risk management technique against rock/slope failure is effective. Although it seems extremely difficult to quantitatively assess all the risks, it is quite significant that we find out the possible terminus ad quem.

(5) In order to activate the result of risk management for the enhancement of accountability, it is important to keep transmitting information to the citizens so that they can recognize the vulnerability of our national land, that is, there is an unknowable part in rock/slope failure and understand that it is impossible to predict all the natural disasters. As well, it is important to transmit information more actively than ever as to the activity and the result of our R&D that is addressing all those issues with those recognitions under the present conditions.

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Civil Engineering from a Broader Perspective
No.1: Harmony between Flexible Materials and Civil Engineering

Usuke HARUI
student member
Naoki IWAMOTO
student member

Civil Engineering is by nature a comprehensive engineering that touches various fields such as natural science, social science and humanities. However, Japanese word for "Civil Engineering", "Doboku" has two kanji (Chinese characters) which represent "soil" and "wood". Unfortunately, it seems that civil engineers in Japan tend to focus on limited field as in Japanese word, and fail to broaden their expertise. We, as students studying civil engineering, are wondering if civil engineering should be a more comprehensive field and if there should be more various sub-fields in civil engineering. With the stream of interdisciplinary collaboration, it is inevitable that a new expertise will be found through cooperation with other fields.

By relating to other fields' specialists who work with civil engineers and/or in civil engineering, we will look for how we can open up our field and enlarge our sphere of activity from inside of civil engineering. The first interviewee is Mr. Nobuyasu IKOMA of Shibata Industrial Co., Ltd., who shares with us his experience on the close relationship between chemical engineering and civil engineering through "rubber materials".

Attracted by Chemical Engineering and by Rubber

- Why did you choose "Chemical Engineering" as your major?

When I was a student in the department of chemical engineering, I was interested in petrochemistry. I was attracted by the potentials of crude oil because various materials such as polyethylene and polypropylene can be made from crude oil by controlling the refinement temperature. Influenced by my major and interests, I joined a company dealing with rubber materials and have been working on rubber materials since then. I think students who choose chemical engineering are not generally good at mathematics but love chemistry when they are in high schools.

Mr. Ikuma recounts his continuing interest in rubber materials.

-Which characteristics of rubber materials attract you?

Well, we can control material properties of rubber materials by compounding about 20 kinds of chemicals. Non-stretching rubber, high-bouncing rubber or even non-bouncing rubber can be produced by different chemical compositions. The compounding of chemicals and the resulting materials are amazing.

By the way, rubber has a very long history as a material. There is a record of rubber being used in the era of the Inca Empire. Also, rubber materials are familiar in our daily lives. You can easily find several rubber products around you, such as the grip of a mechanical pencil and the tip of the legs of a desk.

Civil Engineering and Rubber Materials

- Do we have a long relationship between rubber materials and civil engineering?

Rubber materials have been used as small parts of civil structures for many years. For example, fender beams of port quays and impervious sheets at the bottom of reservoirs are made of rubber materials. However, civil engineers were "unconfident" about the chemical field because deformation in chemical engineering, some hundreds of percents, has too large of figures for civil engineers. At that time, rubber materials had been developed without considering customers and users; these materials were a kind of "idealistic" materials only for chemical engineers.

- What was the first opportunity to work close with civil engineering?

Around 1988, I was told by a manager of a design section in an electrical power company, which I worked with for rubber sheets, "It would be good to develop rubber materials to cope with deformation of civil structures".

Interaction with other fields.

- What did you find by interacting with other fields?

Technologies could develop without interactions with other fields. However, there are definitely gaps between technologies that have developed in such a way. It is essential to understand the requirements of the customers' fields in order to create and proceed with new technologies. For example, by interacting with ship engineers for the development of the fender beam I mentioned before, we could understand that the hulls became thinner with technical innovations and that fender beams with high-energy absorption were required to avoid damage on the hulls. "Rubber Chainer"(Figure-1), which is used for "Mega-Float", for instance, is a composite material product of rubber and chain developed by collaboration with steel specialists.

Rubber is closely stuck around sagged chain. Higher impact energy absorption is expected between chain rings due to rubber.

- Do you have good examples of collaboration with civil engineers?

Yes, there is a good example in the construction of a compressed air storage facility (Figure-2), in which rubber material was used as the sealant. From the material side, we had no idea what kind of phenomenon might occur and what kind of tests and test equipment were required to evaluate those. We, rubber material engineers and civil engineers discussed this extensively, raised questions with each technical view and re-evaluated possible outcomes.

To approach the perfection of composite materials, it is essential to understand the applications over the discussions with the engineers in application fields. From this standpoint, communication between engineers is the bridge over the technical gaps. We can find something new by discussing issues over and over with curiosity.

A facility to store compressed air for power generation with high pressure (8MPa) by using surplus electricity after midnight. The prototype facility was constructed at Kami-sunagawa City, Hokkaido, in 2001.

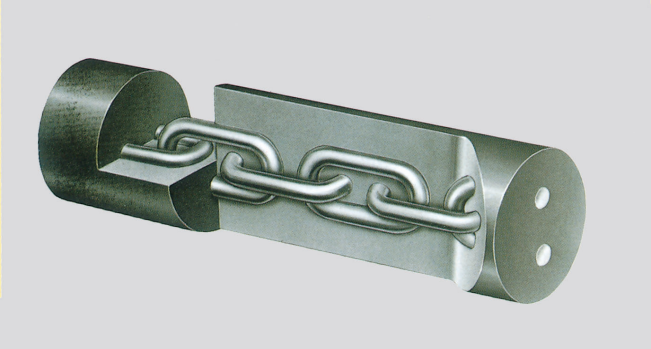

Figure-1: Rubber chainer

"Civil Engineering" way of thinking, "Chemical Engineering" way of thinking

-What did you find as characteristics of civil engineers and chemical engineers by the collaborations?

Civil engineers can express verbally what happens in the natural field. In other words, they are good at taking a broad view of things. On the contrary, chemical engineers tend to observe a thing deeply such as seeing the details of the failure point of an object. However, in reality, the failed one is not for use.

I think phenomena in civil engineering are difficult to evaluate quantitatively unlike machinery because civil engineering is field engineering. Thus, it is important to communicate with each other about requirements and ideas. On the other hand, "rubber" does not have the concept of "allowance", and there are no specification-type manuals. Decisions on life and design requirements of materials rely on civil engineers.

-What is important for further collaboration between chemical engineering and civil engineering?

First, I would like civil engineers to get rid of the sense of incongruity on materials and think flexibly about materials. I think they still consider rubber only for small parts. Materials in civil structures are not only steel and concrete. Since rubber materials are not in the courses for civil engineers, most of civil engineers are unfamiliar with them. As I mentioned, rubber has a very long history for human usage, and rubber materials have been used in industrial products for 150 years. In addition, I am often asked about the endurance of rubber materials by civil engineers. We have a good example in the rubber bearing of a railway bridge in Sydney, Australia. After 99 years of use, only a few millimeters from surface were deteriorated, but the inner portion had no problem at all.

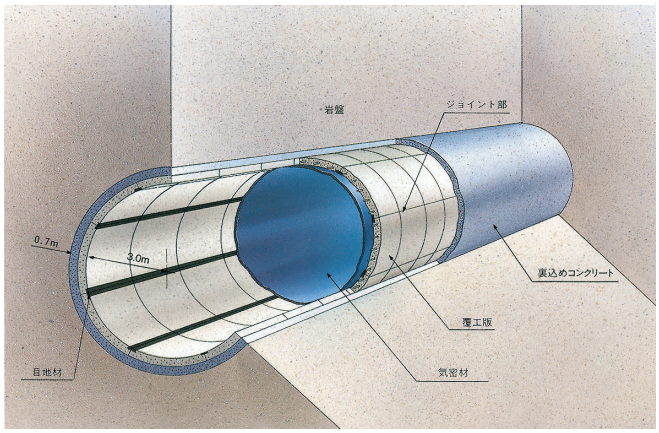

Figure-2: Compressed air storage facility

So, I think, the reason civil engineers are unsure about the endurance of rubber materials is just the lack of uses. Rubber materials can be stronger and/or more durable by compounding and composting.

- Do you have any further comments?

If I can point out another thing, I would insist civil engineers broaden their outlook. I think that civil engineers tend to discuss issues only in the field of civil engineering, probably because their field is very extensive.

In contrast, I often advise "future" chemical engineers, i.e. students studying chemical engineering, to see construction sites. It is almost impossible to construct a civil structure as it is designed; for instance, caissons may collide with each other during construction. However, it is beyond imagination for chemical engineers unless they have learned how the construction is carried out. We can understand how the materials are used in civil structures, how our "common sense" and "allowance" differ from each other by observation and experience at construction sites.

- Do you think it is possible for "future" civil engineers to join a rubber material company?

Yes, of course. I don't see any problems there; moreover, they will play active roles in the company. I suppose they would be a kind of "new stars" in our field. However, they may need to have flexible brains.

- Well, could you give "future" civil engineers your message in conclusion?

I would like "future" civil engineers to be more interested in rubber materials that are very elastic compared with conventional civil materials. Then, think about how the things will be if you use rubber materials in your research subjects. For example, the rubber fender beam can resist hundreds of tons now. How about using rubber materials as pillars of houses?

After the interview

Mr. Ikoma has a large stock of topics, and he related attractive aspects of rubber materials and the importance of collaboration with different fields. Since we have learned little about rubber materials through undergraduate courses, we have hardly come up with the idea to use rubber materials as structural materials. I thought that civil engineers should have more flexible brains like rubber and incorporate new items in our field with "flexible" ideas. (Yusuke HARUI)

Improvement of the Stability of High Embankment and Challenges to Steeper Slope
Trial of a New Reinforced Earth Method Using a Geogrid

Jyunichi TAKASHIMA
Deputy Director, Toga Dam Construction Office
Hokuriku Regional Development Bureau
Ministry of Land, Infrastructure and Transport

Hideki OHTA
Professor, Graduate School of Science and Engineering
Tokyo Institute of Technology

The reinforced earth using a Geogrid is a simple way to reinforce the earth and is found to work far more than our expectation. In order for a steeper embankment of more than 20 meters high to gain higher reliability as a permanent structure, it was necessary to add new improvements. This is a report of our work that devised a new method to reinforce by strengthening the area of the embankment slope and that constructed an actual embankment of 28 meters high with a 1:1 slope.

Development of a new method considering the natural environment and long-term stability

When working on an embankment construction in a mountain area surrounded by a rich natural environment the slope widely extends to the under laying slope bottom if it is designed by the conventional method. (Photo-1) In the case of the road embankment for the Toga Dam construction, however, steepening of the slope of a high embankment was required from the viewpoint of natural environment preservation and also problems of construction such as the carrying-in method of earth. (Figure-1) In addition, because the geological and topographical conditions are very complicated and also the embankments are very high sufficient examination of the reliability and very careful assessment and judgment were required. Hence the "Committee on the Steep Slope of the High Embankment" was set up and the examination was made as to the method that best took into account the natural environment and the long-term stability of the whole embankment.

As a result, a new method was adopted to add compressive pre-stress using the lightweight steel sheet piles and steel bars to the slope of the reinforced embankment. (Click here to view the corresponding figure)

What was specifically discussed in the process of method selection was how to handle the embankment slope. The slope has a small confining pressure by the embankment weight and is apt to be solidified insufficiently when constructed. Because of that, it is vulnerable to the influence of water infiltration by rainfall, snowfall, and earthquake, and is inclined to have slope deformation and failure, therefore, there was a possibility of causing trouble in the stability of the whole embankment in the long term.

The mechanism of this method is to actively restrain the volumetric expansion (positive dilatancy), which occurs at the time of shear by the compressive pre-stress in the vertical direction, and have the Geogrid installed horizontally. (Figure-

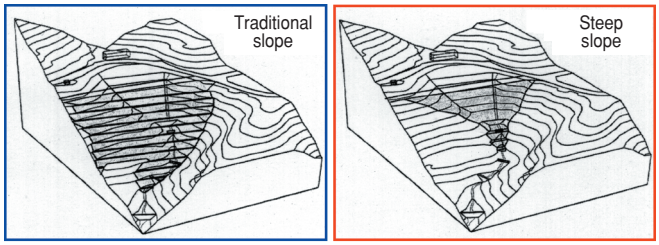

Figure-1: Difference in slope


Photo-1: Topographical photo

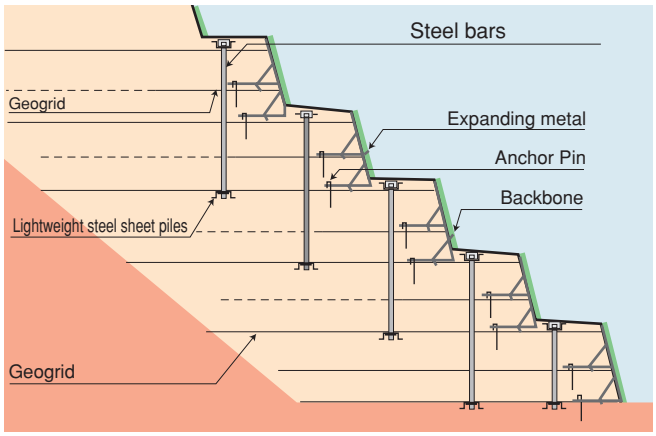

Figure-2: Structural diagram

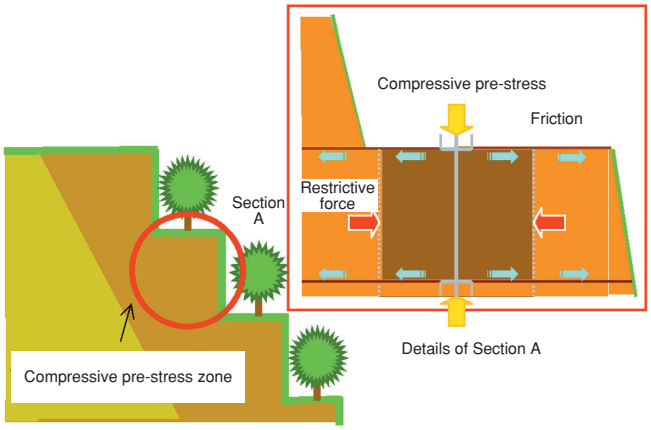

Figure-3: Mechanism of the method.

3) The embankment in the zone that receives the compressive force between the Geogrids gains remarkable increase in the shear resistance as well as toughness. The zone of this embankment works as the pseudo-wall of the earth and exerts the leaning effect by the weight of the whole wall and also by the addition of shear resistance against failure. As a result, from the occurrence of apparent cohesion due to the pressure increase, it was expected to decrease the required Geogrid's strength and to shorten the installment length.

Path to Practical Application

We conducted a preparatory experiment to build a cantilever beam for a reinforced embankment of 0.9m height, 2.0m the largest span length, and 2.0m depth in order to prove the mechanism of the proposed method and confirm the practicability. (Photo-2) We decided to adopt a form of sandwiching the reinforced embankment using Geogrid with the reaction boards of steel sheet piles with 0.5 m intervals in the direction of the span length, and fixed them with nuts adding the compressive pre-stress of 30 KN / piece by two steel bars for each pair of sheet piles. In our experiment, as a result of expanding the beam span length by 0.5 m interval by dissolving the polystyrene foam that was used for support, an elastic movement, which was inconceivable for a single unit of usual reinforced embankment, was observed. Since we could make a confirmation of the expected effect of the embankment unification and the construction practicality, we planned to apply it to the actual embankment as follows:

In the case of new road construction works for the Toga Dam construction, the mountains are steep and the embankment relative height was about 50 meters. Therefore it turned out to be a large scale construction with the height of steep slope embankment; 40-50 meters (reinforced embankment height; 25-30m, lattice wall height; 15-20m), the reinforced embankment area; about 2,000m^2 (vertical height m^2), cut/fill

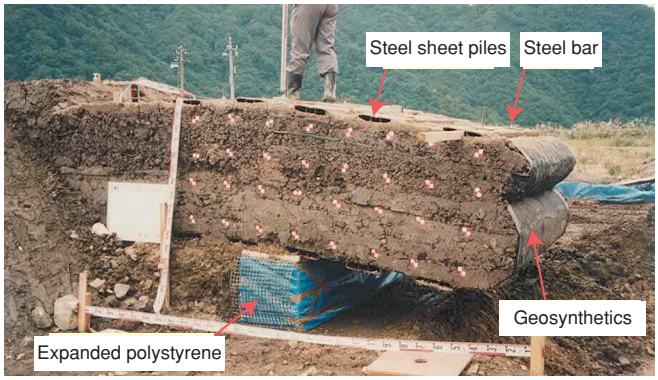

Photo-2: Completion of the cantilever beam

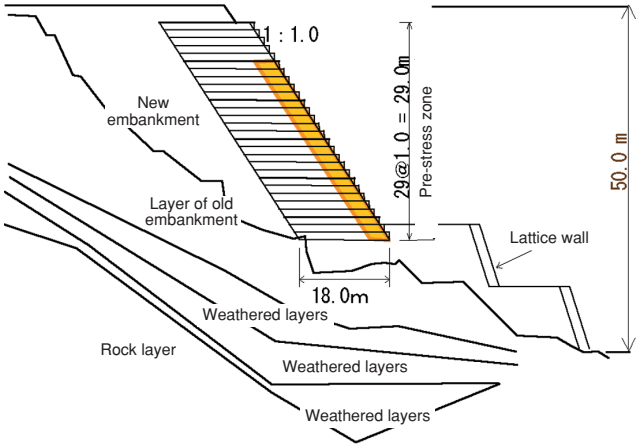

Figure-4: Foundation ground and embankment

amount: about 5,000 m^3.

For the foundation ground, due to the old embankment layer (N=5~10 or so), which was the wasted and un-compacted earth, spread to a large area, counter-weight fill method by lattice wall was carried out and prevented the possible occurrence of failures which might go through the old embankments.

As to the form of the reinforced embankment, in order to satisfy both contradictory requirements, i.e., preserving the environment and securing stability, we decided to make it a steep embankment with 1:1 slope gradient. As well, in order to maintain the compressive pre-stress and secure the space for planting, we made it a step embankment slope with 0.8m widths, 1.0m height for each step. As to the placement of Geogrids (laying interval and laying length), we followed the "Design and Construction Manual of Reinforced Soil Using Geotextile - Public Works Research Center".

However, as to the design constant of the embankment material, we used the result of the shear tests and estimated the compaction effect and the leaning effect by the pseudo-wall of the earth. The apparent cohesion c = 30kN/m^2, and the angle of shear resistance=30°were used in design calculation.

Table-1

Measured items	Measurement methods	Measurement results
Reinforcing material stress	Foil Strain gage (1.0m interval)	The stress increased as the embankment goes up to the height of 3-4m and showed 9kN/m maximum, which is a small figure. (Product standard strength 47 kN /m). After introducing pre-stress, stress rapidly increased and showed 32kN/m maximum, but it was judged to be a cumulative result of a temporary settlement displacement and that there was no problem.
Steel bar stress	Foil Strain gage (0.5m interval)	As a result of introducing 60kN/piece pre-stress to the steel bars and measuring the process, the introduced pre-stress converged at about one-third.
Horizontal and vertical earth pressure	Panel earth pressure gage	As to the vertical earth pressure, the earth pressure equivalent to the covering soil of the embankment was observed. The horizontal earth pressure in the pre-stress zone showed a very small figure. This is considered to be showing the reinforcement effect.
Foundation ground displacement	Borehole inclinometer	Although a displacement at about 50mm on the valley side was observed in the area -4—8m below the top, no big landslides including of the foundation ground, were observed.
Embankment slope surface displacement	Electro-optical transit	The settlement amount was 63cm at the 3-4 layers of the middle part of the embankment and the displacement amount on the valley side was 37cm. Although a big displacement was observed after introducing the pre-stress at each spot, it was about 1.5% of the embankment height and it has turned out to be a small figure, as the total figure of the settlement amount including the embankment and the foundation ground.

Photos-3: ①Reaction board, ②Placement of Geogrids, ③④Compaction of the slope area.

Actual Embankment Construction

In the construction of the embankment, although we were compelled to undertake a rapid construction under severe circumstances that it was a newly adopted method and the construction period was short since it was in an area of heavy snowfall, we were able to manage to complete the construction.

As to the construction procedure, after the grading of the foundation ground, we repeated the process of assembling and laying of the bottom reaction panel, laying of Geogrids and units, spreading out and rolling compaction of the banking material, connection of thread reinforcing bars, assembling and laying of the top reaction panels up to the height of the designed embankment so that we built the embankment. As to the loading of pre-stress, we conducted a preparatory loading once at the time of building the embankment, and after the completion of the embankment, we conducted the actual loading from the bottom of the embankment sequentially.

Photo-4: The entire view

(Photos-3) In addition, we carried out the field observation in order to ensure the stability of the embankment under construction and also to obtain the fundamental data for the future designing and construction. (Table-1)

As you can see the details of the measurement results in the Table-l, the earth amount of the deformed embankment including the ground foundation has turned out to be relatively small in terms of the embankment scale and the stress which works on the Geogrid has converged at a small figure and has been maintaining a very stable condition.

The Future Perspectives and Subjects

Since this construction site is quite close to the designated potential landslide site in the Toga area, and also since the embankment was made on the uneven, soft old embankment layer, an overall slide, including the mountains, was very much anticipated. There were also voices of fear concerning the long-term stability since it was a high embankment at a very steep gradient compared with other common embankments. However, judging from the results of the field observation over two years, we are quite convinced to say that

Photo-5: Current state of greening

we could construct a highly stable embankment for the long term and, in addition, we could contribute a great deal to the natural environment conservation by steepening the embankment thus constricting the construction area to less than a half.

Although it took time to undertake the construction at the beginning, since this was the first construction that adopted the method of adding the compressive pre-stress to the reinforced earth method, which used Geogirds for a large-scale construction work, we were able to complete our construction without any serious troubles.

We are now in the process of construction of the second embankment that goes over the height of 40m. This method is highly expected to be widely diffused and applied to more various purposes in a wider range since this is a method that enables the construction of an embankment to be more reliable and more environmentally friendly as a permanent structure even under severe geological conditions.

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Turning Simple Ideas into Reality: Development and Application of Upward Shield Tunneling Method For the Sewer Construction Project along Bandai - Hannan Line, Osaka City

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The Bandai-Hannan Line Sewer Construction Project hereafter referred to as "Bandai-Hannan Line" started in March 1997. It was undertaken by the Osaka City Urban Environment Bureau in order to dissolve flooding problems in the southern part of the city. The Upward Shield Tunneling Method is a new method to run forward the shield machine to the ground surheading from the first lining of the shield tunnel of the Bandai-Hannan Line, utilizing the tunnel as the manhole for inflow.

By adopting this method, we consider that we were able to achieve a more successful outcome than we had expected in terms of shortening the construction period, saving construction costs, safety improvement, reduction of hazards incidents such as noise and vibration due to the construction.

The outline of the construction

The prevalence of sewage system in Osaka City has reached 99.9% at the end of March 2001. However, due to rapid urbanization, floods still occur with the increased rain flow at times of heavy rain. As shown in Figure-1, the Bandai-Hannan Line was constructed as a part of the flood measure project for Abeno and Sumiyoshi Wards for the purpose of contributing to the resolution of flooding by peak cutting storm water at the upper stream. In this way, the new line seeks to compensate the inadequacy of the already installed sewers.

According to the plan, manholes for inflow are to be placed at seven spots along the approximately 2km line for the uptake of rainwater from the already installed sewers and also as ducts for air emission. This report is a summary report of the "upward shield tunneling method" that was applied to the manhole installation for rain inflow at three spots.

Endeavor for technology development

It is a common practice to apply PC Well method along with certain supplementary works when laying down the shafts, such as manholes in a shield tunnel. However, when the tunnel reaches beyond a certain depth, it becomes difficult to secure sufficient water-sealing capability at the bottom part of the shaft with the conventional method, and in most cases it generates drawbacks in safety, cost and time. Moreover, the effect that these conventional methods have on the traffic management and the lives of the local inhabitants due to long period of road occupation is not insignificant. The "upward shield tunneling method" that we have realized originates in a simple idea, born in the process of looking for a safer and securer way to cope with various restrictions on installation of manholes for inflow at three spots of more than 20 meter in depth.

Following is the list of major restrictions during the inspection period prior to the construction:

1. The construction to be carried out only at nighttime without laying an occupying lane.
2. Ensure the passage of vehicles and secure a passage for pedestrians during construction.
3. The noise and the vibrations to be restricted to as little as possible in order to minimize the effects on the lives of the inhabitants

We proceeded with the inspection before the application of "upward shield tunneling method" but we soon came across technical problems as follows:

1. How to prevent ground failure and spring water caused by face cutting.
2. How to secure the segment ring by the reaction of shield pushing and cutting.
3. Where to place the shield machine and the starting equipment within a narrow shaft.
4. How to maintain the heading and restrain soil crumbling during upward excavation.
5. How to maintain the heading when the soil that covers when reaching the over-heading is insufficient.

Addressing Technological Issues.

Upward shield machine

1. The basic specifications

The upward shield machine hereafter referred to as "shield machine" adopting the basic specifications of the slurry earth

pressure shield, consists of three parts; the top, the middle and the bottom in consideration of its applicability to transportation, building and withdrawal. Photo-l shows the entire shield, Table-l shows the summary of the specifications, and Figure-2 shows its structure.

2. Cutter head

The cutter head adopted a four spoke cylinder type, circumference supportive method and arranged the cutter bits in a dome form as shown Figure-2, in order to avoid damage by the cut-off pieces of the heading (NOMST part) choking up the chambers and the pipes for earth removal. This measure made it possible to cut the starting segment smoothly from the center of the cutter head to the circumference. The cutter bit was what main bits and pre-load bits for heading cutting were arranged on, and the spokes and ultra-hard chips (E5) were buried in. Also center bits for coring were equipped at the center of the cutter head.

3. Chamber

We planned to improve the efficiency of collecting the excavated earth and at the same time to reduce the amount of residual excavated earth by making the form of the chamber a funnel type.

4. Earth removal control

It was decided to use a pinch bulb to control earth removal since experiments have proved that in removing earth by an axis screw conveyer, it is apt to choke up easily, and that it is difficult to control removing earth, with ribbon screw.

We adopted a pinch bulb of air drive gating method as shown in Figure-3, the amount of removed earth is adjusted by the air pressure of the pinch bulb, and we built it double-deck for smoother control of earth removal.

5. Rolling measure

Because the rolling of the shield machines was anticipated when cutting the new material segment, a rolling prevention material was installed around the skin plates of the shield machine.

6. Over cut

Although the over cut was planned for the purpose of rolling prevention of the shield machine at 5 mm at first, since 4 mm bit friction generated at the time of cutting the new material segment at the starting part, the over cut was modified to be 15 mm.

7. Mixing blade

Table-1: Specifications of upward shield machine

Machine type	Upward shield machine (mud pressure type)
External diameter	2,280mm
Machine Length	3,720mm
Total driving force (Number of jacks)	400 t (8 pieces)
The maximum tunneling capability	20 mm/min
Cutter torque (torque index)	353.0kN-m (α =29.8)
Cutter revolutions	3.13 rpm
Bit specifications	E5 chip
Specific equipment	Minute speed control (1 mm / min.)
	Earth removing mechanism (pinch bulb specification)
Weight	About 25.0 t

Photo-1: Upward shield machine

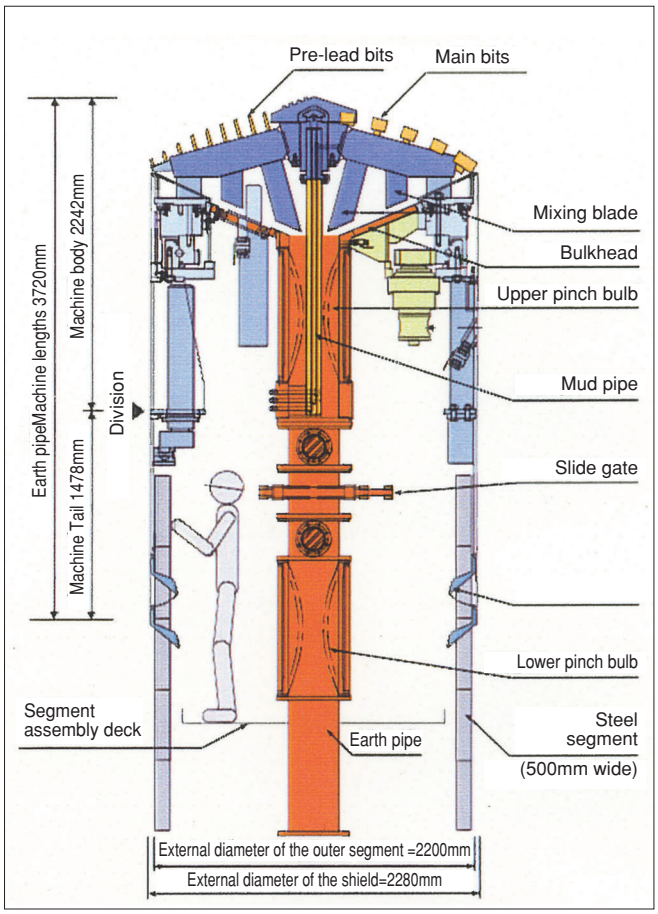

Figure-2: Upward shield machine structure

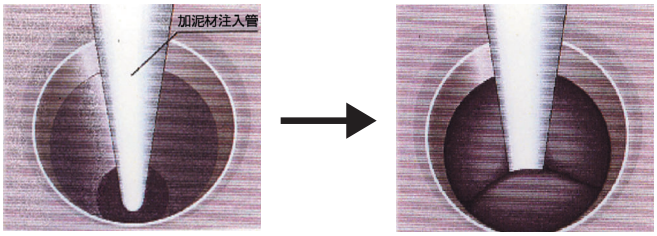

Figure-3: Top part pinch bulb gating image

Because the control of the heading earth pressure and the uptake of excavated earth are closely connected, plasticity liquidation of the excavated earth is a very important factor. In this project, we adopted a system of drilling with a mixing blade which is equipped on the back of the shield machine spokes, using the high polymer viscosity improver (liquid) for excavating additives. As a result of this, the removed excavated earth showed almost the same slump value and so the plasticity liquidation at the beginning stage was achieved.

