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DISTRICT ROADS MAINTENANCE SYSTEMS PROJECT

ENGINEERING AND ECONOMIC CONSIDERATIONS REPORT

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ENGINEERING AND ECONOMIC CONSIDERATIONS FOR THE DISTRICT ROADS MAINTENANCE SYSTEMS PROJECT

Parsons Brinckerhoff International

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EXECUTIVE SUMMARY

The purpose of this report is to provide data and recommendations on the engineering and economic aspects of the maintenance of district (kabupaten) road networks, which may then serve as the basis for a USAID-funded District Roads Maintenance Systems (DRMS) Project. USAID proposes to implement the DRMS Project in two provinces - South Sulawesi and Nusa Tenggara Timor (NTT). The total number of kabupatens is anticipated to be approximately 14. It is expected that USAID and the GOI will provide funds for maintenance, the reconstruction of roads to a maintainable condition, training, equipment, workshop facilities, and consultant assistance.

Background

The historical practice in Indonesia's districts has been to reconstruct existing road links without applying follow-on maintenance. Roads with design lives of 8-10 years in fact retain their design level of service for a much shorter period. Reconstruction is expensive, the district road networks are large, and the funds available are nowhere near sufficient to finance the repeated reconstruction that this approach to the networks demands. As a result, the condition of kabupaten road networks is poor. The burden of the consequent high transportation costs is borne by the public.

The problems posed by the lack of maintenance are compounded by construction or reconstruction practices which frequently result in finished roads that are below the standard for which they were designed. Deterioration is all the more rapid and, without maintenance, unchecked.

The GOI has recently made a commitment to the maintenance of district roads by annually earmarking, for maintenance, a portion of the INPRES Dati II block grant to districts. The districts, however, have no experience with maintenance and are not applying the funds consistently or effectively. In addition, for now, the amount of funds earmarked is adequate in some districts, but inadequate or too much in others; in the long-term, the earmarked amount will not be sufficient. Further, if effective maintenance is applied, resulting in more roads being retained in good condition, and/or maintenance is combined with a reconstruction program, the earmarked maintenance allocations will gradually become inadequate everywhere.

Addressing these problems will require the adoption of an effective system to conduct maintenance at the district level, improvements in the quality of construction and reconstruction, and a commitment to increase the funds available for maintenance over time. The latter is a policy question for the GOI. The first two will require a long-term effort to establish the system framework and to develop the capabilities of District Public Works offices to apply it. This will be an institution building effort that will need to take account of the variety of factors outlined below.

Elements Required

Developing a maintenance program for the kabupaten road network requires a definition of standards to be applied, an inventory of existing conditions and hence needs, the selection of priorities for work to be undertaken, a strategy for the development of organizational and staffing skills, systems for maintenance and reconstruction planning, an allocation of budgets, and an approach to the management of implementation. The study team's review of data and its recommendations in terms of these aspects and the development of the planned project are summarized briefly as follows.

Definition of Road Design and Maintenance Standards

Design standards for road reconstruction at the district level are generally adequate, although improvements could be made by providing more detail for drainage and structure design. These improvements would be useful but are not critical to the success of the AID project. A noted problem of overlap between traffic levels required to justify a transition from the unsealed gravel standard to the sealed gravel standard is reportedly now being corrected by the GOI.

Terminology for road reconstruction is generally adequate with the exception of the term "support works," which is applied to a wide variety of types of road work and, hence, is confusing for management purposes. Alternative terms are recommended for use under the project for this case.

The primary shortcoming is the inadequacy of terminology and standards for maintenance. Definitions of maintenance conflict, are in some cases difficult to apply in the field, and do not distinguish between routine and periodic activities. For example, one version of definitions that is in use for national and provincial networks has been adopted for districts; it precludes maintenance of earth roads. Although adequate for national or provincial networks which have few or no earth links in them, it is inappropriate for district networks where (at least in the Outer Islands) earth roads are dominant. Maintenance standards - work crew performance targets, equipment and other resource needs, etc. - are either not yet tested or do not exist.

The project must begin with clear definitions of maintenance; recommended definitions are provided in this report. The project should also incorporate as a project activity the development and refinement of maintenance standards (initial standards are incorporated and shown in the calculations of maintenance unit costs) as part of a maintenance management system.

Inventory of Existing Condition and Maintenance Requirements

Districts maintain network inventories that state road (and usually bridge) conditions for each surface-type of road, and the kilometers in each road condition. Conditions are defined as good, moderate, damaged, or heavily damaged. Surface-type is usually defined as either asphalt, earth or gravel although a few kabupatens use a finer breakdown. While the existence of inventories is a good start, several steps ahead of many countries, there are significant shortcomings. First, in the condition classifications, generalized judgments ("good," etc.) have been substituted for engineering surveys which state, km-by-km, the exact kind of work to be done, which would ordinarily vary along a route length. As a result of this lack of definition, road work planning and budgeting can only indirectly account for actual needs. Second, the surface-type category "gravel" includes a wide variety of actual surfaces from engineered gravel through the more dominant Telford cobble construction. Because maintenance practices differ dramatically for these surfaces, a finer classification system would facilitate management of the networks. For both engineering and inventory purposes, Telford should be classified as an incomplete gravel road.

The overall condition of the kabupaten networks, as reported by the kabupatens, is poor; only 648 km (6%) of the 10,800 km network in the 14 study kabupatens are reported in good condition. Sixty-two percent are reported as damaged or heavily damaged. The ratio of the length of good roads to moderate, damaged and heavily damaged roads is approximately the same in the two provinces.

There is a greater difference between the two provinces in the type of surface of their respective networks. Of the total network in both provinces, earth roads comprise 57%, gravel roads 33%, and asphalt 10%. But almost 70% of NTT's network is earth and only 2% asphalt.

Traffic volume is not monitored by the kabupatens. From time to time, Public Works authorities from Jakarta have collected traffic counts on kabupaten roads for potential donor-funded activities. But kabupatens do not do so on their own nor are they familiar with the use of traffic counts for engineering or project selection purposes. Thus, traffic counts were initially either not available for the preparation of this report or were from such widely varying sources and time periods (several years difference) that their reliability was highly suspect. However, the scattered traffic data available (some of which became available too late to be incorporated in the body of this report) indicate that traffic composition is heavily biased in all kabupatens toward motorcycles and that in NTT, a greater proportion of the remaining traffic consists of heavy vehicles such as trucks and buses than in South Sulawesi. Total traffic volume is highly variable between links within kabupatens. Generally, a core of roads carries between 50 and 200 vehicles a day, and many links carry no or negligible traffic. Volumes are higher in South Sulawesi than in NTT.

A program of condition surveys is recommended for the first year of the DRMS Project to prepare a complete inventory of maintenance and reconstruction requirements and to confirm or refine the estimates of this report for the project work program. Periodic traffic surveys are also recommended for use in the reconstruction selection process and the project should assist the kabupatens to conduct and utilize traffic counts on a regular basis.

Selection of Reconstruction Priorities

Districts do not, at present, use formal or consistent procedures to assign priority to road links for reconstruction. Formal pre-screening methods have been developed to evaluate and rank road projects at the district level under donor-funded projects. They have been, however, an invention of donors and have required outside consultants to apply.

These methods have attempted to incorporate measures of consumer surplus as a complement to the conventional producer surplus (vehicle operating cost savings) screening indices but have proved very complex, have produced inconclusive results, and in the end have always necessitated resorting to traffic counts and vehicle cost savings as the basis for selection.

A simple rural roads screening method developed by the IBRD is recommended for use under the AID project. This is a single table based on vehicle cost savings only, extended by interpolations to now include the expected road work costs (Rp 9 to 39 million/km) in the project area. In matrix form it identifies the level of traffic at alternative reconstruction cost levels which would produce various internal rates of return between 6% and 15%. Both the cost and the traffic level (average daily traffic) correspond to study area conditions and the table is simple enough to be applied, with supervision, by the kabupatens themselves. Assembly of these observed and probable variations into one screening table was based on sample data and estimated road work costs. Since the sample data were not comprehensive and since the variable parameters (e.g., vehicle composition) may be discovered during project implementation to indeed vary geographically and/or over time, the table will need to be refined periodically as the project proceeds.

A monitoring/evaluation survey is also suggested to measure project effects upon non-vehicle activity such as cash-crop production and transport price changes, as a device to estimate benefits beyond vehicle savings for those roads which are improved, and as a check upon low-volume roads which may be emerging as development areas.

Selection of Maintenance Priorities

It is recommended that, initially, road links and bridges in "good" condition and perhaps the best 20% or so in "moderate" condition begin receiving regular maintenance as soon as possible (based on current data,

this means that until reconstruction work gets underway, the opportunity to begin a full-scale maintenance program exists in only a limited number of kabupatens). A task of the project should be to refine maintenance procedures for assigning priority through planning tools that are included in the proposed maintenance management system.

Organization and Staffing Skills

In NTT, branch offices (Cabang Dinas) of the provincial Public Works department (DPUP) are responsible for kabupaten roads. Since they are under one administrative system, all are organized alike and their organization is basically sound. The only changes desirable are the addition of a materials quality unit, the combining of workshop and warehouse functions, and the creation of a unit responsible for equipment administration.

In South Sulawesi, as in most of Indonesia, kabupaten roads are under the jurisdiction of the kabupaten's own Public Works department (DPUK). Since the kabupaten chief, the Bupati, is responsible, there is a variety of DPUK organizational structures. Some are satisfactory, others are not.

Recommendations include the adoption, for road work, of a uniform organizational structure by the DPUP Cabang Dinas and DPUK in accordance with a model suggested in this report. Special sub-sections for force account reconstruction work and materials control are proposed. Specific job definitions for each staff position are proposed and desired educational levels identified.

Staff skills are weakest in the areas of work methods, contractor or force account supervision, and equipment management. The introduction of

a maintenance management system will, in addition, require that new administrative skills and techniques be learned to adopt effective maintenance practices.

Recommendations are included in this report for a program of training based primarily on short courses for field staff in the first three skill areas identified above, a strong field presence by project consultants to follow-up on the application of lessons learned in short courses, and on-the-job training by consultants in the area of maintenance management. Many of the short course materials required already exist in Indonesia but need to be inventoried and selected. Prevailing teaching methods should place a stronger emphasis on field applications.

Equipment

A varied collection of road construction equipment is in use in the kabupatens for road work. Sources include foreign donors, BANGDA grants-in-kind, leftovers from nearby national projects and pooling arrangements. In addition, kabupatens have access to INPRES Penunjangan Jalan and Dit. II funds for equipment purchase (although this is rarely utilized). Such a variety of sources means that equipment in use is often not appropriate to kabupaten needs due to the absence of a unified kabupaten procurement plan.

A review of existing equipment management practices indicates that some equipment, particularly light dumpers, is being pushed beyond capacity, while much equipment is underutilized. In addition, although a few kabupatens have implemented satisfactory systems for controlling equipment use, the majority have not. Adequate systems already exist, however, at the provincial and national levels of the Public Works organization.

Detailed recommendations are therefore developed in this report for the reallocation of existing equipment in the 14 kabupatens, the procurement of the additional equipment needed to initiate a maintenance and reconstruction program, and for the replacement, halfway through the project, of equipment currently in use.

Other recommendations are that a) kabupatens adopt existing Bina Marga procedures for equipment management and, b) the project provide equipment appropriate to the work required (this means lighter equipment reserved for maintenance and heavy equipment devoted to reconstruction).

Facilities

The only workshops that exist in the kabupatens are those that have been constructed under past donor road programs. Of the 14 study kabupatens, six have workshops that were provided under a Japanese (OECF) program in the early 1980s. These are sound but, since they lack workshop equipment, at present only serve as storage depots. Workshops are now being constructed in an additional two kabupatens. These currently have no provision for utility services or workshop equipment. It is recommended that six additional workshops be built and that the eight existing facilities be completed and equipped with water, electricity and the workshop equipment required for Bina Marga's Level II and III basic equipment servicing. This report lists the requirements in detail.

Well-managed equipment repair shops (ALKAL) are operated by Bina Marga in the capitals of both provinces, and the province (DPUP) maintains a small complement of equipment operators. It is recommended that these facilities be drawn on by the kabupatens for repairs beyond Level II and III basic servicing. It is also recommended that the ALKAL staff and province operators provide on-the-job training to kabupaten mechanics, warehouse storemen, and equipment administrators and operators.

Budgeting

The earmarking for maintenance of 25% of each kabupaten's INPRES Dati II allocation has provided a stable and predictable source of funding on which an effective maintenance management system can be developed. Several deficiencies, however, should be addressed during the project.

First, funds are not received by districts until about four months into the fiscal year for which activities were budgeted. The arrival of funds coincides with the onset of the rainy season, during which most road work must stop. The disruptions this causes are more significant for maintenance than they are for reconstruction work. Although the delay in funds delivery is a government-wide problem, AID should investigate with the GOI mechanisms to assure that funds for maintenance can be made available during the period of delay.

Second, although the 25% maintenance earmark is a predictable amount and, therefore, both administratively easy and useful for planning purposes, it bears no necessary relation to the varying needs of the district networks. Given the present condition of the 14 networks surveyed, 25% is enough in some cases, too little or too much in others. Over time, as the networks improve, it will be too little in most cases. Both an overall increase over time in fur s for maintenance and a method to allocate the funds between districts in accordance with their respective needs should be investigated during the project. The anticipated total maintenance funds requirement for the 14 kabupatens and a possible alternative allocation mechanism are detailed in this report.

Third, in the absence of adequate maintenance standards, present district budget calculations for maintenance are haphazard. The

development of maintenance management systems in each district under the project will yield reliable standards which should become the basis for subsequent annual district budget requests.

Management of Implementation

Road reconstruction work in the districts is primarily implemented by contractors. Road maintenance, by regulation, is implemented by force account staff. Government policy is generally to promote, as much as possible, the role of small private contractors for district road work.

The policy is sound but a variety of issues need to be addressed for it to be effective. Several are mentioned here that are particularly important for the reconstruction component of the project. First, few small contractors in the Outer Islands own equipment and many do not fully understand some of the techniques required to reconstruct roads to standard. Heavily labor-intensive techniques, for example, are used at the cost of adequate compaction and, in the case of Telford construction, a maintainable surface that also minimizes vehicle operating costs. Second, supervision of contractors by Public Works staff is not effective and does not serve the purpose of controlling the quality of work. Third, the contract used by districts provide for phased lump-sum rather than scheduled rate payments. This precludes the use of the contract as an effective tool for assessing performance and controlling quality.

Maintenance is implemented inconsistently and kabupatens are confused about how it should be carried out. Some budget road reconstruction under the term maintenance. Others "maintain" one link one year, but another link the next, unsure of priorities and benefits.

A maintenance management system is recommended (and described) which starts with a clear definition of what maintenance is for and the tasks it consists of. It includes procedures to determine the importance,

budget and schedule the tasks of maintenance work crews and to monitor their achievement against performance standards.

A second recommendation is that the majority of project reconstruction work be implemented by mid-sized contractors and that each district form one force account crew which, under consultant guidance and through training, will set a standard of performance on a small portion of the reconstruction work. This breakdown is reflected in the work program and in the equipment procurement and management sections of this report.

Third, contractor supervision should be improved through training and through a system in which the model force account crew is used as a field training ground for staff who later assume contractor supervision responsibilities. It is suggested, in addition, that the project assist to devise and test alternative contract formats.

Finally, it is recommended that once a maintenance management system is in place, increasing quantities of selected maintenance tasks be let to small contractors in the districts.

The District Roads Maintenance Systems Project

Detailed recommendations for the AID project, by subject area, are given in Section 10 of this report and a suggested plan of action for the project is provided in Section 11. The concept on which these recommendations are based is that maintenance should be performed on all roads in fair to good condition. Maintenance is to be carried out to 1) prevent minor irregularities from causing damage, 2) correct minor damage and deterioration, and 3) preserve the design level of service of the road as long as prictical. Roads that are seriously damaged and cannot be maintained effectively should receive minimal attention until they are reconstructed or abandoned. After a road is rebuilt to standard it should be maintained. All reconstruction should be to standard and only roads that carry significant traffic should be reconstructed.

The primary elements recommended for the AID project to achieve this concept are:

- Training of personnel, the procurement of equipment appropriate to the work, and the use of good materials.

- A maintenance management system that is flexible enough to adapt to the conditions and can be upgraded as conditions change.

- Selected roads reconstructed to a condition for which subsequent maintenance is effective.

The project should involve a preparatory period of approximately one year and six or seven years of work on the ground.

DISTRICT ROADS MAINTENANCE SYSTEMS (DRMS) PROJECT

Table of Contents

Section	Title	Page No.
	EXECUTIVE SUMMARY	i
1.	INTRODUCTION	1
2.	STANDARDS AND DEFINITIONS USED IN ROAD DESIGN AND MAINTENANCE	3
	2.1 Assessment	3
	2.2 District Definitions of Road Work	6
	2.3 District Definitions of Maintenance Practices	7
	2.4 Conclusions	8
3.	CLASSIFICATION OF THE CONDITION OF THE EXISTING ROAD NETWORK FOR MAINTENANCE PURPOSES	11
	3.1 Assessment	11
	3.2 Conclusions	16
4.	SELECTION OF ROAD PROJECT PRIORITIES	17
	4.1 Current Practice	17
	4.2 Comments on Current Practice	19
	4.3 Reported Experience with the Methods Used for Donor Projects	20
	4.4 Conclusions	21
5.	EXISTING ORGANIZATIONAL STRUCTURE AND STAFFING SKILLS	24
	5.1 Responsibilities	24
	5.2 South Sulawesi	24
	5.3 NTT	27
	5.4 Equipment Maintenance and Repair Staffing	29
	5.5 Coordination with DPUP	32
	5.6 Organizational Conclusions	33
	5.7 Skill Level Conclusions	33
6.	MAINTENANCE AND CONSTRUCTION PLANNING/BUDGETING	35
	6.1 Existing Situation	35
	6.2 Conclusions	37

BEST AVAILABLE DOCUMENT

Section	Title	Page No.

7. EQUIPMENT MANAGEMENT AND PLANNING..... 39
7.1 Sources Of Equipment..... 39
7.2 Equipment Operation and Utilization..... 45
7.3 Conclusions..... 46

8. MAINTENANCE AND CONSTRUCTION IMPLEMENTATION PRACTICES..... 48
8.1 Roads Maintained..... 48
8.2 Force Account vs. Contract Work..... 48
8.3 Execution of Construction..... 49
8.4 Materials and Quality Control..... 49
8.5 Construction Inspection..... 50
8.6 Conclusions..... 50

9. MAINTENANCE MANAGEMENT PROGRAM DEVELOPMENT..... 53
9.1 Technical Standards and Guidelines..... 53
9.2 Reconstruction and Maintenance Unit Costs.....
9.3 Evaluation Of Shadow Pricing, Labor Intensity and Employment Impact..... 64
9.4 Evaluation Of Alternative Reconstruction and Maintenance Systems..... 67
9.5 Work Programs and Budgets - Reconstruction and Maintenance..... 92
9.6 Equipment Planning..... 106

10. GENERAL RECOMMENDATIONS..... 133
10.1 Concepts, Definitions, and Guidelines..... 133
10.2 Reconstruction Priority Selection Process..... 137
10.3 Organizational and Staffing Development Recommendations 144
10.4 Recommendations for Equipment Management..... 155
10.5 Recommendations for Allocation of Maintenance Budgets.. 162
10.6 Recommendations on Implementation Procedures, Facilities and Equipment..... 162
10.7 Public Information Program..... 173
10.8 Training Recommendations..... 174
10.9 The Role of National, Provincial and Local Organizations in the DRMS Project..... 181

11. DRMS PROJECT DESIGN..... 185
11.1 Introduction to the Maintenance Management System..... 185
11.2 DRMS Plan of Action, Preparation and Implementation.... 187

BEST AVAILABLE DOCUMENT

TABLES

		Page
1.	Draft Methods Manual Instructions on Maintenance Work	9
2.	Breakdown of Road Networks	12
3.	Summary of Reported Conditions	13
4.	Summary of Roads by Type of Construction	15
5.	Educational Breakdown of Personnel: South Sulawesi	25
6.	Educational Breakdown of Personnel: NTT	28
7.	Summary of DPUK Equipment Section Staff (1986) Educational Level	30
8.	South Sulawesi Equipment Fleet	40
9.	NTT Equipment Fleet	41
10.	Availability of Provincial and Bina Marga Equipment	44
11.	List of Technical Standards and Guidelines for Kabupaten Roads	54
12.	Summary of Estimated Maintenance Unit Costs	61
13.	Summary of Estimated Reconstruction Unit Costs	62
14.	Resources per Crew: Routine Maintenance	63
15.	Required Levels of ADT to Justify Major Road Treatment Costs	75
16.	Road Inventory: South Sulawesi	93
17.	Road Inventory: NTT	94
18.	Distribution of Kilometers	95
19.	Reconstruction Program: South Sulawesi and NTT	97
20.	Budget for Road and Bridge Reconstruction Program	100
21.	Maintenance Program: South Sulawesi	101
22.	Maintenance Program: NTT	103
23.	Budget for Road and Bridge Maintenance Program	105
24.	Equipment Needs for Annual Roads Maintenance Program: Kabupaten Pirang, Year 1	108
25.	Equipment Needs for Annual Roads Maintenance Program: Kabupaten Pirang, Year 7	109
26.	Equipment Requirements: Road Maintenance Equipment	111
27.	Equipment Requirements: Reconstruction Equipment	112
28.	Summary of Equipment Needs in 1st Year: Maintenance and Reconstruction (South Sulawesi)	114
29.	Summary of Equipment Needs in 1st Year: Maintenance and Reconstruction (NTT)	115
30.	Availability of Operating Equipment: South Sulawesi	116
31.	Availability of Operating Equipment: NTT	117
32.	Reallocation of Equipment	118
33.	Equipment Requirements after Reallocation of OECF Equipment: South Sulawesi	120
34.	Equipment Requirements after Reallocation of OECF Equiment: NTT	121
35.	Estimate of Equipment Replacement	123
36.	Support Equipment	124

BEST AVAILABLE DOCUMENT

37. Cost Estimate of Reconstruction and Maintenance Equipment 126
38. Required Levels of ADT to Justify Major Road Treatment Costs 138
39. First Year Permanent Road Staffing Requirements 149
40. Recommended Staff for Equipment Section 152
41. Recommended Staff for Equipment Section by Workshop Section 153
42. Reallocation of Equipment 159
43. Equipment Requirement after Reallocation of OECF Equipment: South Sulawesi 160
44. Equipment Requirement after Reallocation of OECF Equipment: NTT 161
45. DPUK Facilities: South Sulawesi 167
46. DPUK Facilities: NTT 168
47. Training for First Owners Personnel by Private Firms 180

FIGURES

1. Excerpt from Draft Methods Manual 10
2. Kabupaten Road Design Standards 57
3. Diagram of Information Flow for an Equipment Management System 132
4. Model Organization 146
5. Standard Layout of DPUK Workshop 169
6. DRMS Project Schedule 188

1. INTRODUCTION

In response to a need identified from the experiences of other donor programs, the U.S. Agency for International Development (USAID) has proposed to provide assistance to the Government of Indonesia (GOI) for developing and implementing a system to manage the maintenance of kabupaten (district) roads. The District Roads Maintenance Systems Project (DRMS) was conceived to provide technical assistance for developing and implementing a roads maintenance management system, and financial assistance and equipment for restoring selected roads to a maintainable condition. The main purpose of this project is institution building.

Within the broad area of a road maintenance management system are many related systems and subsystems, some of the more important being:

- o valid technical standards and guidelines;
- o road maintenance inventories and condition assessments;
- o procedures for screening, selecting and assigning priority to reconstruction (traffic counts, economic criteria, etc.);
- o annual work plans and performance budgets based on actual road maintenance needs which are balanced according to budget and resource availability;
- o equipment management including workshop and warehouse operations; and
- o road construction management.

These are but a few of the integrated systems that must be coordinated into a full maintenance management system.

The project target areas initially identified by USAID for implementation of the maintenance system are fourteen kabupatens, seven each in South Sulawesi and Nusa Tenggara Timor (NTT) provinces.

Parsons Brinckerhoff International were contracted by USAID to analyze kabupaten road maintenance problems and to make recommendations for the DRMS Project. During the consultancy period (May 12 - July 29, 1986), the engineering and equipment project design consultants made field trips to each province, visiting five kabupatens, two in South Sulawesi and three in NTT. With only two days in each kabupaten, the consultants were able to make only quick visual field inspections of some road links and interview road and equipment personnel in order to assess current practices and the staff's potential for the upcoming project.

The economist met with planning officials in South Sulawesi at the provincial level and in one kabupaten. Two Indonesian consultants traveled with the project design consultants.

During the project design period numerous reports and reference documents were reviewed.* In general much of the primary data collected were not considered to be reliable. For example, traffic counts were very uncertain regarding the duration of the count, the vehicle mix, peak or off-peak traffic flow, etc. Road inventory and condition data were reported from each kabupaten only as total km, not by road link. The equipment data were thought to be reliable.

The following chapters of this report describe the consultants' review and analysis of the data available and their recommendations for improvements to current practices and implementation of the DRMS Project. Although the contents of this report have been discussed with USAID and GOI staff, the views expressed here are the consultants' own and do not necessarily reflect the views of USAID/Indonesia or the Government of Indonesia.

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* Secondary data had been collected by a local firm, P.T. Hasfarm, prior to the consultants' arrival. These data were compiled largely from existing records in the fourteen kabupatens.

2. STANDARDS AND DEFINITIONS USED IN ROAD DESIGN AND MAINTENANCE

2.1. ASSESSMENT

The road building industry worldwide uses a variety of terms to describe different road treatments. This section identifies both the local terminology that should be discarded and the more suitable terms that clearly delineate a function, and therefore provides the basis for proper cost estimates.

The construction of kabupaten roads may be considered a time-staged process, related to expected Average Daily Traffic (ADT). This expectation is also used to create a classification of roads. The Indonesian Roads Department recognizes these road classes for kabupaten roads:

Kabupaten Road Classes

	IIIA Sealed	IIIB		IIIC Unsealed
	Asphalt	Seal	Gravel	Gravel/Earth
ADT (undifferentiated):	500-3000	200-500	50-200	<50

At the first stage, a simple grading of the natural earth provides the running surface for class IIIC light traffic. The term "gravel" is used locally to include Telford cobble and All Weather Compacted Aggregate Subgrade (AWCAS).* Thus, gravel roads classed as IIIB or IIIC may be surfaced with Telford, engineered gravel, or AWCAS. The difference among these classifications is that Telford is large boulders and rocks; true gravel is crushed, sized and graded for specific layered uses, and AWCAS is lesser in quality.

Under this definition, gravel/Telford/AWCAS provides the running surface. However, for IIIB roads which are classified as "sealed roads," some of these gravel-surfaced roads are also treated with a spray sealcoat of asphalt or used motor oil, which may then be coated with gravel chips. This sealing is intended to stabilize the running surface and make it impermeable to water.

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* This Indonesian definition of AWCAS differs from that used outside of Indonesia.

For class IIIB roads, therefore, important design changes may be in order. The seal for gravel may be used as ADT approaches 100, and the more advanced sealcoat as ADT approaches 200. Because the purpose of each sealing method is to stabilize the road, provide a smoother running surface, and to protect it against water infiltration, work must be done to the subgrade and the existing base. This mainly consists of a layered treatment:

Surface : wear-out, protective
Base : gravel and sand, 15 cm
Subbase : aggregate or Macadam (usually only select material), 10-45 cm
Subgrade: stabilized soil (lime/cement) or stone, compacted

For this work, design specifications may provide lower or higher standards, given design speeds, limiting gradients, paved width, shoulder width, camber or slope of crown for surface and shoulders, bridge width (with or without sidewalks), etc. It is at this point that the terminology becomes confusing. It becomes even more confusing if the subbase/subgrade work is omitted at this stage of road building, and must be undertaken at the later stage (ADT 500) of an asphalt overlay.

Any of the following terms may be used to describe the transition from a IIIC road to a IIIB sealed gravel or sealed road: improvement, upgrade, betterment, support work, renovation, rehabilitation, reconstruction. While the latter three terms suggest re-working to an original design standard, in practice, no definitive design standards exist regarding an earth-or-cobble road. Moreover, it is common practice the world over to incorporate "improvements" and "rehabilitations" (i.e., to "upgrade" to a higher standard) at this stage of road-building, to take advantage of the economies of scale inherent in the very large costs associated with re-working the road, virtually from the ground up: the subgrade, subbase, base, and surface treatment and pavement.

The running surface associated with each of the four major road conditions, asphalt, sealed, sealed gravel, gravel/earth, does not describe well the different kinds of surfacing which may be applied to meet the needs of wear and stability. The Indonesian Roads Department defines ten kinds of surface treatment or pavement construction above the level of the IIIC gravel/earth road. In the general descending order of their relative cost and durability they are:

Running Surfaces	Function	Indonesian Term
Asphalt concrete:	overlay, 4 cm, structural	LASTON
Two-layer asphalt* (DBST):	overlay, 35 mm, non-structure	BURDA
One-layer asphalt* (SBST):	overlay, 20 mm, non-structural	BURTU
Aggregate Buton asphalt:	overlay, 3 cm, structural	LASBUTAG
Thin concrete asphalt:	overlay, sealcoat, 3 cm, non-struc.	LATASTON
Macadam Penetration:	pavement or base, 5 cm, structural	LAPEN
Thin sand & asphalt:	sealcoat, reseal, 2 cm, non-struc.	LATASIR
Asphalt spread:	sealcoat, reseal, non-structural	BURAS
Thin pure buton asphalt:	seal, overlay, non-structural	LASTABUM
All Weather Crushed Aggreg.:	wear coat	JAPAT

It may be seen from this list that some surfacing has structural properties, normally associated with overlay treatments (but not always), while others are surface dressings of seal or spray coats without structural value, and some are alternatively used for overlay or simple seal. Relative structural value also indicates longer wearability, and gives a presumptive indication of the expected life of the wear surface, which is important to forecasts of the time lapse between the rehabilitation needs of a road. The type of surface above, which is applied to the general class IIIA or IIIB, therefore has significance to both cost estimates and to service life. It has further significance to the costs associated with routine and periodic maintenance of the specific road surface being maintained.

* 1 stone seal.

Because the use of any alternative surface treatment may depend upon local materials availability, relative cost in the region, and familiarity with its application, differences may exist among regions in the kind of surface coat, cost, rate of wear, and service life, which are not readily identifiable by the loose classification of "asphalt" or "seal." Reports from the districts do not now make the needed distinctions. This was seen previously in the class IIIB roads, classified as sealed, but for which both a seal and a gravel condition may exist, and, for the gravel classification, where a thin surface dressing may or may not have been applied.

2.2. DISTRICT DEFINITIONS OF ROAD WORK

To supplement its road classification system, the Indonesian Roads Department has proposed the following definitions of road work.*

New Road Construction: completely new road over existing track with or without new foundation or new surface.

Upgrading: increase of serviceability and reliability, i.e., to upgrade from gravel to asphalt.

Rehabilitation: of reliable roads (all season), to return a road to its original state of service, e.g., asphalt overlay.

Support Work: restoration of a deteriorated (non-reliable) road to its original standard, i.e., resealing, recoating, etc.

Road and Bridge Maintenance: patch potholes; repair ruts, drainage, signs; fill depressions, etc.

These definitions are simple and clear. But they do not say how, or to what extent these activities will be conducted. This is left to the detailed design standards, which define alternative minimum and desirable specifications. New road construction may be of a bulldozed earth, cobble-laid, gravel, seal, or asphalt type, appropriate to its purpose. Upgrading is defined in the conventional sense. Rehabilitation is reserved for all-weather roads, open 350 days per year, or not closed more than 5 days consecutively due to poor drainage, flooding, or poor alignment contributing to both. This definition protects against the rehabilitation "to its original state of service" of an unreliable road, which would revert to a poor state seasonally.

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* See Bina Marga (Highway Department) draft: Methods Manual for Kabupaten Road Programs.

Support work in Indonesia employs the standard definition given to periodic maintenance by American engineers, although periodic maintenance, but not support work, is presumed to be accompanied by regular routine maintenance. The definition above of road and bridge maintenance is a fair description, but fails to state that this is a regular, repetitive item of work done annually over the expected life of the road. The American definition errs on the side of oversimplicity as well, commonly stated as "that level of work which maintains the road to its original design standard." Both routine and periodic maintenance combine to achieve this result, in theory, under both local and foreign standards.

Both standards are correct as far as they go. But these are static definitions applied to a dynamic condition; the original design standards become obsolete as the "design ADT" is surpassed by actual ADT, as normal weathering takes its toll of even a well-maintained road, or as heavier vehicles enter the traffic flow. Vehicle repetitions and axle-loadings, terrain, weather, and actual design or actual construction, as compared to the standard for design, may all vary from forecasted levels. The periodic resealing or overlays undertaken by support work/periodic maintenance may therefore, in practice, be overlapped by rehabilitation or upgrading.

2.3. DISTRICT DEFINITIONS OF MAINTENANCE PRACTICES

The proposed Methods Manual for kabupaten roads authorities, in draft form at Bina Marga, attempts to define the nature of maintenance and to specify manpower and the level of work to be undertaken. Maintenance means "a routine job in which the degree of damage in gravel roads is no more than 7 percent while in asphalted roads no more than 5 percent. In other words, maintenance only handles small jobs such as filling in holes, grading, and operations on gravel roads." In addition, the manual states:

> "Periodic work such as overlaying is categorized as construction work."
> "Emergency work (natural disasters, etc.) is handled separately."

