

CHAPTER 2

CONTENTS OF THE PROJECT

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2-1 BASIC CONCEPT OF THE PROJECT

After the independent in 1991 from former Soviet Union, the Government of the Republic of Armenia has been promoting the market economy. The government regards the transport network connecting domestic and international as the most important factor, and they are going to develop intensively the physical traffic flow in the capital Yerevan City that accommodates more than 30% of the national population.

The total length of the trunk roads inside Yerevan municipality is 802 km, while that of feeder roads is 320 km. Although the traffic volume and freight inside the municipality have been increased year by year since 1995, some problems, such as the low running speed, obstruction of smooth road traffic, and the frequent troubles of the vehicles, are caused by the poor surface condition of the roads.

The municipal roads are maintained by the Department of Improvement & Construction, (DIC) under the Government of Yerevan Municipality. However, the maintenance equipment retained by DIC is remarkably superannuated because the newly procurement of equipment has been suspended since 1986 due to financial difficulties, and it is necessary that all equipment to be renewed.

DIC has continued simple repair of the road network by these retained equipment with frequent repairing. But it could maintain only 1.9% of 15.9 the million m² per year of total road surface area in Yerevan Municipality due to the insufficient number of the equipment and its lower operating rate. Therefore the road condition has been worsened.

The worsened road condition in the capital means the fall in service quality of the transportation and traffic, and it may be the factor to dull the speed of economic development not only for the capital, but also for the nation.

This Project is to procure road maintenance equipment for the continuous and constant execution of road improvement work in the capital Yerevan City.

2-2 BASIC DESIGN STUDY OF THE REQUESTED JAPANESE ASSISTANCE

2-2-1 Design Policy

This project aims to improve the reliability and safety of the traffic on the municipal roads in the Yerevan City, where the core of physical distribution in Armenia, and is to procure the necessary construction equipment for road maintenance work.

The Government of Yerevan Municipality originally requested 13 types and 49 units of equipment including spare parts as necessary equipment for the maintenance of municipal roads of Yerevan. In response to the request, the Basic Design Study was conducted from September, 2001, and it studied the contents of the Grant Aid, which be possible for indispensable management by Yerevan Municipality as the implementing agency, through the consideration of its technical ability and implementing system.

Based on the field survey and analysis of the present damaged level and past maintenance works on the municipal roads of Yerevan, one of the following three methods are initially recommended for future maintenance works:

- 1) Milling & overlay method (with new asphalt concrete)
- 2) Milling & overlay method (with recycled asphalt concrete)
- 3) In place surface recycling method

Among the above three methods, the most suitable method shall be adopted for the project based on workability and economic considerations.

The necessary equipment for the execution of the above maintenance works is selected for each method, then the equipment which already retained and/or possible to be procured by DIC are excluded from the project. The facilities of the equipment workshop are included in the procurement list because it is insufficient at present.

The basic specifications of the equipment for the most suitable maintenance method among the above three methods was planned with full consideration on the followings;

- To maintain roads effectively in based on existing road dimensions (width, cross section)
- To match the combination with existing equipment retained by DIC for the operation of the maintenance work
- To fit the size of equipment with the ability of the operators
- To keep easy maintenance of the equipment
- To examine the suitable specification and number of units based on approximately 20 km length of annual maintenance roads
- To secure the minimum facilities of the workshop for effective maintenance of the equipment

2-2-2 Basic Plan (Construction Plan / Equipment Plan)

(1) Maintenance Method

Ten years have been passed on the concerned roads without any major rehabilitation works since the independent of the nation. Generally, the life span of the asphalt concrete pavement is approximately 10 years, so it is judged that the time of the rehabilitation of roads has come. On the concerned roads, it seems that the base course of the pavement is not damaged yet as a result of its hard road bed and the effort of daily repair by the patching, even though the damages on the surface course are worsened. But it is judged that the remarkable roughness of the surface with cracking and rutting exceed the limit of effectiveness of the repair done by the patching method. Therefore, the equipment plan was studied with the overlay methods in this project. Additionally it included equipment for the patching method because the repair of the potholes on the vehicular lane and rail zone of streetcar lane prior to overlay is effective to maintain longer life span of the pavement.

The overlay method is to restore the durability and flatness of the surface course by adding the asphalt concrete on the existing surface. In the case of concerned roads, surface elevation exceeds its design due to repeated repairs, and it is necessary to adjust the level, first by milling surface course, then by constructing on overlay. In addition, the request of the equipment by DIC was based on the overlay by In place surface recycling method.

The construction procedures of Milling & overlay method, In place surface recycling method, patching method and conceptual figure of asphalt recycle plant are shown in Figures 2-2-2-1, 2, 3 & 4 respectively.

(2) Utilized Equipment for Selected Methods

The necessary equipment for the suitable 3 maintenance methods previously mentioned in the design policy is listed in Table 2-2-2-1. Also the equipment required for the patching method is included in each method.

(3) Selection of Maintenance Method

The three maintenance methods of Milling & overlay method with new asphalt concrete, Milling & overlay method with recycled asphalt concrete and In place surface recycling method, were evaluated as shown in Table 2-2-2-2.

As a result, the Milling & overlay method with recycled asphalt concrete has acquired the highest points with no striking fault, so it is adopted in this project.

