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of PWRI No. 3614

マイクロフィルム用資料

# **Japan-France Seminar on Materials and Advanced Technologies in Road Construction**

**November 1998**

**MATERIALS AND CONSTRUCTION DEPARTMENT  
PUBLIC WORKS RESEARCH INSTITUTE  
MINISTRY OF CONSTRUCTION**

**1, Aasahi, Tukuba-shi, Ibaraki-ken, 305-0804 Japan**

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Photo1 Participants in Opening Ceremony  
(in front of main building of PWRI)



Photo2 Both Directors-General  
with Newton's Apple Tree in PWRI



Photo3 Technical Tour in PWRI

## **Preface**

This report is the proceedings of France-Japan Seminar on Materials and Advanced Technologies in Road Construction, which was held from 4<sup>th</sup> till 6<sup>th</sup> November 1998, at the Public Works Research Institute (MOC). It is written by each session leader, K. KATAWAKI, A. INOKUMA, S. UEDA, T. MURAMATSU, T. OSHITA, T. IKEDA, H. MIKI, S. MEIARASHI, and H. KAWANO, and is compiled by Research Coordinator for Advanced Material Technology, A. INOKUMA.

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## **1. General**

### **1.1 Principles of Cooperation**

PWRI (Public Works Research Institute; Japan) and LCPC (Laboratoire Central des Ponts et Chaussées; France) has agreed to set up the following principles to promote technical cooperation between the two Institutes.

#### **1.1.1 Purpose of Cooperation**

- (1) Encourage, develop, and implement the exchange of new material technology and other technologies related to construction to share scientific and technological knowledge
- (2) Develop strong technical links of scientific and engineering researchers and encourage exchanges of guest researchers.
- (3) Develop joint research in areas of new material technology and other technologies related to construction and publish findings from joint research efforts.

#### **1.1.2 Cooperative Activities**

- (1) Exchange data and information between the two Institutes.
- (2) Exchange guest scientists and engineers between the institutes.
- (3) Conduct cooperative joint research of new material technology and other technologies related to construction.
- (4) Conduct periodical joint meetings alternating locations between France and Japan.

#### **1.1.3 Modifications**

This may be revised by the concurrence of the two Institutes.

November 5<sup>th</sup>, 1998

**Mr. Yasutake INOUE**

**Mr. Jacques ROUDIER**

**Director-General,  
Public Works Research Institute  
Japanese Ministry of Construction**

**Director-General  
Laboratoire Central des Ponts  
et Chaussées  
French Ministry of Equipment  
Logement, Transports and  
Tourisme**

**Asahi1, Tsukuba-shi Ibaraki-ken  
305-0804  
Japan**

**58 boulevard Lefebvre  
75732 Paris  
cedex 15**

**Tel: 81-298-64-2211**

**France**

**Tel: 33 1 40 43 5000**

## 1.2 Seminar Schedule

### Schedule on 4<sup>th</sup>, November.

- 9:00 Leave hotel for PWRI
- 9:30 Introduction of the LCPC delegates in Director General's Room
- 10:00 Opening Ceremony
- 10:30 Break
- 10:50 Key Note Speech Session
  - Presentation (French side, Mr. J. ROUDIER, Director-General)
  - Presentation (Japanese side, Mr. Y. INOUE, Director-General)
- 12:00 Photography
- 12:15 Lunch
- 13:30 Half day Technical tour in PWRI
  - Introduction of PWRI (Multi TV)
  - Test track
  - Intelligent transport systems and environmental test equipment
  - Earth structure laboratory
  - Structural engineering laboratory
  - Wind tunnel
  - Pavement test field
- 17:00 Leave PWRI
- 18:00 Reception hosted by PWRI

### Schedule on 5<sup>th</sup>, November.

- 9:00 Leave for PWRI
- 9:15 Sessions
  - 1<sup>st</sup> Session-Key Note Speech Session(continued)
  - 2<sup>nd</sup> Session-Pavement and Construction Equipment Session
  - 3<sup>rd</sup> Session-Soil Mechanics and Natural Disaster Session
  - 4<sup>th</sup> Session-Intelligent Highways Session
  - 5<sup>th</sup> Session-Bridge and Related MaterialsSession
- 16:15 Closing Ceremony
- 17:00 Leave PWRI
- 18:00 Cocktail hosted by LCPC

Schedule on 6<sup>th</sup>, November.

Technical tour was held in Trans-Kawasaki Route Construction Site (Multi-Micro Shield Tunnel), Aqua-Line (Trans-Tokyo Bay Highway), and Aqua-Line Office. Detail schedule is in '3. Technical Tour'.

### **1.3 Seminar Participants**

#### **Main Participants in Opening Ceremony and Session1**

##### **1.3.1 French side**

**Jean-Michel NATAF, Ph. D.**

**Ingénieur des Ponts et Chaussées**

**Attaché pour la Science et la Technologie**

**Ambassade de France**

**(All the following people are of LCPC)**

**Mr. ROUDIER Jacques**

**Ingénieur Général des Ponts et Chassées**

**General Director**

**Mr. PILOT Georges**

**Ingénieur en Chef des Ponts et Chaussées**

**Assistant Director International, Also in charge of planing and implementing of this seminar**

**Mr. CHAUSSIN Robert**

**Ingénieur en Chef des Ponts et Chaussées**

**Technical Director-Bridges-**

**Mr. CREMONA Christian**

**Ph. D in Civil Engineering**

**Senior Research Engineer**

**Mr. TEXIER Pierre-Yves**

**Electronic Engineer**

**Technical Director-Road Trafic and Operation**

**Mr. CAUSSIGNAC Jean-Marie**

**Ph D in Optical Science**

**Research Director**

Mr. CORTE Jean-Francois  
Ingénieur en Chef des Ponts et Chaussées  
Technical Director-Pavement

Mr. PEYRET Francois  
Mechanical Engineer  
Head of Site Robotics Subdivision

Mr. MAGNAN Jean-Pierre  
Ingénieur en Chef des Ponts et Chaussées  
Technical Director-Geotechnique

Mr. DURVILLE Jean-Louis  
Ingénieur en Chef des Ponts et Chaussées  
Head of division-Soil Mechanics and Engineering Geology

#### 1.3.2 Japanese side

Kennosuke KANOU  
Director, Construction Equipment Division,  
Economic Affairs Bureau,  
Ministry of Construction

Ken-ich FUJINO  
Director for Engineering Affairs,  
Engineering Affairs Management Division,  
Minister's Secretariat,  
Ministry of Construction

(All the following people are of PWRI)

Yasutake INOUE  
Director-General

Kouichi YAMAMOTO  
Deputy Director-General

Shigeo KAN-O

Assistant Director-General for Geosphere

Kunihiko TAKADA

Director, Planning and Research Administration Department

Makoto NAKAMURA

Director, Road Department

Kiyoshi KATAWAKI

Director, Materials and Construction Method Department

Akira INOKUMA

Research Coordinator for Advanced Materials Technology, Also in charge of planing and implementing of this seminar

Materials and Construction Method Department

Nobuyuki TUNEOKA

Head of International Cooperation Division,

Planning and Research Administration Department

Satoshi UEDA

Head of Intelligent Transport Systems Division,

Road Department

Takuya IKEDA

Head of Pavement Division,

Road Department

Toshimitu MURAMATSU

Head of Construction Equipment Division,

Materials and Construction Method Department

**Takeshi OSHITA**

**Head of Construction Engineering Division,  
Materials and Construction Method Department**

**Hiroshi MIKI**

**Head of Soil Mechanics Division,  
Materials and Construction Method Department**

**Seishi MEIARASHI**

**Head of Chemistry Division,  
Materials and Construction Method Department**

**Hiroataka KAWANO**

**Head of Concrete Division,  
Materials and Construction Method Department**

## 1.4 Seminar Memorandum

A French delegation from LCPC visited Japan and positively took part in the Seminar from November 4<sup>th</sup> till November 6<sup>th</sup>, 1998. LCPC and PWRI have summed up the activities of the cooperation status as the memorandum as follows.

### 1.4.1 Previous Cooperation

Following activities have been conducted since the first meeting which was held in France as France-Japan Workshop on the Advanced Materials and Construction Technology, in 1995.

- (1) Exchange data and information.
- (2) Exchange guest scientists and engineers in the field of automated equipment technology. From LCPC to PWRI, Mr. David Betaille came for the purpose of Robotics research in September 1997. From PWRI to LCPC, Mr. Ken-ichi Fujino went for the purpose of machinery research from November 1997 till January 1998.

### 1.4.2 Seminar Accomplishments

The LCPC-PWRI Seminar 1998, which has been carefully prepared, consists of keynote speech session and four technical sessions (Pavement and Construction Equipment, Soil Mechanics and Natural Disaster, Intelligent Highways, Bridge and Related Materials). All those sessions have proved fruitful thanks to the presentations and active discussions.

### 1.4.3 Cooperation Hereafter

As a follow up of this Seminar, the two Institutes intend to implement the following cooperation program, on condition that financial resources could be mobilized in due time.

- (1) Both sides agree that the next seminar will be held at LCPC in 2001. The Japan side would send delegates to this next seminar on the Japanese budget.
- (2) Exchange data and information.
- (3) Exchange guest scientists and engineers in the field of automated equipment technology.

November 5<sup>th</sup>, 1998

**Mr. Yasutake INOUE**

**Mr. Jacques ROUDIER**

**Director-General,**

**Director-General**

**Public Works Research Institute**

**Laboratoire Central des Ponts et Chaussées**

**Japanese Ministry of Construction**

**French Ministry of Equipment**

**Logement, Transports and Tourisme**

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## 2. Session

### 2.1 keynote Speech Session

#### 2.1.1 General

Keynote speech session was held in the morning of 4<sup>th</sup> November with the participants of about 20 Japanese members and all 10 French members. The Keynote speeches on research management were presented by the Directors-General of the two Institutes.

This session continued on 5<sup>th</sup> November. Two French members (Mr. Roudier, Mr. Pilot) and five Japanese members (Dr. Yamamoto, Dr. Katawaki, Mr. Takada, Mr. Sakai, and Dr. Inokuma) participated in it. Fruitful discussions were made not only on research management but also on institute statutes, on how to deal with international standards and on recycling technologies.

#### 2.1.2 Presentation

##### 1) Title: Research Management-1 ( ref. (1))

(1) Presenter: Mr. Jacques Roudier

(2) Date: November 5, 1998 10h50-11h20

##### 2) Title: Research Management-2 (ref. (2))

(1) Presenter: Mr. Yasutake INOUE

(2) Date: November 5, 1998 11h25-12h00

#### 2.1.3 Discussion

On November 4<sup>th</sup>, after keynote speeches several questions-and-answers were taken place, such as how LCPC was effected by the reform (The answer was that time had passed too little to judge merits and demerits of the reform) or how the members of the external evolution committee of PWRI were chosen (The answer was that they were chosen by PWRI). On November 5<sup>th</sup>, both institutes have shown their recent change about management system. PWRI explained recently settled Central Government Reform Law and LCPC showed their statute and recent reform (ref. (3)).

Then PWRI showed how to deal with making up or keeping in accordance with new international standards like ISO. LCPC showed their way of managing such things. Then PWRI showed that they began research activities on recycled materials from non-construction field which would be applied to public works. PWRI explained the potential environmental standard for the recycled slag from general waste ash.

#### 2.1.4 Conclusion

Participants confirmed that there were many common issues in research management in both institutes and continuous cooperation in this field was necessary hereafter. Also other subjects such as institute statute, how to deal with international standards and recycling were thought very important.

#### 2.1.5 References

##### (1) Management of Research by LCPC

##### 1) Mandates

LCPC is a Public Scientific and Technological Institute under authority of both Transport Ministry and Research Ministry.

It is in charge of fundamental and applied research, methodological studies and test development. LCPC's task is also to finalize research works by developing software packages and test and measurement devices.