These are unsatisfactory definitions, at variance with what is already understood. The 7 and 5 percent damage estimates are supposed to refer to potholing, but make no reference to width or depth, surface cracking (asphalt) or loss of surface (gravel), and seem to imply that beyond these very uncertain parameters, maintenance is to be replaced by some form of periodic surface treatment. However, periodic work such as overlaying is construction work.

These efforts to advise field staff on the degree of wear that should be attended by repair are cited here because they move in the right direction, but somehow miss imparting a clear and functional guideline. That they are also incomplete appears to result from generally slack maintenance performance in the past, and a preoccupation with road building and rehabilitation efforts, for which foreign projects and years of experience have best equipped the engineering staff at all jurisdictional levels.

Serious thought has obviously been given in the draft Methods Manual to instruction on maintenance work. Table 1 and an excerpt from the manual (Figure 1) clarify the types of work included in maintenance work and specifications.

The same problems exist with the instructions given in Table 1. The percentages vary from those given above; other forms of surface wear such as cracking and surface loss are not mentioned; the percentages are impractical in field use, and they imply limits on either side of which the proper kind of maintenance is unclear. The specific numbers of manpower and the frequency of their work may be an average, a maximum, or a minimum, but in practice, must vary with traffic, local conditions, and different weather patterns between different regions.

2.4. CONCLUSIONS

Rehabilitation efforts may expect to confront ill-defined and overlapping road conditions in the field. Road treatment guidelines incorporate a wide range of surfacing types and different costs under the deceptively simple classification of "sealed roads." Narrowly interpreted, rehabilitation therefore means reconstruction to the original standard. Attendant maintenance costs will therefore vary according to the different wear rates of the different surface treatments. A demonstration project intended to enlist institutional support, chiefly for maintenance practices, must thus likely be prepared to rehabilitate roads to a standard which has a consistent maintenance program and cost, is associated with dependable (and fewer) surfacing types, and is consistent with ADT volume and local weather patterns. Too strict a distinction between upgrading and rehabilitation would operate against meeting this goal.

A general lack of experience in maintenance, both routine and periodic, is evident in the guidelines and in the operations of staff at the district level and above. Clear guidelines relevant to surface types need to be formulated at several levels of authority. These guidelines must also provide for effective monitoring in the field.

Table 1

DRAFT METHODS INSTRUCTIONS ON MAINTENANCE WORK

PEKERJAAN PEMELIHARAAN (MAINTENANCE)		
	MACAM PEKERJAAN (TYPE OF WORK)	PERSYARATAN MAKSIMUM (MAXIMUM REQUIREMENT)
PERKERASAN (PAVEMENT)	POTHOLE REPAIR ON: - Perbaikan permukaan jalan yang berlubang : ASPHALT ROAD - Jalan aspal GRAVEL ROAD - Jalan kerikil RUT REPAIR ON: - Perbaikan penurunan : - Jalan aspal (ASPHALT) - Jalan kerikil (GRAVEL) - Perataan kembali pada jalan kerikil (BLADING ON GRAVEL ROAD)	(DAMAGED NOT TO EXCEED 5% OF ROAD SURFACE) Kerusakan 3% total luas jalan Kerusakan 5% total luas jalan (DAMAGED NOT TO EXCEED 5% OF ROAD SURFACE) Kerusakan 2% (DAMAGED 2%) Kerusakan 2% (DAMAGED 2%) 2 x dalam 1 tahun (2 TIMES / YEAR)
DRAINASE (DRAINAGE)	- Perbaikan saluran samping (SIDE DITCH REPAIR) - Pembersihan saluran samping (SIDE DITCH CLEANING) - Pembersihan gorong-gorong (CULVERT CLEANING)	2 orang/Km - 2 x 1 tahun 2 PERSONS/KM - 2 TIMES/YEAR 3 orang/Km - 2 x 1 tahun 3 PERSONS/KM - 2 TIMES/YEAR ½ orang/Km - 2 x 1 tahun 0.5 PERSON/KM - 2 TIMES/YEAR
SISI SAMPING JALAN (ROAD SIDE)	- Membersihan semak pada Damija (BUSH CLEARING) - Pemotongan rumput (GRASS CUTTING) - Perataan bahu jalan kiri + kanan (ROAD SHOULDER REPAIR)	4 orang/Km (4 PERSONS/YEAR) (6 PERSONS/KM - 2 TIMES/YEAR) 6 orang/Km - 2 x 1 tahun Tergantung jumlah kerusakan (DEPENDS ON THE LEVEL OF DETERIORATION)
JEMBATAN (BRIDGE)	- Pembersihan dan Pengecatan jembatan (BRIDGE CLEANING & PAINTING)	2 PERSON/BRIDGE AND ASSUMED 3 orang/jembatan dan 2 Km ada 1 jembatan THERE IS ONE BRIDGE FOR EVERY 2 KM.
LAIN-LAIN (OTHERS)	- Pemeliharaan lalu lintas. (TRAFFIC SIGN REPAIR) - Alat bantu + alat-alat lain (Hand TOOLS, etc).	2 orang/5Km (2 PERSON/5KM) 12 set alat bantu/Km (12 UNIT/KM)

88 x

Figure 1

EXCERPT FROM DRAFT METHODS MANUAL

EXCERPTED FROM:

GUIDE TO THE PLANNING AND CONSTRUCTION
OF KABUPATEN ROADS/BRIDGES
DESIGNS, CONSTRUCTION, BUDGETING AND DOCUMENTATION

5.6. ROAD MAINTENANCE

a. General

Maintenance means a routine job in which the degree of damage in gravel roads is no more than 7% while in asphalted roads no more than 5%. In other words, maintenance only handles small jobs such as filling in holes, grading and operations on gravel roads.

Periodic work such as overlaying is categorized as construction work.

Emergency work (natural disasters etc.) is handled seperately.

b. Types of maintenance work and the Specifications.

In order to clarify the types of work included in maintenance work and their specifications, can be seen in the following table 5.6.1.

3. CLASSIFICATION OF THE EXISTING NETWORK FOR MAINTENANCE PURPOSES

3.1. ASSESSMENT

All roads within a kabupaten are classified by the GOI according to three different systems: 1) Primary (rural) or Secondary (urban); 2) Functional and 3) Administrative or Political. The functional classification separates roads into arterial, collector or feeder categories. Most kabupaten roads are feeders or collectors. The administrative or political classification designates roads as either national, provincial or kabupaten. This classification is primarily used to designate responsibility for construction and maintenance. The political classification is the more important for the DRMS Project; only kabupaten roads are involved.

The kabupaten roads for the fourteen target kabupatens total more than 10,000 km. The breakdown is shown in Table 2 by road lengths. No data were collected for the bridges in each kabupaten in time for the consultancy review, but kabupaten officials estimate that there are as many as 1 or 3 km per bridge for asphalt roads, and somewhat fewer for gravel and earth roads. The officials mentioned that many bridges need repair, or replacement.

The criteria for determining road condition varied from one kabupaten to the next so the reported kilometers for the four different conditions (good, moderate, damaged, heavily damaged) were suspect. This was confirmed during field visits by visual inspection. Generally speaking, the actual condition was observed to be lower than the kabupatens' reported condition. Local consultants agreed with this opinion based on their prior data-collection visits.

Table 2
BREAKDOWN OF ROAD NETWORKS

South Sulawesi		NTT*			
Kabupaten	District Roads (km)	Kabupaten	District Roads (km)	Nat/Prov. Roads (km)	Total (km)
Pinrang	389	Kupang	756	374	1130
Sidenreng Rappang	638	T.T.S.	1430	162	1592
Wajo	868	Belu	494	177	671
Bone	1099	Manggarai	1416	303	1719
Bulukumba	786	Ngada	1000	291	1291
Jeneponto	594	Sikka	331	212	543
Gowa	548	Sumba Barat	464	245	709
Total	4922	Total	5891	1764	7655

Generally speaking, the overall condition of the kabupaten networks is poor (see Table 3). Only 648 km (6%) are reported to be in good condition and 3410 km (32%) are listed as being in moderate condition. The remaining 6755 km (62%) are listed as either damaged or heavily damaged. During the consultants' field visits it was observed that many of the road links in so-called moderate condition were passable but at speeds well below the normal design speed for the type of terrain. No data were collected on the national/provincial networks, but such information is available at Bina Marga in Jakarta.

The condition of the networks as reported by the kabupatens is summarized in Table 3. A complete breakdown of km by condition is provided in Section 9.5.

* Additional information on national/provincial road network kilometers is provided for NTT because road construction and maintenance units there (DPUP Cabang Dinas) execute work on both provincial and kabupaten networks.

Table 3

SUMMARY OF REPORTED CONDITIONS (KM)

Province	Good	Moderate	Damaged	Heavily Damaged	Total
S Sulawesi	469 10%	1233 25%	2020 41%	1200 24%	4922
NTT	179 3%	2177 37%	2311 39%	1224 21%	5891
Totals	648 6%	3410 32%	4331 40%	2424 22%	10813

Taken together, damaged and heavily damaged roads represent 62% of the total network and can be assumed to be in need of reconstruction. The kilometers and percentages of damaged and heavily damaged roads are fairly close for both provinces. For roads in moderate condition, it is difficult to interpret whether such links require reconstruction for the full length of the link or simply scattered portions. That makes a significant difference in reconstruction cost per km and in the time required to return the link to its original level of service. NTT has almost 1000 km more roads in moderate condition than South Sulawesi.

It is assumed that roads in good condition should begin receiving regular maintenance as soon as possible in order to keep them from falling into the lower categories. As shown in Table 3 almost three-quarters of the kilometers which can begin to receive maintenance in the first year are in South Sulawesi. These roads lie in only four kabupatens (Jeneponto 201 km, Pinrang 140 km, Bone 91 km, and Gowa 37 km). Half of the km are in the gravel classification and the rest are split almost equally into asphalt and earth.

In NTT the good road kilometers comprise only 3% of the network and are found in only two kabupatens, Kupang and Sikka, with Kupang reporting most of its good roads as gravel and none in earth while Sikka has more earth roads than either asphalt or gravel.

Based on these data it appears that until reconstruction work gets underway, there will be an opportunity to begin a full maintenance program in only a limited number of kabupatens. Only Bone and Jeneponto in South Sulawesi and Sikka in NTT have a distribution of all three types

of road: asphalt, gravel and earth. Three other kabupatens report good roads as only asphalt and gravel: Pinrang and Gowa in South Sulawesi and Kupang in NTT.

The moderate condition rating is more difficult to interpret. Many of the roads classified as gravel and rated as moderate actually have a Telford or very coarse macadam surface. This type of construction provides a roadway which is normally passable in bad weather; however, it is very rough and vehicle speeds are very low, about 20-25 km/hr maximum. The riding surface of Telford and macadam roads cannot be maintained with equipment. Motor graders cannot be used to reshape the parallel ditches. All maintenance work must thus be labor intensive.

For the riding surface, manual labor can only replace missing stone or fix small depressions. This is a very slow process and the road surface would still be very rough. For engineering and inventory purposes, a Telford or macadam surface should be considered an unfinished gravel road. These roads will require investigation by project TA to determine their soundness for adding a gravel (well-graded crushed aggregate or select material) layer as a riding surface. A gravel surface can be maintained easily and vehicle speeds and riding comfort will increase while lowering vehicle operating costs.

Although the condition ratings are suspect as they now exist, there is a way to obtain more reliable data which is described later in this section.

Table 4 summarizes the classification of the networks by type of construction.

Table 4

SUMMARY OF ROADS BY
TYPE OF CONSTRUCTION (KM)

Province	Asphalt	Gravel	Earth	Total
S Sulawesi	947 19%	1913 39%	2062 42%	4922
NTT	111 2%	1705 29%	4075 69%	5891
Totals	1058 10%	3618 33%	6137 57%	10813

Only the total km of "asphalt," "gravel" or "earth" roads were reported since these are the terms typically used by kabupatens to inventory their road networks. According to these inventory criteria, an asphalt road can be either paved or sealed; a gravel road can be well-graded crushed aggregate that is sometimes surfaced with local pit-run or river-run gravel but commonly either a Telford or very rough macadam.

Traffic counts were initially either not available or were from such widely varying sources and time periods (several years difference) that their reliability was highly suspect.

Later in the project design period, more reliable inventory, condition, and traffic data were obtained from the Ministry of Public Works' Sub-directorate or Local Roads for four of the target kabupatens. These data were collected during 1984-1985 following uniform criteria and procedures under the direct supervision of the staff of the Sub-directorate. The data collection and computerized summaries were funded by the Japanese OECF. Data were not collected for the remaining ten kabupatens but officials in the Sub-directorate stated that they could be gathered in a similar fashion if a donor would finance it.

Their estimates of time range from five to seven months for collecting the traffic, inventory and condition data in an additional ten or fifteen kabupatens. The time estimate includes time for the planning, execution (including necessary training for kabupaten personnel), and summarization of the data in Jakarta. The data collection procedures are well documented. The Sub-directorate has indicated it would be available to train and supervise the personnel from the province or kabupaten who would actually perform the data collection in the field.

3.2. CONCLUSIONS

There are currently insufficient data available, in terms of either road conditions or road usage, for detailed planning of the maintenance work to be carried out under the DRMS Project.

Only 6% of the kabupaten roads in the fourteen target kabupatens are reported to be in good condition and only 32% in moderate condition. It is not clear whether moderate condition relates to sections or the entire length of a particular road link; therefore, the extent of reconstruction which is necessary could not be accurately estimated.

Kabupaten records do not clearly define road construction type. They classify only in terms of asphalt, gravel or earth roads; however, an asphalt road can be either paved or sealed, and a gravel road can be well graded crushed aggregate, sometimes surfaced with local pit run or river run gravel, but commonly either a Telford or very rough macadam. The road conditions observed are generally lower than those reported.

Traffic counts are not collected; nor are they used by kabupatens for planning purposes. For this study, traffic counts were either not initially available or were from such widely varying sources and time periods that their reliability was highly suspect. Although accurate data were available for four kabupatens, they were received too late to be considered here.

In summary, the existing classification process is inadequate for planning maintenance work and conducting economic evaluation of maintenance projects.

4. SELECTION OF ROAD PROJECT PRIORITIES

4.1. CURRENT PRACTICE

A simple pre-screening index has been adopted by the Roads Department and Ministry of Home Affairs for use under donor-funded road programs.* This index is based on Zone of Influence criteria which define two elements, the cost per kilometer per capita and the cost per kilometer per hectare. Apparently developed by ENEX of New Zealand under an IBRD-financed Rural Road Study Project in 1981, the method attempts to select, through preliminary screening, those roads for which 1) costs/km/capita are at a minimum (a large population is served), and 2) costs/km/hectare of cultivated land are at a minimum (a large freight demand).

Originating at the district level, using forms approved and issued by the Roads Department, the following steps are incorporated in a complete proposal submission to donors:

1. List of all road links: name, number, km, surface, surface condition, surface width, previous recent expenditures on link.

2. Classification of links: reliable, unreliable (seasonal closures of two weeks or more), and important network links.

3. Mapping: by jurisdiction (national, provincial, etc.), by function (feeder, market, collector), surface, reliability.

4. Infrastructure: river, rail, airports, ports (alternative modes), shown on map, including populations in each town or village and names of each town or village.

5. Markets: names of market towns and market days in the district and in neighboring districts.

6. Development proposals: if any, details of proposal, to include scope, location, land area, population, required infrastructure, and indication of in or near district, and whether planned or under construction.

7. Additional mapping: topographical (terrain) within the district and in neighboring districts. Land use and/or soil maps showing crop patterns and noncultivatable area, within and in neighboring districts.

8. Planning map: existing district plans for road improvements.

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* In the case where no donor is involved, kabupatens do not use formal screening methods or selection criteria for determining the allocation of road funds.

9. Proposal: the district (DPUK) and district BAPPEDA II jointly prepare road improvement proposals: DPUK is responsible for design and cost estimates on roads selected by BAPPEDA II, or selected by DPUK on the basis of engineering/maintenance requirements.

10. Pre-screening: to accompany each proposal.
    a. Short links less than 2 km eliminated unless serving major population area. Urban roads eliminated (submit under separate program and evaluation procedure).
    b. Development roads separated for more complete evaluation within a coordinated development program. Not suited to pre-screening method, but submittal accepted for review.
    c. Rival routes or modes within a 3 km distance which are not collector roads will not be screened until collector roads are improved and maintainable.
    d. Maintained roads screened out of program; routine maintenance not part of program; place in routine program.

11. Sorting: arrangement of road projects for pre-screening analysis.
    a. Application of cost index:
        Cost/km/capita, over 5-year population forecast period.
        Cost/km/hectare, over 5-year cultivation period.
    b. Design year is 6th year, i.e., based on expected level of population and area cultivated in 5th year.
    c. Ranking: for each road link list proposed projects by order in which they attain least cost for both indexes, in columnar format to show both indexes side by side.

12. Program proposal: this is an annual document submittal, showing for each year of a five-year program:
    a. Annual budgets over a five-year period, related to b) below.
    b. Priority ranking of projects, starting with the topmost in the first year and in descending order annually thereafter. Technical and economic data from steps 1-10 accompany submittal.
    c. Budgetary adjustments: conform annual budget total to individual project proposals (eliminate errors).

13. Technical survey submittal: provide survey, equipment inventory, traffic counts, volume and cost estimates, and relevant supporting information.

14. Screening: by Roads Department (Jakarta). Based on a sample survey of the program data, certain project proposals are selected for testing against economic criteria. Traffic composition and vehicle operating costs identify a weighted average vehicle for forecasts of comparative costs on existing surface/condition against proposed surface/condition, to obtain preliminary justification by benefit-cost ratio after 12% discount. The screening test identifies the general level of reliability of proposals for the year, extent of need for further data/analysis, and monitors the effective use of the pre-screen procedural steps.

4.2. COMMENTS ON CURRENT PRACTICE

The procedural steps listed in points 1 through 9 above appear to be largely administrative, as no practical use is made of them in arriving at the key index method, which must be considered the focal point by both the district and Jakarta. This is indicated by the screening undertaken by Jakarta, which shifts the base of analysis to "economic criteria," an almost exclusive concern with vehicle operating costs. The procedural steps therefore provide data annually which might instead be submitted once, and be followed by changes in the data as they occur to keep the informational base current. Since the real data base consists of cost estimates, aggregate populations and cultivated hectares within the zone of influence, and traffic, the time spent in filling out forms and drawing up maps might be better spent on these four areas alone.

For example, the collection and reporting of all road links by name, number, etc. and the names of towns, villages, and numbers of population in each, is of little value if proposed road projects are for other road links and other villages and populations. Since the zone of influence is the determinant, only road links and populations within the zone are relevant.

Likewise, in classifying links as reliable or unreliable and reporting the names of market towns and number of market days, an unreliable link is automatically screened out of the proposal, even if it is a market road or bears a relatively heavy proportion of traffic (these factors are not correlated). Market towns and market days are not followed by a disclosure of activity levels which relate to goods traffic, and the economic values which they suggest for roads with low vehicle traffic. Because of the importance later given to traffic (and the reported low reliability of the cost/km/hectare index), a simple survey of farmers to collect data on volume marketed locally and frequency of marketing at these markets could produce data on actual goods flow annually, by named type of transport — bicycle, cart, etc. Alternatively, market-day counts of goods arriving and mode of arrival

38x

(perhaps to include both buyers and sellers by mode) could provide real numbers for what is now left to supposition, i.e., that hectares somehow equate with production, and that all production means traffic flow (there are no subsistence farmers, or, all production is a cash crop).

It is noted that the screening process conducted in Jakarta does include an extensive analysis of roads with high-ranked agricultural potential but low-ranked vehicle traffic. No equivalent evaluation exists at the district level, beyond the cost/km/hectare index. Moreover, traffic survey forms for ADT counts at the district level do include counts of pedestrians, bicycles, carts, etc., but not of loads indicative of market days and non-market days.

4.3. REPORTED EXPERIENCE WITH THE METHODS USED FOR DONOR PROJECTS

After five years of operation, the methods instituted for donor projects at the kabupaten level still appear to be awkward to implement and uncertain in terms of identifying suitable projects for rehabilitation. The most recent experience, reported in March 1985 in the Main Report of the Local Roads Component (for 30 kabupaten) by Hoff & Overgaard, Kampsax, relates to feasibility studies undertaken precedent to the ADB 8th Loan. The projects were located in Central Java, Nusa Tenggara Barat, and Bali.

At the time of the study, the Methods Manual, which is summarily described above, had been distributed to the districts, and the program for annual program submittals had been in operation for perhaps two years. In actual practice, the main problems were reported as follows.

1. The index ranking methods do not correlate well with the more conventional screening employed at the national level. As proxies for traffic volume and vehicle cost savings, there was "no significant correlation identified between IRR (resulting from project evaluation) and the area index." For the population index, "a relatively weak statistical relationship ... in the range of $r^2 = 0.5$ to 0.7 and more typically in the range of $r^2 = 0.2$ to 0.4" was found.* That is, the co-efficients of determination (goodness of fit) may be only 20 to 40% in predictive value.

2. The index ranking is accepted as indicative, which is its main purpose. But sampling by advanced feasibility studies must determine project priorities. The addition of more detail to the index method would reduce its simplicity, and "the time and resources required might more usefully be directed to more extensive traffic surveys and direct project evaluation."

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* Discrepancy not explained.

3. Index ranking becomes progressively unrepresentative as the road network becomes more complex. Both population and land area estimates at the district level are subject to subjective interpretation and contain errors resulting from overlapping zones of influence not correctly apportioned between road links.

4. "The Kabupaten generally undertook the necessary work promptly and many put much effort into mapping and presentation. However, the quality of data relating to road costing and zone of influence analysis left much to be desired. Aside from traffic surveys (for which there was specific funding allocation), supplementary field surveys requiring work outside the office were rarely completed satisfactorily. There was evidently limited understanding of the purpose of and connection between different parts of the manual procedures or of their relevance to road programme proposals. Kabupaten planning tended to remain locked on immediate needs over the next year or so. rather than addressing the longer term needs and development of the road network."

4.4. CONCLUSIONS

The Methods Manual and National Screening procedures for donor projects are part of the institutional structure now in place. Notwithstanding the apparent simplicity of the Manual on first glance, it is not simple. Some of its complexity relates to the format, which provides a wealth of detail but fails to address the salient features which later come under intensive study (by means of sample project evaluations in Jakarta). Some problems also arise from calculation errors and interpretations of zonal boundaries. But if the population and cost indexes themselves fail to produce, even when accurate, acceptable measures of relative feasibility, improvement of the indexes would seem to be of higher priority than refinements provided by "more extensive traffic surveys and direct project evaluation" imposed later at the national level.

A reduced informational format would provide the time to obtain field survey data on market volumes of goods by type of conveyance. In addition, cost/km/ton of freight is more nearly equivalent to cost/km/capita than is cost/km/hectare, and also permits estimates of average market price per ton by type freight. Such estimates lead directly to the consumers surplus form of analysis that is applicable to predominantly agricultural areas lacking important vehicle traffic flows. This analytic style is used at the national level for these cases, and seeks to evaluate transport price changes translated into changes in farm-gate prices, and farmers' savings which generate value added by further production -- all expressed as prices and costs per ton. (This is a complicated form of analysis not suited, beyond the level indicated, for application at the district level. It is firmly in place at the national level as the alternate methodology to the conventional vehicle cost savings methodology.)

The introduction of a market-oriented goods volume survey at the district level with supplemental market price information (value estimates) probably will not reduce the incidence of errors associated with existing formats. However, as an extension of the present area index, and used jointly with it, it could well provide the volume and value of estimates that much of the present format seems intended to produce largely by inference.

The reported problems of overlapping zonal jurisdictions in the annual program submission (apparently repeated thereafter for the five-year period) appears to result from (1) a format that identifies all roads, with each road having an equal probability of sharing pro-rata in a zone of influence occupied by another road, and (2) the use of a method or analysis more suited to a sparse network than to the more dense road system found in Central Java, NTB, and Bali.

The suggestion that all the road links need to be named and numbered, etc., in such a dense network may well be a valid concern for overlaps, but only in an exceptional circumstance, e.g., the districts inaccurately reported the priorities, priorities were bunched in a single year, and funds for rehabilitation were unlimited. If the 5-year program truly represents priority rankings and their relative time-staging, the overlap of zonal road boundaries could be of concern only if bunched in a one-year or two-year period. If such bunching occurs, the selection process will likely err in over-selection (i.e., too many roads are being selected) because of a large budget each year or because of a concentration of the network in the areas of highest traffic volume. If concentrated, a probability exists that roads are overbuilt: a later analysis of road links in NTT and South Sulawesi shows that for 364 links, 7% report no traffic, and fully 38% report traffic levels between one and ten vehicles daily, including motorcycles, which average 46% of that total.

This result would dispel the notion that overlapping zones of influence carries meaning, unless accompanied by ADT traffic counts. If so accompanied, both traffic volume and rates of deterioration must be roughly equal to warrant bunching in the program. This should be unlikely under the pre-screening process, which requires that rival routes or modes within a 3 km distance that are not collector roads will not be screened until collector roads are improved and maintainable. Given the narrow 3 km limit, overlaps could occur only if roads were within 6 km of each other, or both were collector roads. Either event could suggest overbuilding (a single collector could serve, with a feeder road structure). If a mountain range or similar barrier divides these roads and thus accounts for their proximity, it also indicates separate zones of influence imposed by terrain rather than by 3 km limits. This possibility is supposedly already presented by the mapping supplements, and could explain roughly equal traffic levels and road conditions for two areas with the same travel patterns. What cannot be explained is how

so many of these roads can be assembled in a budget-limited and time-staged program, yet with so many overlapping problems exist that the districts have difficulty in calculating populations and hectares for each. Because these very calculations enter into the index methods designed to support selection and ranking, there should be little wonder that the methods correlate poorly with later project evaluations.

Generally, inasmuch as the focus of attention at the national level is on vehicle activity and/or tonnage-based value-added analysis, the introduction of a tonnage-based survey report would fill a present void in the analysis. A first-year report of the informational items, rather than consecutive annual re-confirmations, might free some time for improved traffic surveys and tonnage reports. These might include more frequent seasonal counts, reflecting vehicle load (number of passengers and estimated kilograms of produce), market price sampling, and some form of check upon forecasted growth rates. (The latter is mentioned because of the tendency to forecast traffic at significantly higher growth rates than the observed and forecasted population and farm produce rates, which could occur only if income growth and income elasticity were unnaturally high.)

5. EXISTING ORGANIZATIONAL STRUCTURE AND STAFFING SKILLS

5.1. RESPONSIBILITIES

Kabupatens in South Sulawesi, as in most of Indonesia, have a DPUK which answers to the kabupaten chief (Bupati). The kabupatens in NTT rely on the local branch office of the provincial Public Works Department (DPUP Cabang Dinas) to carry out kabupaten road construction and maintenance. The DPUP Cabang Dinas also executes the construction of provincial roads and the maintenance of both national and provincial roads as well as attending to the kabupaten, provincial, and national interests in water resources (Pengairan) and urban development (Cipta Karya).

The organization in South Sulawesi allows for a distinct separation of responsibilities between national/provincial roads (DPUP Cabang Dinas) and kabupaten roads (DPUK). Within the DPUK, units of equipment are usually allocated specifically for road work and sometimes are designated for either construction or maintenance. However, personnel are frequently pooled and are assigned interchangeably to road, irrigation or urban development projects.

In NTT, the Chief of the DPUP Cabang Dinas must answer to two distinct officials and interests: the Chief of the DPUP and the Bupati. Problems of allocating resources are compounded because the same staff and equipment fleet must be shared among national, provincial and kabupaten interests and among each of the subsectors of roads, water resources and urban development. Typically, the Chief of the DPUP Cabang Dinas tries to satisfy all interests in a way that is agreeable to all parties. There do not appear to be any major conflicts arising from this situation but some projects can receive only token attention.

5.2. SOUTH SULAWESI

The structural organizations of the DPUKs in South Sulawesi all differ because each DPUK answers to the Bupati and not to a single official at the provincial level.

Only four kabupatens (Bone, Wajo, Pinrang & Jeneponto) have a Road Section; one other (Gowa) has a Road Design Subsection and a Road Development Subsection. The other two (Sidrap & Bulukumba) have no structural unit for road work. As in NTT, the technical personnel are rotated and some kabupatens actively rotate personnel among road, irrigation, or building projects. This practice may develop better cross-sectoral knowledge but it keeps sectoral skills from fully developing.

The educational distribution of DPUK staff is shown in Table 5. Staffing levels for technicians in the four kabupatens with a Road Section are slightly weaker than in NTT, with an average of 13 each; only

Table 5

EDUCATIONAL BREAKDOWN OF PERSONNEL
SOUTH SULAWESI

Position	Higher Education				Secondary Education			
	5 Year Program		3-4 Year Program		Upper Level			Lower Level
	Ir	Drs.	Bk	BA	STM	SMA/ SLA	ST	SMP
Chief of DPUK	2	2		1	2			
Road Section, Chief (1)			1		1	2		
Road Section, Staff					29	17		6
Plan./Pgm.Sect., Chief (2)	1		2					
Plan./Pgm.Sect., Staff					17			
Tech. Section, Chief (3)							1	
Tech. Section, Staff					2 (4)		1	
Road Design Subsection, Chief (4)			1					
Road Design Subsection, Staff					11			
Road Development Subsection, Chief (5)			1					
Road Development Subsection, Staff								
Roads/Buildings Subsection, Chief (6)	-No Data Provided-							

Continuation of Table 5

Roads/Buildings Subsection, Staff								
Total Permanent	3	2	5	1	62	19	2	6
Total Nonpermanent					(4)			

Note (1) Road Section in Bone, Wajo, Pinrang, Jeneponto
Note (2) Planning Program Section in Bone, Pinrang, Bulukumba, Jeneponto
Note (3) Technical Section in Sidrap
Note (4) Road Design Subsection in Gowa
Note (5) Road Development Subsection in Gowa
Note (6) Road/Building Subsection in Bulukumba

one individual is reported to be temporary. Almost 90% are STM (technical high school) graduates in three of the four kabupatens. The Road Section staff in Jeneponto are all first-level secondary school (SMP) graduates.

The educational levels of the Chiefs of DPUK in South Sulawesi are also good, although more mixed than in NTT. Two are Ir. and two are Drs., one is a BA and two are STM.

Only one of the four Chiefs of a Road Section is a BE (Wajo), one is an STM (Jeneponto) and the other two are SMA. Both Section Chiefs (Road Design and Road Development) in Gowa are BE. If possible, the new job positions for Chief of a Road Section should be filled by a BE when the organization is completed in Sidrap, Gowa and Bulukumba.

The field forces in both provinces are primarily temporary employees. It is not known how many of these people return for the same job year after year but it is assumed that the rate of turnover is probably quite high. Most of the present job tasks do not require skilled workers because much of the work is labor intensive. The proposed maintenance management system will identify some important job positions for skilled workers in the maintenance and construction crews. The GOI should try to come up with a way to retain the more skilled workers so that experience is not lost at the end of each year.

5.3. NTT

The structural organizations of the DPUP/Cabang Dinas in NTT are all the same. The present structure includes a Road Section with Subsections for Engineering Design, Maintenance, and Construction. There is a separate Planning Section with Subsections for Programming, Program Control, and Transmigration. Each section and subsection has a position for a Chief but the technical staffs in each section are treated as a pool of personnel without long-term specific responsibilities or duties. The technical personnel are frequently rotated from one project to the next, especially in construction supervision.

Staffing levels for technicians show an average of 18 in the Road Sections for six of the kabupatens. Kupang reports having only two technicians in its Road Section. Approximately 86% of the Road Section technicians in the other six kabupatens are permanent staff; the ratio of permanent to non-permanent staff is about 6 to 1.

Table 6 summarizes the distribution of personnel by educational level and employment status (permanent or non-permanent) vs. job position. Only Kupang requires additional technicians and perhaps the personnel below the STM educational level in Ngada can be trained to perform their task.

Table 6
EDUCATIONAL BREAKDOWN OF PERSONNEL
NTT

Position	Higher Education				Secondary Education				Other
	5 Year Program		3-4 Year Program		Upper Level			Lower Level	
	Ir	Drs.	BE	BA	STM	SMA/ SLA	ST	SMP	
Chief of DPUP Cabang Dinas	1		4				1	1	
Road Section, Chief			2		3	1			1
Road Section, Staff					84 (15)	2		11	
Planning Section, Chief (1)	1			1	2	1	1		
Planning Section, Staff					17 (1)	4			
Total Permanent	2	-	6	1	106	9	2	12	1
Total Nonpermanent					(16)				

Note (1) Only kab. Sikka does not have an assigned Chief of the Planning Section at this time.

For Chief of DPUP Cabang-Dinas, five of the seven have a BE degree or higher. One is an Ir. (Kupang), four are BE, one is ST (Belu) and the remaining Chief, although listed as SLP, appears to possess good managerial skills.

The positions of Chief of Road Section are all filled but only two are BE and three are STM. The remaining two in Ngada and Kupang are below STM. The positions of Chief of the Subsections are not designated to a particular individual but all of the staff work as a pool directly for the Chief of Section. The technicians rotate in such duties as construction supervisor, foreman, and office staff.

