

**CHAPTER 4 PROJECT EVALUATION
(ASSESSMENT) AND CONCLUSION**

CHAPTER 4. PROJECT EVALUATION (ASSESSMENT) AND CONCLUSION

4.1 Project Evaluation (Assessment)

The Road Sector of the 6th Five Year Plan stresses new research needs including measures for traffic pollution, review of road structures for weak soil areas and mountainous areas, and for heavy traffic roads. However, the IRE is not in possession of sufficient equipment and apparatuses to meet such needs.

The IRE's existing equipment and apparatuses are testing apparatuses for soil properties, simple testing instruments for pavement and other general testing tools. Some are superannuated. The IRE's testing efficiency is quite low generally, and not able to respond to the growing needs in the field.

By obtaining through this project the equipment and apparatuses demanded of the IRE to accomplish its works, the IRE will be able to allocate its limited budget for research and development work instead of purchasing new equipment. As a consequent, the IRE will be able to concentrate their energy to basic research works such as; relatively time consuming weak soil processing methods, surveys on the actual situation of the nationwide road networks and making the maintenance and management plans, research on the supporting strength of pavement taking Indonesia's climate and locally available materials into consideration, and defining the standard values for regulating traffic pollution. Such basic researches will provide the researchers with opportunities for enhancing their capabilities.

In addition, the following results are expected:

- 1) Through the progress in research on measures to protect the environment along roads, and enforcing environmental regulations, air pollution and noise pollution will be reduced.
- 2) Review on road structures will be fostered.
- 3) Roads will be constructed in weak-soil regions and mountainous areas, which have been considered impossible in the past. It will result in the reduction of traveling hours, running cost, and traffic accidents, hence, higher credibility of transportation.

- 4) The technical standard of researchers will be enhanced. By sharing their research achievements widely, the level of technology of the country as a whole will be heightened.

4.2 Conclusion

Under the 6th Five Year Plan that was started in April 1994, road construction has been continued in order to narrow gaps between regions of the archipelago. As a means to promote the road networks all across the country, a special emphasis is given to research and development work.

In recent years, Indonesia has been witnessing rapid motorization reflecting its favorable economic situation. Consequences of which are environmental deterioration, traffic jams, and deterioration of pavement due to the increase in traffic and large-size vehicles.

The IRE in Bandung, a research wing of the Ministry of Public Works prepared 53 new research programs based on the 6th Five Year Plan. So far, the IRE's has been conducted research programs include; asphalt pavement structure for heavy traffic roads, geotechnical studies including roadbed and subgrade, establishment of synthetic girder method using steel girders and concrete bed, research on reducing air and noise pollution by plantation. While it continues these traditional subjects, the IRE will plans to start new R & D programs that include; measures for weak soil to be used for remote and less populated areas, measures against environmental pollution around roads, establishment of paved road maintenance/management system, research on road surface properties to provide skid resistance for enhancing traffic safety, establishing a diagnosis system for the existing bridges, and research surveys on traffic capacity of the existing road networks.

The budget allocation, however, will be made favorably to road construction, and the budget for the research and development sector is not sufficient. With the existing structure and equipment, the IRE will find great difficulty to implement newly assigned research works.

By the new equipment and apparatuses required by the IRE, Japan will help the institute allocate its limited funds to its new undertakings. When the IRE's achievements are shared widely by the nation, the grant aid assistance will prove to be a great help to upgrade the road technology of the IRE, and of entire Indonesia. Thus,

it will be a great contribution eventually to the achievement of the goals of the 6th Five Year Plan.

The direct purpose of the project is the improvement of the IRE's equipment. When the research outcomes are to be put into use, the benefits will be widely shared by the nation, in particular, with increased accessibility to rural areas, and enhanced living environments. Therefore, this project is justified as a Japan's Grant Aid.

4.3 Recommendations

The project is intended to upgrade the IRE's pavement technologies, environmental preservation/betterment technologies, and diffusion of such technologies to other regions of the country, by utilizing the equipment and apparatuses.

To realize this intention, it is essential to improve elements such as, appropriate use of the equipment and apparatuses, analytical techniques to utilize the collected data for another step, management expertise to accumulate technologies (including researchers), diffusion of technologies to other regions, and improved training methods.

On the part of the Indonesian government, the following consideration and arrangements are desired.

- 1) Facilitate custom clearance at the port of Tanjungpriok of the equipment and apparatuses carried by ship, land transport on to Bandung, and installation work within the IRE premise.
- 2) Set up an inter-sectional use system and a maintenance/management system within the IRE at the earliest possible time to foster effective use and management of the equipment and apparatuses.
- 3) Ensure to keep the amount submitted as "research expenses" in the IRE budget for continued use of the the equipment and apparatuses.
- 4) Set up a system for regular communication with the Ministry of Public Works, through which information is to be exchanged between the two organizations on a regular basis.

APPENDIX

List of Appendixes

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- Appendix 7. List of Expected Equipment for Conducting the New Research Theme.
- Appendix 8. Memorandum of Discussions during the Field Survey
- Appendix 9. Research Theme of IRE
- Appendix 10. Result of Analyzed for Requested of Equipment/Apparatuses
- Appendix 11. Cost estimation for Maintenance and Operation

Appendix 1 Members List of the Study Team

- (1) Leader
Name: Mr. Keizo KAMIYA
Present Post: Manager of the Asphalt Pavement Research Division, Laboratory of Japan Public Highway Authority
- (2) Project Coordinator
Name: Mr. Yukihiro KOIZUMI
Present Post: Second Basic Design Study Division, Grant Aid Study & Design Department, Japan International Cooperation Agency
- (3) Chief Consultant / Road Engineering
Name: Mr. Koki KANEDA
Present Post: Pacific Consultants International
- (4) Equipment Planner
Name: Mr. Yukio KOHSAKA
Present Post: Pacific consultants International
- (5) Cost Estimator
Name: Mr. Kenji MARUOKA
Present Post: Pacific consultants International

Appendix 2 Survey Schedule

Day No.	Date	Day	Survey Content
1	Dec. 7	Wed.	Arrive Jakarta(Kaneda, Kohsaka)
2	Dec. 8	Thu.	Courtesy call EOJ, JICA and BIC, Move to Bangdong(Kaneda, Kohsaka)
3	Dec. 9	Fri.	Courtesy call IRE, pre-explanation of the study and discussion with IRE(Kaneda, Kohsaka)
4	Dec. 10	Sat.	Analysis of the data and materials collected
5	Dec. 11	Sun.	arrive Jakarta (kamiya, Koizumi, Maruoka), Back to Jakarta(Kaneda, Kohsaka)
6	Dec. 12	Mon.	Courtesy call EOJ, JICA and BIC, Explanation and discussion of Inception Report, Move to Bangdong
7	Dec. 13	Tue.	Courtesy call IRE, Explanation and discussion of Inception Report
8	Dec. 14	Wed.	Meeting with IRE, Site survey
9	Dec. 15	Thu.	Meeting with IRE, Site survey
10	Dec. 16	Fri.	Meeting with IRE, Site survey, Back to Jakarta(Maruoka)
11	Dec. 17	Sat.	Analysis of the data and materials collected, Collecting cost data
12	Dec. 18	Sun.	Back to Jakarta (kamiya, Koizumi, Kaneda, Kohsaka)
13	Dec. 19	Mon.	Courtesy call ARD, Discussion of the Minutes, Signing of the Minutes
14	Dec. 20	Tue.	Analysis of the data and materials collected, Collecting cost data
15	Dec. 21	Wed.	Report to EOJ and JICA, Depart Jakarta(Kamiya, Koizumi), Visiting EMC and collecting data
16	Dec. 22	Thu.	Depart Jakarta (Kaneda, Maruoka, Kohsaka)
17	Dec. 23	Fri.	Arrive Narita (Kaneda, Maruoka, Kohsaka)

BIC : Bureau of International Cooperation

IRE : Institute of Road Engineering

ARD : Agency of Research and Development

EMC : Environmental Management Center

EOJ : Embassy of Japan

Appendix 3 Member List of Party Concerned in the Recipient Country

Agency of Research and Development

Mr. J. Hendro Moeljono	Director General
Ir. Soedarmanto Darmonegoro	Secretary
Ir. Soesmarjanto Soesmoko	Head, Planning Division
Mr. M. Rusdi	Chief, Foreign Aid Administration Sub Division

Bureau of International Cooperation

Dr. Gembong Priyono	Director
Mr. Darminto	Chief, Birateral Administration Cooperation
Ms. Lenny Marliani	

Institute of Road Engineering

Dr. Patana Rantetoding	Director
Dr. Sjahdanulirwan	Head, Research Division
Ir. Saroso	Head, Development Division
Be. Teun Ruroudie	Chief, Development Division
Ir. Sony T.	Bridge Engineering
Ir. Lanneke T.	Bridge Engineering Research Group
Ir. Iauudh	Head, Experimental Station for Road
Ir. Toitik	Experimental Station for Road
Msc Acas R.	Head, Experimental Station for Soil
Msc Hermin	Geotechnical Division
Be. Imam Santoso	Traffic Engineering
Dr. I. F. Poernomosidhi Poerwo	Traffic Engineering Research Group
Ir. Gandmi Haramap	Traffic Engineering Divion
Dr. Poernomosidhi Poermo	Senior Scientific Officer, Road Environment Research Group

JICA Expert

Mr. Nozomu Mori	JICA Expert, Directorate of Planning, Directorate General of Highway
Mr. Seishi Meiarasi	JICA Expert, Institute of Road Engineering

Appendix 4

MINUTES OF DISCUSSIONS
BASIC DESIGN STUDY
ON
THE PROJECT FOR IMPROVING
OF
THE INSTITUTE OF ROAD ENGINEERING
IN THE REPUBLIC OF INDONESIA

In response to a request from the Government of the Republic of Indonesia (hereinafter referred to as "the Government of Indonesia"), the Government of Japan decided to conduct a Basic Design Study on the Project for Improving of the Institute of Road Engineering in the Republic of Indonesia (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to the Republic of Indonesia a study team, which is headed by Mr. Keizo Kamiya, Assistant Section Chief, Pavement Section, Japan Highway Public Corporation Research Institute and is scheduled to stay in the country from December 7 to 22, 1994.

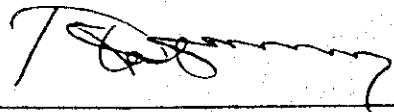
The team held discussions with the officials concerned of the Government of the Republic of Indonesia and conducted a field survey at the study area.

In the course of discussions and the field survey, both parties have confirmed the main items described on the attached sheets. The team will proceed to further work and prepare the Basic Design Study Report.

Jakarta, December 19, 1994



Mr. Keizo Kamiya
Leader
Basic Design Study Team



Dr. Patana Rantetoding
Director
Institute of Road Engineering
Agency for Research and Development



Mr. J. Hendro Moeljono.
Director General
Agency for Research and Development
Ministry of Public Works

ATTACHMENT

1. Objective of the Project

The objective of the Project is to provide research facilities and to develop human resources in order to improve the productivity of IRE in formulating standards and in developing alternative technologies for road and bridge.