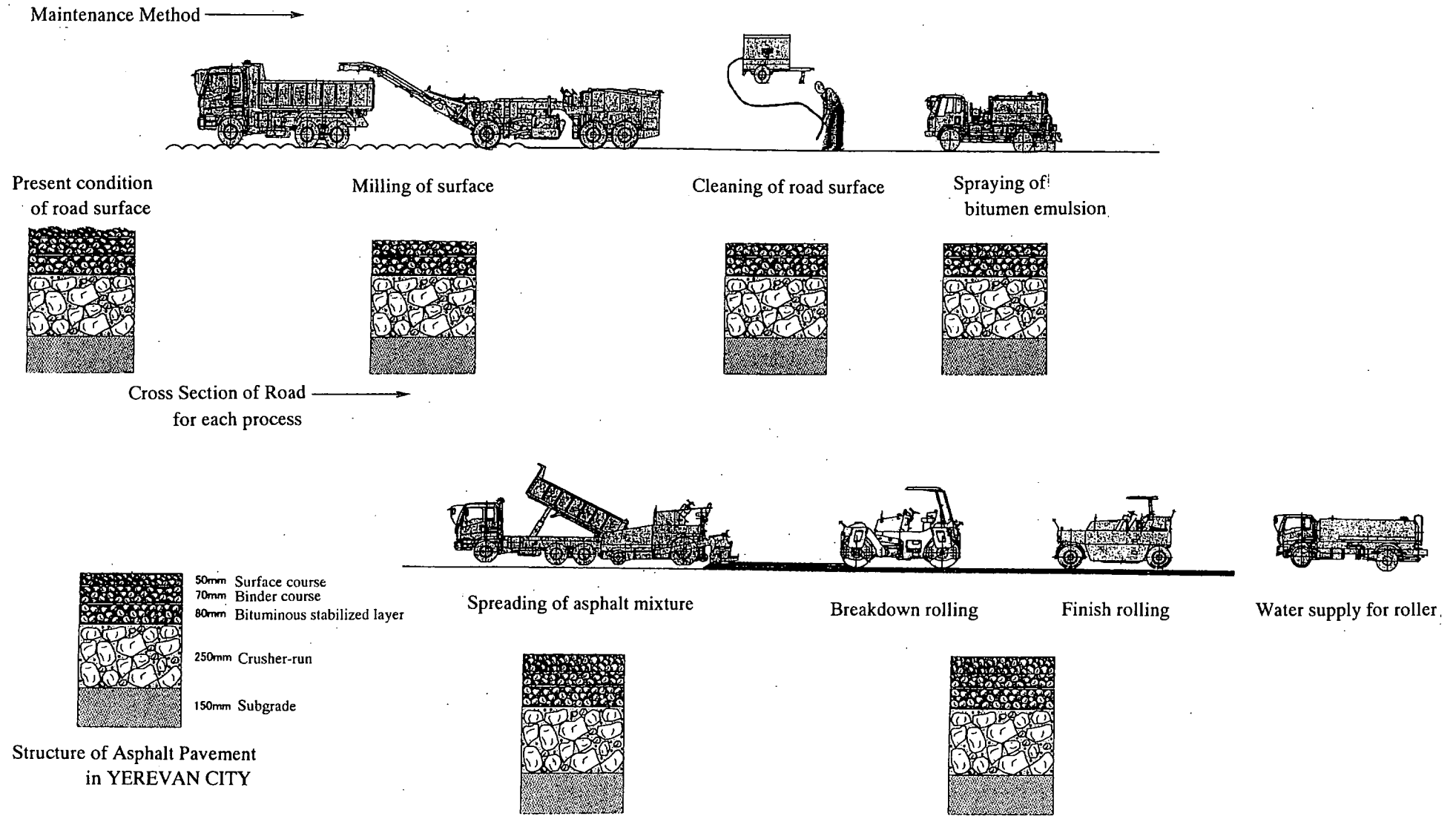


Figure 2-2-2-1 Milling and Overlay Method

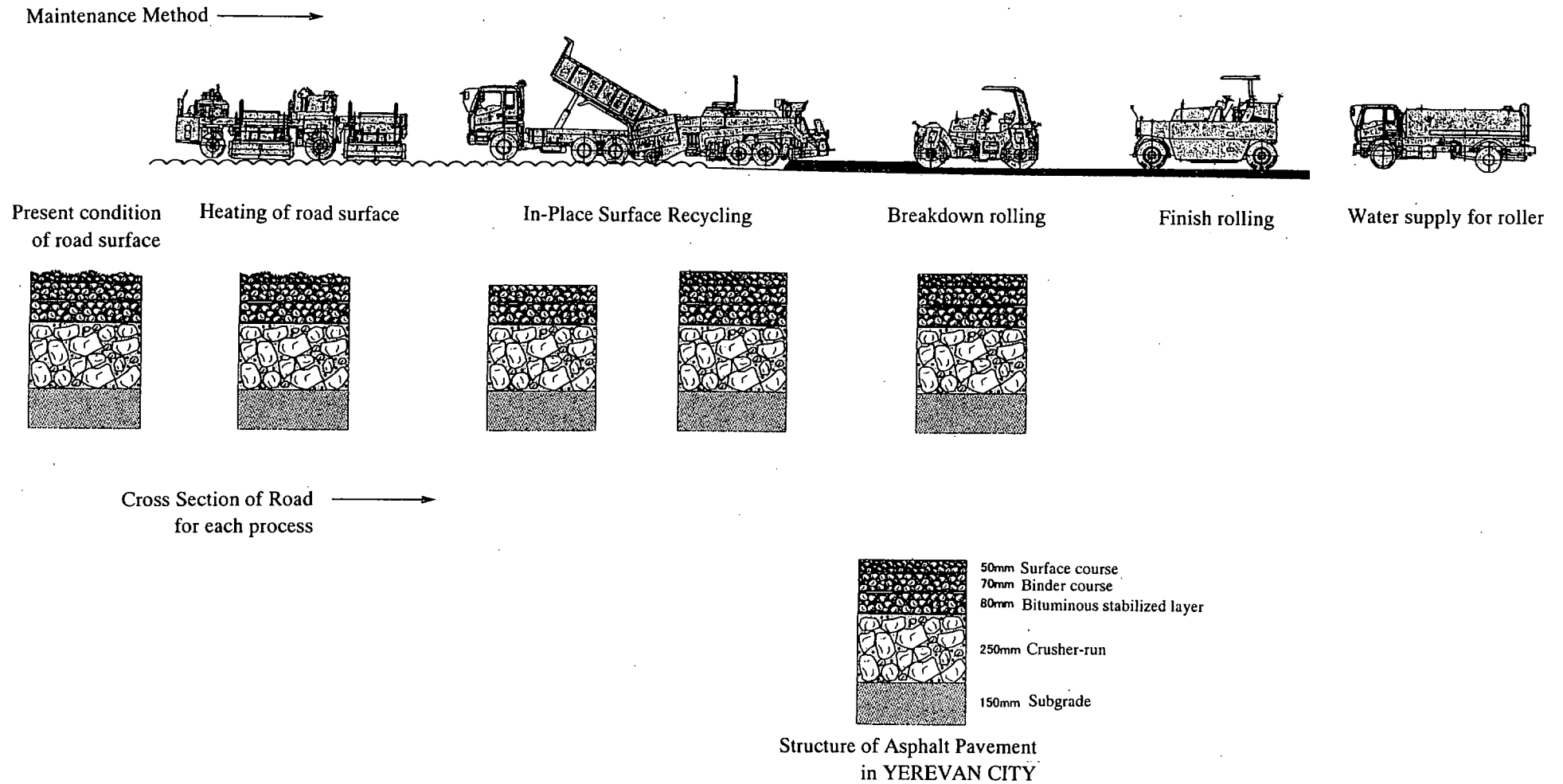
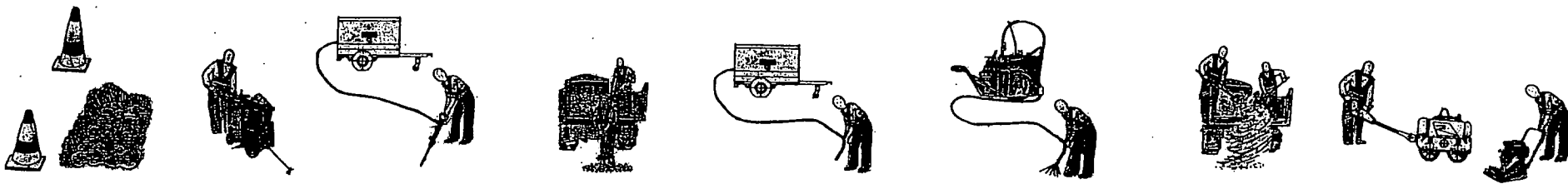


Figure 2-2-2-2 In-Place Surface Recycling Method

Maintenance Method →



Condition of Pothole

Cutting of pavement

Digging

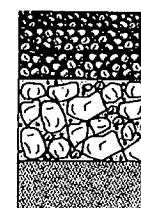
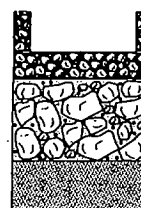
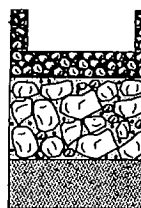
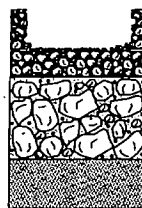
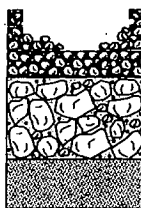
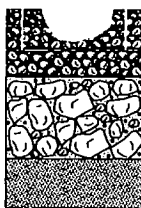
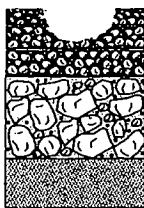
Removal of scrap material

Sweeping

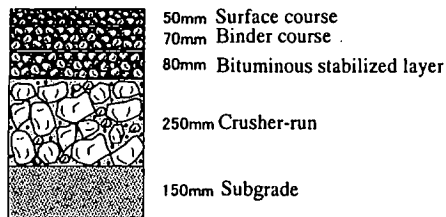
Spraying of bitumen emulsion

Filling in depressions

Compaction



Cross Section of Road for each process →



Structure of Asphalt Pavement
in YEREVAN CITY

2-6

Figure 2-2-2-3 Patching Method

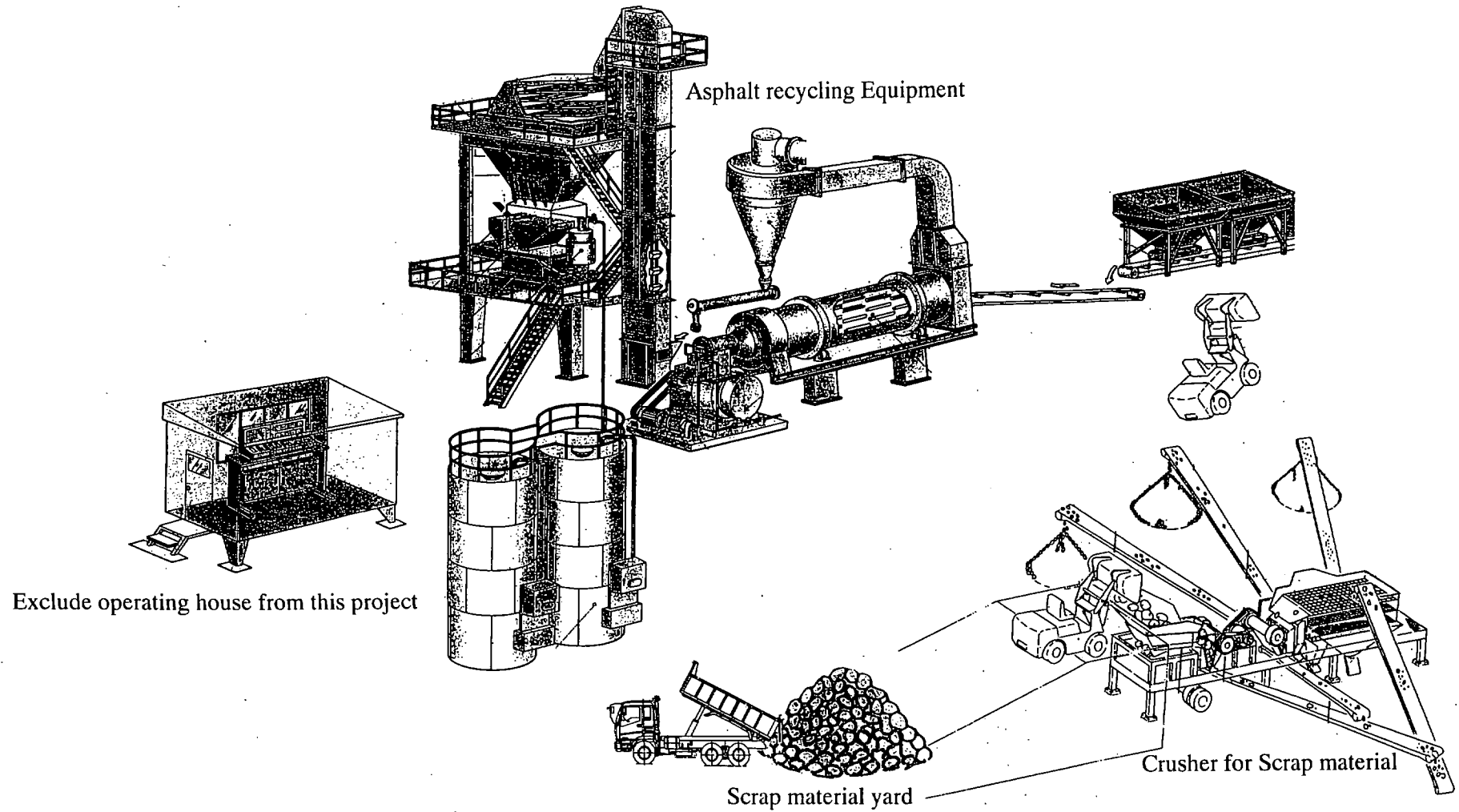


Figure 2-2-2-4 Conceptual Figure of Asphalt Recycle Plant

Table 2-2-2-1 Equipment List for Road Maintenance Methods

		Milling and Overlay Method (Using new hot asphalt mixture : produced in asphalt mixing plant)		Milling and Overlay Method (Using recycle hot asphalt mixture : produced in asphalt recycle plant)		In-Place Surface Recycling Method	Remarks
Asphalt Cutter	1	Cutting of pavement	1	Cutting of pavement	1	Cutting of pavement	Patching
Pneumatic Hand Breaker		Digging of pavement		Digging of pavement		Digging of pavement	
Compressor (digging & cleaning)	2	Cleaning after remove scrap material	2	Cleaning after remove scrap material	2	Cleaning after remove scrap material	
Dump Truck (2 ton)	3	Hauling of scrap material	3	Hauling of scrap material	3	Hauling of scrap material	
Asphalt Sprayer	4	Spraying of bitumen emulsion	4	Spraying of bitumen emulsion	4	Spraying of bitumen emulsion	
Dump Truck (4 ton)	5	Hauling of repair material	5	Hauling of repair material	5	Hauling of repair material	
Vibration Roller (hand guide) Vibration Plate Compactor	6	Compaction	6	Compaction	6	Compaction	
Asphalt Milling Machine	7	Milling of surface pavement	7	Milling of surface pavement	7	Milling of surface pavement	Leveling
Dump Truck (10 ton)	8	Hauling of scrap material	8	Hauling of recycle material	8	Hauling of scrap material	
Compressor (for cleaning)	9	Cleaning of road surface	9	Cleaning of road surface	9	Cleaning of road surface	Overlay
Asphalt Distributor	10	Spraying of prime coat	10	Spraying of prime coat		(Unnecessity)	
Dump Truck (10 ton)	11	Hauling of asphalt mixture	11	Hauling of recycle asphalt mixture	10	Hauling of asphalt mixture	
Asphalt Finisher	12	Spreading of asphalt mixture	12	Spreading of recycle asphalt mixture		(Unnecessity)	
Road Heater		(Unnecessity)		(Unnecessity)	11	Heating of road surface	
Remixer		(Unnecessity)		(Unnecessity)	12	Remixing and spreading for recycle asphalt mixture in-place and new one	
Dump Truck (4 ton)	13	Hauling of material and tools	13	Hauling of material and tools	13	Hauling of material and tools	
Road Roller	14	Breakdown Rolling	14	Breakdown Rolling	14	Breakdown Rolling	
Water Tank Truck	15	Water Supply for Roller	15	Water Supply for Roller	15	Water Supply for Roller	
Tire Roller	16	Finish Rolling	16	Finish Rolling	16	Finish Rolling	
Truck Trailer	17	Hauling of Equipment	17	Hauling of Equipment	17	Hauling of Equipment	
Asphalt Mixing Plant	18	Production of asphalt mixture	18	Production of asphalt mixture	18	Production of asphalt mixture	Plant and Work Shop
Asphalt Recycle Plant		N/A	19	Production of recycle asphalt mixture		N/A	
Wheel Loader	19	Loading of raw material	20	Loading of recycle material	19	Loading of raw material	
Work Shop Equipment	20	Maintenance for equipment	21	Maintenance for equipment	20	Maintenance for equipment	