5.4. EQUIPMENT MAINTENANCE AND REPAIR STAFFING

The current configuration of manpower for the maintenance and repair of equipment in the kabupatens is shown in Table 7. The information has been taken from the P.T. Hasfarm reports. An analysis of the equipment staff in 14 kabupatens follows. It summarizes the information on three classes of personnel:

- o Chiefs of Sections and Subsections;
- o Mechanics; and
- o Operator/Drivers.

For each class, a statement is presented on the current:

- o Status (permanent or temporary);
- o Education level; and
- o Distribution (NTT or South Sulawesi).

5.4.1. Chiefs of Sections and Subsections

Status : Existing personnel currently classified as Chiefs are overwhelmingly in a permanent status position (27 out of 31, or 87%).
The only 4 Chiefs in a temporary status position are found in South Sulawesi.

Education : The predominant educational level is STM/SMA (19 out of 31, or 61%). However 8 out of 31 (26%) Chiefs hold a BE degree or higher.

Distribution : South Sulawesi has more personnel (21 out of 31, or 68%) holding a Chief position. The possible reason is that 4 out of 7 kabupatens in South Sulawesi have workshops established by an OECF project.

Conclusions : The DPUK appear to have recognized that personnel in the position of Equipment Section Chief should be permanent. Under the proposed AID Project the Equipment Section Chief will have much more responsibility than at present: for more equipment, more personnel, a new fully operational workshop and consultant's counterparts. A college level education for the Equipment Section Chief would probably facilitate the transfer of skills and technology.

Chiefs of Subsections should also be guaranteed their jobs to avoid high turnover. They should have a technical or administrative education background.

Table 7

SUMMARY OF DPUK EQUIPMENT SECTION STAFF (1986) EDUCATION LEVEL

POSITION	STATUS	SD (IB)		SMP		SMA		D.III		SMK		DIP		SD		SUB TOTAL	
		NTT	SULSEL	NTT	SULSEL	NTT	SULSEL	NTT	SULSEL	NTT	SULSEL	NTT	SULSEL	NTT	SULSEL	NTT	SULSEL
HEFF, EQUIPMENT SECTION	PERMANENT	-	-	-	1	1	1	1	2	2	1	-	-	-	-	4	5
	TEMPORARY	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
HEFF, WORKSHOP SUB-SECTION	PERMANENT	-	1	-	-	-	-	4	2	1	-	-	-	-	-	5	3
	TEMPORARY	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2
HEFF, WAREHOUSE SUB-SECTION	PERMANENT	-	-	-	-	-	-	-	1	1	-	-	1	-	1	1	3
	TEMPORARY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HEFF, EQUIPMENT ADMINISTRATION SUBSECTION	PERMANENT	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	3
	TEMPORARY	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HEFF, ADMINISTRATION	PERMANENT	-	-	-	-	-	-	-	1	-	1	-	1	-	-	-	3
	TEMPORARY	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
PEMBANTU	PERMANENT	-	-	-	-	-	-	36	1	-	-	-	-	-	1	36	2
	TEMPORARY	-	-	-	-	-	-	1	0	-	-	-	2	-	1	1	11
OPERATOR/DRIVER	PERMANENT	-	-	-	-	-	-	40	-	-	-	3	-	17	12	60	12
	TEMPORARY	-	-	-	-	-	-	-	-	-	-	21	2	40	21	75	23
ADMINISTRATION STAFF	PERMANENT	-	-	-	-	-	1	8	-	-	-	6	-	-	-	14	1
	TEMPORARY	-	-	-	-	-	-	6	-	-	4	-	0	-	-	6	12
JB - TOTAL	PERMANENT	-	1	-	1	1	3	89	9	4	2	9	2	17	14	120	32
	TEMPORARY	-	2	-	-	-	1	7	8	-	4	21	15	48	22	82	50
TOTAL		-	3	-	1	1	4	96	17	4	6	36	15	65	36	102	82

5.4.2. Mechanics

Status : The vast majority of Mechanics (38 out of 50, or 76%) are on a permanent status position. However of the 12 Mechanics in a temporary status position, 11 are in South Sulawesi.

Education: The predominant educational level is STM (46 out of 50, or 92%).

Distribution: Most of the Mechanics are in NTT (37 out of 50, or 74%). The possible reason is that Mechanics in South Sulawesi are more transient in nature. The existing number of Mechanics in NTT seems excessive for the amount of work or facilities currently available.

Conclusions: Mechanics should have at least a technical secondary education and should be permanent employees.

This is generally already the case as 92% of the Mechanics hold an STM degree. And at least 76% of the total are permanent employees. However, special efforts should be made in South Sulawesi to convert all mechanics to permanent status.

5.4.3. Operators/Drivers

Observation: The P.T. Hastarm report did not differentiate between the positions of Operator and Driver; therefore, it was necessary to group them together.

Status : Most of the Operators/Drivers (98 out of 170, or 58%) are in a temporary status position. In South Sulawesi the ratio of temporary to permanent is 2 to 1.

Education: Most of the Operators/Drivers (98 out of 170, i.e., 58%) have only on SD (primary) education. However, 40 out of 170, or 23% of the Operators/Drivers have an STM education and 32 out of 170, or 19%, have an SMP degree.

Distribution: The vast majority of Operators/Drivers (135 out of 170, or 79%) are employed in NTT. Again, the existing number of Operators/Drivers in NTT does not seem to be justified by the amount of equipment or work currently available in that province.

Conclusions: Operators of major equipment have to understand the machines they operate. They should have taken training courses dealing with technical matters, and be able to read and understand operators' manuals, etc.

The data show that at least 42% of the combined Operators/Drivers staff have either an STM or SMP degree. An STM level of education should be preferred for Operators. A good Operator is invaluable to the DPUK organization and represents a considerable investment by the government in training. They should be guaranteed their positions and all Operators of major equipment should be permanent employees.

Drivers must be able to read and pass proficiency exams on their driving ability. They should have at least 8 years of education to ensure responsibility and the maturity for handling a vehicle.

5.5. COORDINATION WITH DPUP

The Government of Indonesia has already created and implemented policies designed to provide assistance to Equipment Sections in the kabupatens. It has established the role of ALKAL (an equipment repair and management facility under the Kanwil PU and located in the province capital) as one of assistance and support to kabupaten equipment fleets. Within the ALKAL, an Equipment Coordinator is responsible for enforcing equipment maintenance procedures and daily record keeping of an equipment management system. The Coordinator position was established by the Director General of Bina Marga in March 1985. The present responsibilities of Equipment Coordinators with regard to road projects in kabupatens can be summarized as follows:

- Prepare the inventory, monitor and maintain Bina Marga equipment used at the kabupaten level.
- Make periodic reports on the utilization and maintenance of equipment.
- Advise mechanics and operators.

ALKAL is a centralized equipment section that includes equipment for all three DPUP technical divisions (Bina Marga, Cipta Karya and Pengairan). Each technical division pools its equipment in the ALKAL. Bina Marga's equipment, through ALKAL, may be used by the other divisions but Bina Marga has priority.

ALKAL workshops are responsible for providing the support necessary to do all repairs identified in the Pedoman Pemeliharaan Peralatan as major repairs (Tingkat IV and V). And upon request ALKAL mechanical staff can provide instructors for "on-the-job" training to DPUK workshop personnel. ALKAL workshops should thus play an important role in providing support to DPUK workshops in the form of training for Mechanics and Operators; providing technical support to DPUK Equipment Sections and for repairs that necessitate using special tools, equipment or

facilities. ALKAL workshops visited in Kupang and Ujung Pandang appeared to be capable of providing the assistance that DPUK workshops require.

5.6. ORGANIZATIONAL CONCLUSIONS

In general, the DPUP Cabang Dinas in NTT are already well structured and all seven are identical. This organizational structure is basically adequate. For road maintenance and reconstruction there should be a materials unit added. For equipment management, the existing Workshop and Warehouse Subsections should be combined and a new Administrative Subsection should be added.

In South Sulawesi the DPUK are directly under the control of the Bupati and thus each DPUK is organized differently. For the purposes of establishing a maintenance management system that is potentially replicable elsewhere in the country, the organizational structure of all the PU organizations should be at least be similar. Local variations are possible, but all of the basic functions must be able to be assigned to a particular subsection or unit. Recommendations for the core roads organization and staff are included in Section 10.3.

5.7. SKILL LEVEL CONCLUSIONS

It was not possible to make a detailed assessment of the present skill levels of DPUP Cabang Dinas or DPUK personnel. The field visits were not extensive enough to make definitive judgments. In general, however, it was felt that the skills required for maintenance management are within the capabilities of existing personnel.

For reconstruction and maintenance work, developing the capabilities of existing staff will require both stronger supervision, particularly in work methods, and training. It was noted during the field visits, for example, that methods are copied from other workers without any understanding of why the task should or should not be done in that fashion. (This is also very obvious in the inability of contractors to construct roads well. Most only know how to build a Telford or macadam road. They could learn other methods if someone were to show them and they were able to practice the newly acquired skills under competent supervision.) This is an area where short-term work methods courses and stronger supervision skills can make a significant contribution.

Construction supervisors who inspect the construction work of contractors will have to acquire new skills such as recognizing when the contractor's practices will result in below-standard work, and materials sampling and field testing. At present supervisors are usually selected from the foreman level and make only a visual check of contract progress in order to allow the contractor to submit his progress payment request. A career path for supervisors should be established, as well as the means

to select the most capable personnel for these important positions. Age should also be considered when assigning an individual to supervise a contractor. A junior technician will hardly command the respect of the contractor nor be able to convice the contractors' men to correct improper methods. Force account reconstruction crews should be the "training ground" for construction inspectors. If members of that crew acquire the proper skills they will have the knowledge and confidence necessary to enforce the correct procedures on the contractor.

Other first-line supervisors (foremen, senior equipment operators, lead mechanics), technicians (soils technicians, storekeepers, etc.), as well as middle-level managers (Chief of Section, Subsection) need to acquire more up-to-date skills as well. The particular skills needed by all members of DPUK staffs should be written up in printed job descriptions by the TA during the project (tentative recommendations are presented in Section 10.3). The job descriptions may undergo several changes during the development of the system but subsequently should be completed and adopted by the GOI as approved job descriptions. These will become very important when the system is introduced in other kabupatens.

A preliminary outline of training requirements is given in Section 10.8. However, the degree of sophistication for new job skills and the related training required will have to be carefully assessed as the project gets underway. Therefore, a well qualified and experienced training advisor will be one of the most important members of the TA team.

6. MAINTENANCE AND CONSTRUCTION PLANNING/BUDGETING

6.1. EXISTING SITUATION

6.1.1. Planning/Budgeting Process

The existing planning/budgeting schedule and review process for kabupaten road work in Indonesia is described in detail in Planning and Budgeting with Special Reference to INPRES Programs, Part I, Planning, by Dwight King. Briefly, construction and maintenance of kabupaten roads are normally the sole responsibility of the kabupaten government; however, most funds for kabupaten road work are subsidies from the central government in the form of INPRES allocations.

The selection of projects for maintenance and construction is made by the DPUP Cabang Dinas or DPUK and the two kabupaten-level planning agencies, Bagian Pembangunan and Bappeda II. In a few kabupatens the selection is a cooperative effort. In many, the DPUK may draw up a list of roads which they feel should be planned, but one of the planning agencies makes the final decisions on project selection.

The DPUP Cabang Dinas or DPUK staff conduct the preliminary site investigation (topographic survey, road condition survey, etc.). The data are then analyzed and the necessary work is designed following standards prepared by the Subdirectorate of Local Roads, Department of Public Works in Jakarta. These standards are officially issued by the Directorate General for Kabupaten Development (BANGDA), Department of Home Affairs.

Project designs must be completed and reviewed at the provincial level prior to being forwarded to the central government in November. Each project is usually scheduled to begin on April 1, the first day of the Indonesian fiscal year (IFY). Normally the approved budgets and authorization to proceed are not returned to the kabupaten until several months after April 1. This forces projects to be compressed. Sometimes the unfinished portion is replanned and rebudgeted for the following year.

6.1.2. Comments on the Planning/Budgeting Process

The delay in the arrival of the approved budget causes a halt in the field work because no work can be carried out either by force account or contract. Because much of the force account work force consists of pegawai harian (daily employees), they must be suspended until the new budget arrives. In the case of construction, the interruption of field work is disruptive. But in the case of maintenance, which should be carried-out all year long to be effective, it is unacceptable. There are certain periods when maintenance is best performed, such as performing drainage maintenance just prior to and immediately following the rainy season. Having to stop all work results in either cutting back the full

54

maintenance program and thereby eliminating some of the work, or intensifying the normal program in order to complete all the work within the shorter time period.

One of the most important principles of road maintenance is that it is time critical. If the work is delayed much beyond the optimum period for each activity, it may be difficult to recover from a deteriorating overall condition. And if the work program must be intensified, there may be increased costs due to labor overtime or extra equipment necessary to make up for the idle period spent waiting for the approved budget.

Another serious drawback is that because many daily employee operators and mechanics must be suspended, valuable time is lost which could be spent in stockpiling materials and completing equipment repairs that were postponed while the equipment was in use.

6.1.3. Maintenance Budgeting Impacts

The way in which budget proposals are prepared does not facilitate good maintenance. Some of the work which is budgeted as "maintenance" is often really reconstruction or even betterment. All work is planned, designed and budgeted as a separate project or a collection of different activities at various locations, but is considered as one project for budget purposes. That work may be performed on lines classified as asphalt (which may be an asphalt pavement or simply an asphalt seal) and on roads classified as gravel (which may have a granular surface or only the very rough Telford surface made from either rounded or angular stones).

True maintenance type activities, if performed at all by kabupatens, are usually only of the routine type; periodic maintenance is not a term in use or an activity carried out at the kabupaten level. Routine activities are normally carried out only on so-called asphalt roads, infrequently on gravel, and practically never on earth roads. The work is usually conducted at various locations under a single line item titled "maintenance" in the project budget and is performed by force account.

Reconstruction or new construction work is also budgeted as a specific project for each line of road. New construction is often disguised as support work or upgrading. Either can be performed by force account, but more often, these jobs are contracted.

6.1.4. Maintenance Budget Allocations

The GOI has recently specified that a minimum of 25% of INPRES Dati II should be used for the maintenance of kabupaten roads. That is a good start toward making people aware of the importance of maintenance. But while the present 25% is just adequate to maintain the small amount of roads in the 14 kabupatens that are currently in good condition, it will not be enough as the project increases the amount of good roads.

Moreover, the INPRES Dati II fund is per-capita based and maintenance funding thus becomes a function of population, not actual maintenance requirements. Kabupatens with higher populations receive more money and thus larger allocations for maintenance without consideration of the size of their road network. The policy benefits kabupatens with high populations relative to the road network (Pinrang and Sikka) and hurts those with low populations and relatively large networks (Sid-Rap and Ngada).

6.2. CONCLUSIONS*

The selection of road projects at the kabupaten level is currently a subjective process based on perceived needs.

Project designs are forwarded to the central government in November and each project is scheduled to start in April of the following year. However, because funds are not received until several months after April, projects must be compressed or replanned and rebudgeted for the following year.

Because all work including maintenance is budgeted as a project, this suspends work on site. This delay is costly in terms of construction and unacceptable in terms of maintenance activities, which must be continuous.

Although the present approach to budgeting is simple and reflects the GOI's commitment to maintenance, the budget allocated for maintenance is not related to the need for maintenance work (which is sill undefined under current planning procedures). Preliminary assessments indicate that current levels of funding will be inadequate for the maintenance activities envisaged under the DRMS Project.

The practices of labeling reconstruction or betterment as maintenance, or financing maintenance as a "project" in the development budget (instead of as a routine budget activity), and or generally limiting maintenance only to asphalt roads have allowed much of the road network to fall into a state of overall poor condition. Reconstruction is therefore necessary to restore damaged roads back to good condition; however, normal practice simply lets them deteriorate once again into damaged condition. This cycle is extremely expensive to both the user and the GOI.

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* The planning and budgeting process is covered in detail in a separate report by Dwight King, Planning and Budgeting with Special Reference to INPRES Programs.

The current practice of funding maintenance and construction from the same INPRES Dati II account is good. It should be continued during the DRMS Project. However, the procedures for estimating the work load will have to be improved to allow for planning for maintenance according to the procedures developed in the proposed maintenance management system and for construction according to the improved standards. A combined work program which identifies both maintenance and construction will permit the allocation of scarce resources to meet the needs of both types of work. The proposed maintenance management system will help to reinforce this practice.

USAID should assist the government to develop ways to ensure that maintenance work can continue uninterrupted throughout the year. This could be a topic for a policy study in the first year or two of the project. It is felt that the major problem is one of pay. Also, limited amounts of fuel, spare parts and some maintenance materials could be stockpiled prior to the end of the fiscal year so that work can be continued during the usual delay in the arrival of the approved budget. Consideration should be given to the use of a special reserve fund.

Present budget allocations are not related to needs, and as more roads are brought up to standard by the DRMS Project, the current allocations for maintenance will become inadequate.

7. EQUIPMENT MANAGEMENT AND PLANNING

7.1. SOURCES OF EQUIPMENT

The existing configuration of the equipment fleet in the 14 kabupatens being considered in the Provinces of NTT and South Sulawesi and their present condition are shown in Tables 8 and 9.

7.1.1. Sources of Equipment

There have been three basic sources of major equipment to the 14 kabupatens:

1. From OECF: Dump Trucks, Graders, Loaders, Dozers, Tire Rollers, Crushers.

2. From BANGDA: Steel Wheel Rollers, Compactors, Crushers.

3. From DPUP and Bina Marga: Dump Trucks, Graders, Loaders, Dozers, Asphalt Sprayers.

With the exception of compaction equipment (steel wheel rollers and hand compactors), most of the major equipment in operating condition in both provinces is the four-year old road equipment provided by the former OECF project. Of the 14 kabupatens tentatively proposed for the AID project, four out of seven kabupatens in South Sulawesi were provided with OECF equipment (Pinrang, Sidrap, Bone and Jeneponto) while only two out of seven (Belu and Manggarai) in NTT were so provided. In South Sulawesi, OECF equipment now represents 57% of all operating equipment. In NTT, OECF equipment represents 30% of all operating equipment.

In South Sulawesi, OECF equipment represents the totality of motor graders, wheel loaders, bulldozers, rubber-tired rollers, concrete mixers and air compressors in operating condition. Only one out of 55 operating dump trucks has not been supplied by OECF and out of a total of five stone crushers currently in operating condition, three were supplied by OECF. In NTT, however, there is an almost equal balance of OECF-supplied equipment and equipment obtained from other sources and there are twice as many (six units) stone crushers in working condition provided by other sources.

TABLE 8

SOUTH SULAWESI EQUIPMENT FLEET

TYPE OF EQUIPMENT	CAPACITY	MANUFACTURING	M O D E L	NUMBERS		PRESENT CONDITION			
						OPERATING		DEADLINED	
				OECF	OTHER	OECF	OTHER	OECF	OTHER
STEEL ROLLER	-	SAKAI	20/081/022	-	5	-	1	-	4
	6 TNS	BARATA	MV6P/MG6 (THREE WHEEL)	-	14	-	7	-	7
	6 TNS		MGT 6 (TANDEM)	-	16	-	16	-	-
	2.5 TNS		MGB 1 (VIBRATING)	-	18	-	12	-	6
SHOVEL NIKKO	-	NIKKO	RH 3.5	-	1	-	-	-	1
TIRE ROLLER	8.5 TNS	KAWASAKI	KR-200	7	-	7	-	-	-
DUMP TRUCK	2.5 TNS	TOYOTA DYNA	BU-30	56	1	54	1	2	-
MOTOR GRADER	-	KOMATSU	GD 31	7	-	7	-	-	-
WHEEL LOADER	-	KOBELCO	LK 300	9	-	9	-	-	-
BULLDOZER	100 HP	KOMATSU	D.50 E	4	-	4	-	-	-
AIR COMPRESSOR	-	HOKUETSU	FOR-250	2	-	2	-	-	-
STONE CRUSHER	-	BARATA	DDV 1	3	7	3	2	-	5
HAND COMPACTOR	-	BARATA	KP 100	3	21	3	19	-	2
CONC. MIXER	1 M3	GOLDEN STAR	SM 450	2	-	2	-	-	-
ASPHALT SPRAYER	40 l.	HOITA	ES CD 3K	-	10	-	10	-	-
T O T A L:				103	93	91	68	2	25
PERCENTAGE:				53%	47%	57%	43%	7%	93%

59

TABLE 9

NTT EQUIPMENT FLEET

TYPE OF EQUIPMENT	CAPACITY	MANUFACTURING	MODEL	NUMBERS		PRESENT CONDITION			
						OPERATING		DEADLINED	
				OECF	OTHER	OECF	OTHER	OECF	OTHER
STEEL ROLLER	6 TNS	BARATA	HVOP/HS5 (THREE WHEEL)	2	57	2	46	-	11
	6 TNS	BARATA	P-T6(TANDEM)	2	8	2	6	-	2
	2.5 TNS		MGB 1 (VIBRATING)	-	14	-	10	-	4
	-	TAYKIO KU	TR 850	-	17	-	16	-	1
TYRE ROLLER	-	SAKAI	TS 7-69	-	3	-	2	-	1
DUMP TRUCK	2.5 TNS	TOYOTA DYNA	BU-30	33	11	33	10	-	1
	-	TOYOTA	HU 45	-	1	-	1	-	-
	-	ISUZU	TLD 54	-	21	-	18	-	3
	-		TXD 120	-	1	-	1	-	-
	-	LOAD STAR	IH 1850	-	10	-	3	-	7
	-	CHEVROLET	C.50	-	1	-	-	-	1
FLAT BACK TRUCK	2 TNS	SAVIEM	TP 3	-	1	-	1	-	-
	-	LOAD STAR	IH 1850	-	2	-	1	-	1
	-	ISUZU	T 7D	-	1	-	-	-	1
	-	FARGO		-	1	-	-	-	1
	-	SCOUTERRA		-	1	-	-	-	1
MOTOR GRADER	-	KOMATSU	GD 31	3	5	3	3	-	2
		CATERPILLAR	CAT 120	-	1	-	1	-	-
WHEEL LOADER	-	ISUZU	DA 220	-	1	-	-	-	1
	-	KOBELCO	LK 300	4	3	4	3	-	-
	-	CAT	CAT 920	-	2	-	-	-	2
	-	KIHCO	JH 600	-	1	-	1	-	1
	-	HALLA	FA 545B	-	1	-	1	-	-
CONC. MIXER	1 M3	GOLDEN STAR	SM 450	2	-	2	-	-	-
BULLDOZER	100 HP	KOMATSU	D 50 E	5	0	5	0	-	-
	140 HP	CATERPILLAR	D 6 C	0	1	0	1	-	-
	200 HP	CATERPILLAR	D 7 G	0	1	0	1	-	-

TABLE 9

NTT EQUIPMENT FLEET (Continued)

TYPE OF EQUIPMENT	CAPACITY	MANUFACTURING	MODEL	NUMBERS		PRESENT CONDITION			
				OECF	OTHER	OPERATING OECF	OPERATING OTHER	DEADLINED OECF	DEADLINED OTHER
STONE CRUSHER	-	BARATA	DD- 1	-	11	-	6	-	5
	-	MINYU	SM-1	3	-	3	-	-	-
	-	SAKAINADA		-	2	-	-	-	2
	-	FRAGRAM	DDV 2	-	1	-	-	-	1
AIR COMPRESSOR	-	HOKUETSU	FOP 250	3	3	3	1	-	2
EXCAVATOR	-	MITSUBISHI	D.70C	1	-	1	-	-	-
	-	FOCIAIM		-	1	-	1	-	-
	-	DROTT		-	1	-	-	-	1
MOBILE WORKSHOP	-	TOYOTA DYNA	J-30	1	-	1	-	-	-
ASPHALT SPRAYER	-	COTEX		-	1	-	1	-	-
	-	ROBIN		-	2	-	2	-	-
TRACK LOADER	-	CATERPILLAR	CAT 931 B	-	1	-	-	-	1
WATER TANK TRUCK	-	HINO	FL 340	-	1	-	1	-	-
	-	LOAD STAR	IH 1850	-	1	-	-	-	1
WHEEL CRANE	5 TNS	IH	AC 261	-	1	-	-	-	1
SEMI TRAILER TRUCK	9 TONS	LOAD STAR	IH	-	1	-	-	-	1
HAND COMPACTOR	-	BARATA/YANMAR	NP 100	0	14	-	14	-	-
	-	YAMAMOTO	YS 14	9	4	9	4	-	-
TOTAL:				69	211	69	156	0	55
PERCENTAGE:				24%	76%	30%	70%	0%	100%

61

The net impact of this diversity of sources seems to be a collection of varied equipment that is not necessarily appropriate to the kabupatens' needs. Some equipment is left to the kabupatens after a national construction project has been completed in the area. Other types have been received from BANGDA, but the kabupatens were not consulted ahead of time as to whether they could use the equipment or whether a different type of equipment would be more appropriate. There has been no policy established at BANGDA on what types and when to give equipment to the kabupatens. This aid by BANGDA, however, has been discontinued since FY 84/85 and it is unlikely that it will be given again in the future.

Besides receiving equipment from BANGDA and foreign-donor projects, the kabupatens may use INPRES Penunjangan Jalan and Dati II funds for equipment purchases with no unusual restrictions on amount, type, manufacturer or origin. The same funds may be used to purchase spare parts for any type of equipment. However, there is no equipment procurement policy at the kabupaten level and these funds are almost entirely used for road work.

Finally, another source of equipment to the kabupatens comes through various formal and informal pooling arrangements. This equipment pooling is generally of a temporary nature and for a specific purpose; the equipment is provided from DPUP/ALKAL or Bina Marga depots upon request. Very seldom is equipment rented from private sources in the kabupatens.

The utilization of DPUP/ALKAL and Bina Marga equipment by kabupatens is regulated by established policies. There is no charge for the use of the equipment itself. However, if a DPUP operator is sent with the unit, his transportation and per diem costs are borne by the DPUKs, as well as the transport cost from the pool to the site (for a Lo-Boy, Bina Marga's Depot in Ujung Pandang would charge only for the fuel and Rp 17,000/day for the driver).

Table 10 shows the present fleet of operating road equipment based at the provincial (ALKAL) facilities in Kupang (NTT) and in Ujung Pandang (South Sulawesi) as well as in the Bina Marga depot in Ujung Pandang. The fleet based at ALKAL in Kupang consists mostly of old equipment, purchased in the early 1970s with a World Bank loan. Few of these units could be considered of real value to the kabupatens except for such short specific tasks as the usage of a 3-ton Crane Truck to help remove the engine of a damaged piece of kabupaten equipment in the field.

Table 10 shows, for South Sulawesi, the total number of operating units of equipment in each class at DPUP/ALKAL and at the Bina Marga Depot, not necessarily the units that could be available for the kabupatens to borrow temporarily. It was not possible to obtain a breakdown of the age and distribution of this equipment. The equipment listed under Depot Bina Marga includes all units distributed among the six provinces under the Depot VII's jurisdiction. Again, some of these units may be available for such brief specific tasks as using a truck-trailer from the Depot to move a piece of heavy equipment to/from a kabupaten to/from the workshop in Ujung Pandang.

Table 10
Availability of Provincial and Bina Marga Equipment

Item No.	TYPE OF EQUIPMENT	MANU-FACTURER	MODEL	YEAR*	N.T.T. DPUP/AIJKAL		SOUTH SULAWESI DPUP/AIJKAL		SOUTH SULAWESI DEPOT (B.M.)**	
					Good	NMR	Good	NMR	Good	NMR
1	Bulldozer on track	KOMATSU/	D.60A	1971	1	-	7	0	57	12
		FIAT ALLIS/	16B	1978	1	-				
		HALLA								
		KOMATSU	D-155	1982	-	1				
2	Motor Grader	KOMATSU	GD.36-5H	1971	-	1	19	2	81	18
		KOMATSU	GD.31RC	1980	1	-				
3	Stone Crusher	JAQUES	JH2014-14	1972	-	1	10	2	26	8
4	Loader on wheel	KIHCO HOUGH	JH-60	1971	1	-	18	6	46	16
		MASSEY FER-	MF-50	1974	-	1				
		GUSON								
5	Three wheel roller	BARATA	MV-6P	1969	5	1	5	26	77	54
				1974	6	-				
				1980	-	1				
6	Pneumatic roller	SAKAI	TS-7400	1980	3	-	24	0	74	10
7	Vibrating roller	BARATA	MCD-1000	1983	2	-	2	0	10	1
		TAYKIOKU	TR-850	1980	3	-				
				1979	1	-				
8	Grass Cutter	SINALONE	S20-113	1980	-	1	-	-	-	-
9	Winch manual	TIRFOR	T35S	1971	-	1	-	-	-	-
10	Asphalt Sprayer	LINNHOFF-	-	1971	-	1	3	2	10	7
		AUTOMAIN								
	Asph.Sprayer Truck	ISUZU	TXD20	1971	-	1				
11	Fuel Tank Truck	ISUZU	TXD20	1971	-	1	0	1	4	5
12	Water Tank Truck	TOYOTA	DA.110	1979	2	-	0	5	16	11
		ISUZU	TLD-54	1980	1	-				
13	Trailer towed	INTERNATIONAL	IH.T20-129	1962	-	1	1	1	6	3
14	Dump Truck	ISUZU	TXD.20	1971	2	-	192	53	463	152
		ISUZU	TLD 54S	1980	4	-				
		IH-1850	Loadstar	1976	2	-				
		TOYOTA DYNA	BU-30	1980	3	1				
	Notes: NMR = Needs minor repairs									

* Year applies to NTT only. Age for South Sulawesi equipment could not be obtained.
**Most Depot equipment is presently spread and being used in the 6 provinces under Depot VII's jurisdiction.

23

7.2. EQUIPMENT OPERATION AND UTILIZATION

7.2.1. Operation

Equipment use was observed in Kupang and Sumba Barat (NTT) and in Jeneponto (South Sulawesi). In Kupang a road reconstruction operation was observed involving the following types of DPUK equipment:

1 Wheel Loader 1.2 m^3 (Kobelco LK300)
4 Dump Trucks 5.5 ton G.V.W. (Isuzu TLD 54/Toyota Dyna BU 30)
1 Motorgrader 110 HP (Komatsu GD 31 RC), and
1 Tire Roller 12 ton (Sakai TS).

A crawler bulldozer had been rented from a private source to loosen the bank material from which the front end wheel loader would load the dump trucks. Operation seemed satisfactory at the quarry. The dump trucks, however, appeared to be fragile and thus not properly suited for the type of work and terrain encountered. Engines were underpowered for the steep grades of rural roads and the dump bed was not thick enough for the type of material being loaded (the actual load capacity was only 2,150 kg). The only advantage for these small dump trucks is their narrower width and short wheel base which facilitate passing other vehicles and maneuvering in narrow roads.

The motorgrader (a Komatsu GD 31-RC) was suitable for light grading but it would have difficulty doing heavy cutting and scarifying. One observation heard from the Chief of Equipment was that the motorgrader frequently sheared its safety load pin. There was no water tank truck on the job and the rubber-tired roller wasn't operating that day. All operators were Kabupaten employees.

In Jeneponto we observed the operation of a stone crusher being fed by a wheel loader with material being transported by dump trucks of 5.5 ton G.V.W. (approximately 12,000 lbs gross vehicle weight). All the equipment was OECF funded and consisted of the following:

1 Jaw Stone Crusher 20 ton/Hr. (Barita DDV1),
1 Wheel Loader 1.2 m^3 (Kobelco LK300), and
6 Dump Trucks 5.5 ton G.V.W. (Toyota Dyna BU30).

The operators were Kabupaten employees, "harian" status.

The crusher was producing one-size aggregate (up to 3" average), powered by an electrical generator with 2,247 hours after 4 years of operation, which is about average utilization. The dump trucks were bringing river rock to a stockpile next to the crusher. The trucks were overloaded, having difficulty negotiating an approximate 6% grade in the crusher yard.

Although these observations were limited and brief, it appeared that all operators were adequately skilled.

7.2.2. Utilization of OECF Equipment

In 1983 the Japanese government funded a project to do major road work in several kabupatens in NTT and South Sulawesi. The equipment was dimensioned, taking in consideration some of the existing restrictions such as road width, standardization, volume of work, etc. The equipment was placed in the kabupatens and managed by DPUK personnel, with little or no supervision from consultants. The results were not always satisfactory.

A reporting system on utilization, production and fuel consumption was used to keep Bina Marga informed. Based on a sample of the information supplied, an analysis of the operation of this equipment is presented here (Annex 20 contains a detailed assessment of this equipment's utilization) and is summarized below.

- During a whole month, the equipment was assigned to work on the Regravelling and Road Stabilization Project (Number 37.[illegible].0.15) in Kabupaten Pinrang (Road No. 37).

- The equipment fleet consisted of:

  11 Dump Trucks 5.5 ton G.V.W. (Toyota Dyna BU30)
  1 Bulldozer (Komatsu D50)
  2 Motorgraders 110 HP (Komatsu GD 31 RC)
  2 Wheel Loader 1.2 m^3 capacity (Kobelco LK300)
  2 Tire Rollers 8.5 - 11 ton capacity (Kawasaki KR-200)
  1 Stone Crusher 20 ton/hr capacity (Barita DDVI)
  1 Concrete Mixer

The equipment actually worked for only two to three hours per day. Much idle time occurred and too much equipment was used. With effective management, more production could have been obtained, on a 5-hour effective work day, with a much smaller fleet consisting of one motorgrader, one loader, four dump trucks, and 1 tire roller.