2. Executing Agency

Institute of Road Engineering (IRE), one of the research centers under the Agency of Research and Development (ARD), Ministry of Public Works is responsible for administration and execution of the Project.

3. Project Sites

Project sites are shown in ANNEX-I.

4. Contents requested by the Government of Indonesia

After discussions, the request for the Project by the Government of Indonesia was confirmed as shown in ANNEX-II. However, the final components of the Project will be decided after further studies in Japan.

5. Japan's Grant Aid System

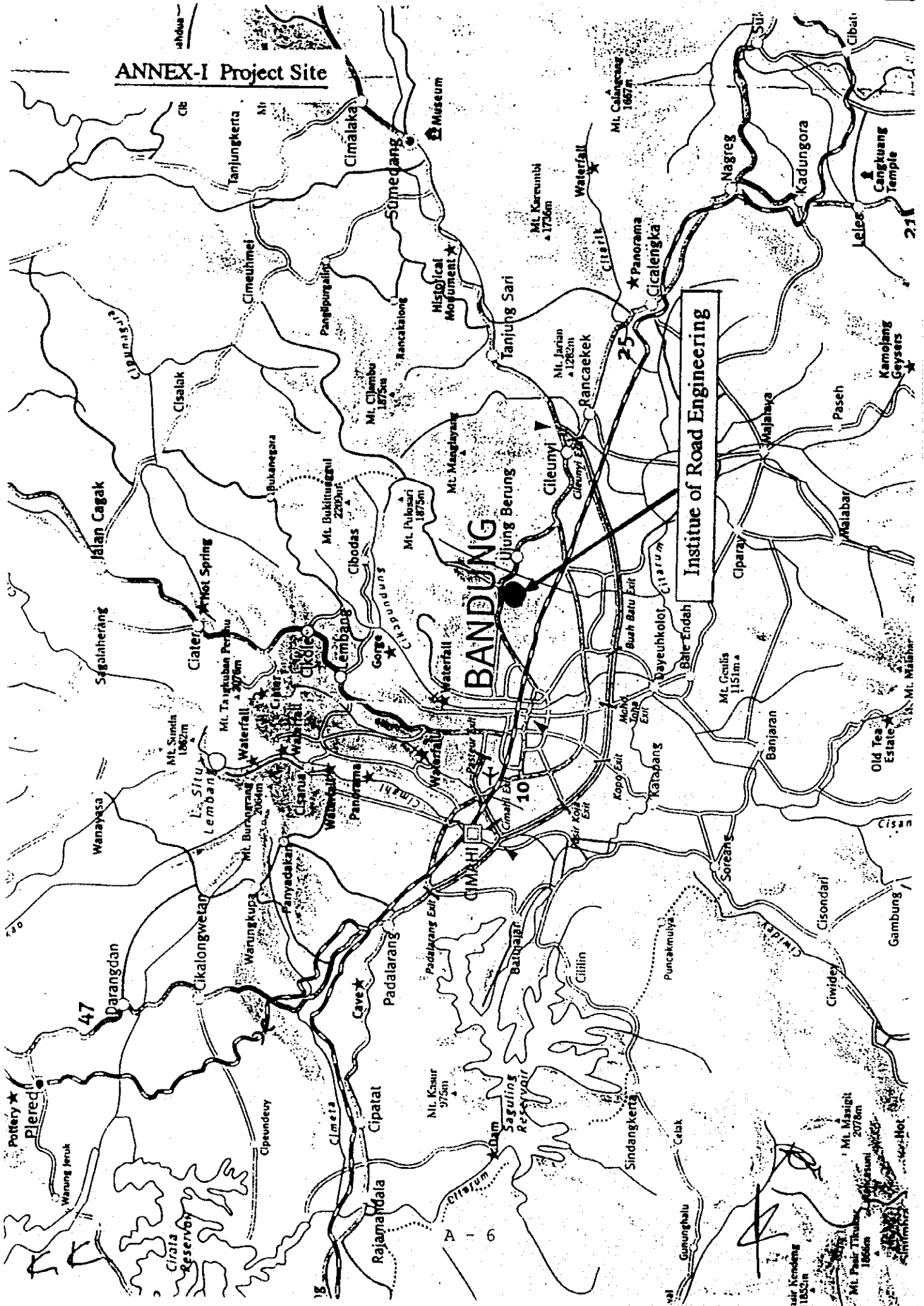
- (1) The Government of Indonesia has understood the system of Japan's Grant Aid as described in ANNEX-III.
- (2) The Government of Indonesia will take necessary measures, described in ANNEX-IV for smooth implementation of the Project, on the condition that the Grant Aid Assistance by the Government of Japan is extended to the Project.

6. Schedule of the Study

- (1) The Consultants will proceed to further studies in the Republic of Indonesia until December 22, 1994.
- (2) Based on the Minutes of Discussions and technical examination of the study results, JICA will complete a final report and send it to the Government of Indonesia in March 1995.

kk.

ANNEX-I Project Site



A - 6

ANNEX II

List of Equipment

No.	Equipment name	Purpose	Qty	Composition/Spec. for each unit & their Nos.	Remarks	
Priority A : Necessary equipment in top priority.						
1	Multi-function High Speed Road monitor	Multi-purpose non-destructive test for damage	1	Vehicle with measuring devices and computer for data store / analysis	Instal B.O.I	
2	Automatic compaction machine for Marshall test	Mixture design for asphalt pavement	1	for Marshall test		
3	Wheel tracking tester	Measuring deformation of asphalt mix	1	Tracking machine	1	Instal
				Automatic recorder	1	Instal
				Constant temperature room	1	Instal
				Isolated mixer (20lts)	1	Instal
4	Rotary vacuum evaporator	Extraction of Asphalt contents from solvent	2	Diagonal cooling	1	
				Freezer for testing of wax contents capacity: 200ltr, cooling temp. -10 C	1	
5	CBR testing equipment	To measure the bearing capacity of soil	2	with automatic mechanical compactor		
6	Resilient modulus tester	For determination of dynamic modulus of granular material	1	as comply with ASSHTO T274	Instal B.O.I	
7	Triaxial test assembly with data acquisition	To measure soil strength	1	with computerize recorder cell size : 50 x 100 mm	Instal B.O.I	
8	Drilling Machine	To take soil sample from deep stratum	1	Max. depth : approx. 80m Drilling diameter. : 2"		
9	Gradient Consolidation tester	By horizontal drainage	1	Rowe-type Cell size : D76mm x H30mm and D151mm x H50mm	Instal B.O.I	
10	Geographical Information System equipment	To store/analyze the geotechnical data	1	Computer : 80486CPU software : ARC/INFO Digitizer : approx. 36" x 48" Pen plotter : A3 size	Instal B.O.I	

(continued)

Remarks: Instal=with Installation, B.O.I.=with Basical Operational Instruction

ANNEX II

List of Equipment

No.	Equipment name	Purpose	Qty	Composition/Spec. for each unit & their Nos.	Remarks
11	Impact-Echo Test System	Non-destructive test for flaws in concrete	1	Senser, Cables, Transducers, Analyzer(Note book computer)	Instal B.O.I
12	Mobile Laboratory for Traffic Noise	To measure of Noise	1	High roof Type, 2500cc with Extra battery , AC converter and Equipment for research	Instal B.O.I
13	Mobile Laboratory for Air Pollution	To measure of Air Pollution	1	Bus Type, 140PS about 7m length with Equipment for research	Instal B.O.I
14	Automatic classified data logger	Detect/record/process traffic condition (at Intersection / Road)	4	Traffic flow detector 1 (half set: tube type & remain : loop type) Data retrieval unit (IBM PC compatible) 1 Data analyzer Unit 1	
15	Speed meter gun	To measure speed of traffic	2	up to 180 kph speed	

Priority B : Desirable equipment.

16	Scale Model Mobile Load Simulator	To accelerate damage to pavement by rotation of cast tires	1	As comply with ASTM STP 1225 1:10 scale	Instal B.O.I
17	Dipstick Floor Profiler	To measure the roughness of pavement	1	Length: 12 inches Self recording	Instal B.O.I
18	Asphalt Milling Unit	Milling the surface of asphalt pavement	1	Cutter drum width : approx. 20 inches Milling depth : min. 12cm	Instal B.O.I
19	Asphalt Mixing Plant	Precise asphalt mixing control by IRE for testings	1	Batch mixing type Capacity: 15 t/h	Instal
20	Asphalt consistency apparatus	To analyze for basic characteristics of asphalt	1	Automatic penetrometer 2 Softening point measure apparatus 1 Saybolt furol machine 1	

(continued)

Remarks: Instal=with Installation, B.O.I.=with Basical Operational Instruction

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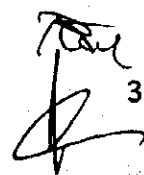
ANNEX II

List of Equipment

No.	Equipment name	Purpose	Qty	Composition/Spec. for each unit & their Nos.	Remarks
21	Portable skid resistance tester	To measure skid resistance of road surface	2	TRL type with rubber tip	20
22	Water pressure tester	To measure the water pressure under the embankment	3	with 7 cells for each set	
23	Geonor Swelling tester	To test soil for swelling by water	1	Overhead type arms with a 10 : 1 arm	
24	Geophysical data acquisition system	Analysis by seismic wave	1	Measurement point : not less than 12 channels with display , processing unit, GP-1B interface and seismic sensors	Instal B.O.I
25	One dimensional consolidation	Analysis of consolidation	1	Sample diameter 2 to 2.5 inch with computer	
26	Hydropuls Machine with Bed Plates and Versatile Test Frame		1	Double Portable Frame Max. payload : not less than 50 ton dynamic payloading type	Instal * B.O.I
27	Anechoic Room	Calibration of Noise	1	Mini. Effective inner size 5x5x3meters	Instal
28	Vehicle accelerometer & fuel consumption measuring apparatus	To measure the running condition of sample car	1	Attached type to the car on the road with normal speed	Instal B.O.I

* Pile Foundation is not included in the installation by the Grant.

Remarks: Instal=with Installation, B.O.I.=with Basical Operational Instruction



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Annex III

Japan's Grant Aid Scheme

1. Grant Aid Procedures

- (1) Japan Grant Aid Program is executed through the following procedures.**

Application	(Request made by a recipient country)
Study	(Basic Design Study conducted by JICA)
Appraisal & Approval	(Appraisal by the Government of Japan and Approval by Cabinet)
Determination of Implementation	(The Notes exchanged between the Governments of Japan and the receipt country)

- (2) Firstly, the application of request for a Grant Aid project submitted by a recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to determine whether or not it is eligible for Grant Aid. If the request is deemed appropriate, the Government of Japan assigns JICA (Japan International Cooperation Agency) to conduct a study on the request.**

Secondly, JICA conducts the study (Basic Design Study), using (a) Japanese consulting firm(s).

Thirdly, the Government of Japan appraises the project to see whether or not it is suitable for Japan's Grant Aid Program, based on the Basic Design Study report prepared by JICA, and the results are then submitted to the Cabinet for approval.

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes signed by the Governments of Japan and the recipient country.

Finally, for the implementation of the project, JICA assists the recipient country in such matters as preparing tenders, contracts and so on.