Starting Segment

1. Opening segment

A new material was used for the top half of the segment that is a starting bore of the upward shield, as shown in Photo-2. The heading was cut with a cutter head and an auxiliary method for the starting part was curtailed. To cut of water at the shaft gate, we made entrance packing combining the tube-form rubber rings and strip-form steel sheets. The mechanism is to swell up the rubber ring. Pumping the air into it to make it adhere to the circumference of the shield machine skin plate. The characteristics of the opening segment are as follows:

- The starting opening segment is made of four pieces as shown in Figure-4.
- To raise the flexural toughness index (resistance after shear), steel and resin fibers are mixed in as reinforcement additives.
- A CFRP (carbon fiber) rod is used instead of reinforcing steel.
- The ring plate is equipped to weld the entrance metal on the spot.
- The non-cut off part consists of three main girders, and skin plates are equipped in the exterior and the interior.
- Glass fibers, which could be cut, are used between the segment rings.
-

2. Reinforcing segment

In order to maintain the segment rings from the reaction of the shield machine, we reinforced the segments in the 3D section for the bore diameter (D) and at the same time installed the temporary steel frame in the 1.5D section along the tunnel axis, trying to disperse the shield reaction. Figure-5 shows the segment reinforcement illustration and Photo-3 shows the reinforcement steel material.

Photo-2: Opening segment installation

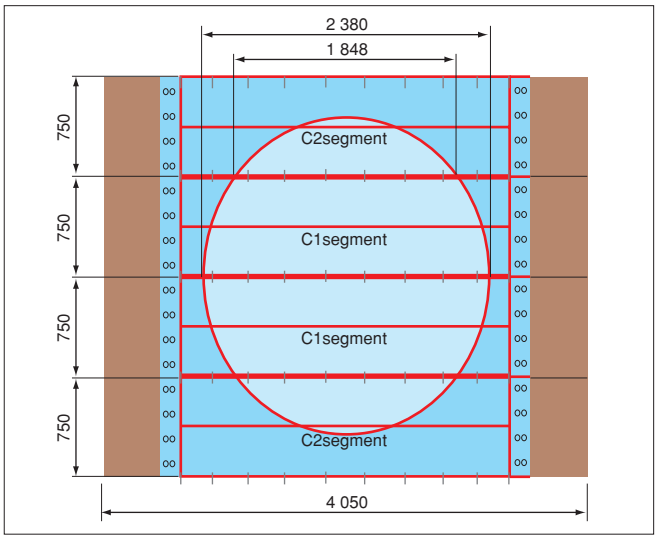

Figure-4: Opening segment plane view

Arrival Shaft

The arrival shaft to withdraw the shield machine was constructed at the same time with the inside-shaft works in the shaft work method using liner plates in order to avoid the traffic suspension of general vehicles.

We carried out the slow excavation by filling muddy water in the arrival shaft just before reaching the arrival shaft. This is because the pressure of the covering earth becomes insufficient and it becomes difficult to secure the pressure on heading earth, which is necessary for excavating.

Photo-3: The primary lining completion

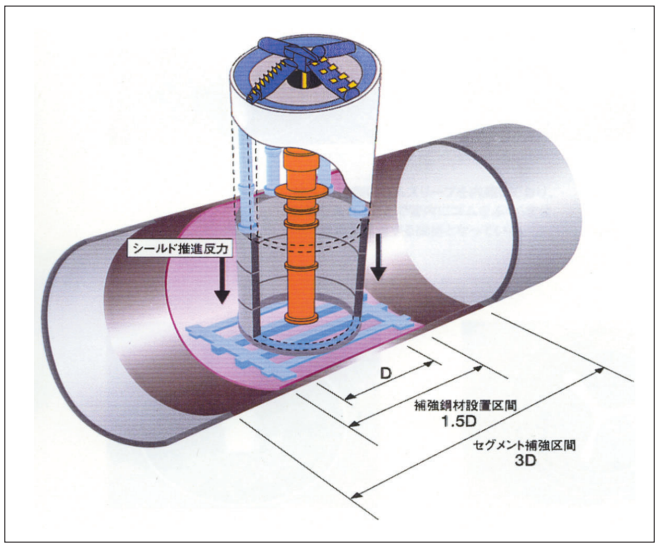

Figure-5: Segment reinforcement design

Construction Results and Future Assignments

The Process and its Effects on the Surrounding Environment.

The advantage of the construction by the upward shield method is to be able to reduce the on-road work time. Compared with the conventional methods, the time necessary for the surface works was shorted to one-sixth. By shortening the work time, we believe that we were also able to reduce to the minimum level, the effects of noise and vibration on the lives of inhabitants, and the functioning decline of the urban system due to the effects on the traffic. The daily rate of completion was 2 rings (segment width 500mm) during daytime and also at nighttime.

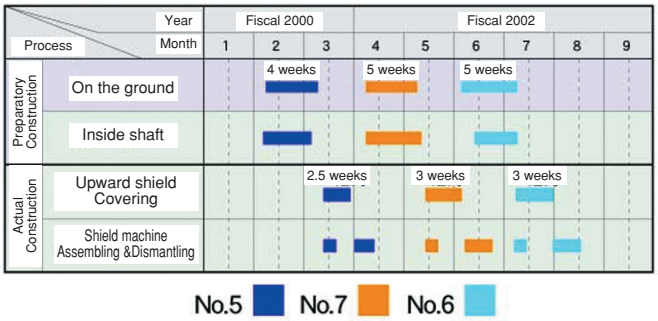

Table-3: Implementation process.

Table-3 shows the implementation process.

Effects on the Surrounding Ground

The movement of the surrounding ground accompanied by the shield excavation was measured by installing a differential settlement gauge and the settlement was less than 1 mm. The settlement of the primary lining due to the shield reaction was 3.1 mm at the maximum, but eventually converged at 0.6 mm after withdrawing the temporary segment.

Future Assignments and Prospects

The future assignments for the upward shield tunneling method are listed below. In addition, Photo-3 shows the completion of this construction work.

1) Shield machine.

Although the shield method has been examined and improved to enable long distance excavation, since the upward shield method is for the excavation of a short distance, we consider it important to streamline in terms of size and cost, rather than seeking the durability of the machine. It is considered possible to excavate in a diagonal direction from upward or apply it to the inclined shaft by trying to improve the articulation and soil removal work.

2) Starting segment

Since the starting segment used in this work is very expensive, it may be necessary to develop a less costly segment or to examine starting the segment from an already established tunnel.

3) Application of a pinch bulb

Pinch bulb is considered applicable to the ordinary slurry earth pressure shield.

4) Recycling and renting of a shield machine

Although the shield method is generally very costly, a considerable cost reduction was achieved by recycling or reusing a shield machine. The main parts that were taken from other functions and reused were the front body, middle body

and the entrance packing of the shield machine. The main recycled parts were the shield machine rear truck equipment and the ground base equipments. By promoting a leasing system of shield machines, a larger cost reduction will become possible from now on.

By addressing these tasks, the upward shield machine is considered to exert its usefulness in constructing middle-sized manholes in deep underground and I expect further progress of the shield machine technology.

Civil Engineering from a Broader Perspective No. 2: With the field of Medical Sciences "Afflicted Urban Population and Civil Engineering"

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Introduction

In this article, by relating to other fields' specialists who work with civil engineers and/or in civil engineering, we will look for how we can open up our field and enlarge our sphere of activity from inside of civil engineering. The second interviewee is Prof. Takehito TAKANO, who teaches the division of public health at the Graduate School of Tokyo Medical and Dental University, and asked about the relationship between civil engineering and medical science.

What is urban medical science?

-To begin with, please tell us about the field of your study.

-My field is what is called "Health Promotion" globally, but there is no exact Japanese equivalent for this word. In the first place, medical science consists of the three main parts, which are rudimentary medicine, clinical medicine and social medicine. I belong to one section of the School of Hygiene and Public Health, which is one of the fields of social medicine.

-We cannot understand instantly what "Health Promotion Medical Science" means. What kind of activities are you doing?

-As a cooperative center for WHO (World Health Organization), we are addressing issues like "whether development and citizens' health go together" or "how a healthy city can be established". Disaster countermeasure is also a big subject.

Although we are often misunderstood, issues like smoking or weight loss are not our subjects. Our main studies are more about the policy-making processes.

-Would you tell us more in detail?

-It costs an enormous amount of money to carry out urban development that has a strong tolerance against disasters like earthquakes and that places great importance to health issues, like the waste problem, air pollution and water pollution. On the other hand, if we implement urban policy that emphasizes industry, we will have problems of public hazards. So we need a good planning and strategies.

No matter how many lives medicine saves, it is a great pity if we lose a great many lives due to disasters, like earthquakes, or if many peoples' health were damaged by a public hazard like Minamata disease or Yokkaichi Asthma. It is within the field of Public Health to address these issues to find solutions.

Photo-1: Professor Takano at the interview

-Would you tell us an example?

-Well, Suginami Ward in Tokyo is actively carrying out healthy city planning. This is a good example in which a healthy city is being built by a strong leadership of the mayor. Important point in this example is "Good health promote development". Good health allows you to work and gives you vitality. The strategy to promote health is building a "healthy city".

-Do you have another example?

-At Minamata City in Kumamoto Prefecture, they classify trash into 23 categories. The people in Minamata City are highly health conscious, and this enables the 23 classifications. The classification also has the advantage of increasing the durability of waste disposal facilities and of enabling the effect use of resources as a result. The Minamata case can't be generalized because it was an outcome of a specific circumstance of Minamata disease in the past, but it is an example in which an administration was changed greatly by the mayor's approach.

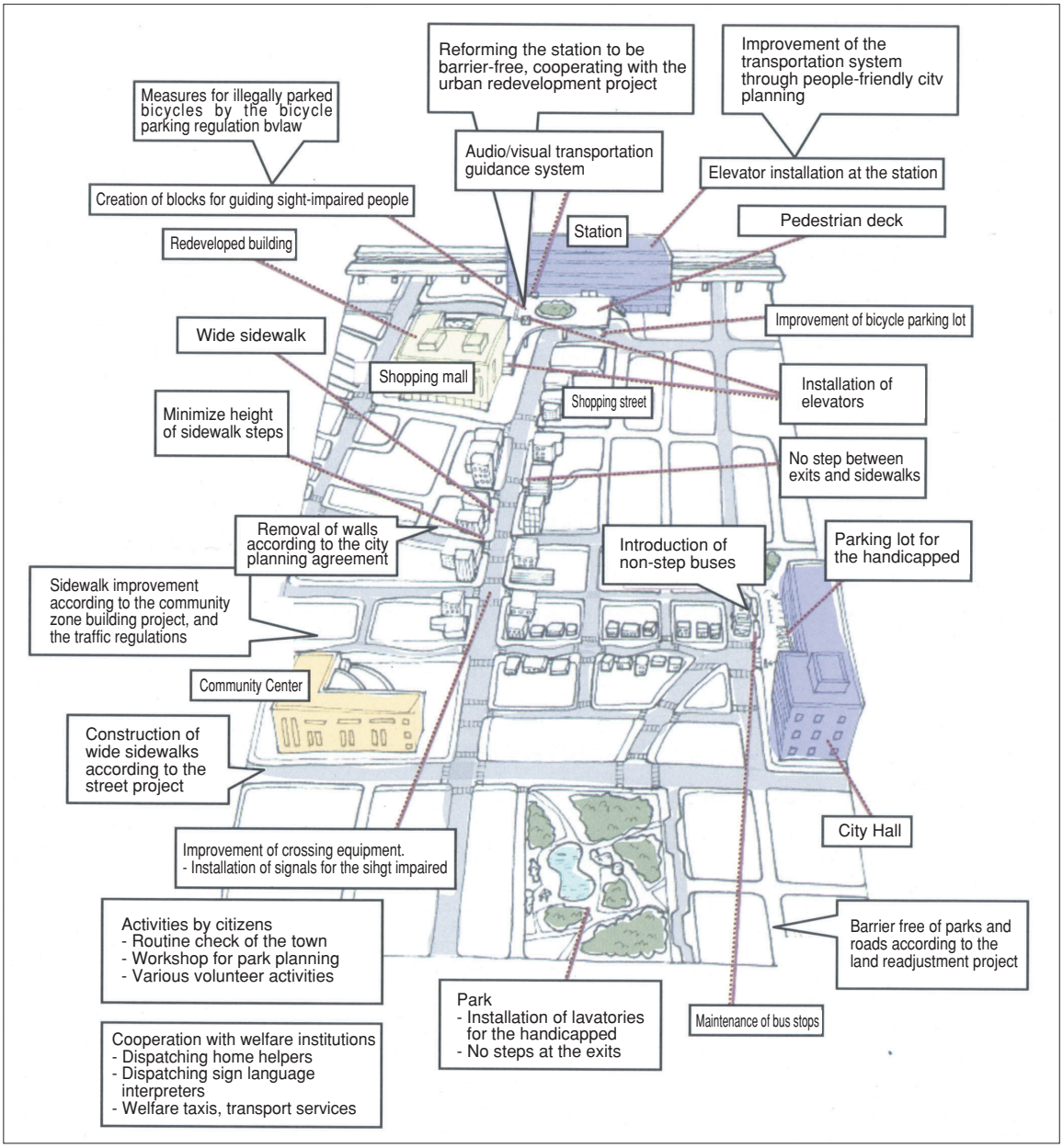

Figure-1: Image of a barrier-free city ("The guideline for making Tokyo barrier free", Tokyo, 2000"

Prescription for urban issues

-Why do you think the urban living environment has deteriorated to the present state?

-In city planning so far, the top priority was put on economic progress and industry promotion, and the citizens' health was left on a back burner. There are few self-government bodies, among prefectures, cities, towns and villages that have their own policies about a healthy city. However, I believe they should stop their conventional way of a follower's approach and convert to a forward-looking approach.

The contact point between urban medical science and civil engineering

-Next, please tell us about the relationship between medical science and civil engineering. It seems there is nothing in common between those two fields but what are the fields in which civil engineering could contribute to the medical science?

-I believe there are many fields in which civil engineering can be involved in my field of study. For example, the knowledge of civil engineering is essential in order to plan a city in which elderly, disabled, sick and injured people can live comfortably. Also, "barrier free" is an important key word for healthy-city planning. In that way, I believe city planning in which human relationships are given the top priority, for example building a house in which all the family members can get together or locating a park nearby, are the field where civil engineering is the key.

-Those are surely the fields of civil engineering. What else?

-For example, supplying clean water is essential for health. Since human health equals city health, knowledge of civil engineering can contribute a great deal to the health of a city.

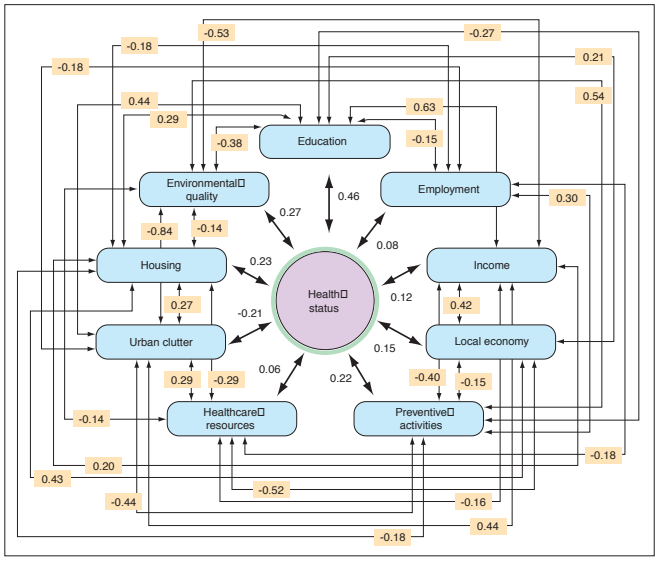

Figure-2: (2002.3.1. Tokyo Medical and Dental University, Takano Laboratory) The chart illustrating the relation between health deciding factors and heath conditions. As shown in this chart, there are various factors, which decide health conditions. Among them, three factors, "Environmental quality", "Housing" and "Urban clutter" is deeply connected with civil engineering.

-Do you mean there are a many areas of urban medical science that civil engineers can study?

-Exactly. In order to realize a healthy city, citizen participation is essential. Let me suggest that utilizing GIS may be one way of digging up the district resources and utilizing it with the participation of citizens.

-Do you happen to know someone who has studied civil engineering and later turned to medical science?

-Unfortunately there has never been a person like that in my laboratory, although there was once a student who temporarily belonged as a postgraduate. However, in the case of Tokyo Medical and Dental University, an alliance with the Tokyo Institute of Technology and Hitotsubashi University is going to be established and I believe interaction among students in different fields will be promoted.

- Do you have anything to add in regards to the human interaction?

-Well, although there is no direct connection to civil engineering, we have many visitors from overseas. Nowadays mayors from various Asian countries visit my research laboratory to study, even for a week or ten days. I am surprised about how long they would stay with us but it makes me very happy to hear that once they return to their country, they develop positively what they have learned in Japan.

About civil engineering

-One of the reasons why we planned this project was based on our reflection that civil engineering has been narrowing the range of its own field and making little effort to have close collaboration with other fields. What do you think about this?

-I think it has been the tendency of every field of learning to carry forward its study by specialization. It holds true with medical science, as well. As a result, every study has accomplished things only within its scope.

-Do you mean every field of learning has removed from the lives of the common people?

-Yes. Recently the society's requests toward learning have been changed. The requests that have been made toward learning have also changed. It has become very difficult to solve the actual problems because of the invisibility of the effects of the scientific progress, while the problems are getting more and more complicated. It has become difficult to make a contribution to society only with conventional efforts.

When you look at the actual world, every researcher has to change in order to cope with any kind of request. The bottom line is that we carry on our study comprehensively, and in order to do that, we need to have more interactions with other fields.

Message to readers

-Lastly, please give your message to the people who are engaged in civil engineering.

-Problems in my field cannot be solved only with medical knowledge. We must share the knowledge with other fields, starting with civil engineering. I would like to collaborate with civil engineers by all means.

It is true that so far, there has been no contact between medical science and civil engineering. However, it is by all means necessary from now on, because we have to make the best use of limited resources.

After the interview

I had not known Dr. Takano until I happened to read a newspaper article explaining that there was a professor who was studying about the health issues of urban population. Honestly speaking, it was quite hard for me at first to imagine the relationship between medical science and civil engineering. However, the social problems we are facing are getting more and more complicated, as Dr. Takano mentioned. In this respect, it has become clear that there are a considerable number of areas where civil engineering can exert its potentiality. I strongly felt that cooperation between medical science and civil engineering is desired now.

Speculating about "Consensus"
Consensus should be made through participating in a public activity

Susumu NISHIBE
Critic & Professor at Shumei University

Artificial consensus shown in the local referendum

Local referendums are showing their power on issues like the construction of nuclear power plants and industrial waste disposal facilities. That is the inhabitants of the construction area are invoking their veto by a majority vote and, as a result, it is becoming more and more difficult to make up a future plan for building nuclear power plants and industrial waste disposal facilities.

Precisely speaking, local referendums have no veto power or legal right to decide on those public issues. However, in our time, the legislative process, administration and even judicial system are affected largely by public opinion. As long as it is considered that the referendum manifests public opinion most clearly, it is actually impossible to exercise the three powers in a way to go against the referendum results. This kind of "public opinion control" has been prevailing throughout Japan these past 20 years, and plans for public facility construction that could possibly cause damage to the inhabitants of the district, have no choice but to be abandoned.

To be more precise, the public opinion of the small place chosen for construction may be overridden by the public opinion of a larger district, say, the nationwide public opinion. The reason why this does not actually happen is that the inhabitants of each district are going to invoke their veto as well in case they have become the party affected. In addition, to back up that kind of tendency, there is a situation where "local autonomy" and decentralization policy is accepted as social justice in postwar Japan.

However, I have to raise some skepticism about leaving consensus making by group decision to the "control by public opinion". First, the veto, in a practical sense, can be justified only in specific cases. In other words, if obvious "tyranny" were being done, it would mean to stand in direct opposition to the utmost value in this modern age that is the liberal democracy. Then, the veto must be admitted as a part of the right of resistance to tyranny. Whereas, a situation that can be called "tyranny" is found nowhere, as you see the facts that there are many cases in which the local referendum is organized in order to overturn a decision by the local government. Hence, there is a good reason to regard the currently exercised referendum that is almost equal to invoking the veto, as a manifestation of the so-called "local egoism"

Second, the reason why the local referendum, which is now in fashion, is actually to invoke the veto is that no public "alternative plan" is required there. For example, if you say "Construct a nuclear power plant in Tokyo, which is a giant energy consuming city", it can be a good alternative plan. However, with the referendums that have been made so far, in a way there is no alternative plan proposed as to public issues. Therefore, it is not too much to say that they are not public decisions from the outset. In other words, that kind of referendum may be a reliable index of public opinion, but the public opinion itself is not in the public dimension. What is not public is camouflaged as public, that is the "control by public opinion" and most of the referendums have turned out to be camouflages.

Third, who are the inhabitants? Most of the public issues will affect the next generations. In addition, although how the interested district should cope with the public issue in question is deeply connected with the nature of the locality, it is also affected by the past. The nature of inhabitants is to be affected by the past and at the same time responsible for the future. The etymology of "inhabitant" is "in + habit" and if that is so, what inhabitants are required to have is the sedentary nature and the tradition-oriented nature based on it. The modern people are often disqualified as inhabitants in the sense that they find the civilization progress equivalent to voluntarily abandoning the sedentary and tradition-oriented nature.

Fourth, under the current situation in which local customs are being destroyed, we have to place top priority on consideration of the influences that the current public issues will have to the wider area beyond the affected district. In other words, wide-area issues should be addressed correspondingly, and we should not make a decision only on the basis of the interests of the affected district. To say it differently, in order to make the situation of the affected district a top priority, that district

must have a cultural tradition that should be preserved by all means. While you let cultural traditions being damaged by civilization, if you disregard the effects that the public issue will give to the wider area, in other words, if you disregard issues such as energy supply and industrial waste disposal facilities, then that kind of attitude can be called "district egoism".

Looking from this perspective, reaching consensus by referendum is too artificial because it trivializes public issues into private problems, converts long-term issues based on historical backgrounds into short-term problems, and minimizes the global issues into local problems. As long as that kind of artificial consensus is placed in the center of public measures and policies, the distortion of the "post-war" civilization, that is, the expansion of private interests and degeneration of public interests, will never be corrected.

Pitfall of "Democracy"

It was J. S. Mill who mentioned "control by public opinion." His thought followed A. de Toqueville's theory in "Majority's Tyranny." As for the fact that the referendum was placed in the center of the group decision-making in postwar Japan, there is a historical background of lack of doubt about democracy as in de Toqueville's theory.

In the first place, the word "Democracy" should not be interpreted into "Minsyu-syugi" or people's sovereign policy in Japanese. Since "demos" stands for "people" and "kratia" for "policy," People's policy should be the equivalent translation. The majority of the people make decisions by the majority vote; that is the methodology of "democracy". In it, there is a consensus that whether a result by the majority decision turns out to be good or not, entirely depends on whether the majority of the people are wise or fool. To regard "democracy" as the absolute social justice without taking it into consideration is simply democratism as an idea, in a sense that there is no concern about "mobocracy".

In Japanese, "Minsyu" means "the people have the sovereignty" and "sovereignty" means "the supreme and absolute right". What kinds of people are entitled to have "sovereignty"? Unless we go back to the time of the Enlightenment in the 18th century, which believed in human perfectibility, what we can do is just expect that the sovereigns have what can be called "historical commonsense". In addition, if you notice that historical commonsense is different from nation to nation, you will find that the "people" are not only the people but also the "citizen of a nation". In other words, "Minsyu" is "the nation's people's sovereignty", which is different from "the people's sovereignty".

Conversely, there is a premise that the citizens of a nation share an unspoken agreement on the "historical commonsense". Each individual of a nation may express what his/her commonsense is like in a slightly different way depending on the time and place. Nevertheless, the idea of the citizen of a nation itself cannot exist unless we deem that they share commonsense at an abstract level. The people can become the citizen of a nation only by having a basic attitude to follow the reason of the historical commonsense. In that sense, it was quite reasonable that FUKUZAWA Yukichi and his followers translated the term "right" using the Chinese characters representing "power" and "reason" instead of the common characters of "power" and "profit" which is commonly used today. Citizens of a nation can be sovereigns only by going forward in accordance with the right reason, or at least by trying to do so.

What G. K. Chestaton really meant by his advocating "The democracy of the dead" was to vote consulting the "historical commonsense," handed down by the predecessors. If the living ones vote based only on temporary desire without looking back into the past or seeing into the future, it will be a behavior described as ochlocracy. Even if you say what justifies that kind of behavior is the public opinion, it is merely a cry of "Vox Populi, Vox Dei." What can be truly relied on is not the public opinion but the opinion of the public with sound judgment. Not the opinion of mass which surrenders itself to trend or desire, but that of common men based on tradition carrying the weight of history. This is what must be the foundation of the democracy.

The public opinion implies that the commonsense notion that "indirect democracy" is superior to "direct democracy". Another name for indirect democracy is "parliamentary democracy". The wonder in the modern age is that, while supporting parliamentary democracy, at the same time, we are praising direct democracy by submitting the parliament to public opinion. That parliamentary decision is easily turned over by a referendum. This may be an indication of our downfall towards direct democracy.

Ordinary people know from their living experiences, what personality and wisdom are suitable as their representative, thanks to their high regard of the "historical commonsense". However, they lack or are deficient in the capacity, on average, to judge the right or wrong of an individual policy including the relationship with other policies and the estimation of long-term effects. That is the reason we leave the deliberation and decision making up to the representatives

for the house. If the public has complaints about the decisions, they vote for another suitable candidate in the next election and thus are the logic of the parliamentary system.

The parliamentary system also encompasses the notion that our representatives are not supposed to stick to their own individual profits. That is a matter of course because our representatives may stand on a position that represents the national profit, taking the example of a minister. In an extreme case, our representatives must work for the national profit even if it is against the local profit, while making efforts to persuade the local people.

To say it in a few words, the parliament situates itself on the borderline of trust and doubt, that is, it should trust its people in the sense that they have the ability to choose their representative and it should doubt its people in the sense that they lack the ability to select an appropriate policy. And since this is neglected in democracy's assentation with the people, the parliament system is upset and the public opinion runs out of control. The recent situations in which public policies are decided by the outcome of referendum are vividly telling of the breakdown of the process of the parliamentary people's policy.

Were there is no public mind, there is no public benefit

Although liberal democracy may be called the supreme political ideology in the modern age, it can't be the one without any restriction because freedom with no restriction will fall into indulgence, and the majority decision with no attention to the minority will invite the minority's rebellion. It is only the "historical commonsense" that establishes a balance between freedom and restriction, or between the priority of the majority and the protection of the minority. In that sense, both liberalism and democracy must have tendency towards historicism in order to be sound.

After World War II in Japan, the left wing slanted history-destroying Sovietism and the right wing (or anti-left wing) slanted to Americanism, which has no history. The two were actually of the same kind as they both lacked historical recognition as the base. In this sense, even the cold war had its root in the hatred between close relatives. Post-war Japan did not have the insight into this fact and deviated so much from the "historical commonsense" that it lost it's national identity, eventually having no national characteristic to conserve. And now it is going to trap the nation into destruction named "reform without sanctuary".

At the bottom of such a destructive idea, there is a process where modern Japan has been underestimating the three pillars of the French Revolution; Freedom, Equality and Fraternity. I have already mentioned that the current freedom without restriction would fall into "indulgence". Equality without admitting actual disparity would fall into "averaging", and fraternity without actual competition would fall into "hypocrisy". If you call the balance between these ideals and the reality "dynamism, fairness, and moderation", what was necessary was to find out what the concepts of dynamism, fairness and moderation were based on "historical commonsense" and at the same time depending on the "time, place and occasion," accumulate the nationwide discussions, persuasions and decisions for that purpose. Since Japan has failed to make such efforts after the war, it has lost the commonsense notion that it is public policy that gives the base, frame and direction to the citizens of the nation's dynamism, fairness and moderation.

Any citizen must have his/her own public mind as well as private mind. Also, he/she must have a group mind as well as an individual mind. Morality is the strength of mind that keeps balance between the public/private and group/individual. Those who do not have the strength of that kind cannot have the ability to make sound decisions. One of the examples is our Constitution, where concept of the "public welfare" is not indicated at all. It's true that it is stipulated in Article 13 that the citizens have a right to freedom as long as it does not go against the public welfare. Whereas the normal understanding is that if the standard of public welfare is to succeed historically the Japanese national characteristics and its morality is prohibited in this Constitution. After all, judging from the "democratic" nature of the Constitution, we may only understand from it that what the majority desire is for the public welfare. Nowhere in the Constitution is a criticism of the majority's desire to convert itself from a public mind into a private mind, and confine itself as an individual, throwing away group mind. Therefore, we could assume that this criticism was also absent from post-war Japan.

Where there is no public mind and group mind, neither a national profit nor a local profit can be found. Now that it is not sought any longer, the "reform" that preeminence of the market, liberalization and privatization regard absolute are being imposed on public projects, or more precisely, on the destruction of public projects. J. Shumpeter's slogan of "creative destruction" is used to justify this act of barbarism. However this is wrong, for creative destruction, there must be a concrete plan and implementation for the "creation". It is utter optimism toward human nature and the society to believe

that destruction is spontaneously followed by creation.