7.3. CONCLUSIONS

Equipment in the 14 kabupatens is obtained from a variety of sources, the largest being an OECF project. Although INPRES funds may be used to purchase equipment, these funds are usually spent on road works only. The equipment available is not necessarily in accordance with needs and the misuse of light equipment was noted.

A general conclusion on utilization is that practices involve excessive idle time and too much equipment was used. Despite the attractiveness of the equipment stored at AKAL or Bina Marga's Depot (e.g., bulldozers, motorgraders, wheel loaders or dump trucks), it is not advisable for the DRHS Project to rely on this source. Only support-type equipment such as Lo-Boy truck-trailers or a 3-ton crane truck should be requested by DPUKs and only for some limited specific purpose. In the case of Lo-Boys, consideration should be given to the construction of Lo-Boy units in areas where access to AKAL or Bina Marga's depots is difficult (e.g., involves crossing between islands).

8. MAINTENANCE AND CONSTRUCTION IMPLEMENTATION PRACTICES

8.1. ROADS MAINTAINED

At present, maintenance may only be performed on "stable" roads. The term "stable" is understood to mean only an asphalt (paved or sealed or both) road or a gravel road in reasonably good condition. Therefore, earth roads are eliminated from consideration, even immediately after they are constructed. This situation results from the application of maintenance definitions used for national and provincial networks (which include few if any earth roads) to the kabupaten networks (which, in the Outer Islands at least, include many earth roads).

It should be noted that Public Works staff have indicated in discussions that the exclusion of kabupaten earth roads from maintenance may have been an oversight and that they would not be excluded from maintenance programs under the AID project.

8.2. FORCE ACCOUNT VS. CONTRACT WORK

At present, all maintenance and a limited amount of construction work are executed by force account. Most of the construction work is by contract. Contracts are lump sum, which hinders good quality control.

The GOI has a policy of helping small local contractors. Moreover, because the typical value of a kabupaten road work contract is small, only smaller contractors are interested or eligible to bid.

All contractors must prequalify according to a set of financial standards and be registered. Most registered contractors are small firms without a well-trained labor force and lack even basic equipment. Usually they will recruit local unskilled labor for each project. Sometimes, a few equipment units can be rented (compensation is questionable) from the DPUP Cabang Dinas or DPUK. The practice does not work well and is described and commented on in more detail in Section 9.6.8.

Because of the unskilled labor, the lack of equipment and a lack of technical knowledge, contract construction work methods are usually labor intensive and follow traditional methods. For earth roads, simple rough pioneering is all that is usually done, frequently by local community groups (under the Padat Karya Program) and experience many shortcomings (inadequate subgrade crown or compaction, narrow width, inadequate drainage). The roads are later declared to be kabupaten roads and are added to the total of substandard roads in the kabupaten network. For gravel roads, the construction method is usually a hand-placed Telford or coarse macadam without a gravel surface layer. Drainage construction is

also usually inadequate. These construction methods are usually so below standard that even if maintenance activities were performed, they would not be effective.

Construction work by force account normally is more equipment intensive; nevertheless, practices are also below standard in this area. For example, during the field inspection of the construction of a gravel road, it was observed that there was no shaping or compaction of the subgrade before a thin (± 10 cm, loose) layer of pit-run material was placed as a surface course. The material was very dry and had a high percentage of fines. It did not appear that moisture was added before compaction. Drainage did not appear to be adequate; in many areas the ditch cross-section appeared to be too small and culverts did not seem to be placed in the low spots. This new gravel road appears to be a typical example. It will probably never receive any regular maintenance and due to its below-standard construction, it will deteriorate to a damaged condition within a few years. It will then have to be reconstructed or remain in that condition until funds are available.

8.3 EXECUTION OF CONSTRUCTION

For construction, the typical designs and even the construction plans for the one AWCAS project visited in the field appeared to be adequate. However, when the consultants arrived on the site, what was actually being done did not match the drawings. There was no crown or compaction of the subgrade, the gravel layer was a select material with too many fines, the granular layer was too thin, and there was very little crown and no moisture added before a roller made a few passes. The work was progressing rapidly but at the cost of another substandard road added to the network.

8.4. MATERIALS AND QUALITY CONTROL

In the kabupatens visited during the field trips, no one was performing any sort of quality control other than a visual check of the materials or their sources. There are no laboratory facilities or field testing equipment in the kabupatens. Pit-run or river-run surfacing material receives only a visual approval. This material should receive a gradation analysis to determine if the blend of large and small sizes is within the allowable ranges permitted in the specifications.

Existing training courses for materials testing offered by the Diklat Bina Marga were considered to be adequate for use by kabupaten level personnel. Several technicians have received formal training in Kupang and Surabaya.

8.5. CONSTRUCTION INSPECTION

The present practice of construction inspection, called construction supervision in Indonesia, is weak. Typically the inspectors or construction supervisors visit the site perhaps only once a week, and due to transport shortages, sometimes only if the contractor provides a vehicle. That visit is usually for the purpose of noting the completed progress to date for authorizing progress payments.

8.6. CONCLUSIONS

The current definition of maintenance work restricts maintenance to certain kinds of roads. This definition excludes the maintenance of earth and some gravel roads.

Contractors involved in road construction in the kabupatens do not have the equipment or technical skills for the standard of work required. Force account units, though better equipped, also do not construct work appropriate to standards. Severe deficiencies in the roads under construction were noted. For the DRMS Project, upgrading the quality of construction is the first step to ensure that all the elements of the road (thickness, crown, type of material, soil type and compaction effort) are adequate for the conditions and acceptable for follow-on maintenance.

Construction units generally appeared to be understaffed and under-equipped. The progress control, cost control, site inspection and materials quality control work were considered to be inadequate.

Contractors need to be exposed to techniques so that they can estimate the production, resource requirements and costs associated with the standards. In the case of DPUP Cabang Dinas or DPUK staffs, formal and/or on-the-job training in the same techniques should be the responsibility of the project consultants. The consultants should also oversee the training of force account field crews in the improved work methods.

The staff of construction supervisors should be upgraded in number and experience. They should be present on the same site most of the time and have transportation available when they need it. They should be experienced enough to understand plans and specifications and to recognize when contractors' performance will result in substandard work. Supervisors should also have the authority to enforce that work be performed to standard. It is probable that all of these goals will be difficult to meet. The TA should study this issue carefully and assist the GOI in introducing measures to address the problem.

Reporting of project progress must also be strengthened. In particular, maintenance reporting should be done according to the work which was scheduled. Field reports should be simplified as much as possible and matched to the educational levels of the foremen and supervisors. Summary reports of overall work performance must be reviewed by the Chief of the DPUP Cabang Dinas or DPUK soon after the work is completed so that there is still time to react and take corrective action if necessary.

Another issue that may be a delicate one in that of cost accounting. The management system needs to define the work program in units of crew-days and total quantity of work units. It should also identify each activity unit cost and total costs, and break down the total cost into labor, equipment and materials components.

For effective control, a manager must know how his units are performing in terms of both production and costs. Production performance is easy to understand and accept; a manager wants to know if his foremen are meeting the average production rates used for planning. Cost control is less well understood and will require careful introduction.

Prior to the project, USAID and the GOI should agree that cost accounting as well as production accounting will be introduced for both maintenance and construction work. A cost accountant should be part of the TA team. If the word "cost" is sensitive then perhaps the title of Management Information Specialist is appropriate.

A materials laboratory should be created at the kabupaten PU. It does not have to be a full-fledged laboratory, but it should have at least a set of sieves and scales for checking aggregate and soil gradation. It should also have field density equipment such as a sand cone set or similar device for checking compaction density. Proctor equipment and a stove or oven should be provided to determine optimum soil density and moisture content. Concrete slump test equipment and cyclinder molds should also be provided. More sophisticated testing such as Atterberg Limits and concrete cylinder breaking can be requested from the DPUP Soils Laboratory.

Supervision shortcomings in Indonesia are related to problems of the format of contracts over which supervision is exercised. Existing policy requires that contracts are tendered as lump sum and usually in small contract values to attract smaller contractors. There are two drawbacks to this policy. Lump sum contracts, although easy for administration, are not a good method to provide close control on workmanship or materials quality. If a specific part of the job is defective, it is difficult to reject. Small contract values tend discourage or disqualify larger contractors who have more equipment at their disposal and who frequently provide better workmanship. Smaller contractors have little equipment and are limited to the traditional construction methods.

Contracts should be changed from the lump sum format to one with line items and unit prices. This is more complicated and will take time to initiate and adopt. (Perhaps grading work could still remain as a lump sum item for a while, but material items such as gravel surfacing and sealing activities should be converted to unit prices as soon as practical.) However, Bina Marga has already adopted, for donor projects, a unit cost approach to calculating the cost of almost every kind of work task, activity and type of material. The same standardized codes are used for reporting progress as well on these projects. This method should be checked for possible application to the project and investigated as a potential basis for introducing alternative contract formats.

DPUP Cabang Dinas or DPUK should have the ability to tender project contracts at levels higher than Rp. 200 million. This would enable larger contractors registered at the provincial level to bid for the work. This procedure was agreed to by the GOI for the World Bank District Roads I Project, IBRD 3585.

Recommendations on maintenance practices are set out in Section 10.6.

9. MAINTENANCE MANAGEMENT PROGRAM DEVELOPMENT

9.1. TECHNICAL STANDARDS AND GUIDELINES

9.1.1. Introduction

Most technical standards and guidelines for road construction and data collection for kabupaten roads are already written or are in various stages of development. Several standards and guidelines for maintenance, however, are not yet available or are inadequate. Table 11 gives a comprehensive list of all the standards and guidelines that should be available and used for the project. Each is discussed regarding its present status and applicability to the DRMS Project. Construction, maintenance, and data collection are listed separately. A fourth category, materials and quality control, is also provided. Specific recommendations are contained in the following individual discussions of each document.

The Sub-directorate of Local Roads is responsible for preparing technical standards and guidelines for kabupaten road works. At present most of the attention has been focused on construction but new donor projects will increasingly emphasize maintenance. The Sub-directorate should retain the responsibility for the preparation of all standards and guidelines for kabupatens, but donor project consultants should form a technical advisory group to assist the Sub-directorate to improve them.

9.1.2. Guide to the Planning and Construction of Kabupaten Roads/Bridges - Designs, Construction, Budget and Documentation

Various standards and guidelines are contained in this draft manual, which is under development by the Sub-directorate of Local Roads. Although still a draft, it has been used in kabupatens which have recently received foreign donor assistance, and will probably be the manual for the DRMS Project as well. The standards/guidelines contained in the manual are discussed as a group first.

Design Standards for Kabupaten Roads. See Figure 2. Basically, these standards provide the same design parameters which have been used by all of the donors, and they are reasonable for Indonesia at this time. No changes are felt necessary.

Technical Design Standards and Guidelines. See Chapter III of the draft Guide. The Sub-directorate states in paragraph 3.1.2 "As the Kabupaten Public Works has as yet no adequate standard designs, Bina Marga has prepared road standard designs suitable for kabupaten roads or other roads with low traffic volume (less than 200 vehicles per day)."

Table 11

LIST OF TECHNICAL STANDARDS AND GUIDELINES
FOR KABUPATEN ROADS

Title	Purpose	Available
CONSTRUCTION STANDARDS AND GUIDELINES		
Design Standard for Kabupaten	Describe the basic road and bridge road design parameters; type of pavement, width, grade, etc., for different levels of traffic.	Yes
Technical Design Standards and Guidelines	Describe the approved practices of guidelines (construction) for designing all of the road features (geometry, pavement, drainage, bridges, etc.).	Draft
Materials and Construction Specifications	Describe the use of materials and construction work that are acceptable to the government.	Draft
Construction Supervision Guideline	Provide guidance to construction supervisors (inspectors) on how to check that a contractor is performing the work according to accepted practice.	No
Construction Work Methods	Basically a how-to-do-it field guide covering the most frequent and important construction operations.	Partially
Construction Unit Costs	A breakdown of the cost per day or unit cost for each resource for each construction activity.	Yes
MAINTENANCE STANDARDS AND GUIDELINES		
Maintenance Quality Standards	Describe the level of condition in which the various road elements or features should be maintained.	No

Table 11 (Continued)

Title	Purpose	Available
Maintenance Frequency Standards	Describe the number of times per year that a particular maintenance activity must normally be performed in order to maintain the quality standard for each of the features.	No
Maintenance Performance Standards	Describe the purpose, composition of resources, approved work method and the average daily production for each activity.	No
Maintenance Unit Costs	A breakdown of the daily cost and unit cost of measurement for each activity according to the maintenance performance standard.	Partially
Maintenance Work Methods	A how-to-do-it field guide covering the most frequent and important maintenance activities.	Partially
DATA COLLECTION GUIDELINES		
Traffic Counts	Determines the average daily traffic (ADT) on a particular road link.	Draft
Maintenance Feature Inventory	Counts all of the maintainable road features according to preselected units of measurement.	Draft Partially
Road/Bridge Condition Survey	The inspection of each of the major road features which results in a quantative evaluation of the condition of each of the features and overall condition of the road.	Draft Partially
MATERIALS AND QUALITY CONTROL STANDARDS AND GUIDELINES		
Materials Production Standards	Similar to maintenance performance standards.	Work Cost Analysis Forms Only

Table 11 (Continued)

Title	Purpose	Available
Materials Production Work Methods	Similar to construction and maintenance work methods	No
Materials Quality Control Guidelines	Describes the approved work methods for field inspection of all construction and maintenance materials.	No
Materials Standard Testing Procedures	Prescribes the standardized procedures for sampling and testing all construction and maintenance materials.	Yes, for Bina Marga

EXCERPTED FROM:

GUIDE TO THE PLANNING AND CONSTRUCTION OF KABUPATEN ROADS/BRIDGES

DESIGNS, CONSTRUCTION, BUDGETING AND DOCUMENTATION

TABEL 7.2

STANDAR DISAIN JALAN KABUPATEN

KLASIFIKASI JALAN		KLAS III A			KLAS III B						KLAS III C		
JENIS PERKERASAN		ASPAL (PH, LASBUTAG)			ASPAL (LASBUTAG, BURDA)			KERIKIL/MACADAM MAK. DENGAN LAPIS PENUTUP (BURDA, BURAS ATAU LATASBUM)			KERIKIL / JALAN DENGAN LAPIS PENUTUP (BURDA, BURAS ATAU LATASBUM)		
LALU LINTAS HARIAN RATA-RATA (Kendaraan bermotor roda empat)		3000 - 500			500 - 200 (LALU LINTAS PADAT)			200 - 50 (LALU LINTAS RINGAN)			< 50		
KEMIRINGAN MEDAN (TERRAIN)		DATAR	BUKIT	GUNUNG	DATAR	BUKIT	GUNUNG	DATAR	BUKIT	GUNUNG	DATAR	BUKIT	GUNUNG
JALUR LALU LINTAS		2	2	2	1+	1+	1+	1+	1+	1+	1	1	1
KECEPATAN RENCANA (Km/Jam)	DISARANKAN	70	60	40	70	40	30	60	40	30	50	30	**
	MINIMUM	30	30	30	30	30	**	30	30	**	30	**	
KEMIRINGAN (GRADIEN) (%)	DISARANKAN	4	5	8	4	6	8	4	7	8	5	8	12
	MAXIMUM	7	7	10	7	8	10	7	9	12	7	12	16
LEBAR PERKERASAN (m)	DISARANKAN	6,0	6,0	6,0	4,5	4,5	4,5	4,5	4,5	4,5	3,5	3,5	3,5
	MINIMUM	4,5	4,5	4,5	3,5	3,5	3,5	3,5	3,5	3,5	3,0	3,0	3,0
LEBAR BAHU JALAN (m)	DISARANKAN	2,0	1,5	1,5	1,5	1,5	1,0	1,5	1,0	1,0	1,0	1,0	0,75
	MINIMUM	1,5	1,0	0,75	1,0	1,0	0,75	1,0	0,75	0,75	0,75	0,75	0,75
LEBAR BADAN JALAN (m)	DISARANKAN	10,0	9,0	9,0	8,0	7,5	6,5	7,5	6,5	6,5	5,5	5,5	5,0
	MINIMUM	7,5	6,5	6,0	5,5	5,5	5,0	5,5	5,0	4,5	4,5	4,0	4,0
DAERAH PENGARUH JALAN (DMJ)	DISARANKAN	16 M			12 M			12 M			12 M		
	MINIMUM	12 M			10 M			10 M			8 M		
KEMIRINGAN MELINTANG MAKSIMUM	PERKERASAN	3 %			4 %			5 %			6 %		
	BAHU JALAN	4 %			5 %			6 %			7 %		
LEBAR JEMBATAN: DENTAIK ≤ 6 M	DISARANKAN	7,0 M			7,0 M			7,0 M			4,5 M		
	TANPA TROTOIR (MIN)	4,5 M			4,5 M			4,5 M			4,5 M		
6 - 30 M	DISARANKAN	7,0 M			7,0 M			4,5 M			4,5 M		
	TANPA TROTOIR (MIN)	4,5 M			4,5 M			4,5 M			4,5 M		
> 30 M	DISARANKAN	7,0 M			4,5 M			4,5 M			4,5 M		
	TANPA TROTOIR (MIN)	4,5 M			4,5 M			4,5 M			4,5 M		
- JEMBATAN SEMENTARA (MIN)		3,0 M			3,0 M			3,0 M			3,0 M		
MUATAN RENCANA JEMBATAN		70 % BM			70 % BM			50 % BM			50 % BM		

Figure 2

KABUPATEN ROAD DESIGN STANDARD

Although there are weaknesses in the document, e.g., vague language which does not adequately qualify when or how much a standard may be changed to suit existing conditions, it can be used for the project. The Sub-directorate admits that there should be more detail for drainage and structure design.

Materials and Construction Specifications. See Chapter IV of the draft Guide. The same comments as above apply to this part as well.

9.1.3. Traffic Counts, Road Inventory, and Road/Bridge Condition Survey

These procedures have been developed primarily for construction purposes and have been applied, apparently with success, to the data collection exercises for other donor projects. It appears that the traffic counting guideline is adequate. The OD (origin/destination) Survey Sheet used during the data collection recently financed by OECF would be of value to the DRMS Project because it asks for vehicle cargo and weight, which is recommended in this report as an ancillary activity in the reconstruction selection process.

The Road Inventory and Condition Survey chapters will require modification to be more useful for maintenance; e.g., each road/bridge element or feature which requires a specific maintenance activity will have to be counted in the units that are associated with that activity (e.g., pavements can be measured in lane-kilometers, m^2, km, etc.). These modifications are necessary for the maintenance management system and are a normal task for technical assistance in developing a system. Later in the project an improved method of determining overall road condition using weighted ratings should be tested.

9.1.4. Construction and Maintenance Unit Costs

The Sub-directorate has prepared and distributed to all donor funded kabupatens, a set of Work Cost Analysis (WCA) standards which are calculated using local labor rates, materials unit prices and equipment rental rates for each kabupaten. They adequately cover construction, but some standards could still be added and improved for maintenance.

These unit costs are used to prepare a total cost for reconstruction projects and that total becomes a ceiling for tendered projects as well as force account work. At present, unit costs do not include contractors' profit but that practice should be examined to encourage competent work.

There is some doubt as to whether or not the Work Cost Analysis standards agree totally with the Construction and Maintenance Work Methods (e.g., WCA No. K 342, New AWCAS Construction, lists a different spread of equipment and thickness than does its corresponding work method, Execution Guide: All Weather Compacted Aggregate Road (JAPAT), No 07/PT7B/1983). Project technical assistance should check both for uniformity.

9.1.5. Construction and Maintenance Work Methods

A set of fourteen booklets was developed in 1983 for Bina Marga which cover many of the operations for pavement work. All are for construction and a few are applicable to periodic maintenance as well. The series should be expanded to cover more of the most common operations for both kinds of work such as how to cut ditches, how to smooth an improved road with a motorgrader, etc.

During the same period, a Highway Maintenance Manual was also prepared consisting of eight volumes covering maintenance, rehabilitation, support work, and replacement of roads and bridges. Only volume IA was reviewed by the consultant. It contains twelve of the booklets mentioned above. Many of the figures appear to be taken from the series of technical handbooks from the Asphalt Institute on the maintenance of asphalt pavements. These books should also be reviewed by project TA and, if applicable to the kabupatens, reprinted and distributed.

9.1.6. Materials Standard Testing Procedures

Although not specifically developed for kabupatens, this manual is found at Bina Marga and should be adopted as the standard for the proposed kabupaten Materials Units. The sampling and testing procedures are based on those of the American Association of State Highway and Transportation Officials (AASHTO) and the American Society for Testing Materials (ASTM). They appear to be acceptable.

9.1.7. Materials Production Standards and Materials Production Work Methods

The only guidance found concerning materials production were several Work Cost Analysis forms. They do not fully describe the steps of production. There should be a set of Production Work Method Guides produced for aggregate production and perhaps other materials such as concrete pipe and cold-mix.

9.2. RECONSTRUCTION AND MAINTENANCE UNIT COSTS

This section recommends that unit prices be used for reconstruction and maintenance under the AID project. Data for determining unit costs were hard to come by. The sources of data used were as follows. Current unit prices for labor and some materials were collected from each kabupaten by PT Hasfarm. Equipment rental rates for imputing force account equipment costs were borrowed from a set of typical GOI Work Cost Analysis (Analisa Biaya Pekerjaan) forms. These equipment costs/hour were the same as those calculated by ENEX Consultants and the Sub-directorate of Local Roads in their report entitled Rural Road Study Report for 5 Yr. Road Programs, 1984-1989, Kupang, NTT, dated January 1984.

The equipment rates used include capital recovery, interest and insurance as well as direct operating costs. Bina Marga itself does not include these ownership costs in its rental rates so there was some doubt as to whether they are truly applicable to kabupaten fleets. For the equipment management system, it is suggested that only direct operating costs be used in the rental rate.

9.2.1. Maintenance Unit Costs

Maintenance unit costs for routine and periodic activities were estimated using the above unit prices and hourly equipment rental rates. Periodic maintenance crew composition and production were based on the standard Work Cost Analysis forms and the Bina Marga Highway Maintenance Manual (Manual Pemeliharaan Jalan) work guides. Routine maintenance crew composition and production were estimated from the consultant's experience or maintenance activities in developing countries. An effort was made to simplify and standardize the activity resources for the purpose of calculating resource requirements later on. Basically the same materials rates (qty per m2, km, etc.) specified in the Bina Marga work guides were followed but the production figures were modified to take into consideration a somewhat reduced pace to allow for on-the-job training and close supervision by the consultants and PU staffs.

The maintenance activities were assumed to be performed by force account. The unit prices so estimated may be somewhat high for force account, but may be applicable to contractors if some of these activities are tendered later.

The recommended maintenance unit costs are summarized in Table 12. The individual work sheets for each activity are included as an annex.

Table 12

SUMMARY OF ESTIMATED MAINTENANCE UNIT COSTS

Type of Road / Type of Maintenance	Sealed Roads km/yr/Crew	Sealed Roads Rp(000)/km	Gravel Roads km/Yr/Crew	Gravel Roads Rp(000)/km	Earth Roads km/Yr/Crew	Earth Roads Rp(000)/km
o ROUTINE - Routine	60	510	100	360	125	150
- Smoothing	-		400	70	400	70
Subtotal Routine Cost (Incl. an allowance for emergency work)		510		430		220
o PERIODIC - Resealing	350	680	-	-	-	-
- Regraveling	-	-	450	800	-	-
- Reshaping	-	-	200	255	200	255
Subtotal Periodic Cost		680		1055		255
o TOTAL MAINT. COST Routine + Periodic		1,190		1,485		475

Average cost of Resealing:

50% Chip Seal (using # 4 stone)	Rp(000)	475/km
50% DBST (using 3/8" & #4 stone)	Rp(000)	890/km
Average Unit Cost	Rp(000)	680/km

Average Production for Resealing:

50% Chip Seal	100 km/yr per 400 km inventory
50% DBST	60 km/yr per 300 km inventory
Average Production	80 km/yr per 350 km inventory

9.2.2. Reconstruction Unit Costs

There was not enough time to investigate the actual production rates (km/day) and crew compositions for reconstruction work. The Bina Marga Work Cost Analysis forms specify crew compositions and a production rate but some of these rates are not practical. For example, activity K342, All Weather Compacted Aggregated Subgrade (AWCAS), calls for a gravel

layer of 4 cm (loose). This is not sufficient thickness to produce a lasting riding surface. Therefore, the actual production may be somewhat less if 15 cm were used.

The Asian Development Bank and the World Bank each had large teams of consultants working several months to prepare staff appraisals for the Eight Road Project (ADB Rural Roads II) and the Highway Maintenance and Betterment Project (IBRD 6066-IND). It was assumed that since the banks' projects are both follow-ups to previous projects, their unit costs for construction type activities were calculated with all due consideration to locally proper work methods. Therefore, the reconstruction unit costs were estimated from the banks' costs, adding in a factor for inflation to account for the time between when they were prepared (1984) and the beginning of work projected for the DRMS Project (1988). The recommended reconstruction unit costs are summarized in Table 13.

Table 13

SUMMARY OF ESTIMATED RECONSTRUCTION UNIT COSTS

Type of Work	Rp(000)/km
REHABILITATION	
o Rebuild paved road	35,000
o Rebuild sealed road	25,000
o Rebuild gravel road:	
- on existing granular surface	17,000
- on existing Telford or macadam surface	20,000
o Rebuild earth road	9,000
BETTERMENT	
o Upgrade existing gravel road to sealed road	29,000
o Upgrade existing earth road to gravel road	22,000

In order to estimate the equipment requirements for maintenance, the crew compositions were summarized and are shown in Table 14. The individual equipment units that will be required were calculated using these compositions and the number of each of the various crews required in each kabupaten. See Section 10 for the list of required equipment.

Table 14
RESOURCES PER CREW:
ROUTINE MAINTENANCE

o Routine Activities - Sealed & Gravel & Earth Surfaces; frequency depends on type of road

Labor	Equipment	Materials (Max Annual)
(1) Foreman	(1) 3.5 T Dump Truck	(120) m^3 cold mix
(1) Driver	(1) Hand operated compactor	(1440) l asphalt prime sealed road
(10) Workers	(1) Paddle wheel mixer (cold mix)	(315) m^3 gravel - gravel roads

o Grader Smoothing - Gravel & Earth Surfaces; 2 x /yr; 800 km work/year per 400 km inventory

Labor	Equipment	Materials
(1) Operator	(1) Motorgrader 100 HP	None

Periodic Maintenance

o Resealing - Sealed Surfaces; 80 km work/year; 1 x ea 4.4 years avg. per 350 km inventory

Labor	Equipment	Materials (Max Annual)
(1) Foreman	(1) Tractor (farm type)	(1,100) m^3 1st Course stone)
(2) Operators	(1) Broom attachment (optional)	(95,700) l 1st Course asphalt)
(3) Drivers	(1) Asphalt sprayer 800 l	(1,100) m^3 2nd course stone)-DBST
(2) Skilled	(2) 3.5 T Dump Trk.	(99,000) l 2nd course asphalt
(2) Semi-skilled	(2) Tailgate spreader	
(10) Workers	(1) Pneu. roller	
	(1) Asphalt tank (optional)	
	(1) Flat bed truck 3.5T	

o Regraveling - Gravel Surfaces; 150 km work/yr; 1 x ea 3 yrs per 450 km inventory

(1) Foreman	(1) Motorgrader 100 HP	(33,000) m^3 crushed aggregate, (well-graded or select material)
(3) Operators	(1) Loader 1.2 m^3	
(4) Drivers	(1) Vib. roller	
(1) Driver	(4) 3.5 T Dump Trk.	
(4) Workers	(1) Water Truck	

o Reshaping - Gravel & Earth surfaces 200 km work/yr 1 x per yr per 200 km inv.

Labor	Equipment	Materials
(1) Foreman	(1) Motorgrader 100 HP	None
(2) Operators	(1) Vib. roller	
(1) Driver *	(1) Water Trk.*	
(2) Workers		

* Not needed if the work is performed when the surface is moist.

Continuation Table 14

Other Maintenance

Labor	Equipment	Materials
As required	(1) Flat bed trk., 3.5T (1) Concrete Mixer 0.25m^3	As required

9.3. EVALUATION OF SHADOW PRICING, LABOR INTENSITY AND EMPLOYMENT IMPACT

9.3.1. Shadow Pricing

In road projects shadow pricing is attempted when clear evidence exists that market price or policy distortions create an uneconomic allocation of resources. Such cases would arise from: 1) a controlled foreign exchange rate which understates the real values of imported capital and consumable items (road equipment, vehicles, fuel, tires, etc.); 2) controlled interest rates which do not reflect true capital scarcities that may be observed in the "black" market for money; 3) labor wages paid on current road work which are well above alternative potential earnings levels in other economic sectors; and 4) major unemployment of the labor force in the region of the proposed project from which labor will be drawn, in which case "true" economic costs are less than financial outlay.

In the first case, foreign exchange nationally is at open market exchange rates, traded freely according to supply and demand by commercial banks to private citizens, and appears to present no need for shadow pricing.

The cost of domestic borrowing is fairly high, which may affect the ability of private contractors to establish qualifications according to equipment available, but only for equipment relatively idle and not productive in commercial road-building activity. As the main thrust of government policy is to employ contractors rather than force account, for both reconstruction and maintenance, the interest costs should be assumable during the course of this project, which aims to expend added funds for such purposes. Such higher interest costs enter into a further economic consideration of the IRR, which may be sought from road investment costs within the project. The IRR is expected to exceed commercial loan rates by an element acceptable for risk-taking, i.e., several percentage points more than the commercial rate, and roughly equal in total to the best return available in the economy from alternative investments. The best return is usually not known, but the implication of high money market rates is that some sectors must be producing such a return — or rates would be lower. Rates soften as demand declines. On the other hand, a government project, having other

aims than profitability expressed in financial terms, is not compelled to exact an economic rate of return which reflects national alternatives in the private sector if it is engaged in selective investments in regional sub-sectors which do not enjoy those alternatives. A road project in low-income regions designed for rural areas is not generally the place to look for such a return; the more so if institution-building and demonstration effects are its goals. This frame of reference will condition the rate of return actually sought, but still demands that such returns be maximized to provide the greatest economic benefits that can be realized in the selective placement of funds within the subsector.

Labor wages paid by DPUKs for casual and permanent labor appear to be marginal, ranging throughout all kabupatens from Rp. 1500 to Rp. 4000 daily (US $1.35 to 3.57), for unskilled labor, equipment operators, and crew foremen. This level of wage, according to kabupaten accounts, results in the loss of staff to other employments — claimed usually to be private contractors. This would indicate that the opportunity costs of local labor are being perceived and acted upon; opportunity costs are being exercised, and labor is finding its best alternative employment. It then appears that labor wages are not excessive in the project area, provide mobility of labor, and, by implication, a free movement of labor between its perceived opportunity cost levels in this subsector.

The question of area unemployment/underemployment cannot be fully known from available data beyond a presumption that it exists. It is probably greater in NTT than in South Sulawesi, if opportunities for commercial (paid) employment is meant. However, as these areas are dominantly rural, farm sector employment provides the main means of employment and income. This sector is not amenable to analysis of the kind applied to the commercial sector, and its paid employments and higher standards of living. What is known is that standards are low, and inheritances tend to reduce acreages passed on to descendents in the normal course of rural life. In its relation to the road-building sector, reports by kabupaten staff state that seasonal patterns exist, such that labor becomes scarce for road re-building during harvest periods. This suggests that labor wages for road work in the project areas are too low to be attractive, except seasonally (during underemployment) because alternative farm work affords a preferred level of return. This would indicate that in general, labor is neither scarce nor abundant, and is relatively balanced between seasons in its best choices in a way to maximize its opportunities. The conclusion cannot be drawn that the "true" labor wage rate is at an economic cost less than the financial outlay, but that labor is being paid its actual economic value.

9.3.2. Labor-Intensive Road-Building

Under the conditions named above, a substitute road-building practice intended to maximize labor input would seem to be more a theoretical choice than a real one for these project areas. As a technical choice, having alternative economic outcomes different from

capital-intensive road-building, a measure would have to be taken of the change in IRR (lower labor costs over a longer time period accompanied by certain losses in efficiency traded off for more labor employment and wider income distribution). These nominal measures do not undertake to evaluate other factors which are inherent in the trade-off: the desired build-up of private contractor capacity in giving efficient assistance to government agencies in charge of roads, or the relative effects upon quality and durability of the road itself (which means a trade-off to higher vehicle operating costs in the short-run and earlier rebuilding costs in the long run).

The evidence cited by the ADB 8th Loan pre-appraisal team is that labor-intensive work is inappropriate as a least-cost choice for paving and the major rebuilding of surface, base, and sub-base, in which machines are best utilized. Labor remains a complement to such work, but the addition of labor beyond the economic numbers required is uneconomic. For routine and periodic maintenance labor finds its most economic and broadest employment: clearing roads and drainage ditches, pothole patching, smoothing depressions in spot repair, grass cutting, bridge deck repair and sign painting, etc.