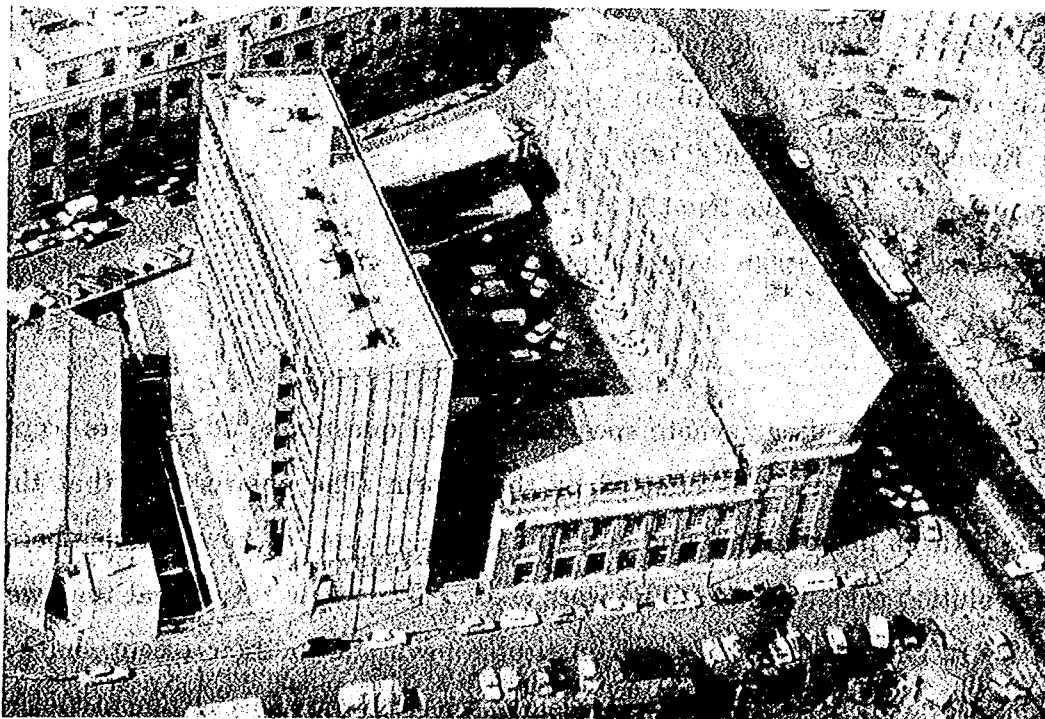


Fig. 1 Main Building of LCPC in Paris

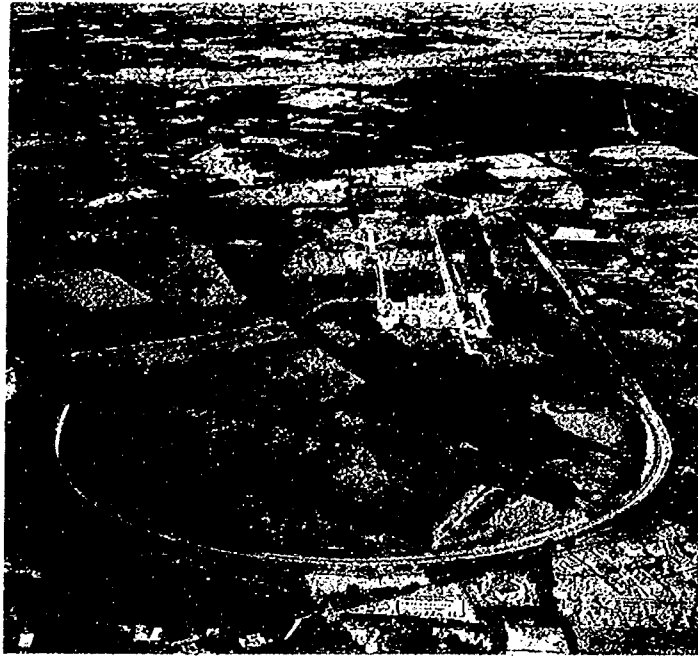


Fig. 2 Test Track of LCPC in Nantes

## 2) Fields of Activities and Staff

- ① Personnel present at October. 1<sup>st</sup>, 1998: 562 employees
- ② Fields of Activities and Staff Breakdown in Function of the Research Fields (Fig. 3)
  - Pavements: 81(9%)
  - Geotechnics: 71(7%)
  - Civil Engineering structures: 72(7.5%)
  - Environment and Urban Engineering: 32(3%)
  - Road Operating and Safety: 24(2.5%)
  - Engineering Sciences: 107(11%)
  - Total staff of technical units: 397(42%)
  - Direction: 25(3%)
  - Horizontal Services: 140(15%)

|        | Pavement | Geotech. | Eng. Struc. | Env.- Urban Engineer. | Road Oper. & Safety | Engineer. Sciences |
|--------|----------|----------|-------------|-----------------------|---------------------|--------------------|
| PARIS  |          | × ×      | × ×         |                       | × ×                 | × ×                |
| NANTES | × × ×    | × ×      | ×           | × × ×                 | ×                   | ×                  |
| MARNE  |          | ×        |             |                       | ×                   | ×                  |

Fig. 3 Distribution in function of the Research Fields

③ Staff distribution:

Senior research executives and research executives: 91(16%)

Engineers from the French State Engineering Colleges: 69(12%)

Other management staff: 63(11%)

Technicians and qualified technicians: 223(40%)

Administrative staff: 116(21%)

3) Breakdown of Activities (Fig. 4)

Studies and expertise 9%

Technical standards and regulations 3%

Research development and dissemination 17%

Research 71%

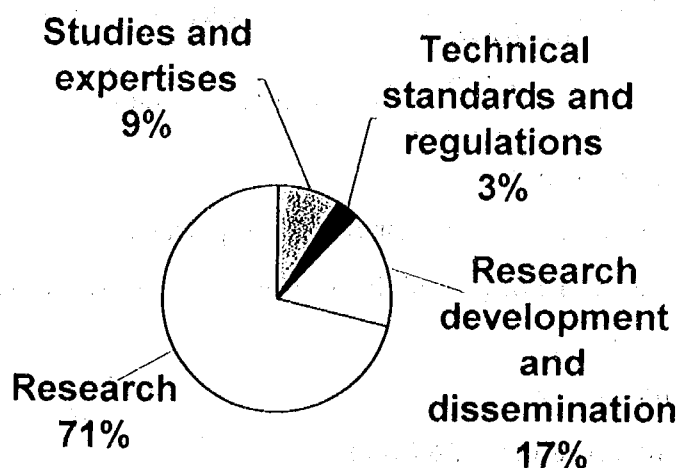


Fig. 4 Breakdown of Activities

4) Incomes and Expenses

① Income

research funding from Ministry of Research 82%

other resources 15%

other state funding 3%

Total=5.600.000.000Y

② Expenses

investment 7%

salaries 66%

functioning 27%

## 5) Research Valorization

### ① Patents (between 1996 and 1997)

Patent deposits in France: 40

Patent extensions in Europe: 155

Patent extensions in the rest of the world: 46

### ② Devices and softwares

The following devices are jointly developed and marketed by LCPC, the Public Works Engineering Network (Fig. 5) and favored private partners:

-Testing devices: 83 are registered in our catalogue, 47 are proposed for an external distribution.

-Software packages: 33 are registered in the LCPC catalogue, including CESAR / LCPC, a general finite element code specialized in civil engineering applications.

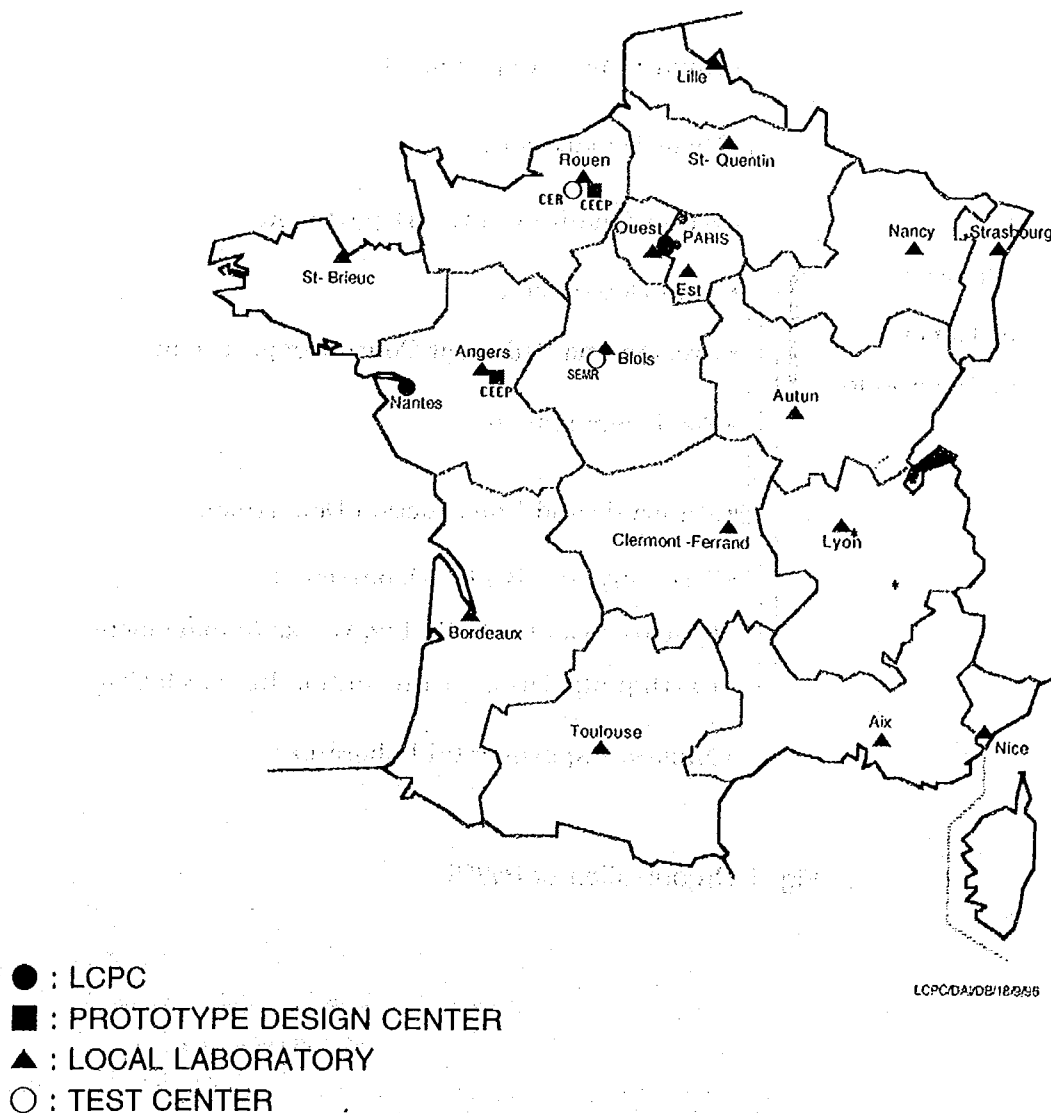


Fig. 5 Laboratory Net Work of LCPC

## (2) Management of Research by PWRI

### 1) Outline of the Public Works Research Institute

- ① Organization (Fig. 1), Budget (Figs. 2, 3), Personnel (Fig. 4)
- ② With the Central Ministry and Agency Reform Basic Law established in 1998, the Ministry of Construction is scheduled to merge with the current Ministry of Transport and other agencies to become the Ministry of National Land and Transport (Name is not official translation) within five years. Some of national institutes' functions are targeted to be transferred to independent administrative corporations similar to "agencies" in the U. K.