2. Basic Design Study

(1) Contents of the Study

The aim of the Basic Design Study (hereinafter referred to as "the Study"), conducted by JICAA on a request project (hereinafter referred to as "the Project") is to provide a basic document necessary for the appraisal of the Project by the Japanese Government. The contents of the study are as follows:

- a) Confirmation of the background, objectives, and benefits of the requested project and also institutional capacity of agencies concerned of the recipient country necessary for the Project's implementation.
- b) Evaluation of the appropriateness of the Project to be implemented under the Grant Aid Scheme from a technical, social and economic point of view.
- c) Confirmation of items agreed on by both parties concerning the basic concept of the Project.
- d) Preparation of a basic design of the Project.
- e) Estimation of costs of the Project.

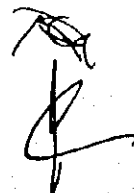
The contents of the original request are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of Japan's Grant Aid Scheme.

The Government of Japan requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

(2) Selection of Consultants

For smooth implementation of the Study, JICA uses (a) registered consultant firm(s). JICA selects (a) firm(s) based on proposals submitted by interested firms. The firm(s) selected carry(ies) out a Basic Design Study and write(s) a report, based upon terms of reference set by JICA.

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The consulting firm(s) used for the Study is(are) recommended by JICA to the recipient country to also work on the Project's implementation after the Exchange of Notes, in order to maintain technical consistency and also to avoid any undue delay in implementation should the selection process be repeated.

3. Japan's Grant Aid Scheme

(1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non-reimbursable funds to procure the facilities, equipment and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with the relevant laws and regulations of Japan. Grant Aid is not supplied through the donation of materials such.

(2) Exchange of Notes (E/N)

Japan's Grant Aid is extended in accordance with the Notes exchanges by the two Governments concerned, in which the objectives of the Project, period of execution, conditions and amount of the Grant Aid, etc., are confirmed.

- (3) "The period of the Grant Aid" means the one fiscal year which the Cabinet approves the Project for. Within the fiscal year, all procedures such as exchanging of the Notes, concluding contracts with (a) consultant firm(s) and (a) contractor(s) and final payment to them must be completed.

However in case of delays in delivery, installation or construction due to unforeseen factors such as weather, the period of the Grant Aid can be further extended for a maximum of one fiscal year at most by mutual agreement between the two Governments.

- (4) Under the Grant Aid, in principle, Japanese products and services including transport or those of the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant Aid may be used for the purchase of the products or services of a third country.

However the prime contractors, namely, consulting, contracting and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means

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persons of Japanese nationality or Japanese corporations controlled by persons of Japan nationality.)

(5) Necessity of "Verification"

The Government of recipient country or its designated authority will conclude contracts denominated in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. This "Verification" is deemed necessary to secure accountability to Japanese taxpayers.

(6) Undertakings required of the Government of the Recipient Country

In the implementation of the Grant Aid project, the recipient country is required to undertake such necessary measures as the following:

- a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the construction.
- b) To provide facilities for the distribution of electricity, water supply and drainage and other incidental facilities in and around the sites.
- c) To secure buildings prior to the procurement in case the installation of the equipment.
- d) To ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid.
- e) To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts.
- f) To accord Japanese nationals whose services may be required in connection with the supply of the products and services under that Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.
- g) "Proper Use"

The recipient country is required to maintain and use the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to

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assign staff necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

h) "Re-export"

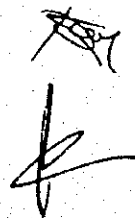
The products purchased under the Grant Aid should not be re-exported from the recipient country.

i) Banking Arrangements (B/A)

The Government of the recipient country or its designed authority should open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to over the obligations incurred by the Government of the recipient country or its designated authority under the Verified Contracts.

- The payments will be made when payment request are presented by the Bank to the Government of Japan under an authorization to pay issued by the Government of the recipient country or its designated authority.

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ANNEX IV

Necessary Measures Taken by the Government of Indonesia
in case Japan's Grant is executed

1. To provide data and information necessary for the implementation of the Project.
2. To secure the spaces of the equipment to be provided.
3. To provide facilities for distribution of electricity, water supply and drainage and other incidental facilities.
4. To bear the advising commission and the payment commission of the Authorization to Pay to the Japanese foreign exchange bank for the banking services based on the Banking Arrangement.
5. To ensure prompt unloading and custom clearance at the port of disembarkation in Indonesia and prompt internal transportation of the products provided under the Grant Aid.
6. To exempt taxes including value added tax (PPN), business taxes (PPn and PPh), import duties and any other fiscal levies for the purchase and import of the products provided under the Grant Aid.
7. To exempt Japanese nationals involved in the Project from customs duties, internal taxes and other fiscal levies which may be imposed in Indonesia with respect to the supply of the products and the services under the verified contracts.
8. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into Indonesia and stay therein for the execution of the Project.
9. To maintain and use properly and effectively the equipment provided under the Grant Aid.
10. To bear all the expenses other than those to be borne by the Grant.

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MINISTRY OF PUBLIC WORKS
AGENCY FOR RESEARCH AND DEVELOPMENT
INSTITUTE OF ROAD ENGINEERING

JALAN RAYA TIMUR 264 KOTAK POS 2 UJUNGBERUNG Tl (022) 7802251 - 3 Tlx 28377 pppj bd. Fax. (022) 7802728 Bandung 40294

No : HL. 02. 01 - Lj / 1296

13th December 1994

JICA Basic Design Study

Team Leader to IRE

Attn : Mr. Keizo Kamiya

Subject : JICA Grant Aid for Improving IRE Research Capability.

Dear Mr. Kamiya,

On behalf of the Institute of Road Engineering, let me first express my deepest gratitude to your team visit to the IRE. As I understand, the purpose of your team's visit would be to examine our need so that your grant aid may contribute our forthcoming research as much as possible.

I should tell you at this stage that the areas of research for which we request your aid have slightly changed from those in Our original 1991 request. The reason for that is because we want to get the maximum benefit from your grant aid, reflected in more areas of research served by the equipment which can be purchased from your grant. Two areas of research, namely Geotechnique and structural or bridge have been added to get your equipment. The reasons for that have been that the research themes in the coming years which will use your equipment are different from the research themes we had in 1991. This will obviously produce the difference in equipment required to conduct the research.

During the present Sixth Five Year Plan (Repelita VI) which began this year, the government of Indonesia is planning to build 10.000 kms of new road and bridges to serve the road, while remains maintaining and improving the existing road as we did in the past.

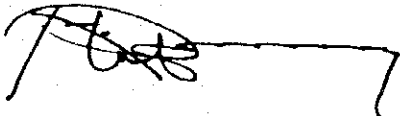
The construction of the new road, some of the road must go through geotechnically difficult areas, I will continue in the future

to serve our remote areas, will certainly require research in geotechnique and bridge.

I would like to revise the former list of equipment to that of the attached information.

Thank you very much for your teams's assistance to IRE and I do hope your support would remain in the years to come.

My Sincerely,



Dr. Patana Rantetoding.

Director of IRE.

jica/at/07/94

Appendix 6. New Research Theme of Laboratory based on New 5 Years Plan

THEME AND RESEARCH TITLE	EXPECTED BENEFIT	Annually MM		Cost (Million Rp)	
		1995-96	1997-96	1995-96	1997-96
1. GEOTECHNICAL ENGINEERING (GE)					
-1 Strengthening by curduroy technology on soft soils	To overcome problem in road construction on peat soils	25	25	100	110
-2 Wing pile foundation	Standard design method and construction of pile slab	30	30	100	110
-3 Pile slab foundation development	Standard design method and construction of pile slab	20	20	50	55
-4 Subgrade improvement of lime and cement stabilization	Standard method for marine clay stabilization	20	20	100	110
-5 Protection of road deterioration of expansive soil by geomembrane	To overcome expansive soil problem of the road Construction	25	25	100	110
-6 Slop stability technology Development by geogrid	To overcome slope failure by Using geogrid	20	20	50	60
-7 GIS method for land slide evaluation	To overcome landslide potential b GIS method To find out map of land slide potential in Indonesia	25	25	65	70
-8 Remote sensing for slope stability analysis	Analyze slope stability by Remote sensing more accuratly	20	20	45	50
-9 Technology of grouting for Rock Failure	To overcome slop failure of rock slope of the road by grouting method	20	20	50	60
2 PAVEMENT ENGINEERING					
-1 Study of Pavement Structure Number Coefficient	Avoid over Thickness design	40	40	350	200
-2 Research of Pavement Design for Heavy Load in Tropical Season (Indonesia)	Development an Implementtation of Current Tecnology	20	20	75	40
-3 Road Service Ability Model Especiality Degradation of PSI and Impact of over Axle Loaded	To Asses Pavement Design Method	30	30	150	85
-4 Research of Mode of Decreasing Rigid Pavement Condition	To Assess Rigid Pavement Performance	20	20	80	45
-5 Research of road drainage System for Hilly Mountainous Area	To Extend road design life	20	20	50	30

-6 Development of Overlay Design Method for Flexible Pavement	Constant/Parameter Improvement	30	30	100	55
-7 Research on Various Type Pavement Performance in Cileunyi Full Scale road,	Development of Improved Pavement Engineering	20	20	80	45
-8 Research of Pavement Maintenance Management System for Country road	Application of of Simple Technology	16	16	66	36
3 Material ENGINEERING (ME)					
-1 Research of the use of Local Material for pavement	Specification road pavement with Local materials	60	55	180	200
-2 Development of rubber asphalt in enhancing quality of pavement mixture		50	55	170	200
-3 Research of Various asphalt mixture for Indonesian Tropical Climate	To develop mix design specialy for Indonesia country	70	110	115	275
-4 Research of the influence of pavement texture on friction coefficient	To reduce traffic accident	20	20	700	40
-5 Research of coarse aggregate for sub base, base and shoulder	To apply technology of road Material	21	25	90	75
-6 Development of recycling execution for bituminous mixtures	Application of technology	17	20	80	100
-7 Specification revision designing new specification for hot mix	To develop technology and human resource	25	27	300	400
-8 Development of pavement geotextile	Effective wa of rehabilitation for road maintenance	56	60	100	150
-9 Characteristic an performance of Emulsion asphalt	Emulsion asphalt to be abl to store for long time	56	60	120	175
10 Equipment calibration for hotmix	By using the manual road building work will be carried out property, and make longer service ability of the road	70	35	800	200
4 BRIDGE ENGINEERING (BE)					
-1 Residual capacity of existing bridge	To create a criteria in bridge repair replacement	20	20	65	50
-2 Concrete deck slab technology for steel truss bridges	To ensue long life of Concrete decks	20	15	65	40
-3 Repair and rehabilitation method for existing bridges	To classify BRIDGE condition to Repair methods	18	10	60	30
-4 Cable stay Bridge design	To achieve lon span brodge	20	20	85	85
-5 High performance concrete	To minimize concrete	20	20	65	65