Table 2-2-2-2 Evaluation Table by Maintenance Method

	Milling & Overlay (New AC)	Milling & Overlay (Recycled AC)	In Place Surface Recycling
Workability	(3 points)	(2 points)	(1 point)
	Already have sufficient knowledge and experience because similar to present work	No problems on the site work as the same reason with the left but need the skill on the operation of recycle plant & design of mix	No experienced personnel and it needs skill for adjustment of the work based on the site condition
Economy	(1 point)	(3 points)	(3 points)
	Rough estimated cost • 10,000,000/km	Rough estimated cost with 50% recycle • 6,500,000/km (it can be reduced by increasing recycle ratio)	Rough estimated cost • 6,000,000/km
Recycle ratio	× (0 point)	(3 points)	(2 points)
	Impossible to recycle dispose all	Possible to recycle all	Partly recycle & partly dispose
Quality of AC	(3 points)	(2 points)	(1 point)
	Possible to supply regular quality of designed mix & temperature	To be irregular by the adjustment of penetration of recycled materials	To be irregular by the surface condition and need the skill for the quality control.
After service of the equipment	(2 points)	(2 points)	(1 point)
	Possible for maintenance at local agent who has the knowledge of basic mechanism even though there is no agency of Japanese equipment	Possible for maintenance at local agent who has the knowledge of basic mechanism even though there is no agency of Japanese equipment	No mechanic who has knowledge of the equipment is available. It needs the time for maintenance due to reporting from site through local agent to Japan
Available of the equipment	(2 points)	(2 points)	(1 point)
	1 model is limited to only one manufacturer	1 model is limited to only one manufacturer	3 models are limited to only one manufacturer
Project cost	(3 points)	(2 points)	(1 point)
Total points of evaluation	14 point	16 point	10 point
	3- , 2- , 1- , 1- ×	2- , 5- , 0- , 0- ×	1- , 1- , 5- , 0- ×

Note: excellent (3 points), ordinary (2 points), poor (1 point), worse × (0 point)

(4) Necessary Number of Equipment

Necessary formation of equipment for the Milling & overlay method with recycled AC is considered based on reasonable road maintenance cost and daily work volume for DIC. The conditions of the works in this calculation are assumed as follows:

- Working period is 8 months only because of the suspension of works during the 4 months of winter.
- Operative days are 20 days per month.
- Unit width of the work in is 8 meter corresponding to the lane width of one carriageway.
- Existing surface level is regarded as 6 cm higher than that of designed level and it shall be milled prior to the overlay.
- The thickness of the overlay is 5 cm.
- Average transport distance of hot-mixed AC is 10 km.
- There is a pothole every 5 meter interval in average.
- Unit cubic weight of hot-mixed AC is 2.3 t/m³

The reasonable work capability of DIC on the production amount of hot-mixed AC will be determined according to the explanation by DIC.

The production amount of hot-mixed AC was 120 t/day on September, 2001 (DIC record). This figure record is bigger than other months. It is concluded that the pavement work capability is set up by the figure of average 120 t/day in accordance with the suitable work volume (upper record) by DIC.

1 Annual work volume

- The work volume (in area) which is equivalent to 120 t/day of hot-mixed AC becomes 1,050 m²/day according to unit cubic weight and thickness of overlay.

The applied formula is as follows;

$$120 \text{ (t/day)} \div 2.3 \text{ (t/m}^3\text{)} \div 0.05 \text{ (m)} = 1,050 \text{ (m}^2\text{/day)}$$

- The annual work volume (in distance) becomes 20 km/year based on road width, monthly working days, annual working months and daily working volume (in area).

The applied formula is as follows;

$$1,050 \text{ (m}^2\text{/day)} \div 8 \text{ (m)} \times 20 \text{ (days/month)} \times 8 \text{ (months/year)} = 20 \text{ (km)}$$

2 Number of dump trucks

- Number of dump trucks necessary for the transport of disposed milled materials.

The work volume of the surface milling is 1,050 m²/day as the result of above item

Volume of disposed milled materials: $1,050 \text{ (m}^2\text{/day)} \times (0.06+0.05) \text{ (m)}$
 $120 \text{ (m}^3\text{/day)}$

Disposing site of milled materials will be located inside the asphalt plant. The transport distance is 10 km. The standard work volume by a dump truck (Loading capacity: 10 t) is about $30 \text{ m}^3\text{/day} \cdot \text{unit}$ according to the Standard of Estimation for Civil Construction, Ministry of Land, Infrastructure and Transport, Japan (SECC).

Necessary number: $120 \text{ (m}^3\text{/day)} \div 30 \text{ (m}^3\text{/day} \cdot \text{unit)} = 4 \text{ units}$

- Number of dump trucks necessary for the transport of hot-mixed AC for overlay.

The transport volume of hot-mixed AC is 120 t/day.

This figure is converted into cubic volume as follows;

$120 \text{ (t/day)} \div 2.3 \text{ (t/m}^3\text{)} = 52 \text{ (m}^3\text{/day)}$

Necessary number: $52 \text{ (m}^3\text{/day)} \div 30 \text{ (m}^3\text{/day} \cdot \text{unit)} = 2 \text{ units}$

Necessary total number of dump trucks is 6 units.

3 Asphalt cutter

For extending pavement life it is necessary to conduct overlay after removing the whole damaged portion on a pothole including cracks.

If the affected area of a pothole forms a square (2.5 m x 2.5m), the total length of cutting pavement on a pothole becomes as follows;

$2.5 \text{ (m/side)} \times 4 \text{ (side)} = 10 \text{ (m/ a pothole)}$

According to SECC, the standard work performance of an asphalt pavement cutter is 220 m/day.

Therefore, the number of potholes based on the above work volume is as follows:

$220 \text{ (m/day)} \div 10 \text{ (m/pothole)} = 22 \text{ (potholes/day} \cdot \text{unit)}$

Daily work length of milling & overlay: $1,050 \text{ (m}^2\text{/day)} \div 8 \text{ (m)} = 131 \text{ (m)}$

Number of potholes in daily work length: $131 \text{ (m)} \div 5 \text{ (m/pothole)} = 27 \text{ (potholes/day)}$

Necessary number: $27 \text{ (potholes)} \div 22 \text{ (holes/day} \cdot \text{unit)} = 1.2 \text{ (units)}$

Necessary total number of asphalt cutter is 2 units.

4 Compressor

The necessary compressors are; 1 unit for digging and cleaning at patching work and 1 unit for cleaning at overlay work. Those 2 kinds of tasks will be conducted at the same time on different places, so the necessary total number of Compressors is 2 units.

5 Pneumatic hand breaker

According to SECC, the standard work performance of a pneumatic hand breaker is $150 \text{ m}^2\text{/day}$.

Daily working volume (in area) of patching pothole is as follows;

$$2.5 \text{ (m)} \times 2.5 \text{ (m)} \times 27 \text{ (potholes/day)} = 169 \text{ (m}^2\text{/day)}$$

Therefore, the necessary number of pneumatic hand breaker is calculated as 2 units based on the daily working volume and the work performance as follows;

$$169 \text{ (m}^2\text{/day)} \div 150 \text{ (m}^2\text{/day} \cdot \text{unit)} = 1.13 = 2 \text{ (units)}$$

6 Vibration compactor

According to SECC, the standard work performance of a compactor is 100 m²/day.

Daily working volume (in area) of patching potholes is 169 m²/day.

Therefore, the necessary number of vibration compactor is calculated as 2 units based on the daily working volume and the work performance as follows;

$$169 \text{ (m}^2\text{/day)} \div 100 \text{ (m}^2\text{/day} \cdot \text{unit)} = 1.69 = 2 \text{ (units)}$$

7 Wheel loader

At the asphalt recycle plant, 1 unit is necessary for supplying materials to the plant and 1 unit for transportation to the crusher.

Working requirements are as follows;

- The distance between the asphalt recycle plant and the crusher is more than 100 m covering the stock yard and access road for transportation. A wheel loader will be operated in this distance.
- Disposed materials that contained asphalt after crushing will combine together and unfit as suitable materials for a recycle plant, because of the size of combined materials becomes bigger than the standard one.
Disposed materials should be crushed within a day after arriving at the site.
A wheel loader will carry the materials from the stock yard of disposed materials to the crusher.
- The working hours of the asphalt recycle plant are approximately 5 hours, considering the closing time of pavement work site. It is necessary to secure the amount of materials within this period.
- The above 2 different transport works are required to be done at the same time, therefore a total of 2 units of wheel loaders are necessary.

Those are the equipment necessary in plural units, but the retained equipment by DIC and/or the equipment possible to procure by themselves, which are listed in the field survey of the basic design study and shown below, are excluded from the procurement list at this time.

- Dump truck (2 ton) for the transportation of depositing materials at patching work

- Dump truck (4 ton) for the transportation of hot-mixed AC at patching works
- Dump truck (4 ton) for the transportation of fuel, tools, etc. at Milling & overlay work
- Asphalt plant for mixing of AC material for Milling & overlay work

As the result of the study, the equipment necessary to procure on this project is listed in Table 2-2-2-3.

Table 2-2-2-3 Necessary Equipment to Procure

Model		unit	Model		unit
1	Asphalt cutter	2	10	Asphalt finisher	1
2	Pneumatic hand breaker	2	11	Road roller	1
3	Compressor (for dig, cleaning)	2	12	Water tank truck	1
4	Asphalt sprayer	1	13	Tire roller	1
5	Vibration roller (hand guide)	1	14	Trailer truck	1
6	Vibration compactor	2	15	Asphalt recycle plant	1
7	Asphalt milling machine	1	16	Wheel loader	2
8	Dump truck (10 ton)	6	17	Workshop facilities	1
9	Asphalt distributor	1			

(5) Spare Parts for the Equipment

Generally the cost for the maintenance and repair of the equipment shall be borne by the implementing agency, and the spare parts also shall be procured by themselves.

However, to reduce the cost of maintenance by the implementing agency and the difficulty on procurement of Japanese spare parts, spare parts of the supplied equipment to be procured by the Japanese side are selected based on the following criteria;

- Parts which are replaced periodically for the prevention of troubles caused by the internal factor of the equipment
- Quantity which will be consumed within approximately 4 years (a period of 4 years is set up based on the average time necessary until the first overhaul of the equipment)

2-2-3 Basic Design Specifications

The technical specifications of the equipment is studied in accordance with the design policy of this Study, standard specifications of the equipment for the Milling & overlay work and road maintenance work of the SECC.

The basic specifications of the selected equipment and its selection reasons are shown in Table 2-2-3-1 and its details are presented in Table 2-2-3-2.