Under present goals of the government, private contractors are being encouraged as a new industry. They have already been designated by the Bina Marga to perform most of the work on national and provincial roads, both rehabilitation and maintenance. Bina Marga's instruction to AID is to consider this factor in road work in kabupaten areas. The economic choice appears now to rest mainly, in the long-term, with the contractor, and with his least-cost considerations. So far, the contractors are alleged to be building up their skilled or semi-skilled staffs with ex-DPUK personnel, which suggests that labor application has not lost ground to capital-intensive procedures in ways which can yet be measured.

9.3.3. Employment Impacts

At the kabupaten level no reports exist of employment and income effects of their road-building programs beyond the employment records of DPUK staff (force account); private contractors are graded and ranked by equipment and financial resources. A monitoring system does not exist for secondary benefits which may be passed on to farmers and rural communities that result from reduced transport costs on improved roads. Such a monitoring system is being proposed in Section 10.2, which will take account of changes in production volume, and transporters' prices per kilogram and per passenger, with and without road improvements.

Although the planning on donor project which takes place at provinc al and district levels attempts to take account of populations, development areas, and road network, this is not done in a systematic manner. The simple format seen in South Sulawesi, for example, is a series of map overlays, with estimated population by area overlain on a map of the road network; another map showing "development areas" indicates whatever degree of correspondence is clearly manifest, and decisions are made on this basis — with the emphasis upon growth and development. This has resulted in building new roads into development areas when roads already exist which are not being used, because they are not being maintained. No account is taken of the time-stage of the "development" area: its original state was merely marked for development by a foreign consulting group which performed soils tests and earmarked different crops for potential development, or a planned development with a sponsor undertaking a planned scope of investment, or an investment now underway, or a mature "project" with measurable volumes of production.

Given this level of economic planning, employment impacts have not been formally considered. The monitoring which is suggested for this loan program is of sufficient detail to permit evaluation of the amount of transfer which may occur between transporters and rural communities, in the way of reduced transport prices. As transport price is reduced, a measure is made of the reduction in vehicle operating costs achieved by road improvements (the price falling less than the cost decrease), and at the same time, the transfer of some portion of the cost reduction to the farmer and rural community. Volume monitoring of produce entering the market supplements these data, indicating how transport price changes induce further goods production, which is a measure of increase in regional income and apparent employment. The joint beneficiaries are the transporter and the farmer's family; the total benefit which is bestowed by the road improvement may be taken as the change in VOC forecasted for that road link, and the shares in that benefit are recorded in the amount retained by the transporter, and released to the buyer of transport.

These proxy measures of employment, income, and well-being do not now exist. When installed, they are expected to produce the kind of detail which will then be used in planning at local levels, as a start toward more complete evaluation procedures.

9.4. EVALUATION OF ALTERNATIVE RECONSTRUCTION AND MAINTENANCE SYSTEMS

9.4.1. A Forecast and Test of Simplified Methods

The Roads Department recognizes three classes of district level roads. These are recounted here:

Kabupaten Road Classes

	IIIA Sealed	IIIB		IIIC Unsealed
	Asphalt	Sealed	Gravel	Gravel/Earth
ADT:	500-3000	200-500	50-200	< 50

The traffic levels daily which correspond to these classes and conditions imply that as traffic increases, an improved road condition may be considered. A preceding section reviewed the nature of this road improvement process.

The relationship between ADT volume and its composition (type of vehicle), and between composition and vehicle cost (cost/km varying with vehicle type) will be demonstrated in this section. The composition and the costs are those which correspond with expected traffic volumes to be found in Nusa Tenggara Timor and South Sulawesi. They are, however, abstracted from 210 traffic counts in 20 kabupaten intensively studied by Hoff and Overgaard in the Local Roads Component study of March 1985 preliminary to the ADB 8th loan appraisal. These tend toward greater accuracy than current ADT estimates now available from the outer island project area, but represent a wider sample, and appear to reflect the same vehicle composition.

A ten-year forecast will use current (Hoff and Overgaard, March 1985) cost estimates for rehabilitation (relative to surface type), and annual maintenance costs for sealed and unsealed roads which were derived in that study to correspond to both the ADT volume and the road surface. In this way, the current costs and traffic volumes which may be expected for project area roads can be tested in advance of project commitment, for four different kinds of rehabilitation activity, each carrying vehicle volumes appropriate to the design class of road. It will be seen whether these ADT levels and cost levels are consistent with the Roads Department vehicle volume standards: i.e., does a volume of 50-200 ADT justify an improvement to a gravel from a gravel/earth standard? Does a volume of 200-500 justify a movement from gravel to sealcoat? Are these the standards which should guide the AID program, or are there other considerations in addition to these?

In order to test the results, a simplified formulation prepared by IBRD will be used. This is borrowed from tables which may be suitable for use at the district level, showing the ADT level required to earn a specified rate of return over a ten-year period, given a particular traffic growth rate. This ADT level is correlated with the composite level of vehicle operating costs (weighted average), and the percentage of these costs saved in the transition from a lesser surface to an

improved surface. The critical question of costs invested in the rehabilitation and annual maintenance is directly associated with ADT. It therefore becomes possible to identify a required level of ADT needed to perform the functions which will be specified here at expected cost levels:

From poor seal to fair seal	From unsealed to fair seal
From gravel to fair seal	From unsealed to gravel

These will be the typical rehabilitation efforts in the project study area.

It may be noted that the simplified method borrowed from the IBRD reference work is the simplest of eight increasingly complex methods which are suggested therein. As is the case with the district use of the index population and area methods, it may be seen that the application of this reference table to work in the kabupatens may strain the definition of "simple." For a review of this method and others, see Economic Appraisal of Rural Roads, World Bank Staff Working Paper, number 610, 1983.

The sample survey from 210 traffic counts related ADT volume to type of road surface. The road surface itself represented a specific road class (asphalt, seal, poor seal, fair seal, and unsealed), which corresponds to ADT levels shown below. The percentages of vehicle composition are also indicated.

Road Type and Vehicle Composition (%)

Road	ADT	4-Wheel	Motor-cycle	Carts Bicycles	Pedestrians Shoulder-Burdens
Fair seal	500	27	34	18	21
Fair seal	200	19	29	20	32
Poor seal		18	24	32	26
Fair seal	200	7	22	27	44
Unsealed	50	7	16	16	61
Average		16	25	23	37

The most striking quality of this table is the proportion of non motorized traffic (60%) plus the high proportion of motorcycles in the remaining total. These same proportions are confirmed in the traffic counts of the study area.

Vehicle operating costs per kilometer have been used to weight the average vehicle cost, using the percentage distributions shown above. The vehicle costs are borrowed from the March 1985 reference study, which

defined operating costs according to road type (asphalt, gravel, earth), and according to condition (good, fair, poor, bad). The resulting cost matrix produces an average cost composition of expected traffic on project area roads, and the average total cost per composite vehicle for four different road classes.

Average Cost Composition of Traffic

	4-wheel Vehicle		Motorcycles/Bikes/Carts		Total	
	Rp/km	%	Rp/km	%	Rp/km	%
Fair seal	103	23	9	50.5	112	73.5
Poor seal	135	13	10	56	145	75
Fair gravel	128	7	10	49	138	56
Unsealed	178	7	9	32	187	39

The proportion of total traffic which is accounted for in these figures is shown as a percent in the total column; the balance represents pedestrians and porters (pikulans). Full-scale project evaluations conducted by the reference study assigned costs to both pedestrians and porters, and further assumed for the "with rehabilitation" case that this traffic would adopt a conveyance mode (truck or bus). These costs and assumptions are not used here.

Rehabilitation costs per kilometer, which were prepared in the reference study for application as the average expected costs for 30 kabupaten, and expected average routine repair and maintenance costs per kilometer, may now be incorporated into a forecast of input costs as the final stage of the three-step analysis which leads to the use of the simplified IBRD table. From the table we can learn the level of ADT which is consistent with an intended rehabilitation, at specified vehicle cost and savings rates, selected discount rate and rate of traffic growth, for a ten-year forecast period.

Summarizing the four forecast tables which have been prepared, input costs for rehabilitation and maintenance are presented below as net present values after discounting at 15%.

Rehabilitation and Maintenance Costs for Four Road Types

Treatment	Implied ADT	Rehab. cost	Maint. cost/ year	Net Present Value
		..... Rp. 000/km	.....	.....
Poor seal to fair seal	200-500	22,400	559	25,068
Fair gravel to fair seal	200	27,600	528	30,119
Regravel of gravel	50-200	15,000	406	16,937
Unsealed to gravel	200	20,000	606	22,892

It may be noted that the costs of applying a seal of asphalt overlay to gravel exceed the costs of resealing an already sealcoated road, just as the costs of initially applying gravel to an earth (unsealed) road are greater than the costs of regravelling. This is mainly due to the sub-surfacing costs necessary to provide a suitable subgrade, subbase and base, and widening associated with going to a higher standard.

The basis for entry into the IBRD table is U.S. dollars equivalent, which is intended to facilitate use by any country of the standard cost figures which are shown. The table itself could therefore be converted into Rupiah equivalents, if its use is found suitable for general employment on the project. It has been found necessary to interpolate, in actual use of the table, using six calculation steps to find two significant numbers: the net present value total and the ADT level. The final results of the full analysis are the following:

IBRD Simplified Screening Method Results

(10-year period, 5% traffic growth, 15% discount)

VOC $/km	VOC-S %	NPV: (Rp	$15,125 16,937	$20,450 22,892	$22,400 25,068	$26,900 30,119)
			interpolated value:			
			ADT level required:			
.167	40		124			
.167	26.2			247		
.13	23				505	
.123	19					768

(The designations VOC and VOC-S mean vehicle operating cost per kilometer and the savings in VOC expressed as a percentage of the prior road costs. NPV is the net present value over ten years of the combined rehabilitation and maintenance costs after discounting at 15%: the Rupiah equivalent is shown in thousands.)

These final figures permit a comparison of existing kabupaten road design standards (and classes), which are based upon expected ADT levels, with the externally-given parameters that associate ADT levels with the ten-year cost structure of the rural road. The comparison is shown below.

Comparative ADT Design Thresholds for 15% Return

Treatment	Kabupaten Design ADT	Table ADT	Difference
Reseal sealed road	500-3000	768	268
Gravel to sealcoat	200-500	505	305
Regravel gravel	50-200	124	---
Earth to gravel	<50	247	197

The higher levels of ADT which the IBRD tables indicate to be consistent with the decision parameters would suggest that kabupaten thresholds for upgrading to a higher design standard are below the levels needed to gain a 15% rate of return on the invested capital. It is not certain, however, that such a return is intended, as considerable emphasis is placed at the kabupaten level (and at the provincial planning level) upon road-building as a development tool in geographic areas considered strategic to growth of employment and income.

Other rates of return may therefore be considered, at 12% or 10%, if it can be accepted that this policy addresses longer-term issues than the sole criterion of reducing vehicle operating costs. It is only the savings in vehicle costs which are being measured by the table. The shift to a partial analysis of both vehicle costs and of value-added, in order to address both issues simultaneously, or to omit vehicle costs and go to an analytic base mainly concerned with measures of value-added, would add considerable complexity to a simplified screening method intended for kabupaten use. Such a shift encompasses an entirely different approach, consisting of with-and-without forecasts of: 1) production costs by type of crop, 2) farm-gate prices, 3) transport prices and transport costs by type vehicle and route to market, 4) market prices by type of crop, 5) estimates of production volumes and cultivable land area. Analysis of this kind is commonly conducted by consultants for large-scale development schemes, for which the input of associated infrastructure (utilities, specialized crops and technical specialties, financing sources and credit terms, etc.) are an important part of project evaluation.

The apparent differences in levels of ADT suggested by the table and now in use by the kabupatens as benchmarks for design can possibly also be explained by conceptual differences. The reported life of roads for each design class does not in actual experience attain a full ten years. Consulting firms reviewing kabupaten roads and provincial road networks for ADB, IBRD, OECF and JICA have reported generally a surprisingly short life of roads, even those built at higher design standards. The basis for this shortcoming appears to be associated in part with weather (heavy rainfall), choice of alignment over flood-prone ground, and improper construction in the use of selected and graded materials, combined with failure to adhere to the design standards regarding width, sub-surface working (compacting, water-binding, depth of and kind of material, etc). The resulting early failure of such roads, as a matter of practical local experience, may lead to the establishment of lower ADT standards in an effort to 1) prolong the life of the road, if it is perceived that life is associated with traffic level rather than with external factors, and/or 2) to provide some form of seal-coating to an all-weather standard at all levels of traffic as a response to the weathering factor as the main source of the problem.

In either case, the application of the IBRD table to the road classes and design standards of the kabupatens would be inappropriate to existing roads now affected by poor construction supervision. However, if effective construction supervision assured that construction methods met the design standards, it may be believed that the ADT levels associated with the ten-year lives of roads could induce a change in concept and in road standard to provide for rehabilitation and upgrading at higher levels of ADT.

There are some problems associated with use of the IBRD table. The first is a minimum traffic growth rate of 5%, which the "table" permits to rise to 8, 10, 12, and 15% via a series of similar tables, with discount rates from 10 to 18%, for all roads with a service life of ten years. Succeeding tables are related to a 15-year service life, with the same order of growth prospects and discount rates. For the study area kabupaten roads, which are mainly lightly trafficked, a 5% growth rate may be too high in some cases (the tables do not require that a forecast be made over the ten year period to arrive at a design level ADT, but rather that the existing ADT count in the present year assumes some rate of growth) and that that rate of growth be either 5%, or 8, 10, 12, or 15%. The extrapolations from table to table which may result are as difficult as the interpolations within the existing tables.

Interpolations on the reference table are forced by the NPV of aggregated construction and maintenance costs, in intervals of: $10,000, $18,000, $20,000, $25,000, $35,000, etc., combined with VOC and VOC-S relationships which block out $.10/km costs and varying fixed levels of savings as a percentage of those costs, and then jump to $.25/km, and $.50/km, etc., with similar ratios of savings. It is unlikely that a

line item for ADT will be found unless the horizontal NPV cost item is squarely related to the vertical columns of VOC and VOC-S. In our use of the table, five applications of the table found no such perfect fit, and six separate calculations were required to find one ADT number.

It is yet possible that this system can be made to yield the relatively small range of costs associated with kabupaten roads, and expanded to show the most frequently appearing costs, and therefore become a very usable guideline.

See Table 15 for further interpolations of these data which produce ADT levels yielding a range of IRRs from 6% to 15% for seven levels of rehabilitation costs.

9.4.2. Evaluation of Rehabilitation, Routine and Periodic Maintenance, Versus Current Non-maintenance Practice

This section will bring together assorted elements which are seen as the major economic variables influencing the choice of road treatment, and the selection procedures that can optimize each choice. The factors addressed are as follows:

1. Sample survey of vehicle type and volume on project study roads.
2. Composition of expected average vehicle costs and ADT volumes on each of the five kabupaten road classes.
3. Reported and expected road life for each class under existing procedures and under forecasted controlled procedures.
4. Comparative vehicle savings over ten years under routine, periodic, routine and periodic combined, and rehabilitation procedures, against a common base of non-maintenance, for each of the five classes of roads.
5. Discounted present values of all cost flows compared.
6. Discounted benefit/cost ratios of all cost flows.
7. Comparative marginal costs and marginal revenues (savings) of each of the alternative procedures.
8. The apparent influence of ADT level, rate of traffic growth, vehicle composition and its cost level, upon the choice of alternative road treatment procedures.
9. The influence of timing of road treatment during road life upon the choice of treatment.

9.4.2.1. Survey of ADT on Project Roads

Traffic counts prepared under the OECF II Feasibility Study for three kabupatens in the study area during 1985 supply ADT traffic counts for 145 road links distributed geographically as follows: Ngada (NTT) 50 links; Sumba Barat (NTT) 35 links; Gowa (South Sulawesi) 60 links.

TABLE 15

REQUIRED LEVELS OF ADT TO JUSTIFY MAJOR ROAD TREATMENT COSTS

(Rp.000/Km) Base Year Rehabilitation/Upgrade costs:

IRR %	8960	11200	13440	15680	17920	20160	22400	25200	28000	30800	33600	36400	39200
	Base year ADT volume:												
6	46	58	70	82	94	105	110	128	146	160	173	186	199
7	49	62	75	87	99	111	118	137	155	170	184	198	212
8	52	65	79	92	105	118	126	145	164	180	195	210	225
9	55	69	83	97	111	124	134	154	173	190	206	222	238
10	58	72	87	102	116	131	145	164	182	200	217	234	251
11	60	76	92	107	122	137	151	171	191	210	228	246	265
12	63	80	96	112	128	143	155	177	199	219	239	259	279
13	66	83	100	117	134	150	167	188	208	229	250	271	291
14	69	87	105	122	139	156	175	196	217	239	261	283	304
15	72	90	109	127	145	163	185	206	226	249	272	295	317

(10-year period, ADT growth rate 5% implied, Rp. 1120 = US$1)

A summary of these links according to daily volume shows the dispersal of traffic over low-volume and high-volume road links.

		ADT volume by ADT class									
	Road Links	0	1-10	11-30	31-50	51-100	101-200	201-300	435	500	600
Sumba Barat	35	1	6	17	7	2	1	1			
Ngada	50	11	15	8	6	6	2	0			
Gowa	60	4	5	4	3	18	17	6	1	1	1

The vehicle types composing the volumes shown above are: car/jeep, minibus, light truck or light pickup, and motorcycle. The relative proportion of motorcycles (%) for each ADT class is:

48	54	53	45	48	60			
28	45	49	32	38				
62	54	68	56	41	42	46	50	42

In their previous Feasibility Study Inventory Survey of March 1980, the OECF I consultants found for seven other kabupatens in the present AID project study area a more concentrated grouping of traffic in the 1-10 and 11-30 vehicles per day class. The kabupatens represented in that survey were Manggarai and Belu (NTT), Takalar, Bone, Sidrap, Pinrang, and Jeneponto (South Sulawesi), which reported only one road with more than 100 ADT among 219 road links, and showed 10 links which had no traffic.

The 1985 volumes for NTT reflect a similar tendency toward grouping at lower level ADTs, but Gowa shows 35 road links carrying traffic levels between 51 and 200 ADT. Among the 145 links counted in 1985, 16 links carry no traffic, or 11% of the total counted. This may indicate the inventorying of an abandoned road, over-building of the road network, or a road seriously overdue for repair.

A sampling of the 1985 counts, to provide, from each ADT volume class, an average volume and an average composition of vehicle types associated with that volume, furnishes a basis for forecasting vehicle operating costs for these volumes over different road classes. The sample provided the following characteristics:

ADT Volumes by Road Class and by Composition

ADT Class	200-500		50-200		< 50	
	No.	%	No.	%	No.	%
Car/Jeep	101.4	28	35.4	28	7	24
Minibus	40	11	14.2	11	.5	2
Lt. truck	65.7	18	30	24	4.5	16
Motorcycle	157.1	43	47.1	37	16.7	58
Average Total	364.2	100	126.7	100	28.7	100
Number of cases:	7		12		10	

For the two road cases reported in Gowa as having over 500 ADT, a fourth road class may be added (the asphalt case). The percentage composition of traffic for these roads, in the order as above, is: 23, 15, 16, and 46, with an average 550 ADT.

Application of the vehicle operating cost tables prepared in March 1985 for the Local Roads Component, Main Report (Hoff & Overgaard, Kampsax), specific to kabupaten roads in Central Java, NTB, and Bali, permits an analysis of the range of vehicle costs from "good" to "bad" conditions. For each of the above vehicle types, these designations will be used to infer that "good" exists in year 0 of the ten-year forecasts (a newly resurfaced or re-worked road to appropriate standard for its class — and that this carries no cost through the forecast). In the years following, "bad" conditions and costs will be reached according to the field reports of the short lifetimes of these roads; these will vary in life by type of road. But because maintenance and rehabilitation efforts are supposed to extend these road lives beyond the levels observed with no maintenance, the forecast will indicate for the non-maintenance condition (the null hypothesis, or "do nothing case"), that from "bad" we can go to "worse." For this case alone, the rate of growth in costs annually will be forecasted at one-half the annual rate which arises for the years between good and bad cost levels (from good design standard to end of service life). In this way, a full ten years of forecast can be made, and this can provide for introducing maintenance and/or rehabilitation according to cost levels identified with the average for 30 kabupatens in the March 1985 study. This will permit a measure of comparative effects upon vehicle costs, and may indicate the proper timing of periodic works.

In summary form, the vehicle cost forecast for the composite vehicle on each road class is shown below.

96

	Sealed Roads			Unsealed Roads		
	Asphalt	Seal	Gravel	Gravel	Gravel	Earth
ADT:	550	364	127	364	127	29
Class:	500	200-500	50-200	200-500	50-200	<50
Year	Rp/km vehicle operating costs:					
1	58.0	71.6	77.7	72.8	77.7	97.8
	Rp/km in bad condition or at end of service life:					
3				148.5		134.9
4					160.5	
5		133.8	160.6			
8	127.6					
	Rp/km in final year of forecast:					
10	143.3	200.8	257.8	577.4	346.4	415.9

In this forecast, the overlapping of gravel road classes which is part of the present kabupaten road classification system will be subjected to a two-part analysis. This is designed to test the effects upon a gravel road of a high volume of traffic (364 ADT) on an unsealed road, a low volume (127 ADT) on an unsealed road, and a "nominal" volume (also 364 ADT) on a sealed road. In each of these cases, the volume falls within the designated road class, but for each road class, a different kind of potential surfacing may exist.

The cost forecasts for the selected ADT volumes will also assume a 1.7% traffic growth rate annually. This is the average population growth rate for NTT and South Sulawesi Provinces in the period 1980-1983. The method of forecast is to add the 1.7% annually to inital ADT volumes, multiplied by Rp. cost/km, multiplied by 365 days.

Abstracting from the forecasts of average expected costs per kilometer in the March 1985 study of 30 kabupatens (for the ADB 8th Loan), the summary table following will show the amount of cost for routine, periodic, and rehabilitation work, by type of road.

Summary of Cost and Timing for Intervention Practices

	Sealed			Unsealed	
	Asphalt	Seal	Gravel	Gravel	Earth
ADT:	550	364	127	364	29
Cost/km (Rp 000):					
Routine	590	529	360	606	300
Periodic	2857	2223	2709	2709	1224
Rehab.	22400	17000	20000	15000	2709
Year of Intervention:					
Routine	annual	annual	annual	annual	annual
Periodic	8	4 and 8	5	4, 7, 10	6
Rehab.	8	4 and 8	5	4, 7, 10	6

The selection of the timing for periodic or rehabilitative work does not follow the previous estimate of years of road life in most of these cases. The reason for this lies with the economic argument that the search for a correct timing must find that year-to-year period for which the rise in vehicle costs is greater than the amount of cost being introduced, so that the savings in vehicle costs are at least equal to the amount of input costs. That is, marginal revenue (savings) equals marginal costs, and timing is at an optimum. For low volume roads and for some higher volume roads with lesser annual rates of increase in vehicle costs, that particular year was either delayed beyond the so-called service life of the road, or was not found at all.

Another reason for delayed intervention is that in year one of the forecast, following a year 0 in which the road is brought to "good" cost levels, the vehicles enjoy the good, or minimum cost level, and not the higher costs associated with succeeding years. For this same reason, routine maintenance is not introduced until year 2 of the forecast (i.e., end of year one).

9.4.2.2 Comparative Vehicle Savings

Each road treatment designed to intervene in the rise of vehicle operating costs on the unmaintained road base case must be assigned a cost-saving function. The accepted fact that both maintenance and rehabilitation perform cost-saving functions does not tell us how this

function operates or how much will be saved. Models of maintenance savings, usually for gravel or earth roads, typically portray traffic of heavy trucks (6-tons and tractor-trailer compositions), measured rutting and gravel losses on the roads per vehicle pass, and interventions based on the joint rise in vehicle and resurfacing costs. Low volume roads in such cases produce high savings resulting from routine, periodic maintenance practices which consist of relatively low-cost blading, shaping, and surface gravel replacements.

The high levels of vehicle savings to large vehicles reported by such studies will not be duplicated on low-volume light vehicle roads which consist about 50% of motorcycles. Rather, other questions may be asked than the specific savings functions of each intervention: 1) What is the minimum or the maximum expected savings? 2) How does the function operate exactly? 3) What are the real choices between routine and periodic maintenance and rehabilitation, in cost, timing, and benefits?

The forecasts which follow will attempt to answer these questions. Certain variables in the forecast which must remain fixed for the present analysis should be later tested by computer modelling to arrive at better or more optimum answers. These variables are ADT level forecasted for each road type; composition of ADT and therefore vehicle cost per unit; rate of traffic growth; comparative costs of routine, periodic and rehabilitation work per kilometer; and therefore, expected savings and cost levels and timing itself, which must vary as all the components of the forecast vary. For these reasons, the following assumptions enter the forecast:

Basic estimates of functions:

Routine Maintenance

1) Routine maintenance is introduced in year 2, as year 1 vehicle costs are "good" following year 0 optimum road conditions which carry no cost.

2) Routine maintenance continues annually at a fixed level designated for each of the five forecasted road types.

3) Savings in vehicle cost arise, year-to-year, out of the incremental rise in vehicle costs from one year to the next, as the residual difference between the amount of rise and the cost of routine maintenance. That is, after deducting routine maintenance costs, the entire balance of the rise in vehicle costs is claimed as a maximum savings level for the year.

4) In the next year and all succeeding years, vehicle savings from the prior year are also deducted, along with current-year maintenance costs, to avoid cumulative effects not attributable to the effects of an annual program.

5) It is asserted in this model that the residual savings are maximum. They may not be. Some portion of the routine maintenance costs may accrue as savings to vehicles. In the forecast, a percentage rate of savings per year is therefore shown, relative to the alternative level of unmaintained road vehicle cost levels in that year.

Periodic Maintenance

1) Periodic maintenance should be introduced in the year in which the incremental gain in savings is at least equal to the input cost. Failing that, the input should be in the year when savings and cost differences are at a minimum.

2) The cost of routine maintenance is saved in the year of periodic maintenance. For one forecast format which compares total ten-year costs, the savings is taken as a credit; for another which examines benefits and costs, the full value of the periodic maintenance cost is reflected.

3) When periodic maintenance occurs, the prior year's vehicle costs on the maintained road are used as the reference basis (rather than the forecast table of vehicle costs on the unmaintained road). The rise in vehicle costs permitted in this year is the rate of rise in annual traffic growth only (1.7%). This identifies the new level of vehicle costs given by the periodic maintenance. The level of savings is the difference between the forecasted level of vehicle costs — with routine maintenance — and the new level given by periodic maintenance.

4) Because periodic maintenance involves overlays, re-sealing, and regravelling, this is not a complete return to "good" or minimum vehicle cost levels of year 0, as the road width and general configuration are not being changed as with rehabilitation/upgrading, although higher traffic levels now exist. Savings are therefore accounted as some intermediate level between minimum vehicle costs given by rehabilitation and that level given by routine maintenance. At the present, this is a convention, which assumes major work tasks for rehabilitation not encompassed in periodic maintenance: base, sub-base and sub-grade work may be re-worked for substantial improvement to vehicle operation.

5) In years following periodic maintenance, the annual rate of increase in vehicle costs is taken as one-half the rate shown by the forecast of vehicle costs on the unmaintained road, until another periodic maintenance year is selected. The calculation process then repeats as above.

Rehabilitation

1) Rehabilitation is forecasted to occur in the same years as selected for periodic maintenance. These years approximate the reported life of the road types, and may correspond to the time at which rehabilitation is sought to restore these roads in actual practice.

2) Consistent with present practice, no maintenance is given the road until it is rehabilitated, and no maintenance thereafter. Unmaintained road vehicle cost forecasts are used as the basis for analysis.

3) With rehabilitation, "good" vehicle costs are resumed in the year of rehabilitation. Good vehicle costs per unit are applied to the total vehicle numbers forecasted in the rehabilitation year to obtain annual vehicle costs; rehabilitation therefore returns vehicle costs to their condicion in year 0, multiplied by the forecasted vehicle volume in year X.

4) In succeeding years, the rate of growth which obtains for vehicle costs on an unmaintained road will apply, as a rate, to the vehicle costs newly set in year X of the rehabilitation.

9.4.2.3 Discounted Present Values of all Alternative Cost Flows

The ten-year forecasts permit comparisons of the annual cost flows and their discounted net present value sums (at 12%), in two parts: vehicle costs annually and input costs of routine, or periodic, or rehabilitative interventions. As the base case, the unmaintained road forecast will show vehicle costs only, as no interventions occur. All alternative costs of treatment and their cost-reducing effects upon vehicle cost levels, will be compared with the base case to measure the total cost reduction achieved by each relative to the base case. Savings over the base case are then compared for each alternative treatment. The results of this first stage evaluation are shown below.

Comparative NPV Sums of Costs and Savings over Ten Years
(at 12% discount)

	Sealed			Unsealed	
	Asphalt	Seal	Gravel	Gravel	Earth
ADT:	550	364	127	364	29
NPV (Rp 000/km) Costs:					
Unmaintained	103,755	93,793	39,108	174,138	11,751
Rehabilitated	99,030	86,147	41,760	103,994	9,753
Routine	100,416	89,613	29,549	147,602	9,685
Rout./periodic	98,197	80,674	29,464	129,378	9,740
NPV (Rp 000/km) Savings:					
Rehabilitation	4,725	7,646	(2,652)	70,144 *	1,998
Routine	3,339	4,180	9,559	26,536	2,066
Rout./periodic	5,558 *	13,119 *	9,644 *	44,760	2,011

It may be seen that the aggregate cost-reducing effects of any alternative treatment in most cases is not a large percentage of the total cost without any treatment at all. The maximum achieved appears to be 40% under unsealed gravel conditions for rehabilitation, which occurs three times in ten years in the forecast, and for a traffic volume on the distinctly high side for a gravel road. The important instruction given by the table above is that: 1) vehicle costs must be borne by the traffic flow under any condition of maintenance or lack of maintenance, 2) high levels of traffic which tend to approach levels consistent with a road transition to a higher design standard will benefit the most from road treatments, and 3) low volumes of traffic on any road class (design standard) which approach the lower limit of those standards will benefit the least from road treatments.

The last statement is underscored by the response of the sealed gravel road carrying the low volume 127 ADT, for which rehabilitation costs, incurred only once midway in the forecast, actually produce higher total costs than the unmaintained alternative. In fact, for such a low-volume road, routine maintenance alone is almost as effective as the combination of routine and periodic maintenance combined.

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* Selected as preferred

For the earth road with light traffic and very moderate annual vehicle costs, one rehabilitation in the ten year forecasts is more expensive and produces less than one periodic maintenance in the same period, which is, in turn, less productive than simple routine maintenance throughout the period. This again emphasizes the role of vehicle volume and the cost level for that volume (variable with road design standard) upon the savings generated by a given road treatment (and the cost of that treatment relative to vehicle costs).

In effect, the fixed parameters described above are all indeed variable. The forecast attempts to take what appears to be known from field data and to make it inform about broad conditions which occur most frequently. These assembled "facts" say that in some cases, depending upon input costs and other factors, rehabilitation can provide the correct answer, and in other cases the wrong answer (or, the worst answer). In any road treatment something is achieved. In four out of five cases, the combination of routine and periodic maintenance is the least-cost solution compared to routine maintenance alone; but in two cases rehabilitation saves more routine maintenance (asphalt and seal), and less than the combined effects of routine and periodic maintenance. The combined effects are again to be preferred for low volume gravel but low volume earth responds best to routine only. In only one case is rehabilitation to be preferred to routine or combined routine and periodic maintenance: the test case high volume traffic on low volume road (gravel).

For this last case, the high volume (364 ADT) started out in year 1 in excess of the design capacity of the 50-200 ADT Class IIIB road, and therefore obtains its preferred status from failure of the Year 0 design standard to accurately take account of the real level of ADT. This test case was visited upon the gravel standards, along with a narrowly acceptable level of 127 ADT for the same gravel standard, to compare the outcomes of higher and lower volumes of traffic on a road design which begins to accept gravel at only 50 vehicles day, but for which the IBRD design standard requires 216 ADT (which would place IBRD ADT in the sealed road class of 200-500 ADT IIIB class).

Further conclusions on the functions of these variations in traffic level, input cost, timing, and savings levels must await a computerized version. With this model, other tests may find the optimum conditions for least-cost solutions to each of the five road types, using any of the road treatment tools as appropriate to different ranges of traffic volume.

9.4.2.4 Benefits, Costs, and Marginalities

The second stage analysis looks to the preferred solution not in terms of least total costs and comparative total savings over the ten year period, but as the net gains received for the cost effort expended. The same forecast yields annual cost data as inputs and measures annual

savings as benefits. Their net present value sums (NPV) produce a benefit-cost analysis, a relative priority ranking profile based on the amplitude of the surplus of benefits over costs above the 1.00 value (for which the sum of benefits is equal to and no greater than the sum of the cost effort), and a clearer picture of the incremental benefits bestowed by the separate function of periodic maintenance.

This is also important to the distributional aspect of the cost shares borne by the public and private sectors. The trade-off in costs undertaken by the road treatments (the public) to shoulder some of the vehicle costs (the private sector) by substituting road outlays for a reduction in vehicle costs will never succeed in producing equal cost shares. It was seen above that vehicle costs must be largely borne by the traffic such costs derive from. They can only be reduced marginally by road treatment alternatives. So the marginal trade-off rate becomes more important, and this will be examined.