In what direction is "creation" sought in modern Japan? The answer is in direction the direction of solving public issues. The reason is that the citizens' dissatisfaction generates the public actions (relating to the public profit), not about the products supplied in the market (as a place where the profit is disposed of). In fact, because the public actions like natural resource, energy, currency, trust, risk management, administration improvement, family, environment, urban and rural areas, school systems, education in general, research and development have not been developed consistently, the infrastructure of market mechanism has dissolved and suprastructure has fallen apart as well. If we ask for the fundamental reason for the unfulfillment of those public activities, we bump into a fact that "democracy" abuses the decision-making ability of the citizens.

Implementation of PAP (Public Action Project)

What is immediately necessary is to make a concrete plan for the PAP (Public Action Program) and implement it. The reason why the market dynamism is no longer responsive is because PAP does not involve private corporations and families. This is no wonder as the market-based principle and the "small government" policy was in the center of the reform theory of the so-called "lost decade" of the 1990's. It must be said that the necessity for the authority to advocate PAP was rather denied there.

The market mechanism falls into malfunction in front of, first, the uncertainly as a probabilistically foreseeable crisis, second, the scale economy that is the effectiveness of mass production, third, the public property to be used collectively. Consequently, if it were not for PAP, the market unbalance, instability and inequality would not find a way to be solved. Even though it has become the biggest issue, we have a bloom of reform theories that can only be called market fundamentalism. It is no wonder that market dynamism has declined.

To envisage PAP concretely and implement it means to lower the public issues down to a regional level to examine therein. In a district, concrete things like who, where, when, why and how are always questioned. To work on the specifics of the district is what we call the dynamism of the inhabitants. Only when that kind of local action takes place spontaneously in every place throughout Japan, the citizen's dynamism is confirmed, and we call it creative destruction in that the old conventions are destroyed by the dynamism towards creation.

PAP needs public-private partnership. Cross partnership between the public and private sectors, among various government agencies and different classes, must be developed. The four pillars to support PAP are public, local, concrete and partnership. We have to consider that only by solving the aforementioned public issues from currency to education by PAP with these four pillars, the market dynamism can be cultivated and stimulated.

Although I mention local districts, I am not for the decentralization, which is currently in fashion. All districts including the capital are interconnected. That' is why inter-regionalism, and not local decentralism must be advocated. In the case of inter-regionalism, it is possible that a certain district takes on PAP for the national profit. There is no question about it because it is the nation that governs the regional relations.

I am going to launch a PAP project, even though it may be small scale, in Hokkaido where I was born. It is titled the "Restoration of Hokkaido for the nation". In Hokkaido, there is plenty of possibilities left in the areas like natural resources, energy, risk management, urban and rural areas, schools, research, and development which could be contributed to the national profit. It does not mean to sacrifice Hokkaido for the nation. On the contrary, by dedicating it to the national profit, it will manifest a meaningful existence of Hokkaido, and by doing so, it will increase the dynamism of Hokkaido.

At present time, the entire country of Japan, including Hokkaido is following the course of decline. Half, at least, of the reason is the natural consequence of self-destruction that the Japanese themselves plunged into in the name of "reform". As a result of mistaking situations like the nation without history, democracy without commonsense, freedom without norms, market without the public frame, with a reform, contemporary Japanese generation has wasted almost all its heritage, that is, the historical wisdom which should be handed down to our own descendants. In that sense, it can be said that mental asset deflation is going on. It may be too late, but we have to do something to avoid the folly of waiting for death without doing anything.

Reevaluation of Traditional Engineering Methods: Forgotten River Engineering Technology

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Currently, the creation of a social environment that places the least burden on the environment is being advocated and there are measures aimed at preventing global warming. In river works, nature-oriented river works and neo-natural river works are being used. For these measures, vegetation and water life have been used to improve water quality. Furthermore, materials such as Soda, wood and stone have come to reevaluation, for they have been used since the old days.

Traditionally, ancestors creatively combined locally available materials such as stone, wood, and Soda to protect the precious life and property of local residents and create a safe living environment. Structures built with these materials can continue to exist without any adverse effects on the global environment. Its system is one of civil engineering methods that does not destroy the ecosystem of fishes, birds, insects, microorganisms, and plants.

Utilization of Secondary Forests for Living

Shiba[2] is mentioned in the famous "Peach Boy" fairytale, which begins with the line, "Once upon a time, grandpa went to the mountain to gather Shiba while grandma went to the river to do the washing..." Shiba was an important source of fuel for warming and was a necessity of life until around 1950s. Today, we are dependent on oil and coal and rarely does anyone use Shiba as the source of fuel. First of all, to collect Soda does not require cutting down large trees in the forest. Rather, Soda is gathered in thickets that have been the source of charcoal and firewood for the people. That is why the thickets were called Secondary Forests for living.

Soda is obtained at 10-year cycles from broad-leaved deciduous trees, which involve sticky trees such as oak, cherry trees, maple, witch hazel, and clethra barvinervis. Several Sodas are bound together into a bundle for use. Because uses for charcoal and firewood are rare these days, forests and thickets close to people are becoming abandoned. There, the trees are cut down or left untreated as the development changes landscape, and they come to be called obstructive trees.

The History of Soda Engineering Methods

The history of Soda engineering methods goes back a long way. It appears in Volume 2, number 197 of the "Collection of Myriad Leaves (Manyo-syu)" in which a short poem by Kakinomotono Hitomaro mentions: "If a weir is placed on Asukaga River, the river would flow more gently." The "weir" that appears in this poem is believed to be consisting of stakes and Sodas woven around them. In the reservoir for agricultural irrigation called "Sayamaike (Osaka Prefecture)" there is evidence indicating a history of using brushes, reeds, and cedar leaves mixed with soil to create a multi-layered embankment. This record appears in "Manyo-syu" or the historical "Record of Ancient Matters (Kojiki)" as well as the oldest imperially mandated official history completed in the Nara Period, the "Chronicles of Japan (Nihonshoki)". In these ways, Soda has been used for the embankment of reservoir bank and settlement protection blanket for wetland reclamation.

The Dutch engineers of the Meiji Period, G.A.Escher, J.de Rijke, C.J. Van Doorn, and others promoted development of rivers, sediment control, and ports in Japan. Among these, Dutch river improvement engineering using Soda mattresses was advocated, prompting to review Japanese river improvement technology. Its flexible resistance to the flow softens the impact of water and this technique is a more effective engineering method than the traditional Japanese way of weakening the flow with pine stakes. Soda mattresses envelop water and become part of the riverbed, serving as an effective form of river improvement engineering to prevent erosion and was historically implemented in many rivers such as Yodo River, Edo River, Kitakami River, Mogami River, Tone River, Kiso River, Kuzuryu River, Chikugo River, and Shinano River. When it was first implemented, it was known as the Dutch Soda mattress method and in the guidance report submitted by Van Doorn called the "Introduction to River Improvement," it is stated that, "In Holland, lumber and stones are expensive so in many cases brush branches are used to make mattresses. However, in Japan, lumber and stones are

easily obtained at reasonable prices so stones, lumber and brush should be used in appropriate combinations to improve the river." As these statements show, in Japan there were plenty of lumber to make Soda mattresses and the natural resources were plentiful. Documents reveal that Soda mattresses made using Dutch river engineering technology were implemented in various locations all over the nation until around 1950s. In the Shinano River and Agano River in Niigata Prefecture, owing to mild currents, riverbeds are sandy, allowing Soda mattresses to stabilize. Therefore, they are still used today for river management projects.

Changes due to the Modernization of River Engineering Methods

Current river engineering methods use many concrete blocks for wave-absorbing and riverbed stabilization works. Concrete blocks are either used singularly or combined but in general, they are ill suited for the riverbeds of natural rivers and when the impact from hydraulic power exceeds the design, these structures fall apart. In recent years, where several such cases have become known, restoration works using Soda mattresses are being done.

Where the riverbed is composed of sand, silt and other fine particle matters, concrete blocks get buried under the riverbed and cease to function. Soda mattresses cover a large area of the riverbed and evenly distribute the load to hold down the riverbed so only the front edges settle. That is why Soda mattresses are better suited to the riverbed compared to concrete blocks. In many cases Soda mattresses are placed during winter. Trees tend to retain a lot of water during wintertime, causing the weight of brush mattresses to reach 120 to 150kg per square meter. For each 100m^2 of construction unit it can reach up to 12 to 15 tons.

In recent years, there are great changes in the implementation methods of Soda mattresses. Traditional Soda mattress construction used a temporary manual pulling/lifting setup called Kendan. Kendan fixes a sand boat to the riverbank and lifts floating logs by manila ropes. It was a very complicated procedure, which required about 5 highly trained technicians and boatmen. For this reason it was considered a special method of construction for limited regions. However, in recent years, with the use of hydraulic cranes with larger capacities, Soda mattresses are constructed on land and made into a raft. Then, the raft is lifted and set on the river by the crane, which led to a visible decline in the number of highly trained river specialists. However, it still requires many laborers to fabricate a Soda mattress. As traditional construction methods for river engineering are reevaluated, with the coming demand for Soda mattresses, our major task is to train specialists to fabricate Soda mattresses (Photo-1).

Photo-1: Hanging Soda mattress using a large crane

The Decay of Soda and the Creation of Diversity

Generally, Soda can be cut into the standard diameter of 2 to 6cm at the bottom, using an axe or a chopper. Projects are currently underway to clean water environment so that the brooks would once again become the habitats for fireflies. There are also elementary school environmental education projects. Soda revetments made of broad-leaved deciduous trees are used in these projects of biotopes creation and waterfront mitigation. Brooks made using Soda revetments have many porous holes between the branches and many have been implemented in recent years to offer habitats to various organisms. However, even brooks used in agriculture that previously used Soda and where many organisms were nurtured are now paved by concrete. There, the water is dried up after rice irrigation. Many Sodas are decomposed by underwater organisms after several years and return to soil. This phenomenon is positioned at the very bottom layer of the ecosystem pyramid of the river environment and is a large factor in the creation of biological diversity. Also, the regional water quality has a large effect on the rate of decay for Sodas as the years pass by. Year by year data of the decay of a recently constructed Soda revetment is shown on Figure-1.

The evaluation took place in the site of the repair work of a waterway, which is partly used for agriculture. The site is 5 meters wide and the revetment is 1 meter high and 1.2km long. At the beginning, a three-sided concrete waterway was considered, but a Soda revetment was adopted to serve as a model case for nature oriented river works under the authority of the Niigata Prefecture's Shibata Public Works Office. The changes over 8 years after construction was observed.

Photo-2: February 1994 Soda revetment h=one-meter)

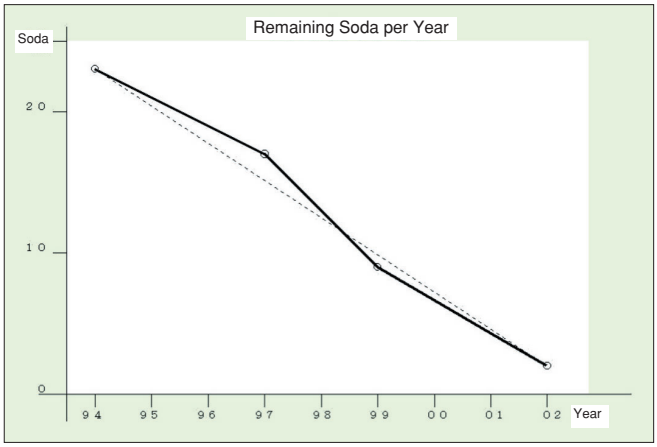

Figure-1: Remaining Soda over time

Photo-3: May 1998 decomposition starting at the upper part

Photo-4: May 2002 decomposition of the brush mattress almost complete

The structure of the Soda revetment consists of Sodas (L=3.0m, D= 2 to 3 cm) and stakes (c.t.c. 60cm). 46 Sodas are woven around stakes alternatively. That is to say you can see 23 Sodas from the front. In this survey, Sodas in front of the stakes were used to confirm the rate of decay for the Soda revetment. In 1994, just after completion, there were 23 Sodas in place (Photo-2) and 3 years later there were 17 (Photo- 3). Further, 5 years later there were 9, and after 8 years the number was reduced to 2 (Photo- 4). This indicates an annual average decay of 2.6 Sodas (Figure- 1). You can see that the shore protection is roughly 8.6 cm high. In the site under study, the riverbed gradient is 1:80, and as the scouring of the riverbed progresses and the riverbed lowers, the Soda revetment becomes higher than the water surface and becomes exposed. The condition is far from good, but where grass vegetation is formed at the waterfront, the Soda revetment still exists. Although Sodas forming the revetment have dried up, the fine roots of the grass vegetation bonds with Soda to stabilize it. By the time the Soda decays, sand penetrates the pores where cobbles were formally placed. The sand acts as filling material, transforming the porous area into a firm rockwork, so that the revetment serves its role as the protection of the shore. In areas where cobbles have fallen due to water impacts, these cobbles serve to naturally regulate water flow. Where the water is stagnant around the multi-porous rock works and the Soda revetment, fish habitats have been confirmed. From the above observation, it is clear that not only does Soda revetment functions as reinforcement over the years but it can also be expected to serve as an engineering method to help create the natural diversity of rivers.

Characteristics of Brush Mattresses under Water

In Niigata Prefecture, Soda mattresses are mainly used as riverbed reinforcement for the gentle water flow. However, in river areas where the flow speed varies, the water contains a lot of silt and is murky and it is rare that the effects of Soda mattresses can be confirmed.

In one case, Soda mattress was installed as foundation for the embankment construction around 1965. The remaining of the mattress was confirmed when a large-scale river work involving embankment repair was carried out. The Soda mattress installed at the lower part of the embankment served as effective riverbed reinforcement with the intertwining of cobbles with other riverbed materials. In the areas revealed by excavation, Shiba bundles and Soda bundles were confirmed.

Photo-5: Compressed Soda mattress (near the Arakawa river mouth, Niigata Prefecture)

Photo-6: December 2000 laying of Soda mattress (Tone River, Ibaraki Prefecture)

The wood was in good condition without any sign of decay and water was retained. When it was first sunk, the mattress was 90 cm thick but it was compressed to 45 cm (Photo- 5) when it was excavated. The excavated Soda mattress looked relatively fresh, and when a Soda was bent it showed enough resilience. However, one month after exposure, Soda looked dry due to surface evaporation and became more brittle.

In another case confirmed in the riverbed of the Tone River, a Soda mattress that is estimated to be constructed around 1955 merged with the silty riverbed. On visual inspection, the Soda ends seemed to be in a good condition but it broke easily by hand. However, since the mattress is intertwined with the riverbed (Photo- 6), it does not sink down even with the weight of a person on top, demonstrating that it is a firm structure.

Diversity of Soda Mountains

The mountains where Soda is collected, at the altitude of 200m in the northern part of Niigata Prefecture, have unique environmental conditions not seen on the mountains where woods for fuel are collected. The human impact of gathering Soda is different from that of gathering firewood and fallen leaves on nearby forests. For example, while firewood forests are felled every 20 to 30 years, Soda forests are felled more frequently, roughly every 10 years. In forests where less than 15 years have passed after felling, there is little difference in the height of trees and bushes, and the density of branches is high. In the spring, many young leaves are formed. Another special characteristic is that roughly 40 species were found in every 50m^2 area. Since there is also a wide variety of grass in addition to trees, it is presumed that many insects seeking honeydew come in spring.

At the time of the survey, there were two layers of bushes and grasses, consisting of 44 species from 35 families. The bush layer included around 8 species such as willow-leaved pear, Japanese witch hazel, *Lindera umbellata, Clethra barvinervis,* and *Corylus sieboldiana* and the germination was abundant due to regular felling. Such species grow in the beech area and are byproducts of yielding activities such as felling. In the grass layer, about 13 species such as *Stachyurus praecox, Camellia japonica, Viburnum furcatum*, Japanese Snowbell, and Japanese Nutmeg- were germinating and sprouting. In addition to these, there were about 13 species of grass such as Japanese pampas grass, mugwort, and brier.

This indicates that in mountains where Sodas are gathered, the plants are revived from the forest floor seed bank, and Japanese antelopes that live in the mountains visit the area seeking these short plants. Also, in Soda mountains where vegetation is plentiful, birds of prey like goshawk appear seeking small animals. This supports the fact that the artificial cycle of felling is suitable for protecting the diversity of the Soda forests.

In this manner, not only does the use of Soda bring benefits to people, animals, and plants but also the porous space created by Soda becomes the habitat for fish and other underwater organisms. Construction measures using Sodas contribute to the protection of nearby forests and water environment serving as a total environmentally friendly engineering method.

In future, we hope that the benefits of traditional river engineering methods will be properly understood and that recyclable yields of Soda will be increasingly used in accordance with the purpose of contributing to the cohabitation of humans and nature.

1 Soda: Piece(s) of wood that are cut straight at the diameters of approximately 2cm~6cm.

2 Shiba: cut or broken twig or branch

JSCE'S New Civil Engineering Library Opening Ceremony Memorial Lecture "From Civil Engineering to Environmental Civil Engineering"

Norihito TAMBO
Former JSCE President

I would like to express my heartfelt gratitude for the completion of such a splendid library. I feel it is an honor to be the first to give a speech in this place, to commemorate its opening with a lecture titled "From Civil Engineering to Environmental Civil Engineering."

The origin of the word "Doboku[1]" is found in a book titled "Enanji", which was written circa 2 B.C. The following passage is found in Vol. 13 of this book. "In the old days, people lived by the water and in caves, in winter beaten by snow and frost, in summer beaten by the heat and worms. Then a wise man stood up to mound the earth and assemble wood, which was made into a house, raising the roof and lowering the eaves, which sheltered from the wind and rain, and thus avoided the heat and the cold. Farmers felt comfortable in it."[2]

The word consisting of four Chinese characters found in this passage, "ChikuDoKouBoku" was abbreviated into "Doboku" the second and the fourth characters and came to signify civil engineering in the 19th century in Japan. The world population in the 2 B.C. was minimal compared to today so I presume that people's lives at that time were just as described in the passage in "Enanji."

Figure-l indicates the world population estimate in terms of the formal demography. As you see in the graph, the world population in the year 2000 was 6 billion. Supposing the earth is a closed system and bases on the familiar logistic curve, the population will reach the saturation level at 10 billion under the current system. The earth population at present has just passed over the 60% mark.

I would now like to speak about a picture book for children titled "The Little House Way Out in the County[3]" written by Virginia Lee Burton. I used to read this book to my children when they were four or five years old. Figure-2 is the first page of the book, showing a small house in a field surrounded by farm animals. There, human beings live amidst animals as their equals. This kind of life is not so different from the one described in "Enanji," where people lived in caves by marshes, surrounded by cows and bears. The presence of livestock in this picture indicates that this book was written centuries after the age of "Enanji" but the essence of human lives were unchanged and people still lived with consciousness that "we were one of them." This is when the Doboku took place.

The transition from the time when humans lived happily as a species in nature as in "A little house way out in the country" (also the title of a famous Japanese sitcom) coincides with the development of civil engineering. Figure-3 shows a picture of "the countryside slowly changing" and the land being developed. As you see in Figure-1, there was no significant

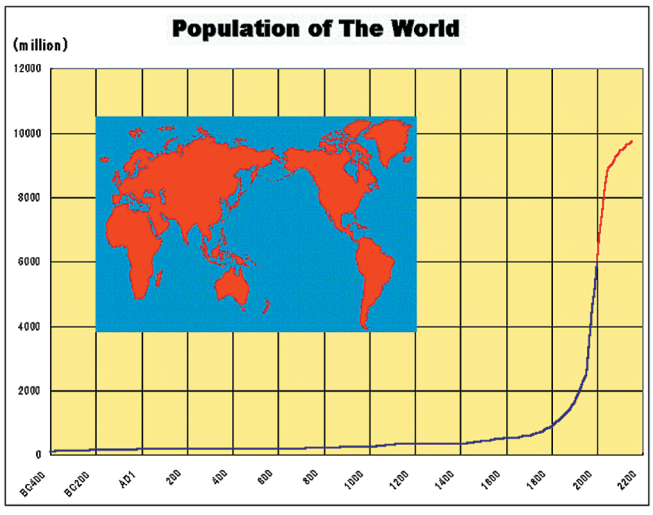

Figure-1: Population of the world

Figure-2: "A Little House way out in the Country" Burton, Virginia Lee. Iwanami: 1965.

Figure-3: "The Countryside slowly changing"

Figure-4: "A horseless carriage coming down"

change of the population until around 15th century. Although it is a bit different on a log scale, there was little increase.

In those days, agriculture and stock farming were done using cattle. Cattle power and waterpower were supposedly used in "raising the roof, lowering the eaves" and in building structures that are the essentials of human life.

In the 18th century, the modern era began and the industrial revolution took place. Roads were paved and rivers were bridged. Figure-4 describes a scene where "a horseless carriage (an automobile) com(es) down (the road)" indicating that the cattle power was replaced by the steam power, the greatest technological development which gave rise to the modern era.

Please refer to Figure-1 once again. Since the world had been an agricultural society until the 16th century, there had been little growth in the world population. With the arrival of modern era in the 17th and the 18th century, the world population begins its rapid increase. When the former British Prime Minister Margaret Thatcher visited Japan, she said, "Japan expanded getting a free ride on the technologies invented in England." We cannot deny it because in the 18th century, the Japanese were still wearing traditional topknots, a sign of a Samurai. It was only in the mid-19th century that the Meiji Restoration took place. Meanwhile in Great Britain, and mainly in Scotland, incredible modern technologies have been born. This is also when basic civil engineering technology gave its birth.

And now, how should we interpret this situation under which the world population has increased in a rapidly rising curve during the last 100 years until it has reached 6 billion? The modern era is supported by various academic disciplines and technological fields, and among them, civil engineering has been a study that has been playing a central role. In Japanese, "civil" is translated into "doboku" originating in the expression "mounding earth and assembling wood", found in "Enanji". I am undecided whether this is the most appropriate translation as the direct translation of civil engineering would be "Shimin-Kougaku".

When I was a student in the '50s, the civil engineering courses at the former Teikoku University (Emperor's University), included courses on road engineering, bridge engineering, railway engineering, river engineering, harbor engineering, city planning and sanitary engineering among others. These courses were supported by courses on structural mechanics, hydraulics, geological engineering, and concrete engineering. Thus, in academic discipline called civil engineering, applications preceded the fundamentals, which were established to create a systemized discipline. There were science and other engineering fields as well but the educational system of civil engineering until the 1970s was constructed in a way such that it was possible to study the field without going all the way back to these fundamentals. In other words, starting with the applications and digging a little into the fundamental principles.

In fact, the growing society in modern age is a technological society. Roughly speaking, we could perhaps say that science is a theory of procedures. It is a theory proving that if one follows a certain procedure, one is able to reach a certain conclusion. In order to determine a procedure, given conditions must be simple; otherwise one could end up with more than one answer. It was a typical example of modern science that Newton established the law of motion, which

Figure-5: "Everyone and everything move much faster now than before"

Figure-6: "More roads were made, more houses and bigger houses spread over the land and crowded around the Little House"

simplified the conditions as to how objects move in a vacuum and made a perfect explanation of the law of inertia. Its elements are simple and therefore it becomes difficult to solve the problem with our current knowledge in science when the situation becomes complicated. Civil engineering is a good example of a case in which science was not 100% utilized, and in that sense, it was located slightly apart from other scientific fields. Lining up simple parts in straight lines, we have created a vertically divided society. Mechanics don't know much about electricity. Agricultural engineers might not have studied much about civil engineering but studied mainly agriculture. Being divided vertically as need arose, so many courses were created in the Department of Engineering. The departmentalized system developed in which by the sophomore year, students received different education from each other.

Comparatively speaking, civil engineering is an integrated field of engineering. This also means that it is a field, which has not gone through division and specialization in this modern era. When it comes to the study of fluid, for example, it seems that aviation fields were far more sophisticated. As for the mechanics, aviation and some other engineering fields were studying much more sophisticated things than our structural mechanics. However, they have no ability to build a suspension bridge that is 2,000 m long. It is one of its characteristics that civil engineering has not been specialized, and thanks to that only civil engineering was able to produce management type engineers form among various engineering fields. In the government, a technocrat who holds the post of vice minister comes from civil engineering, while a technocrat from other fields can make his career up to a section head or a bureau head at the best. I am not saying that moving up in the government office is the only thing that matters, but from the viewpoint of overall ability, it can be said that civil engineering holds an unique position. It has long been the case when an engineer accomplished in one field changed the section; he/she was not regarded as full-fledged unless he/she can handle the work of that section.

Human beings have accomplished a great many things based on the know-how of each field of various vertically segmented studies. Taking the example of thermodynamics, there is the "2nd law of thermodynamics", known as "entropy law". I believe it is the most beautiful scientific law among many other natural laws we have discovered. These ideas, like entropy or thermodynamics, did not exist from the outset but were discovered after the steam engine was invented, as its explanation. However, once the law is established, the engine was created by learning the law and using some additional know-how. This is the shift from industry to engineering. However, engineering can only describe the framework. It cannot teach know-how or wisdom such as what to do with the engine material, or what part will begin to break when worn out. Thus our technology has been developing by the exchange of know-how with other fields. The invention of the motor has Ohm's law as its basic principle. This was followed by the Watt's energy consumption law, establishing the electrical engineering and finally the discovery of the law of the left hand thumb led to the invention. This was the time when the electrical engineering department was established and if you study there, you could become an electrical engineer.

Figure-5 shows a typical city of the 19th and 20th century that people who are my senior or my age might remember. There,

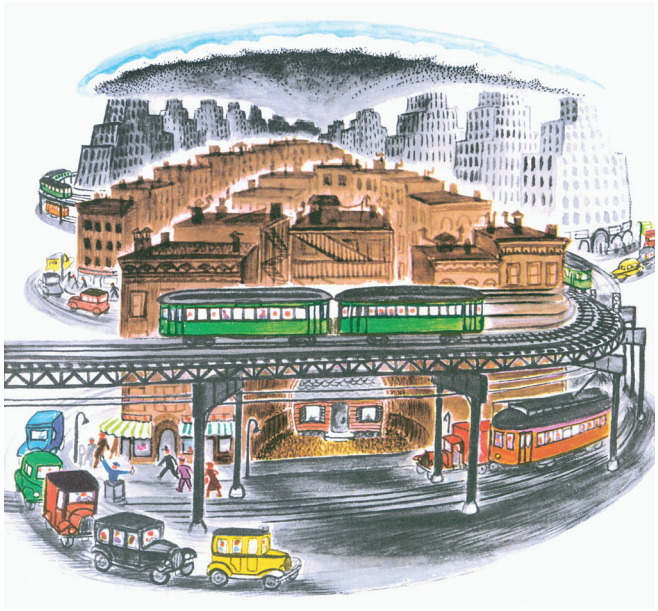

Figure-7: "They hurried by without a glance"

Figure-8: Time of environmental restriction

you see lampposts and automobiles. Civil engineers are taking an active part and "every one & every thing moved much faster now than before." In the 19th and the 20th century, know-how developed into science, to technology and to engineering. This is also an era of education when even not-quite-smart people could learn the technology to achieve reasonable results. They might not be able to invent splendid things but they can manage most things. Technologies disseminated rapidly in our society during the 19th and the 20th centuries.

The Figure-6 shows the '20's and the '30's when "more roads were made, more houses and bigger houses ...spread over the land and crowded around the Little House". The description also fits Japan just before the World War II. The Little House symbolizes the way of life during the time of "mounding earth and assembling wood" but in the beginning of the 20th century, it is surrounded by tall buildings. The picture reminds me of Chicago where Al Capone may have been roaming around.

Figure-7 shows an urbanized society in the latter half of the 20th century where "the people hurried by without a glance". At the beginning of the 1960s, when I was studying there, big cities in the U.S. resembled this. Trains were running on overhead lines and automobiles were running on the overpasses. I was astonished when I first saw an overhead road for automobiles and I still remember that it was so dark under the overpass that neon lights were on even in daytime. The Little House existed there even at this time. At the end of the 20th century, we, the human beings, began to think about the issues, which are symbolized in the Little House's surroundings and realized that "we must consider about our environment seriously." The word "environment" has become the key word. In the late 20th century, departments named "Environmental Engineering" appeared in the civil engineering branches in universities. Sanitary Engineering Department, to which I belonged in Hokkaido University, was changed to the Environmental Engineering Department. At present, all engineers think of themselves as practicing environmental engineering. Chemical engineers are practicing environmental engineering, so are the biological engineers. Even the architects are aware of the environment. In this way, environmental engineering has become "everyone's pie" and came to represent the engineering practice in the 21st century. The department of sanitary engineering was where I held my first post after graduation I consider it to be a forerunner of the environmental engineering field but today, it has become a small part of the environmental engineering. Now that it has become crucial to reorganize the academic fields of engineering, I think it is appropriate to rename this field. I suggest "environmental civil engineering" as perhaps wordy but correct choice.

The era of environment has arrived. In this era of environmental restrictions, like the Little House in Figure-8, our life began to be crushed by the surrounding environment and has no choice but to escape to the suburbs. At the end of the 20th century, it is the end modern era where it is no longer endurable to live in the midst of a city surrounded by various kinds of office buildings and business centers. On the other hand, there are people who would enjoy living in skyscrapers constructed one after another in the heart of Tokyo. But life is becoming harder and harder for many ordinary people who would want to escape without being able to. Tsukudajima is such an example where they coexist in chaos. It is the natural

process that the modern society, which had been continuously growing, comes to an end at the dusk of the 20th century.