for PC girder	dimension in long spans				
-6 Prefab segmental element for Bridge substructures	To enable the use of prefab element for piers & abutments	20	20	65	65
-7 Performance of bolt tightness and elastomeric bearing in steel truss bridges	To support maintenance work of bolt & bearings	15	10	50	20
-8 RC tunnel lining	To achieve a appropriate design & method construction	15	15	50	50
-9 Reinforced earth abutments	To achieve an abutment design for soft soil condition	15	10	50	25
10 Soft wear for Bridge analysis	To achieve more sophistication i evaluation & design	15	15	55	55
11 Bridge type to accommodate light traffic	To achieve low cost bridge for poor regions	20	20	400	400
12 Bridge strengthening by external prestressing system	To achieve a higher capacity	20	10	150	75
13 Corrosion control of steel pipe piles	To achieve durable steel pipe pile foundation	20	20	100	100
5 ENVIRONMENTAL ENGINEERING (EE)					
-1 Study of economy cost of Noise and Pollution impact	To promote better enviroment	20	20	70	80
-2 Development of Enviromental assessment of road Material quarry	To reduce Transport cost To promote better environment	20	20	60	60
-3 Study of effect of vegetation in reducing air Pollution	To promote better environment	20	20	100	100
-4 Development of sound barrier design	To reduce Noise	15	15	40	60
6 TRAFFIC ENGINERRING (TE)					
-1 Road Geometry Study for Inter-city and Rural road	To reduce transport cost To minimize accident	20	-	80	-
-2 Development of Low Cost Traffic Management of Heavy Traffic road	To reduce transport cost To promote road safety	20	20	150	150
-3 Technology Development for Safety road Traffic	To prompt road safety	20	20	50	100
-4 Development of Urban Transport Planning Model	To reduce Transport cost	20	20	90	90
-5 Pedestrian road Network and Traffic Management of Primary road network for Arterial road	To reduce transport cost To minimize accident	20	-	50	-
-6 Workshop of Highway Capacity Manual	To reduce transport cost	20	20	100	100
-7 Mode for Accident Reduction	To reduce road Accident	20	20	100	100

Grand Total	1299	1248	6416	4986
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Appendix 7. List of Expected Equipment for Conducting the New Research Theme

GEOTECHNICAL ENGINEERING

No.	Name of Equipment	Quantity
GE1	Strain gauge	3
GE2	Pressure test	3
GE3	Settlement cell	20
GE4	Automatic compactor machine	2
GE5	CBR test laboratory	2
GE6	Geonor swelling test	2
GE7	Resilient modulus test	2
GE8	Geotextile testing machine	1
GE9	High capacity triaxial automatic recorded	2
GE10	Drilling bore machine O-ring Placing Tool	3
GE11	Gradient consolidation (rowe type) Two-way split former	1
GE12	Slake durability apparatus Valve	1
GE13	Point load test Rubber membrane	1
GE14	Geographical information system (GIS) equipment Porous disc	1
GE15	Rock permeability equipment	1
GE16	Global position system (GPS) receiver	3
GE17	Core drill of rock specimen preparation	1
GE18	Geophysical data acquisition system (seismic)	1
GE19	Electronic one dimension consolidation complete with software (ADU software)	1

PAVEMENT ENGINEERING

No.	Name of Equipment	Quantity
PE1	Pavement Skid Testing Bus	4 Unit
PE2	Cohesiometer	2
PE3	Constant Temperature Room	3
PE4	Mobile Simulation Pavement Test	4
PE5	Dipstick Floor Profiler	2
PE6	Wet Track Abrasion Tester (WTAT)	2
PE7	Loaded Whell Tester (LWT)	2
PE8	The Portable Skid Resistance Tester	2
PE9	Asphalt Miling Unit Pugmill Type Portable Asphalt Plant	2
PE10	Multifunction High Speed Road Monitor	5
PE11	Asphalt Mixing Plant (Mini)	2
PE12	Stone Crusher (Mini)	2
PE13	Truck	2
PE14	Paver	2

MATERIAL ENGINEERING

No.	Name of Equipment	Quantity
ME1	Marshall apparatus with automatic recoder or with personal computer complete with accessory and automatic compaction	3
ME2	Automatic asphalt penetrometer	2
ME3	Rolling thin film oven	1
ME4	Traverse type wheel tracking machine	1
ME5	Indirect tensile machine with personal computer	2
ME6	Dynamic modulus test apparatus complete with computer	2
ME8	Atomic absorption spectrophotometer complete flame and furnace full automatic system	4
ME9	Rotary vacuum evaporation	2
ME10	Electronic Analytical Balance	1
ME11	Mixer with isomantle fitted	2
ME12	Spray paint machine	1
ME13	Saybold furol viscometer	
ME14	Penetrometer	20
ME15	Core Drill	2
ME16	Small concrete cutter	2
ME17	Stormer krebs type viscometer	2
ME18	Sieve for gradation test apparatus	6
ME19	Portable skid resistance tester	2
ME20	Ring of ball apparatus with magnetic stirrer	2
ME21	Creep Test Apparatus	1
ME22	Freezers	2

BRIDGE ENGINEERING

No.	Name of Equipment	Quantity
BE1	Hydropuls Machine with bed plates and versatile test frames comperising of basic system elements :	1 Unit
BE2	Pile Driving Analyzer Comprising of main	1 Unit
BE3	Impact-Echo Test System for flaw detection of R.C Structures	1 Unit
BE4	Prestressing Jack & Accesories, capacity 200 ton	1 Unit
BE5	Gunite Dry Mix Machine, Rotating barrel type, portable type, with hose & nozzle (spare nozzle tips required) & spare for maintenance of wearing surfaces between rotaing barrel & upper/lower plates.	1 Unit
BE6	Portable Core Drilling Machine, gasoline engine, drilling position	1 Unit
BE7	Grinding Machine for preparation of concrete and rock samples.	1 Unit

ENVIRONMENTAL ENGINEERING

No.	Name of Equipment	Quantity
EE1	Sound Level Meters (with callibrator)	10
EE2	Level recorder	4
EE3	Microphone impedance measure high equipment	2
EE4	Intensity Measurement Prove	2
EE5	DAT(8 channels)	4
EE6	Small microphone	
	- Size 1/4 inch	10
	- Size 1/2 inch	10
	- Size 1 inch	10
	- Pre-amplifier	10
	- Microphone + measuring level meter cable	5
	- Measuring level meter	5
EE7	2 or 3 channels FFT (Fast Furrie Transformation)	2
EE8	Atomic absorption spectrophotometer	1
EE9	Mobile Application (mobil laboratory)	1
EE10	Air pollution monitoring network	1
EE11	Ambient NOx Monitor (APNA - 350 E)	1
EE12	Ambient HC monitor (APNA - 350 E)	1
EE13	Ambient CO monitor (APMA - 350 E)	1
EE14	Ambient SO2 monitor (APSA - 350 E)	1
EE15	Ambient Particulate monitor (APDA - 350 E)	2
EE16	Ambient O3 monitor (APOA - 350 E)	1
EE17	S3 Vibration monitor	1
EE18	Automatic weather station (AWS)	1

TRAFFIC ENGINEERING

No.	Name of Equipment	Quantity
TE1	Automatic Classified Traffic Data logger	4 Unit
TE2	Traffic Data Visual Recording	4
TE3	Dynamic Weighing Scale	4
TE4	Speedmeter	2
TE5	Vehicle Accelerometer & Fuel Consumption Measurement Apparatus	2 Unit

Appendix 8.

MEMORANDUM OF DISCUSSIONS
BASIC DESIGN STUDY
ON
THE PROJECT FOR IMPROVING
OF
THE INSTITUTE OF ROAD ENGINEERING
IN THE REPUBLIC OF INDONESIA

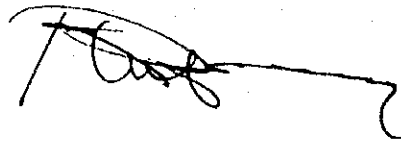
The mission received the revised request from the Institute of Road Engineering (IRE) on December 13, 1994. The mission accepted to discuss based on the request..

After discussions, both parties agreed the priorities of the requested equipment as attached list.

Bandung, December 16, 1994



Mr. Keizo Kamiya
Leader
Basic Design Study Team



Dr. Patana Rantetoding
Director
Institute of Road Engineering

No.	Equipment name	Purpose	Qty	Composition/Spec.for each unit	Nos.	Priority	Priority
PE 1	Pavement Skid Testing Bus	measure the skid resistance of road surface	1	measuring vehicle speed range : 10-80 km/h self recording		C	13
PE 2	Cohesimeter	measure cohesive resistance of aggregate mixture	1	canber temperature : 60 degree C +- 1.2degree C		C	12
PE 4	Scale Model Mobile Load Simulator	To accelerated damage to pavement by rotation of cast tires	1	As comply with ASTM STP 1225 1:10 scale	Train	B	2
PE 5	Dipstick Floor Profiler	measure the roughness of pavement	1	length: 12 inches self recording		B	4
PE 6	Wet Track Abration Tester	measure the abraision of slurry	1	As comply with ASTM D-3910-80a		C	8
PE 7	Loaded Wheel Tester	measure the stability of slurry	1	As comply with ASTM D-3910-80a		C	9
PE 9	Asphalt Milling Unit	milling the surface of asphalt pavement	1	cutter drum width : approx. 20 inches milling depth : min.12cm		B	7
PE 9	Pugmill Type Portable Asphalt Plant	mixing machine for trial	1	capacity : 5 t/h		C	10
PE 10	Multifunction High Speed Road monitor	multi-purpose nondestructivetest for damage	1	vehicle with measuring devices and computer for data store / analysis	Train	A	1
PE 11	Asphalt Mixing Plant	Precise asphalt mixing controlled by IRE for testings	1	Batch mixing type Capacity: 15 t/h	Inst	B	5
PE 12	Stone Crusher	for trial crushing rock/stone	1	jaw type + cone type capacity : approx. 10 ton/h		C	11

Remarks: Inst=with Installation, Train=with short time Training
Priority A: to be procured B: desirable, if possible

1

No.	Equipment name	Purpose	Qty	Composition/Spec. for each unit	Nos.	Priority	Priority
PE 13	Truck	as a load for testing of road bearing ratio	1	8 ton rear axle payload		B	3
PE 14	Paver	trial pavement	1	width of paver. finishing width :		C	6
ME 1	Marshall apparatus	Mixture design for asphalt pavement	1	Marshall test automatic recorder automatic compaction machine	1 1 1	C C A	1
ME 2	Asphalt consistency apparatus	Analyzing for basic characters of asphalt	1	automatic penetrometer softening point measure apparatus Saybolt furol machine	2 1 1	B B B	3
ME 3	Rolling thin film oven	Measuring deterioration of asphalt	1	volume of oven: Min. 80lts		C	4
ME 4	Wheel tracking machine	Measuring deformation of asphalt mix	1	Tracking machine automatic recorder constant temperature room automatic compaction machine isolated mixer (20lts) mold	1 1 1 1 1 20	Inst Inst Inst Inst Inst C	2
ME 5	Indirect Tensile machine	for stability of asphalt mixture	2	by constant thermo chamber with computer analyzer		C	7
ME 6	Dynamic modulus Tester	for stiffness of asphalt mixture	2	by constant thermo chamber with computer analyzer		C	8
ME 8	Atomic absorption spectro photometer	composition analysis of various materials	1	measuring wave length : 200-900mm with computer for analysis		C	9
ME 9	Rotary vacume evaporator	Extraction of Asphalt contents from solvent	2	diagonal cooling equipment freezer for testing of wax contents capacity: 200ltr cooling temp. -10C	1 1	A A	5