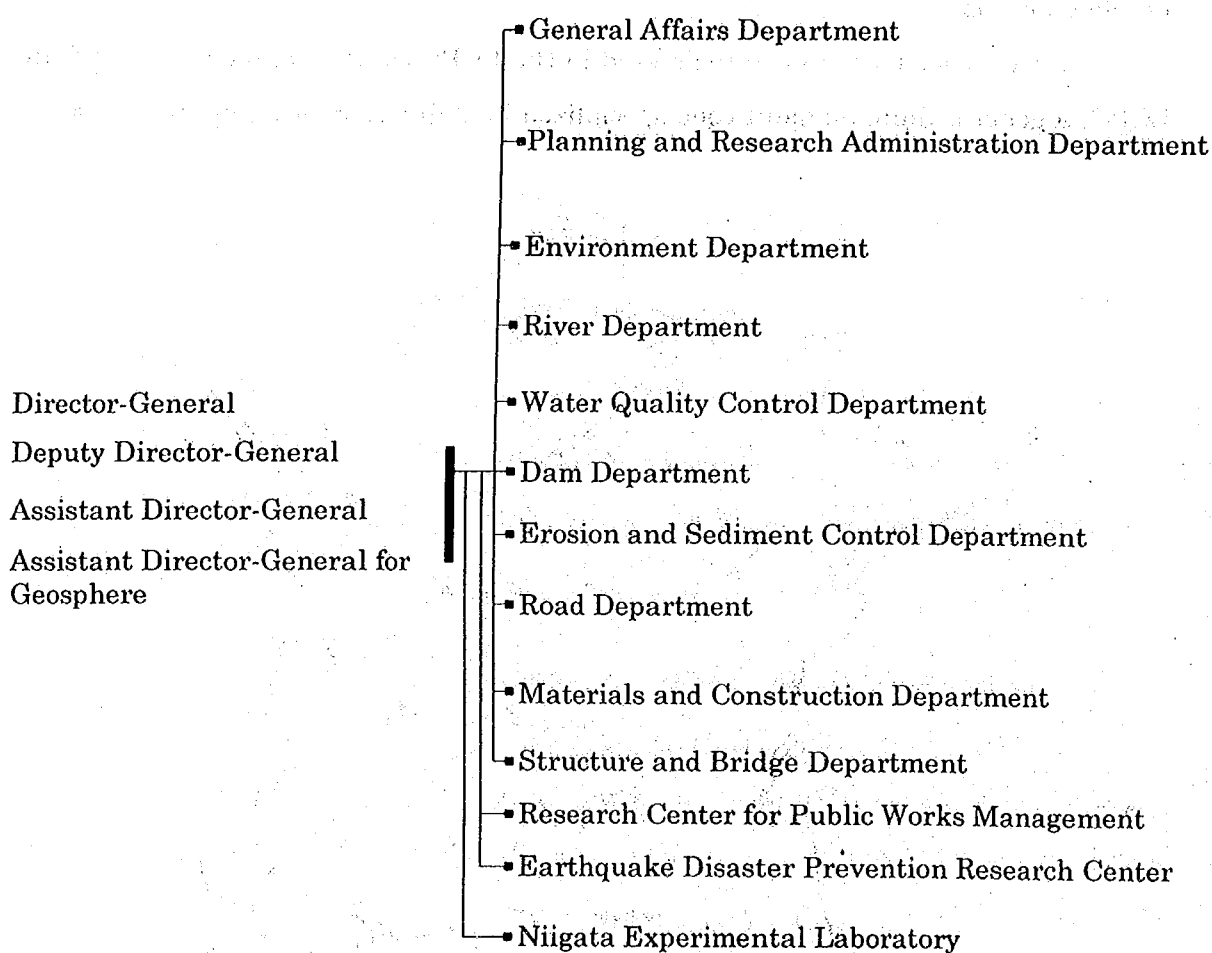


Fig. 1 Organization of PWRI

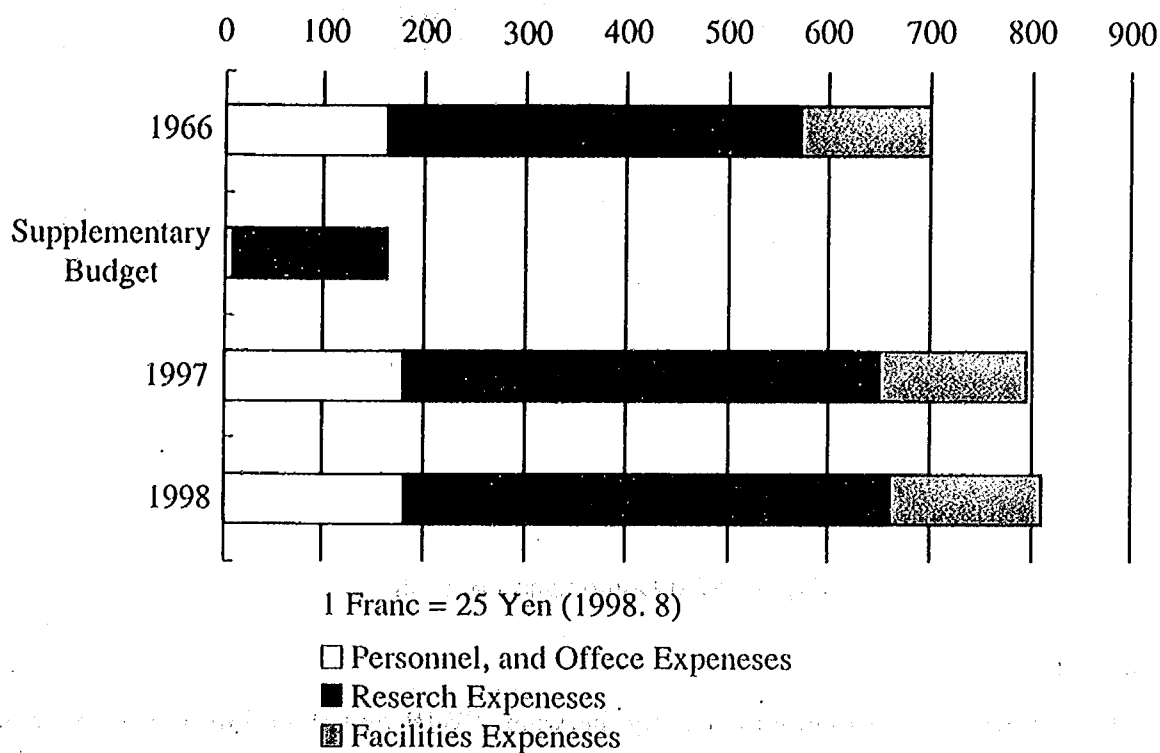


Fig. 2 PWRI Total Budget Distribution (Million Franc)

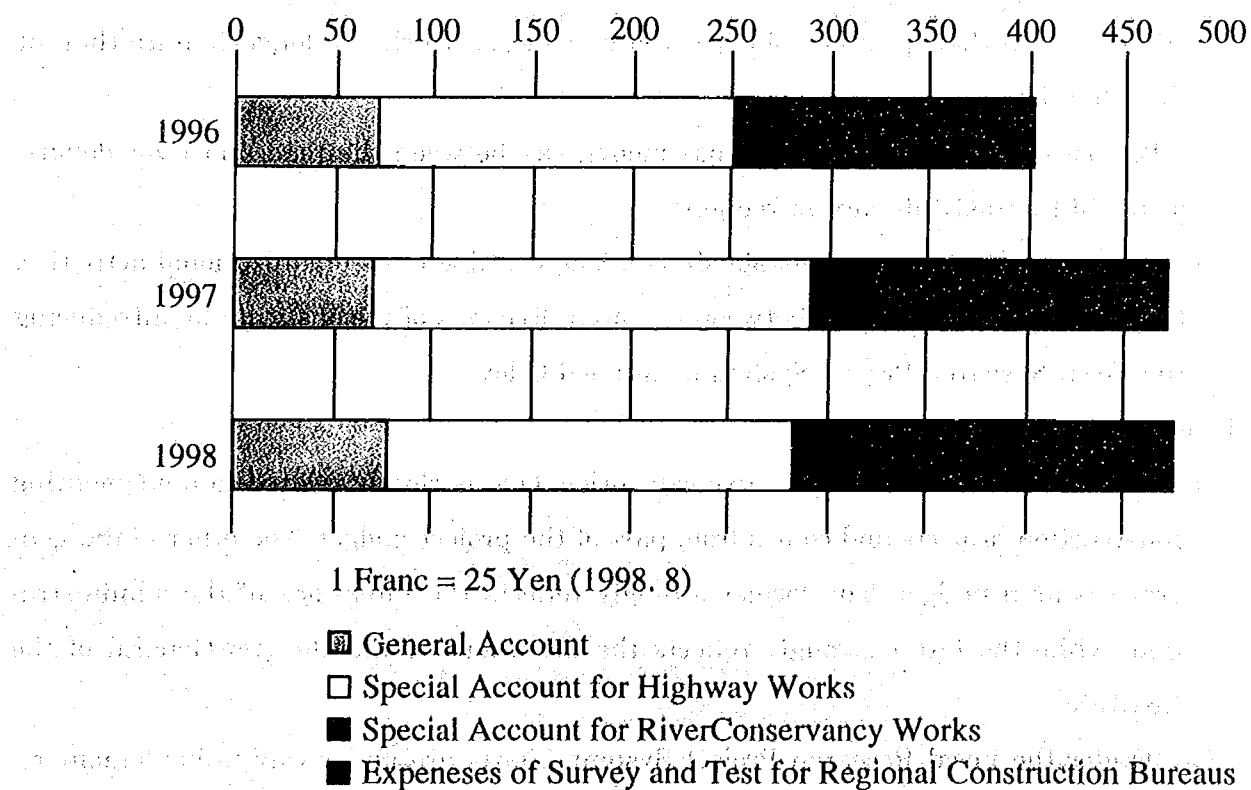


Fig. 3 PWRI Research Budget Distribution (Million Franc)

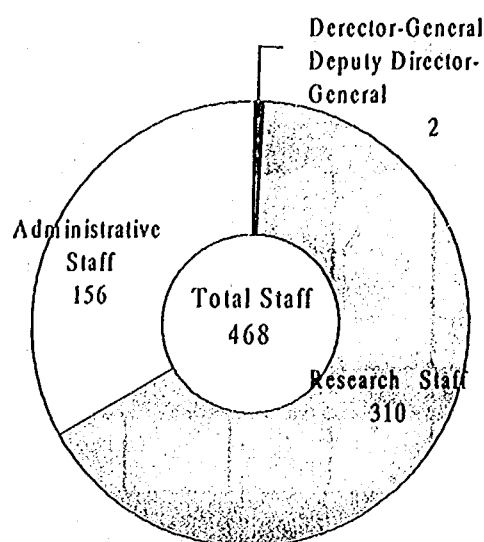


Fig. 4 PWRI Composition of Staff

## 2) Personnel

- ① There is frequent personnel exchange between PWRI and the administration. It is often the case that personnel recruited by PWRI as fresh person are transferred to the administration in about five years. Also, it is often the case that personnel from the administration are transferred to the Institute. Thus, the Institute and the administration maintain close personnel exchanges. Heads of PWRI research divisions often serve in their positions for five years or more, which is a longer tenure than at the administration.
- ② Personnel exchanges between departments, say between the road and river departments of the Institute, are infrequent.
- ③ Efforts are under way to establish as far as possible cross-organizational activities, transcending the boundary between research divisions of the Institute by introducing the Focal Research Project System mentioned below.

## 3) Budget

- ① The budget is classified into two categories. One is closely related to implementing construction projects and comes from part of the project budget. The other is the general research budget. The former strongly reflects the intentions of the administration, while the latter strongly reflects the intentions of the Director-General of the Institute.
- ② Under the Focal Research Project System, efforts are under way to implement reforms so that the Director-General of the Institute will become able to readily invest the suitable budget, including the category closely related to implementing construc-

tion projects, on research themes which meet current social needs.

- ③ The head of the research division is responsible for allocating the budget to his tasks and executing them in the division. He has a fair degree of freedom. However, the situation has recently been shifting to a stricter one where research projects come under the evaluation of external experts.

#### 4) Selection and Evaluation of Research Themes

- ① Selection and evaluation of research themes in the past

The Public Works Research Institute, as an Institute affiliated with the Ministry of Construction, is held solely responsible for resolving a range wide of technical issues relating to the planning, drafting and execution of the policies for public works that come under the jurisdiction of the Ministry of Construction. For this reason, the Institute tends to place the focus of research activities more on application and development than on basic research. The results of research activities are, therefore, put together not only as research papers, but also often as, technical criteria, or design and construction manuals.

Internal evaluation at the Institute has not been fully established in the form of a quantitative evaluation system, but has been qualitatively performed in accordance with criteria such as the level of contribution to the administration and, in addition, the numbers of manuals and other documents produced.

Themes were mainly selected through bottom-up type proposals presented by the head of each research division. However, reforms to make up for the drawbacks of this system are now in progress.

- ② Recent trends in Japan

Japan as a whole is trying to build a system to promote research of excellence at the international level, and established the Science and Technology Basic Law in 1995. The law is designed to secure the research budget and, at the same time, carry out strict evaluations. Based on this background, PWRI has started the Focal Research Project System and an external evaluation system.

- ③ Focal Research Project System

The Focal Research Project System (FRPS) is a type of research project in which multiple research themes are coordinated and designed to promote quick response to current social needs, to systematically classify multiple research themes which need to be addressed to, to allocate research themes to relevant research divisions and to solve problems in collaboration with external organizations. The FRPS is character-

ized by a shift from the conventional seeds-orientated approach to a needs-orientated approach, a structural shift from domain-oriented research to focusing more on inter-department research and intensive injection of research resources. The FRPS has been adopted on a trial basis since F. Y. 1998.

#### ④ External evaluation

External evaluation is designed to establish a system of evaluation that ensures a high level of transparency for the public. External academics make explicit evaluations of a focal project at three stages of pre, concurrent and post research period. PWRI discloses the results of such evaluations. External evaluation has been adopted on a trial basis since 1998.