Take a look at Figure-9, "Population transition in Japan". Japan had been developing by importing cultures from Sui and Tang. During the Kamakura era, the population kept growing steadily and it increased even during the Age of Civil Wars when the society was in chaos. During the Tokugawa Era, Japan closed its doors to foreign countries for 260 years and meanwhile cultivated agricultural societies in the three islands of Honshu, Shikoku and Kyushu. To express this in a modern term, they were living in Green by solar power until the food self-sufficiency ratio came to a saturation point and the population growth halted. The population decreased by 3% due to this and the closed system of food self-sufficiency in Japan collapsed. In 1853, with the arrival of Commodore Perry, when Japan reopened its door to other nations, food self-sufficiency system had collapsed and the national isolation policy had begun to fall apart. The Japanese population at this time was from 25 - 26 million to 30 million. Since the Heian Era, Japanese developed new rice paddies in the northern territories, moving up 1 km north per year until they finally reached Aomori Prefecture by the end of the Tokugawa Era. Therefore, it took them 1,000 years to almost reach Hokkaido. It was years later when rice paddies were developed in Hokkaido.

The period before Commodore Perry's arrival is when people lived in an environmentally friendly manner. But after the arrival and the consequent opening of the country, Japanese population began to grow rapidly due to modernization. I was born in the early 1930s when the Japanese population was approximately 70 million. Today, it has reached 125 million, but it is said that it will be less than 70 million in hundred years from now. We tend to talk about the population decrease, declining birthrates or the aging population without deep consideration. However, as you see in this curve, the situation is much more serious.

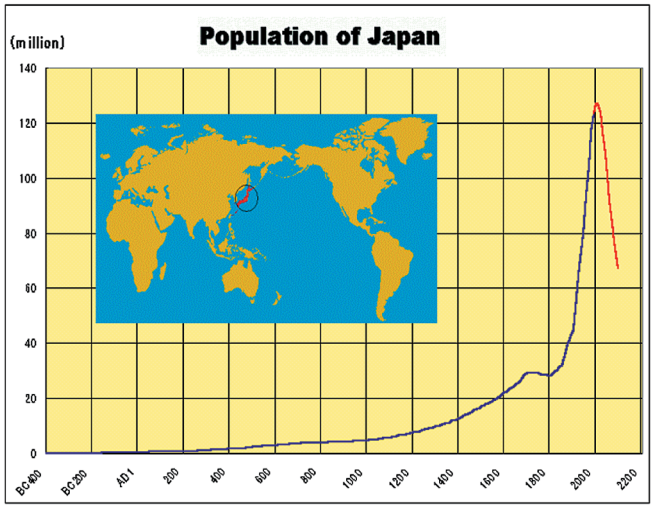

Figure-9

How should we address this issue? As JSCE, or as civil engineers, this is the most important issue to consider. I would like to list a few key facts here. First of all, as you can see from the logistic curve of the world population, it is still growing, although it has passed the period of maximum increase. What caused this growth was the modern western civilization. Science was born by inspiration for God, during Renaissance by the movement called humanism. Humanism is the freeing of human spirit from God's control to think on its own. Since then, we have been progressing in the framework of humanism. And therefore, we have created a modern western-style society, which is a vertically segmented society led by science and technology.

Today, Asian population is increasing at the maximum speed and it is at the steepest part of the logistic curve. The population is probably the largest social index in many ways. The U.S., which is the only super power in the world today and in the past history, is still growing as well. It already passed its maximum growth in the 50s' and the present population is about 25% before the saturation point. Europe has already stopped growing and has entered a period of maintaining the status quo.

As for Japan, not only has the population stopped its growth but moreover it has been rapidly decreasing. Like an object thrown towards the sky, it is now falling in parabola-like curve.

Japan experienced a rapid population increase during the 20th century. In 1900, Japanese population was 40 million, the environmentally sustainable limit including the space in Hokkaido. Unless we develop a technology, which allows us to retain solar energy in the near future, the only things capable of retaining solar energy are the plants. Therefore, the environmentally sustainable population in Japan is about 40 million. This means that Japan had already reached the saturation point of population sustainable by solar energy at the end of Russo-Japanese War in 1905 and the situation after this point went out of control. In 1935, the year of the Manchurian Incident and the beginning of Chinese-Japanese War, it grew to be 70 million, 30 million over the sustainable limit. This excess 30 million could be supported if energy and raw materials were imported and trade was undertaken: Thus. Japan was industrialized. Now in the year 2000, the population has reached 125 million, an excess of 85 million people in

order to live ecologically. We must be recognized the fact that approximately 70% of the population which are excessive live on the trade.

In 2100, we expect the population to drop to 70 million. This means that 30 million are still in excess of the limit of environmental sustainability. This number coincides with the population during the "time of mobilization" when Japanese colonized Taiwan and Korea, provoked Manchurian Incident and emigrated to Hawaii and California. After the wars, Japan mobilized economy and goods since it was no longer possible to mobilize its people.

Then, what should we do by the year 2100? As we undertake national planning as civil engineers, we must think of a way to deal with this overpopulation by 30 million people. Otherwise, our plan will simply be an armchair theory, we will be criticized, and our efforts will go down the drain. The bottom line is that only Japan is declining amidst the growth of the United States and China and that unless we deal with this issue properly, Japan will disappear. On the contrary, if Japan continues to exist and establish its own culture and civilization, I believe it can be honored as the first developed country in the world that could have stepped into the era proceeding the "modern age". Today, Japan is at the crossroad of disappearing without any achievement and of the honor as the leader of the 21st century.

I regret that the Japanese people lack the awareness of the severe situation in which our country finds itself despite being within a clearly defined boundary separated from other countries by sea. Japan is a country where only 40 million can live in an environmentally friendly manner and therefore we have to seek our solutions overseas. What could we provide and what could we receive in return? I predict that from now on Japan will exercise an absolutely fair trade. Even in debt, the United States remains the world super power as dollar continues to be the world currency. However, from now on, we must raise the issue of the U.S. deficit as well as Japanese surplus in considering trade imbalance. I cannot predict when the problem will occur but we are at a stage when we should foresee the problems in the future.

As civil engineers, we must consider the possible measures in order to render our national land autonomous. However, we have neither energy nor resources. Moreover, there is the problem of overpopulation by 80 million so there is even more need to be enriched by trade and to use the limited land space effectively and proportionately. For that purpose, we have to consider our national land as divided into the three areas as shown in Figure-10.

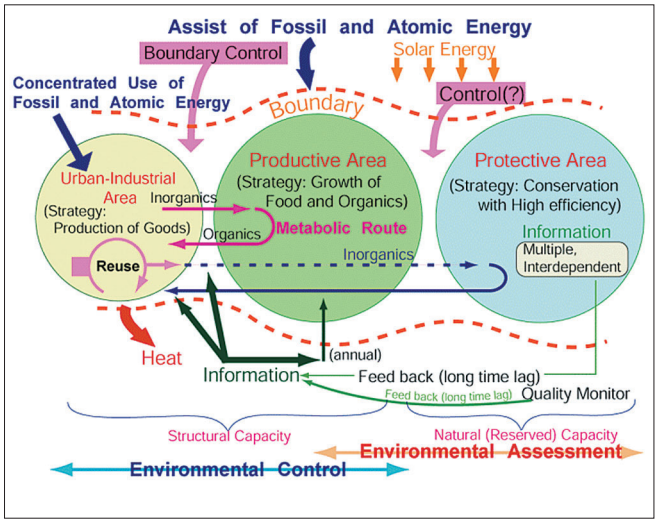

Figure-10

One of them is the urban space which is basically an inorganic space although there will also be limited child raising (life production is declining because the population is decreasing). This is a space dedicated to the production of goods and services.

The one next to it is the area dedicated to the growth of foods and organics. It is the largest area, which retains solar energy. It produces food in order to feed the urban population. In the Edo Era, consumed foods were recycled as fertilizer. The predominant period for the material cycle between this area and the urban area is two years. However, the self-sufficiency ratio in our nation's food supply is less than 40% on the energy basis. In other words, we are wasting a lot of solar energy by eliminating the rice paddies, by importing 60% of our food and by feeding it to the cattle. Since we import 60% of our food, only 40% is recycled. 60% is going to be wasted, which means we are importing a lot of waste. Our next target is to establish a recycling system that does not produce waste and thus create a balance between the urban and the food producing area.

Outside of this area is the nature conservation area. It is of utmost importance to preserve a stable ecosystem and Japan's ratification of the Convention on Biological Diversity is an act to prove it. In this area, there will be a variety of animals and plants living safely, receiving and sharing the solar energy among them. This kind of diversified safe zone is impossible for a human being to recreate.

How can we clearly mark these three areas on earth? We tend to carry out our plans according to city planning and national planning, daring to mention "so and so axis" but the natural environment is not so simple that we could classify it in such a rough way. How then, could we achieve this? The answer is that man can only control a part of the planning and we must leave the rest to the nature. In brief, the plan is to create a

boundary made of artificial forest between the urban/agricultural areas where human activities take place and the nature conservation area. An artificial forest is cut down once in every 50 - 100 years but this period equals to 3-4 generations for the small animals living there. Therefore even an artificial forest could be a large stable habitat for small animals. For human beings who live nearly 100 years, 3-4 generations spans 300 - 500 years and we consider the primeval forest in Shiretoko, Hokkaido, a tropical rain forest, or the Siberian taiga as real forests. But for the small animals, the ecosystem can be preserved in good balance if an artificial forest is made and maintained properly. Despite the fact that Japan has high forest coverage of over 60% among the developed countries, the reality is that it is importing cheap lumber from abroad, ravaging the forest industry, causing the forests to be devastated. This issue of national land maintenance must be taken seriously but the reality is that it is not discussed at all.

Japan is now overpopulated by 85 million. The population dwells in urban areas, causing the depopulation in rural areas except for the regional hub cities. Nowadays we often hear about "Self-sustainable area", an independent area where enough food to feed the habitants is harvested, water is available and a forest where people could rest is nearby

Figure-12: Matured post-modern time

However, in Tokyo for example, there is no such harmony, and even productive green areas have disappeared due to sprawl. The green hills have disappeared and the flat land stretches for 20 km. Forests barely remains at the fringe of the mountains. In Tokyo, the urban area is over-extended and Japan is centrally governed by this metropolis. The logic in Tokyo is imposed on rural districts, textbooks are published in Tokyo and journalism originates in Tokyo. Thus the whole nation crumbles, as metropolis is not a place where humans can lead a well-balanced ordinary life.

In a metropolis, the majority of excess population is working diligently, and profiting from trades with foreign countries, while rural districts receive returns such as subsidies, keeping a balance as a nation. And large cities are facing toward foreign countries, or more precisely toward the U.S. and Europe as these cities earn income from these regions. Even when the Japanese population falls to 70 million, 30 million people will still need these places, therefore, we have to consider what those 30 million people should do in the long run. In other words, we must redesign Japan, keeping cultural aspects in mind, distinguishing the metropolitan areas such as Tokyo, Osaka and Nagoya, and the rural area such as Akita and Hiroshima where watershed areas may be established. In the future, it will be important to consider how "combating" cities like Tokyo and the space where the Little House could coexist in our country.

It sometimes takes two hours at rush hour to get to the heart of Tokyo from Urayasu where I live. It also takes 2 hours to go all the way back to Sapporo. There is no sense in discussing whether the roads are improved and well maintained or not, while leaving the roads in large cities heavily congested. In Hokkaido however, widen general arterial roads, install safety equipments and set the speed restriction at 80 km per hour at night and at 100 km at daytime so that construction of a special highway would not be necessary. Though there may be many reasons, the speed restriction is set at 60 km per hour even in Hokkaido. Drivers loose their patience and go crazy, driving all the way at 60 km/hour in Hokkaido but the people in Tokyo

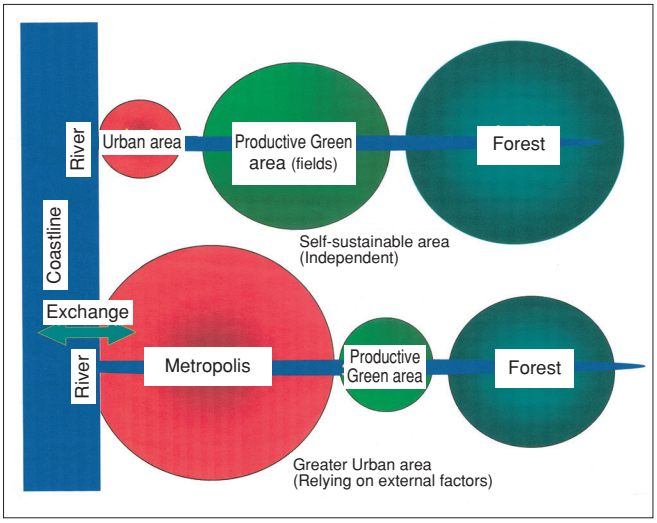

Figure-11

Figure-12: Matured post-modern time

would never understand such situations. The regional differences are seen in every field such as river, dam, road, and airport. I believe we have to consider how we could connect these different fields.

Finally, the Little House reaches the matured post-modern age of habitat segregation (Figure-12). We could achieve this in the 21st century Japan. We would redesign Tokyo for international competition. Tokyo habitants would hop on a bullet train for 1 1/2 or 2 hours to go rest in rural areas when they are tired. We would make use of the spatial differences. Those between the age of 30 and 50 would be Fighters and those above the age of 50 would move to places like Sapporo as a reserve army. Many things could be achieved if the gap among age groups is effectively used. Otherwise, 120 million people will decrease to 70 million and surrounded by the U.S., the continuously growing China and the Asia, I think it is highly improbable that Japan could survive on the same way of doing in the day. These are the issues that Japanese engineers, above all civil engineers, must consider.

Figure-13 shows the subcategories of civil engineering. This might be inaccurate as I redrew the diagram following my memory form my student years. Engineering is divided into two major categories: Civil Engineering and Military Engineering. Mining Engineering followed by Metallurgical Engineering, Mechanical Engineering, and Naval Architecture were probably the first fields to be set apart from Civil Engineering. Then in the 19th century, Electrical Engineering was separated. Since then, specialized fields were created one after the other. What was left was called the civil engineering. Since it was the original body, it was "multidisciplinary". Physical Engineering was derived from the discipline of physics, so it was established in a different way.

Following these were Chemical Engineering and Sanitary

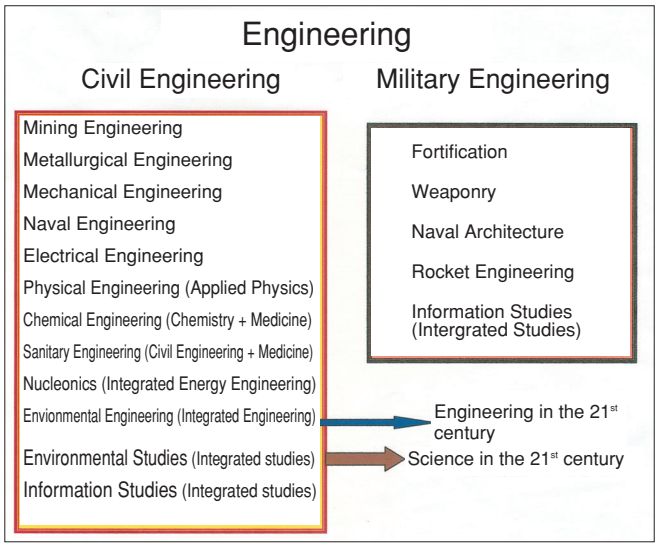

Figure-13

Engineering, which were established around the time when I graduated from the university. After the WWII, a delegation of industrial inspectors from the U.S. came to Japan and left a report to General MacArthur suggesting to reorganize as many industrial chemistry departments and applied chemistry departments in universities into chemical engineering. This caused chemistry and some part of mechanics to integrate, establishing a new department that would produce new chemical products. Thus opened a period of petrolo-chemical industry. Chemical engineering department was created in almost every national university in Japan. In addition, they suggested establishing sanitary engineering departments at three leading universities at least. Accordingly they were established in Hokkaido University and Kyoto University. At Tokyo University, architecture and civil engineering fought with each other to bring it into their side, but failing to establish sanitary engineering, created urban engineering instead. Half of it was architecture and the other half was sanitary engineering.

To my understanding, the message of the American delegation was to convince MacArthur of the importance of establishing multidisciplinary departments in Japan where there has only been departments focusing on single discipline, previously. As a result, two sanitary engineering departments were established, but since the order was for three departments, urban engineering department was established at Tokyo University. It was 10 years after this point when environmental engineering was finally established at Osaka University. I am impressed of the impact that the American army report had on the Japanese Ministry of Education.

Department of nuclear engineering, which is the first kind of interdisciplinary energy department, was created under the original aim to build nuclear power plants. As I mentioned before, since environmental engineering is an interdisciplinary study of all engineering fields, it may be said that all engineering fields in the 21st century are parts of environmental engineering. For example in the case of electrical engineering, when we install the electric feeder lines, we must be concerned of the negative effect of the electromagnetic waves on the inhabitants in the neighborhood. This shows that today, there are not many academic fields, which consists only of differential equations. I don't know if we should feel happy or sad about this but the time up to the 20th century when the greatest strength of science was the all -solving mathematic equations might have been the time when we admired science. Environmental studies is the science of the 21st century and it is a combination of the humanities and

sciences. I believe future academic fields will no longer be differentiated between humanities and science.

Information studies is also an interdisciplinary field, which consists of both humanities and sciences. This discipline widely covers the military engineering field as well as the civil engineering. It is however unlikely that the environmental studies becomes a part of the military engineering in the future. Environmental engineering is what emerged from the leftover of the civil engineering field. As shown in Figure 13, the fields of civil and military engineering correspond to each other approximately. Military engineering has developed from fortification, weaponry, naval architecture, rocket engineering to information studies and is a field involving great number of people and a gigantic budget.

Although it might have been a bit lengthy, I have explained how civil engineering, which originated in the old book of "Enanji" has diversified into various independent and vertically segmented departments, today. I believe what supports this interdisciplinary field at its foundation today is the scientific societies related to civil engineering. It is also the "21st century engineering," which supports the move towards more interdisciplinary exchange in environmental engineering. Thank you very much for your attention.

(2002.5.13, at the new JSCE library hall)

1 Stands for civil engineering in Japanese. The term consists of two Chinese characters representing earth and tree.
2 Kusuyama, Haruki. Enanji, Meiji Shoin
3 Burton, Virginia Lee. The Little House Way Out in the Country. Trans. Momoko Ishi. Iwanami Shoten 1995

Infrastructure for Coexistence with Nature
Thinking Globally and Acting LocallyHokkaido Case Study
Resident Network Protects Coastal Plant Species along Ishikari Coast

Kouji TAKAMATSU
Director,
Ishikari Seaside Vegetation Conservation Center
Life and Environment Division
Ishikari Municipal office

Kouichi KANETA
River and Harbor Improvement Division Director
Sapporo District Public Works Management Office
Hokkaido Government

Overview of the Ishikari Coast

At Ishikari coast, dunes stretch for 20 km along the mouth of Ishikari River, providing a habitat for coastal plants such as Japanese rose (*Rose rugosa*) and for aquatic birds. The coast is designated as "an outstanding nature zone" according to "Hokkaido Prefecture Nature and Environment Conservation Guidance". It has also become a popular recreational destination. There are approximately 450 to 600 thousand visitors per year for beach, camping, and hot springs. However, in recent years, vegetation zones for coastal plants are rapidly deteriorating due to the invasion of the beach by sport utility vehicles. Protection of coastal plant species in Ishikari Coast is a task that requires an urgent resolution.

The characteristic of distribution of plant habitats on the Ishikari Coast is that each habitat lies parallel to the seashore. From the beach to the dune, habitats for American dunegrass (*Elymus mollis*), Eulalia (*Miscanthus sinensis*), Japanese Rose (*Rosa rugosa*), Sasa (*Sasa palmata*) and Daimyo Oak (*Quercus dentate*) are found. As for the insects, a super colony of Wood Ants (*Formica yessenis*) is considered to be "endangered" in the Red List Database (1983) of the International Union for Conservation of Nature and Natural Resources. In this area, the presence of endangered insects such as Sand Wasps (*Bembix niponica*) and Orange Zephyrs (*Japonica onoi*) and endangered birds such as Eastern Marsh Harriers (*Circus spilonotus*), Japanese Snipes (*Gallinago hardwickii*), and Brown Shrikes (*Lamisus cristatus*) is confirmed.

Current Condition of the Coast

Invasion of the beach by SUVs resulted in a lattice-like pattern of bare lands. Moreover, wind erosion accelerates desertification of the coast. Influence on the coastal environment caused by human activities is as follows.

1. Desertification caused by the invasion of coastal plant habitats by SUVs.
2. Habitat deterioration caused by destruction of colonies and division of territories.
3. Illegal disposal of large size trash such as household appliances.

According to an investigation conducted by the Ishikari City in 2000, cases of illegal disposal included household wastes adding up to 760 cubic meters in volume or equivalent to 11,400 plastic bags, oversize wastes of 70 cubic meters, and serious cases such as the disposal of vehicles, batteries or tires.

In 1978, the Ishikari City Hall recognized the area extending about 1.4 kilometers from the Ishikari lighthouse to the mouth of the Ishikari River on the Ishikari Coast as a habitat of especially endangered plant species. And according to the "Municipal Regulation for the Protection of Coastal Plant Species of the Estuary of Ishikari River," the city designated 16.5 hectares of the coastal habitat as the Coastal Plant

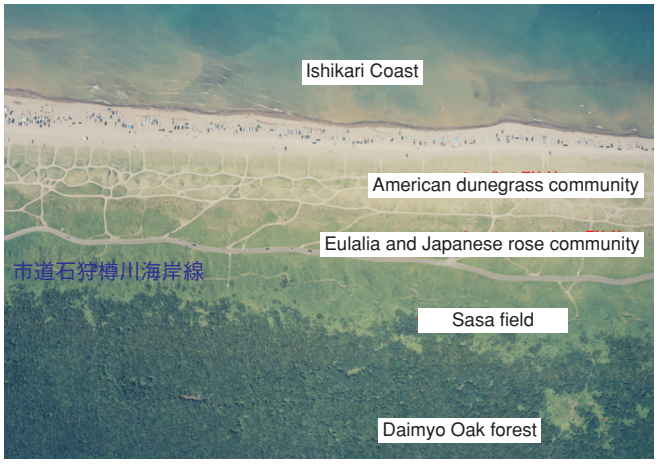

Photo-1: Aerial photo of Ishikari Coast


Photo-2: Destruction of vegetation by invading vehicles

Protection Zone. Moreover, in 1991, the city designated 26.9 hectares of adjacent habitat as "Hamanasu-no-Oka Park," surrounding it by the fence and forbidding the vehicle entry.

In April 2000, the Ishikari Seaside Vegetation Conservation Center opened and since then, it has been used as a base where the residents, volunteer groups and the municipal administration work together to preserve the coastal vegetation. This center has also played an important role in educating residents on environmental issues, in PR activities, in research and in restoration activities.

Future Activities

The coastal law, which was revised and implemented on April 1, 2000, aims to govern the coast al area within the balance among issues of disaster prevention, environmental protection and utilization on the coast area. In order to achieve this, it prohibits any activities, which interfere with the protection of animal and plant habitats. It designated zones that are prohibited to vehicles and penalize any violators.

At the present stage, it seems appropriate to limit the use of Ishikari coast to the beach areas, which are equipped with recreational facilities such as bathrooms and parking. And it seems necessary to thoroughly restrict vehicles in the coastal area even temporarily.

In implementing the regulation, it would be important to coordinate the efforts of Ishikari municipal administration and the local NPOs and also to provide information to the residents and visitors alike. Furthermore, it would be important as well to realize follow-up researches in cooperation with research institutes on the recovery and change of the vegetation after the implementation and to publicize the effects of the measures. In this way, the vegetations could be restored, the beach users could become more aware of the issue and their manners could improve and thus it would eventually be possible to withdraw the regulation. It is my belief that this could be a way in which humans could learn to coexist in harmony with nature.

Restoration of River Nature
Restoration of an Old Meandering River

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Ministry of Land, Infrastructure and Transport

Today, Nemuro and Kushiro regions in eastern Hokkaido are known as an area for large dairy farms but until several decades ago these open spaces were undeveloped wetlands. During the history of pioneers, the wetlands were reclaimed and transformed into farmlands and meandering rivers were straightened. The straightening of the rivers served its purpose for flood control but also lowered the ground water level of the surrounding wetlands and expanded the land available for agriculture.

In recent years, demands of the citizens for the protection and the restoration of the environment are becoming stronger. In response to this, there are undertakings to restore the meandering form of the old river as part of the restoration of the nature.

Planning for the Shibetsu River

The Shibetsu River is located in the eastern part of Hokkaido (Diagram 1). Although it is a Class B River, under a special regulation, it is directly under the control of the Minister of Land, Infrastructure and Transport to conduct improvement works as a designated river. Straightening of the once meandering river and other river management measures started on a full scale around 1965 (Photo 1). Through this, the safety of the Shibetsu River was dramatically improved and the initial goal of the improvement works was fulfilled to a certain extent.

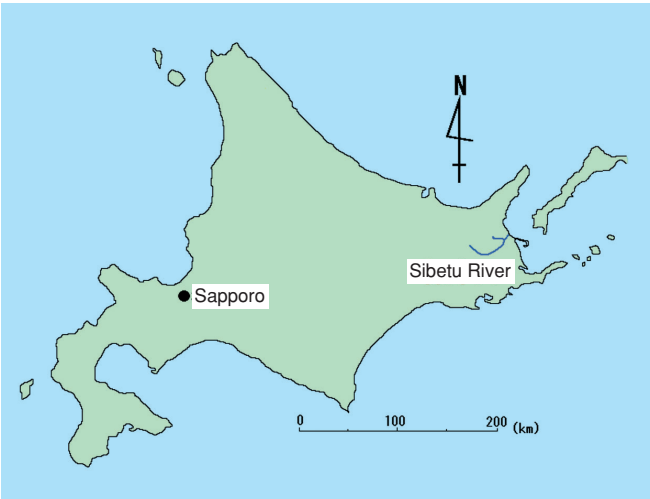

Figure-1: Positioning of the Shibetsu River

However, to respond to the growing regional demand to restore the river's natural environment, a new form of river management is being proposed as a part of a wider planning. Precisely, the plan aims to restore the meandering river in the areas that have been straightened but still retain the older meandering form, by letting the water flow in the old river during normal times and using the straightened areas as waterways during floods to ensure a degree of river management safety (Diagram 2). In addition, vegetation and other aspects of the river's natural environment will be restored to the old conditions as much as possible in order to allow the area to become a habitat for diverse species.

For the river management plan of the Shibetsu River, experienced scholars from the region served as principle members of the Roundtable for the Shibetsu River Basin. Also, in order to adequately assess the effect of natural restoration and its impact on the environment, academics from various braches such as rivers, ecosystems, forestry, fishery, water quality and vegetation formed the Shibetu River Technical Evaluation Committee, which was established to

Photo-1: Changes in the Shibetsu River

Photo-2: Test area before the restoration (The former river is in the front)

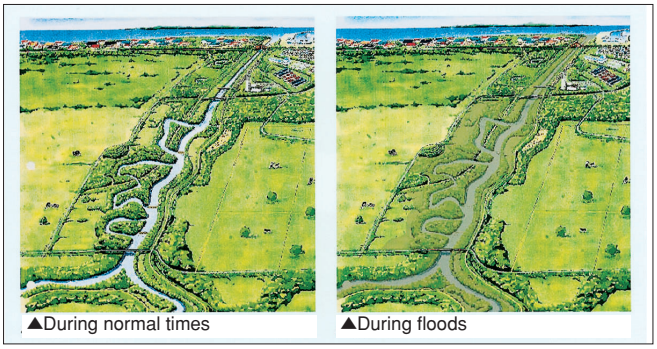

Figure-2: Artist's rendering of restoration

evaluate technological aspects of the Shibetsu River restoration.

Test Construction

There are still many unsolved technical questions even while the Technical Evaluation Committee debated on the restoration of the meandering river. Therefore, it was necessary to implement a small-scale test construction at the local site, before undertaking the reconstruction at a larger scale. Therefore, the restoration was implemented for one section only (1 curve) in an area where the old river still remains foreland side (Photo 2). In this restoration, 200m of the straightened area was connected to the remnant old river area and the regular flow was guided to the old river area (Photo 3). To guide the flow, the straightened area was blocked with boulders (Photo 4). Also, in carrying out the restoration, consideration was given to agriculture and fishery that would be affected by the change in the underground water level of the surrounding area.

The effect and impact of restoration, especially the effect on restoring nature is not something that can be evaluated in a short span of time. There is a need to take adequate time for survey and analysis. Last spring, the area experienced the first

Photo-3: The Area immediately after test ground restoration (upstream is in the upper area)

Photo-4: Damming facilities

inundation after the restoration due to the snowmelt. The resulting changes in the riverbanks were generally as expected and the water flowed both in the straightened river and the older meandering river.

The next plan is to plant the trees along the restored riverbanks as the survey on the test site continues.

Future Issues

In restoring the old Shibetsu River, it is pointless to simply recreate its meandering shape. It is more important to restore the river to the good old days, including its natural environment. Yet, there is a fundamental problem that the idea of a "good river" depends on each individual and there are still many unsolved issues on whether the restored river would be what we have planned initially. Therefore it is all the more important to make further plans with the local opinions in mind while carrying out the survey on the test site.

The Kunnui Fishing Port: Coexistence with the Natural Seashore

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The Kunnui fishing port is in southwest Hokkaido and is located in the innermost area of Uchiura Bay (Funka Bay) and southwest of the port is Kunnui River, a Class B river (river extension 14.4 km), pours into the bay (Figure- 1).

The fishing industry mainly consists of scallop culture combined with set-net salmon fisheries, gill net flatfish fishries, and beam thawl of Sakhalin surf clam. Also, the surrounding waters are good fishing grounds for Sakhalin surf clams and hair crab.