Remarks: Inst=with Installation, Train=with short time Training
Priority A: to be procured B: desirable, if possible

No.	Equipment name	Purpose	Qty	Composition/Spec. for each unit	Nos.	Priority	Priority
ME 10	Electric analytical balance	precise weight measuring	1	capacity: 200-250g readability: 0.1mg		C	13
ME 12	Spray Paint Machine	apply of cold type road marking	1	airless type, hand trawling tank capacity : min. 10 liters		C	12
ME 16	Portable small concrete cutter	cutting samples in the field	2	max weight 300kg dia of blade: 30cm spare blades	5	C	11
ME 17	Stormer Krebs type viscometer	measurement of viscosity of road paint	2	comply with ASTM D562		C	10
ME 19	Portable skid resistance tester	Measuring skid resistance of road surface	2	type: TRL with rubber tip	20	B	6
GE 1	Water pressure test cell	To measure the water pressure under the embankment	3	with 7 cells for each set		B	7
GE 3	CBR testing equipment	To measure the bearing capacity of soil	2	with automatic mechanical compactor		A A	6
GE 4	Geonor Swelling Test	To test soil for swelling	1	overhead type arms with a 10: 1 arm		B	8
GE 5	Resilient modulus test	For determination of dynamic modulus of granular material	1	as comply with ASHOTO T274		A	5
GE 6	Geotextile Testing Machine	To measure the tensile of textile	1	(Catalogue is unavailable)		C	9
GE 7	Triaxial test assembly with data acquisition	to measure soil strength	1	with computerized recorder cell size : 50 x 100 mm		A	4

Remarks: Inst=with Installation, Train=with short time Training
Priority A: to be procured B: desirable, if possible

No.	Equipment name	Purpose	Qty	Composition/Spec. for each unit	Nos.	Priority	Order
GE 8	Drilling Machine	To take soil sample from deep stratum	1	Max. depth : approx. 80m Drilling dia. : 2"		A	1
GE 9	Gradient Consolidation (rowe type)	By horizontal drainage	1	Rowe-type Cell size : D75.7mm x T30mm and D151.4mm x T50mm		A	3
GE 10	Slake Durability Apparatus	To measure slake durability	1			C	15
GE 11	Point Load Test	To measure the strength of rock / concrete	1	Point load : 10-200kgf/ cm ²		C	16
GE 12	Geographical Information System (GIS) equipment	To store/analysis the geotechnical data	1	Computer : 80486CPU software : ARC/INFO and ERDAS Digitizer : approx. 36" x 48" Pen plotter : A3 size		A	2
GE 13	Rock Permiability equipment	To measure the permiability of rock	1			C	13
GE 14	Groval positions systems (GPS) Receiver (portable)	To define the location absolute	3	Accuracy : apprpx. 2cm		C	14
GE 15	Rock specimen preparation equipment	For the preparation of specimen	1	Core : D30.1mm x L.100mm		C	12
GE 16	Geophysical data acquisition system (seismic)	Analysis by seismic wave	1	measurement point : not less than 12 channel with display , processing unit, GP-1B interface and seismic sensors		B	11
GE 17	One dimensional consolidation	Analysis of consolidation	1	sample diameter 2 to 2.5 inch with computer		B	10
BE 1	Hydropuls Machine with Bed Plates and Versatile Test Frame		1	Double Portable Frame Max. payload : not less than 50 ton dynamic payloading type		B	2

Remarks: Inst=with Installation, Train=with short time Training
Priority A: to be procured B: desirable, if possible

No.	Equipment name	Purpose	Qty	Composition/Spec. for each unit	Nos.	Priority	Priority
BE 3	Docter Impact-Echo Test System	Non-destructive test for flaws in concrete	1	Hammers, Cables, Transducers, Analyzer, Note book computer (catalogue later from Denmark w/quotation)		A	1
BE 4	Prestressing Jack	To prepare the trial PC beam	1	200 ton capacity		C	3
BE 6	Portable Core Drilling Machine	cutting out concrete core samples	1	Vertically and Horizontally core size dia. : 2"-8"		C	4
BE 7	Grinding Machine	preparation of concrete and rock samples	1	cube upto 20cm cylinder upto 8" dia.		C	5

EE 1	Mobil Laboratory for Traffic Noise	Measure of Noise	1	High roof Type, 2500cc with Extra battery(W) , AC converter(A) and Equipments of attached list		A	1
EE 2	Mobil Laboratory	Measure of Air Polluti	1	Bus Type, 140PS about 7m length with Equipment of attached list		A	2
EE 3	Anechoic Room	Calibration of Noise	1	Mini. Effective inner size 5x5x3meters	Inst	B	3
TE 1	Automatic classified data logger	Detect/record/process traffic condition (at Intersection / Road)	4	traffic flow detector (half set: tube type & remainig : loop type) Data retrival unit (IBMPC compat Data analyzer Unit	1 1 1	Train A	1

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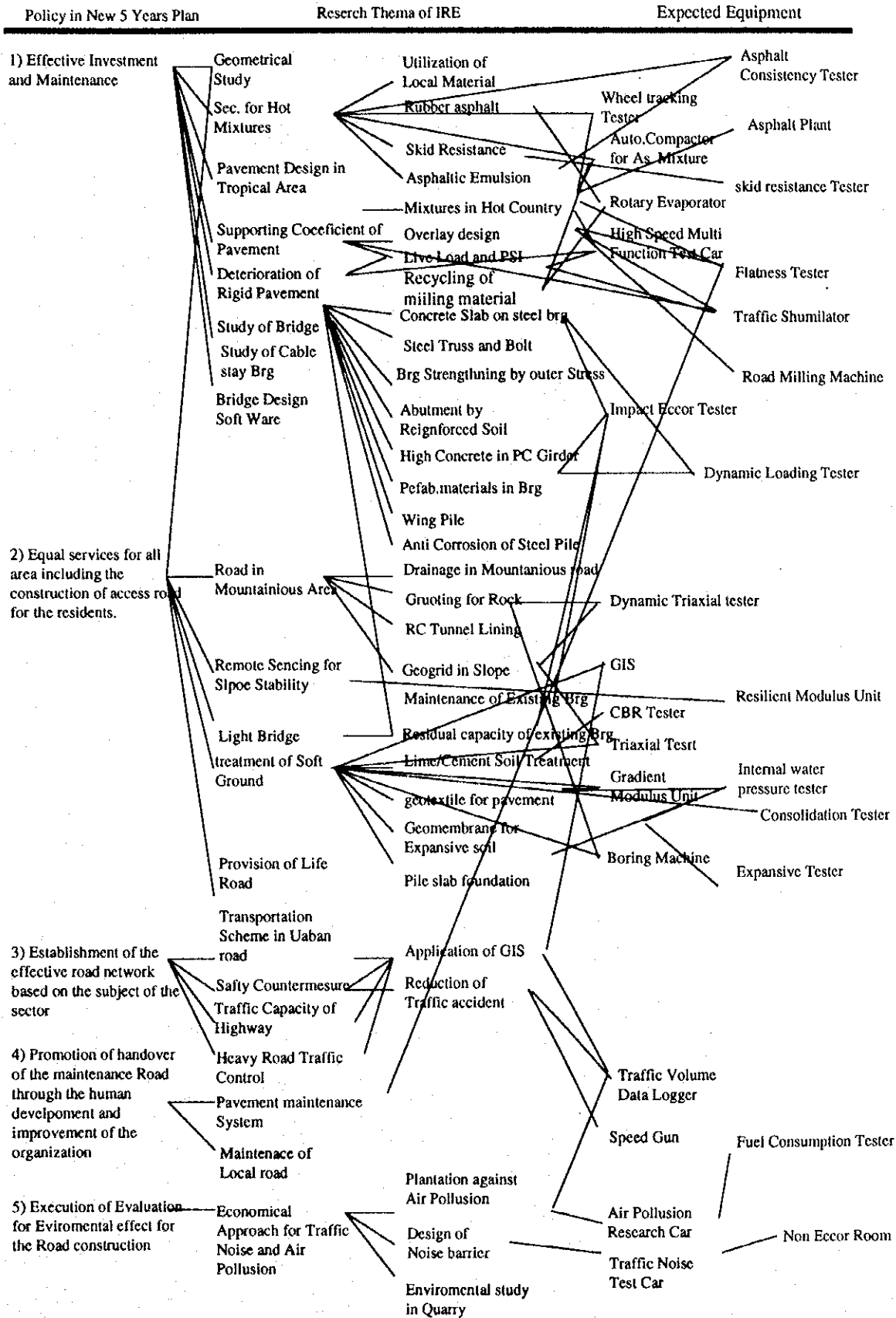
Remarks: Inst=with Installation, Train=with short time Training
Priority A: to be procured B: desirable, if possible

No.	Equipment name	Purpose	Qty	Composition/Spec. for each unit	Nos.	Priority	Priority
TE 2	Traffic data visual recording	survey of traffic condition	4	Timelapsed Video player(8mm) Timelapsed Video Camera Display 20 inch	1 1 1	C	4
TE 3	Dynamic Weighing scale	measure speed/weight of traffic	4	Detector for single lane up to 25ton weight up to 100 kph speed		C	5
TE 4	Speed meter gun	measure speed of traffic	2	up to 180 kph speed		A	2
TE 5	Vehicle accelerometer & fuel consumption measuring apparatus	measure the running condition of sample car	1	attached type to the car on the road with normal speed		B	3

	for EE1	sound level meter with calibrator			10		
		level recorder			10		
		microphone high impedance measure equip.			1		
		intensity measurement probe			2		
		DAT (8 channel)			2		
		Small microphone 1/4 inch			10		
		Small microphone 1/2 inch			10		
		Small microphone 1inch			10		
		Microphone level meter			10		
		level meter cable			10		
		S3 Vibration monitor			10		
		Fast Furie Transformation (2 channels)			1		
		Noise generator			1		
	for EE2	Auto Absorption Spectrophotometer			1		
		Air pollution monitoring network			1		
		Ambient NOx monitor(APNA-350E)			2		
		Ambient CO monitor(APNA-350E)			1		
		Ambient HC monitor(APNA-350E)			2		
		Ambient SO2 monitor(APNA-350E)			2		
		Ambient Particulate monitor(APNA-350E)			2		
		Ambient O3 monitor(APNA-350E)			2		
		Automatic weather station (AWS)			1		

Remarks: Inst=with Installation, Train=with short time Training
Priority A: to be procured B: desirable, if possible

Appendix 9. Research Theme of IRE



Appendix 10. Result of Analyzed for Requested of Equipment/Apparatuses

10-1 High Speed Mobile Pavement Survey Equipment

This equipment analyzes some kinds of pavement condition and comfort of Vehicle etc. during driving in high speed.

The most important matter is "How the result is analyzed" rather than its survey method.