Table 2-2-3-1 Basic Specification of the Equipment

Equipment	Selection Reason	Basic Specification
Wheel loader	Forwarding AC per day with wastage factor 1.2: $1,050 \text{ (m}^2\text{/day)} \times 0.05 \text{ (m)} \times 1.2 = 63 \text{ (m}^3\text{/day)}$, operative hours per day of wheel loader is 4.5 hours/day according to the calculation table of depreciable value, work load is $63 \text{ (m}^3\text{/day)} \times 4.5 \text{ (hr/day)} = 14 \text{ (m}^3\text{/hr)}$, time for one cycle is 180 sec, working efficiency is 0.5, equivalent factor of soil volume is 1.0, loading factor is 0.75, bucket volume is $(14 \times 180) \div (3,600 \times 0.75 \times 1.0 \times 0.5) = 1.9 \text{ (m}^3)$	Bucket Capacity (heaped) 2 m ³ class
Asphalt finisher	Road width of one side is 8 meter, and spread width more than 4 meter is required for working with opening half lane	Max. spread width 4.5m class, wheel type
Asphalt milling machine	Lane width of one side is 8m, so it needs 6 runs with 1.5m milling width, but it can be reduced to 4 runs with 2.0m milling width to reduce the cost of maintenance of the machine	Max. milling width 2.0m class
Vibration roller (hand guide type)	Referred SECC	Weight 700kg class
Vibration compactor	Referred SECC	Weight 60kg class
Tire roller	Referred SECC	Weight 8 ton class
Road roller	Referred SECC	Weight 10 ton class
Asphalt cutter	A cutting depth more than 120mm is required depending on the condition of potholes	Blade size 350mm class
Asphalt sprayer	Spraying volume of asphalt is 43 litter/100m ² , daily volume is $(2.5 \times 2.5 \times 27) \times 43/100 = 73 \text{ litter/day}$ asphalt sprayer with tank capacity 400 litter can reserve asphalt volume for 5 days	Tank capacity 400 litter class
Compressor (digging, cleaning)	To secure the air consumption of 2.4m ³ /min for the utilization of 2-pneumatic hand breaker at the same time	Air delivery volume 3.5m ³ /min class
Pneumatic hand breaker	Suitable weight for man-power	Weight 7kg class
Dump truck	Referred SECC	Loading capacity 10 ton class
Asphalt distributor	Spraying volume of asphalt is 126 litter/100m ² , daily volume is $1,050 \times (126/100) = 1.3 \text{ m}^3\text{/day}$ asphalt sprayer with tank capacity 4m ³ can reserve asphalt volume for 3 days	Tank capacity 4,000 litter class
Trailer truck	To load the maximum weight of 29 ton of asphalt milling machine which is the heaviest weight among supplied equipment	Loading capacity 30 ton class
Water tank truck	To select the smallest tank among over 6,500 litter size which is the volume necessary to transport for water tanks of road roller and tire roller	Tank capacity 8,000 litter class
Asphalt recycle plant	Specific gravity of AC is 2.3t/m ³ , wastage factor is 1.2, forwarding volume of AC per day is; $1,050 \times 0.05 \times 1.2 \times 2.3 = 145 \text{ ton/day}$ according to SECC operative time per day of the plant is 3.79 hr/day, so the required the plant capacity is: $145 \text{ (t/day)} \times 3.79 \text{ (hr/day)} = 38 \text{ (ton/hr)}$	Mix volume of recycled AC 45 ton/hr class
Workshop facilities	Tools, tester, puncture repair facilities, electrical repair facilities, etc. suitable size for the maintenance of the supplied equipment	

Table 2-2-3-2 SPECIFICATIONS FOR EQUIPMENT(1/5)

WHEEL LOADER			ASPHALT FINISHER			ASPHALT MILLING MACHINE			VIBRATION ROLLER (HAND GUIDE TYPE)		
ENGINE OUTPUT	kw	≥88	ENGINE OUTPUT	kw	≥37	ENGINE OUTPUT	kw	≥360	ENGINE OUTPUT	kw	≥3.6
OPERATING WEIGHT	kg	≥9,900	OPERATING WEIGHT	kg	≥7,400	OPERATING WEIGHT	kg	≥28,900	OPERATING WEIGHT	kg	≥610
DIMENSIONS			DIMENSIONS (transportation)			DIMENSIONS			DIMENSIONS		
•Overall Length	mm	≤7,500	•Overall Length	mm	≤6,450	•Overall Length	mm	≤16,500	•Overall Length	mm	≤2,900
•Overall Width	mm	≤2,800	•Overall Width	mm	≤2,500	•Overall Width	mm	≤2,500	•Overall Width	mm	≤810
•Overall Height	mm	≤3,400	•Overall Height	mm	≤3,300	•Overall Height	mm	≤3,800	•Overall Height	mm	≤1,240
•Ground Clearance	mm	≥350	UNDER CARRIAGE			•Wheel Base	mm	≥6,000	•Wheel Base	mm	≥500
•Wheel Base	mm	≥2,800	•Type	Wheel		PERFORMANCE			PERFORMANCE		
PERFORMANCE			•Size			•Max. Working Speed	m/min	≥30	•Max. Travel Speed	km/h	≥3
•Max. Travel Speed			Front	≥18-6-12		•Cutting Width	mm	≥2,000	•Frequency	Hz	≥55
Forward—Reverse	km/h	≥33-21	Rear	≥11-20-12		•Max. Cutting Depth	mm	≥150	•Centrifugal Force	kN	≥10
•Min. Turning Radius	mm	≤6,500	PERFORMANCE			•No. of Cutter Bits	pcs	≥135	ENGINE		
•Digging Force	kN	≥90	•Max. Paving Speed	m/min	≥10	CONVEYER			•Type	Diesel	
WORKING RANGE			•Capacity of Hopper	ton	≥7.5	•Belt Width	mm	≥600	•Displacement	cc	≥300
•Dumping Clearance	mm	≥2,600	WORKING RANGE			•Loading Height	mm	≥3,500	UNDER CARRIAGE		
•Dumping Reach	mm	≥880	•Standard Paving Width	mm	≥2,000	•Swing Angle	deg	≥25	•Roller		
•Digging Depth	mm	≥50	•Max. Paving Width	mm	≥4,400	ENGINE			Type	Smooth	
ENGINE			(infinitely variable)	mm	≥4,400	•Type	Diesel		Steel Drum		
•Type	Diesel		•Max. Paving Thickness	mm	≥150	•Displacement	cc	≥15,200	Diameter	mm	≥350
•Displacement	cc	≥5,500	ENGINE			UNDER CARRIAGE			Width	mm	≥630
TIRE			•Type	Diesel		•Type	Wheel		No. of Roller	pcs	2
•Size	≥17.5-25-10		•Displacement	cc	≥2,950						
BUCKET			BAR FEEDER								
•Type	General Purpose		•Max. Speed	m/min	≥12						
•Capacity (heaped)	m ³	≥1.9	SCREW SPREADER								
CANOPY			•Max. Revolution	rpm	≥50						
•Type	ROPS		SCREED								
			•Max. Frequency	Hz	≥36						
			HEATER			LPG					
			ATTACHMENT			Canopy					

2-15

Symbol

≥ : equal or over

≤ : equal or less

Table 2-2-3-2 SPECIFICATIONS FOR EQUIPMENT(2/5)

VIBRATION PLATE COMPACTOR			TIRE ROLLER			ROAD ROLLER			ASPHALT CUTTER		
ENGINE OUTPUT	KW	≥2	ENGINE OUTPUT	kw	≥68	ENGINE OUTPUT	kw	≥56	ENGINE OUTPUT	kw	≥5
OPERATING WEIGHT	kg	≥55	WEIGHT			OPERATING WEIGHT	kg	≥9,450	OPERATING WEIGHT	kg	≤140
DIMENSIONS			• Empty Weight	kg	≥8,450	DIMENSIONS			DIMENSIONS		
• Overall Length	mm	≤1,200	• Gross Weight	kg	≥12,900	• Overall Length	mm	≤5,200	• Overall Length	mm	≤2,000
• Overall Width	mm	≤400	DIMENSIONS			• Overall Width	mm	≤2,200	• Overall Width	mm	≤600
• Overall Height	mm	≤900	• Overall Length	mm	≤5,200	• Overall Height	mm	≤2,600	• Overall Height	mm	≤1,100
• Plate (L × W)	mm	≥510 × 340	• Overall Width	mm	≤2,300	• Wheel Base	mm	≥3,200	PERFORMANCE		
PERFORMANCE			• Overall Height	mm	≤2,700	PERFORMANCE			• Blade Size	mm	≥350
• Max. Working Speed	km/h	≥21	• Wheel Base	mm	≥3,700	• Max. Travel Speed	km/h	≥13	• Max. Cutting Depth	mm	≥120
• Frequency	Hz	≥90	PERFORMANCE			• Min. Turning Radius	mm	≤7,000	ENGINE		
• Centrifugal Force	kN	≥8	• Max. Travel Speed	km/h	≥19	• Rolling Width	mm	≥2,000	• Type		Gasoline
ENGINE			• Min. Turning Radius	mm	≤7,000	ENGINE			• Displacement	cc	≥200
• Type		Gasoline	• Rolling Width	mm	≥2,000	• Type		Diesel	OPTIONAL GOODS		
• Displacement	cc	≥120	ENGINE			• Displacement	cc	≥3,000	• Cutter Blade	pcs	5
			• Type		Diesel	UNDER CARRIAGE					
			• Displacement	cc	≥5,700	• Front Roller					
			UNDER CARRIAGE			Type		Smooth			
			• Tire			Drum Dia.	mm	≥1,500			
			Type		Smooth	Drum Width	mm	≥500			
			Size		≥9-20-10	No. of Tire	pcs	2			
			No. of Tire	pcs	Front: ≥3	• Rera Roller					
				pcs	Rear: ≥4	Type		Smooth			
						Drum Dia.	mm	≥1,500			
						Drum Width	mm	≥1,000			
						No. of Tire	pcs	1			

Symbol

≥ : equal or over

≤ : equal or less

Table 2-2-3-2 SPECIFICATIONS FOR EQUIPMENT(3/5)

ASPHALT SPRAYER			COMPRESSOR			PNEUMATIC HAND BREAKER			DUMP TRUCK		
ENGINE OUTPUT	kw	≥2.6	ENGINE OUTPUT	kw	≥26	WEIGHT	kg	≥7	ENGINE MAX OUTPUT	kw	≥200
DIMENSIONS			OPERATING WEIGHT	kg	≤830	DIMENSIONS			WEIGHT		
•Overall Length	mm	≤3,300	DIMENSIONS			•Body Length	mm	≥460	•Max. Loading Capacity	kg	≥10,000
•Overall Width	mm	≤1,900	•Overall Length	mm	≤2,500	•Cylinder Dia.	mm	≥35	•Vehicle Weight	kg	≥8,700
•Overall Height	mm	≤1,800	•Overall Width	mm	≤1,550	•Shank Dia.	mm	≥25	•Gross Vehicle Weight	kg	≥19,000
PERFORMANCE			•Overall Height	mm	≤1,350	•Shank Length	mm	≥80	DIMENSIONS		
•Spraying Capacity	L/min	≥25	PERFORMANCE			•Hose dia.	mm	≥19	•Overall Length	mm	≤7,700
•Loading Capacity	liter	≥400	•Free Air Delivery	m ³ /min	≥3.5	PERFORMANCE			•Overall Width	mm	≤2,500
ENGINE			•Working Pressure	MPa	≥0.65	•No. of Blows	bpm	≥900	•Overall Height	mm	≤3,300
•Type		Gasoline	ENGINE			•Air Consumption	m ³ /min	≤1.6	•Wheel Base	mm	≥3,300
BURNER			•Type		Diesel	•Piston Stroke	mm	≥120	•Body		
•Type		Kerosene	•Displacement	cc	≥1,400	OPTIONAL GOODS			Length	mm	≥4,800
UNDER CARRIAGE			UNDER CARRIAGE			•Hose		20m×2pcs	Width	mm	≥2,200
•Tire			•Tire			•Hose Band	pcs	4	Height	mm	≥890
Size		≥6.5-16-8	Size		≥5-10-6	•Moil Point Shank	mm	450	PERFORMANCE		
No. of Tire	pcs	2	No. of Tire	pcs	2	•No. of Moil Point	pcs	5	•Max. Travel Speed	km/h	≥85
OPTIONAL GOODS			OUTLET VALVE						•Min. Turning Radius	mm	≤7,600
•Spray Hose			•Size	mm	≥19				•Gradeability	deg	≥20
Dia.×Length	mm	≥19×5,000	•No. of Valve	pcs	≥2				ENGINE		
No. of Hose	pcs	2							•Type		Diesel
•Spray Bar									•Displacement	cc	≥12,500
Dia.×Length	mm	≥19×1,600							POWER LINE		
No. of Bar	pcs	4							•Number of Speed		≥6F-1R
•Spray Nozzle									TIRE		
No. of Nozzle	pcs	8							•Size		≥11R22.5-14
									•Number of Tire	pcs	10