The absolute relative cost shares which result from the forecasts above are identifiable from the forecasts. These show, for the different ADT volumes on different road types, how present volumes of traffic affect this distribution. With higher or lower ADT volumes, different cost shares would be represented.

Relative Cost Shares as Percent Private and Public

	Sealed						Unsealed			
	Asphalt		Seal		Gravel		Gravel		Earth	
ADT:	550		364		127		364		29	
	priv.	publ.	priv.	publ.	priv.	publ.	priv.	publ.	priv.	publ.
Unmaintained	100	0	100	0	100	0	100	0	100	0
Rehabilitated	91	9	79	21	73	27	84	16	86	14
Routine Maint.	97	3	97	3	94	6	98	2	85	15
Rout./Periodic	96	4	94	6	89	11	95	5	79	21

It is seen that the high cost of rehabilitation usually undertakes a higher share of public costs than does routine or combined routine and periodic maintenance. However, as noted above, it may be misplaced spending, as with the Gravel 127 ADT case, and may be less efficient than some alternatives which are suitable for the same timing and same level of traffic, accompanied by routine annual treatments at less cost.

The marginal costs and benefits of the same levels of spending as forecasted may be reviewed below.

Comparative Benefits and Costs of Alternatives

(NPV at 12%, period 10 years)

	Sealed			Unsealed	
	Asphalt	Seal	Gravel	Gravel	Earth
ADT:	550	364	127	364	29
(Rp. 000/km)					
1) Rehabilitation with no maintenance					
Savings	13,772	25,325	8,689	91,924	3,461
Costs	13,624	19,551	13,329	27,876	1,678
Ratio	1.01	1.29	.65	3.27	2.06*
2) Routine Maintenance without Periodic					
Savings	6,885	2,498	12,035	32,952	2,969
Costs	3,143	2,819	1,918	3,229	1,599
Ratio	2.19*	2.66*	6.27*	10.20*	1.85
3) Incremental Values of Periodic Maintenance					
Savings	3,508	12,225	1,689	23,732	590
Costs	1,291	2,588	1,723	4,280	694
Ratio	2.72*	4.72*	.98	5.54	.85
4) Routine and Periodic Maintenance Combined					
Savings	10,393	19,723	13,724	56,684	3,559
Costs	4,434	5,407	3,641	7,509	2,293
Ratio	2.34*	3.64*	3.76	7.54	1.55

* Selected as preferred

Note: Item 1) includes as costs the loss of vehicle cost savings afforded by routine maintenance up to the year of rehabilitation.

From this second-stage approach to comparative analysis, we learn that the marginal savings produced by present rehabilitation practices are generally less than the marginal savings produced by routine, and/or routine-and-periodic maintenance. Only two exceptions exist, one of which was previously identified in the first-stage analysis: 1) the cost of rehabilitation for the 127 ADT gravel road increases the total cost stream over the ten-year period beyond cost levels for non-maintenance, and 2) the low-trafficked earth road case was previously seen to be

better served by routine maintenance but now appears to be better served by rehabilitation midway in the ten-year period. The comparative benefit-cost ratios for earth roads are:

rehabilitation	2.06
routine maintenance	1.85
rout/periodic	1.55

These ratios say that for the marginal cost involved in treatment, the marginal savings exceed a 12% rate of return by amplitude over 1.00 shown above. The selection of routine maintenance as the correct solution, on the basis of comparative total ten-year cost flows discounted, would have been incorrect. But in this case, only "marginally" incorrect: the total difference in total cost flows discounted over ten years is only Rp. 68,000. But it is still Rp. 68,000 per kilometer.

To better understand marginalities, compare the actual savings levels and cost levels forecasted for rehabilitation and for routine maintenance.* The difference between savings levels is Rp. 492,000, and between costs is Rp. 79,000; for the added expenditure by rehabilitation of Rp. 79,000, savings is increased 6.22 times over the level of that expenditure (another marginality). This is well worth the incremental cost. However, the attempt to implement a periodic maintenance program for this road must come in at a higher cost than Rp. 79,000 — the incremental cost will in fact be Rp. 694,000. But the gain in savings is only Rp. 590,000, or even less than the added cost, and gives a .85 benefit-cost ratio (less than 12%). The reason for this is explained by cost curves, and the relative point on this U-shaped curve at which the cost input falls. The right-hand part of the curve indicates increasing costs, and the point at which the extra costs of periodic maintenance must be, because on that rise is also found decreasing marginal revenues. The lower-cost increment of rehabilitation must be on the decreasing cost side of the curve, at which increasing marginal revenues appear. In industrial terms, the scale of plant is too small to permit large incremental investments, and only moving to a larger scale of plant (higher ADT volumes) can move the new investment back to a lower cost/larger revenue part of the curve.

With these two exceptions noted, it is shown to be generally true that routine maintenance produces higher benefit-cost ratios than rehabilitation as now practiced. Whereas rehabilitation of the low volume 127 ADT gravel road succeeds only in contributing more costs to a high cost case, routine maintenance provides a 6.27 B/C ratio. It is also seen for this 127 ADT gravel road case that the added expenditure for periodic maintenance does not pay its way, at .98 ratio, and would

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* The same earth road case.

only lower the total benefits of a combined routine and periodic maintenance program, to a B/C of 3.76. For this low-volume road, and for the low-volume earth road, periodic maintenance does appear to be unwarranted for those present traffic levels.

The incremental values shown for periodic maintenance provide a guide to the selection of this option: when B/C ratios are greater than those for routine maintenance alone, the periodic option should be selected, as it will raise the total combined B/C ratio. When lower than routine, the total combined B/C ratio will fall.

The second-stage benefit-cost ratio analysis gives a second reversal of an earlier selection based upon total costs/total savings: for the 127 ADT gravel road case total savings of Rp. 9,644,000 produced by combined routine and periodic maintenance are greater than the total savings of Rp. 9,559,000 produced by routine only. The combined maintenance programs were therefore selected. But the marginal analysis shows clearly that the added periodic maintenance shows only a .98 ratio against a routine maintenance of 6.27, and brings down the combined ratio to the level of 3.76. It is not an economic option. Routine maintenance alone is preferred.

It remains true that total savings are higher with the option than without it. The marginal influence, however, shows that the cost of obtaining the added savings is greater than the amount of the added savings, and brings down the "marginal efficiency of capital" — a rule that says every added cost should at least pay its own way. This is another way of talking about "decreasing returns," or the "law of diminishing marginal efficiency."

All of this has to do with the properties of the U-shaped total cost curve, and the relation of marginal cost curves and marginal revenue curves. The marginal cost curve rises from the lower left of the U curve, bisects it at its lowest point (a minimum cost point), and continues upward to the right on the inside of the U. This curve says that to the left of the intersection, added variable costs may be undertaken in the pursuit of optimum company profits (vehicle savings) and minimum company unit costs (composed of fixed and variable costs, which together give the U shape to the total cost curve). As marginal costs (variable costs) are undertaken, the roads budget is moving up the marginal cost line toward a minimum unit cost point of intersection with the U, and correspondingly, down the left-hand side of the U (total costs per unit are falling). But why expand costs marginally in this way? Where is the payoff? This is explained by the marginal revenue curve, which moves opposite to the marginal cost curve, and slopes downward to the right, bisecting the U also at the minimum cost point. Therefore, as marginal costs (added road expenditures) approach the point at which they may intersect, total costs are falling, marginal costs are rising, and marginal revenues added by each incremental variable cost are falling, but we are still proceeding toward an optimum: each added unitary cost brings in an added unitary revenue greater than its cost.

When the marginal cost curve intersects the marginal revenue curve, the maximum condition is reached. Total costs are at a minimum and the last added expenditure has produced the last and optimum level of added savings. Beyond this point, continued additions to cost are above the optimum level and total costs must begin to rise. At the same time, the revenue which is brought in is falling. That is, adding periodic maintenance to routine maintenance now produces a .98 B/C ratio, whereas the former marginal cost of routine brought in a 6.27 B/C ratio. This relationship of total cost to marginal cost and marginal savings explains how total costs can be less and total savings more by selecting the periodic maintenance option, but how also its selection becomes sub-optimum in the marginal efficiency of its application.

In the real world, where costs per kilometer are fixed as bulk sums, you cannot glide smoothly up the marginal cost curve, but sometimes find among alternatives that the lumpy investment carries you beyond the desired goal. Each of the kabupaten road types has its own U-shaped cost curve and related marginalities. From the earth class to the asphalt class, they may be represented by a little industrial plant, then a bigger one, followed by a medium-size plant, and a large-scale plant.

The scales represented here carry the meaning that, for the earth road, built to the scale designed to handle up to 50 vehicles a day, routine and/or periodic expenditures (the marginal cost curves do not really care what the costs are called), are worthwhile so long as traffic is growing to the level of 50 vehicles per day. At 50, added expenditures only increase input costs and total costs. It may be time to consider a trade-off to a larger scale of plant, represented by the gravel road. If a trade-off is made, the whole cost structure is changed, a new plant is built with higher fixed costs (the new investment) but with potentially greater output and much lower unit costs. The greater vehicle volume which this plant can accommodate is 200 vehicles per day, and you only have 50 to 100 vehicles a day now. Therefore you can expand routine or periodic variable costs as volume increases and achieve a reduction in total costs, which means more marginal revenues (vehicle savings). At some point in future operation, this scale of plant will be performing at its optimum level, at or near 200 vehicles per day, and consideration should again be given to shifting total cost curves by moving to a sealed road, which can carry from 200 to 500 vehicles a day.

9.4.2.5 Summary and Conclusions

A forecast of vehicle volumes and costs, reduced to net present values, may use either of two methods of analysis: reductions in total costs from a base case, and the corresponding total savings, or a marginal analysis with a benefit-cost ratio. The marginal analysis is preferred, and is not more complicated. It has special value in the case of timing and amount of periodic maintenance, which along with rehabilitation, are the only variables which may exist as discretionary costs for any road.

The comparative evaluation of a given level of traffic, each within the design parameters for that road class, and one well above the road's design capacity, has tested several main considerations which will confront the rural roads project.

1) Timing of interventions relates more to vehicle volume and rate of annual cost change than it does to reported years of service life of the road. It is possible that the lighter vehicles which compose traffic on study area roads impart the lower unit costs which result in lower savings levels annually, longer apparent service life of the road (by which is meant that the cost of intervention is greater than the value of the savings for most roads having traffic levels which do not yet approach the design capacity of the road), and that the imputed traffic growth rate of 1.7% is a rate that does not produce sufficient year-to-year savings to warrant the incremental costs of even Routine and/or periodic maintenance, in the case of earth roads carrying 29 ADT, but do warrant a one-time rehabilitation.

2) Routine maintenance in all cases except the Earth road case produces better economic results than Rehabilitation, at the forecasted levels of traffic. Periodic maintenance, at the timing stages shown, adds substantially to the marginal savings of vehicles in the case of Asphalt and sealed roads, but tends to bring down the average savings rate for low-volume gravel, high-volume gravel, and earth roads — at forecasted ADT levels. Periodic maintenance is nevertheless worthwhile for the high-volume gravel, as its B/C ratio is still positive, though declining, and it is better alternative than rehabilitation, which has a negative B/C ratio.

3) Too much importance should not be attached to outcomes of this kind which must "fix" ADT levels, growth rates, and traffic composition. Although they are drawn from the project study areas as a sample of the weighted average, they cannot reflect the range of conditions that are inherent in that average. To arrive at more definitive statements of the likely ADT level of any given road, in particular, a computer modelling of average compositions of traffic, and the average costs associated with these compositions, may lead to reasonable identification of that ADT level which is the threshold case for upgrading (earth to gravel, gravel to seal). If this level can be found, it will mark certain roads for rehabilitation/upgrading.

4) The costs of intervention are derived from forecasted average expected costs for the ADB study of 30 kabupaten, of March 1985, for other provinces. Costs may vary from these in future actual practice. Any further model-building must take account that all costs are variable costs, the more so in the long-run, and become fixed only by the management decision which place them in the model. This fixes the outcomes, even though they remain to be found.

5) The approach to the project must consider that the forecast basis of the above analysis assumed that in year 0 each road type had been brought to a level of design standard which produced a minimum or "good" vehicle cost for that level of ADT. It did not say who brought them to this condition. It is unlikely that most roads will be in this condition in the study area. But it was necessary to test interventions for this environment only, because of the nature of the test: service lives, timing, kind and amount of cost associated with alternatives, and present practices. The previous section explored the question of feasible levels of ADT for rehabilitation, using a simplified IBRD selection table. This section exposes the question of how to deal with routine maintenance, which may be an alternative in the model, but is commonly a no-choice event following road improvement — and the main focus of the institution-building and applied practices sought by the project. That is, routine maintenance is not commonly subjected to a selection or performance criterion. In normal practice, neither is periodic maintenance, but it has been shown that it should be, and is an important alternative to rehabilitation.

6) If the project elects to rehabilitate a road, it will face costs and ADT levels which may be tested by a simple reference table as suggested by IBRD. That table may be converted to Rupiah relationships, and made more manageable by focusing on the narrower range of ADT levels, costs, savings, and growth rates, which will apply to the project area, avoiding the time-consuming effort of interpolations. However, once the "good" condition road is discovered in the field or selected for initial work, it is brought to a state which has presumably been justified by a given level of traffic. The presumption exists that the good state should be maintained and that routine maintenance is the vehicle for this. In four cases out of five, it has been shown to be the earth road, 29 ADT case excepted. Even in that case, a positive benefit-cost ratio was identified (1.85), and represented no miserable failure alongside the 2.06 ratio given by the one-time rehabilitation. For this reason, and because of the direction of the project, routine maintenance should be seen as a normal follow-on to road restoration or upgrading, not subject to selection.

7) It is possible to make a further case that salvage values of roads maintained produce further economic values at the end of year ten, whereas roads unmaintained do not. In all cases this would enhance the benefit-cost ratio, and is nice to see, but provides very little by way of selection criteria or comparative choice in intervention options.

8) Traffic levels and traffic savings dominate these selection options, as currently stated. The alternative value-added approach to low-volume roads is not treated.

9.5. WORK PROGRAMS AND BUDGETS - RECONSTRUCTION AND MAINTENANCE

There was insufficient data to make work programs final with any degree of confidence. The project will utilize annual traffic-based screening procedures to determine which links are eligible for reconstruction financing. Unfortunately, accurate and complete inventory and traffic data were not available for estimation purposes at the time of this consultancy -- a complete traffic counting exercise is recommended for the first (i.e., preparatory) year of the project. However, in order to determine new the general size of the program, several assumptions and approximations were made.

The following exercise is thus illustrative only. Once reliable data on traffic road inventory and conditions are obtained, the programs will be verified.

9.5.1. Procedure Followed

Work programs and budgets for reconstruction and maintenance were developed based on the inventory and road condition data collected from each DPUK/Cabang Dinas. The individual kabupaten inventories according to road type and condition are summarized for each province in Tables 16 and 17. These summaries are only for the initial 14 kabupatens. The provincial summaries were tabulated according to the existing practice of classifying roads into only three types: "asphalt," "gravel" and "earth" and according to the reported road condition.

In order to determine what work is needed it was necessary to distribute the inventory kms among the different types of road that are actually found in the networks. From that distribution is it easier to visualize what work has to be done. Since the kabupatens are reporting some km of each classification in good condition, it was assumed that those km were in acceptable condition for maintenance. A small percentage of the asphalt roads in moderate condition was also assumed to be in acceptable condition for maintenance. The rest were considered unacceptable for maintenance and therefore in need of reconstruction, if the traffic counts so justified.

The numbers in the far left margin of Table 18 are the total km (summarized from Tables 16 and 17) as reported by the kabupaten for "asphalt," "gravel" and "earth" broken down according to their own rated conditions; good, moderate, damaged and heavily damaged. The percentages are for the km of each condition based on the total of all the kabupatens, or 10,813 km.

Based on the consultant's field observations, discussions with the kabupaten officials, and the personal observations of the local consultants who collected the data, the total km were distributed to the various types of road (the figures in brackets [] in Table 18). Next, the km per each type of road were distributed to either acceptable for

Table 16
ROAD INVENTORY: SOUTH SULAWESI

		ASPHALT					GRAVEL					EARTH					
		G	MOD	D	HD	TOT	G	MOD	D	HD	TOT	G	MOD	D	HD	TOT	TOTAL
PINRANG	Km	32	45	14	-	91	108	45	27	-	180	-	94	24	-	118	389
SIDENRENG RAPPANG	Km	-	356	60	-	416	-	79	35	45	159	-	-	-	63	63	638
WAJO	Km	-	10	25	13	48	-	-	82	223	305	-	-	516	-	516	869
BONE	Km	14	40	90	26	170	35	99	220	64	418	42	121	268	79	510	1099
BULUKUMBA	Km	-	40	37	-	77	-	26	172	58	256	-	98	133	222	453	786
JENEPONTO	Km	34	15	10	20	79	85	27	35	204	351	82	13	17	52	164	594
GOWA	Km	24	23	19	-	66	13	102	129	-	244	-	-	107	131	238	548
SULSEL PROVINCE TOTAL		104	529	255	59	947 19%	241	378	700	594	1913 39%	124	326	1065	547	2062 42%	4922

G = 10% Good MOD = 25% Moderate D = 41% Damaged HD = 24% Heavily Damaged

1127

Table 17
ROAD INVENTORY: NTT

		ASPHALT					GRAVEL					EARTH					
		G	MOD	D	HD	TOT	G	MOD	D	HD	TOT	G	MOD	D	HD	TOT	TOTAL
KUPANG	Km	15	7	-	-	22	69	111	199	49	428	-	-	90	216	306	756
TTS	Km	-	8	-	-	8	-	291	-	-	291	-	1131	-	-	1131	1430
BELU	Km	-	1	-	-	1	-	209	82	-	291	-	-	202	-	202	494
MANGGARAI *	Km	-	27	8	-	35	-	-	171	10	181	-	-	1133	67	1200	1416
NGADA	Km	-	-	-	-	-	-	-	112	33	145	-	50	119	686	855	1000
SIKKA	Km	20	9	-	-	29	29	37	8	3	77	46	54	79	46	225	331
SUMBA BARAT	Km	-	16	-	-	16	-	226	56	10	292	-	-	52	104	156	464
NTT PROVINCE TOTAL		35	68	8	-	111 2%	98	874	628	105	1705 29%	46	1235	1675	1119	4075 69%	5891

G = 3 % Good MOD = 37% Moderate D = 39% Damaged HD = 21% Heavily Damaged

* P.T. Hasfarm data incorrect. During the field visit the Chief, Road Section confirmed that the above data are correct.

Table 18
DISTRIBUTION OF KILOMETERS
3rd Trial - 12 July

Before Work (Actual Type and Existing Condition)		Work Program	1ST YEAR ROUTINE & PERIODIC MAINTENANCE	RECONSTRUCTION REHABILITATION	RECONSTRUCTION BETTERMENT
	[Neg.]	P Asphalt Concrete Acceptable (Neg.) Unacceptable (Neg.)			
"ASPHALT" ROADS	[428]	P Penetration Macadam Pavement Acceptable (100)	100	Drop 37%	
		Unacceptable (328)		328 - 121 = 207	
G = 139 = 1%					
M = 597 = 6%	[Neg.]	S Bituminous Surface Treatment Acceptable (Neg.) Unacceptable (Neg.)			
D = 263 = 2%					
HD = 59 = 1%					
T = 1058 = 10%	[630]	S Penetration Seal Over Macadam Acceptable (150)	150	Drop 37%	
		Unacceptable (480)		480 - 178 = 302	
	[Neg.]	S Penetration Seal Over Aggregate/Gravel Acceptable (Neg.) Unacceptable (Neg.)			
"GRAVEL" ROADS	[248]	G Well-graded Aggregate/Gravel Acceptable (135)	135	Drop + 37%	
		Unacceptable (113)		113 - 41 = 72	
G = 339 = 3%	[1500]	G Water-bound Macadam Acceptable (Neg.) Unacceptable (1500)		Drop 73%	G/S 94
				1406 - 1028 = 378	
M = 1252 = 12%		G Select Material Surfacing			
D = 1328 = 12%	[370]	Acceptable (204)	204	Drop 37%	
HD = 699 = 6%		Unacceptable (166)		166 - 62 = 104	
T = 3618 = 33%		G Telford			
	[1500]	Acceptable (Neg.) Unacceptable (1500)		Drop 73%	G/S 95
				1'05 - 1028 = 377	
"EARTH" ROADS	[6137]	E Earth Acceptable (170)	170	Drop 89%	
G = 170 = 2%		Unacceptable (5767)		584 - 5212 = 629	E/G 126
M = 1561 = 25%					
D = 2740 = 25%					
HD = 1666 = 15%					
T = 6137 = 57%					

P = Paved S = Sealed G = Gravel E = Earth T = Total

G/S = Gravel to Sealed E/G = Earth to Gravel

maintenance or unacceptable and in need of reconstruction (the figures in the parentheses ( ), if later traffic counts so indicate). This distribution to acceptable or unacceptable follows the reported condition of good plus a small percentage of moderate for asphalt roads. In the gravel and earth category, only those km in good condition were felt to be in acceptable or maintainable condition.

Next, those km in acceptible condition were earmarked for maintenance in the first year. These km comprise only 7% of the entire network.

The remaining km were earmarked for reconstruction, both rehabilitation and betterment. None of the existing "asphalt" roads were considered for betterment because an upgrade from a sealed road would be asphalt concrete pavement. That kind of road would require a very high ADT and is not thought to be a likely design class for kabupaten roads. It was felt that a percentage of gravel roads (25%) and earth roads (20%) which are earmarked for reconstruction might yield significant traffic to justify upgrading to the sealed and gravel categories, respectively.

Finally, and most important, there are sufficient funds in the proposed USAID loan to allow only for reconstruction of about 20-25% of the entire network. There are also a significant number of existing gravel and earth roads which do not carry enough traffic to justify even their current type of construction. Therefore, due to expected low traffic and not enough funds to reconstruct all the km in bad condition, 70% of the unacceptable gravel classification and 89% of the unacceptable earth classification were dropped from consideration.

9.5.2. Reconstruction Program

Table 19 shows a distribution of the eligible km over the years of the project during which civil works will occur. The distribution of the work was assumed to be best if it would start at a reduced level, gradually increase, and finally taper off so as not to be too great a load or a sudden end of work for the construction industry. The percentages were distributed as follows:

YEAR:	1st	2nd	3rd	4th	5th	6th	
Percentage:	10	15	20	20	20	15	= 100

Table 19
RECONSTRUCTION PROGRAM: SOUTH SULAWESI AND NTT
3rd Trial - 12 July

RECONSTRUCTION PROGRAM	TOTAL PROGRAM Rehabilitation P	S	G	E	Btrm't G	S	E	G	1st YEAR (10%) Rehabilitation P	S	G	E	G	Btrm't S	E	G	2nd YEAR (15%) Rehabilitation P	S	G	E	G	Btrm't S	E	G
TOTAL PROGRAM																								
2384 - 22%	207	303	931	629		189		125	21	30	93	63	19		13		31	45	140	94		28		19
10813				2384								240								375				
SULSEL																								
PINRANG Km This Year																								
61 - 16% Total Km	12	17	20	12		-		-				10 km								15 km				
389																								
SIDRAP Km This Year																								
285 - 45% Total Km	90	130	45	7		13		-				30 km								45 km				
638																								
WAJO Km This Year																								
203 - 23% Total Km	12	18	87	54		18		14				20 km								30 km				
869																								
BONE Km This Year																								
285 - 26% Total Km	39	56	109	49		22		10				30 km								45 km				
1099																								
BULUKUMBA Km This Year																								
190 - 24% Total Km	18	26	73	48		15		10				20 km								30 km				
786																								
JENEPONTO Km This Year																								
126 - 21% Total Km	11	16	75	9		15		-				10 km								20 km				
594																								
GOWA Km This Year																								
135 - 25% Total Km	10	14	66	25		13		7				10 km								20 km				
548																								
PROVINCE SUBTOTAL Km	192	277	475	204		96		41				130								250				
				1285																				
N.T.T.																								
KUPANG Km This Year																								
172 - 23% Total Km	-	-	102	32		21		17				15 km								25 km				
736																								
T.T.S Km This Year																								
251 - 18% Total Km	8	-	83	119		17		24				25 km								35 km				
1430																								
BELU Km This Year																								
121 - 24% Total Km	-	-	83	21		17		-				10 km								20 km				
494																								
MANGGARAI Km This Year																								
229 - 16% Total Km	7	11	50	126		10		25				25 km								35 km				
1416																								
NGADA Km This Year																								
160 - 16% Total Km	-	-	41	90		11		18				15 km								25 km				
1000																								
SIKKA Km This Year																								
40 - 12% Total Km	-	5	14	21		-		-				10 km								10 km				
331																								
SUMBA BARAT Km This Year																								
126 - 27% Total Km	-	10	83	16		17		-				10 km								10 km				
464																								
PROVINCE SUBTOTAL Km	15	26	456	425		93		84				110								170				
				1099																				

P=Paved; S=Sealed; G=Gravel; E=Earth
G-S=Gravel to Sealed; E-G=Earth to Gravel

116X

Table 19 (Continued)
RECONSTRUCTION PROGRAM: SOUTH SULAWESI AND NTT

RECONSTRUCTION PROGRAM	3rd YEAR (20%) Rehabilitation	3rd YEAR (20%) Btrm't	4th YEAR (20%) Rehabilitation	4th YEAR (20%) Btrm't	5th YEAR (20%) Rehabilitation	5th YEAR (20%) Btrm't	6th YEAR (15%) Rehabilitation	6th YEAR (15%) Btrm't
	P S G	E C S E G	P S G	E C S E G	P S G	E G S E G	P S G	E G S E G
TOTAL PROGRAM	41 60 186	126 38 25	41 60 186	126 38 25	41 60 186	126 38 25	32 47 140	94 28 19
	505		506		461		297	
SULSEL								
PINRANG	20 Km		16 Km					
SIDENRENG RAPPANG	60 Km		60 Km		60 Km		30 Km	
WAJO	40 Km		45 Km		45 Km		23 Km	
BONE	60 Km		60 Km		60 Km		30 Km	
BULUKUMBA	40 Km		40 Km		40 Km		20 Km	
JENEPONTO	25 Km		25 Km		26 Km		20 Km	
GOWA	30 Km		30 Km		25 Km		20 Km	
PROVINCE SUBTOTAL Km	275		276		256		143	
N.T.T.								
KUPANG	35 Km		35 Km		35 Km		27 Km	
T.T.S.	50 Km		55 Km		50 Km		36 Km	
BELU	25 Km		25 Km		20 Km		21 Km	
MANGGARAI	50 Km		50 Km		45 Km		24 Km	
NGADA	35 Km		30 Km		30 Km		25 Km	
SIKKA	10 Km		10 Km					
SUMBA BARAT	25 Km		25 Km		25 Km		21 Km	
PROVINCE SUBTOTAL Km	230		230		205		154	

The budget for the reconstruction program was then prepared using the total km and the activity unit costs (see Table 20).

It does not appear that the proposed reconstruction program will be too great a burden on kabupaten staffs. A review of past experience shows that DPUKs have been tendering up to five or more road work contracts per year and implementing a combined force account and contract value of Rp. 430 million in road work per kabupaten per year. There will, however, have to be improvements made in contractor supervision procedures (see Section 8.5) and the ability of a DPUK to take on the work will depend on other factors such as the quality of contractors and the amount of paperwork.

It must be emphasized again that the calculated program is illustrative, and that the actual distribution of works during the project will be made based on annual screening, which will be based in turn on measures of traffic volume.

For gravel road reconstruction, the AWCAS method of construction by stages* using well-graded crushed aggregate is prefered because it provides a durable surface appropriate for that volume of traffic as specified in the Kabupaten Road Design Standard. (See Section 9.1.)

Because no data were available in the inventory for bridges or for calculating unit costs, bridge reconstruction was estimated to be 10% of the reconstruction program. This compares with 6% in the ADB Rural Roads II Project and 13% in the World Bank Highway Maintenance and Betterment Project.

9.5.3. Maintenance Program

Tables 21 and 22 show the estimated reconstruction kilometers distributed to each of the kabupatens in the first and the last year.

The budget for the maintenance program was prepared in the same manner as for the reconstruction program, multiplying the unit costs by the estimated kilometers for both the first and last years. The total kilometers to be reconstructed for each type of road were added to the first year kilometers for the estimate of the maintenance program in the year following the last year of reconstruction, labeled the 7th Year. As in the reconstruction program, bridge maintenance costs were estimated directly using 10% of the total maintenance programs. See Table 23.

It is assumed that the maintenance program will be funded by the GOI. The unit costs were calculated as direct cost only; therefore, a percentage for overhead and administration (35%) was assumed to arrive at a total budget cost.

* Refer to Annex 22 for the description by Bob Nairn, paragraph 4.2, page 28.

Table 20
BUDGET FOR ROAD AND BRIDGE RECONSTRUCTION PROGRAM
3rd Trial - 12 July

	Unit Cost Rp(000) per Km	x	Km	=	Total Cost Rp(000)
ROADS:					
Rehabilitation					
o Rebuild Paved Road on Penetration Macadam Pavement	35,000		207		7,245,000
o Rebuild Sealed Road on Penetration Sealed Macadam	25,000		302		7,555,000
o Rebuild Gravel Road					
- on Gravel & Select Mtrl. Surface	17,000		176		2,992,000
- on Water Bound Macadam & Telford	20,000		755		15,100,000
o Rebuild Earth Road on Earth Subgrade	9,000		629		5,661,000
Total Rehabilitation Cost:			2,069 Km		38,548,000
Betterment					
o DBST on Existing Gravel & Select Mtrl. Surface	29,000		189		5,481,000
o Graveling on Existing Earth Subgrade	22,000		126		2,772,000
Total Betterment Cost:			315 Km		8,253,000
Subtotal Road Program:			2,384 Km		Rp. 46,801,000
BRIDGES:					
Rehabilitation & Betterment					
Assume 10% of the reconstruction program					
Subtotal Bridge Program:					5,199,000
TOTAL ESTIMATED DIRECT COST ROAD AND BRIDGE RECONSTRUCTION PROGRAM:					Rp. 52,000,000

GOI/USAID PARTICIPATION

Assume: 70% USAID Rp. 36,400,000,000 = $32,500,000 *
30% GOI Rp. 15,600,000,000

* Note: Not included: individual project administrative or indirect costs, allocations for equipment purchase, TA, research, etc.
Assume Rp. 1120 = US$ 1.00

Table 21
MAINTENANCE PROGRAM:
SOUTH SULAWESI

(number of kilometers that can be maintained in years one and seven)

3rd Trial - 12 July

YEAR		1ST			4th			7th		
TYPE OF ROAD		S	G	E	S	G	E	S	G	E
PINRANG	Existing = 389 Km									
Km Increase	Network							29	20	12
Total Km		45	108	-				74	128	12
SIDENRENG RAPPANG	Existing = 638 Km									
Km Increase	Network							233	45	7
Total Km		66	-	-				299	45	7
WAJO	Existing = 869 Km									
Km Increase	Network							48	101	54
Total Km		-	-	-				48	101	54
BONE	Existing = 1099 Km									
Km Increase	Network							117	119	49
Total Km		20	35	42				137	154	91
BULUKUMBA	Existing = 786 Km									
Km Increase	Network							59	83	48
Total Km		7	-	-				66	83	48
JENEPONTO	Existing = 594 Km									
Km Increase	Network							42	75	9
Total Km		37	85	82				79	160	91
GOWA	Existing = 548 Km									
Km Increase	Network							37	73	25
Total Km		28	13	-				65	86	25
YEARLY PROVINCIAL INCREASE Km		-	-	-				565	516	204
PROVINCIAL MAINTENANCE TOTAL Km		203	241	124				768	757	328

Table 21 (continued)
MAINTENANCE PROGRAM
SOUTH SULAWESI

MAINTENANCE CREWS CALCULATED AND ASSIGNED		YEAR	1ST Calc.	1ST Assign	4th	7th Calc.	7th Assign
PINRANG	Routine	Routine	1.9	2		2.6	3
		Smoothing	0.3	-		0.3	-
	Periodic	Resealing	0.1	*		0.2	*
		Regraveling	0.2	1		0.3	1
		Reshaping	0.5	-		0.7	1
SIDRAP	Routine	Routine	1.1	1		5.6	6
		Smoothing	-	-		0.1	-
	Periodic	Resealing	0.2	*		0.9	*
		Regraveling	-	-		0.1	1
		Reshaping	-	-		0.2	-
WAJO	Routine	Routine		-		2.2	3
		Smoothing		-		0.4	-
	Periodic	Resealing		-		0.1	*
		Regraveling		-		0.2	1
		Reshpaing		-		0.8	1
BONE	Routine	Routine	1.0	1		4.5	5
		Smoothing	0.2	-		0.6	-
	Periodic	Resealing	0.1	*		0.4	*
		Regraveling	0.1	-		0.3	1
		Reshaping	0.4	1		1.3	1
BULUKUMBA	Routine	Routine	0.1	-		2.3	3
		Smoothing	-	-		0.3	-
	Periodic	Resealing	-	*		0.2	*
		Regraveling	-	-		0.2	1
		Reshaping	-	-		0.6	1
JENEPONTO	Routine	Routine	2.2	2		3.6	4
		Smoothing	0.4	-		0.6	1
	Periodic	Resealing	0.1	*		0.2	*
		Regraveling	0.2	1		0.4	1
		Reshaping	0.8	1		1.3	-
GOWA	Routine	Routine	0.6	1		2.2	3
		Smoothing	-	-		0.3	-
	Periodic	Resealing	0.1	*		0.2	*
		Regraveling	-	-		0.2	1
		Reshaping	0.1	-		0.5	1
TOTALS PROVINCE SULSEL	Routine	Routine		7			27
		Smoothing		-			1
	Periodic	Resealing		*			*
		Regraveling		2			7
		Reshaping		2			5

* Most districts only need an average of 0.2 crews for resealing. Perhaps it is best have this work performed by the DPUK Reconstruction (Force Account) Crew. Even though SIDRAP has enough sealed Km to warrant its own crew, keep all the kabupatens uniform.