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Compact type of "Pavement Survey Equipment"</p> <p>1. Surveying Items</p> <p>1.1 Surface deformation</p> <p>(1) Rut depth: Max. more than 1mm</p> <p>(2) Rut depth: Ave. Min. 3mm</p> <p>(3) Transverse profile: 20m pitch, Min. 3mm</p> <p>(4) Longitudinal profile: 0.1m pitch, Min. 3mm</p> <p>(5) MCD(Mid-Chord Deviation)</p> <p>1.2 Driving response of Vehicle</p> <p>Analyzing items:</p> <p>(1) Rolling</p> <p>(2) Bounce</p> <p>(3) Roughness index</p> <p>1.3 Pavement (surface) condition</p> <p>(1) Crack ratio: More than 3mm</p> <p>1.4 Road structure</p> <p>Analyzing items:</p> <p>(1) Alignment</p> <p>(2) Slope</p> <p>1.5 Front view: Video camera (8mm)</p> <p>2. Software for analysis</p> <p>High speed survey of Pavement, Investigation of Vehicle response, Investigation of Front view, Comfortably of Vehicle</p>	<p>It is firstly necessary to survey for making "full complete of road registration". According to the strong request from IRE who like to proceed the analysis by themselves with accumulating, the data of each route in each district for long period, we decided to donate this equipment.</p>	<p>Annual maintenance cost : ¥100,000.-. (for maintaining the vehicle). When the test is done, the actual cost is necessary which would be about ¥2,000,000.-.</p>	<p>NIL</p>

10-2 Automatic Asphalt Compaction Machine for Marshall Test

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Applied standard : ASTM D1559</p> <p>1. Electronic driven</p> <p>2. Auto-stopping device : Preset counter system, Auto-stop after optional number of times</p>	<p>The efficiency of test depends on "preparation work" for the compaction of specimen on Marshall test which is the basic test to fix the mixture of asphalt pavement. The condition of existing Marshall testing machine is good. We decided to donate only automatic Asphalt compaction machine.</p>	<p>Annual maintenance cost : NIL</p> <p>In addition the cost for consumables is required.</p>	<p>The existing manual and automatic compaction machine in Institute of Road Engineering are not enough.</p>

10-3 Wheel Tracking Machine

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>1. Size of standard specimen : 300x300 / 500x50mm</p> <p>2. Wheel load device</p> <p>2.1 Ground contacting pressure</p> <p>Wheel load : 70 ± 1kgf(Standard)</p> <p>Ground contacting pressure : 6.4 ± 0.15kgf/cm²</p> <p>Wheel load : 55 ± 1kgf(Immersed)</p> <p>Ground contacting pressure : 5.5 ± 0.15kgf/cm²</p> <p>2.2 Wheel : Solid tire</p> <p>Rubber hardness : JIS hardness 78 ± 2(60°C) JIS hardness 84 ± 4(40°C)</p> <p>Size of wheel : 200(D) x 50(W) x 15(T) mm</p> <p>3. Running device</p> <p>Running speed : 42 ± 1(times/min)</p> <p>Running distance : 230mm(non-immersed) 350mm(immersed)</p> <p>4. Traverse moving device</p> <p>Traverse speed : 40 ~ 160mm</p> <p>5. Immersing device</p> <p>Water bath, pipe heater (6kW)</p> <p>6. Measuring and recording device</p> <p>Number of running, Displacement, Recording of temperature</p> <p>7. Constant temperature room</p> <p>Inner dimensions : 2,612x1,712x1,900mm</p> <p>Outer dimensions : 2,700x1,280x2,100mm</p> <p>The temperature (60°C ± 0.5°C) should be kept more than 5hours.</p> <p>8. Asphalt mixer : 20°C</p>	<p>This testing method is now the most popular for checking the convection movement of pavement in the world. Institute of Road Engineering now has the one which was donated about 15 years ago and made in Japan. The existing equipment becomes superannuated, also Institute of Road Engineering is doing the comparative test in the constant temperature's water. The main purpose of immersed test is to check the condition of film stripping between asphalt and aggregate, this equipment is not for it. At the moment, Institute of Road Engineering is performing the test by an expedient since they have no the high and constant temperature facility. This improvement is urgently required.</p>	<p>Annual maintenance cost : NIL</p> <p>In addition cost for consumables is required.</p>	<p>Institute continues the present comparative test by the existing equipment after donating the new equipment with the constant temperature room, in addition, will compare with the testing result by the new equipment.</p>

10-4 Rotary Vacuum Evaporator

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>1. Rotary Vacuum Evaporator</p> <p>(1) Revolution : Approx. 30-200rpm, controllable</p> <p>(2) Temperature adjustment : 5℃~80℃(room temperature)</p> <p>(3) with Cooling water circulator : Controllable temperature range : More than 10℃ Less than 40℃</p> <p>2. Freezing machine</p> <p>(1) Capacity : more than 220 ℓ</p> <p>(2) Freezing capacity : more than minus35℃</p>	<p>At the moment, there are many vertical type of soxhlet which are becoming aged.</p> <p>We decided to donate 2 sets of "Slope type of rotary vacuum evaporator" which are able to abstract in low temperature.</p>	<p>Annual maintenance cost : NIL</p> <p>In addition, cost for consumables is required.</p>	<p>Apart from the existing equipments (soxhlet type), a new equipment is utilized.</p>

10-5 CBR Testing Machine

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Applied standard JIS A 1211</p> <p>1. Loading apparatus : Both of manually and electrically driven.</p> <p>(1) Capacity : More than Max. 5ton (43.03kN)</p> <p>(2) Loading speed : Approx. 0.5~1.5mm/min, stepless</p> <p>2. with Standard accessories and Automatic mechanical compactor</p>	<p>At the moment, there are many kind of testing equipments in the IRE. On the other hand, the existing equipments are not enough to test for many subjects. The improvement of efficiency by automatic record and analysis of many testing results can contribute to the productive improvement in quality for engineering persons.</p>	<p>Annual maintenance cost :JPY1,500 (only for V-belt)</p> <p>In addition, cost for consumables by testing is required.</p>	<p>Institute correspond to a lot of test in future by utilizing this equipment with the existing CBR testing machines.</p>

10-6 Resilient Modulus Test Apparatus

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Applied standard : AASHTO T274</p> <p>1. Loading frame : Min. capacity 3,000kg</p> <p>2. Load cell : Flat type, more than max. 3ton</p> <p>3. Servo actuator (1) Max. loading : More than 3,000kg (2) Max. speed : More than 18.1cm/sec (3) Stroke : More than ± 25mm (4) Displacement detector : Linear gauge Max. measurement : More than 10mm Min. measurement : Less than 0.001mm</p> <p>4. Hydraulic Power Source (1) Rated output : More than 210kg/cm² (2) Pump discharge : More than 13.5 l /min</p> <p>5. Control device (1) Servo control Wave form : Sine, Triangular, Rectangular wave Approx. 0.1~20Hz (2) Pulse generator Output voltage : Approx. 0~+10V, Continuous changeable</p> <p>6. Testing Equipment (1) Cell for triaxial test Applicable specimen : $\phi 100 \times 200$mm (2) Lateral Pressure Apparatus Max. pressure : More than 6kgf/cm² (3) Jig for Indirect tensile test Applicable specimen : $\phi 101.6 \times 76.2$mm</p> <p>7. Constant temperature bath (1) Controllable temperature range : +5°C~60°C (2) Accuracy of temperr distribution: Within ± 1°C</p> <p>8. Recorder : 2 pen recorder Accuracy : within full scale $\pm 0.5\%$</p>	<p>At the moment, there is no this kind of apparatus, but this is usefull for improving the analyzing capacity.</p>	<p>Annual maintenance cost : NIL</p>	<p>Existing equipment : NIL</p>

10-7 Triaxial Compression Apparatus

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Applied Standard : ASTM D2850</p> <p>1. Triaxial Chamber : for both ϕ 35mm and ϕ 50mm</p> <p>2. Axial Loading Apparatus : Electric gear driven, strain control</p> <p>(1) Capacity : More than 2,000kg (2) Loading speed : 0.2~2.0mm, stepless</p> <p>Loading measurement : Load cell, Max. 500kgf</p> <p>3. Lateral Pressure Apparatus</p> <p>(1) Water pressure : Air to water pressure conversion more than Max. 7kg/cm²</p> <p>(2) Loading control : Precise regulator, Min. 0.1kg/cm², Max. 7kg/cm²</p> <p>4. Vacuum Back Loading Apparatus : Min. 6.6kPa</p> <p>5. Pore Water Measurement Apparatus : More than Max. 10kg/cm² Less than Min. 0.01kg/cm²</p> <p>6. Data Analysis Apparatus : More than 8MB</p> <p>7. Data Analysis Software : (1) for UU, CU, CU and CD tests (2) for Data analysis</p>	<p>This apparatus is for checking the internal friction angle and cohesion which are essential to calculate the soil stability. It is possible for the recent model to analyze by computer, however, the IRE has only manual type. This apparatus gives the correctness as well as the improvement of test efficiency.</p>	<p>Annual maintenance cost : ¥13,000 (please refer to the maintenance section described in the end of this document) In addition, cost for consumables is required.</p>	<p>Improve the efficiency and correctness using this equipment together with existing manual one.</p>

10-8 Drilling Machine

Main Specification	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Rated capacity : Min. 80m AW Rod : More than 80m Engine power : Approx. 10HP Mud pump : Max. discharge: Approx. 70 r/min Max. pressure : Approx. 48kg/cm² Engine power : Approx. 14HP</p>	<p>The IRE is planning to increase the execution in soft subsoil area. It is difficult for the existing equipment to correspond.</p>		<p>Improve the efficiency using this equipment together with existing equipment.</p>

10-9 Gradient Consolidation Test Apparatus (Rowe Type)

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
1. Specimen Container : Light Alloy 2. Specimen Size : ϕ 60x20mm 3. Measurement of Settlement : 10mm - 0.01mm 4. Control Device : Axial Automatic Pressure Generator Max. 12.8kgf/cm ² 5. Differential Pressure Detection : More than Max. 7kgf/cm ² Setting Accuracy : 0.01kgf/cm ² 6. Back-Pressure Generator : Accumulating Water Tank Type More than max. 7kgf/cm ² Setting : Less than Min. 0.1kgf/cm ²	The Gradient Consolidation Test Apparatus which is requested by this proposal contributes to improvement of the Consolidation Test, and is concluded as a donated equipment from the reasons that is, it can minimize the hydraulic gradient in the specimen, the influence of the side friction so that it is always in the state of Pore Water Pressure being generated, it can shorten the testing period and make it ease to automate the consolidation test by continuously increasing load.	Annual maintenance cost : NIL In addition, cost for consumables is required.	Existing equipment : NIL.