Symbol

≥ :equal or over

≤ :equal or less

Table 2-2-3-2 SPECIFICATIONS FOR EQUIPMENT(4/5)

ASPHALT DISTRIBUTER			TRUCK TRAILER						WATER TANK TRUCK		
ENGINE OUTPUT	kw	≥ 115	TRUCK TRACTOR			SEMI TRAILER			ENGINE MAX OUTPUT	kw	≥ 140
WEIGHT			ENGINE OUTPUT	kw	≥ 210	WEIGHT			WEIGHT		
•Max. Loading Capacity	kg	≥ 3,500	WEIGHT			•Max. Loading Capacity	kg	≥ 30,000	•Max. Loading Capacity	kg	≥ 8,000
•Vehicle Weight	kg	≥ 5,500	•Max. Combination Mass	kg	≥ 40,000	•Vehicle Weight	kg	≥ 7,000	•Vehicle Weight	kg	≥ 5,800
DIMENSIONS			•Vehicle Weight	kg	≥ 6,400	•Gross Vehicle Weight	kg	≥ 37,000	•Gross Vehicle Weight	kg	≥ 14,000
•Overall Length	mm	≥ 8,000	•Gross Vehicle Weight	kg	≥ 15,500	DIMENSIONS			DIMENSIONS		
•Overall Width (without Bar)	mm	≥ 2,500	DIMENSIONS			•Overall Length	mm	≤ 13,500	•Overall Length	mm	≤ 8,000
•Overall Height	mm	≤ 3,000	•Overall Length	mm	≤ 6,900	•Overall Width	mm	≤ 3,200	•Overall Width	mm	≤ 2,500
•Wheel Base	mm	≥ 3,700	•Overall Width	mm	≤ 2,500	•Overall Height	mm	≤ 3,300	•Overall Height	mm	≤ 3,300
•Asphalt Tank Capacity	m ³	≥ 4	•Overall Height	mm	≤ 3,300	•Body			•Wheel Base	mm	≥ 4,100
PERFORMANCE			•Wheel Base	mm	≥ 3,100	Length	mm	≥ 6,500	TANK		
•Max. Travel Speed	km/h	≥ 90	PERFORMANCE			Width	mm	≥ 2,950	•Capacity	liter	≥ 8,000
•Min. Turning Radius	mm	≤ 8,000	•Max. Travel Speed	km/h	≥ 90	Height	mm	≥ 800	PERFORMANCE		
ENGINE			•Front Fitting Radius	mm	≤ 3,000	PERFORMANCE			•Max. Travel Speed	km/h	≥ 95
•Type		Diesel	•Gradeability	deg	≥ 13	•Rear Fitting Radius	mm	≤ 2,200	•Min. Turning Radius	mm	≥ 8,000
•Displacement	cc	≥ 6,500	ENGINE			TIRE			ENGINE		
SPRAY SYSTEM			•Type		Diesel	•Size		≥ 8.25-16-14	•Type		Diesel
•Engine Output	kw	≥ 6.7	•Displacement	cc	≥ 12,500	•No. of Tire	pcs	≥ 8	•Displacement	cc	≥ 6,900
•Max. Spray Width	mm	≥ 3,600	POWER LINE			ATTACHMENT			POWER LINE		
•Spraying Capacity	L/min	≥ 350	•No. of Speed		≥ 7F-1R	•Loading Ramp		Manual or Spring	•Number of Speed		≥ 5F-1R
•Nozzle Setting Interval	mm	≥ 120	TIRE						TIRE		
TIRE			•Size		≥ 11-20-14				•Size		≥ 10-20-14
•Size		≥ 8.25-16-14	•No. of Tire	pcs	10				•Number of Tire	pcs	6
•No. of Tire	pcs	6									

Symbol

≥ : equal or over

≤ : equal or less

Table 2-2-3-2 SPECIFICATIONS FOR EQUIPMENT(5/5)

ASPHALT RECYCLE PLANT						WORK SHOP EQUIPMENT	
RECYCLE CAPACITY	t/h	45				High-speed Cutter	Cutting Blade Dia. 405mm
DRYER			ADDITIVE SUPPLY UNIT			Garage Jack	10t and 20t
•Drum Dia.	mm	≥1,800	•Tank Capacity	liter	≥500	Portable Jack	10t : 2pcs. and 50t : 2pcs.
•Drum Length	mm	≥8,000	•Spray Pump Capacity	L/min	≥50	Diesel Inject. Pump Tester	8cylinder, 7.5kw motor
•Thickness of Lagging	mm	≥50	•Heater Capacity	kw	≥2	Lubrication System	Pneumatic Concentrating system
•Burning		Natural Gas	MIXER			Parts Washer	Jet washer type
•Blower Capacity	m ³ /min	≥120	•Type		Twin Shaft	AC Arc Welder	300A with welding accessories
STOCK BIN					Pug-mill	Air Compressor	15kw motor, with piping
•Surge Bin Capacity	ton	≥30	•Capacity	kg	≥800	High Pressure Car Washer	Cap. 900L/h, Press.100kg/cm ²
•Skip Bucket Capacity	kg	≥800	CHARGE HOPPER			Battery Charger	DC Output 6-12V/50A, 12-24V/35A
•Thickness of Lagging	mm	≥75	•Capacity	m ³	≥4		
•Heater Capacity	kw	≥11	•Quantity	pcs	≥3	Tester	Circuit Tester, Diesel Tachometer, Hydraulic Test Gauge, Nozzle Tester, Battery Hydrometer, Cylinder Bore Gauge, Volt Ampere Regulator, Dial Gauge & stand, Vernire Caliper(300mm), Micrometer(0-25, 50-75,75-100mm),Torque Wrench(10-45, 40-180,100-700Nm)
WEIGHING UNIT			•Feeder		Variable Speed Belt Conveyor		
•Type		Load cell	FILLER SUPPLY UNIT				
•Capacity	kg	≥1,000	•Hopper Capacity	m ³	≥4		
•Heater Capacity	kw	≥4	•Stock Unit Type		Elevator		
DUST COLLECTOR			•Feeder		Screw Conveyor		
•Primary		Cyclone Type	OPERATION SYSTEM			Mechanic Tool	Total 150 items of hand tools (metric & inch size) with steel tool cabinet : 3sets
•Secondary		Venturi Wet	•Control Panel		Indoor Type	Machine Tool	Disc Grinder : 2pcs., Electric Hand Drill : 2pcs.,Drill Bit : 2sets, Tap & Dies(M3~M20)
•Water Pump Capacity	L/min	Scrubber Type	•Scope of Control		Supplying,Weighing and Burning	Removal Tool	Hydraulic Puller (30t ram), Impact Wrench (1/2sq:8-32mm,3/8-5/4inch),Impact Wrench (3/4sq:19-46mm,3/4-3/2inch), Impact Wrench (1sq:32-50mm,3/2-11/4inch)
ASPHALT SUPPLY UNIT			CRUSHING UNIT			Tire Changer	Applicable Rim Dia. 16-26 inch
•Tank Capacity	ton	≥10	•Crushing Capacity	t/h	30		
•Spray Pump Capacity	L/min	≥50	•Product Size	mm	0-13		
•Transfer Pump Capacity	L/min	≥190	•Conveyor Belt Width				
•Heater Capacity	kw	≥2	Main	mm	≥500		
•Burning		Heavy Oil	Return & Stock	mm	≥400		
•Fuel Tank Capacity	liter	≥1,000					
•Fuel Pump Capacity	L/min	≥25					

Symbol

≥ : equal or over

≤ : equal or less

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

(1) Implementation System

In case of implementing this project under the Japan's Grant Aid, the relationship between the concerned parties is shown in Figure 2-2-4-1 below.

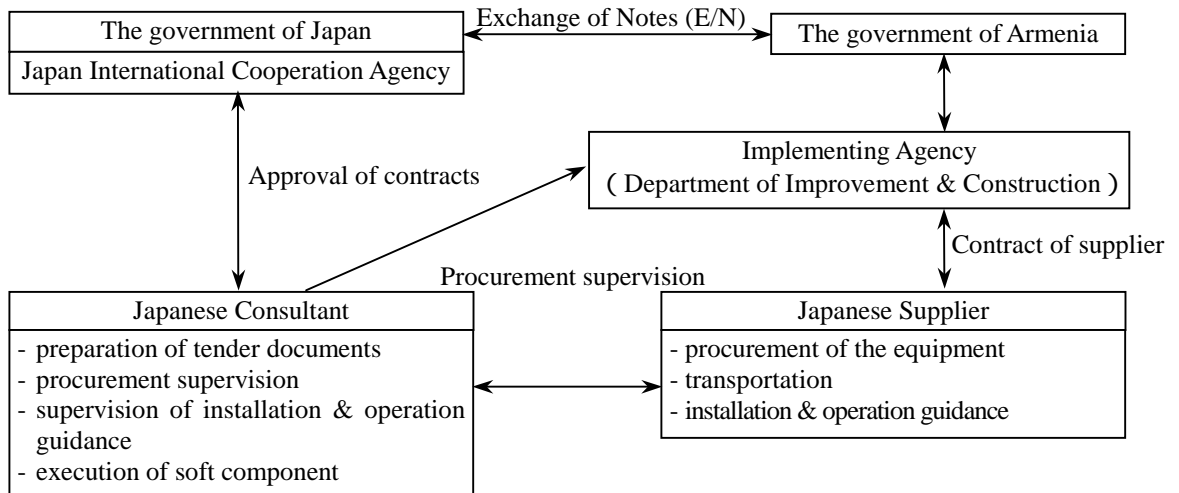


Figure 2-2-4-1 Relationship of Each Parties

Implementing agency of Armenian side is the Department of Improvement & Construction, the Government of Yerevan Municipality (DIC). In accordance with the provision of Japan's Grant Aid scheme, a Japanese consultant is in charge the detailed design and the procurement supervision, and a Japanese physical personnel shall be a contractor for the procurement of the equipment in this project.

(2) Consultant

After signing of E/N, DIC shall promptly conclude the agreement for the consulting services on the execution of this project with a Japanese consulting firm. The consultant contracted with DIC shall provide the engineering services on the detailed design, preparation of tender documents, assistance in tender, procurement supervision, etc., and shall take a responsibility up to the turning over of the equipment and the completion of the soft component.

(3) Supplier

Successful tenderer (supplier), qualified by the evaluation on the required quality and

specification through the general competitive bidding with conditions of applicants qualification, will make a contract with DIC for the delivery of the equipment of this project. Supplier shall take a responsibility on the honest execution for the delivery of the equipment required by DIC, installation guidance, operation guidance and daily inspection guidance within the period of the execution.