RESOURCE CALCULATIONS		No. of Kilometers/Crew/Year Type of Road - Inventory		
KABUPATEN ROAD MTCE WORK		Sealed	Gravel	Earth
Routine	Routine	60	100	125
	Smoothing	-	400	400
Periodic	Resealing	350	-	-
	Regraveling	-	450	-
	Reshaping	-	[illegible]	[illegible]

Table 22
MAINTENANCE PROGRAM
NTT

3rd Trial - 12 July
(number of kilometers that be maintained in years one and seven)

YEAR		1ST			4th			7th		
TYPE OF ROAD		S	G	E	S	G	E	S	G	E
KUPANG	Existing = 756 Km									
Km Increase	Network							21	119	32
Total Km		20	69	-				41	188	32
T.T.S.	Existing = 430 Km									
Km Increase	Network							25	107	119
Total Km		-	-	-				25	107	119
BELU	Existing = 494 Km									
Km Increase	Network							17	83	21
Total Km		-	-	-				17	83	21
MANGGARAI	Existing = 1416 Km									
Km Increase	Network							28	75	126
Total Km		5	-	-				33	75	126
NGADA	Existing = 1000 Km									
Km Increase	Network							11	59	90
Total Km		-	-	-				11	59	90
SIKKA	Existing = 331 Km									
Km Increase	Network							4	14	21
Total Km		22	29	46				26	43	67
SUMBA BARAT	Existing = 464 Km									
Km Increase	Network							27	83	16
Km Increase		-	-	-				27	83	16
YEARLY PROVINCIAL INCREASE Km		-	-	-				133	540	425
PROVINCIAL MAINTENANCE TOTAL Km		47	98	46				180	638	471

Table 22 (continued)
MAINTENANCE PROGRAM
NTT

MAINTENANCE CREWS CALCULATED AND ASSIGNED		YEAR	1ST Calc.	1ST Assign	4th	7th Calc.	7th Assign
KUPANG	Routine	Routine	1.0	1		2.9	3
		Smoothing	0.2	–		0.6	–
	Periodic	Resealing	0.1	*		0.1	*
		Regraveling	0.2	1		0.4	1
		Reshaping	0.3	–		1.1	1
T.T.S.	Routine	Routine		–		2.5	3
		Smoothing		–		0.6	–
	Periodic	Resealing		–		0.1	*
		Regraveling		–		0.2	1
		Reshaping		–		1.1	1
BELU	Routine	Routine		–		1.3	2
		Smoothing		–		0.3	–
	Periodic	Resealing		–		0.0	*
		Regraveling		–		0.2	1
		Reshaping		–		1.5	–
MANGGARAI	Routine	Routine	0.1	–		2.4	3
		Smoothing	–	–		0.5	–
	Periodic	Resealing	0.1	*		0.1	*
		Regraveling	–	–		0.2	1
		Reshaping	–	–		1.0	1
NGADA	Routine	Routine		–		1.5	2
		Smoothing		–		0.3	–
	Periodic	Resealing		–		0.0	*
		Regraveling	–	–		0.1	1
		Reshaping		–		0.8	1
SIKKA	Routine	Routine	1.1	1		1.3	2
		Smoothing	0.2	–		0.3	–
	Periodic	Resealing	0.1	*		0.1	*
		Regraveling	0.1	1		0.1	1
		Reshaping	0.3	–		0.5	–
SUMBA BARAT	Routine	Routine		–		1.4	2
		Smoothing		–		0.2	–
	Periodic	Resealing		–		0.1	*
		Regraveling		–		0.2	1
		Reshaping		–		0.5	–
TOTALS	Routine	Routine		2			17
		Smoothing		–			–
N.T.T.	Periodic	Resealing		*			*
		Regraveling		2			7
		Reshaping		–			4

* All districts need less than 0.1 Resealing Crews. Perhaps it is best to have this work performed by the DPUK Reconstruction (Force Account) Crew.

RESOURCE CALCULATIONS		No. of Kilometers/Crew/Year Type of Road - Inventory		
KABUPATEN ROAD MTCE WORK		Sealed	Gravel	Earth
Routine	Routine	60	100	125
	Smoothing	–	400	400
Periodic	Resealing	350	–	–
	Regraveling	–	450	–
	Reshaping	–	200	200

Table 23

BUDGET FOR ROAD AND BRIDGE MAINTENANCE PROGRAM

3rd Trial
12 July

TYPE OF MAINTENANCE WORK	Unit Cost Rp(000) per Km	1st YEAR Km	1st YEAR Total Rp(000)	7th YEAR Km	7th YEAR Total Cost Rp(000)
ROADS:					
Routine and Periodic Maintenance					
o On Paved and Sealed Roads					
- Routine Tasks	510				
- Periodic	680				
Subtotal Paved and Sealed	1,190	250	297,500	948	1,128,120
o On Gravel Roads					
- Routine Tasks	360				
- Smoothing	70				
- Periodic Regraveling	800				
- Periodic Reshaping	255				
Subtotal Gravel	1,485	339	503,415	1,396	2,073,060
o On Earth Roads					
- Routine Tasks	150				
- Smoothing	70				
- Periodic Reshaping	255				
Subtotal Earth	475	170	80,750	799	379,525
		759	881,665	3,143	3,580,705
BRIDGES:					
Assume 10% of the total Maintenance Program			97,963		397,856
Subtotal Direct Road and Bridge Maintenance Program			979,628		3,978,561
Administrative Cost @ 35%			342,870		1,392,496
TOTAL ROAD AND BRIDGE MAINTENANCE PROGR			1,322,498		5,371,057

9.6. EQUIPMENT PLANNING

The characteristics of the equipment fleet should be related to the equipment needs for the maintenance and reconstruction work to be performed and on the availability of existing adequate equipment to do the work.

9.6.1. Equipment Needs

Maintenance Equipment. The criteria adopted for calculation of required quantities of maintenance equipment are described in the following pages.

The first step is to identify the type of equipment needed for a crew to perform road maintenance activities. Table 14 in Section 9.2 indicates the types and quantities of equipment for the following activities:

1) Routine Activities

1 Dump Truck (3.5 ton)
1 Hand Compactor
1 Paddle Wheel Mixer (for cold mix), 0.5 m3

2) Smoothing

1 Motorgrader (100 HP)

3) Reshaping

1 Motorgrader (100 HP)
1 Vibratory Roller, self-propelled, 6 ton
1 Water Tank Truck, 4000 l.

4) Regraveling

1 Motorgrader (100 HP)
1 Wheel Loader (1.2 M3)
1 Vibratory Roller, self-propelled, 6 ton
4 Dump Trucks (3.5 ton)
1 Water Tank Truck, 4000 l

Note: Resealing is a periodic maintenance activity. It will be performed by the reconstruction group while doing single and double surface treatment until such time as there is enough work every year to occupy a complete resealing crew. The equipment needs for resealing are considered under reconstruction group requirements.

5) Resealing

1 Asphalt Sprayer, 800 l., towed
2 Dump Trucks (5 ton)
2 Tailgate Chip Spreaders
1 Rubber-tired Roller (11 ton), self-propelled
1 Flat Bed Truck (3.5 ton)

6) Other

1 Flat Bed Truck (3.5 ton)
1 Concrete Mixer (0.25 m3)

At the beginning of the first year of operations, all kabupatens should have equipment for:

- Routine Activities,
- Smoothing and
- Reshaping.

That is, one each: motorgrader, dump truck, vibratory roller, water tank truck, hand compactor and paddle wheel mixer.

The next step is to obtain the number of crews required for each of the maintenance activities. The calculated number of crews were shown in Tables 21 and 22, for the beginning of the first and seventh years of operations. The calculated number of crews are given in fractions. A rational approach was taken to combine the fractional amount of work required for equipment of the same type. For example: smoothing, reshaping and regraveling all require a motorgrader. The sum of the fractions of motorgrader needed for each activity gives the total number of required motorgraders. If the sum is above a full number, for example 1.1 or 2.1, then an additional unit is added. Tables 24 and 25 are samples of the calculations done for each kabupaten. They summarize the calculated and assigned quantities of equipment required in the 1st and 7th year of operations. A complete set of tables for all kabupatens is in the Annexes. The same reasoning applies to other type of equipment such as:

Vibratory Rollers (needed for reshaping and regraveling),
Water Tank Trucks (for reshaping and regraveling), and
Dump Trucks (for routine activities and regraveling).

Hand compactors are used for pot-hole patching of asphalt-paved surface. Because this activity is not done all the time, the quantity of hand compactors needed is estimated as a fraction (50%) of the number of routine activity crews.

Paddle wheel mixer quantities are calculated as one unit per kabupaten. This unit will be located in the workshop yard to prepare and stock cold mix for pot-hole patching.

Table 24

EQUIPMENT NEEDS FOR ANNUAL ROAD MAINTENANCE PROGRAM

PROVINCE: SOUTH SULAWESI KABUPATEN: PINRANG YEAR: 1st

ITEM	MAINTENANCE ACTIVITY TITLE	NUMBER OF CREWS	Equipment - Per Crew: Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.9	1.9	-	-	-	-	-	1.9	1.9	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.5	-	0.5	-	0.5	0.5*	-	-	-	-
4	Regraveling	0.2	4**	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		5.9	1.0	0.2	0.7	0.7	1.0	1.9	1.9	1.0
	Total Assigned		6	1	1	1	1	1	1***	1*	1

NOTE: TOTAL CALCULATED quantities of equipment per crew reflect the equipment needed in the 1st year of maintenance operations
TOTAL ASSIGNED quantities of equipment per crew reflect the equipment needed through the 3rd year but delivered at the beginning of the 1st year of maintenance operations.

* Water tank truck is not needed for reshaping activity when the surface is moist.
** Dump trucks are needed for regraveling as a complete group of 4 units.
*** Hand compactors are needed as approx. one-half of number of crews for routine activities.
**** Paddle wheel mixer is estimated as one unit per kabupaten.

Table 25

EQUIPMENT NEEDS FOR ANNUAL ROAD MAINTENANCE PROGRAM

PROVINCE: SOUTH SULAWESI KABUPATEN PINRANG YEAR: 7th

ITEM	MAINTENANCE ACTIVITY TITLE	NUMBER OF CREWS	Equipment - Per Crew: Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	2.6	2.6	-	-	-	-	-	2.6	2.6	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.7	-	0.7	-	0.7	0.7*	-	-	-	-
4	Regraveling	0.3	4**	0.3	0.3	0.3	0.3	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.6	1.3	0.3	1.0	1.0	1.0	2.6	2.6	1.0
	Total Assigned		7	2	1	1	1	1	1***	1****	1

NOTE: TOTAL CALCULATED quantities of equipment per crew reflect the equipment needed in the 7th year of maintenance operations.
TOTAL ASSIGNED quantities of equipment per crew reflect the equipment needed in the 7th year but delivered at the beginning of the 4th year of maintenance operations.

* Water tank truck is not needed for reshaping activity when the surface is moist.
** Dump Trucks are needed for regraveling as complete group of 4 units.
*** Hand compactors are needed as approx. one-half of number of crews for routine activities.
**** Paddle wheel mixer is estimated as one unit per kabupaten.

Flat bed truck and concrete mixers are needed for other types of maintenance work such as bridge and drainage structures repairs, sign maintenance, etc. One unit per kabupaten was estimated.

A wheel loader is needed for regraveling operations. Whenever this operation is performed on a scale requiring a regraveling crew, one wheel loader will be added to the list of required equipment. A regraveling crew is either formed at the beginning of the first or at the beginning of the fourth year of operations, depending on the requirements of the work program. If the crew is only formed in the fourth year, at that time the following equipment should be added:

1 Wheel Loader
4 Dump Trucks

Table 26 shows an example of the quantities of equipment required for each kabupaten at the beginning of the 1st and 4th years of operations. The projected needs for the 7th year are to be delivered at the beginning of the 4th year. A complete set of tables for all kabupatens is in the Annexes.

The requirements are limited to units needed for the direct performance of road maintenance operations. Support equipment such as pick-up trucks, jeeps and motorcycles are planned separately.

Reconstruction Equipment. The following criteria were taken into consideration for selecting the types and sizes of reconstruction equipment:

1) The type of road and number of kilometers of reconstruction work were shown in Table 19 in Section 9.5. This table shows that approximately 2/3 of the work will be done in rehabilitation and betterment of gravel and earth roads.

2) Large sized equipment is omitted because of the limitations on the width of road.

3) Uniformity with existing types of equipment is preferred to facilitate repairs and operations.

4) Complex equipment is ommitted.

5) The capacity of the equipment is a function of the volume of reconstruction work.

6) With the exception of crawler type bulldozers, all the equipment moves on wheels.

Types and quantities of equipment required for composing a basic spread for each kabupaten are shown on Table 27.

Table 26

EQUIPMENT REQUIREMENTS:
ROAD MAINTENANCE EQUIPMENT

Kabupaten: PINRANG
Province : SOUTH SULAWESI

ITEM NO.	TYPE OF EQUIPMENT	Required at Beginning of 1st year	Required at Beginning of 4th year
1	Dump Trucks, 3.5 ton	6	7
2	Motorgrader, 100 HP	1	2
3	Wheel Loader, 1.2 m3	1	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4,000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 1st year.		

Table 27
EQUIPMENT REQUIREMENTS:
RECONSTRUCTION EQUIPMENT
(for each kabupaten)

Item No	Type of Equipment	Main Characteristics	Quantity Required at beginning of 1st year
1.	Bulldozer w/ Ripper	100 HP, 12 ton.	One
2.	Motorgrader	100 HP, 9 ton.	One
3.	Wheel Loader	80 HP, 8 ton. Articulated, 1.2 m^3	One
4.	Roller, Vibratory	65 HP, 6 ton. Self-propelled	One
5.	Roller, Rubber-Tired	80 HP, 8-15 ton. Self-propelled	One
6.	Asphalt Sprayer w/spray bar	800 l., one-burner, Towed	One
7.	Dump Truck	130 HP, 5 ton load capacity.	Four
8.	Tailgate Chip Spreader	To fit 5 ton dump truck	Four
9.	Water Tank Truck w/spray bar	130 HP, 4.000 l. tank Water pump driven by PTO	One
10.	Flat Bed Truck	45 HP, 3.5 ton capacity	One
11.	Rock Crusher/Screens	30 TPH, portable, Electric generator set	One

The bulldozer should come equipped with a ripper. It will be used in the quarries and to assist in the road work.

The size and type of motorgrader should be the same as the ones recommended for road maintenance due to the criteria mentioned earlier. The same reasoning applies to the selection of wheel loaders, vibratory rollers, water tank trucks and flat bed trucks.

A rubber-tired roller is necessary primarily for the work related to asphalt sealing, but could also be used for the compaction of aggregate.

The asphalt sprayer should come equipped with a spraybar for work on sealing and resealing of roads. The capacity is dimensioned to the volume of work expected to be performed.

Dump trucks for the reconstruction group are of a size and capacity larger than the ones used for road maintenance. The recommended type has a more powerful engine of approximately 130 HP and a G.V.W. (Gross Vehicle Weight) of at least 8.5 ton. The dump body should be of heavy duty construction and with a minimum struck capacity of 3 m^3.

Tailgate chip spreaders should be dimensioned to fit the dump body when used on asphalt sealing operations.

A rock crusher/screening plant should be provided to the kabupatens which do not have access to a commercial source of crushed aggregate. It should be portable to accompany the reconstruction group while performing its rehabilitation and betterment programs throughout the district.

Maintenance and reconstruction equipment needs for the first year are summarized in Tables 28 and 29, for South Sulawesi and NTT, respectively.

9.6.2. Availability of Equipment

The types and quantities of existing operational equipment now available in the 14 kabupatens for road maintenance and reconstruction are summarized in Tables 30 and 31.

The information was obtained from the P.T. Hasfarm reports. Only equipment identified as suited for road maintenance and reconstruction and only equipment in good and fair condition have been included in the tables. Deadlined equipment was omitted.

Equipment availability varies greatly within the provinces. In South Sulawesi, one kabupaten that received OECF equipment (SidRap) has a total of 29 units in operational condition. Others such as Gowa have only one piece of equipment. The same contrast is seen in NTT with variations from 43 units (Belu) to 8 units (Sumba Barat).

Note that these total numbers include minor pieces of equipment such as hand compactors. Common and abundant types of equipment in the kabupatens, such as three-wheel rollers, are left out.

Table 28

SUMMARY OF EQUIPMENT NEEDS IN 1st YEAR - MAINTENANCE AND RECONSTRUCTION

Province: SULSEL

TYPE OF EQUIPMENT	PINRANG		SIDRAP		WAJO		BONE		GOWA		JENEPONTO		BULUKUMBA		TOTAL
	MTCE	REC	MTCE	REC	MTCE	REC	MTCE	REC	MTCE	REC	MTCE	REC	MTCE	REC	
Bulldozer 100 HP, 12 ton	-	1	-	1	-	1	-	1	-	1	-	1	-	1	7
Motograder 100 HP	1	1	1	1	1	1	1	1	1	1	2	1	1	1	15
Wheel Loader 1.2 m3	1	1	0	1	0	1	0	1	0	1	1	1	0	1	9
Roller, Vibratory 6 ton	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Roller, Rubber Tired	-	1	-	1	-	1	-	1	-	1	-	1	-	1	7
Asphalt Sprayer, 800 l.	-	1	-	1	-	1	-	1	-	1	-	1	-	1	7
Dump Truck, 5 to	-	4	-	4	-	4	-	4	-	4	-	4	-	4	28
Tailgate Chip Spreader	-	4	-	4	-	4	-	4	-	4	-	4	-	4	28
Water Tank Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Flat Bed Truck	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Rock Crusher	-	1	-	1	-	1	-	1	-	1	-	1	-	1	7
Dump Truck, 3.5 ton.	6	-	3	-	2	-	3	-	2	-	7	-	2	-	25
Hand Compactor	1	-	1	-	1	-	1	-	1	-	1	-	1	-	7
Paddlewheel Mixer	1	-	1	-	1	-	1	-	1	-	1	-	1	-	7
Concrete Mixer	1	-	1	-	1	-	1	-	1	-	1	-	1	-	7

Table 29

SUMMARY OF EQUIPMENT NEEDS IN 1st YEAR - MAINTENANCE AND RECONSTRUCTION

Province NTT

TYPE OF EQUIPMENT	AUPANG		TTS		BELU		SONBA BARAT		MANGGARAI		NGADA		SIKKA		TOTAL
	MTCE	REC	MTCE	REC	MTCE	REC	MTCE	REC	MTCE	REC	MTCE	REC	MTCE	REC	
Bulldozer 1 HP 12 ton		1	-	1	-	1	-	1	-	1	-	1	-	1	7
Motorgrader 1 HP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Wheel Loader 1 2 M3	1	1	0	1	0	1	0	1	0	1	0	1	1	1	9
Roller, Vib 6 ton	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Roller, Rub Tired	-	1	-	1	-	1	-	1	-	1	-	1	-	1	7
Asphalt Spr 600 l	-	1	-	1	-	1	-	1	-	1	-	1	-	1	7
Dump Truck on	-	4	-	4	-	4	-	4	-	4	-	4	-	4	28
Tailgate spreader	-	4	-	4	-	4	-	4	-	4	-	4	-	4	28
Water Tank	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Flat Bed Tr	1	1	1	1	1	1	1	1	1	1	1	1	1	1	14
Rock Crusne	-	1	-	1	-	1	-	1	-	1	-	1	-	1	7
Dump Truck, 3 5 ton.	6	-	2	-	1	-	1	-	2	-	1	-	5	-	18
Hand Compactor	1	-	1	-	1	-	1	-	1	-	1	-	1	-	7
Paddlewheel Mixer	1	-	1	-	1	-	1	-	1	-	1	-	1	-	7
Concrete Mixer	1	-	1	-	1	-	1	-	1	-	1	-	1	-	7

TABLE 30

AVAILABILITY OF OPERATING EQUIPMENT
PROVINCE: SOUTH SULAWESI

TYPE OF EQUPMENT	PINRANG	SIDRAP	WAJO	BONE	GOWA	JENEPONTO	BULU-KUMBA	TOTAL
Bulldozer 100 HP, 12 ton	1	1	0	1	0	1	0	4
Motorgrader 100 HP	2	2	0	2	0	1	0	7
Wheel Loader 1.2 m3	2	3	0	2	0	2	0	9
Roller, Vibratory 6 ton	1	1	1	1	1	1	1	7
Roller, Rubber Tired	2	2	0	2	0	1	0	7
Asphalt Sprayer, 8001	0	0	0	0	0	0	0	0
Dump Truck, 5 ton	0	0	0	0	0	0	0	0
Tailgate Chip Spreader	0	0	0	0	0	0	0	0
Water Tank Truck 4000 L	0	0	0	0	0	0	0	0
Flat Bed Truck 3.5 ton	0	0	0	0	0	0	0	0
Rock Crusher	2	1	0	0	0	1	1	5
Dump Truck, 3.5 ton	12	14	0	14	0	15	0	55
Hand Compactor	2	4	2	3	0	0	4	15
Paddlewheel Mixer	0	0	0	0	0	0	0	0
Concrete Mixer	1	1	0	1	0	1	0	4
T O T A L	25	29	3	26	1	23	6	113

TABLE 31

AVAILABILITY OF OPERATING EQUIPMENT
PROVINCE: NTT

TYPE OF EQUIPMENT	KUPANG	TTS	BELU	SUMBA BARAT	MANGGARAI	NGADA	SIKKA	TOTAL
Bulldozer 100 HP, 12 ton	0	0	3	0	3	1	1	8
Motorgrader 100 HP	1	0	2	0	2	0	2	7
Wheel Loader 1.2 m3	1	0	2	0	3	1	1	8
Roller, Vibratory 6 ton	3	2	1	0	2	1	3	12
Roller, Rubber Tired	1	0	0	0	0	1	0	2
Asphalt Sprayer, 8001	0	0	0	0	0	0	0	0
Dump Truck, 5 ton	0	1	0	0	1	0	2	4
Tailgate Chip Spreader	0	0	0	0	0	0	0	0
Water Tank Truck	0	0	0	0	3	0	0	3
Flat Bed Truck	0	0	1	0	0	0	0	1
Rock Crusher	2	0	3	0	2	1	1	9
Dump Truck, 3.5 ton	5	5	22	6	15	5	4	62
Hand Compactor	4	0	7	2	10	4	0	27
Paddlewheel Mixer	0	0	0	0	0	0	0	0
Concrete Mixer	0	0	2	0	1	0	0	3

9.6.3. Reallocation of OECF Equipment

An analysis of the current utilization of OECF equipment shows that some kabupatens are not using their equipment efficiently and that some units rem in idle for large periods of time. This situation has prompted Bina Marga to reassign some OECF units to other activities.

A reallocation of OECF equipment within the fourteen project kabupatens is recommended. This will greatly reduce the number of new units that must be procured. Furthermore, the existing OECF fleet of dump trucks, motorgraders and wheel loaders could then be assigned to do road maintenance, leaving the heavier reconstruction work to the new units being procured. It should be made clear that the kabupatens that are having some of their equipment reallocated will be receiving newer units that will form part of the reconstruction group. The recommended reallocation of OECF equipment is shown in Table 32.

Table 32
REALLOCATION OF EQUIPMENT

Type of Equipment	Reallocated From	Reallocated To	Number of Units
		SOUTH SULAWESI	
Motorgrader Komatsu GD-31	Pinrang	Gowa	1 Unit
	Sidrap	Wajo	1 Unit
	Bone	Bulukumba	1 Unit
Wheel Loader Kobelco LK300	Bone	Bulukumba	1 Unit
	Sidrap	Wajo	1 Unit
	Jeneponto	Gowa	1 Unit
Dump Truck Toyota Dyna	Bone	Bulukumba	4 Units
	Jeneponto	Gowa	4 Units
	Sidrap	Wajo	4 Units
Rubber Tire Roller Kawasaki KR 200	Pinrang	Gowa	1 Unit
	Sidrap	Wajo	1 Unit
	Bone	Bulukumba	1 Unit

Table 32 (continued)

NTT

Type of Equipment	Reallocated From	Reallocated To	Number of Units
Dump Truck Tovota Dyna	Belu	T.T.S.	4 Units
	Belu	Kupang	4 Units
	Manggarai	Ngada	3 Units
	Manggarai	Sikka	4 Units

Calculations for reallocating equipment were made taking into consideration the equipment requirements for the first year and the current availability of operating equipment (Tables 30 and 31). The balance of equipment requirements after reallocation of OECF equipment is presented in Tables 33 and 34 for South Sulawesi and NTT, respectively.

9.6.4. Equipment Procurement Requirements

The balance of equipment needed for road maintenance and reconstruction at the beginning of the first year of operations and after reallocating the existing OECF equipment was shown in Tables 33 and 34. To estimate the total equipment procurement requirements for the duration of the project, it is necessary to add:

- Equipment needed at the beginning of the 4th year of operations (as the reconstruction program advances, additional kilometers of road will be in need of maintenance.);
- Equipment needed for replacements; and
- Support equipment.

The required total amount of road maintenance equipment at the beginning of the fourth year of operations is shown in the Annex 1. The increase in numbers represents the additional equipment that would be required to maintain the rehabilitated sections of road.

TABLE 33

EQUIPMENT REQUIREMENTS AFTER REALLOCATION OF OECF EQUIPMENT
PROVINCE: SOUTH SULAWESI

TYPE OF EQUIPMENT	PINRANG	SIDRAP	WAJO	BONE	GOWA	JENEPONTO	BULU-KUMBA	TOTAL
Bulldozer 100 HP, 12 ton	0	0	1	0	1	0	1	3
Motorgrader 100 HP	1	1	1	1	1	1	1	7
Wheel Loader 1.2 m3	0	0	1	1	1	1	1	5
Roller, Vibratory 6 ton	0	0	0	0	0	0	0	0
Roller, Rubber Tired	0	0	0	0	0	0	0	0
Asphalt Sprayer, 8001	1	1	1	1	1	1	1	7
Dump Truck, 5 ton	4	4	4	4	4	4	4	28
Tailgate Chip Spreader	4	4	4	4	4	4	4	28
Water Tank Truck	1	1	1	1	1	1	1	7
Flat Bed Truck	2	2	2	2	2	2	2	14
Rock Crusher	0	0	1	1	1	0	0	3
Dump Truck, 3.5 ton	0	0	0	0	0	0	0	0
Hand Compactor	0	0	0	0	1	1	0	2
Paddlewheel Mixer	1	1	1	1	1	1	1	7
Concrete Mixer	0	0	1	0	1	0	1	3

TABLE 34

EQUIPMENT REQUIREMENTS AFTER REALLOCATION OF OECF EQUIPMENT
PROVINCE: NTT

TYPE OF EQUIPMENT	KUPANG	TTS	BELU	SUMBA BARAT	MANGGARAI	NGADA	SIKKA	TOTAL
Bulldozer 100 HP, 12 ton	1	1	0	1	0	0	0	3
Motorgrader 100 HP	1	1	0	1	0	1	0	4
Wheel Loader 1.2 m3	1	1	0	1	0	1	1	5
Roller, Vibratory 6 ton	0	0	0	0	0	0	0	0
Roller, Rubber Tired	0	[illegible]	1	1	1	0	1	5
Asphalt Sprayer, 8001	1	1	1	1	1	1	1	7
Dump Truck, 5 ton	4	4	4	4	4	4	4	28
Tailgate Chip Spreader	4	4	4	4	4	4	4	28
Water Tank Truck 4000L	1	1	1	1	0	1	1	6
Flat Bed Truck 3.5 ton	2	2	2	2	2	2	2	14
Rock Crusher	0	1	0	1	0	0	0	2
Dump Truck, 3.5 ton	0	0	0	0	0	0	0	0
Hand Compactor	0	1	0	0	0	0	1	2
Paddlewheel Mixer	1	1	1	1	1	1	1	7
Concrete Mixer	1	1	0	1	0	1	1	5

Except for replacement units, it is estimated that no new reconstruction equipment is needed in the fourth year because the reconstruction spreads are basically formed by new units acquired at the beginning of the project.

9.6.5. Equipment Needed for Replacement

A replacement program for existing equipment should be considered for the beginning of the fourth year of operations, estimated to occur in 1991. In calculating the amount of available equipment to be used in the project, only units in good and fair condition were considered. The bulk of the OECF heavy equipment is in good operating condition because of the continued assistance provided by ALKAL in the form of mechanical repairs and supply of spare parts.

The exceptions are the 3.5 ton dump trucks. As discussed earlier in this section, these trucks are under dimensioned for the type of work currently being done. This problem should be solved when heavier new units are brought in to do the reconstruction work.

The present fleet of 3.5 ton dump trucks amounts to 117 units. The estimated need for this type of equipment at the beginning of the project is 43 units reserved strictly for maintenance work. Thus, most of the kabupatens will start the project with twice as many light dump trucks as necessary. Because of their sparse utilization, it is quite possible that many of these units will still be available for continuing light maintenance work in 1991. However, considering that these units are currently 4 years old and will be about 9 years old in 1991, it is prudent to assume that a new fleet of 43 3.5 ton dump trucks should be added as replacements at the beginning of the fourth year of operations.

The total number of hours of operation for the existing heavy equipment is not accurately known but a rough estimate can be made from the Hasfarm reports and from a few units observed in the field. An average of 600 hours of operation per year is a realistic figure to calculate the current number of hours worked.

The OECF equipment currently available averages 4 years of age or an estimated 2400 hours operated. Therefore it can be assumed that the OECF heavy equipment would still be fully operational in 1991. Only a few units of heavy equipment obtained from other sources should be considered for replacement. These units are identified in Table 35.

Table 35
ESTIMATE OF EQUIPMENT REPLACEMENT

Type of Equipment	Manufacturer	Model	To be Replaced in 1991
Wheel Loader	KIMCO	JH600	1 unit
	Fiat Allis	54SB	1 unit
Stone Crusher	Barata	DDV1	4 units
Dump Truck	Toyota Dyna	BU-30	43 units
Motorgrader	Komatsu	GD-31	3 units
	Caterpillar	120	1 unit
Bulldozer	Caterpillar	D6C	1 unit
	Caterpillar	D7G	1 unit

9.6.6. Support Equipment

The requirement for support equipment for the maintenance and reconstruction programs was prepared taking into consideration the following:

- Each DPUK should receive one Jeep four-wheel drive vehicle and one pick-up truck (1/2 ton) to assist the Road Section and the Equipment Section in carrying out inspection and administrative duties. One pick-up truck (3/4 ton) should be assigned to each reconstruction group.

- Maintenance crew foremen should be equipped with motorcycles as a means of transportation. The quantity of motorcycles required is in direct proportion to the number of maintenance crews formed for routine activities, reshaping and regraveling work.

- Lubrication trucks, mobile workshops and Lo-Boy truck-trailers should be based and operated from ALKAL workshops. These units should be assigned exclusively to assist in the maintenance and mobilization of the reconstruction group units.

- SSB radio equipment should be provided to be installed in the DPUK workshops, in ALKAL workshops and in the reconstruction group pick-ups (mobile units). As the World Bank I Project has recently acquired SSB radio equipment for 25 kabupatens in Java and Sumatra, specifications and frequencies will have to be checked with Bina Marga.

A distribution of the support equipment is shown in Table 36.

Table 36
SUPPORT EQUIPMENT

Type of Equipment	Total Quantity	Distributed to	Observation
Jeep 4 x 4	14	14 DPUK	One unit for each DPUK Road Section
Pick-up (1/2 ton)	14	14 DPUK	One unit for each DPUK Equipment Section
Pick-up (3/4 ton)	14	14 DPUK	One unit for each DPUK Reconstruction Group
Lub Truck, 68 HP	4	4 ALKAL	One unit each based at: ALKAL in Kupang ALKAL in Waingapu ALKAL in Ende ALKAL in Ujung Pandang
Mobile Workshop, 68 HP	1	1 ALKAL	Based at ALKAL in Ujung Pandang
LO-Boy Truck/Trailer (12 ton)	4	4 ALKAL	One unit each based at: ALKAL in Kupang ALKAL in Waingapu ALKAL in Ende ALKAL in Ujung Pandang
SSB Radio, base and mobile units	32	14 Reconst. Groups 14 DPUK 4 ALKAL	One each, mobile units. One each, DPUK Workshops. One each at: ALKAL in Kupang ALKAL in Waingapu ALKAL in Ende ALKAL in Ujung Pandang
Motorcycles	45	26 Maintenance Crews in S. Sulawesi	One for each Maintenance Crew Foreman at: Pinrang - 4 Sidrap - 4 Wajo - 3 Bone - 4 Gowa - 3 Jeneponto - 5 Bulukumba - 3
		19 Maintenance Crews in NTT	Kupang - 4 TTS - 3 Belu - 2 Sumba Barat - 2 Manggarai - 3 Ngada - 2 Sikka - 3

9.6.7. Equipment Procurement Cost Estimate

Table 37 lists the equipment to be procured in the first year of the project plus the additional units to be procured mid-way in the execution of the project, estimated to be in 1991.