The west shore of Uchiura Bay, where Kunnui fishing port is located, has a gentle gradient of 1/100 and in neighboring fishing ports where jetty structures that cut off coastal flows were adopted, there was a concern that sand drift was causing the siltation of port entrances and port areas as well as coast deformation in neighboring areas.

From this experience, in drafting the Kunnui Fishing Port Plan, focus was on solving issues such as 1) preventing the siltation of port entrances and port areas from drift sand and 2) minimizing the effects of fishing port construction on surrounding seacoasts.

For this issue, 1) sand accumulation can be reduced by setting the port entrance as the critical depth for sediment movement and 2) by letting coastal sand drift pass in the back of the fishing port, the connectivity of coastal sand drift can be preserved in order to create a plan for an island type fishing port.

The structure of the Kunnui fishing port was set as -6m of the total critical depth for sediment movement for the port entrance water depth. The tombolo in the back of the facilities was suppressed, and calmness of water within the port was secured as the result of tranquility, near-shore current simulations, and hydraulic model experiment. The Kunnui fishing port was constructed over ten years from 1984 to 1993and the project cost was 4.96 billion yen (Photo- 1).

Regarding changes in the geographical features around Kunnui fishing port area, after construction started on the outer parts of the structure, survey results from 1989 to 2000 indicate that 1) a tombolo formed behind the fishing port after commencement of construction but afterwards mostly stabilized and 2) the contour line around the fishing port area is symmetrical and there are no effects from blocked sand drift.

Judging from these geographical changes, the characteristics of geographical changes in the Kunnui fishing port area are dominated by shore and offshore drift sand caused by waves from typhoons and the winter season and repeats a process of erosion from autumn to winter and sedimentation from spring

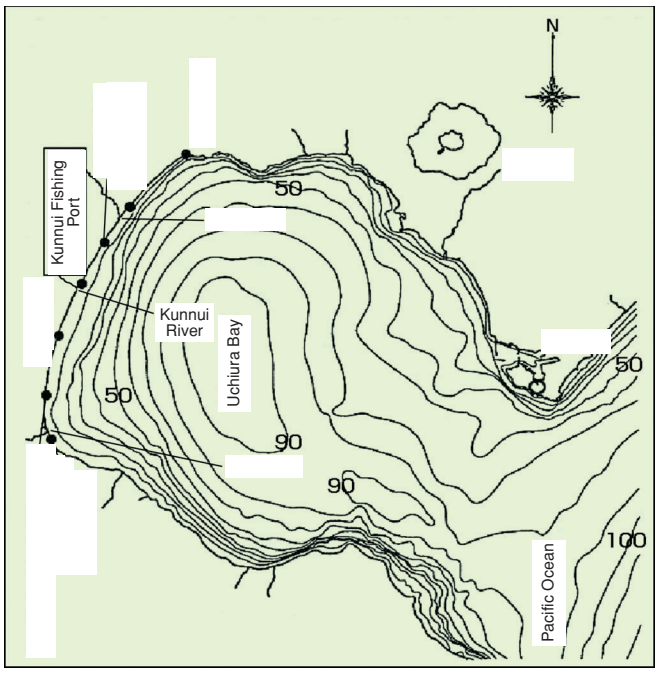

Figure-1: Location of Kunnui fishing port

Photo-1: Aerial photo of Kunnui fishing port (taken in August 2000)

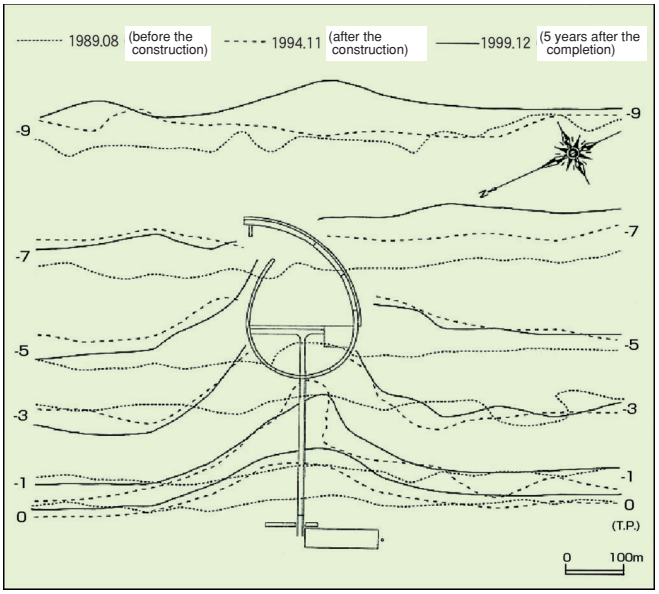

Figure-2: Comparison of contour lines

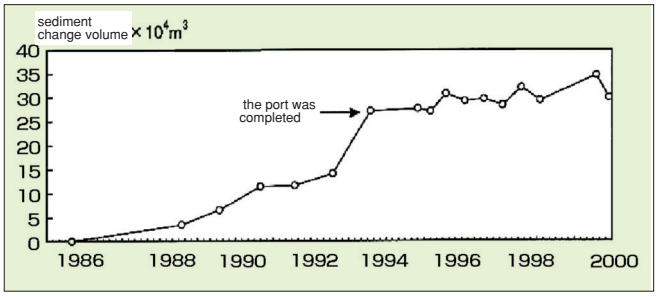

Figure-3: Changes in the sand bar's sediment volume

to summer and it is assumed that this process will reach dynamic stability in the long term (Figure- 2).

From Figure- 3, it could be observed that the tombolo behind the fishing port was formed 5 years after construction of the fishing port. After completion of the fishing port in 1994, geographical changes were minimal.

The evaluation of environmental conservation of the Kunnui fishing port, which is an island-type fishing port, is as follows. 1) The tombolo behind the fishing port and the seashore geography of the surrounding area is virtually stabilized after construction. 2) There is some sedimentation at the seaway and port entrance but the needed depth is ensured and since maintenance dredging is not necessary, the coastal ecosystem can be maintained in its natural state. 3) Since the sand bar behind the fishing port is in a calm area, a large quality of both mature and baby clams are breeding, making the area a more fertile fishing ground than before construction.

I would like to report briefly on the "Island-type Fishing port Workshop in Kunnui" that was held in Oshamanbe City on July 12, 2000. Participants included members from the fishing industry, construction industry, academic researchers, and public institutes as well as government officials from organizations such as the Fisheries Agency. The following was debated in acknowledging the effectiveness of island type fishing ports. 1) The purpose of preventing fishing port siltation is achieved. 2) There are some concerns over the maintenance of continuity of sand drift in the coastal area. 3) The permeable structure of the connecting bridge is biologically effective.

Future issues for island-type fishing ports include: 1) a broad and adequate preliminary survey and follow-up survey without the constraints of vertically segmented bureaucratic obstacles is necessary for planning, 2) biological examinations are also necessary for evaluations, 3) island-type fishing ports should be interspersed as a wide-area drift sand measure.

Preserving Wetlands

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Hokkaido Electric Power Co., Inc.

General Plan of Kyogoku Project

Kyogoku Project is a pumped-storage hydroelectric power plant with 600 MW (200 MW by 3 units), located in northern area of Kyogoku Town, Abuta County in Hokkaido, Japan. Upper Reservoir of Kyogoku Project is located on the plateau at EL. 850 meters to EL. 910 meters, and Lower Dam and Reservoir, a 3 km distance to Upper Reservoir, are on the confluence of Pepenai River and Bihinai River at EL. 450 meters, approximately 4 km upstream of the existing Futaba Dam for irrigation. Kyogoku Project is currently under construction, and the first unit (20 MW) will be scheduled to operate in October 2008.

Upper Reservoir of Kyogoku Project is a horizontal square shape with about 440 meters length of each side and four rounded corners. The gentle sloped Plateau will be excavated a maximum depth of 70 meters with 1:2.5 slope, and 3 sides of Upper Reservoir will be embanked (a maximum height is 22.6 meters) with rocks and soils, and will be formed as a pool-type reservoir. All surfaces inside of the reservoir will be lined by asphalt facing for sealing works. Photo-1 shows the bird view image of Upper Reservoir, and Figure-1 shows specific data on Kyogoku Project.

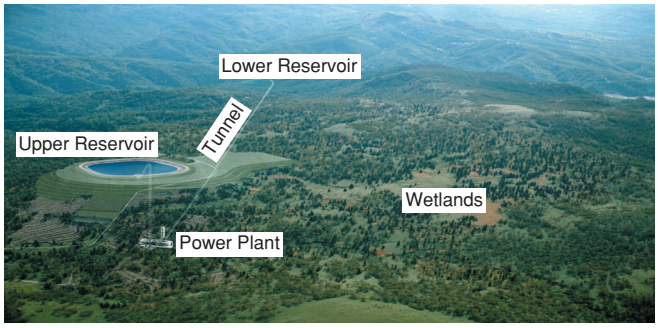

Photo- 1: Aerial Photo of Kunnui fishing port (taken in August 2000)

Items	Specific Data	
Maximum Output Capacity	600 MW (200 MW by 3 units)	
Maximum Intake Flow	190.5 CMS or cubic meters per second	
Maximum Net Head	369.0 meters	
Type of Reservoir /Dam	Upper Reservoir: Embankment Dam with Asphalt Facing	Lower Dam: Rock fill Dam with Vertical Clay Core
Active Capacity	4,120,000 cubic meters	4,120,000 cubic meters
Height of Embankment/Dam	22.6 meters	54.0 meters
Length of Embankment/Dam	1,108.6 meters	332.5 meters
Volume of Embankment/Dam	1,251,000 cubic meters	1,269,000 cubic meters

Table-1

Environmental Survey and Wetlands

The environmental survey on Kyogoku Project was started in 1997. In this survey, various sized wetlands, their total area is 7.3 hectares, were confirmed at and around the previous layout of Upper Reservoir. Additional studies on geological conditions, the fluctuation of underground water, and the species and distribution of plants and wildlife were carried out to make measures for conserving these wetlands under guidance and advice of specialists and supervisors.

These wetlands were recognized as the oldest wetlands in Hokkaido such as on the Plateau in high elevation that were estimated to be formed about 13,000 years ago by analyzing pollen, sediment facies, and radiocarbon ages. There are the characteristic and large colonies of *Fauria crista-galli* in these wetlands (Photo-2), and are precious natural environments that have scientific valuable resources including the surrounding virgin forest. Based on the survey on geological conditions, wetlands are on the peat layer piled on low spots and low lands along tributaries. Under the peat layer, there is an extremely weathered rhyolite tuff zone that has low permeability (Figure-1). Moisture of wetlands is not to be depended on the underground water in the rhyolite tuff zone but on the surface water from melted snow, rainfall and mist at and around wetlands.

Based on the result of studies, Upper Reservoir was removed two times to avoid the impact of construction works, and to

Photo-2: A colony of *Fauria crista-galli* in the wetland

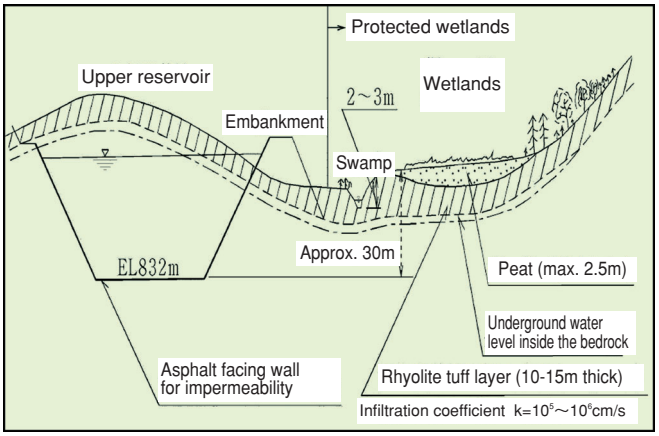

Figure-1: Cross section of upper reservoir and the wetland

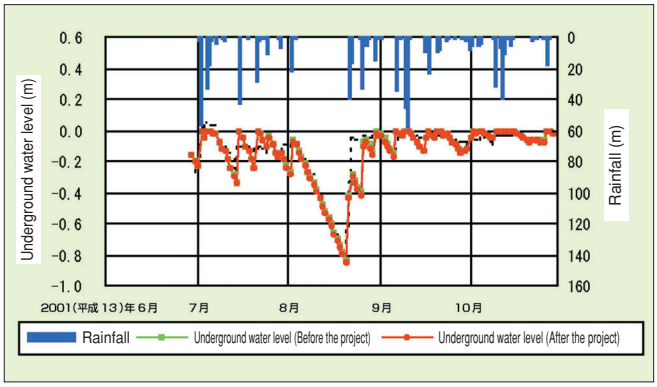

Figure-2: Simulation of the underground water level at the small wetland

conserve the basin where the surface water was recharging wetlands.

Measures for Preserving Wetland

7.3 hectares wetlands were almost preserved by measure of changing the location of Upper Reservoir. However, in spite of the avoided measure, the small wetland that has 0.2 hectares area very close to Upper Reservoir will lose the surface water basin because of the disposal area. It is necessary to preserve the small wetland taking other strategic measures.

In this small wetland, boreholes for monitoring the fluctuation of the underground water, and the soil moisture meters were set up to analyze the moisture condition for two years. Based on the observation, numerical analysis model on moisture conditions of the small wetland was assembled considering geological conditions and permeability of each zone. This model simulated underground water fluctuated for the influence of construction works. The simulation analysis (see Figure-2) shows that the level of underground water was reduced by 2 cm of maximum shortage in summer season. It is clear that the construction of disposal area, which will fill up the surface water basin of the small wetland, will not fluctuate the underground water. However, it is necessary to take measures for keeping the level of underground water constant and maintaining moisture conditions as used to be. The following permanent measures will be considered at present.

- Supply the surface water instead of the lost basin of the small wetland by pumping up from alternative facilities.
- Supply the drainage water through the disposal area to the forest located in the upstream basin of the small wetland.
- Accumulate snow in the basin of the small wetland and surrounding area in spring season to make snow melting slowly.

During construction works, the measurement on the fluctuation of underground water, moisture conditions, distribution of plants and water quality will be monitored constantly, in addition to these monitoring, maintenance water will be discharged to keep moisture balance good condition at the small wetland. Monitoring data during construction works will be observed to ensure permanent measures as mentioned above. Maximum efforts will be taken to conserve precious wetlands under a slogan "Preserving Wetlands".

The Development and Construction of Seawalls In Harmony with Aquatic Life

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Hokkaido Regional Development Bureau

Island seawall of the Kushiro port was authorized as the first eco-port of Japan as a port administrated project in June of 1998. This island seawall created a back mound on the traditional seawall structure to add a formation function for aquatic life habitats as well as reduce the body of the seawall by placing the mound and also strives to reduce the treatment costs for dredged sand and was developed as a "seawall in harmony with aquatic life" that will reduce construction costs as well as be environmentally friendly.

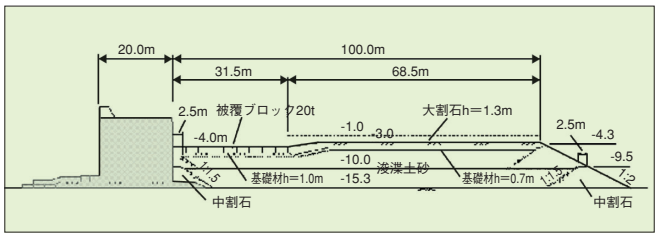

Figure: Cross section of the Island seawall

Overview of the Eco-port Model Project

The Kushiro port island seawall is a seawall extending over a total span of 2500m and located 3km offshore as a port tranquility measure and of this, a 1600m section has a 100m wide eco-ground and the plan calls for the creation of a extremely large 16ha artificial seaweed bed.

In creating the eco-port model project plan, requests from the local fishery industry as well as cooperation from relevant research institutes was used as a foundation in addition to a committee composed of experienced academics regarding the structure format, leading to the final decision. The characteristics of this seawall are summarized below:

1) Effective use of dredged sediment will reduce costs for surface storage (Eco-nomical) and will reduce burdens on the environment (Eco-logical).
2) For the design, the earth fill in the back contributes to slide resistance and can reduce the seawall structure's width (Eco-nomical).
3) By setting the upper side of the earth fills in the back to an appropriate water depth, an environment suitable to the harvesting of seaweed is created to foster a diverse ecosystem.

Island Seawall Structure and Scale

1) Body Structure

The seawall's outer port side is not that affected by reflection waves so a mixed caisson seawall was adopted without any wave-dissipating engineering.

2) Inner Port Earth Fill Structure

In accordance with the shallowness of the water depth, sunlight can be effectively used and it is advantageous to the habitat of seaweed species so the construction limits were considered to set the standard upper limit of the earth fill in the back as -3m.

3) Scale of the Earth Fill and Placement

The tidal currents of the surrounding area are not affected in a major way and considering the effect of large ships entering and leaving on the passage, it was around 300m removed from the water course with a length of 1600m and a width of 100m.

Condition of Measures toward Project Implementation

The island seawall was implemented since 1998 and at the end of FY 2001, the seawall was 580m and of this 100m was used as a testing field for onsite tests of the back earth fill.

In the future, the project implementation for the back area will involve an unprecedented large-scale underwater sediment processing and further investigation will be needed to ensure the stability of the entire structure, create a beneficial habitat environment for organisms and also a more economical facility development.

Currently, the specific issues and problem areas are being analyzed using appropriate methods and investigations are underway under a committee composed of experienced academics. The most relevant condition of the investigations are as shown below.

Structural Issues

1) The effect of passing waves on the back structure

The covering blocks within the port the back side of the seawall body is extremely shallow compared to the front side and is affected by the invasion of passing waves so traditional

load calculations formulas are inadequate for evaluation. For this reason, hydraulic model tests are used to assess the range of impacts in evaluating covering materials.

a) Range of impacts due to the invasion of passing waves

The flow speed above the back earth fill on the seawall is measured and the range of impacts was confirmed. The immediate back area of the seawall has almost no flow and 15-20m is the peak and for over 30m the flow speed becomes regular so the range of impacts for passing waves was set to be 30m behind the seawall.

b) Required load of covering blocks for the back earth fill (30m sections)

Covering blocks for the 30m sections of the back earth fill with an upside height of -3m and -4m were effectively set for 200 waves per wave group and 1200 waves per 6 wave groups and the damage percentage was set as less than 1% for the necessary weight. For -3m it is 23.0t and for -4m it is 17.5t and since the harvesting of seaweed is not expected above the blocks, economic comparisons resulted in the adoption of upper ceiling heights of -4m with 20t blocks.

2) Boiling Measures

The wave pressures occurring on the front side of the seawall are transmitted to the inner parts of the foundation mound and pore pressure will become greater than the effective earth covering pressure and the danger of back boiling is present. If there is a width of 2.5m for the back covering rocks, then the pore pressure is reduced to under half and since it will not exceed the effective earth covering pressure, it will have the necessary effect to prevent boiling.

3) Liquefaction of Earth Fill

The upper part of the earth fill is under water so unlike traditional reclaimed land, it is supposed that consolidation settlement cannot be expected. For this reason, gentle movements of earth fill and under differing weight bearing conditions, investigations are under way to assess the stability of liquefaction during earthquakes.

4) Earth Retaining Structures

To prevent the loss of sedimentation and maintain the function of the back earth fill, issues such as construction costs, practical implementation, environment and stability under earthquakes were considered to adopt a 2 step incline seawall structure.

Under earthquake behavior, tests are being conducted for the probability of occurrence at 10 years, 75 years, and several hundred years using 100 gal, 350 gal, and 800 gal respectively.

Environmental Issues

1) Environment of the back earth fill

In order for the back earth fill to function as a facility in harmony with aquatic life, suitable environmental conditions were researched. The rate of photosynthesis for oar weed species is saturated at roughly 200-400 μ E/m2/s and in the Kushiro sea area at water depths of -3m, it is reduced to roughly 200 μ E/m2/s so the standard height of the back earth fill is set as -3m.

2) Effects of suspended sediment and others issues

In order to create a suitable habitat environment for organisms, a little clouding and the accumulation of suspended soil becomes a major problem. The Kushiro port area is easily affected by the flow of sediment from Kushiro River so continued surveys of the suspended sediment and suspended soil among other conditions are necessary.

3) Movement characteristics of suspended soil

During the budding of seaweed species, if suspended soil and other particles accumulate on the substrate side the settling of spores is blocked and literature indicates that growth is blocked so the sweeping effect of waves on the island type seawall are being considered.

Implementation Issues

1) Implementation plan for construction

For the development of the back mound, the optimal transport and evening method for the sediment and the specifications of sediment blocking sheets and other construction issues for large-scale earth works are being evaluated through experimental tests.

2) The environment during the transportation of sediment

For the transport of sediment in the back the construction volume, timing of construction and the soil quality of the sediment being transported will be considered and the occurrence of clouding will be simulated with mathematical models to take appropriate measures.

Mitigation of Deer Vehicular Collisions on Shari Eco-Road

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Abashiri Development and Construction Department
Hokkaido Development Bureau
Ministry of Land, Infrastructure and Transport

National Route 334 is heavily trafficked by visitors to Shiretoko National Park and, as the only road from downtown Shari to the Utoro district of that town, it is an important route for local residents. In the Makoi district of Shari, the route traverses a wintering area for yezo deer. During the spring thaw, these deer feed on the roadside slope protection vegetation (grasses), and deer-vehicular traffic accidents there have been on the rise, making measures for wildlife management and traffic safety an urgent matter. A 2.4-km section where deer-vehicular collisions and other roadkill accidents concentrate was designated as the "Shari Eco-Road test section" and countermeasures to such accidents were implemented.

In considering traffic accidents involving yezo deer, specialists, academic experts, and local stakeholders established the Shari Eco-Road Conference in 1993. Over the following 9 years, deer-vehicular collision countermeasures were developed and implemented, and follow-up surveys were conducted.

Development Policy for Shari Eco-Road (National Route 334)

The development policies for this section are divided into measures targeting yezo deer and measures targeting drivers. For the deer, these measures were established: 1) deer that entered the roadway at access roads and other places without deer fences were allowed to escape through one-way gates (Photo 1), "out jump" facilities, and other facilities, and 2) entrance to the road was blocked with deer fences, and deer underpasses were constructed to prevent fragmentation of the wildlife habitat (Photo 2). For drivers, awareness-raising campaigns were promoted in which pamphlets on deer behavior were distributed, and warning signs were installed to draw drivers' attention to deer.

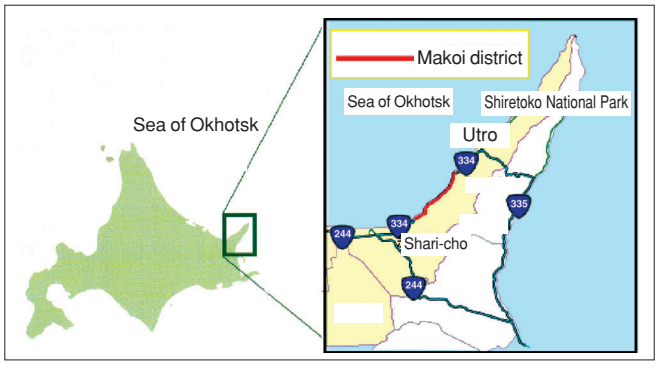

Figure-1: Shari Eco-Road project area, Makoi district

Effectiveness of Shari Eco-Road

Deer-vehicular collisions in the Makoi district of Shari Town totaled 63 cases from 1988 to 1996, or 46% of all collision accidents in that town (Figure 2). Of these, 27 cases (19.7%) occurred on the 2.4-km test section. In 1997, there were 11


Photo-1: Deer fences and one-way gates, and yezo deer exiting through a gate.


Photo-2: Yezo deer using the deer underpass.

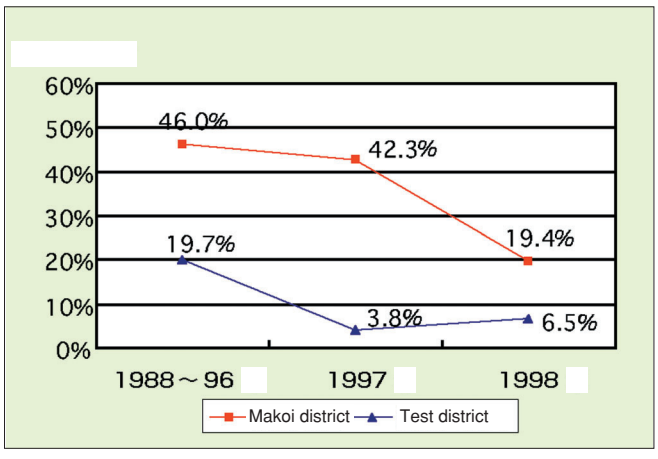

Figure-2: Proportion of deer-vehicular collisions to all traffic accidents in the Makoi district and in the test district.

cases (42.3%) in the Makoi district, with 1 (3.8%) of these being in the test section. After countermeasures were completed in 1998, there were 6 cases in the Makoi district (19.4%), with 2 (6.5%) of these being in the test section. The proportion of deer-vehicular collisions to all traffic accidents shows a clear reduction after implementation of the countermeasures.

Efforts for Resource Recycling (Coal Ash)

Hitoshi KOBAYASHI
Director, Sales Plan Manager
Hokuden General Engineering Design & Consulting Company Inc.

As many national initiatives are taking place for the creation of a resource recycling society, Hokkaido prefecture created the "Realizing a Resource Recycling Society through the Implementation of the Hokkaido Waste Disposal Program-'Zero Trash Program Hokkaido'-" in December 2001 and set targets for the reduction and recycling of waste and reduction in volume of waste disposal. Citizens, industry, the waste industry, and government are to work together to realize these goals.

Most of the waste generated by electric utilities involves coal ash from thermal power generation and in 2000, 6.32 million tons were generated nationwide and of this 4.92 million tons are effectively utilized but 62% of the reused volumes or 3.03 million tons are handled for use as raw materials for cement by companies that produce cements. Also, the 1.4 million tons not used go to landfills.

A cross-examination of coal ash generated by our company is roughly 650,000 t and of this roughly 92% is effectively reused (Figure-1) and in June of 2002, the fourth generator of the Tomatoh Atsuma electric plant began operations and in the future 80,000 t will be generated annually, so the expansion of effective coal ash reuse is an urgent priority.

Under these conditions, our company established a coal ash research project group within our research institute in 1996 to develop coal ash utilization technology for imported ash and as a result of indoor and outdoor research as well as field tests; this was used for company construction projects and public works since 1998.

Figure- 1 shows projects major projects where fly ash (FA), accounting for 90% of the coal ash generated, was used to reduce the cost of construction (in the last 4 years). Other than in-company use, most of it is used for works commissioned by the Hokkaido Development Bureau of the Ministry of Land, Infrastructure and Transport and roughly 140,000 t of coal ash was effectively reused. Of this, the "improvement of construction sludge" in 4 is based on the guidance regarding the reuse of waste in Hokkaido and by mixing a certain proportion of FA into inorganic sludge generated by construction (Photo- 1), it can be made plastic and reused as site preparation materials (Photo-2). By bringing together construction sludge, which is an industrial waste, and coal ash

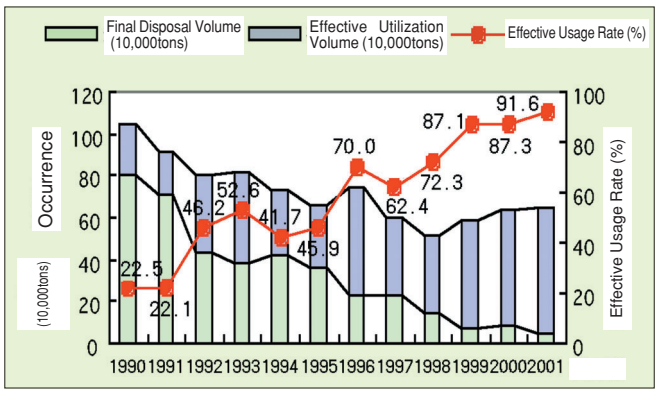

Figure-1: Effective coal ash usage and final disposal volumes


Photo-1: Before rehabilitation of construction sludge


Photo-2: After rehabilitation of construction sludge

through technology, there are examples where it can be used as effective materials and in the future, it can be horizontally developed as a method for effectively reusing construction sludge.

Coal ash can substitute natural materials as an effective form of construction materials and as the technological development, quality control, stable supply and the reduction of transport cost, among other cost reduction measures, is sought from the producers, users will be sought to be open to non-conventional materials and construction methods to actively contribute to the creation of the recycling society in their efforts and initiatives to promote resource recycling.

Forestry Formation Projects for Flood Mitigation for the Tokachi River System

Mikio KOBAYASHI
River Management Section Manager
Obihiro Development and Construction Division
Hokkaido Regional Development Bureau
Ministry of Land, Infrastructure and Transport

Forest formation projects are being promoted by the Hokkaido Development Bureau and refer to "forestry bands," "sediment erosion prevention forest," and "green corridor projects." Forest formation projects for flood mitigation involve the planting of trees along the levees and sediment overflow areas and have the effect of promoting the suppression, dispersion, and accumulation of sediment by reducing inundations through the reduction of flood flow speeds when levees over flow and break for flood mitigation and sediment disaster prevention functions.

Regarding measures for "forestry bands," a revision of the River Law in 1997 created measures for the development and protection of riverside forests as river management facilities by the river administrator. The Obihiro Development Construction Department promoted the development of riverside forests for the Tokachi River and the tributary stream of Satsunai River for "green corridor projects" and "green sediment erosion prevention zones (sediment erosion prevention forest)," but from 1999, at the tributary river of Sarubetsu river a forest band that became the first national forest band project under the new measure was started (Diagram 1). This area repeatedly suffered from flood inundations and as part of the integrated measures for flood mitigation under the "flood disaster reduction measure," flood mitigation forests are being developed in addition to the creation of hazard maps from a menu of programs.