2-2-4-2 Implementation Conditions

Supplied equipment shall be delivered by the supplier to the yards instructed by DIC. After delivering the equipment at the instructed yards, supplier shall carry out installation guidance for the equipment necessary to install, operation guidance and daily inspection guidance for all equipment with prior inspection for proper functioning by the test operation, then it shall be turned over to DIC.

2-2-4-3 Scope of Works

The cost for procurement of the equipment including inland transportation shall be borne by Japanese side. Armenian side shall be required to arrange the exemption from customs duties, internal taxes and other fiscal levies involving the import of the equipment.

The demarcation on the installation of asphalt recycle plant and workshop facilities are as follows:

- Installation guidance shall be borne by Japanese side
- Acquisition of a lot for installation, leveling, preparation works including foundation, arrangement of the equipment, facilities and labor necessary for the installation work and supplying primary power source and fuel shall be borne by Armenian side.
- Removal and transfer of existing structures which obstruct the installation of supplied equipment shall be borne by Armenian side.

Items shown below shall be submitted to Armenian side in advance from Japanese side.

- Drawings of a lot for the installation
- Drawings of foundation design
- Drawings of installation
- Types, numbers of equipment, facilities, tools and labor and necessary days for installation
- Electric power consumption

2-2-4-4 Consultant Supervision

(1) Basic Policy of Procurement Supervision

In case of implementing this project under Japan's Grant Aid, particularly the sufficient understanding on the following matters is necessary for the preparation of tender documents and the execution of the procurement supervision.

- Background of the decision on the project
- Basic Design Study Report
- Japan's Grant Aid Scheme
- Exchange of Notes concluded between the two countries

Based on the above, the summary of the work, demarcation and remarks on the detailed design and procurement supervision are explained.

(2) Consulting Services

After the signing of E/N, the consultant shall conclude the agreement for consulting services with implementing agency based on the scope of works mentioned in E/N. The major works of the consultant are as follows:

1) Detailed design

- Discussion & preparation of tender documents (Armenia/Japan)
- Approval by Armenian side on the tender documents (Armenia)
- Execution of tender, evaluation, report & approval on its result (Japan)
- Promotion of the contract procedure (Armenia/Japan)
- Confirmation of the obligation borne by Armenian side (Armenia/Japan)

2) Procurement supervision

- Confirmation of the issuance of order sheets for the equipment
- Observation of the progress of the procurement
- Carrying out a factory inspection
- Assignment of an inspection agency for a pre-shipment inspection
- Carrying out a turning over inspection
- Report the progress
- Presence at the turning over
- Issuance of certificate of the completion

3) Operation guidance of the equipment

The operation guidance and daily inspection guidance of the equipment shall be carried out by the engineers of the manufactures under the control of the consultant.

4) Soft component

To secure the earlier appearance of project effect and its durability on the road maintenance works by the DIC, who manages the road maintenance equipment procured by the Grant Aid, the soft component is introduced as the technical support on the equipment management, maintenance works, detailed design of road rehabilitation

and construction supervision.

(3) Remarks on the Service

The tender documents shall be prepared through confirmation of the equipment type and its specification studied on the basic design study and also review of the contents of the design after signing of E/N to fit the specification with the purpose of the equipment project under the Grant Aid.

2-2-4-5 Procurement Plan

Most of the equipment retained by DIC are products of former Soviet Union or former Eastern Germany. The construction equipment made in Japan or third countries is not popular in Armenia, and isn't represented by any agent.

If the implementation of this project is approved, the existence of the local agent is required for the maintenance of the supplied equipment. It is guessed that the procurement of spare parts by the agent will be made via Moscow, so the condition of the Japanese and/or third country's equipment will be the similar on this point.

Considering the above condition, the procurement plan was established as follows:

(1) Country of Origin

Japan: This case will get definite promise on the delivery time and quality, be able to satisfy the price level. The service system will be secured based on the local agency where should be set up in the tendering conditions. On the execution of the soft component regarding maintenance of equipment under Japanese standard, the Japanese guideline will be able to be reflected.

Armenia: There isn't any manufacturer of the equipment in Armenia satisfies the specifications.

Third country: All kinds of equipment procured by the project will be produced in Japan. The fairness of tender will be secured in limited Japanese products. The price including transportation cost hasn't big difference and there isn't any urgency. Therefore, there is no need for the procurement in a third country for the project.

Principally the procurement of Japanese products it adopted in this project.

(2) Delivery Route

The delivery route to Yerevan City is considered as follows:

1) Via Georgia

The cargo is transported from Japan to an international port in the Mediterranean Sea by general cargo ship, transshipped to draw light feeder boat for crossing the Black Sea, unloaded at Poti Port in Georgia, then transported inland.

There are routes of inland transportation by road and rail both of which start from Poti Port to Yerevan via Tbilisi in Georgia, Sadakhle at the Georgian side border.

The necessary time for transportation from Poti Port is 3 ~ 4 days by road and 5 ~ 6 days by rail. Regarding this route for inland transportation, there isn't any remarkable problems as shown below.

- To shorten the time for inland transportation from disembarkation port
- No obstacles on the route so that no restriction for the height of cargo loading
- No steep grade sections even in mountainous roads so that no hindrance passing by large vehicles even in winter
- To secure the balance of the cargo due to good condition of the pavement

2) Via Iran

The cargo is transported from Japan to Dubai Port in the United Arab Emirates by general cargo ship, transshipped to barge, and unloaded at Bandar Abbas Port in Iran, then transported inland. There is the route of inland transportation by road which starts from Bandar Abbas Port to Yerevan via transnational road in Iran, Agarak at the Iranian side border.

The necessary time for transportation from Bandar Abbas Port is 10 ~ 14 days. It is supposed that the road transport will be difficult in winter season because the route is passing through the mountains in Northern Iran.

In this project, it is required to complete all the tasks before winter. Therefore it is necessary to shorten the time schedule on each step and to avoid the delay caused by indefinite factors.

The delivery route via Georgia, which has no hindrance on the route and shortens the necessary time for transportation, is adopted as the delivery route in this Project. The delivery route to Armenia is shown in Figure 2-2-4-2.

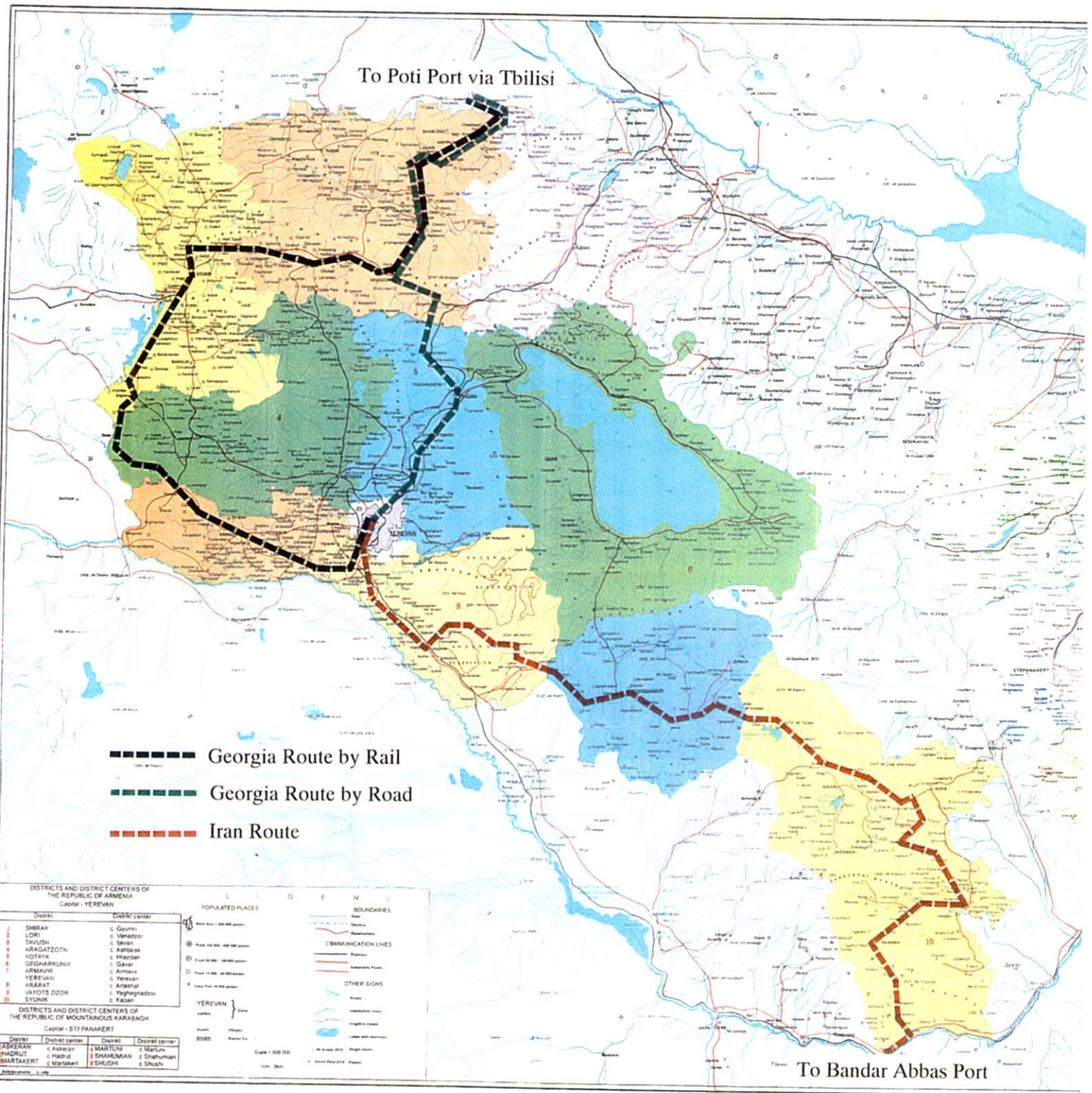


Figure 2-2-4-2 Delivery Route in Armenia

(3) Tendering Method

The country of origin of the equipment is limited to Japan as mentioned in prior paragraph, and some equipment will be limited only to one manufacturer. Regarding these equipment, fairness of the tenders shall be secured by dividing the tender into lots in accordance with the difference of equipment function and limited manufacturer and to enforce the manufacture to submit a written oath for issuance of the quotation to every tenderers.

2-2-4-6 Quality Control Plan

To confirm that the technical specifications appointed in the contract of supplier are satisfactory, the consultant shall carry out the following inspections on each step during the procurement of the equipment.

- Confirmation of the issuance of the order sheets for the equipment
- Carrying out a factory inspection
- Assignment of an inspection agency for a pre-shipment inspection
- Carrying out a turning over inspection

2-2-4-7 Implementing Schedule

Implementing schedules for the equipment procurement by the Government of Japan are shown in Table 2-2-4-1.