#### 5) Future

Our current issues are to firmly establish the Focal Research Project System and external evaluation system, both of which are currently being adopted on a trial basis. Concurrently, we are also planning to implement and evaluate basic research themes from a seeds-oriented long-term perspective and will announce the results of the research publicly. We consider it important to ascertain what kind of civil engineering researches has been carried out in our society as a whole and, from an overall perspective, how society has used the results of these researches. Whatever results come from administrative reform, it remains important at all times to improve the productivity of research and development and to produce results of excellence. We will therefore take on the above mentioned challenges.

### (3) Recent Reform of LCPC

#### 1) Organization and Personnel

##### ① Two types of public agency

System of Public agency began after WWI. Basically there are two types of public agencies. One is Administrative public agency and the other is Commercial public agency.

##### a. Administrative public agency

This type includes most of research public agency. Some of them are called Etablissement Public Scientifique et Techniquis (EPST). Examples of EPST are,

EPST { =CNRS (National Science Research Centre)  
 =CEMAGREF  
 = INRA  
 = LCPC  
 = INSER

b. Commercial public agency=Etablissement Public Industriel et Commercial (EPIC). The Example is

EPIC=CSTB (BRI in Japan)

② Employees of Public Agency

a. Administrative public agency

People are public servant. Limitations of the employee number is set by the Ministry, temporary employee who are not civil servant are decided by the agency.

The average term of the temporary employment is from 6 months to 2-3 years.

b. Commercial public agency

People belong to private, that is, people are not public servant. Number of employee is decided by agency with permission of Ministry of Treasury. Substantially the number is limited by the budget fixed in the way shown in Fig. 1.

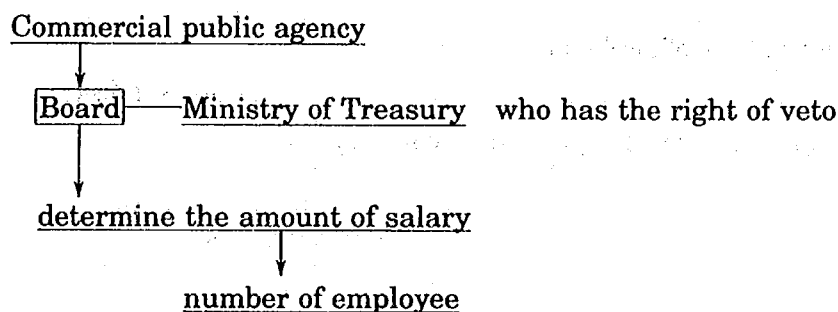


Fig. 1 Procedure of Budget Making in Commercial Agency.

③ Present state of LCPC

Concerning the statute of LCPC, basic law was set in 1982. Discussion on the statute has continued from then till present. In recent 2-3 years, ardent discussion was done and LCPC transformed from part of Ministry to administrative public agency in 1998.

④ Personnel

LCPC and Ministry do personnel exchange between administration and research. Minister nominates the Director-General of LCPC.

Concerning recruit of fresh person and retire, permanent employee are chosen by examination which takes place in May or June, after graduation. The exam includes presentation about what they have done in university or else. Jury makes list of candidates to be employed. Director General makes comments. Retirement age is about 60-65 years old.

⑤ Board

Board of LCPC consists of 7 persons from government, 7 persons from university or else nominated by government and 4 persons from employee.

⑥ Scientific Council

Check is done by Scientific Council. Part of members come from outside research organization.

Objective is not only to check the money LCPC used, but also to see how LCPC manages organization.

2) Budget and Accounting

① Frame of the budget of LCPC is shown in Fig. 2.

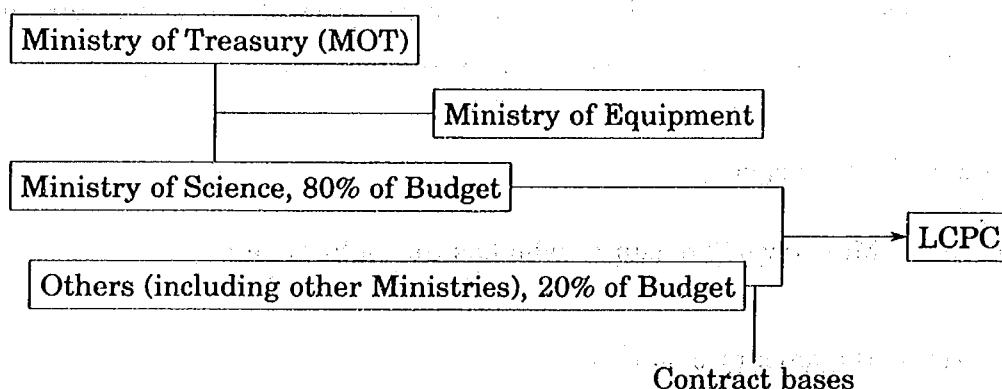


Fig. 2 Budget Origin of LCPC

② Budget System

Budget term of LCPC begins on 1<sup>st</sup> January and ends on 31<sup>st</sup> December. In July or August, plan is made by MOT.

Before LCPC transformation to agency, budget was executed by the name of Minister and was often changed or cut. After transformation, LCPC can execute budget more freely. In case that Ministry changes or cut budget, LCPC has to negotiate with Ministry because 80% of the budget comes from Ministry.

Table 1 Tax Imposition

|                 | administrative public agency | commercial public agency |
|-----------------|------------------------------|--------------------------|
| income tax      | ×                            | ×                        |
| property tax    | ×                            | ○                        |
| value added tax | ○                            | ○                        |

(○ means 'imposed')

### ③ Account

Agency has to make annual account and Balance Sheet. Budget residual is brought to next year account but in that case budget allocation from government may be reduced next year. No bankruptcy of agency has been reported until now.

### ④ Tax

Tax is imposed differently between the types of agency (Table 1)

### ⑤ Contracts

The examples of contracts LCPC made include pavement and pile measurement in Thailand and construction of bridge of Basco da Gama.

## 3) Other Country Conditions

### ① TRRL (Traffic Lab, UK)

It became non profitable foundation. Stockholders are companies or else. It was the good compromise between total privatization and remaining in government. TRRL became active to get contract after remake.

### ② Generally speaking, in Europe, research is not the target of privatization.

## 4) Joint Research or National Research Project

The procedure of project is described as follows. First agreement among the participating bodies has to be made up, then setting up management committee, and then the committee becomes self-continuing. Anyone can take initiative. For example LCPC initiates, negotiates and leads the project on centrifuge. The principle rules are 1. Consensus among participants and 2. what has been known should be known in common.

## 2.2 Pavement and Construction Equipment Session

### (Construction Equipment Sub Session)

#### 2.2.1 General

The first part of this session was for automation and equipments in the road construction and road maintenance. Dr. Francois Peyret, head of site robotics subdivision-LCPC, presented 1) SESSYL (test facility) and accuracy of GPS for machine guidance, 2) The CIRC project: the automatic guidance and quality control system for asphalt pavement, 3) The automatic re-painting machine.

In the response, Mr. Nitta, researcher of Construction Equipment Division presented 1) The automatic re-painting machine, 2) The application of the 3D machine control system to the earth work of road construction, 3) The application of CALS technology to construction and maintenance projects as a base of utilizing GPS and GIS for construction and maintenance works.

#### 2.2.2 Presentation

1) Title: Robotics in road construction and maintenance at LCPC and in Europe.

(1) Presenter: Dr. Francois Peyret.

(2) Date: November 5, 1998 9h30-10h15

2) Title: Activity for development of automatic construction machinery in Japan.

(1) Presenter: Mr. Yasushi Nitta

(2) Date: November 5, 1998 10h15-11h00

#### 2.2.3 Discussion

Dr. Peyret presented the historical background of development of construction robotics in both countries, then he mentioned about the French situations in 1998.

According to his presentation, there are strong motivations from end users, in the field of productivity, quality control, safety aspects and so on. LCPC believes RTK-GPS will become very popular on civil engineering job sites through the experience of SESSYL. Then the European CIRC project was presented that was funded by the European Commission to establish a numerical link between design, work and control (computer integration), and to develop accurate systems which assist operator to control path and speed of compaction at the real time using RTK-GPS. At last he presented the French project on the automatic re-painting machine.

On the other hands, Mr. Nitta presented the Japanese automatic repainting ma-

chine, and its mechanism and performance. Then, he presented the application study of 3 D-machine control by MOC in the construction site embankment. He presented a project on salt spreader as a pioneering example of using integrated database (GPS and GIS that linked to winter road information).

Dr. Corte asked how much progress in developing the integrated database. Mr. Muramatsu and Mr. Ohshita introduced there is only MICHII as a fundamental database of road facility. And He presented the necessity for linking MICHII and other related database which is organized by project of construction and maintenance from and for each process (plan, survey, design, construction, maintenance) based on common data format or platform.

Dr. Peyret asked about the mechanism of detecting the lane line in Japanese re-painting machine. Mr. Nitta explained that Japanese system is using 2-D image data from CCD camera.

Mr. Nitta asked whether the geometric data is handed from design process. Dr. Peyret responded that CIRCOM system indicate the machine speed, number of path, and positions. Dr. Peyret added to explain geometric data with compactor was coming from CAD data for construction.

Mr. Muramatsu mentioned that the re-engineerings in construction works will be inevitable in order to give full play to the ability of construction robot. Dr. Peyret agreed and supported.

#### 2.2.4 Conclusion

Both sides recognized the importance of common data (Integrated DB) in realizing automatic machine control and quality control.

Dr. Peyret and Mr. Muramatsu and all of the audience highly appreciated those information exchange shown above. And, both French and Japanese sides agreed to continue exchanging information for expected cooperation in the study of automatic construction work.

## 2.2 Pavement and Construction Equipment Session

### (Pavement Sub Session)

#### 2.2.1 General

The second part of the session 2 was for test on paving materials and utilization of non-road by-products for pavement. Dr. Jean-Francois Corte, Technical Director of Road Research Center, presented a paper on historical background of development of gyratory compactors. In response, Mr. Ikeda, Head of Pavement Division presented a paper on utilization of non-road by-products such as glass culled made from glass bottles and slag made from incinerator ash.

#### 2.2.2 Presentation

##### 1) Title: The Gyratory Shear Compactor. Its Use in France and Perspective

(1) Presenter: Dr. Jean-Francois Corte

(2) Date: November 5, 1998 11h10-11h30 (5th November)

##### 2) Title: Recycling of Non-Road By-Products in Japan

(1) Presenter: Mr. Takuya Ikeda

(2) Time: 11:30-11:50 (5th November)

#### 2.2.3 Discussion

Major points of Dr. Corte's presentation were:

Evaluation of asphalt mix for thick lift pavement

Relationship between gyratory and actual tire roller compaction

Evaluation of workability of asphalt mix using gyrator compactors

Comparison of French and SHRP specifications

Mr. Ikeda raised some questions on the presentation. The first question was whether gyratory compactors could properly simulate workability of asphalt mix that was laid in 8 to 15cm thick. Dr. Corte responded that gyratory compactor is good equipment to simulate real compaction at construction sites. The second question was about availability of gyratory compactor for road contractors. Dr. Corte responded that large construction companies have their own gyratory compactors to test asphalt mix by themselves. In case of small companies, they bring the materials to regional technical centers owned by the government or laboratories owned by large construction companies. The technical centers and private laboratories both charge testing fee for the test.

Dr. Corte asked about pollution by the slag made from incinerator ash. Mr. Ikeda re-

sponded that incinerator ash contained heavy metals such as lead and mercury. In order to remove the harmful ingredients, incinerator ash should be melted at high temperature 1,100 degree Celsius or over. The Dr. Corte asked the cost for the processing. Mr. Ikeda responded that cost for landfill under strict environmental control is more expensive than processing the ash using electric power and other resources.

#### 2.2.4 Conclusion

Both sides agreed that information provided by Dr. Corte and Mr. Ikeda was interesting and stimulating, since the subjects were concern of each side. Dr. Corte and Mr. Ikeda highly appreciated direct information exchange

## 2.2 Pavement and Construction Equipment Session

### (Modified Asphalt and Cold Asphalt Emulsion Sub Session)

#### 2.2.1 General

The third part of the session 2 was on modified asphalt and cold asphalt emulsion.

(1) Date: November 5, 1998 13h15-16h05

(2) Place: Meeting room #526 at PWRI, Tsukuba

(3) Participants: France side: Dr. J. F. Peryret, Dr. J. F. Corte, Japan side, Dr. Meiarashi, Dr. Muramatsu, Mr. Ikeda, Mr. Nitta

Observers

13 Peoples

#### 2.2.2 Presentation and Discussion

##### (1) Modified Asphalt

##### 1) Presentation

##### ① Presentation by Dr. Corte (LCPC)

Topics are as follows.