Figure-1: Image of the flood mitigation forest completion for Tokachi River and Saruebetsu River.

In addition, in this region the levee area became a harsh environment for the fostering of trees due to strong winds, aridity, and the cold climate after construction. For this the planting method for the flood mitigation forest was conducted with supervision from Toshikuni Okamura, a professor of Hokkaido Institute of Technology using the "ecological mixed planting method" to rehabilitate vegetation, this method involves the collecting of seeds from roughly 30 native species such as elm, oak, cypress, and others and planting them in a 3m radius mulching through grafting, seeding, and potted plants and the vegetation that survive form forestry and rehabilitate natural forests after around 30 years later. Through this process, seed collection, management of

Photo-1: Planting under the supervision of Professor Okamura

Figure-2: Image of the overall plan for the flood mitigation forest for the Tokachi River system

seedlings and planting is carried out by elementary school children and other local residents (Photo-1).

Currently, the Obihiro Development Construction Department implements 1 km of such works along the levees or floor stabilization works of the Tokachi river and Sarubetsu river (Makubetsu Town). For the future, it will take some years before completion but to connect the ecosystem corridor with greenery from the mountain land to the river mouth, a flood mitigation forest will be created with the initiative of regional residents in all area within the Tokachi river's administrated area and sediment erosion control area and the final goal will be to connect this with the "Taisetsu-Hidaka Greenery Corridor" that is being developed and conserved by the Hokkaido Forest Management Bureau (Figure 2).

Concluding this Special Feature

Yukihiro KOHATA, Dr. Eng.
Associate Professor, Department of Civil Engineering and Architecture
Muroran Institute of Technology

This issue was based on the theme, "Striving for 21st Century Quality of Life" for the Sapporo JSCE Annual Meeting in September of 2002 to cover the ideal of social infrastructure development for the 21st century and the region of Hokkaido prefecture as well as the important theme of "infrastructure in harmony with natural environment" for the development of Japan's national land to get opinions from panelists engaged in a broad discussion as well as giving special coverage to infrastructure development case studies from Hokkaido. Traditional infrastructure development emphasized convenience through "building" but the future of civil engineering technology will be to place greater importance on "infrastructure in harmony with natural environment" as this special feature has shown. As you know, Hokkaido is a region in Japan with the most nature and the promotion of infrastructure development that is harmonious with nature will lead to the promotion of civil engineering and also provide a direction for the future of Japan's infrastructure development. We hope this special feature will make a contribution for the overall discussion in Sapporo as well as for infrastructure development in general.

To Be the Guidepost for Succeeding Women From the survey on the activities of female graduates from Civil & Environmental Engineering Courses in the Department of Engineering at Yamanashi University

Miyoshi OKAMURA
Interdisciplinary Graduate School of Medicine and Engineering
University of Yamanashi

A survey has recently been carried out about the activities of female graduates from the civil and environmental engineering related classes at Yamanashi University to which I belong. The result of the survey not only revealed the problems that female civil engineers are facing, but also provided us with useful information for counseling on job taking and advancing to graduate school. In addition, when we held a seminar for the female students of the Civil & Environmental Engineering Department and reported the result of the questionnaire, it was found that the female students need a life-size role model of a female engineer.

A role model means a "model of their role", or "a figure to be a good model", and the actual existence of a role model not only facilitates a student picturing a simulation of her future, but also helps set her future goal. In that sense, it is said to have a big influence on one's way of living.

Photo-1: Female students registered at the Civil & Environmental Engineering Department, Yamanashi University

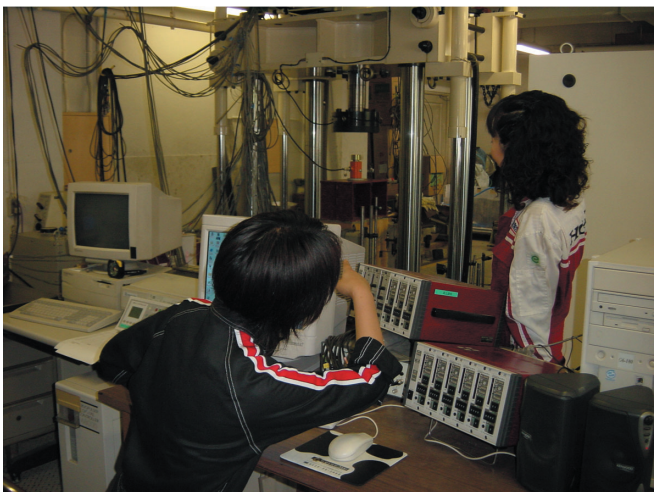

Photo-2: A scene of an experiment

Here I am going to report the summary of the survey results about the activities of female graduates from the civil & environmental engineering related courses in the department of engineering at Yamanashi University, and about the seminar, which was subsequently held for the female students.

Why was the questionnaire survey carried out

In the beginning, civil engineering branch was the only one of the civil and environmental engineering fields in the Department of Engineering at Yamanashi University. In 1975, sanitary engineering courses and infrastructure planning courses were separated from the civil engineering and were reorganized into the new environmental engineering branch, creating two distinct branches with limited enrollment of 60 students each. Later in 1993, the two branches have been united into the civil & environmental engineering branch with limit enrollment of 110 students and it has been thus until this day.

It was in 1977 that the first female student entered the Department of Civil Engineering. The next year, another female student entered the Department of Environment Engineering. Since then until 2000, for about 20 years, about 100 female students graduated from the two departments and their employment ratio at their graduation time was nearly 100%.

During the past 20 years, the Equal Employment Opportunity Law between Men and Women was established and amended later, and the working environment for women has been improved. Yet, it is not easy for working women to juggle work and family. Many of the female graduates from the Department of Civil & Environmental Engineering, Faculty of Engineering, Yamanashi University are facing the problems of marriage and child-raising and having trouble combining these aspects of their lives with their career. Recently I happened to hear of a female graduate who quit her job, which made me curious to know how many female graduates are keeping their jobs and if they do quit their jobs, what are the

reasons behind their resignation.

Thus I carried out a survey during the period of May-June, 2001 targeting female graduates from the civil & environmental branches of the department of engineering at Yamanashi University before year 2000. I sent the questionnaire by postal mail to 89 people, asking them to fill them out and send them back, excluding those who had advanced to graduate school in 2000 and those whose addresses were unknown.

The questions were about their working situations, living circumstances surrounding their marriages, births, child raising, their workplace environment, and the future prospect of their jobs, and the answers were in multiple-choice format. In addition, I asked them to write freely about what they wanted their workplace to consider or what they wanted form their jobs, their future prospects and their advice for female students and female engineers. I received 45 replies. (The collect rate was 50.6%)

Figure-1 shows the number of female graduates each year until 2000 and the collect rate of the questionnaire. The total number of female graduates until 2000 was 97, every year more than 5 female students have graduated since 1994, though there was a little increase and decrease, which made up more than 10% of the total number of the students. The reason why the collection rate of the questionnaire from the graduates before 1990 was low was mainly that there were many whose addresses were unknown due to the time lapse, and also, perhaps, because some questions were difficult for them to answer.

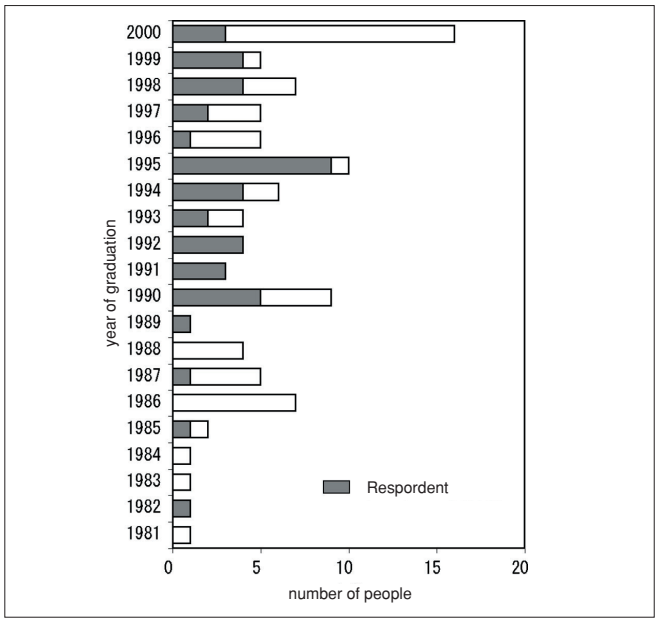

Figure-1: The number of female graduates and the respondent ratio.

Aiming at juggling both work and motherhood

A lot of returned questionnaire were telling not only of how hard the graduates were addressing their jobs but also how they were struggling against problems like juggling their jobs and families, and concern about their futures, which was sometimes unbearable to me.

According to the complied results, to the questions "how many graduates are continuing their jobs" and "if they quit their jobs, what's the reason they did so", which were the primary questions I had, two-thirds of the respondents answered that they were continuing their jobs, while the reasons why the others quit their jobs were mainly giving birth, child-raising and their husbands' job transfers. The following is the report summarizing their living circumstances in relation to their jobs, pregnancy and child raising.

Working circumstances

Figure-2 shows their working place classification. 44.4% of them belong to local governmental bodies, 31.1% work for consulting business. The others work for administrative jobs other than civil engineering and there are some technical school students.

Figure-3 shows their working years. 48.9% are working for less than 5 years, more than 90% are working for less than 10 years, and 2.2% are working more than 15 years. Compared with the respondents' ages shown in Figure-1, the rate of those who have been working more than 5 years and less than 10 years is low. This is probably because I asked the people who quit their jobs to write about the situation just before they quit, so the result shows the working years of those who had already

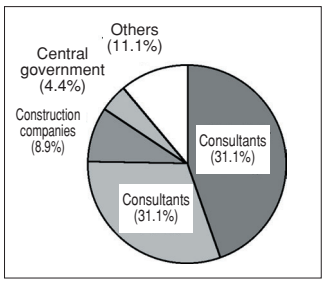

Figure-2: Working place

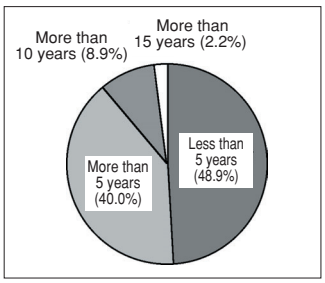

Figure-3: Working years

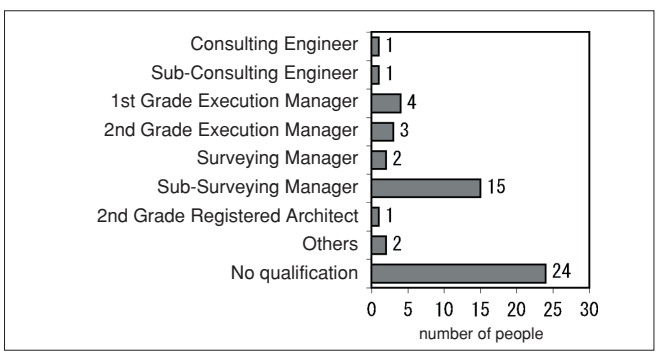

Figure-4: Acquired qualifications

Photo-3: At my wedding reception

Photo-4: With my family

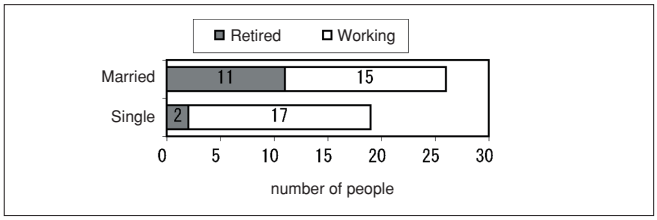

Figure-5: Numbers of the married and single

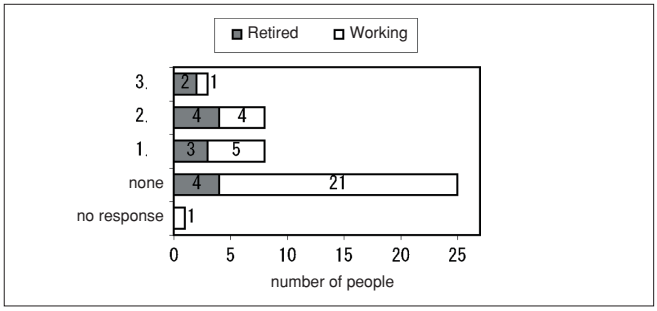

Figure-6: Numbers of children

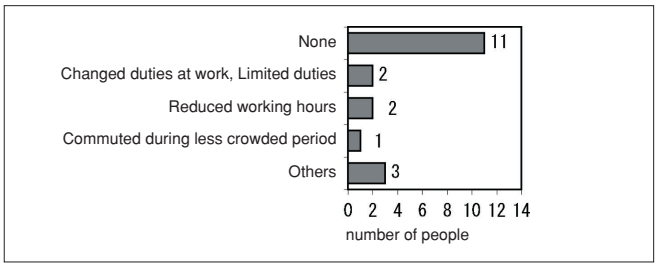

Figure-7: Measures taken during pregnancy

quit their jobs.

Figure-4 shows the numbers of those who had acquired various qualifications. Almost 50% are "without any qualifications". The average number of the qualifications acquired is 1.35 and the largest number of qualifications is 4.

Pregnancy and child-raising

Figure-5 shows the numbers of married and non-married women. Also it overlaps the numbers of those who quit working. 26 people (about 58% of the respondents) are married, and the number of those who are still working after marriage is 15 (33.3% of the respondents). The number of those who quit their jobs is 13, which is 29% of the respondents. As for the reasons, 11 people named marriage, birthing, child-raising and their husbands' work transfers. For the marriage as a reason for resignation, they answered they had to quit their jobs because of their husbands' work location.

Figure-6 shows the numbers of their children. 19 women have one or more children. And 10 of them are continuing their work. (22.2% of the respondents.) And most of those who were still working after marriage answered that their husbands and children share more than 40% of the housework.

Figure-7 shows what kinds of measures were taken during the pregnancy period. There were only a few cases in which the measures like moving to an easier post or the curbing of work or shortening of working time were applied, but most of them answered that they had not used any measures. As for the reasons, some answered, "There was no need" or "There were no such precedents in the company nor has the system been established yet" but most of them answered, "I did not want to bother other people in the office" and "The circumstances prevented me from expressing any requests".

Actually I heard a lot of voices requesting consideration at the beginning stage of pregnancy, which is the most important time, when there are not any apparent physical changes. We can figure out that the systems are not fully utilized, because, in spite of being pregnant, they feel constraint by the circumstances and that they have a lot of stress physically and mentally.

Figure-8 shows the utilization of the system of child-care leave. All of the respondents took child-care leave except some people who quit their jobs before giving birth, and the duration was 6-12 months. One of the graduates who took child-care leave for less than 12 months answered that it was impossible to take leave for as long as 12 months considering the busy circumstances. The work time cut was 30-60

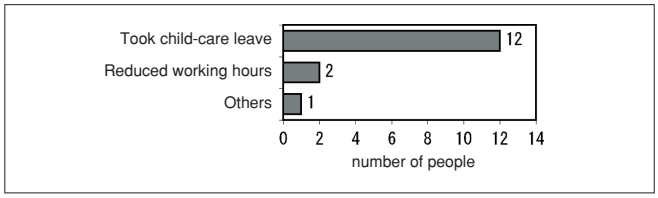

Figure-8: Utilization of child-care leave system

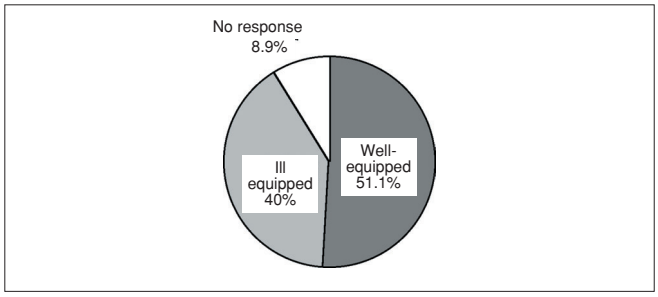

Figure-9: In-company systems for pregnancy and child- care.

minutes. Figure-9 shows preparedness the in-company systems for pregnancy, birth and child-care. More than a half answered they were prepared. On the other hand, other people who answered they were not well prepared expressed their hopes for systems which would facilitate them taking child-care leave when a child got sick, move them to an easier post, and secure substituting staff as well as introduce a flex-time system, an in-company child-care center and a lounge for women.

From the graduates who were going to get married or have babies in the near future, we heard voices that "they have anxiety because there are few female engineers and few precedents".

There are a lot of misgivings, but go for it!

When I finished compiling the summary of the questionnaire, I held a seminar titled the "Seminar about female engineers in the civil & environmental engineering field" for female students of the Department of Civil & Environmental Engineering to report on the results of the questionnaire survey. At the seminar, I distributed booklets wrapping up the survey results to the female students and reported the summary of the survey results.

The civil & environmental engineering branch holds a seminar every year intended for juniors on job search or advancing to graduate school. This is also an occasion for students to listen to graduates' experiences. However, we had never had female graduates participate before and we had never held a seminar intended only for female students. 27 female students from the freshmen to second year students of the master program (47% out of the 57 enrolled female students) participated in the seminar.

In order to have the participants' comment about the survey results and the seminar, I also carried out a questionnaire survey to the female students who attended the seminar on the spot. From most of the participants I had comments like "I would like to have this kind of seminar again", or "I would like to listen to our female graduates' experiences". Before the seminar, there were even concerns that the female students may come to hesitate to become civil engineers if they knew the real situation of female engineers. On the contrary, I had a lot of comments like "now I'm determined" or "I feel eager all the more" and I was very pleased with the toughness female students.

In order for female civil engineers to continue working

I had been wishing that as many women as possible would continue working before carrying out the survey. After the survey, however, I have come to want everyone to live her own life even if she quits her job and becomes a homemaker. From now on, there may arise more opportunities for them to utilize their expertise and experiences in cases like a civil engineering project with the participation of residents.

In conclusion I would like to state my opinions about the problems surrounding female civil engineers and female students and future measures for these issues. The revised Family and Medical Leave Act was put into effect on April 1, 2002, and the age of a child to be covered by the measure was raised up to 3 years old. Although the Family and Medical Leave Act was not intended only for women, this will increase female engineers who continue working. However, since a three-year-long-leave may cause a gap of expertise, there are voices expressing misgivings about taking a long-term leave. Also, a husband's job transfer is one of the reasons for a female engineer to quit her job, though there were few such cases in this survey. I would like to make a suggestion for establishing a system of recurrent education at universities or utilizing the continuing education system at JSCE, for those who took a long-term leave or quit temporarily, to brush-up their expertise.

Although there are various protective measures during pregnancy and child-care period, if the actual situation is that they can not apply for a measure out of constraint or out of guilty feeling toward fellow workers, it will be necessary to secure substitute staff or introduce a work sharing system, as well as to ask for consideration and understanding from the workplace. These systems not only ease the female engineers' mental and physical stress but also open a way of

reinstatement for those who quit temporarily due to child-raising and other reasons.

In addition, I believe it is necessary to consider a way of counseling on career options for female students. The female students who have been receiving education of gender equality often suffer setbacks when they realize the real society's attitude toward women during job-hunting. The report of this questionnaire survey concerning the activities of female graduates unexpectedly has turned out to present a life-size role model for female students. I would like to think that it would help female students in some way or other in choosing their careers and eventually increase the number of female civil engineers who can continue working.

The title of this report was taken from a message sent by one of the female graduates, which is as follows; "I would like to support, from the bottom of my heart, the people who are determined to continue working for a life time to be a guidepost for succeeding women in the long run."

I would like to express my sincere gratitude to the female graduates from the Civil & Environmental Engineering Related Courses in the Department of Engineering, at Yamanashi University who spared their busy time in answering the questionnaire.

The Civil Engineering Landscape and the Landscape Design

Soichiro OGAWA
Manager
Civil Engineering Division, SHIMIZU Corporation

I studied architecture in collage and then trained myself in Ecological Landscape Engineering. I became interested in external space design and studied landscape architecture in the U.S.. Later I was involved in spatial development projects at domestic and foreign consultant offices, and now I work for the civil engineering design department of a construction company. Also, I give lectures titled "Landscape and Civic Design" at a university. Based on these experiences, I would like to talk about civil engineering landscape from the standpoint of an ecological landscape specialist.

Who leads the design of outdoor space?

Outside of Japan, there exist a profession called landscape architect who designs outdoor space comprehensively. In Japan, however, this profession is not yet established and it has been my belief that, as long as such is the case, civil engineers should take the initiative in outdoors design. The realm of architects is quite narrow. Looking at the order placements, infrastructure improvement of the residential estates, roads, rivers and ports, which spread across the space, are all designed by civil engineers. While civil engineers have been eager to build safe structures, unfortunately they have been less interested in spatial design. When you look at the curriculum of civil engineering departments nationwide, there are few that teach spatial design. We probably must begin by reforming the educational system.

Spatial design means to design structural framework of the social environment, which is built upon the natural environment. The product is therefore the landscape of the region. Spatial design is important since it forms spatial structure for the society and the natural environment. It is necessary to undertake the task of designing the land earnestly in the planning stage. This is the so-called land use plan.

A land use planning plays the key role in determining the spatial design. Although a functional layout planning is a necessary component of a land use plan, what is more important is that it decides how the local nature and cultural environment are reflected in the designed landscape. However, civil engineering has not yet taken part in spatial design or earth design fully.

By missing the chance of total landscape planning for a proposed project, various professionals can only make proposals for partial improvements in designing stage. In a residential development, a civil engineer is expected to follow the master plan made by the city planner, making it into a feasible design. In detail, a civil engineer will design road alignment, grades, cut and fill balance, slope stability, rainwater drainage, and retention pond capacity. Then a garden designer tries to plant some trees on artificial slopes, water plants on the banks of the retention pond to improve the landscape. Finally an architect comes and builds a town center, and a civil engineer designs bridges, intake towers and other structures. In other words, nobody is in charge of the overall spatial design. It is by no means possible to make a comprehensive "total landscape planning" based on a single design philosophy.

Civil engineers should take the leadership in spatial design. Civil engineering is a profession that handles earth, water and wood, as the Japanese equivalent word goes. It is also a profession, which should accumulate the overall spatial design technology, as it is the most efficient path for civil engineering to take charge of this field. In the past, functionality, safety and economical efficiency were given priority. Design and harmony with the natural environment were not so much cared for. I'm afraid we have been taking matters too lightly to relegate once broken environment to garden designers. The more closely we analyze the nature of the area, the more conditions we find. I believe it is the mission of civil engineers to converse the natural environment of the area, at the same time to seek and present the spatial structure for sustainable society in harmony with nature.

Then, what is missing in the field of civil engineering for the mission? There are many points we have to address in order to make comprehensive spatial designs, but the philosophy and skills urgently needed are the application of ecological knowledge to spatial design (Figure-l), and the skill to draw accurately scaled landscape by sketches (Figure -2).

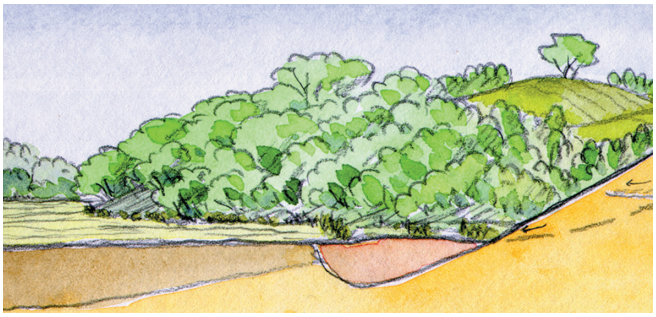

Figure-1: Thinking of the environment from the viewpoint of ecological planning

Figure-2: Depicting the landscape accurately can convey the feeling of space

To create a unique space which cannot exist anywhere else

Landscape architect may be thought as a profession to pursue personal creativity. Ecological landscape design, which is my specialty, rather denies a designer's improvisation.

The philosophy of ecological landscape design is "to create a unique space which cannot exist anywhere else" responding to the unique combination of natural and social context of the site. The less the scenery looks artificial, the better. Following skills are the prerequisites for success.

Finding nature's essence and reflect it in the design

The environment should not be judged only by its appearance. For example, a climax forest of Quercus serrata grown on shallow soil on bedrock has much greater conservation value compared to a similar-looking secondary forest on deep soil. Species that are endangered by human activities should not be the only target of conservation effort.

Analysis of the interrelationship between topography, geology, soil, hydrology, and vegetation, reveals what is most important in the area. You can differentiate what man's hands may touch and what should not be touched. In reality, it is difficult to preserve all the places that are recommended for conservation, but it makes a difference when you understand the value of the objects and places to be preserved and plan as much measure for them.

If you understand the functional framework of the local environment, you can make a design of a space based on the essence. After all, there is a limit to the space a man can create. Then why don't you borrow nature's hand? What you should do is just help nature to form itself in the direction it wants to go. With little help from man, what may otherwise take long time to form may be realized a little faster. Moreover, it is necessary to take a stance that a designer make half of the space and function, and let the other half be made by nature. If a designer misinterprets the direction of nature's intention, the result continuously requires maintenance.

It is civil engineer's task to design a structure that gets along well with nature for a long time, and therefore, we have to listen to nature's requests. It is interesting to know that the important part of an area's natural environment is in many cases understood according to Feng-Shui as well.

A skill to design by sketch and convert the sketch into a plan

In the field of architecture, civil engineering or landscape architecture, many designers design a plan first, and then use perspective drawings, models, and CG to verify the plan. In case a designer himself is going to verify his design using perspective drawings, models or CG, he may find problems in the design in the process of its production and make modifications. But this is not the case if the design is contracted to another office. Despite a considerable amount of time and labor spared by outsourcing, you have to persuade yourself to believe you could not have done any better. I, being one who is not patient enough, cannot stand such a time-wasting way of verification.

What is more important here are sceneries from major viewing points. Then, it is far more efficient to draw the sceneries in mind first, and convert them into a plan. More precisely speaking, a designer needs to find major viewing points first, and quickly draw accurate drawings seen at the standing height. (Photo-1, Figure-3). It should not be a mere image drawing, but a drawing with the sense of scale. I regard this drawing as a combination of a plan and a three-dimensional drawing. This work can be done within two hours, so when the imaged scenery is found impossible to realize on the plan, you can draw another sketches at once. Consequently, there is little gap between the imaged space and the scenery by the engineer and that actually created.

If you enlarge a photo taken by a 28mm pant scope camera into A3-size, 40m ahead of the shooting point it is just equivalent to 1/100 scale on the paper. Since "the apparent size is in proportion to the size of an object and in inverse proportion to visual distance", 80m ahead is 1/200. If the eye-

Photo-1: Original landscape before the land reform

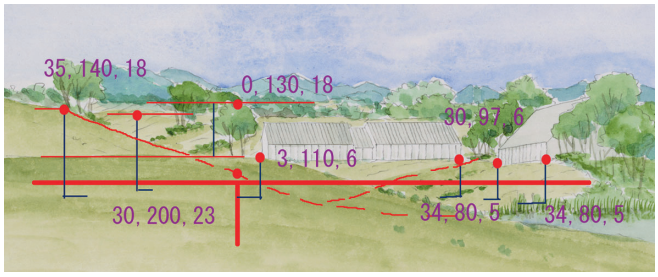

Figure-3: Deciding heights in a sketch

height is set at 1.5 m above the ground, an 8m high tree at 80m ahead is 40mm high on the paper, its root comes and 75mm beneath the horizontal line is its root. Likewise, an 11m high tree at 137m ahead is 32mm high and 4mm beneath the horizontal line is its root. If the topology is not flat, all you have to do is just move an object on the paper vertically according to the difference of height, and the horizontal distance should correspond to the visual distance scale. This skill acquired only by moving your hands, not by just knowledge. Since a 900m high-mountain at 18km distance becomes 20mm on the paper, you can make a precise drawing of the mountains at distance. I will make an in-depth explanation another time but by this method you can convert a sketch into a plan in a short time. (Figure-4, Photo-2) What is important is to develop a sense of scale.

Read the contours on a map

By drawing sketches with a sense of scale, the designer reads contours and understands the relationship between sketches and actual topology. By reading contours, the designer draws a picture of the landscape from any point in the plan. Then it becomes easy to set a main standpoint in terms of the spatial design. Using a perspective drawing, which was learned, at school takes too much time and using the complicated topography of civil engineering is no use because there are too many focal points. Computer tools do not help learning the sense of scale.

Photo-2: Creating a space as imagined by converting sketches into a plan.

Figure-4: Converting the sketch into a plan

Improving the sense of scale

A designer must carry a sketchbook to field surveys. A quick sketch shows just what one sees, that helps finding the essence of the landscape. Photographs should be used only as backup. A designer must be careful not to depend on photographs because taking some photos make you feel that you understand the landscape. One cannot design space without drawing sketches. An engineer who can make spatial designs will be able to communicate by sketching. Draw and think. A first-class engineer is always thinking by drawing, questioning established theories, and formulating a pattern language based on his own experiences. Civil engineers must create spaces that permanently fit in the natural environment. Spatial design is a process to hand down the value of the landscape. There are many who aim to create comprehensive spaces and I am sure that architects and landscape architects share my vision as well. Civil engineers must also take the chance to lead the initiative of spatial design.

Cases of Countermeasures for Soil Pollution by Heavy Metal Containment Measures by Solidification and Precipitation

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Today, the soil pollution problems accompanying the redevelopment projects and sales of corporate fallow land are coming to the surface. The cases in which a huge amount of polluted soil is delivered to the final disposal place, causing rapid decrease of the room left at the final disposal place are rapidly increasing. In this report, as an example of countermeasure for soil pollution by the administration, I will take up a case of measure giving as little change as possible in the bedrock strength in solidification and in precipitation based on the present status in the Tokyo Metropolitan Redevelopment Project. This report is on the decision-making process and information disclosure on selecting the chemical agent for precipitation and on the disposal methodology.