10-10 Geographical Information System Equipment

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
1. Computer CPU : 486, More than 90MHz RAM : More than 32MB HDD : More than 1GB CD-ROM Drive VGA Board Color Monitor : 20" DAT : More than 5GB Printer : A3 size 2. Digitizer : A0 size 3. Color Plotter : A0 size 4. PC ARC/INFO 3.4 ARC VIEW d-BASE IV software 5. PC VGA Erdas Ver. 7.5 software 6. Uninterruptible Power Supply Power Compensation : More than 20minutes	Head quarter, Ministry of Public Works in Jakarta introduced this system 10 years ago, and they have been made Road Registration. We thought it is important for IRE to make a connection with the head quarter data base system, and to input and analyze the data of Soft Ground and Instable Slope Area.	Annual maintenance cost : NIL In addition, cost for papers, ink cartridges, and other consumable are required.	Existing equipment : NIL

Geonor Swelling Tester	Reason
To test the swelling of the soil.	One set of the same equipment exists in the IRE. Then, it is judged that the test is enough by using existing one.

Dipstick Floor Profiler	Reason
To automatically record the roughness of pavement moving the edges of approx. 30cm scaled measuring device like a looper, and analyze its result.	It is enough to perform the tests using 8m or 3m scaled profilometer that is usually used.

10-11 Impact-echo test apparatus

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>1. P-wave Measuring Impact Sensor 6 kinds of Impact sensor (ϕ 5,6,5,8,9,5,11,12,5mm)</p> <p>2. R-wave Measuring Impact Sensor 9 kinds of Impact sensor (ϕ 5,6,5,8,9,5,11,12,5,15,20,25mm) Automatic impact mechanism, Transducer, Signal amplifier and Plate for R-wave measurement</p> <p>3. Laptop Computer with Transformer (220V to 12V)</p> <p>4. Analyzing Software DOCTer, PIZAZZ or equivalent</p>	<p>It is essential that existing bridges will be rehabilitated and new ones will be completed in order to improve the access to the undevelopping villages. The improvement of the access is one of the important items in New 5 year Program. This test system is very useful in both laboratory and field as the testing equipment for this research.</p>		Existing equipment : NIL

10-12 Mobile Laboratory for Traffic Noise

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Applied standard : JIS Z8731</p> <p>Mounting vehicle : 2,500cc class, High-roof, compact with Measuring equipment table, Storing Rack, DC Supplementary power supply : DC12V (40AH)</p> <p>Mounting Equipment :</p> <p>Sound Level Meter (10)</p> <p>Level Recorder (10)</p> <p>Microphone (10)</p> <p>1/3 Octave Real Time Analyzer (2)</p> <p>2ch FFT Analyzer (1)</p> <p>DAT (2)</p> <p>Vibration Monitor (10)</p>	<p>Measure the traffic noise varied with meteorology, etc., and grasp the noise environment along roads. Collect the basic data for the prediction and the countermeasures of traffic noise. In case that the R&D of the materials for sound insulation wall is necessary, it will be possible to research them in comparison with the actual sound insulation wall in field.</p>		If this donation is materialized, the research environment will be tremendously improved.

10-13 Mobile Laboratory for Air Pollution

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Measuring standard : Air pollution continuous monitoring manual</p> <p>Mounting Vehicle : 190PS Microbus class</p> <p>Mounting Equipment : Gas Sampler Atmospheric SO₂ Analyzer Atmospheric NO_x Analyzer Atmospheric Ozone Analyzer Atmospheric SPM Analyzer Atmospheric CO Analyzer Atmospheric Non-Methane Hydrocarbon Measuring Equipment Dynamic Calibrator for Oxidant Analyzer Spectrophotometer Wet Gas Meter Meteorological Instruments (Wind direction and velocity, Insolation, Balansometer, Rainfall) Data Logger (More than 128KB) Personal Computer (Memory 4MB, HDD More than 40MB) Recording Equipment (Laser Printer, Print size more than A4 size) Supplementary Power Supply : Generator, approx. 5kW x 2units</p>	<p>The research of environment is the future important item for the IRE.</p>	<p>Annual maintenance cost : JPY 120,000 In addition, the cost for the consumables valued approx. JPY 3,000,000 is required.</p>	<p>Enable to obtain good results using this equipment together with the research equipment already owned by the IRE.</p>

Example of the Mobile Laboratory for Air Pollution

Equipment especially added to the Mobile Laboratory for Air Pollution in this project.

	Reason	
Generator	Usually, the power supply of the measurement station is distributed from the Commercial power supply. However, in case of Indonesia, we suppose that the powers for the equipment including air conditioners have to be supplied from the generator since all the electrical distribution facilities are not necessary available.	
Cord reel	In this case, the generator has to be installed at the place 200 - 300m away from the vehicle considering the effect of its exhaust gas. Therefore, the cord reel also has to be needed.	

Attached equipment excluded from adoption regarding the Mobile Laboratory for Air Pollution in this Project.

	Reason	Alternatives
Telemetering System	To send the collected data always to the Main Station is mainly for the countermeasure against the emergency. This time, this equipment was excluded from adoption due to the necessity of installing the other one at the Main Station.	
Installation of a sink	Excluded due to the space of the inside of the vehicle. It will be enough to change to alternatives.	Bucket, etc.
Ultrasonic Anemometer (3 elements)	Available by usual anemometer.	Vane type anemometer
Atomic Absorption Spectrophotometer	1) This equipment is used for the analysis of heavy metals. Since leaded gasoline is mainly used in Indonesia, the necessity for this equipment will be recognized. However, since the standard values of heavy metals have not been established in Indonesia, it is so difficult to distinguish the origins of generation, such as from vehicle, road, or the neighbor factories. 2) As this equipment is rather big and delicate, it is undesirable to mount on the vehicle due to its necessities of exhaust device and AC power distribution device.	We heard that University of Technology, Bangdong has this equipment, and we can suggest that the analysis will be available at there.

10-14 Automatic Classified Data Logger

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
Loop sensor (2sets:2loops/set) High frequency perception type Tube sensor (2sets:2tubes/set) Pneumatic type Sensor length : more than 10m Loop sensor data logging and retrieval unit 1 unit Data memory : more than 64KB Available to measure : more than 4 loops at a time Computer for analysis 3units IBM (or IBM compatible) Note type personal computer CPU 486 or more Software for Loop sensor data analysis 1set Showman Plus or equivalent Software for Tube sensor data analysis 1set Showman Lite or equivalent	To grasp the traffic flow is a important research task not only for the traffic planning dept. but also for the environment dept. It is essential to donate this apparatus which enables to analyze the traffic flow every vehicle classification with automatic measuring.	Annual maintenance cost : NIL In addition, cost for consumables is required.	Although the IRE has this kind of equipment, these equipment will be used together with the existing one due to getting extend the research objects for the traffic flow.

10-15 Speed Meter Gun

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
Measuring method : Doppler input method Furequency : 33.4 - 36.0 GHz Measuring accuracy : ± 1 km/h Measuring range : 1 - 100km/h 12V DC drive with Battery charger Battery capacity : Approx. 1.5AH	It is important to grasp the travelling speed of vehicle in case of the measuring of the traffic flow.	Annual maintenance cost : NIL In addition, cost for consumables is required.	The IRE does not have the speed meter gun at present.

10-16 Asphalt Consistency Apparatus

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p><u>Automatic Asphalt Penetrometer</u> Applied standard : JIS K2530, K2808 ASTM D5 Automatic timer : 0~60 seconds Accuracy : within ± 0.1 second Interlocking stopper with timer equipped</p>	<p>Various testing methods prescribes the method for the Softening which is a part of the basic nature of thermoplastic asphalt. Especially, these three equipment were judged to be donated since they became too old to work. Considering the frequency of the planned tests, these proposed quantities of the equipment will be enough to perform the test at the present.</p>	<p>Annual maintenance cost : NIL. In addition, cost for consumables is required.</p>	<p>The existing equipment have problem of their accuracy since they are quite old to use. It is difficult to use them due to the above reason, and it will considerably cost to repair them.</p>
<p><u>Softening Point Apparatus</u> Applied standard : JIS K2531 ASTM D36 (1) Electric heating method or equivalent (2) Heater Capacity : More than 1kW</p>		<p>Annual maintenance cost : NIL. In addition, cost for consumables is required.</p>	
<p><u>Saybolt Furol Viscosimeter</u> Applied standard : JIS K2208 ASTM D88</p>		<p>Annual maintenance cost : NIL. In addition, cost for consumables is required.</p>	

10-17 Water Pressure Tester

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Pneumatic Piezometer (7sets/set)</p> <p>Measuring range : Approx. 0~2000kPa</p> <p>Accuracy : 0.5% at full scale</p> <p>Diaphragm volumetric displacement : Within $\pm 0.01\text{cm}^3$</p> <p>Filter : Bronze made or equivalent</p> <p>Pneumatic indicator (3sets)</p> <p>Measuring range : Approx. 0~2000kPa</p> <p>Accuracy : 0.5% at full scale</p> <p>Nitrogen gas cylinder attached</p> <p>Switching Box with Charge-over valves (3 sets)</p> <p>Allowable pressure : Max. more than 2000kPa Available more than 7pcs of piezo-meter</p>	<p>At the follow-up survey for the behaviour after the treatment of the soft subsoil, it is essential to perform the measuring of the pressure caused by the gravitational force of moisture contained in the soil.</p>	<p>Annual maintenance cost : NIL</p> <p>In addition, cost for consumables is required.</p>	<p>Will use these equipment together with the old ones.</p> <p>New donation : 3sets, 7points measuring/set</p>

10-18 Scale Model Mobile Load Simulator

Equipment that simulates traffic loading on a model pavement by means of resilient rolling wheels with many rubber tires linking circularly.

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
<p>Applied standard : ASTM STP1225</p> <p>1/10 scale size</p> <p>Specimen : 1x3x6ft</p> <p>Number of axles : 12</p> <p>Number of tires : 4 on each axle (2 sets of double wheels)</p> <p>Average contact pressure : 560kPa</p> <p>Travelling speed : 1.1m/s</p> <p>Nominal wheel diameter : 100mm \pm 10mm</p> <p>Tire width : 25mm</p>	<p>Since tracking tests tend to be conducted at 40°C as a standard in Europe, this equipment has to be donated with the constant temperature room. Indonesia side is eager to study the field of the road surface evaluation approach. It is worth while studying this approach as a new road surface evaluation.</p>	<p>Annual maintenance cost : NIL</p> <p>In addition, cost for consumables is required.</p>	<p>No existing equipment</p>

10-19 Vehicle Accelerometer & Fuel Consumption Measuring Apparatus

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
Vehicle mounting type non-contact speed meter, vehicle mounting type fuel flow meter Speed measuring range : Approx. 2kgm/h~200km/h Fuel flow measuring range : Approx. 0.5~100 l /h	It is worth for both the environment dept. and traffic planning dept. while grasping how the travelling of the vehicle change by road improvement and pavement, as basic study.	Annual maintenance cost : NIL In addition, cost for consumables is required.	No resemble equipment exists in the IRE at present.

10-20 Porble Skid Resistance Tester

Main Specifications	Selection Guide / Reason	Maintenance	Coordination with the existing equipment
Applicable standard KODAN 221 ASTM E303 1. Pendulum arm type main unit with Strong box 1 set 2. Auxiliary rubber slider 3. Gauge plastic made 4. Thermometer 5. Spanner 6. Portable bag for soil tools 7. Stand gauge with chain rubber slider 20pcs attached	In order to compare the measuring at the laboratory and the field, this equipment is essential to efficient measuring as supplement to existing two units of this equipment.	Annual maintenance cost : NIL In addition, cost for consumables is required.	Try to improve efficiency using the new equipment together with existing ones.