-Investigation of present status of modified asphalt in the world (result of questionnaire)

-Present status of modified binders in France; quantities, characterization.

-There is no standard in France, but "Avis techniques" is a published issue on modified asphalt.

-Explanation of Avis techniques.

-Anhydrous binder, MICROFLEX binder.

##### ② Presentation by Mr. Imai (JMAA)

Topics are as follows.

-Current status of polymer modified bitumen

(Types of modified binder, consumption, characterization and technical issues)

##### ③ Presentation by Dr. Meiarashi (PWRI)

Topics are as follows.

-Current activity on modified asphalt in Chemistry division

-Chemical modification of asphalt

-Measurement of NMR

##### 2) Discussion

On the basis of the presentations, discussion was made actively on the following items.

-If the specification of modified asphalt in the presentation of Mr. Imai is a state (na-

tional) standard or not.

- Test method of low temperature performance
- Average polymer content
- Modification property of polyethylene
- Premix type is the majority of modified asphalt in France
- Selection of resin
- More information of Avis techniques
- Number of producer of modified asphalt in France (about 12)

## (2) Cold Asphalt Emulsion

### 1) Presentation

#### ① Presentation by Dr. Corte (LCPC)

Topics are as follows.

- Consumption of Emulsion
- Application of emulsion in France
- Avis Techniques
- NEOFLEX binder

#### ② Presentation by Mr. Mizuguchi (JEAA)

Topics are as follows.

- Introduction of JEAA
- Bitumen Emulsion Plant in Japan (location and quantities)
- In-situ recycling of base course
- Micro-surfacing
- Cold mixtures

#### ③ Presentation by Dr. Meiarashi (PWRI)

Topics are as follows.

- Current activity on cold pavement
- Energy consumption of construction materials
- Carbondioxide emission of construction materials

#### ④ Presentation by Dr. Corte (LCPC)

Topics are as follows.

- The use of Micro-surfacing in France
- ECF
- Field of application of ECF (mainly in urban areas)
- Main use of ECF, composition and mix-design

-Effect of glass fiber on the cone flow

-Limit of use ECF

## 2) Discussion

On the basis of the presentations, discussion was made actively on the following items.

-Application of emulsion (is it limited for light traffic?)

-Violet pendulum test (for emulsion)

-Standard and problem of micro-surfacing

### 2.2.3 Conclusion

Both sides agreed that information provided from both France side and Japan side was interesting, stimulating, since since the subjects were concern of each side. Dr. Corte and Dr. Meiarashi highly appreciated direct information exchange.

## 2.3 Soil Mechanics and Natural Disaster Session

### 2.3.1 General

(1) Date: November 5, 1998 9h00-12h00, 13h30-16h00

(2) Place: 617 meeting room, PWRI

(3) Participants: Dr. Jean-Pierre MAGNAN (Technical Director of geotechnics research center, LCPC), Mr. Jean-Louis DURVILLE (Head of Soil Mechanics and Engineering Geology Division, LCPC), Dr. Hiroshi MIKI (Head of Soil Mechanics Division, PWRI), Dr. Ryosuke TSUNAKI (Head of Landslide Division, PWRI), Mr. Keiichi MONMA (Head of Slope Failure Division, PWRI), Mr. Hidetoshi KOHASHI (Senior Researcher of Soil Mechanics Division, PWRI), Mr. Joji NAKANO (Senior Researcher of Soil Mechanics Division, PWRI), Mr. Atsuki FUJII (Researcher of Soil Mechanics Division, PWRI), Mr. Mitsuhiro FURUTA (Researcher of Soil Mechanics Division, PWRI), Mr. Kazushi FURUMOTO (Researcher of Soil Mechanics Division, PWRI), Dr. Gyaneswor Pokharel (Research Fellow, Soil Mechanics Division, PWRI)

(4) Schedule:

9:00 Introduction

9:15 Landslides, rockfalls and rockslides①

(Presentation of French side)

10:45 Coffee break

11:15 Landslides, rockfalls and rockslides②

(Presentation of Japanese side)

12:00 Lunch

13:30 Discussion on landslides, rockfalls and rockslides

14:15 Soft soils

(Presentation of French side and Discussion)

14:45 Coffee break

15:00 New research programs of LCPC

15:30 New research programs of PWRI

### 2.3.2 Presentation

(1) LCPC presentation: Landslides, rockfalls and rockslides

(by Jean-Louis DURVILLE)

Mr. DURVILLE presented the state and the countermeasures of landslides, rockfalls and rockslides in France, mainly in following items.

-Hazard evaluation, mapping, zoning, regulations and recommendations ("P.P.R." program)

-Monitoring of unstable slopes (Technical recommendations, Decision to set up a monitoring system, Relation between the monitoring methods and the available time delay, Examples at "Séchilienne" and "Mont Cornet")

-Stabilizing and protective works (Stabilization by nailing, Passive protection)

-Taking account earthquakes (PSEUDO-static method)

(2) PRWI presentation: Landslides, rockfalls and rockslides

(by Hiroshi MIKI, Hidetoshi KOHASHI, Ryosuke TSUNAKI, Keiichi MONMA, PWRI)

Dr. MIKI presented some typical examples of disasters and countermeasures in Japan. Then, Mr. KOHASHI presented the present status and problems of road disaster management, and introduced "Overall Evaluation of Disaster Prevention Inspection".

Dr. TSUNAKI introduced the survey and observations of behavior of the Tani-nouchi landslides in Kochi Pref. as an example of a large-scale landslide area. Then, Mr. MONMA introduced an example of a field experiment on the Shirasu slope collapse by captured acoustic emission.

(3) LCPC presentation: Soft soils (by Jean-Pierre MAGNAN)

Dr. MAGNAN presented the use of numerical models for the description of the behavior of embankments and tunnels in soft soils. A new program called LIM1 (3-dimensional FEM) was introduced.

(4) LCPC presentation: New research programs of LCPC

(by Jean-Pierre MAGNAN)

Dr. MAGNAN presented new research programs of LCPC in following fields.

-Aggregates and quarries

-Road earthworks

-Geology and site investigation methods

-Soil and rock mechanics and foundation engineering

-Ground environment preservation technology

(5) PWRI presentation: New research programs of PWRI

(by Hiroshi MIKI)

Dr. MIKI presented following new research programs of PWRI:

-Risk management methods and evaluation of the stability of levees and roads

slopes

- Development of construction technologies which help to preserve the ground environment

- Soft ground improvement methods

### 2.3.3 Discussion

#### (1) Landslides, rockfalls and rockslides

Concerning the presentation about the state and the countermeasures of landslides, rockfalls and rockslides in France by Mr. DURVILLE, Japanese participants asked some detail points on the French "P.P.R. (Plan de Prévention des Risques)" program which includes hazard mapping, zoning, regulations and recommendations. The "P.P.R." program was appreciated because of its very logical and systematic structure.

Concerning the "Overall Evaluation of Disaster Prevention Inspection", French side indicated the problems of manpower in order to continue the daily inspection. Japanese side explained the organization of ministry of construction and the existence of local road management offices, and both sides recognized the importance of maintenance of disaster prevention programs.

Then, the roles of the central government and local government on disaster-risk management in two countries are discussed, and it was proved that the responsibility of executioners of countermeasures works is comparatively important on disaster-risk management in France.

#### (2) Soft soils countermeasures

After the presentation about a new program called LIMI (3-dimensional FEM) by Dr. MAGNAN, there was especially no questions from Japanese participants. But it is interesting that LIMI has been successfully tested on various types of geotechnical structures.

Excavation accompanied by the removal of load, as well as the load on soft ground, are dealt.

#### (3) New research programs

Concerning the new research programs, there was not enough time to discuss, but most of the research items are in our common interest.

#### 2.3.4 Conclusion

Two French members, Dr. MAGNAN and Mr. DURVILLE, and 9 Japanese members participated the session, and we had very active and significant discussion and exchange of information.

Through the presentations and discussion in the field of landslides, rockfalls and rockslides, the mutual understanding of the present situation, the countermeasures and the research activities in each country was achieved. And we could deepen the knowledge of risk management system and related administration in both countries. Japanese participants were deeply impressed by French logical approach and methodology in this field.

The participants recognized the necessity of research and development on risk management that correspond to the geological conditions and the administrative situations of each countries, and also agreed further mutual exchange of information and research cooperation.

Through the presentation and discussion in the field of soft soil, the mutual understanding of the present situation and the research activities in each country was achieved.

Furthermore, "Memorandum of understanding concerning the joint study project of soft ground improvement" was come to an agreement through this session.

#### 2.3.5 References

##### (1) Documents from French side

- Étude par photo-interprétation des phénomènes d'effondrement liés à la dissolution du gypse

- Essais de cisaillement en vraie grandeur d'une discontinuité renforcée par une barre passive

- Stabilisation des glissements de terrain / guide technique, 1998

- Surveillance des pentes instables / guide technique, 1994

- Copies of OHP sheet about presentation

- Creep of soft soils under embankments and shallow foundations

- Behaviour and modeling of rigid, semi-rigid and flexible piles under horizontal loading

- Analyse tridimensionnelle du poinçonnement de fondations superficielles en tête de talus par calcul cinématique régularisé en éléments finis

-Main research and related activities (period 1997-1999 partial list)

-General Activity Report for 1997

(2) Documents from Japanese side

-Present Status and Problem of Road Disaster Management in Japan, New Technologies of Road Disaster Management

-Example of a Survey and Observations of Behavior of a Large Scale Landslide Area

-Field Experiment on the Shirasu Slope Collapse by Captured Acoustic Emission

-Application of Thermal Infrared Remote-sensing to Shotcreted slopes

-Development of Ground Environment Preservation Technology In Construction

-Investigation of Prediction of Collapses in Bed Rock Slopes

## 2.4 Intelligent Highway Session

### 2.4.1 General

The status of studies in both countries was introduced for four themes of ITS such as SMART roads, road condition measuring technologies, etc., followed by exchange of views on the themes.

#### (1) Program

|         |        |                                                                                                    |
|---------|--------|----------------------------------------------------------------------------------------------------|
| Theme 1 | France | What is a SMART road ?                                                                             |
|         | Japan  | Japan's ITS and the Smartway                                                                       |
| Theme 2 | France | Methods for monitoring of foul weather (prevention of freezing, rain, and frost)                   |
|         | Japan  | Current status of road weather information management                                              |
| Theme 3 | France | New technologies for SMART (optical fiber sensors, road condition grasping technologies)           |
|         | Japan  | AHS principal user services and a priority system                                                  |
| Theme 4 | France | Road condition measuring technologies (road surface temperature, road unevenness, crack detection) |
|         | Japan  | Development of a road condition grasping system (AHSRA)                                            |

#### 2) Participants

France: Pierre-Yves TEXIER (Directeur de Recherche / Directeur Technique, Exploitation et Securite Routieres), Jean-Marie CAUSSIGNAC (Service Metrologie et Instrumentation)

Japan [Public Works Research Institute]: Nakamura, Director of Road Dept, Ueda, Head of ITS Research Div, Mitsuhashi, Head of Traffic Safety Research Div, Urano, Chief Researcher, Tanaka, Chief Researcher, Hirasawa, Research staff, Murata, Research staff

[AHSRA] Isogai, Managing Director, Kasuga, General Manager, Kitano, Sugiyama

### 2.4.2 Presentation and Discussion

#### (1) Theme 1

1) Title: What is a SMART road ? , Presenter: Pierre-Yoxier Texier

Mr. Texier explained the structure of ITS researches at LCPC (Civil Engineering Research Institute of France). LCPC defined ITS for roads by classifying the same into three subsystems of "Intelligent Infrastructure" involving road structure, paving, foundation and ground, "Intelligent Mobile" involving drivers, vehicles and HMI, and "Intelli-