Countermeasures for soil pollution

In Tokyo, countermeasures for soil pollution have been based on the "Polluted soil disposal standards" and the "Details for implementation of the polluted soil disposal standards" by Tokyo Metropolitan Government Bureau of Environment Maintenance. Both of them were abolished in 1994 due to the enactment of the "Ordinance concerning the environment to secure the citizens' health and safety" - hereinafter referred to as the "Polluted soil disposal standards" and the "Details for implementation of the polluted soil disposal standards".) Later in 2001, the "Tokyo Pollution Prevention Ordinance" and the details for implementation of the same ordinance were entirely revised and the "Ordinance concerning the environment to secure the citizens' health and safety" and the details for the implementation of the same ordinance were enacted. The provision on the soil pollution measures has been enforced since October l, 2001[1]. Based on the above situation, we are going to introduce a case implemented in the Tokyo Metropolitan Redevelopment Project as a countermeasure for soil pollution by the administration.

Tokyo Metropolitan Redevelopment Project

The "Kameido, Ojima, Komatsugawa" district is located in the Koto delta area between the Sumida River and the Arakawa River, and this redevelopment project is part of the disaster prevention plan related to urban redevelopment project. The scale of the project covers a vast area of about 114 ha. (Of which 98.6 ha is designated as the area to be covered by this project and the rest is for another project) (Photo-1)[2]. At the time of the project launching, most of the site was where factories used to exist.

Choosing chemical agent for precipitation and deciding on the method

In the area to be covered by this project, pollution by lead, arsenic and mercury has been confirmed. It is a characteristic of this area that combined pollution (by more than two kinds of pollutants) by lead and arsenic was confirmed in a part of this area (Figure-1), and in depth, pollution was confirmed as deep as AP-6.3m, which is relatively deep. Because of this, as a disposal method of polluted soil, we examined several ways such as a disposal by discharge of polluted soil by bracing open cut, and after a comparative review of economical efficiency, we decided to take a measure for containment at the original position after solidification and precipitation treatment.

The measures for respective pollutants were decided according to the following two methodologies:

Photo-1: The area under the redevelopment project

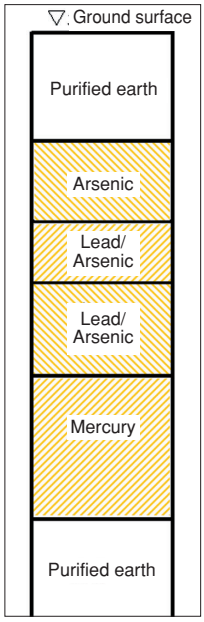

Figure-1: Combined pollution distribution table

(1) Lead should be solidified by cement, arsenic should be precipitated by iron chloride and they should be contained after decreasing the discharge amount to less than the soil environment benchmark.
(2) Mercury should be disposed by carrying out to the final disposal place.

As an implementation method of solidification and precipitation disposal;
(1) The solidification and precipitation disposal of lead and arsenic at shallower than the AP-4.0 m depth should be done by the mixing and stirring method using backhoe.
(2) As for the solidification and precipitation disposal of lead at deeper than AP-4.0 m depth, after a comparative review of economical efficiency, we adopted the precipitation disposal at the original place by the vertical /successive mixing and stirring disposal method (Power blender method).

Solidification and precipitation disposal

Solidification disposal is to mix a solidifying chemical agent such as cement into the polluted soil and stabilize the pollutants physically and chemically. The most widely used precipitation chemical agent is cement. The physical effect by cement depends on the calcium silicate hydrate (C-S-H), which generates at the time of solidification. Since the calcium silicate hydrate is an aggregation of micro crystallite, which has microscopic airspaces, it is said to have effects to solidify (absorb) heavy metal. The coefficient permeability of hardened cement is very small, around 10^{-5} ~10^{-6} cm/s, and this is said to prevent harmful substances and water from combining and enhance the effect of precipitation treatment.[3)] Moreover, as a chemical effect, precipitation effects can be expected since heavy metal ions are hydrated due to high alkalization by cement ingredients and the solubility of the generated hydroxides becomes very low.

Precipitation treatment is to add and mix various chemical agents to the polluted soil and to stabilize pollutants by changing them into chemically water-insoluble substances. It is said that this effect of precipitation largely differs according to the conditions such as the soil pH level and the combination of precipitation chemicals and pollutants[3)]. Figure-1 shows the kinds, actions and reactions of precipitation chemicals used for lead and arsenic in general.

Table-1: Precipitation chemical agents and their reactions

Pollutants	Precipitation chemical	Reaction
Lead	(1) Sodium sulfide(Na_2S)	(1) Generates insoluble sulfides with S^{2+}
	(2) Alkali (OH^-)	(2) Neutralize by alkali and generates insoluble hydroxides
Arsenic	(1) Iron chloride ($FeCl_3$)	(1) Makes insoluble iron salt with Fe^{3+}. At the same time, precipitate with iron hydroxide generated by antalkali.

Combining chemical agents for precipitation

Basically, in the case of single pollution (by one kind of pollutant), the precipitation chemical agent is selected from those listed in Figure-l, and in the case of combined pollution, the designated chemicals are combined and used. However, in a case of the combined pollution by lead and arsenic in part of the relevant area, like this pollution case, if alkaline sodium sulfide (Na_2S) and acid ferric chloride ($FeCl_3$), which are precipitation chemical agents for respective pollutants, are mixed up, noxious hydro sulfuric (H_2S) gas generates. Because of this, for solidification and precipitation treatment of lead, we decided to use cement. Also, we considered about hexavalent chromium, which is said to be possible to elute from cement and we decided to use the portland blast-furnace slag cement B type.

Deciding the amount of additive

In deciding the amount of cement as an additive for the solidification and precipitation treatment of lead, it was necessary to satisfy the following requirements.
(1) To precipitate below the environment limit.
(2) Not to make a secondary effect such as increase of eluted amount generate due to the affect of soil pH changed by the addition of precipitation chemical agent.
(3) As the target ground strength to ensure the present ground strength as strong as N value of this relevant area, to ensure the short-term strength of $q_u(7)=1\sim2 kgf/cm^2$ and to make the long-term estimated strength under $q_u(91)=4 kgf/cm^2$ (equal to the strength of solidified cohesive soil).

Because of the above, as to the precipitation effect and development of strength, we consulted the data of the added amounts of cement in the past, and we also considered about the neutralization treatment in order to neutralize acidification by ferric chloride used for arsenic precipitation treatment and we decided that the added amount of solidification chemical be 55 kgf/m^3 after a confirmation test.

As for the additive amount of ferric chloride to be used for arsenic precipitation treatment, we implemented a confirmation test referring to a methodology example of arsenic treatment indicated in the "Details for implementation of the polluted soil disposal standards" and decided that the additive amount be 1.4~1.9 kg/m^3.

Disposal of the polluted soil by carrying it out of the site

As for the disposal method of polluted soil by mercury, we examined ways of containment into an isolated type of structure, referring to the disposal methodologies of mercury indicated in the "Polluted soil disposal standards", we were unable to take a measure to set up an isolated type of structure and contain the polluted soil into it, since the relevant area is planned to be utilized. Because of that, since the elution amount of mercury was under the standard indicated in the Environment Agency Announcement No. 13, we decided to carry it out of the site to the final disposal place, which is a new sea landfill.

Examination of precipitation treatment at the original place

In examining the precipitation treatment at the original place, it was necessary to satisfy the following requirements.

(1) To ensure the stability of the machine because the relevant place is weak in ground strength (N value around 1~2)

(2) The cost must be low compared with the deep mixing stabilization method and the bracing open cut method.

(3) To improve up to AP-6.3 m at the original place.

After examining some implementation methods to satisfy the above requirements, by keeping the blending of cement and earth even and by stirring slurred cement with earth, we adopted the "Vertical/successive mixing and stirring disposal method" Slurry spray method (Power blender method)". (Photo-2) In addition, the disposal scope covers about 50% of the relevant area, and the maximum length in the depth direction in part of it is as long as 4.9 m from AP-1.4 m (formation level) to AP-6.3 m. (Photo-3)

Information disclosure

In the course of implementing this countermeasure project, we made an active effort toward information disclosure to obtain the understanding and cooperation of the residents in the neighborhood. For example, we put out a sign explaining about this countermeasure work of polluted soil disposal. In addition, we elaborated on the plan about the temporary fence built around the site, put up screen type all-purpose walls at every turn (Photo-4) and showed the inside of the site openly to the citizens who were walking along the roadside. As a result of such efforts, we obtained their cooperation, which helped us greatly in accomplishing the work without any trouble.

Photo-2: Power blender method

Photo-3: Blending at the deepest part

Photo-4: The sign and the screen type all-purpose wall

Future perspective

While the soil pollution issue is becoming obvious, since many of the present measures are to carry out the polluted soil to the final disposal place for landfill, the remaining room left at the disposal place is becoming very limited.

The soil is a useful resource and it is necessary to utilize it effectively. Concerning the solidification and precipitation treatment implemented this time, there is a voice pointing out a possibility of pollutant re-elusion due to contact with groundwater. On the other hand, although confirmation of the

elusion amount of the polluted soil was made in an elusion test by crushing the polluted earth pursuant to the Environment Agency Announcement No.46, there is little examination about the elusion characteristic from the polluted earth with the strength increased by cementation and the coefficient permeability lowered. Though the elusion characteristic of such disposed soil is now being clarified [4], the result will make the difference from the Environment Agency Announcement No. 46 acknowledged, and if the safety is verified, there may be some changes in the measures such as building impervious structures and carrying the soil out to the final disposal place. Also, as a result, this measure of solidification and precipitation treatment of polluted soil will be used more to be advanced as a soil pollution measure nationwide.

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General Presentation of ITS System System Architecture for ITS in Japan

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The system failure prompted by the integration of Mizuho Financial Group (former DaiichiKangyo Bank, former Fuji Bank, and former NihonKougyo Bank) developed into a social issue and resulted in the loss of confidence in the new Mizuho Financial Group. The media and the specialists cite as the cause of failure, the lack of leadership by the top management in time of integration. They also report that in order to unify individual and varying systems and to make ex post adjustments, it was necessary to involve advanced technology and considerable manpower.

System failure caused by the integration of existing structures is not a problem limited to the banks. On the contrary, every system found in a society possesses the same potential danger. In order to avoid this threat to come to the surface, it is important to grasp beforehand, the individual systems, which will come into connection as well as to have a bird's eye view of the entire system.

What is System Architecture?

A system of a large scale is in general formed by associating diverse technologies that compose the systems in many ways. Therefore, in order to design such system, common practice is to organize the structure of the entire system in advance and then to develop specific systems conforming to the structure. System Architecture is like a picture that shows the overall structure of the system by presenting the basic elements of the system and their relations to each other.

You could imagine a puzzle consisting of intricately shaped pieces representing the individual systems. By successfully piecing together the parts, you start to see the entire picture and you come to understand the role that each pieces play in the whole.

We have a tendency to use the term "System Architecture" in wide range of situations from the basic structure of a computer to the totality of a large-scale system that has a social extent. However, what we call a ITS System Architecture often designates the latter of the two.

Necessities to Construct System Architecture for ITS

ITS is an intricate large-scale system consisting of many individual systems such as VICS and ETC. Moreover, among the individual systems, some like VICS and ETC have already been in operation and some are yet to be realized such as the systems for safe driving assistance and for traffic demand management. Although they currently coexist, it is highly probable that one individual system takes over another in a generational transition. Also, we must be reminded that ITS cannot stand alone in the social system as it must be compatible with the move towards an advanced information oriented social system such as seen in the toll payment system.

With the above particularities in mind, ITS related parties in industry, academia and government acknowledged from the beginning that the System Architecture is indispensable in order to design ITS and to develop it effectively for the market. In the summer of 1996, the United States completed the national ITS System Architecture design. The completion was followed by standardization and PR activities and the actual deployment of systems. In Europe, there has been a project to design System Architecture since 1994.

During the same time in Japan, five government bodies related to ITS published "The Comprehensive Plan for ITS in Japan (July 1996)" and presented the milestones for the development of twenty User Services in nine fields. Thanks to this general plan, ITS, which was formerly regarded simply as a navigation system, started to be widely recognized as an advanced total transportation system. The plan also succeeded in demonstrating conceptually the compatibility between ITS and the advanced information oriented society. However, it did not suffice to organize ITS conceptually as problems such as duplicate investment were foreseen in the measures and in business. A cartoon caricature popular at the time showed a car flooded with various equipments in order to benefit from numerous ITS services. Standardization of in-vehicle equipments and of infrastructure and information sharing become the subjects of immediate investigation.

Characteristics of Japanese ITS System Architecture

In January 1998, with the help from VERTIS (current ITS Japan), five government bodies related to ITS started the design of System Architecture. They formed a project team of 100 members consisting of technicians from fields such as automobile, electronics, and communication as well as construction consultants and members from think tanks. The project team endeavored energetically and after numerous consultations, Japanese ITS System Architecture was finally completed in November of 1999.

The result was based on the 20 User Services established in the Comprehensive Plan for ITS in Japan but also included following points:

1. The areas requiring harmonization with ITS to ensure mutual connectivity with the advanced information oriented society has been established as the 21st User Service and has been added to the system.
2. Within the framework of 21 User Services, broke down the categories into 172 detailed sub-services capable of defining the requirements as concrete systems. As intermediate classification, created 56 individual User Services (refer to Figure-ure1).
3. Using Object-Oriented Analysis Method extracted and organized the information used or necessary functions within each sub-services. (Logical Architecture or Physical Architecture in the professional terminology).
4. Clarified the information or functions that should be standardized or shared within the 172 sub-services.

As a result, Japanese ITS System Architecture has following two characteristics compared to the systems found in the U.S and elsewhere. Firstly, by concretizing the information and functions of the twenty-first user service to the same level as previous twenty services, we were able to secure interoperation and interconnectivity with various systems in the society and thus was able to develop ITS in harmony with the advanced information oriented society. Secondly, a System Architecture built upon an object-oriented analysis method facilitates partial modification compared to the one based on structural modeling adopted by the U.S. As a result, the entire ITS gained flexibility and adaptability to social changes, technical advancement, or generational change.

World of ITS regulated by System Architecture

In Japanese ITS System Architecture, information extracted from 172 sub-services is grouped according to similarity and other points. The information groups are in turn, organized in the hierarchical fashion based on the minuteness of the details. Moreover, they are placed in five conceptual fields of People, Vehicle, Center, Roadside, and Exterior Elements depending on characteristics sought after in each function.

Figure-ure 2 shows the layout plan of top-level functions. Technically, it is called sub-system interconnect diagram but it is commonly known as sausage diagram. This diagram

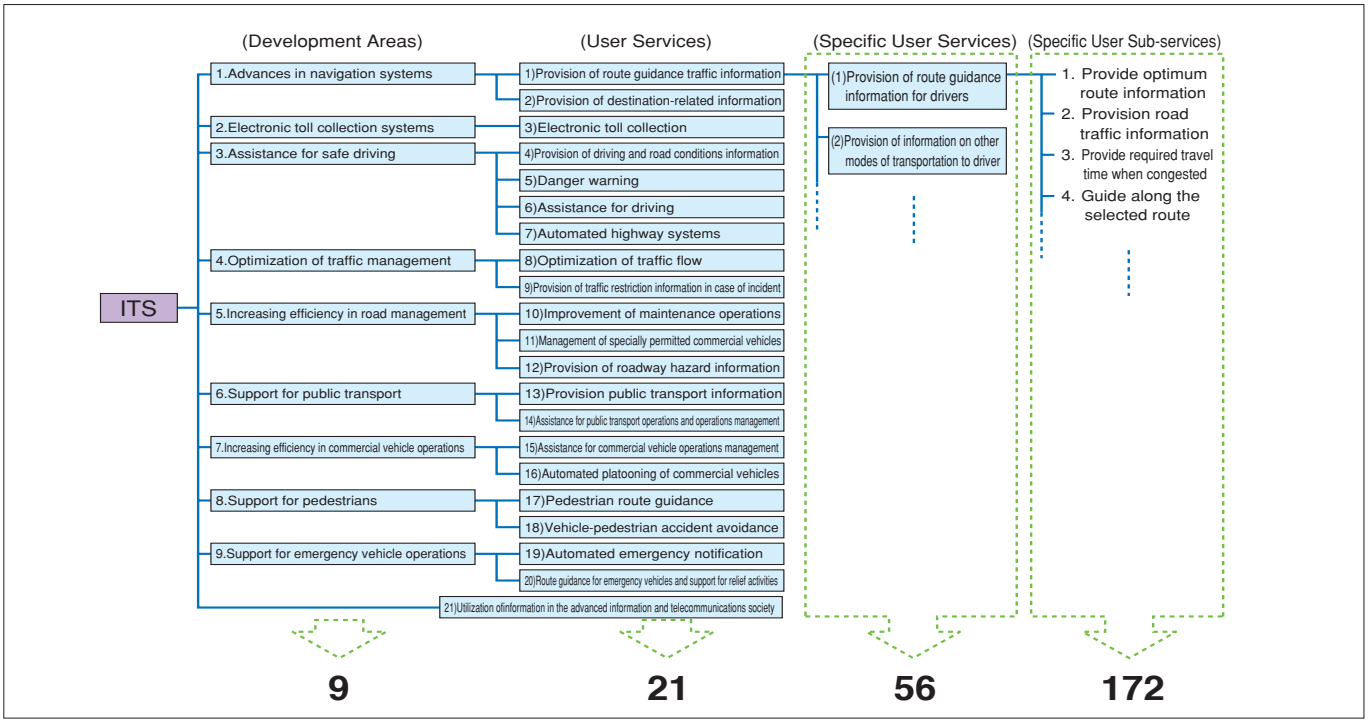

Figure-1: Overall structure of ITS user services
Source: System Architecture for ITS in Japan. National Police Agency, Ministry of International Trade and Industry, Ministry of Transport, Ministry of Posts and Telecommunications, Ministry of Construction, 1999

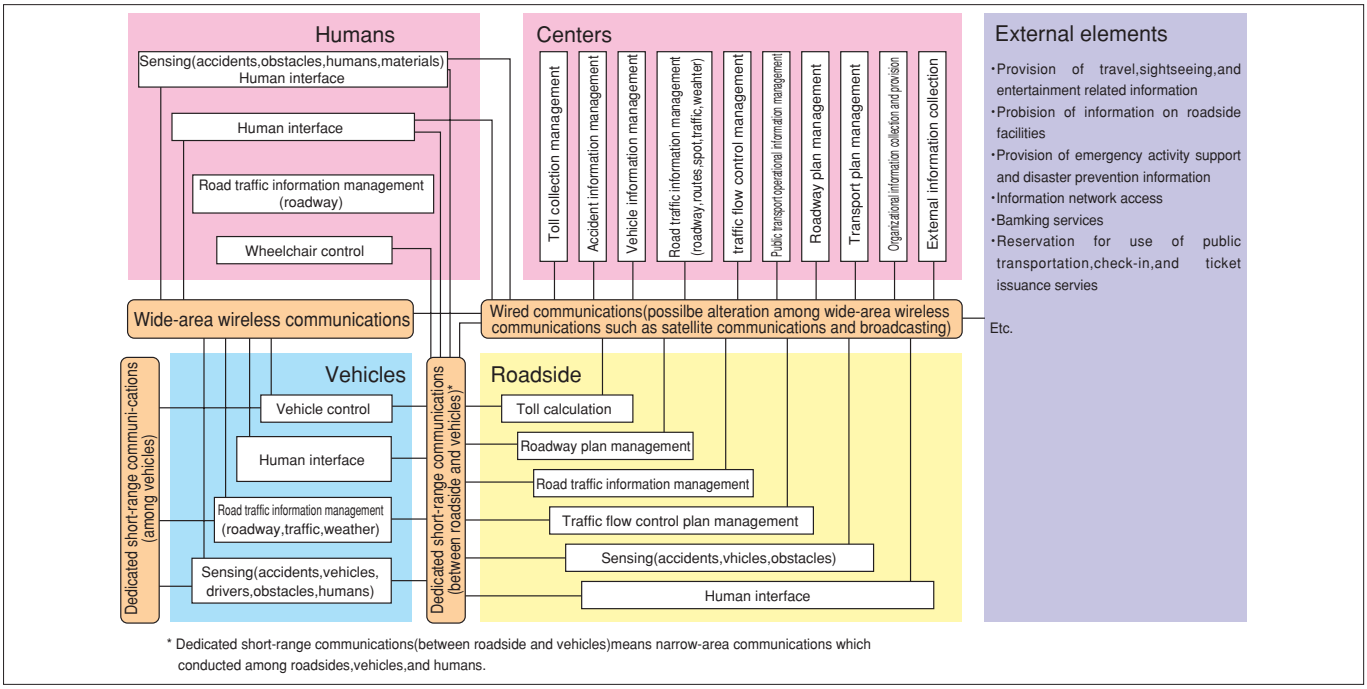

Figure-2: Subsystems interconnect diagram
Source: System Architecture for ITS in Japan. National Police Agency, Ministry of International Trade and Industry, Ministry of Transport, Ministry of Posts and Telecommunications, Ministry of Construction, 1999

shows the allocation of each function as well as the ways of communication among functions. From this diagram, one could for example understand that a) it is preferable to calculate the tolls at Roadsides but the actual account management should be done at the Center or b) it is favorable to connect between Roadsides and the Vehicles with a narrow-range communication system.

Thus, by developing the individual system based on the understanding of the framework set by the System Architecture, it basically becomes possible to avoid duplicate investment of ITS infrastructure or to prevent similar services to be separated and isolated from each other. Nevertheless, System Architecture does not specify how functions and information should be organized or placed in the physical space nor does it tell us what equipment or media to use. Moreover, it does not set specific rules or protocols concerning communication such as the message set or data dictionary. As it becomes obvious from the above, there are many points left to be clarified as we try to actually implement the system and to commercialize it. This is why after the completion of System Architecture, there is still a continuous effort in concretization, such as planning of details, standardization of individual systems and drafting of a business strategy.

For your information, Japanese System Architecture is available for download from the website of ITS Japan (http://www.vertis.or.jp). There also is a software that enables you to search within the System Architecture at the website of the Road Bureau of the Land, Infrastructure and Transportation Ministry (http://www.mlit.go.jp/road/ITS./j-html/).

Developing Freight and Fleet Management in ITS and Civil Engineering

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A Need for Freight and Fleet Management in ITS

Road freight transport accounts for 90 percent of the entire freight volume (tons)[1] and handles majority of cargos from fresh products to gravel and sand. At the same time, trucks account for 40 percent of the traffic volume[2]. This demonstrates the public significance of streamlining road freight transport, as it will lead to the improvement of the traffic environment and safety. There are two points in road freight transport policies that are subject to freight and fleet management in ITS; traffic and fleet control measures based on the number of trucks and freight (commercial and manufactured articles) control measures.

I think ITS contributes to the aims of Japanese logistics policy, " The New Comprehensive Program on Logistic Policies" in the following ways.

Facilitating and Speeding up the International Logistics

In response to the globalization of economy and to the lowering hub function of major Japanese ports, freight and fleet management system in ITS minimizes the delay of cargos at ports by linking with sea, port terminal and land information and thus promoting efficiency and smooth operation.

Reducing Logistics Costs and Improving the Logistics Services

Freight and fleet management system in ITS could promote efficiency in freight transportation by promoting traffic information system, by introducing dispatch and route planning using digital road map and by promoting fleet management using GPS. It could also contribute to the improvement of logistics services in response to the client needs such as delivery at designated time.

Improving the Environment

By providing in-advance freight information, freight and fleet management in ITS improves planning and loading efficiency with proper type (loading weight and size) of vehicle. It also increases proportion of loaded trips by providing information on fleet management. Moreover, freight and fleet management in ITS reduces the discharge of air-polluting substances, protects the earth environment, and contributes to the construction of recycle-oriented society by reducing fuel consumption as part of economic fleet management.

ITS User Services and Freight and Fleet Management in ITS

Among ITS user services, the areas related to road freight transportation are divided in the manner shown in chart 1. There are less and less elements in these areas that are the subjects of further technological development. Recently, the focus is rather on undertaking the new development project and creating a framework for deployment and diffusion.

Common Menus with ITS for passenger cars

Areas valuable to passenger cars such as danger warning are equally valuable to freight vehicles. However, freight vehicles seldom require a navigation system because they often transport same routes between origin and destinations. Instead, they require a simple and inexpensive means of communication and operation such as mobile phone other than car navigation.

ITS Particular to Road Freight Transport

1. Road maintenance and management, and traffic regulation (administrative interface of freight transportation)
   A need for surveillance and control on heavy vehicles transportation of hazardous materials such as radioactive materials and surveillance of industrial wastes transportation.
2. Streamlining commercial vehicles operation (joint delivery, promote efficient delivery by matching cargos and vehicles among carriers).
   As a measure to reduce traffic volume, encourage cooperation among carriers in joint delivery in order to promote loading efficiency (percentage of loaded volume in maximum loading weight and seize of vehicle) and in matching cargos and vehicles among carriers and reducing return unloaded and thus increase the percentage of trips of loaded vehicles in all trips of freight vehicles. Among the

Table-1: ITS user services and freight and fleet management

1	Common Menus with ITS for passenger car
	・Improvement of Navigation System
	・Toll Payment System
	・Assistance for Safe Driving
	・Road Pricing for improving environmental condition
	・Support for Emergency Vehicle Operation
2	ITS Particular to Road Freight Transport
	・Improvement of Maintenance and Management
	A) Electronic processing on specific vehicle control
	B) Automated measurement of vehicles
	・Management of Special Vehicles
	C) Provision of Vehicle Position history
	D) Management of Hazardous Materials
	E) Supervision of International transfer of Containers
	・Provision of Traffic Control Information
	・Increasing Efficiency in Commercial Vehicles Operations
	F) Cargo Transshipment System
	G) Joint Delivery System
	H) Forwarding System
	I) Vehicle Tracking System
	J) Fleet Management System
3	ITS in relation to other transport modes
	・Inter-Modal Freight Transport
	K) Land, Sea, and Air Information System
	L) Ferry Reservation System
	M) Transport Route Selection System for International Logistics
	N) Tracking System for the International Transport of Containers
	O) Land and Sea System of International Transport of Containers

main substances of the support by ITS are the use of digital road map in planning vehicle allocation and the improved handling of vehicles and cargos by sharing traffic information.

To promote safety, it is necessary to maintain a "hands-free environment of mobile phone" in this area.

ITS in Relation with Other Modes (Railroad, Harbor and Airport)

When seeking efficiency and smooth operation of freight transportation and the improvement of its environment, it is indispensable to improve the logistics system from the point of view of users. It is also important to reduce the cargo stock by synchronizing the time of arriving and processing and by pursuing speed and transparency in inter-modal freight transportation. In Japan, an experiment for logistics information system linking land and sea is currently under way (see Figure-1).

Effective Use of Freight and Fleet Management in ITS and Existing Infrastructures

As Freight and Fleet Management in IT / ITS come into wider use, one could expect following effective usages of existing

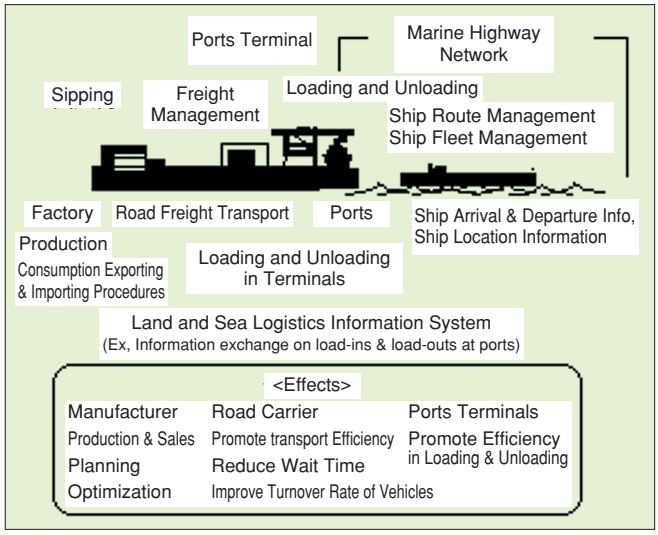

Figure-1: Land and sea logistics information system
Source: Ports Bureau of the Ministry of Land, Infrastructure and Transport

infrastructures by transportation demand management:

Leveling of peak time

By anticipating concentrated demands that might arise, it becomes possible to avoid the peak traffic time by planned guidance and thus it becomes possible to level the demand and reduce unnecessary lines and waiting times.

Increasing Options

When it becomes possible to compare the conditions of various modes of transportation, it becomes easier to choose or find alternatives among rail, roads, ports and airports, depending on the individual shipping requirements. This in return avoids the bottleneck.

Improve adaptability of selective guidance measures

In transportation demand management, adaptability of fee, route guidance, or time restriction reflecting various conditions such as time, route, vehicle type or urgency, increase promoting effective use of existing infrastructures within the spatial and temporal restrictions.

Civil Engineering and Freight and Fleet Management in ITS

Optimization technique of freight and fleet management in ITS could be adapted to the field of civil engineering in following ways:

Simulation Analysis

ITS technique is a technology of spatial and temporal supervision closely related to geographical information system. In civil engineering, it could be used during the stage before construction, when choosing among alternative plans. It could be useful in evaluating the validity of land use, transportation network or facilities.

Working out Transportation Planning

We can expect the improvement of techniques of transportation planning by analyzing the trend in the movements of micro in the data of the route traveled and by collecting the comprehensive data for a macro level analysis, rather than forecasting the transportation demands of each system by trips.

Streamlining Construction-Related Transportation

Vehicle allocation planning and optimization techniques for the positioning of facilities and materials in logistics could be applied in construction materials supply, in land usage planning, and in the construction wastes disposal.