10-21 Although the following Equipment were described in the List of Equipment attached with the Minutes of Discussions with Indonesia side, these are excluded from this donation list. Names of equipment and reasons are as follows :

Asphalt Milling Unit	Reason
Mill the surface of the pavement in specific thickness in case that the Ruts undulates the surface of the pavement.	This is the equipment for construction.

Asphalt Mixing Plant	Reason
The plant which has a capacity of Approx. 10t/h now exists at the corner of south-east area in the IRE. This time, the IRE requested its renovation. The purpose is to perform the tests of various asphalt mixing.	It is not only more economical but also more practical that the existing plant and construction equipment are used together cooperating with the construction field.

Anechoic Room	Reason
Anechoic room is roughly divided into the Anechoic room and the Hemi-Anechoic room. Hemi-Anechoic room is used in case of measuring the large-weight source and the source that includes many incidental facilities. Various scaled rooms, and these are used according to a purpose.	The present purpose, calibration of measuring equipment is also available at external inspection organization.

Hydropuls Machine with Bed Plates and Vesatile Test Frame	Reason
The apparatus which loads on the large structure repeatedly, and This is the machine which applies the dynamic force to the large structure specimen and enables to observe its fatigue-fracture.	The construction fee and the test cost are tremendously expensive comparing with other equipment. Moreover, since the maintenance cost for the equipment itself is also expensive, it is better to allocate the limited budget to other equipment for its efficient usage.

One Dimensional Consolidation	Reason
To test the situation that the moisture of the soil drains by own weight or loading weight.	There are many consolidometers in the IRE, and these are available to use if repaired.

Geophysical Data Acquisiton System	Reason
To analyze the impact wave caused by hammer, and enables to research geological survey.	Considering the contents of the study, the frequency of use is assumed to be low. Then, excluded from the donation.

Geonor Swelling Tester	Reason
To test the swelling of the soil.	One set of the same equipment exists in the IRE. Then, it is judged that the test is enough by using existing one.

Dipstick Floor Profiler	Reason
To automatically record the roughness of pavement moving the edges of approx. 30cm scaled measuring device like a looper, and analyze its result.	It is enough to perform the tests using 8m or 3m scaled profilemeter that is usually used.

Appendix 11. Cost Estimation for Maintenance and Operation

No.	Description	Estimated Working period, Frequency	Spare parts	Consumables	Other maintenances	Cost for Consumables	Cost for Maintenance
1	High Speed Mobile Pavement Survey Equipment	100 km(survey)/day 100 days/year		Video Tape (VHS High Resolution Type) 8mm Tape (H) Floppy for Profile (4)x100 (4)x100 (1)x100	Maintenance Charge Oil Charge Paris (Oil Element etc.)	2,138,000	100,000
2	Automatic Compaction Machine for Marshall Test	6 specimen/day 80 days/year		Tamper Stopper Hammer Cap Hammer Notch Chain Bell (1) (1) (1) (1) (1)	Lubrication of Grease Lubrication	113,000	
3	Wheel Tracking Machine	6 specimen/2days 120 days for one year		Recording Paper Printer Paper (2) (2)	Lubrication of Grease Oil Charge (every 5 years)	13,800	
4	Rotary Vacuum Evaporator	One year	*Solid Tire (every 2 years)	Vacuum Seal Set Rotary Joint Capillary Sample Flask Receiving Flask (1)x2 (1)x2 (1)x2 (1)x2 (1)x2		113,600	
5	Refrigerator	for 1 year		Recording Paper (12)x2		20,000	
5	CBR Testing Equipment	every 2 year			Replacement of V-belt		1,500
6	Resilient Modulus Tester	No. of Loading : 200 Loading Frequency : 1 Hz 2 specimen tested every 2 weeks 100 specimen for one year		Hydraulic Oil Compressor Oil Recording Paper Filter Paper Oil Pressure Unit Oil Element Air Element (1) (1) (15) (100) (2) (1)	Lubrication of Grease Lubrication Exchange of Chamber Packings (every 3 years)	129,000	
7	Triaxial Test Assembly with Data Acquisition	240 specimen for one year		φ35 Filter Paper φ50 Filter Paper O-Ring for Rubber Membrane O-Ring for Triaxial Chamber Porous Stone Plotter Pen Recording Paper (300) (300) (each 6) (2) (each 4) (2) (2) (240)	Lubrication of Grease Exchange of Oil Tube (5m) Air Element (1)	142,000	13,000
8	Drilling Machine	Drilling Depth : 1,200m/year Middle Hard Rock 400m Soft Rock 600m Surface Soil Layer 200m		Diamond Core Bit Diamond Sealing Shell Carbide Core Bit Tyree Cone Roller Bit Thin Wall Tube (8) (4) (60) (7) (24)		7,957,500	

No.	Description	Estimated Working period, Frequency	Spare parts	Consumables	Other maintenances	Cost for Consumables	Cost for Maintenance
9	Gradient Consolidation Tester (Rowc-Type)	Testing Period : 4 - 10 hours 50 specimen/year		Porous Stone (2 sets) O-Ring (1 set) Belophram		\$2,000	
10	Geographical Information System Equipment			Ink Cartridge (2)		50,000	
11	Impact-Echo Test System	Measuring Point : 2,000 points/year		Lead Cap I (1,000) Lead Cap II (1,000)		994,500 930,750	
12	Mobile Laboratory for Traffic Noise			Recording Paper for Level (50) Recording Paper for Frequency (50) Ceramic Pen (50) Battery-Pack for 1/3 Octave Real Time Analyzer (8) Dry Battery UM-6 (372)	Maintenance Charge Oil Charge Pars (Oil Element etc.)	1,901,520	108,000
13	Mobile Laboratory for Air Pollution Calibration Gas	Operation through year		SO ₂ (80~90ppm) 10 ℓ Gas cylinder, 1 bottle/year NO (1.8ppm) 10 ℓ Gas cylinder, 1 bottle/year CO (9ppm) 10 ℓ Gas cylinder, 1 bottle/year CH ₄ (4~4.5ppm) 10 ℓ Gas cylinder, 1 bottle/year N ₂ (NOx zero gas) 10 ℓ Gas cylinder, 1 bottle/year N ₂ (Carrier gas for HC) 10 ℓ Gas cylinder, 1 bottle/year	Maintenance Charge Oil Charge Pars (Oil Element etc.)	658,000	120,000
	Automatic SO ₂ Analyzer			Hall union (5) Ball (PP) (5) Husc (2) Teflon filter assy (1) Glass element S (1) Valve seat (1) Diaphragm (1) H.C. Cutter assy (2) Carbide (1) Purafil (1) Pura carbo assy (1) Light source lamp (1) Cartridge filter (1) Metal interference filter (1) Lens (1) Quartz wool (1) Recording paper (12)		490,000	

No.	Description	Estimated Working period, Frequency	Spare parts	Consumables	Other maintenances	Cost for Consumables	Cost for Maintenance
14	Automatic Classified Data Logger	Measuring Point : 1 point		Adhesive Kit (1) Loop Sensor (2) Tube Sensor (2)		22,000 430,000	
15	Speed Meter Gun			Battery (2)		\$270	
16	Asphalt Consistency Apparatus						
(1)	Automatic Asphalt Penetrometer	200 specimen/year for test		Specimen Container (50)x2 Standard Needle (1)x2 Glass Container (1)x2		126,000	
(2)	Softening Point Apparatus	200 specimen/year for test		Ball (10) Heating Bath (1)		7,000	
(3)	Saybolt Furol Viscosimeter	200 specimen/year for test		Receiving Flask (4)		24,000	
17	Water Pressure Tester	every year		Rechargeable Battery (1) Nitrogen Gas (1)		50,000	
18	Scale Model Mobile Load Simulator	Axial Load : 40,000 times (6-8 pavement specimen)		Drive Chain (4) Drive Belt (2) Drive Sprocket (1) Wheel Bearing (1) Carbon Brush (1) Nylon Wheel and Bearing (1) Rubber Tire (1 set)	Lubrication Lubrication of Grease	\$3,120	
19	Vehicle Accelerometer & Fuel Consumption Measuring Apparatus	120 hours/year		Recording Paper (10) Hologen Lamp (2)		102,000	
20	Portable Skid Resistance Tester	500 points/year for investment		Rubber Slider (10)		120,000	

No.	Description	Estimated Working period, Frequency	Spare parts	Consumables	Other maintenances	Cost for Consumables	Cost for Maintenance
	Automatic Hydrocarbon Analyzer			<ul style="list-style-type: none"> Sampling tube (1) Ignition (1) Thermister (1) Sampling pump (1) Shaft seal assy (1) Moleculic chieve S. assy (1) Gelman filter (12) Gas leak (1) Chart paper (12) Realed yarn (1) Chart ink (Black) (2) Chart ink (Green) (2) Chart ink (Red) (2) Chart ink (Blue) (2) Ink pad (1) Cartridge pen (2) Packing for pressure reducing valve (5) 		266,000	
	Hydrogen Generator			<ul style="list-style-type: none"> 96% caustic soda (500g) (2) Activated carbon cylindar (1) OP soloppe (6) 2% caustic soda (2 L) (1) Cell (1) 		406,000	
	Automatic NOx Analyzer			<ul style="list-style-type: none"> Teflon filter PF-1 (1) (φ 55, 30shems/pack) Glass element S (1) (2microns) Valve sheet (1) (for APN-085LVX) Diaphragm (1) Glassine carbone (3) (GC20, φ 3, 15g/pack) Quartz wool (1) Catalyst (1) O-ring (1) Carohite (2) Catalyst tube (1) Teflon tube (φ 4x φ 6, 2m) (2) Teflon tube (φ 2x φ 3, 3m) (3) Teflon tube (φ 2x φ 3, 2m) (2) Cartridge filter (1) Solenoid valve (1) Half union (10) Z-union sleeve (φ 3, PP) (10) 		303,800	

No.	Description	Estimated Working period, Frequency	Spare parts	Consumables	Other maintenances	Cost for Consumables	Cost for Maintenance
	Automatic Ozon Analyzer			Fuse (3A) (2) Ozon cutter assy (1) Teflon tube (φ 4) (3m) Teflon tube (φ 2) (1m) Diaphragm for Pump (1) Valve for Pump (1) Mercury lamp assy (1) Sampling tube (1) Diaphragm (2) Chart paper (12)		312,200	
	Automatic SPM Analyzer			Plug fuse (3A) (2) Glass fiber filter (12) Filter rewind roller (1) Diaphragm (2) Vacuum pump (1) Sampling tube (1) Tube (4m) (4) Sleeve (4) Hose (2) Ink ribbon (1) Roll paper for Printer (4)		337,400	
	Automatic CO Analyzer			Valve (1) Diaphragm (1) Packing for pressure reducing valve (2) Chart paper (12) Chart ink (Red) (2) Chart ink (Green) (2) Realed yarn (1) Glass element S (1) Gelman filter (30) Silica gel (2) Catalyst unit (1)		131,600	

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