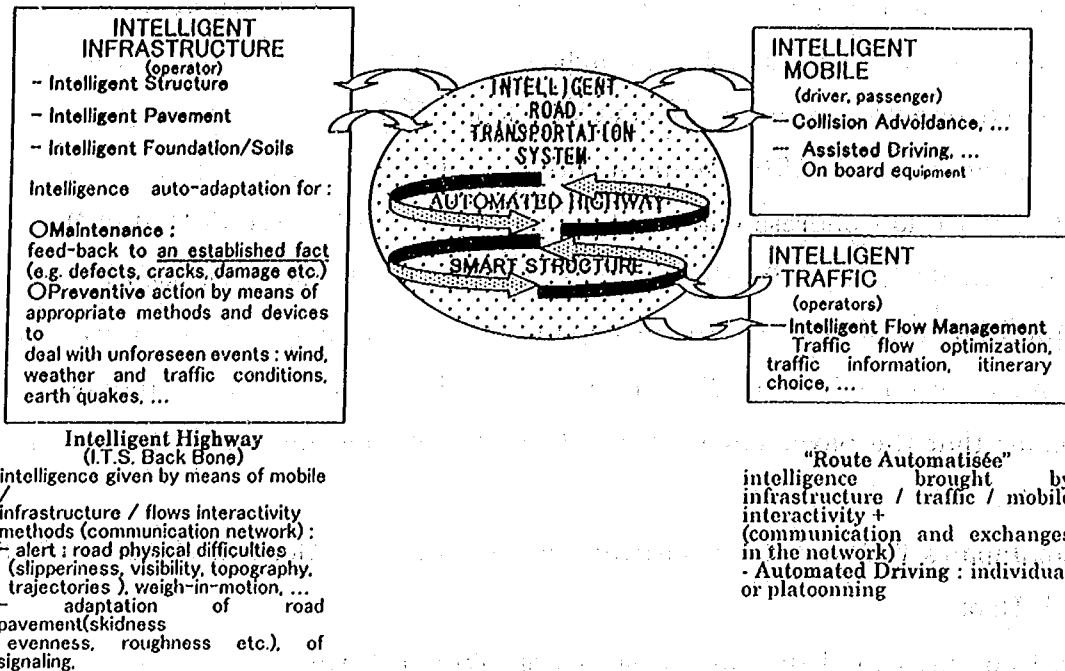
gent Traffic" involving the flow of traffic. It has been underlined that the French ITS state of the art was not complete but represented the LCPC approach in order to consider infrastructure as an ITS subsystem. Emphasis was put on the fact that this approach was research oriented as no significant development has been carried yet neither in Europe, in Japan, nor in USA. Mention was made of the French project as presented in International World Congress held in SEOUL in October 1998 (see OTS SEOUL Proceedings paper called "Scenario for the Route Automatic : The French Approach").

A first comparison between the two approaches shows that PWRI is in favour of combining under the same heading ITS and AHS. For the LCPC, the "route intelligente" concept applies that the pavement itself has to be legible and interactive to be call" Route Intelligente.

2) Tittle: Japan's ITS and the Smartway, Presenter: Ueda, General Manager of ITS Research Dept

Mr. Ueda presented the current status of ITS which was moving toward realization and its multi-applications were getting commercialized in the market, and stressed the importance of integration of ITS and research of ITS platforms based on the interoperability. In addition, he reported that a project "Smartway 2001" had been established in order to develop ITS strategically, and that international cooperation was vital for realization of the Smartway.

## INTELLIGENT ROAD TRANSPORTATION SYSTEM



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Fig. of Theme 1 France: What is a SMART road ?

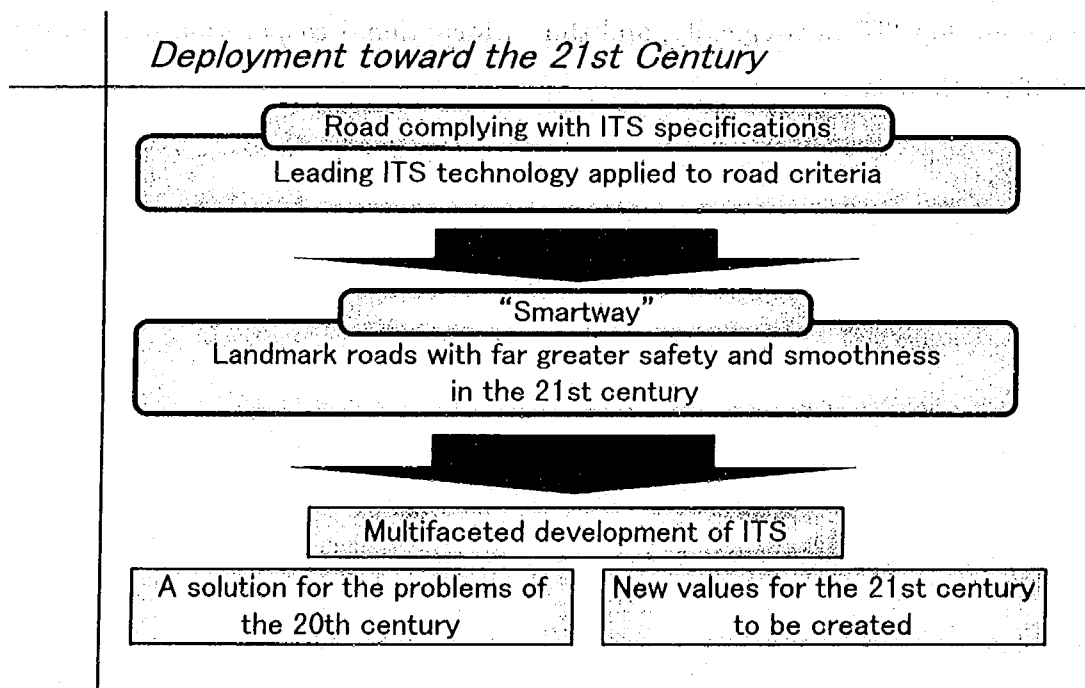


Fig. of Theme 1 Japan: Japan's ITS and the Smartway

### (2) Theme 2

1) Tittle: Methods for monitoring of foul weather, Presenter: Pierre-Yexier Texier

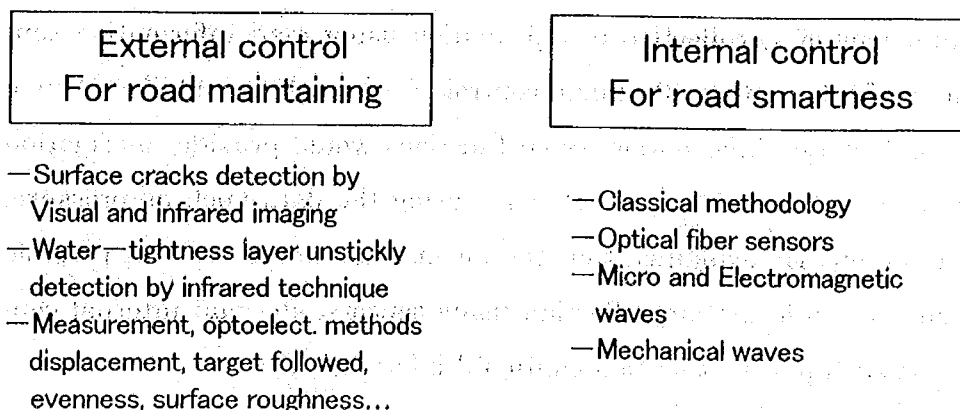
Mr. Texier reported that LCPC collected information of all kinds of weather and in-

formation on roughness of the road surface, and conducted researches on the means to predict the road conditions. He stated that in France the Ministry of Transportation and the Meteorological Agency were working together on researches of weather covering, among others, rain and snow and of the influence of water remaining on the road surface, and such information could be made available.

He added that in France there was a complex problem of water penetrating through to the underneath of road surface to form a film of water which would then freeze there.

2) Title: Current status of road weather information management, Presenter: Mitsuhashi, General Manager, Traffic Safety Research Dept

Mr. Mitsuhashi explained the current status of road weather information management in Japan. Japan endures very severe natural conditions for road management due to heavy snowfall in winter, a number of typhoons hitting the country, falling of rocks easily triggered by rain as Japan is geologically young. Various kinds of weather information are collected in Japan by sensor technologies and TV cameras, etc. in order to overcome such hardships for management of roads. The information so obtained is utilized for road management including snow clearing, etc. or made available to road users through "Road Stations" and the radio. He stated that the optical fiber was used as the medium to convey such information and that information transmission technologies for transmission of various weather informations were essential for road management.



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Fig. of Theme 2 France: Methods for monitoring of foul weather

**Natural conditions in Japan are more severe  
than in many other industrialized nations**

|                                                                                                                                                                                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Geological Feature</b> <ul style="list-style-type: none"><li>• The entire nation is quite young.</li><li>• The mountain ranges are still in the prime of life and the nation has not yet completed the erosion process.<ul style="list-style-type: none"><li>→ The land is extremely vulnerable to disaster.</li></ul></li></ul> |
| <b>Weather Feature</b> <ul style="list-style-type: none"><li>• Locate in the monsoon zone</li><li>• Frequently be the target of typhoons.<ul style="list-style-type: none"><li>→ Heavy Rainfall</li></ul></li><li>• About 60% of land area is snowy and cold.</li></ul>                                                             |

Fig. of Theme 2 Japan: Current status of road weather information management

**(3) Theme 3**

**1) Title: New technologies for SMART, Presenter: Jean-Marie Caussignac**

Mr. Caussignac reported on SMART roads. SMART roads are those which are equipped with four functions of 1) collection of information using road information sensors, etc., 2) multiplicity of information, 3) remote control of information and 4) real time supply of meaningful and related information. Such functions would provide information by judging the characteristics, conditions, etc. of roads using the data such as pressure, temperature, deformation, etc. He explained that the means that would make it possible comprised external control of information collection using sensors, etc. and internal control which would convert such information to meaningful information.

**2) Title : Dept AHS basic user services and a priority system, Presenter : Murata, Research staff of ITS Research**

Mr. Murata explained the progress of AHS research and development focussing on basic user services and a priority system, and further explained determination of priority themes, settlement of targets, implementation of preliminary evaluation from a viewpoint of collection and analysis of needs based on an idea that linking together of seeds and needs was essential for successful research and development.

In the first place, he established 19 basic user services related to the safety, efficiency and environment based on social needs, and extracted 6 priority services related mainly to safety where the effect of reduction of accidents by AHS was considered high based on the data of accidents. He stated that further work would be carried out for development of necessary component technologies with the focus placed on experimental evaluation, all in order to make the select basic user services available in the future.

Mr. Texier explained the roles the road was expected to perform, and suggested that the road administrators should provide meaningful information in the form of sensuous means such as visions, sound, vibration, etc. to drivers, and that LCPC should aim at researches of reference trajectories as the basics therefor, or, in other words, it should determine the characteristics and conditions of the road surface from the collected information. Also, he stated that the study of responsibility of the road administrators in an age of improvement of roads and the study of balance of efficiency, safety and economy of the system were necessary.

### Answers to Give

- Which information, how are they generated, acquired, transmitted by ? :
  - the driver,
  - the "aid" devices,
  - the infrastructure
- Which balance in terms of ?
  - efficiency (in which way),
  - safety,
  - economy.
- Which responsibility for which actors ?

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Fig. of Theme 3 France: New technologies for SMART

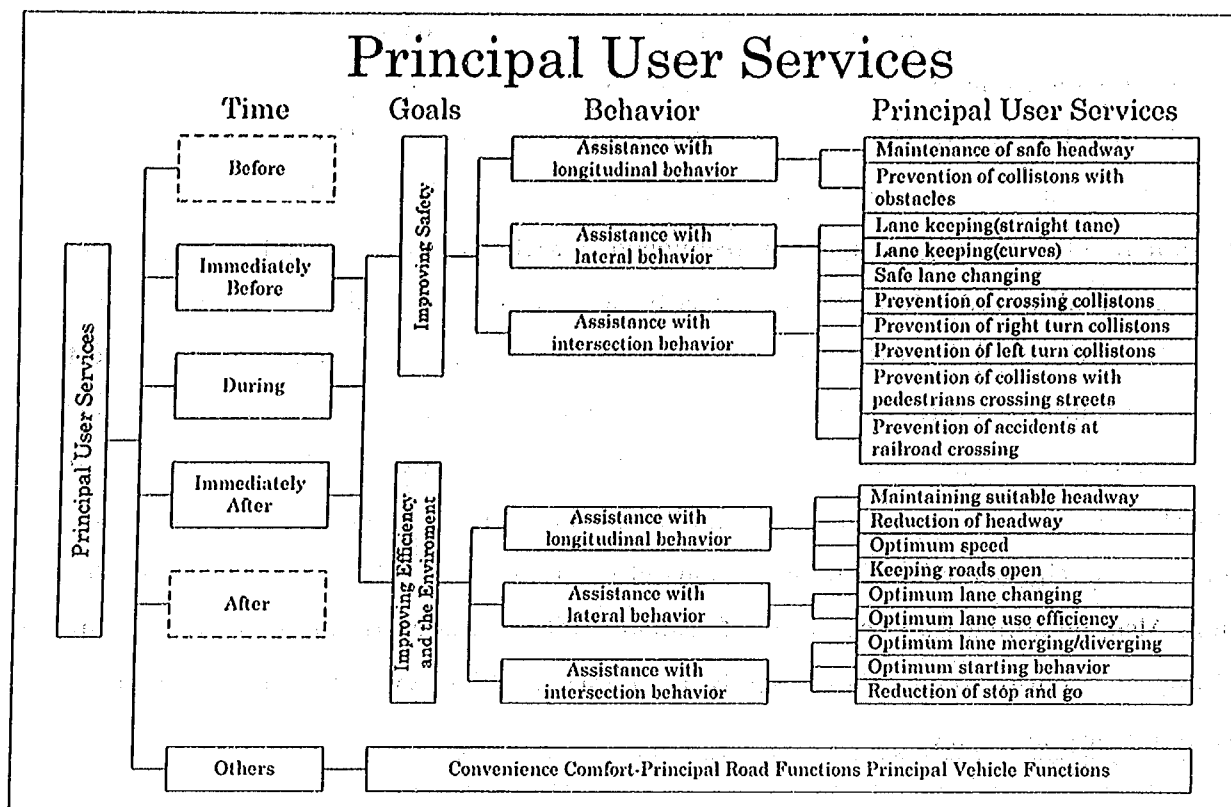


Fig. of Theme 3 Japan: AHS principal user services and a priority system

#### (4) Theme 4

1) Title : Road condition measuring technologies, Presenter : Jean-Marie Caussignac

Mr. Caussignac reported that three methods for grasping road conditions / road characteristics were currently under examination at LCPC, namely 1) an image analysis method using CCD cameras, 2) an analytical method using diffusion of light, and 3) an analytical method using a micro-profilometry (a method for measuring profiles), and that the unevenness of road surface, cracks and other defects (malfunction or lack) could be grasped by these methods.