Table 2-2-4-1 Implementation Schedule

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
D/D Assistance in Tendering	■ (Detailed Design, Preparation of Tender Documents)																		
		□ (Tender Publication, Tendering, Tender Evaluation)			■														
					□ (Supplier Contract, Verification of Contract)														
Procurement Supervision					□ (Fabrication of Equipment)														
											■ (Transportation)								
													■ (Final Inspection, Trial Operation, Turnover)						
Technical Assistance					■ (Discussion of Detailed Plan)														
													■ (Preparation of Manual Holding Seminar)						
															■ (Training in Site)				

■ (Work in Armenia)

□ (Work in Japan)

2-3 OBLIGATIONS OF RECIPIENT COUNTRY

During the implementation of the Project, if approved, the obligations of the government of Armenia and the Yerevan Municipality are as follows:

- To bear the commissions to the Japanese foreign exchange bank for its banking services.
- To ensure prompt tax exemption, customs clearance and internal transportation of the equipment purchased under the project.
- To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contract such facilities as may be necessary for their entry into Armenia and stay therein for the performance of their work.
- To exempt Japanese national 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 verified contracts.
- To provide necessary permissions, licenses and other authorizations for implementing the project.
- To provide data and information necessary for the project.
- To secure and reform a lot for an asphalt recycle plant, including leveling, distribute primary power source, water supply and sewage and construct plant foundation.
- To remove existing structures obstructing the installation of an asphalt recycle plant.
- To install the asphalt recycle plant including the equipment, facilities, tools, fuel, labor.
- To secure a lot and facilities for new repair workshop, distribute primary power source, water supply and sewage and construct facility foundations.
- To relocate the existing workshop facilities to a new workshop
- To install the workshop facilities procured by the project
- To secure and level a lot for parking yard of the equipment.
- To maintain and use properly the equipment.
- To implement rehabilitation work on concerned roads.

Project cost borne by the Republic of Armenia is estimated at US\$15,600.

A breakdown of estimated cost:

- Installation cost of asphalt recycle plant: US\$12,500
- Installation cost of workshop facilities : US\$3,100

2-4 PROJECT OPERATION PLAN

Maintenance Work for the municipal roads of Yerevan City shall be done under direct management of the DIC utilizing supplied equipment. Also the maintenance of the equipment shall be done by DIC.

The implementing system for the above tasks is already organized under DIC, and basically this organization shall be in charge of the project management and maintenance program.

The cost for the management of the equipment is estimated at US\$187,000 and the details are presented in Table 2-4-1.

Table 2-4-1 Annual Operation Cost of Equipment

Type of equipment	Output (Kw)	Base price (1,000 Yen)	Annual working hours (h)	Annual repair ratio (%)	Fuel and oil consumption (l/Kw·h)	Maintenance cost (② x ④) (1,000 Yen)	Fuel & oil ⑤x ①x ③ x 0.039 (1,000 Yen)	Annual labor cost (1,000 Yen)	Equipment operation cost ⑥+⑦+⑧ (1,000 Yen)	No. of unit	Total equipment operation cost ⑨ x ⑩ (1,000 Yen)
Wheel loader	91	14,200	540	5.91	0.156	839	299	120	1,258	2	2,516
Asphalt finisher	70	32,900	460	3.81	0.155	1,255	195	120	1,570	1	1,569
Asphalt milling machine	273	47,200	380	3.77	0.145	1,781	587	120	2,488	1	2,488
Vibration roller	5	1,210	470	3.77	0.205	46	19	120	184	1	184
Vibration compactor	3	145	300	11.96	0.31	17	17	120	154	2	309
Tire roller	71	7,240	450	3.69	0.102	267	127	120	514	1	514
Road roller	66	6,280	470	2.87	0.114	180	138	120	438	1	438
Asphalt cutter	4	210	300	7.50	0.231	16	17	120	153	2	305
Asphalt sprayer	2.6	166	300	9.09	0.231	15	11	120	146	1	146
Compressor	26	1,500	350	3.37	0.211	50	75	120	245	2	491
Pneumatic hand breaker	-	50	-	6.67	-	3	0	120	123	2	247
Dump truck	246	9,350	1,040	7.41	0.054	693	539	120	1,351	6	8,108
Asphalt distributor	123	8,140	720	4.81	0.094	391	325	120	836	1	836
Trailer truck	235	15,800	700	3.68	0.076	581	488	120	1,189	1	1,189
Water tank truck	199	8,420	720	5.56	0.041	468	229	120	817	1	817
Asphalt recycle plant	151	75,000	720	6.18	360	4,635	10,109	480	15,224	1	15,224
Workshop facilities	-	-	-	-	-	-	-	480	480	1	480
Total										25 + 2	35,861
Convert Total into 8 months ⑩ x 2/3											23,907

Notes:

- Repair ratio means maintenance and repair cost to keep equipment good condition.
- Fuel and oil costs mean Diesel (175 A.Dram) and Gasoline (275 A.Dram).
- Labor cost means ¥10,000/month for equipment operator and mechanic.

2-5 IMPLEMENTATION PLAN OF SOFT COMPONENT

Enforcement burden matters concerning equipment management/maintenance management for by Armenian side, and to smoothly promote design and construction of road repair, the road maintenance management, which utilizes the equipment supplied under the Grant Aid, should consider the following matter as a subject that be coped with in first stage.

- Solution of the technical level problems faced by the Armenian side on management / maintenance management of the road maintenance equipment:
 - The required technical level of equipment operation management (construction method, arrangement plan)
 - There is no much achievement of road repair due to limited number of operational equipment in DIC.
 - There is lack of experience for equipment operation management and the sufficient performance of procured equipment can not be obtained.
 - A guideline of equipment operation management will provide the knowledge of function and effect on working quality for each equipment
 - The equipment operation management is the important factor for the road repair work to be completed within the construction period in high quality.
 - The required technical level of equipment maintenance management (daily inspection, periodic maintenance).
 - Inspection of equipment in DIC is carried out during the winter period when the repair work is stopped. Any daily inspection and periodic maintenance haven't been conducted.
 - Regular inspection is important for equipment to keep long life operation and for preventing mechanical trouble.
 - The guidance on equipment maintenance management will improve the present sense of maintenance management. Therefore such guidance should be secured to make procured equipment be operated for more long time.
- Solution of the technical level problem faced by the Armenian side holds on the design and construction of road repair (maintenance management).
 - The required technical level of a road repair plan (construction method, material/labor procurement).
 - Patching pothole is the major maintenance method in DIC with few experience in the milling and overlay method proposed by the Project.
 - The guidance on road repair plans will introduce the total construction method of milling and overlay according to the execution plan, necessary equipment and materials, timing and volume of labor. Therefore the execution of road maintenance work by milling and overlay method will become possible.

- The required technical level of construction supervision (quality, measurement, schedule control).
 - DIC hasn't enough experience on mixed-overlay method, therefore it is difficult for them to use the manual of construction supervision for mixed-overlay method.
 - In case of insufficient construction supervision work, various problems will arise such as missing the quality of design, shortening the design life, delaying the construction period and spending more costs.
 - The guidance on a suitable construction supervision method will introduce DIC to shortening the period of maintenance work with high quality and economization.

Considering the above items, technical support will be conducted on the following tasks of road repair work by the method of Milling overlay:

(1) Method and Contents

Preparation of Manuals and Programs

During the detailed design period of this project, manuals for the technical training will be prepared. The following documents are considered to be necessary.

- Equipment operation manual
- Equipment maintenance manual
- Road repair construction program
- Construction supervision manual
- Technical guidelines

Seminar

Before the site training, a seminar will be held to introduce and lecture on the methods of management using the above manuals, aiming to get technical knowledge for smooth transfer to the site training.

Site Training

Site training aims to provide field technical transfer to staff of the implementing agency. Following sectors are considered to be necessary for the site training.

- Workshop
 - Staffing in the workshop
 - Use & operation of equipment
 - Inspection & repair of equipment
 - Procurement & management of spare parts
 - Management of workshop

- Asphalt Recycle Plant
 - Staffing in the plant
 - Installation & operation of plant
 - Inspection & repair of plant
 - Quality control of disposed and recycled materials
 - Quality control of products
 - Management of plant
- Road Maintenance
 - Method, procedure & noticeable matter on each work
 - Operation & inspection of equipment
 - Arrangement and management of equipment party and labor party
 - Procurement & management of materials
- Supervision
 - Quality control & measurement of work
 - Progress control, safety control & work program
 - Procurement Program & labor program

(2) Implementing Schedule

Implementing schedule of Soft Component is shown in Table 2-4-1.

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

CHAPTER 3

PROJECT EVALUATION AND RECOMMENDATIONS

3-1 PROJECT EFFECT

This Project aims to provide safe and reliable transportation facilities (road condition) to promote social and economic development in Yerevan City, where is the capital of Armenia. The population of Yerevan City is 1.25 million who obtain the direct effect from the Project.

The major direct effect of implementing the Project is as follows;

- The procurement of new equipment by this project provides quite improvement of road maintenance capacity.

	AC Overlay	Patching
2,000 (results record)	0.3 km/year	10,000m ² /year
After procured (projected)	20.0 km/year	27,000m ² /year

The indirect effects are also expected as follows;

- 1 To reduce the distribution cost and activate traffic and commercial activities due to improvement of road access condition in Yerevan City,
- 2 To secure continuous and useful traffic flow by the rehabilitation and improvement of damaged road sections and the promotion of development on other road sections,
- 3 To promote the activation of the economy not only for Yerevan municipality, but also for the whole nation through the improvement of municipal roads condition in Yerevan City that accommodates 1.25 million people corresponding 1/3 of the national population and is the core of the political, cultural and commercial activities as the capital of Armenia.

3-2 RECOMMENDATIONS

Since the Project will greatly contribute to improve socio-economic development and traffic conditions in Yerevan City, and the implementation organization is considered to have sufficient capacity to manage the Project, it is concluded that it is appropriate to implement this Project under Japan's grant aid. However, smooth operation of the plan will become difficult if the following points are not considered;

- To secure the necessary manpower for maintenance work.
- To built a sufficient organization for routine inspection and repair work of equipment.
- To secure materials for maintenance work.
- To secure the necessary budget.