Streamlining Maintenance and Management

Techniques for freight and fleet management could be used in surveillance of snowfall and snow accumulation, in managing the operation of snowplows, and in providing information on the cleared routes.

Disaster Countermeasures

Automated driving and guidance technologies could be applied to the operator-less handling of civil engineering vehicles using GPS or wireless LAN.

In these ways, ITS does not limit itself to the real-time communication system during fleet management nor does it require the foundation of public information as an indispensable prerequisite. Especially in the field of civil engineering, we could expect tremendous positive effects in planning based on information collected in advance using ITS.

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1 When calculating the freight volume by tons.
2 Based on the traffic load volume (vehicles / km).

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Environmental Engineering and Management

In the "Tokyo Agenda for Action" at the 2nd Tokyo International Conference on African Development (TICAD II) hosted in Tokyo in October 1998, poverty reduction was recognized as one of the most important issues for Africa's development.

On this opportunity, the International Development Committee of the International Monetary Fund requested the drafting of Poverty Reduction Strategy Papers (PRSP) by African nations. As part of this general movement, the Japan International Cooperation Agency (JICA) implemented a development survey in Niamey, the capital of the Republic of Niger in July 2000 and completed the survey in December 2001.

The author was involved in work on the development survey as part of a joint venture formed by two consulting companies for JICA's environmental project, with an emphasis on strengthening public participation and capacity building. Currently, following the completion of the development survey, the country is trying to procure possible financing and South-South cooperation under the PRSP to realize the project. In this paper, an overview of the Clean Niamey Campaign as well as the public participation efforts will be presented.

Figure-1: Map of the Republic of Niger

Current Situation of Sanitation

The landlocked West African Republic of Niger (Figure 1), which is one of the poorest nations, excluding countries with conflicts and civil wars, has a land area of roughly 1,267,000 km2 (roughly 3.4 times Japan) and a population of roughly 10,000,000 people as of 2000 (of which 650,000 reside in Niamey) and is surrounded by 7 nations. As a former colony it forms a French colony and there is a strong European economic influence. The sanitation environment of the capital of Niamey is horrendous and there have been no effective measures taken for a long time up till now.

In Niamey City the drainage of rainwater and disposal of household waste is an urgent issue for the sanitation environment, but even with the urgency of administration, resident, and citizens, improvement plans have not been implemented and have not reached realization. As a reason, the lack of financing, organizational problems for the relevant authorities, and a lack of ownership and initiative are some of the problems indicated. For this reason, roads and open space commonly become sites for trash and human waste disposal, leading to extremely bad sanitary conditions. During heavy rain, blockages from the accumulation of waste and other matters reduce the flow surface for potential floods and accidents resulting in injury or death. Photo 1 shows how the road serves as a drainage canal during heavy rain and screens are placed over the vents. The purpose of the screens is unclear but can only be for the prevention of personal injury or death. Photo 2 shows a point roughly 1km upstream and where there are drainage ditches, you can see sights like this.

Contents of the Sanitation Improvement Plan

The Master Plan for the Clean Niamey Campaign places an emphasis on diagnosing the current situation and the survey team created an original framework in drafting the plan. As a result, the target year for the plan was set as 2015 and the target year for priority districts was set as 2005. The existing plan for urban sewerage was changed from a separate flow format to an interflow format and a separate flow method was

Photo-1: Drainage along the road and the protection screen

Photo-2: Current state of garbage disposal

adopted for districts without rainwater drainage for a progressive approach to the project plan. The establishment of treatment districts was based on the principle of one treatment plant per district and facilitated the creation of construction plans in accordance with prioritization. Also, the treatment method selected was lighted anaerobic sludge method and to assess the treatment performance a suitability experiment for the treatment method was implemented at a pilot plant for 6 months.

On the other hand, following the results for a survey of alternates, the implementation of a new collection system was considered for the waste disposal plan and the establishment of recycling center for the purpose of recycling was proposed. In addition, for the creation of a new organization, a new organization was proposed to facilitate resident participation and citizen participation, soft measures were strengthened to allow capacity building for human resources development, an educational program for sanitation and environmental issues was established, and a sanitation education campaign was seriously implemented at the abovementioned pilot plant and through the construction of toilets/septic tanks.

Emergency Improvement Program and "Clean Niamey Campaign"

Following an assessment of current conditions and an analysis of problem areas as well as the procedures in drafting the master plan, feasibility studies (F/S) were implemented for high-priority projects, the practicability of project categories to meet development by 2005 were evaluated and project planning was carried out. The Republic of Niger was advised on emergency improvement works regarding especially urgent projects considering current domestic conditions and sanitation improvement schemes with the most possibilities. This was the proposal of a sanitation improvement project using the F/S district as a model area for the sewerage program. This program was a combination of the development of sewerage/drainage of specific districts within a treatment district, primary and secondary collection of waste, construction and improvement of public toilets, and a sanitation educational campaign. Immediate results on investment were expected by incorporating soft measures in the improvement scheme and the plan was designed to contribute to sanitation improvement in the district.

By developing the model project horizontally as the "Clean Niamey Campaign" with residents and citizens, it is believed that sanitation improvement can be expected little by little. An important lesson from the case study of sanitation environment improvement in the Curitiba City, Parana State in Brazil, that received the Environment Award of the United Nations, is that the lack of money is not a determinant of success but to start with actions that can be done through coordination among residents and gradually build on the budding independence of residents. The outcome of the Clean Niamey effort needs to be kept an eyen with this basic principle in mind. For this reason, the study team organized 2 international seminars while stationed, publicized and disseminated this information to residents, citizens and media, and demonstrated the possibility for project realization. Aspects of the project details for the scheme were aligned with the Millennium Development Goals adopted at the United Nations General Assembly by member countries in September 2000.

Experiencing this campaign, I feel that it would be effective to include project management as one of the choices for evaluation and approval standards as part of Japan's engineer training program at institutions of higher education. As mentioned in the special feature of the JSCE Journal of May 2002, it did not take time, as some general managers point out, that there is a strong need for the "exhibition of comprehensive competency" and this characteristic must be cultivated as a necessary facet of any project manager.

Sanitation Education through Coordination with Japan Overseas Cooperation Volunteers (JOCV)

In accordance with the sanitation education campaign proposed as part of technical cooperation in the software sector, this was carried out in the field of education at public elementary schools and the pilot plant that serves as the wastewater treatment plant. Three preliminary hearings were scheduled for local authority members, residents and citizens and a homemade campaign was designed and implemented with the help of local NGOs while ensuring appropriate public participation. Eight toilet booths and a consolidate septic tank that can process water volumes of 50m3/day as well as the pilot plant mentioned above (average waster water processing of 100m3/day) was used for 4 days of educational seminars. The sanitation education campaign for elementary schools was used as an experimental case study for environmental education as well as to enhance the coordination of JOCV and the development study team. The sanitation campaign carried out by JOCV instructors is introduced as an example of coordinated cooperation in JICA's press release of June 27, 2002. Figure 2 is a handmade cartoon used as teaching material for sanitation education geared towards elementary school children.

In addition, the implementation of this sanitation campaign is the first step for cooperation with NGOs and will remain as the product of coordination as a "reflection of living resident wishes toward the project" (ODA newspaper March 30, 2002). This experience emphasized the strong need for sharing the information and knowledge of residents as part of a common awareness. Although it is not necessarily a fully participatory ODA project for national citizens, the sanitation campaign was implemented under a scheme of support and technical cooperation for the sectors of environment and poverty reduction and is in accordance with the 3 pillars mentioned in the specifics of ODA reform as noted in the final report of the "2nd Informal Advisory Committee for ODA Reform" submitted on March 29, 2002 and will contribute to regional vitalization. In the future, please use the ODA monitoring policy to look up this project.

Pilot Study

The wastewater treatment method introduced at the pilot plant was the first in Africa and is known as the upflow anaerobic sludge bed treatment method, classified as a form of anaerobic treatment. This treatment method is effective for tropical and subtropical regions where the temperature is high throughout the year. For the post anaerobic pond, some form of aerobic treatment is necessary but it still deserves attention as a low energy and low treatment cost solution.

In this survey, sponge was used as a filter element after anaerobic treatment for the water spray bed method and naturally cycle method. The wastewater quality monitoring was the 3 months of the survey period and although the suitability of the treatment method was judged, this is inadequate and it is hoped that cooperation for evaluations and follow-ups will be carried out through such measures as follow-up surveys and monitoring analysis.

Capacity Building

The development consultant's role is to increase the capacity or indicate a framework to improve ownership needed for the Republic of Niger's PRSP and it is important to have the desire to work with residents to start things up under the common awareness that public participation is important for frameworks and mechanisms and to disclose information through public participation methods.

Public participation projects involve rights (granted by administration) and duties (independence as well as cooperation and coordination) and there are many choices for

Figure-2: Pamphlet for sanitation education aimed at elementary school children (in French)

measures that support capacity building but the administration must take the leadership in activities to raise awareness and publicity. For the administrations side, some collateral is needed for resident burdens but from the point of human resources development continued repetition is strongly thought as the shortest path to solution.

For PRSP measures in the Republic of Niger, 1) the priority of sanitation improvement projects was raised, 2) the sanitation improvement master plan of regional cities was drafted, and 3) legislative measures were taken to implement registration measures for local consultants. On the other hand, the World Bank Institute has implemented undertakings to strengthen and support developing countries as part of its coordination activities with developing countries and will heighten the effects of developmental assistance, so these deserve followed attention. In addition, the TICAD III to be held in autumn of 2003 also deserves attention.

Continuation of Friendship Activities between the Republic of Niger and Japan

Over 10 years have passed since the need for harmonization between development and the environment was called for and Japan has strived to establish a sustainable regional society through its various ODA schemes. Even in the Republic of Niger, the string of such activities could develop into a resourse-recycling urban society and it is hoped that the day will come in the near future when solid waste treatment and the local agriculture industry can coordinate together for effective town development.

This survey served as an opportunity to create a circle of friendship with partner organizations and counterpart organizations in the Republic of Niger and we hope to continue this friendship. Fortunately, this country has an alumni society for former JICA trainees and is steadily working as a friendship organization and we would like to support these organizations voluntary activities.

Finally, I would like to extend my gratitude to the local JICA mission and the JOCV people who cooperated with us for their help during the year and a half that this development survey lasted.

Earthquakes and Cultural Assets

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In September of 2001, the government's Earthquake Survey and Research Promotion Headquarters announced that the occurrence of an earthquake in the south sea trough is highly likely and the probability of occurrence in the next 30 years is roughly 40% for the south sea earthquake and roughly 50% for a southeast sea earthquake. On this opportunity, the concern over east sea, southeast sea and south sea earthquakes grew and in April of 2002, the strengthening of regional earthquake prevention measures were reviewed. Following this, in July of 2002, a "Special Law on the Promotion of Earthquake Prevention Measures Regarding the Southeast Sea Earthquake and South Sea Earthquake" was enacted.

In this manner, the topic of earthquakes on the south sea trough are raising general concern but before this the likeliness of an earthquake occurring on the active faults inland of the Kinki region is being pointed out considering the historical occurrence of earthquakes. Considering the fact that over 70% of national cultural treasures are in the Kinki region, earthquake measures for cultural assets for a highly likely inland earthquake preceding an earthquake on the south sea trough is an urgent matter.

Culture and Civilization

The Great Hanshin-Awaji Earthquake of 1995 that struck Kobe and the surrounding area wreaked great havoc but recovery was much faster than the initial forecasts and after 5 years the rehabilitation measures were virtually complete. Some pointed out that rapid recovery was because it was the reconstruction of civilization. However, if this was Kyoto, the rehabilitation of culture would also be necessary in addition to the rehabilitation of civilization and this would be impossible.

Then, what is the difference between civilization and culture? According to the dictionary, civilization represents the product of artificial technology and material activities and culture involves the products of religion, morals, liberal arts and other spiritual activities. In other words, civilization is widely dispersed among the current generation and whatever was needed for the rehabilitation of Kobe could be gathered from all over the country and all over the world. On the other hand, culture is not universal. The culture of Kyoto is unique to Kyoto and Gandhara's Buddhist culture is unique to Gandhara. If this is destroyed, it cannot be rebuilt. If it burns only the ashes will remain.

Then, what is a cultural asset? If culture represents the spiritual activities of our ancestors, then cultural assets are the artifacts of such activities and we are able to know of these spiritual activities of our ancestors through such artifacts. Whether it is architecture, calligraphy, paintings or whatever, unless it is left in some kind of material form, it is impossible to know of our ancestors spiritual activities. All Japanese have ancestors from the Heian era and Jomon era, but which do we feel the closest to? We can surmise a lot of what people thought and how they lived in the Heian era. However, it is difficult to imagine what our ancestors from the Jomon era thought. This is mainly due to the existence of cultural assets. This is where the importance of the existence of material cultural assets is.

Disaster Measures for Cultural Assets

Efforts to protect cultural assets have been taken since ancient times but the burning down of the Horyuji Golden Pavilion of 1949 in the postwar era accelerated such activities and currently national treasures and other important cultural assets are protected by disaster prevention measures and fire prevention measures for the buildings that house them. However, these measures are to prevent the spread of arson and accidental fires from inside the temple grounds. It is obvious from the Great Hanshin-Awaji Earthquake, major earthquakes are always followed by the occurrence of fires and given certain conditions can spread over a wide area. Also, in the case of Kyoto, in the town area where fires are likely to spread, there is a wide dispersion of cultural assets as if on purpose. In other words, the many architectural structures that probably house cultural assets are usually national treasures and important cultural assets themselves and widespread, long fires that come from outside are the problem.

How do measures for inside fires and outside fires differ?

There are two issues. The first is that water hoses and other facilities are mainly not designed to be pointed outside of the compounds and are weak toward fires originating from outside. The second is that the water store volume needed for fire extinguishing and fire prevention are limited to the necessary amount for the several minutes before the fire engines arrive. However, earthquake fires occur concurrently with many other disasters happening at the same time and since the roads are obstructed, fire engines do not arrive. In other words, in constructing fire extinguishing and fire preventing facilities, the danger of extended fires caused by earthquakes from the outside is not considered.

Another inconvenience is that fire extinguishing and fire preventing facilities are that fire hoses are almost always connected to water storage tanks located underground or in the back mountain by pipe works. In Horyuji and other facilities, the extension reaches 1.5km. It goes without saying that the underground pipe works were laid when earthquake prevention technology was relatively underdeveloped and are extremely vulnerable to earthquakes. Even in the Kobe earthquake of 1995, the underground pipes of two famous temples in Kyoto, which is located 50 to 60km away was bent and the system could not function. If the earthquake occurred in Kyoto, many more facilities would lose their fire fighting and fire preventing capacities. Also, under such conditions, earthquake fires will ensue.

This is why I have been advocating the need for the "protection of cultural assets from earthquake fires" these past 5 to 6 years.

Many Cultural Assets Lost

The density of wood housing in Kyoto is several times that of Kobe. If the earthquake in Kobe caused such a major fire disaster then it does not take any imagination to assume the same would happen to Kyoto. And the density of national treasures and important cultural assets in the hollow of Kyoto is the greatest in the nation and the cultural assets per capita is probably more than tenfold compared to the national average. There are roughly 20 architectural structures in the Kyoto basin designated as national treasures and there is the same number of temples and shrines designated as world heritage sites. If the next major earthquake strikes Kyoto, these precious cultural assets would burn down and be lost.

On the other hand, some wonder why these earthquake fire measures need to be rushed when cultural assets have survived war fires and fire disasters in the past. However, this is a mistake. All the national treasure architectural structures in Kyoto, excluding the Nijo Castle were located in a district unaffected by the Great Fire of Tenmei (1788). This great fire covered the area of Kamogawa in the east, Senbondori in the west, Kitaooji in the north and Rokujodori in the south. Within this area the only important structure that was left is only Nijo Castle. The Nijo Castle is surrounded by a moat and there is considerable distance from the buildings on the inside where the fires cannot reach. Therefore, the reason why many important structures still exist is because the fire disaster was contained within that area. So the remaining cultural assets will definitely be lost if extended fires reach their area and areas without cultural assets were already burned down by previous fires. So, as it is plainly obvious, these important issues were avoided until now. The oldest wooden structure still existing in Kyoto is the Senbonshaka-do (Daiho-onji) built in 1227, which is relatively new considering the capital relocation to Kyoto was in 794 AD. This signifies that much was lost when Kyoto became the battleground of the Onin War of 1477 and only the Senbonshaka-do survived the fires. In other words, all the current cultural assets existing in Kyoto luckily escaped fires. Much has already been lost.

Now, so the old assets still left are on the outside of the area devastated by the Great Fire of Tenmei and back then the density of housing was low for fires to reach the area and if fires occur in the basin of Kyoto today, fires will easily reach the outer boundary of cultural assets. The vulnerability of Kyoto to fires is more than in the past.

The Next Earthquake is bound to Happen

On the other hand the next major earthquake is expected in the region from the east sea to south sea and the possibility is extremely high. But before an earthquake strikes the south sea trough, an inland earthquake, especially on the scale of the recent earthquake of Kobe in the Kinki Region is expected from historical review of past earthquakes. The source of earthquake activities in the Kinki Region are from earthquakes that occur in the oceanic trough from the Kishu waters to Tosa waters. These earthquakes happen at period of 100 to 120 years and it is obvious from Japan's earthquake history over the past one thousand and several hundred years. Therefore, the general trend that earthquake activities in the inland area of Kinki Region will become more active before such earthquakes is assumed. If such an active period lasts for 30 years, the next 50-60 years will be relatively quiet.

After the several decades following the southeast sea earthquake in 1944 and south sea earthquake in 1946, roughly 50 years of quiet time elapsed until the Great Hanshin-Awaji Earthquake after the Fukui earthquake of 1948 that caused

3800 deaths. However, before the southeast sea earthquake in 1944, several earthquakes continued over roughly 30 years such as the Kitatango earthquake in 1927 and the Kitatajima earthquake in 1925. In this manner, earthquakes in the Kinki Region alternate between roughly 50 years of quietude and roughly 50 years of high activity and it is because the origin of such inland earthquakes are caused by the southeast sea/south sea earthquakes that occur over a continuous 100 year cycle.

The high probability of a southeast sea/south sea earthquake occurring within the next 30 to 40 years was anticipated and the need for an emergency measure to respond to this situation was pointed out and a legislative measure was passed in the 2002 National Diet session. If a measure against the southeast sea/south sea earthquake is necessary, it is necessary to consider the fact that an earthquake due to an active fault inland will precede this and if this is in the region of Kyoto or Nara, a major fire will likely ensue and precious historical artifacts and cultural assets will be burned down. In a southeast sea/south sea earthquake, a tsunami disaster from the Kii peninsula to the Shikoku island south coast as well as Osaka port is feared and the need for measures is being advocated but in a similar manner or even before this, a measure against a possible fire hazard burning down cultural assets is necessary.

Of the many national treasures, wood architecture are also designated as world heritage sites and if these are lost from a highly likely earthquake in the future there will be no excuse toward our ancestors or the world community. In the case, they would say that nowadays, Japanese only care about how rich their daily life is and look down on such matters.

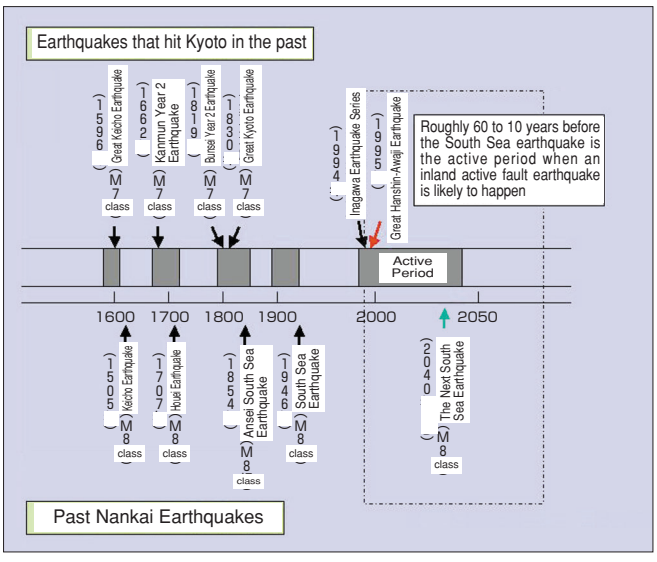

Figure-1: Kyoto's active fault

What We are Striving to Accomplish

Various types of measures can be considered for such activities but the most effective is to drape a water curtain around the structure to be protected. Fortunately for Kyoto, water diverted for Lake Biwa supplies a large volume of water to Keago on Sanjo way. Keage is on a perch so underground pipes can be laid to where the water is necessary and the water head difference can be used to spread a water curtain around the structure being protected to prevent the further spread of fires.

Using water will require such a large quantity so inflammable gas or a dense group of trees can be used instead of a curtain and when necessary, research indicates that water can be dropped from the trees for the same effect. There are many issues that need to be resolved for these matters. On the other hand, facilities for fire fighting and prevention need to be located compatibly with the natural and social conditions. For this reason, several points within the Kyoto hollow area are being selected for case studies. The first is the oldest wooden architecture designated as a national treasure in Kyoto, the Senbonshaka-do. The second is Nijo Castle. This site is squarely surrounded by a moat but this should be effectively used to establish appropriate response facilities. The third is the Kodaiji Temple area, designated as a traditional architecture prevention district and must be geared towards areas spread out and need a differentiated approach.

There are problems that need to be resolved before these are realized but what must especially kept in mind is that effective measures that are suitable to the current urban environment must be promoted. As part of these activities, in FY2001 the Ministry of Land, Infrastructure and Transport made a construction technology research grant for the "Research and Development of Environmental Fire Prevention Water Usage Facilities to Protect Wood Structure Urban Areas from Earthquake Fires." Such measures will require a great amount of money. To make these possible will ultimately require a political decision and will be implemented through government measures. For such matters to be understood, consensus needs to be built among residents and citizens and for this purpose the "Council to Protect Cultural Assets from Earthquake Fires" was established in 1997. KOMATSU Sakyo, a novelist, serves as the Chairman and SETOUCHI Jakuchou, also a novelist, and the former president of Kobe University, NIINO Koujirou, serve as vice chairmen and many other celebrities serve as committee members. At the same time, supporters from the general public are sought through the

"Society to Protect Cultural Assets from Earthquake Fires" established in 1999 and this serves as the parent organization for the "Society to Protect Cultural Assets from Fire Disasters" set up as an NPO in 2001. As a gathering of people that understand the importance of protecting cultural assets from earthquake disasters, similar minded people need to become more vocal to realize effective measures against the spread of fires starting with even small things and these activities are being continued to realize this.

Time has come to fulfill the Roles of Japanese Civil Engineering in Coping with Global Environment Issues

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The Japan Society of Civil Engineers (JSCE) started its full-fledged research into global environment issues in 1992, when the Global Environment Committee was established within JSCE. The year 1992 was a milestone of Global Environmental Issues, which was 20 years after the United Nations Conference on the Human Environment (UNCHE) in 1972and the year of the United Nations Conference on Environment and Development (UNCED) called as the Earth Summit. The new international movement against global environment issues had started taking its shape this year through adoption of the Framework Convention on Climate Change (UNFCCC), Agenda 21, and so forth.

Since then, JSCE, as an academic society, carried out active roles in raising awareness of global environmental issues through formulation of the JSCE Global Environment Action Plan in 1994, establishment of a new common session on "global environment issues" at its annual national meeting, introduction of "the JSCE environment award" in 1998, organizing a series of symposiums on the roles of civil engineering in coping with global warming, and active participation in the 2nd World Water Forum held in 2002. Meanwhile, various academic research activities are carried out under the regular committees of JSCE in the areas of climate change impacts analysis, global warming prevention and mitigation measures, environmental pollution control in developing countries, evaluation of environmental performance in civil engineering sector, and so forth.

As it is currently recognized, the efforts of international community can do nothing but delay global warming by 10 years albeit the Kyoto Protocol adopted by all relevant parties. Taking the single example of global warming, the friction between humankind and nature becomes even more alarming today. The role of civil engineering becomes ever more important in building the foundation of sustainable human society in harmony with the nature.

With the participation of China and other countries in the Kyoto Protocol, which was officially announced at Johannesburg Summit in August 2002, the foundation of collaboration against global warming is further strengthened among the developed and developing countries. The roles and responsibilities of developed countries are of great importance including Japan. Discussed here are some important views in fulfilling these roles and responsibilities. I strongly hope that JSCE and Japanese Civil Engineers will take active roles in the solution to global environment issues.

The 21st Century, as the century of Maximized Conflict between Humankind and the Environment

The world's population, which was about 1 billion in 1900, surpassed 2 billions in 1950, and reached 6.2 billions today. It is further estimated to reach 8 billion in 2025 and over 9 billion in 2050. Since 1950, we are now in the midst of a population explosion, where about a half of the current world population will be further increased in the coming 50 years.

The 20th century is the century of population explosion, as well as the century of the world of humankind. We found fossil fuels for energy resources and rapidly expanded our socio-economy by consuming them. Billions of peoples in the developed countries including Japan had been blessed with these energy resources while most of developing countries were left away from them. In the next 50 years, the world population will increase by more than three billions, mainly in the Asian and African countries. Approximately 8 billion peoples in the developing countries are going to expect the same socio-economic benefit as the developed countries obtained in the past century. In terms of the population in the developing countries, their impact upon the nature and the environment will further aggravate the conflict between the humankind and global environment.

Global Environmental Issues, that Cannot Be Solved within our generation, but will Go beyond the Generations of Our Children and Grandchildren

Global environment issues will bring about serious environmental crisis in the coming 50 years with the growth of world population and economy. Taking the example of serious environmental pollution in Japan, it was about 20 years

between 1960s and 1970s when environmental pollution and natural resources degradation became serious with the record high growth of economic development. The world after 50 years belongs not just to the next generation, but also to the current generation where many of peoples currently in their thirties or less will still live their lives. It means that global environment issues are those of current generation as most of the past regional environmental issues were.

On the other hand, response measures against global environment issues has to be taken immediately and can not be postponed as many of adult diseases like hypertension and arteriosclerosis (cerebral thrombosis, aneurism, heart infarction, etc.) are mostly caused by the peoples' dietary life and lifestyle in younger age and cannot be completely recovered by the symptomatic treatment. The near future of global environment will mostly depend on how the current peoples live their lives and carry out their economic activities and will not be able to change after the environmental crisis.

It is of great importance to correctly recognize the urgency of global environmental issues that need to be immediately addressed and require sustainable efforts. Furthermore, it has to be kept in mind that such efforts must be jointly made by all the peoples living in the earth including developed and developing countries and the global environment issues can not be managed individually especially without the participation of developing countries.

What is the Role of "Japanese Civil Engineering"

Currently, many of developing countries are trying to catch up with the economy of the developed countries for the purpose of realizing wealthy life like the developed countries represented by U.S., Japan, and other European countries. The history of economic development such as Japan and China showed that many countries experienced rapid growth of population and economy in the process of their national development. Japan had experienced high growth of population and economy in 1960s and 70s while China is currently in the middle of such growth. It is anticipated that many of developing countries will follow the same path within the next few decades.

Different from U.S. and other European countries, Japan carried out its economic development without colonization and immigration policies after the defeat in World War II. Japan's unique experience in rapid industrialization and urbanization and the policies taken for responding to the increasing demand of land, food, water, and energy with high growth of economy is expected to provide developing countries with good examples and lessons for their economic development.

Moreover, the unique characteristics of Japanese national land, which is blessed with rivers and mountains and surrounded on all sides by the ocean, stretching from north to south, creates a variety of contacts as well as conflicts between human and nature. Japanese civil engineering has been accumulating various unique technologies and know-how through the use, management, and control of nature that are also conducive to symbiosis between human and nature. The principal role of Japanese civil engineering is to make the most of the above unique experiences in coping with global environmental issues.

Recognizing the Importance of Civil Engineering in Building the Infrastructure of Socio-Economic Activities

Civil engineering played the leading role in building the infrastructure for record-making development of economy in Japan after the World War II up until 1980s. Most of the buildings and infrastructure currently available were designed and made by the first generation of post-war civil engineers in Japan.

Most of the major works of the civil engineers had been completed around 1990. The next 10 years were the decade of confusion for civil engineers and building contractors, when Japan's economy and past development were comprehensively reviewed. However, entering the second era of postwar national land and urban development now, we are facing a lot of new issues such as global environment, decrease and aging of population, and so forth. The role of civil engineering is still of great importance in improving and building the infrastructure for the second era of national land and urban development.

With the accelerated progress of science and technology, civil engineering technology will be required to integrate with many surrounding technologies so that it can cover wider technology areas including city planning. On the other hand, the experience of Japanese civil engineering in the era of high growth of population and economy needs to be comprehensively reviewed in terms of their positive as well as negative effects and to be utilized for the solution to the environmental issues in developing countries as well as to the global environmental issues. These are the major roles and potentials of Japanese civil engineering in realizing sustainable future of humankind.

Active Participation of Civil Engineers in Coping with Global Environment Issues

The impacts of climate change start to be found all over the world such as the flood in Eastern Europe and China glacial melting in Russia, and so forth. Under these conditions, the increase in populationfor the next decadewill mostly take place in the Asian regions. Accordingly, problems such as the scarcity of food and water resources, the destruction of nature caused by the urban, agricultural, and industrial developments, and the chain reaction of the environmental destruction caused by the degradation of ecosystem will also take place in the Asian regions. Moreover, it is anticipated that it will be the developing countries that will be mostly suffered from these crisis because of their economic and social vulnerability.

Finally, I strongly hope that Japan's civil engineering will contribute to the second generation of national land and urban development, which encompasses the leading roles in coping with global environmental issues at national level while it will be developed into an "internationally respected civil engineering" through contributions to the living and economic development of developing countries.