2) Title : Development of a road condition grasping system, Presenter: AHSRA Kitano

Mr. Kitano explained a road condition grasping system. Objectives of the road condition grasping system of AHS included supply of road information required by drivers and supply of information on the friction coefficient of the road surface necessary for control of cruising vehicles. The system serving for this purpose would comprise road sensors installed on the roadside, multiple supplementary sensors to be installed between the road sensors for the purpose of supplementing the road sensors and the road patrolling sensors equipped in road patrolling vehicles. A wide-area estimation of road conditions became possible by integration of the data obtained from those sensors. He presented the

result of experiments on grasping of road conditions respectively by a laser radar, a millimeter wave diffusion meter and an infrared camera as the road sensors, an optical fiber sensor, a wet sensor and an infrared sensor as the supplementary sensors, and an infrared sensor as the road patrolling sensor, and made it clear that the road friction coefficient could be estimated with approximately 0.1 accuracy by detecting nine conditions comprising dryness, wetness, two conditions of water filming, three conditions of snow-fall, two conditions of freezing.

Mr. Pierre stated that the road condition grasping systems were being studied in both France and Japan in similar ways and that the same could be made a subject of joint study or interchange of study in the future.

## Conclusion

Equipment for road smarthness

- Tools for helping managers to decide for roads and bridges maintaining
- Means for helping users to drive and improve safety

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Fig. of Theme 4 France: Road condition measuring technologies

## 15.CONCLUSION

- The feasibility of the newly road condition monitoring system has been made clear, which is essential to AHS.
- Experimental results of each sensors have been obtained and it makes clear that each sensor can be used as a key sensor for the road surface conditions monitoring.
- More sensor performance test is planned under actual road surface conditions.

Fig. of Theme 4 Japan: Development of a road condition grasping system

### 2.4.3 Conclusion

- 1) As the key element of structure of ITS, integration of intelligent infrastructure, intelligent mobiles and intelligent traffic (management) is essential, and that will lead to creation of a concept of new road infrastructure (the Smartway) for the 21st century.
- 2) Views were exchanged on the role of infrastructure on the Smartway, particularly that of the intelligent monitoring system and road administrator's mission.
- 3) Both parties exchanged views to the effect that for successful ITS, studies of not only the applications but also the common platforms were important, and such studies should be utilized in the process of creation of new concepts such as the Smartway.
- 4) Both parties shared a view in common that those new concepts and ITS technologies should contribute greatly to the safety and efficiency of road traffic and to global environmental problems.
- 5) As future cooperation in studies in this field, both parties agreed to proceed with exchange of information on ITS concepts, ITS research and development and ITS implementation. Further, it was agreed that the communication channel between LCPC and PWRI should be between Mr. Texier and Mr. Ueda.

## 2.5 Bridges and Related Materials Session

### 2.5.1 General

1) Date: 5th November 1998,

2) Place: 610 meeting room, PWRI

3) Participants: French side: Mr. R. Chaussin and Dr. C. Cremona

Japanese side: Mr. H. Kawano, Mr. H. Watanabe, Mr. Y. Tanaka and Mr. M. Suzuki from Concrete Division, Mr. T. Mabuchi and Mr. K. Ohgi from Structure Division, Mr. A. Hiromatsu, Mr. M. Sugaya, Mr. K. Ono and Mr. S. Kawama from Bridge Division

### 2.5.2 Presentation

09.40-09.50: Introduction of the participants

09.50-10.00: Introduction of the Bridge Department, LCPC, by Mr. Chaussin

Mr. Chaussin was the director of the Bridge Department in LCPC and has recently changed to the bridge inspection division of the Ministry of Public Works which covers the inspection of bridges in northwest area of France, almost a quarter area of France.

The Bridge Department, LCPC has three sections; concrete, steel, durability of structures. The research themes are on Materials, Durability, and Structural Behavior, Bridge Management. The theme on Durability consists of fatigue, corrosion due to chloride, alkali-aggregates reaction, carbonation, and execution. Structural Behavior includes wind resistance design. The department is also involved in standardization, technical approval, special investigation (case study). (Dr. Rossi succeeded Dr. Acher as a head of concrete section.)

10.00-10.45: LCPC presentation. Dr. Cremona: Bridge Aerodynamics

Dr. Cremona is in charge of research on wind resistance design and structure, and he started the research on this theme three years ago. He takes mainly theoretical and numerical approach for aerodynamics. He presented the outline of his research and case studies on Vasco da Gama bridge and Normandy bridge.

11.15-11.55: PWRI presentation Mr. Mabuchi: Japanese wind resistant design of road bridges.

Mr. Mabuchi is in charge of development of "Expert System on Aerodynamic Design" by which bridge engineers can judge easily whether they need further examination or not for wind effects on a particular bridge.

13.30-14.00-LCPC presentation: Mr. Chaussin: French experience in prestressed concrete  
Mr. Chaussin presented the state of prestressed concrete and its technology in France in

following items:

- The product of PC tendons
- Methods of quality control including CIP (intnl. commission on prestressing)
- Approval method of tendons.
- Technical certification, execution and qualifying by PTSC (post-tensioning specialist company)
- The role of LCPC on construction of PC structures

He also introduced the quality control method of grouting for PC tendon ducts as well as related problems.

14.50-16.20: Theme 2-Bridge Maintenance

14.50-15.40: PWRI presentation Mr. Kawano: Concept on minimum maintenance of road bridges.

The concrete division and the bridge division of PWRI are going to start the research on "Minimum Maintenance (MM) of concrete bridges". Mr. Kawano showed the statistic data of road bridges in Japan and explained the importance of maintenance of bridges. In order to achieve the minimum maintenance they are going to try comprehensive technical approaches.

15.40-16.20: Dr. Cremona: Probabilistic assessment and maintenance of bridges.

Dr. Cremona firstly explained the concept of Limit States Design Method, Probabilistic Design Method and Reliability Design Methods. And he showed the advantages when introducing the Probabilistic assessment into maintenance of Bridges, with showing a calculation methods and case studies.

### 2.5.3 Discussion

Followings are main Q&As and discussions in the bridge and related materials session;

Q: What kind of standards is LCPC involved with?

A: Domestic and European standards.

Q: How many years do French engineers estimate for life span of bridges?

A: 100 years or so on are assumed. No clear standard except statistical analysis for loading.

Q: For numerical aerodynamic analysis, is Vortex theory better than Naville-Stokes theory?

A: It seems that Vortex theory can be easier to implement and to use. The problem lies in the introduction of turbulence. A lot of work has to be done on both approaches.

C: "Expert System on Aerodynamic Design" of PWRI is not an expert system in a narrow sense.

PWRI and LCPC take different approach to aerodynamic design of bridges. PWRI takes experimental method and LCPC theoretical. So they can supplement each other through information exchange.

Q: Are there any trial to improve grouting materials for the PC tendons in France ?

A: They started to use chemical agents, for example, high range water reducing agents or viscosity increasing agents.

Q: Are there many PC structures using outer cables in France ?

A: More than 100 bridges. Newly constructed bridges as well as rehabilitation for existing bridges.

Q: Are outer PC tendons grouted in France ?

A: Pre-coated tendons were used before but rarely today. Grouting for outer tendons is common.

New pre-coated tendons come to be used recently.

Q: Concerning to improving the durability, what is "insensitivity to quality of in-situ works ?"

A: Quality of some materials or members much depends on workmanship in-situ. So we have to develop materials or members of which quality does not depends on quality of execution. For example, high flowable concrete which requires no compacting procedure.

Q: What is the deterioration of slab decks of bridges in Japan ?

A: (Photos of examples were shown) Reasons for the deteriorations were shown as well.

C: There are no cases like the Japanese examples in France.

Q: What are the thickness and the concrete strength of the cracked slab decks ? Effect of increasing thickness ?

A: Thickness of slab decks used to be 18cm for 2 to 3 meter span and compressive strength of concrete is 24 to 27 MPa. It is effective to increase thickness so that it is 20 cm or more today.

Q: Are there serious fatigue problems in Japan ?

A: Many crackings were found, for example in welded parts, but those do not lead failure of structures yet.

Q: In the case study of probabilistic assessment for maintenance of bridges, judge of failure of welded part is based on the stress concentration. If so, cracking must occur in

the direction at the right angle of the principal stress ?

A: Failure in limited area is examined here and this analysis is enough.

Q: In the calculation of life span cost, is it possible to estimate the cost for the case where the structure is destroyed ?

A: It is very difficult to estimate the cost from influences other than failure of structure itself.

Q: Probabilistic approach can be applied to practical design near future ?

A: Yes. For example, it is efficient to apply it to time-dependent problems.

#### 2.5.4 Conclusion

Two members from France, Mr. Chaussin and Dr. Cremona, and 10 members from Japan participated the session. We had a very active discussion so that the session continued to over the scheduled time.

In the morning session, two presentations, one each from two countries, were made on Aerodynamic Design of bridges. Both institute are going to develop more sophisticated Aerodynamic design method and research contents are related each other. But the approaching methods of both sides seem to be different. French side has more experience on numerical analysis, and Japanese side has more data from wind tunnel experiments. It is, therefore, useful to collaborate each other in this field.

In the afternoon session, both sides made presentations related maintenance of bridges. Both countries are facing the problem of maintenance of road bridges. From Japanese side, research on Minimum Maintenance of road bridges was introduced. And from French side a trial for probabilistics assessment for maintenance on road bridges was shown. And also French experience on Prestressed Concrete was introduced with a very thrilling video.

As the conclusion of the session, we agree to continue to exchange research information in those fields.

#### 2.5.5 References

Documents submitted from Japanese side

- Development of Expert System for Wind Resistant Design of Highway Bridges / Hiroshi Sato, Toshiaki Mabuchi
- A Concept of Minimum-Maintenance Bridges / Kazuhiro Nishikawa

Documents submitted from French side

- Evaluation of Existing Steel and Composite Bridges / Christian Cremona / IABSE Workshop Lausanne 1997
- The possibilistic reliability theory: theoretical aspects and applications / C. Cremona, Y. Gao
- Probability-based assessment and maintenance of welded joints damaged by fatigue / C. Cremona, M. Lukic
- Model order testing in discrete time domain identification methods / C. Cremona, J. Brandon
- On recursive forms of damped complex exponential methods / C. Cremona
- Simplified approach for assessing bridge buffeting response with aeroelastic interaction / C. Cremona, A. Solares
- Lifetime management and evaluation of plant, structures and components / J. Edwards, etc.,
- Reliability updating of welded joints damaged by fatigue / C. Cremona
- Applications of Statistics and Probability-Civil Engineering Reliability and Risk Analysis / M. Lemaire, J. Favre, A. Mebarki
- LCPC Brochure on "Acoustic monitoring system"
- Brochure of the structures laboratory in LCPC
- 1997 report on general activities of LCPC
- External Prestressing / SETRA
- Catalog / "lpc equipment"
- Catalog / "logiciels lpc"
- Catalog / LCPC publishing

### 3. Technical Tour

#### 3.1 General

Technical Tour was held following.