APPENDICES

APPENDIX 1

MEMBER LIST OF THE STUDY TEAM

APPENDIX ñ 1 MEMBER LIST OF THE STUDY TEAM

1. The Field Study in the Republic of Armenia

Mr. NAKANO Satoshi	Leader	Deputy Director, Grant Aid Management Department, JICA
Mr. AOKI Minoru	Project Coordinator	Planning Division, Grant Aid Management Department, JICA
Mr. MIURA Minoru	Chief Consultant / Road Maintenance Planner	Katahira & Engineers International
Mr. KOGAWA Satoshi	Equipment Planner	Katahira & Engineers International
Mr. SATO Tadashi	Procurement Planner / Cost Estimator	Katahira & Engineers International
Ms. MURAKAMI Masayo	Interpreter (Russian ñ Japanese)	Katahira & Engineers International

2. Explanation of Summary of the Study in the Republic of Armenia

Mr. NAKANO Satoshi	Leader	Deputy Director, Grant Aid Management Dept., JICA
Mr. MIURA Minoru	Chief Consultant / Road Maintenance Planner	Katahira & Engineers International
Mr. KOGAWA Satoshi	Equipment Planner	Katahira & Engineers International
Mr. SATO Tadashi	Coordinator	Katahira & Engineers International
Ms. MURAKAMI Masayo	Interpreter (Russian ñ Japanese)	Katahira & Engineers International

APPENDIX 2

STUDY SCHEDULE

APPENDIX ñ 2 STUDY SCHEDULE

1. The Field Study (September e, 2001 to October 14, 2001)

No.	Date	Activities
1	Sept. 3 (Mon)	• Messrs. Nakano, Aoki, Sato and Murakami left Tokyo and arrived at Moscow.
2	Sept. 4 (Tue)	• Courtesy Call to Embassy of Japan
3	Sept. 5 (Wed)	• Above 4 members left Moscow and arrived at Yerevan. • Courtesy Call to Ministry of Foreign Affairs.
4	Sept. 6 (Thu)	• Courtesy Call to Municipality of Yerevan and Lincy Foundation. • Discussion with Municipality of Yerevan
5	Sept. 7 (Fri)	• Discussion with Municipality of Yerevan • Courtesy Call to World Bank and Europe Union.
6	Sept. 8 (Sat)	• Site Inspection in Yerevan City
7	Sept. 9 (Sun)	• Data Collection
8	Sept. 10 (Mon)	• Discussion with Municipality of Yerevan
9	Sept. 11 (Tue)	• Discussion with Municipality of Yerevan • Messrs. Miura and Kogawa arrived at Yerevan.
10	Sept. 12 (Wed)	• Signature of Minutes of Discussions
11	Sept. 13 (Thu)	• Messrs. Nakano and Aoki left Yerevan for London. • Report to JICA England Office
12	Sept. 14 (Fri)	• Inspection of the road condition in Southern Yerevan City
13	Sept. 15 (Sat)	• Inspection of the road condition in Northern Yerevan City
14	Sept. 16 (Sun)	• Data Collection
15	Sept. 17 (Mon)	• Discussion with Municipality of Yerevan
16	Sept. 18 (Tue)	• Inspection of depot, workshop and Asphalt plant
17	Sept. 19 (Wed)	• Discussion with Lincy Foundation
18	Sept. 20 (Thu)	• Inspection of road maintenance section
19	Sept. 21 (Fri)	• Data Collection (Independence Day)
20	Sept. 22 (Sat)	• Data Analysis
21	Sept. 23 (Sun)	• Data Analysis
22	Sept. 24 (Mon)	• Discussion with Municipality of Yerevan
23	Sept. 25 (Tue)	• Discussion with Municipality of Yerevan
24	Sept. 26 (Wed)	• Data Analysis
25	Sept. 27 (Thu)	• Discussion with Yerevan Design Institute
26	Sept. 28 (Fri)	• Discussion with Transportation Company
27	Sept. 29 (Sat)	• Inspection of Transportation Route in Armenia
28	Sept. 30 (Sun)	• Data Analysis
29	Oct. 1 (Mon)	• Discussion with Yerevan Design Institute
30	Oct. 2 (Tue)	• Discussion with Municipality of Yerevan
31	Oct. 3 (Wed)	• Inspection at the quarry site
32	Oct. 4 (Thu)	• Data Analysis
33	Oct. 5 (Fri)	• Discussion with Municipality of Yerevan
34	Oct. 6 (Sat)	• Preparation of the report

No.	Date	Activities
35	Oct. 7 (Sun)	• Preparation of the report
36	Oct. 8 (Mon)	• Discussion with Municipality of Yerevan
37	Oct. 9 (Tue)	• Discussion with Municipality of Yerevan
38	Oct. 10 (Wed)	• Report to Municipality of Yerevan and Ministry of Foreign Affairs
39	Oct. 11 (Thu)	• Left Yerevan
40	Oct. 12 (Fri)	• Messrs. Sato, Kogawa and Murakami arrived at Tokyo
41	Oct. 14 (Sun)	• Mr. Miura arrived at Tokyo

2. Explanation of Summary of the Study in the Republic of Armenia
(March 25, 2002 to April 10, 2002)

No.	Date	Activities
1	Mar. 25 (Mon)	<ul style="list-style-type: none"> Messrs. Miura, Kogawa, Sato and Murakami left Tokyo and arrived at London.
2	Mar. 26 (Tue)	<ul style="list-style-type: none"> Above 5 members arrived at Yerevan. Courtesy Call to Municipality of Yerevan
3	Mar. 27 (Wed)	<ul style="list-style-type: none"> Discussion with Municipality of Yerevan
4	Mar. 28 (Thu)	<ul style="list-style-type: none"> Discussion with Municipality of Yerevan
5	Mar. 29 (Fri)	<ul style="list-style-type: none"> Discussion with Municipality of Yerevan
6	Mar. 30 (Sat)	<ul style="list-style-type: none"> Data Analysis
7	Mar. 31 (Sun)	<ul style="list-style-type: none"> Inspection of Asphalt recycle plant site
8	Apr. 1 (Mon)	<ul style="list-style-type: none"> Mr. Nakano left Tokyo for Moscow. Discussion with Municipality of Yerevan
9	Apr. 2 (Tue)	<ul style="list-style-type: none"> Inspection of Lincy Foundation's site
10	Apr. 3 (Wed)	<ul style="list-style-type: none"> Mr. Nakano arrived at Yerevan Courtesy Call to Municipality of Yerevan, Ministry of Foreign Affairs and World Bank. Discussion with Municipality of Yerevan
11	Apr. 4 (Thu)	<ul style="list-style-type: none"> Discussion with Municipality of Yerevan
12	Apr. 5 (Fri)	<ul style="list-style-type: none"> Signature of Minutes of Discussions
13	Apr. 6 (Sat)	<ul style="list-style-type: none"> Mr. Nakano left Yerevan. Inspection of disposal sites
14	Apr. 7 (Sun)	<ul style="list-style-type: none"> Data Analysis
15	Apr. 8 (Mon)	<ul style="list-style-type: none"> Messrs. Miura, Kogawa, Sato and Murakami left Yerevan.
16	Apr. 9 (Tue)	<ul style="list-style-type: none"> Mr. Miura left Vienna. Messrs. Kogawa, Sato and Murakami left Paris.
17	Apr. 10 (Wed)	<ul style="list-style-type: none"> Above 4 members arrived at Tokyo.

APPENDIX 3

**LIST OF PARTIES CONCERNED
IN ARMENIA**

APPENDIX 3 LIST OF PARTIES CONCERNED IN THE REPUBLIC OF ARMENIA

- Ministry of Foreign Affairs

Rouben Karapetian Director of Pacific Division

Michael Vardanian Head of Pacific Division

- Ministry of Finance and Economy

Suren Karayan Director of General Department of
State Revenue Policy

- Municipality of Yerevan

Rovert Nazaryan Mayor of Yerevan

Ashot S. Sargsyan Head of Department of Improvement
and Construction

Husic Matevosyan Deputy Head of Department of
Improvement and Construction

- The World Bank

Owaise Saadat Resident Representative

Gevorg Sargsyan Infrastructure Operations Officer

Naira Melkumyan Financial Management Officer

- Lincy Foundation

Vahe Aghabegians Advisor to the Minister

- Europe Union

Sebastien Dubust Manager

APPENDIX 4

MINUTES OF DISCUSSIONS

**Minutes of Discussions
on the Basic Design Study
on the Project
for Improvement of Road Maintenance Equipment for Yerevan City
in the Republic of Armenia**

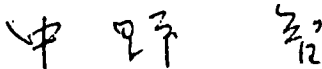
(Explanation on Draft Final Report)

In September 2001, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Basic Design Study Team on the Project for Improvement of Road Maintenance Equipment for Yerevan City (hereinafter referred to as "the Project") to the Republic of Armenia (hereinafter referred to as "Armenia"), and through discussions, field survey, and technical examination of the results in Japan, JICA prepared a draft final report of the study.

In order to explain and to consult with the officials concerned of the Government of Armenia on the components of the draft final report, JICA sent to Armenia the Basic Design Explanation Team (hereinafter referred to as "the Team"), which was headed by Mr. Satoshi Nakano, a Deputy Director of the Third Project Management Division, the Grant Aid Management Department, JICA, from March 26 to April 8, 2002.

As a result of discussions, both sides confirmed the main items described on the attached sheets.

Yerevan, April 5, 2002

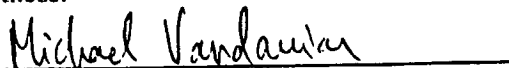


Satoshi Nakano
Leader
Basic Design Explanation Team
Japan International Cooperation Agency



Ashot S. Sargsyan
Head of Department of Improvement and
Construction
Yerevan Municipality
Republic of Armenia

Witness:



Michael Vardanian
Head of Pacific Division
Ministry of Foreign Affairs
Republic of Armenia

Witness:



Suren Karayan
Director of General Department of State
Revenue Policy
Ministry of Finance and Economy
Republic of Armenia

ATTACHMENT

1. Components of the Draft Final Report

The Government of Armenia agreed and accepted in principal the components of the draft final report explained by the Team. The Armenian side also agreed to the equipment planning based on the milling and overlay method with recycled asphalt concrete.

2. Japan's Grant Aid Scheme

The Armenian side understands the Japan's Grant Aid scheme and the necessary measures to be taken by the Government of Armenia as explained by the Team and described in Annex-4 and Annex-5 of the Minutes of Discussions signed by both sides on September 12, 2001.

3. Schedule of the Study

JICA will complete the final report in accordance with the items confirmed by both sides and send it to the Government of Armenia by June 2002.

4. Other Relevant Issues

4-1. The Armenian side shall undertake the works that were described in the articles 5 and 7 of the Minutes of Discussions signed by both sides on September 12, 2001.

4-2. The Armenian side shall allocate necessary budget and personnel to carry out the Armenian side's undertakings, which are described in the chapter 3 of the draft final report of the Project.

4-3. Both sides confirmed that the new asphalt recycle plant could not be attached to the existing asphalt mixing plant as it was described in the draft final report due to the technical difficulties, and it should be constructed and operated separately in Yerevan city. The Armenian side shall undertake the installation work under the supervision of a Japanese engineer.

4-4. The Armenian side shall complete necessary administrative procedures on environment protection before the delivery of the equipment for the new asphalt recycle plant.

4-5. The Armenian side shall discard the waste from the new asphalt recycle plant according to the laws and regulations on environment protection in Armenia.

4-6. The Armenian side shall undertake necessary preparation work in the depot, such as repairing of the building, the foundation work, securing the parking space, before the delivery of the equipment supplied under the Grant Aid.

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4-7. The Armenian side shall undertake the installation work of the new maintenance equipment supplied under the Grant Aid and relocation of the other necessary existing equipment from the maintenance depot.

4-8. The Armenian side shall secure the sufficient budget and personnel so that the equipment supplied under the Grant Aid is utilized properly and effectively for the purpose of the Project.

4-9. The Armenian side confirmed that they would implement the road rehabilitation work more than 20km per year in Yerevan city using the equipment supplied under the Grant Aid.

4-10. Both sides agreed that draft final report and the draft detailed specifications, which were prepared by the Team, should be confidential to third parties in order to secure the fairness of the tender of the Project.



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APPENDIX 5

**COST ESTIMATION BORNE
BY THE RECIPIENT COUNTRY**

APPENDIX 5 COST ESTIMATION BORNE BY THE RECIPIENT COUNTRY

In the implementation of the project, some costs shall be borne by Armenia side, the recipient country as shown below.

Cost for Construction under Armenia Side

• Installation cost of asphalt recycle plant		US\$ 12,500
• Installation cost of workshop facilities		US\$ 3,100
	Total	US\$ 15,600

Annual Cost Management of Equipment & Workshop (refer prior Table 2-4-1)

• Annual Management Cost	JP• 23,907,000.-	US\$ 186,790
	Total	US\$ 186,790

Note: Exchange rate used for this calculation is JP• 127.99/ US\$