##### (1) Participants

LCPC French Delegates and Japanese staffs which Dr. INOKUMA leads.

##### (2) Schedule

Nov. 6th (Fri.)

8:50 Departure from Kenshū-kaikan to Yokohama

am Inspection in the Metropolitan Area

Tokyo Port Area

Yokohama Port Area

12:00 Arrive at Daikoku S. A. (Yokohama), Lunch

12:50 Departure from Daikoku S.A.

13:30 Arrive at Trans-Kawasaki Route

Inspection of Multi-Micro Shield Tunnel

14:30 Departure from Trans-Kawasaki Route

15:00 Arrive at Aqua-Line (Trans-Tokyo Bay Highway)

Inspection of Aqua-Line Office

move by bus

Inspection of Umihotaru S. A.

16:30 Departure from Umihotaru S. A.

17:00 Arrive at Shinagawa Prince Hotel

### 3.2 Outline of visiting field

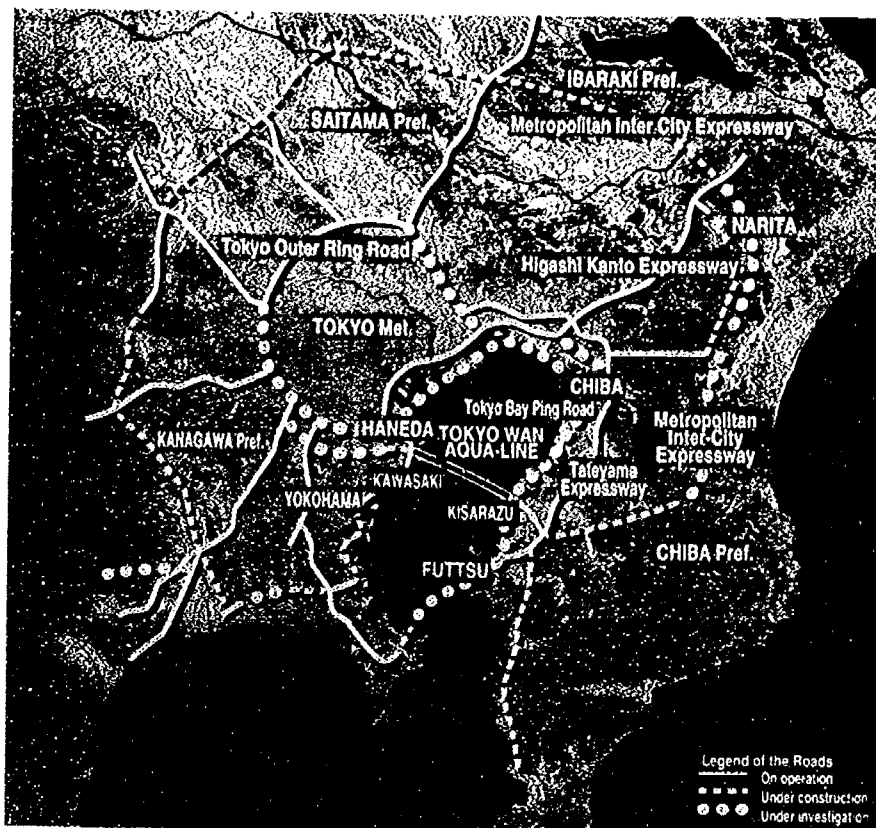


Fig. 1 Location of visiting fields

#### (1) Multi-Micro Shield Tunnel (Trans-Kawasaki Route, Fig. 1)

Restrictions including neighboring buildings and road alignment may make ordinary methods without cut-and-cover, such as shield method and NATM, inapplicable. Metropolitan Expressway Public Corporation in Tokyo has established a Research and Study Group Concerning Practical Application of the MMST Method to the Trans-Kawasaki Route.

The MMST (Multi-Micro Shield Tunneling) method is a large-section tunneling method. Tunnel outer skin portions are excavated in advance by means of multiple small-section shields, followed by connection of excavated portions to make up external structures (Fig. 2, Fig. 3). Soil from inside the skin structure is then removed. Conventionally, large-section rectangular tunnels have been constructed according to the cut-and-over method. The MMST method, on the other hand, enables construction of similar large-section rectangular tunnels without cut-and-cover, a singular advantage in projects requiring urban tunneling.

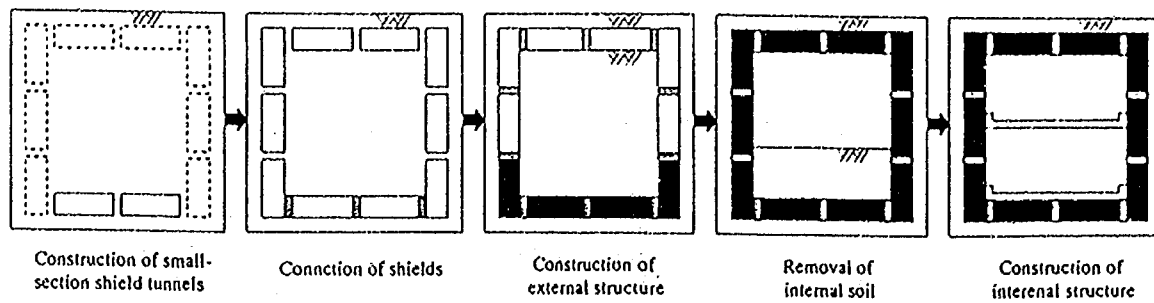


Fig. 2 Construction procedure according to the MMST method

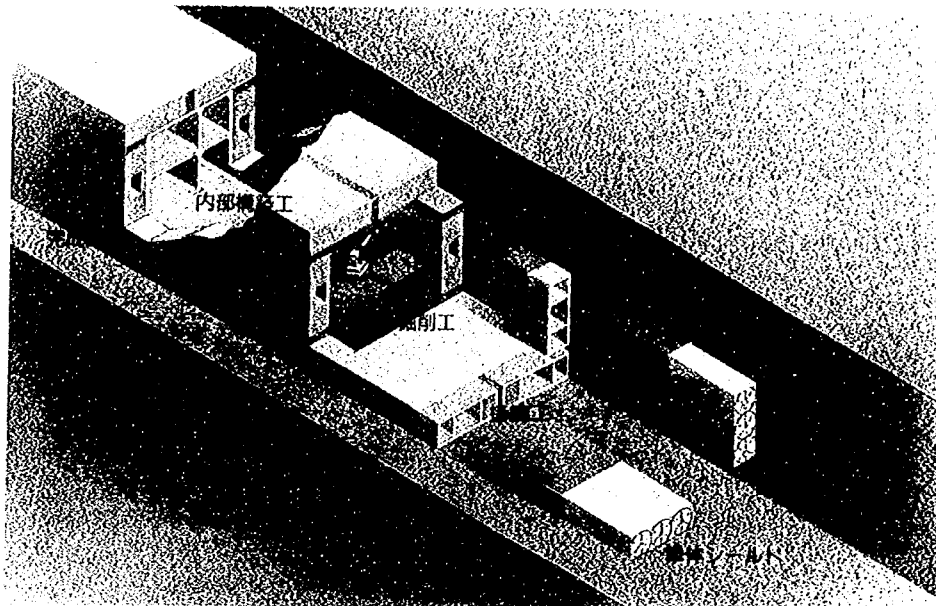


Fig. 3 Outline of MMST method

## (2) Tokyo Wan Aqua-line (Fig. 1)

Tokyo Wan Aqua-line is a 15km toll highway that runs across the central portion of Tokyo Bay from east to west in connecting Kawasaki and Kisarazu. Along the coast line is located the Tokyo megalopolis consisting of Tokyo, Yokohama, Kawasaki, Chiba, Kisarazu and other cities.

To smoothly accommodate the yearly increasing traffic load in greater Tokyo, completion of the highway network of three-belt highways and nine-radial highways in the area is urgently needed.

Tokyo Wan Aqua-line has greatly shortened the driving distance and time between the densely populated Keihin area and the Boso area. It is expected that exchanges between the two areas will prevail.

The characteristics of Tokyo Wan Aqua-line are the about 9.5km undersea tunnel from Kawasaki and the 4.4 kilometer bridge. In the middle of the tunnel, there is a venti-

lation tower Kazenotou (Towers of wind). The connection island between the bridge and the tunnel is a rest area called Umihotaru (Marine Firefly). Furthermore, at Kawasaki tunnel entrance, there is a pyramid shape ventilation building namely Ukishima Access. The toll gates are situated on the Kisarazu side.

The tunnel was built under AA class "Road tunnel emergency facilities design standard" (April 1981, official notice from the Ministry of Construction and Fire department). The space under the road platform is used for emergency evacuation and is built for emergency escape and fire rescue. The evacuation system is constantly under review to ensure all safety facilities are in best conditions.

Umihotaru parking area is built on a man-made island which connects the tunnel section and the bridge section. The island has a total length of 650 meters and a total width of 100 meters.

In order to ameliorate traffic congestion in toll gates, ETC is a cashless and convenient way to collect toll, and is designed to save management expenses. Toll gates at Kisarazu, Tokyo Aqua-line, have started using the new ETC system after the inception.

### 3.3 References

- Japan Highway Public Corporation: TOKYO WAN AQUA-LINE
- Shinichi Egawa, Shuji Tokumura, Akira Saito, Mitsunori Hirai: Study on Practical Application of the MMST Method
- Metropolitan Expressway Public Corporation: MMST Method

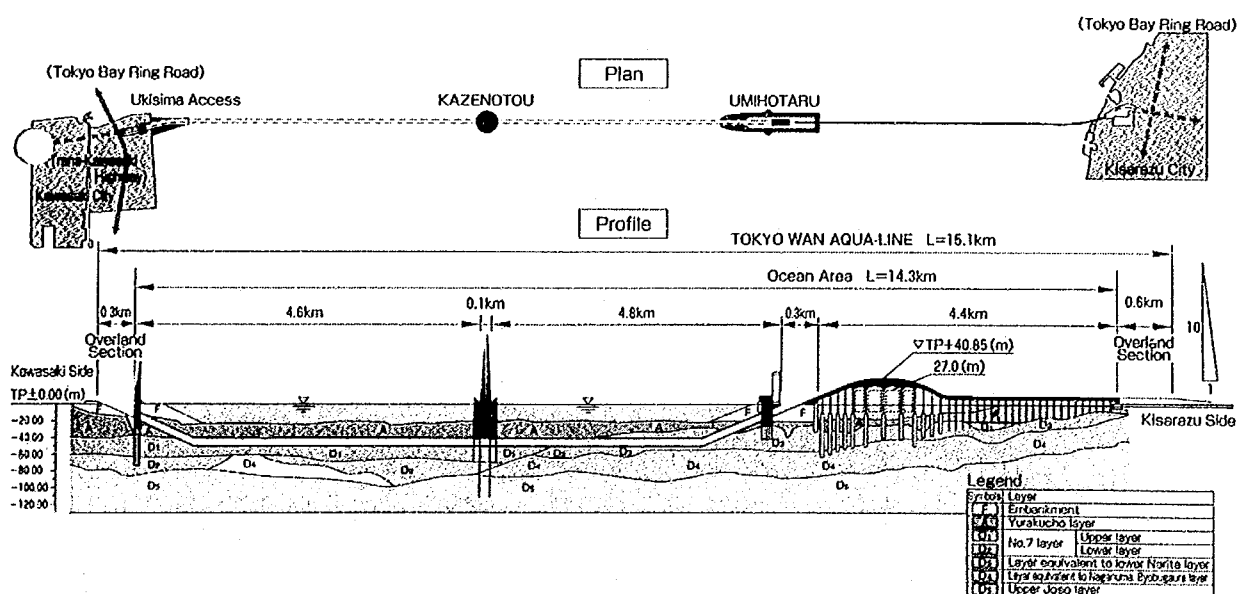


Fig. 3.4 Characteristics of Tokyo Wan Aqua-line

State of the Road Tunnel Equipment

英文所報第 号

Technology in Japan

平成11年 月(1999)

-Ventilation, Lighting, Safety Equipment-

Tunnel Division, Road Department, Public Works  
Research Institute, Ministry of Construction

Synopsis

This report shows the state of the road tunnel equipment technology in Japan. The contents are based on the published materials and the recent data from the tunnels in public use. Chapter 1 shows the general affairs of road tunnels and tunneling technology in Japan. Chapter 2, 3, 4 discuss road tunnel ventilation, road tunnel lighting and road tunnel safety technology respectively.

Key Words : tunnel equipment, ventilation, lighting, safety



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