The initial procurement cost is comprised mostly of heavy equipment necessary to perform road reconstruction work. Basically, fourteen spreads of equipment would be grouped in the early stages of the project in order to bring the the highly-trafficked links of road network in the kabupatens to maintainable condition.

All support equipment, comprised primarily of light vehicles, jeeps and motorcycles, should be made available at the same time to ensure the mobility of inspectors and foremen to travel to the work site. These vehicles should be assigned exclusively to the project. For this purpose existing available vehicles in the kabupatens were considered as additional support equipment and were not subtracted from the total to be procured.

The total cost of US $11,136,255.00 represents the estimated maximum amount that would be spent on road equipment throughout the project. This is based on current available prices of equipment of primarily Japanese origin, except for some Indonesian made equipment. It is estimated that heavy equipment originating in the USA would cost approximately 40% more. It is recommended that Bina Marga be responsible for arranging competitive bidding for all of the road equipment.

Bina Marga may already own some pieces of new equipment that could be assigned to the project. A case in point are four stone crushers (Golden Star) seen by the consultants in the yard at the ALKAL workshop in Kupang. These four units were waiting to be assigned to kabupatens throughout NTT. One of these units should be assigned to each of the kabupatens of T.T.S. and Sumba Barat, respectively, thus eliminating the need to acquire them and reducing the total cost by US $100,000.

It is recommended that an equipment engineer be engaged before the beginning of the project to make a comprehensive condition inventory of the existing equipment in all project kabupatens, as well as any equipment that could be made available by Bina Marga. The equipment engineer could then select specific units to be transferred to the chosen kabupatens before the start of the project. There is also a possibility that a few units of used heavy equipment in good condition may be found in the yards in Kupang and Ujung Pandang. However, the project should not depend on obtaining much of its required equipment from the current stock of Bina Marga. It should be kept in mind that the USAID project is a long-term one that will use up most of the life of even new equipment. It is not advisable to start a road reconstruction program with old, unreliable equipment. There will be reconstruction targets to be met

Table 37

COST ESTIMATE OF RECONSTRUCTION AND MAINTENANCE EQUIPMENT

Item	Number Required	Total Cost ($)
I. Equipment to be procured in the First Year		
Bulldozer 100 HP, 12 ton w/Ripper	6	570,000
Motorgrader 100 HP	11	660,000
Wheel Loader 1.2 M^3	10	600,000
Roller, Rubber-Tired 80 HP	5	200,000
Asphalt Sprayer, 800 l	14	126,000
Dump Trucks, 5 ton	56	1,344,000
Tailgate Chip Spreader	56	168,000
Water Tank Truck 4000 l	13	585,000
Flat Bed Truck 3.5 ton	28	420,000
Stone Crusher 30 TPH, portable	5	250,000
Hand Compactor	4	4,000
Paddle Wheel Mixer	14	56,000
Concrete Mixer	8	24,000
Jeep 4 X 4	14	126,000
Pick-Up Truck 1/2 ton	14	70,000
Pick-Up Truck 3/4 ton	14	112,000
Lubrication Truck	4	120,000
Mobile Workshop	1	35,000
Lo-Boy Truck-Trailer	4	160,000
SSB Radio Equipment	32	80,000
Motorcycles 125 CC	45	54,000
Spares at 15% of equipment value		864,600
Sub-total		6,628,600

Item	Number Required	Total 1/ Cost ($)
II. Equipment to be procured in the Fourth Year (incl. replacement)		
Bulldozer 100 HP, 12 ton	2	218,500
Motorgrader 100 HP	14	924,000
Wheel Loader 1.2 M^3	12	792,000
Stone Crusher	4	220,000
Dump Truck 3.5 ton	100	1,725,000
Motorcycles 125 CC	29	40,200
Spares at 15% of equipment value		587,955
Sub-Total		4,507,655

TOTAL: US $11,136,255

1/ Includes 10% for estimated increase in prices.

which will determine the amount of road maintenance that can be done. The spread of equipment for reconstruction has to be kept as a complete operating group and the inclusion of an unreliable wheel loader, for example, would disrupt the whole operation.

9.6.8 The Ownership of Project Equipment

Ownership of all the equipment assigned to the project should remain with the Directorate Jenderal Peralatan (Bina Marga). The equipment should be permanently assigned to the DPUKs (and be identified by code) for exclusive use in force account work. It should not be rented out to contractors. The ownership of the equipment by Bina Marga will ensure a Bina Marga interest in facilitating repair work from the ALKAL workshops and also at Bina Marga depots in Ujung Pandang and Surabaya. Ownership of the existing OECF equipment has remained with Bina Marga and the assistance given them by ALKAL has been satisfactory. However, it will be necessary for DPUKs to be informed and to understand the already existing guidelines and policies issued by Bina Marga on this matter.

9.6.9. Equipment Standardization

It is recommended that during bid evaluation, care be taken to standardize, as much as possible, to existing types and makes of equipment. Non-standardization would result in increased stocks of spare parts, additional training for mechanics and operators, additional needs for special tools for major repairs, etc. The large amount of equipment funded by OECF has definitely standarized the fleet. Tables 8 and 9 in Section 7 showed the predominance of equipment of Japanese origin in the kabupatens being considered. The current configuration of operating units is as follows:

Motorgrader Komatsu GD 31	:13 out of 14 units	(93%)
Bulldozer Komatsu D50E	:9 out of 11 units	(82%)
Wheel Loader Kobelco LK300	:16 out of 18 units	(89%)
Rubber-Tired Roller Kawasaki KR-200	:7 out of 9 units	(78%)
Dump Truck (3.5 ton) Toyota Dyna BU-30	:98 out of 116	(84%)

Most of the major manufacturers of equipment have agents or representatives in Indonesia. The tables in Annex 22 summarize the facilities that can be provided by some of the local firms and the name of a person to contact for further information.

P. 172

Plus $107,000 for each Kabupaten Workshop

or

14 x $107,000 = $1,498,000

9.6.10. Renting Equipment Out to Contractors

It has been a common practice for DPUKs to rent out equipment to small contractors for road works. However, much confusion and contradiction appear to occur in each kabupaten as to what type of equipment can or cannot be rented out. This depends partly on who owns the equipment (pusat, province or DPUK) and partly on what type of work the equipment is assigned to do (maintenance or construction). An analysis of the information obtained from the P.T. Hasfarm reports and observations in the field indicate that, as a rule, in South Sulawesi all equipment owned by DPUK as well as OECF equipment designated for road maintenance can be rented out to contractors. In kabupatens Pinrang and Sidrap, for example, OECF-financed stone crushers and dump trucks are identified as maintenance equipment and are being rented out. OECF reconstruction equipment, however, was not allowed to be rented out. A summary of rental regulations in South Sulawesi is included in the Annexes. The regulations apply only to equipment owned by DPUK and are made by the kabupaten governments themselves. Terms and rates thus vary from kabupaten to kabupaten.

In NTT all equipment, regardless of who owns it and what work it does, may be rented out as long as the Cabang Dinas follows the terms established in:

"Keputusan Menteri P.U. (various)" for pusat equipment;
"Keputusan Gubernur (various)" for province equipment; and
"Peraturan Daerah (various)" for kabupaten equipment.

Most of the equipment actually being rented out in both provinces is road rollers, as these are the most common type of equipment in the kabupaten public works fleets.

The Government of Indonesia is taking tentative steps to phase out the DPUK rentals to contractors and to encourage contractors to obtain their own equipment. This policy is newly in force for Public Works offices at the national and provincial levels but will, apparently, take longer to be effective at the kabupaten level due to: a) the fact that most of the small contractors eligible for kabupaten work do not own or have access to equipment other than that provided by the DPUK, and b) the regulations on the disposition or use of equipment owned by the kabupatens are under the authority of individual Bupatis, not the Ministry of Public Works. The gradual shift to a system in which DPUK equipment is not rented out could be facilitated by offering a continuity of work to local contractors through multi-year contracts; this would attract medium-sized contractors who most probably do own some equipment. Multi-year contracts would also help contractors to obtain equipment financing from local banks, or to make leasing or rental arrangements with equipment suppliers or equipment hire firms.

Three of these equipment hire firms were contacted for information:

P.T. Amarta Karya (Jakarta);
P.T. United Tractors (Jakarta); and
P.T. Adi Jaya Lima Pradana (Ujung Pandang).

Some are partly owned by the government (Amarta Karya); others are branches of large equipment agents (United Tractors) or are small privately owned and operated firms (Adi Jaya). In all cases, the rental agreements are very flexible. The equipment can be rented with or without operational costs (fuel, oil, parts, repairs), the transportation to the work site is negotiable, and the form of payments and down payments is variable. In general terms however, the firms provide their own operators and mechanics and prefer to have all-inclusive rates for fuel, oil, maintenance, parts, all repairs and mobilization (if within reasonable distances).

The types of equipment offered range from vehicles and heavy equipment of all sizes, types and capacities to a few simple units. Amarta Karya, which is associated with Public Works, rents the equipment from the equipment pools established at PU depots in many parts of the country. Their equipment, however, is mostly older equipment, left over at the end of a large national construction project and now idle or under repair in Bina Marga workshops or depots. A few of these units, if available in the right place, would be useful to small contractors.

9.6.11. The Proposed Equipment Management System

Kabupatens, with some exceptions, do not have the information or procedures to manage equipment effectively. Procedures for this purpose are already developed and used, however, for Public Works equipment at the provincial and national levels. These procedures should also be used by AID project kabupatens. The rationale for doing so is presented below.

The principal objective of an equipment management system is to obtain maximum productivity from the equipment and the people who support the equipment. The four basic components and purposes of equipment management are.

Equipment Control. This system consists of procedures to maintain an up-to-date inventory of all units in the equipment fleet. The inventory identifies all units of equipment controlled or owned by the kabupatens, the present location of each unit, and who is responsible for each unit. It also provides information on the utilization of each individual unit, the condition of the equipment, and the availability of equipment units for reassignment to other work.

Servicing and Repair Management. Formal procedures are needed for effective planning, scheduling and control of equipment maintenance and repair operations. A system of regular preventive maintenance of equipment must be clearly defined and integrated with the scheduling of other work and control processes. The purpose is to ensure regular attention to routine prescribed service so as to prevent excess wear which may lead directly to breakdowns and more costly repairs.

To maintain control of repair operations, an equipment workshop job order should be used. The form serves several purposes, including:

- o documentation of the problems with the unit and the work that is required;
- o formal authorization for performing the work; and
- o documentation of the actual labor hours, spare parts and materials used in the performance of the work.

The workshop job order becomes the principal source document for cost data related to servicing and repair of individual equipment units.

Parts Management. Parts management uses a systematic approach to determine optimum levels for various parts and supplies. It includes formal procedures for purchasing, warehousing, stock control and issuing of parts.

A key element of parts management involves maintaining parts in stock at levels that are effective for equipment servicing and repair and are also affordable. In setting these control levels the storemen must consider factors such as the value of the items, their rate of usage, and local conditions which may influence the ease of procurement from local sources. The management of inventories of parts and supplies requires effective control of the issuance and receipt of parts so that records will accurately reflect current quantities of each.

Equipment Costs. Analyses of the effectiveness of equipment use require detailed records of the direct costs of operating and maintaining the equipment. Cost data are also used for developing equipment unit cost rates (rental rates). The principal purpose of equipment rental rates is to provide a means by which the actual costs of road maintenance or reconstruction work can be identified. When rental rates include consideration of all equipment-related costs and when the amount of time of equipment usage on maintenance or reconstruction work is reported (utilization), actual costs of work can be determined accurately for future planning and budgeting.

Rental rates provide a convenient and reliable means for preparing performance-based road maintenance budgets in ways that permit comparison of different approaches as they relate to the amount of available funds.

There are several criteria and procedures commonly used for measuring equipment usage as a basis for determining the rental rate: cost per kilometer, cost per hour, cost per day, or cost per month. It is suggested that in the AID project, equipment unit cost rates for the kabupatens be based on cost per day of actual usage. This is the simplest approach for preparing annual work programs and performance budgets. It also provides the easiest way of reporting actual equipment usage. For calculating these unit costs, there are three general cost elements: direct costs (parts, repairs, fuel, oil), indirect costs (overhead items), and depreciation.

Which categories are to be included in the equipment unit cost rate calculation will depend on the basic purpose of these rates. If rental rates are to be used for budgeting and control purposes, the indirect costs and/or the depreciation costs may be excluded from the rates.

It is proposed here that equipment unit cost rates (rental rates) reflecting direct costs only should be adopted in the AID project for preparing annual maintenance programs and budgets. This will simplify budgeting and provide adequate budgeted funds for fuel, oil, parts, supplies and repairs. Thus the road work budget should not include line items for fuel, oil, spare parts, supplies and labor for repairs. Existing procedures at the provincial and national levels are generally adequate for this purpose and should be adopted as the basis for developing an equipment management system in each project kabupaten. The following existing Bina Marga forms should be used:

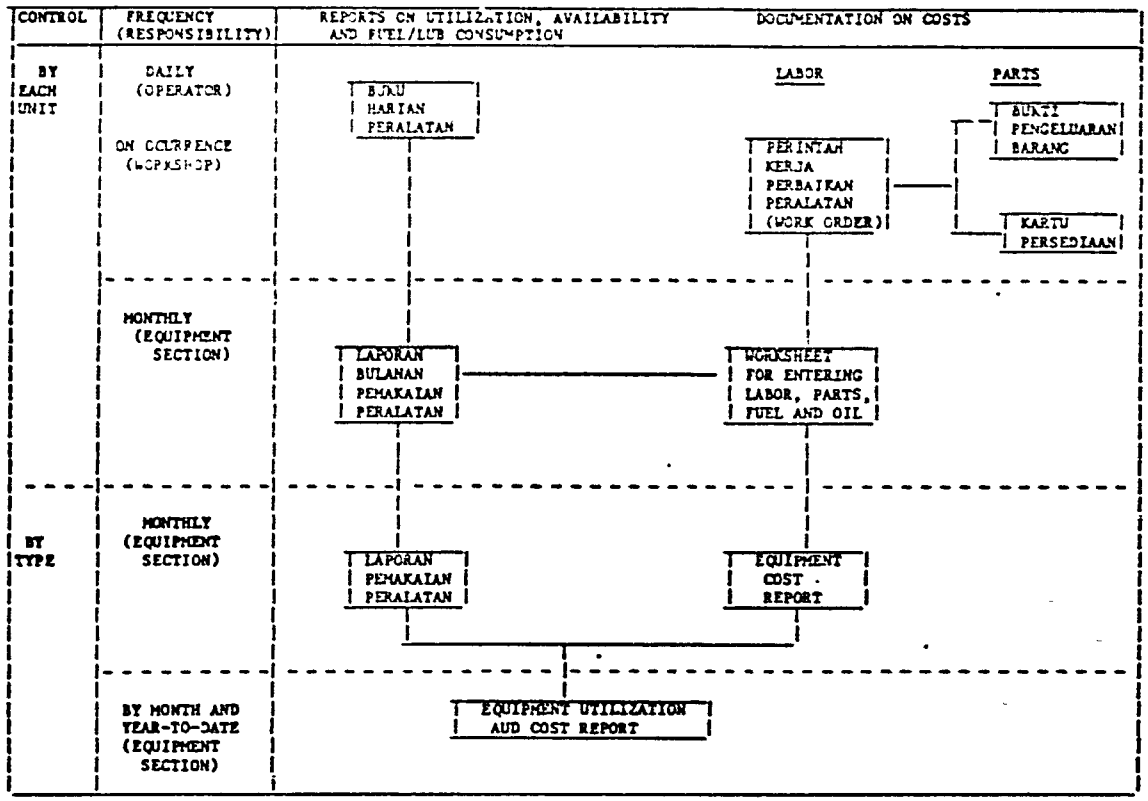
- for equipment control:
  - Buku Harian Peralatan
  - Laporan Pemakaian Peralatan (form LLP5)
  - Laporan Bulanan Pemakaian Peralatan (form LBPP);
- for servicing and repair management:
  - Kartu Servis
  - Perintah Kerja Perbaikan Peralatan;
- for parts management:
  - Kartu Persediaan
  - Kartu Rak
  - Bukti Pengeluaran Barang.

Samples of these forms are provided in the Annexes. Figure 3 on the following page indicates the information flow for an equipment management system using these forms.

Data provided by the system should be compiled in a simplified format (to be developed by Public Works with assistance from the technical assistance team) as the basis for establishing an average equipment unit cost rate for each type of equipment.

Figure 3

DIAGRAM OF INFORMATION FLOW FOR AN EQUIPMENT MANAGEMENT SYSTEM



10. GENERAL RECOMMENDATIONS

10.1. CONCEPTS, DEFINITIONS, AND GUIDELINES

The most important first step is to change perceptions of road maintenance. This should begin by establishing clear definitions of maintenance. It should be cautioned that changing attitudes cannot be accomplished in a short time. It should instead be a process in which the GOI itself creates a new set of definitions with assistance from experienced road and bridge maintenance engineers.

Basically, the concept to be promoted is that maintenance should be performed on all roads in fair to good condition in order to protect the original investment and to keep the road safe. Maintenance is carried out to 1) prevent minor irregularities from causing damage, 2) correct minor damage and deterioration, and 3) extend the useful life of the road as long as practical. Roads that are seriously damaged and cannot be maintained effectively should receive minimal attention until they are reconstructed or abandoned. After a road is rebuilt to standard, it should be maintained.* All reconstruction and new construction should be to standard.

It is not necessary to wait for the project to begin before initiating this process of definition. Field trips revealed that there are wide differences in road definitions among the DPUK/DPUP Cabang Dinas personnel and staff of the Bagian Pembangunan, BAPPEDA and Bupati. Because road terminology must be precise for the DRMS Project, a set of basic and specific definitions is proposed here for discussions between USAID and GOI personnel. Both parties should share a common understanding when project concepts are discussed. Clear distinctions between rehabilitation and betterment will also be very important later when the ground rules are being established on what work will be eligible for USAID reimbursement and what must be borne by the GOI.

* In the selection process for reconstruction, it is assumed that only roads which carry significant traffic will be reconstructed.

PROPOSED BASIC DEFINITIONS

Road Maintenance	- the purpose is to keep all of the road elements or features (pavement, subgrade, drainage, signs, guardrail, bridges, etc.) of all types of roads above a specified minimum level of condition and therefore sustain the level of service (capacity).
Road reconstruction	- the purpose is to rebuild a seriously damaged road back to its original state (level of service and condition) or to rebuild a road to a higher level of service when the traffic so warrants.
Road new construction	- the purpose is to build a road for a specified level of service where no road for vehicle traffic existed before.
Level of service	- the capacity of a road to handle a certain volume of traffic. Level of service is influenced by width, degree of curvature, gradient, obstructions, surface type, and surface condition. The higher the level of service, the higher the volume of traffic.
Level of condition *	- the quantitative measurement of the overall state of the total road system: pavement, drainage, safety features, bridges, shoulders, etc.
Surface condition	- the quantitative measurement of the riding surface area, including subgrade, subbase, base, surface covering, smoothness, crown, hardness, friction, etc.

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* The level of road condition is the total weighted value of individual feature ratings as evaluated according to standard criteria. For example, a road with a fair pavement rating and a poor drainage rating would probably rank higher than one with a poor pavement and a good drainage system.

PROPOSED SPECIFIC DEFINITIONS
Road Maintenance

	Routine Maintenance Regular, repetitive & frequent work which will prevent serious deterioration and/or correct minor deterioration and safety problems.	Periodic Maintenance Regular, repetitive but infrequent work which will restore minor deterioration or extend the life of the road and bridge.	Emergency Maintenance Irregular, non-repetitive and infrequent work which will correct localized severe damage or closure and restore the level of service.
Road Feature	Sample Activities	Sample Activities	Sample Activities
Carriageway & Shoulders	. Asphalt pavement patching . Asphalt seal patching . Gravel surface patching . Smoothing unpaved roads (crown is OK)	. Asphalt wearing surface overlay (HRS) . DBST or SBST . Chip sealing or sand sealing . Replenishing gravel surfaces (regraveling) . Reshaping unpaved roads (restore crown and earth ditches)	. Removing slides . Erosion repair
Drainage & Roadside	. Cleaning ditches & culverts . Trimming vegetation	. Drainage repairs	. Emergency drainage repair
Bridges	. Bridge cleaning	. Bridge painting . Minor bridge repair (repair guardrail, patch deck, etc.)	. Major bridge repair (repair a damaged span or damage caused by vehicle accidents)
Miscel.	. Sign cleaning & repair		. Temporary detour construction

Note: When a road has deteriorated too far below the specified level of condition and can no longer sustain the level of service, it can no longer be restored using the typical routine and periodic sample activities above. Therefore, normal maintenance activities should not be continued. Instead, the road should receive the minimum amount of attention which is necessary to keep the road passable until it can be reconstructed or abandoned. This should be called "minimum maintenance" or perhaps "sustain passable condition." The term "support work" is the most descriptive, but as now used is too misleading and can include almost any kind of work. It may be best to select a new term.

PROPOSED SPECIFIC DEFINITIONS
Road Reconstruction

	Rehabilitation	Betterment
	Rebuilding a seriously deteriorated road or bridge back to its original state.	Rebuilding a seriously deteriorated road or bridge to a higher level of service than the original state.
Road Feature	Sample Activities	Sample Activities
Carriageway & Shoulders	. Rebuilding asphalt roads . Rebuilding sealed roads . Rebuilding gravel roads . Rebuilding earth roads . Major subgrade repair	. Pavement widening and structural pavement overlays . Upgrading from earth to gravel and from gravel to sealed . Shoulder upgrading
Drainage	. Drainage replacement	. Drainage upgrading
Bridges	. Bridge replacement (rebuild the original bridge)	. Bridge reinforcement (rebuild a bigger bridge or make an existing bridge stronger) . Bridge widening

Note: Traffic measurements and forecasts should determine the choice between rehabilitation and betterment. If the existing or forecasted traffic is within the limits used for the original design, rehabilitation is the correct procedure. If the traffic is higher than the limits of the original design, then betterment is proper to upgrade the road to the higher level of service when it is reconstructed.

For the reconstruction program the classification of roads by type of construction should be: paved, sealed, gravel and earth; the most commonly encountered will be the last three. A sealed road should be a double bituminous surface treatment (DBST) or a chip seal. A gravel road should be a well-graded crushed aggregate or select material surface. Existing Telford or macadam roads should be considered as unfinished and therefore requiring a gravel layer. No change is necessary for earth roads.

For condition ratings there must be a uniform criterion. USAID and the GOI should consider seeking assistance in the first year of the project to review the condition rating procedure in the draft Bina Marga manual before starting the traffic survey and road inventory/condition updates recommended for the preparatory phase of the project.

The remaining standards and guidelines for reconstruction work (in addition to those given in Section 9.1) are not yet available. They should be developed on a priority basis by the Sub-directorate of Local Roads with the assistance of project TA. The Sub-directorate should coordinate with the Diklat Bina Marga, which should concurrently develop a series of training courses on construction inspection based on the technical guide prepared. These standards specifically related to the maintenance management system (performance standards, frequency standards, quality standards) will be developed in the course of the project with assistance from the TA consultants.

10.2. RECONSTRUCTION PRIORITY SELECTION PROCESS

10.2.1. Recommended Simplified Screening Method

Review of reference work on simplified methods for evaluating low-volume rural roads has produced no better method than the IBRD tabular format. This format shows the relationships between road investment costs, ADT volumes, and Internal Rates of Return (IRR). This format is set out in Table 38. The problems of interpolation between tables of IRR and within each table, have been resolved here by simply completing all the interpolations which correspond to the ranges of vehicle operating costs (VOC) and vehicle operating cost savings (VOCS) to obtain the levels of detail needed for small changes in ADT (Annex 30 explains how the interpolations were made). In the project area, these costs tend to be grouped at the lower end of the scale. This lower scale reflects the lower unit costs of operating relatively light vehicles, which produce, in turn, a demand for higher levels of ADT to meet specified rates of return.

TABLE 38
REQUIRED LEVELS OF ADT TO JUSTIFY MAJOR ROAD TREATMENT COSTS*

(Rp.000/Km) Base Year Rehabilitation/Upgrade costs:

IRR %	8960	11200	13440	15680	17920	20160	22400	25200	28000	30800	33600	36400	39200
	Base year ADT volume:												
6	46	58	70	82	94	105	110	128	146	160	173	186	199
7	49	62	75	87	99	111	118	137	155	170	184	198	212
8	52	65	79	92	105	118	126	145	164	180	195	210	225
9	55	69	83	97	111	124	134	154	173	190	206	222	238
10	58	72	87	102	116	131	145	164	182	200	217	234	251
11	60	76	92	107	122	137	151	171	191	210	228	246	265
12	63	80	96	112	128	143	155	177	199	219	239	259	279
13	66	83	100	117	134	150	167	188	208	229	250	271	291
14	69	87	105	122	139	156	175	196	217	239	261	283	304
15	72	90	109	127	145	163	185	206	226	249	272	295	317

* motorized vehicles only

(10-year period, ADT growth rate 5% implied, Rp. 1120 = US$1)

10.2.2. Use of the Screening Table

The interpolations explained in Annex 30 provide the basis for the expansion of Table 38: this summary table shows a matrix relating ADT levels required to justify a range of invested costs between Rp 000/km 8,960 and 39,200, in order to obtain a range of IRRs from 6% through 15%. This range of IRR was stated to show 1) the relatively low IRRs yielded by certain lower levels of ADT, 2) the alternative use of the table for development areas which produce low current traffic levels, but may be found to be acceptable for other reasons, and 3) an optional management tool for use according to policy decisions relating to level of expenditure selected (whether to regravel or newly seal a gravel road, for example: two separate costs which will place the IRR in a different class for a given level of traffic).

The invested cost levels are differentiated to provide intermediate cost steps, to take account of cost differences which may exist from one kabupaten to another, and the need to distinguish between the "minimum" and the "desirable" standard which is commonly employed in Indonesian road design practice.

Example of Use: a field report shows an ADT of 72 for a specified road link. This ADT can be located at several places in the table: a 15% IRR can be obtained for this level of traffic, if the invested costs of restoration/upgrading are estimated at Rp 8,960,000/km; if these invested costs were placed at the level of Rp 11,200,000/km, this level of traffic would produce a reduced IRR of 10%; if invested costs were still higher, at Rp. 13,440,000/km, the IRR would drop to midway between 6 and 7%.

A higher traffic count is reported at 198 ADT: for an invested cost of Rp 25,200,000, the IRR is slightly above 14%; for Rp 28,000,000/km the rate of return is just under 12%, and will fall for still higher levels of invested cost. But suppose the cost level is Rp 15,680,000: at this lower cost level the table reports that an ADT of only 127 will yield a 15% IRR--and the 198 ADT level is off the chart. In this case, more than 15% is yielded; the exact yield can be readily plotted, if desired, by extrapolation.

A more awkward case: one link is reported to have an ADT of 58. It is in a development area, but no counts or surveys have been made of products coming out by road on bicycle or cart. It is a link in a kabupaten which has notably few roads qualifying for restoration because traffic levels are universally low. The aim of the project is to demonstrate, ultimately, the advantages of maintenance (but all roads here are unmaintained), and considerations of equity between kabupatens cannot be addressed by an ADT screening table. The screening table shows that a 10% return can be earned at an invested cost level of Rp 8,960,000/km. But local costs will demand an expenditure of Rp

11,200,000/km because of the long length of haul for aggregates peculiar to this location. At that cost level, only 6% can be returned. This is a policy decision case which cannot be answered now for a six-year expenditure program.

Some specific local survey data, which are later recommended for road regions that are especially low-volume traffic generators, will assist in close judgments of this kind. Their use, both as monitoring devices following road restoration and maintenance investments, and as a data base needed for most roads before restoration, will supplement traffic counts and provide alternative measures of latent activity not reflected in traffic counts. Until such data become generally available, the grounds for clear decision-making, even if for recognizably marginal investments, will remain uncertain. With such data in hand, the marginal investment may be placed in contention with competing alternative road links of the same kind, and of the kind that assure high IRRs. The availability of funds, the existing levels of rivalry for those funds, and policy considerations will all remain the final determinants of decisions affecting these sub-optimum allocations of road funds.

10.2.3. Mechanics of the Screening Table

The ADT levels shown are a composite of the total sample survey of traffic counts, first assembled according to "apparent" road class (asphalt, seal, gravel, earth) to individuate the internal compositions that produce unique VOC structures, and the VOCS rate obtained by rehabilitation. These unique costs and savings were then averaged by group: asphalt class with seal road class, low-volume gravel road class with high-volume road class, and earth road volumes with estimated VOC and VOCS which would be expected in the differential between gravel and earth if not skewed by motorcycle traffic responding to deteriorated road conditions. Finally, all distributions, correlated with invested cost levels and IRR savings rates, were averaged to reflect the total composition of sampled traffic.

The ADT shown is base year (reported, not forecasted) traffic. The table assumes a 5% traffic growth rate over a 10-year road life following restoration/upgrading. The table has distilled that forecast of rising VOC and VOCS into a single figure: ADT in the base year which yields the IRR shown. Actual growth rates on the project area roads are not known. There are no prior year counts available for comparison with present year counts. Five percent growth, however, is a nominal annual rate. Existing counts show that about 94% of all road links carry traffic volumes of less than 200 ADT. If they all carried as much as 200 ADT, it represents an annual increase in vehicle numbers of only 10 ADT. This seems a likely attainable growth rate.

The IRRs for different ADT levels show a sensitivity to small changes in VOC and VOCS, which in turn is due to traffic composition and to change in road condition from bad to good. Some of these effects shown by five sampled levels of traffic flow on different road classes have been merged by averaging. This has placed all roads in an initially "bad" condition, as a prerequisite to rehabilitation, to better reflect the change to "good," and to reduce the effects of variations in composition as volume varies. That is, unique compositions have been purposely merged to better reflect the overall sample rather than the special outcome of each of five tests. It may appear that the ADT requirements for the higher standard roads have been unduly increased by this merger because of the higher ADT levels found for earth roads. In fact, the objective of the table is better served in the generalized form, as earth and low-grade gravel roads comprise over 75% of the network and over 95% of the traffic now reported.

The Table 38 ADT table is for traffic which includes motorized vehicles only. Annex 23 reviews the ADT requirements which include bicycles and carts in the motorized traffic flow. That traffic flow, for a specified set of VOC and VOC savings, showed the need for higher levels of ADT needed to obtain selected rates of return than is required in Table 38. The former analysis specifically related the ADB 8th Loan road treatment costs to these traffic volumes: from earth to gravel, regravelling, from gravel to seal, and re-seal of seal. The present table does not do this. Instead, costs are not presumed to be known in advance, nor are they specific to the kind of road treatment or kind of original road surface type. Because such costs are now stated as variable costs, a wider range of cost change may be shown for intermediate levels within the probable cost range. This extends the application of the table, permitting flexibility in dealing with cost differences which may exist between road districts, or in engineering design variations which distinguish "minimum" from "desirable" standards. These distinctions may make the difference between feasibility and non-feasibility.

It should be emphasized that the ADT values in Table 38, while adequate for project start-up, will need to be adjusted over time and perhaps between geographic regions as well. The primary reason for this is that the table assumes uniform traffic composition and uniform traffic growth rates across all kabupatens. There is some evidence that these may vary significantly and that the ADT required to justify a given level of investment could be substantially higher or lower depending or location. Data to refine the table, however, will only emerge once kabupaten traffic counting begins during the first project year. Table refinements can be easily made, particularly if one of the common microcomputer spreadsheet programs is utilized. Responsibility for updating or refining Table 38 should be assigned to the appropriate GOI agency before the project begins.

10.2.4. Monitoring and Evaluation

The types of project monitoring suggested here are applicable to road links both before any road rebuilding and maintenance takes place, and also after a project has been approved by the screening test. Most of these have been mentioned in earlier sections which dealt with existing pre-screening practices.

1) A pre-screen traffic count, preferably by an independent local consulting firm not subject to local pressures, taken annually on road links in each kabupaten indicated to have more than 15 motorized vehicles a day. Existing forms prepared by Bina Marga can be used to count both motorized and non-motorized traffic. The form provides for composition of traffic and total number of passes by type of traffic. The count program could start in 1987, to be repeated annually thereafter, perhaps by the DPUP or DPUK following the initial count by the independents.

2) Supplementary monitoring surveys, by DPUK/DPUP, to also start in 1987, for these same road links, would provide a basis for measuring other growth indicators than traffic. A single survey of three kinds of data would provide a year-by-year index of the changes occurring in non-traffic activity levels: volume of goods entering the cash market, value of cash-crop, price of transport.

- On-Farm surveys of cash-crop volumes and reported market price, showing the form of non-motorized transport used during main harvest seasons.

- Market price surveys at market or assembly stations, to note tons of cash crop entered per market day or assembly day, for non-motorized traffic only. Surveyor may check three times over a three-week period during the main harvest-market seasons, to produce an average tonnage per day and average season price per ton.

- Transporters' price survey, of transporters of goods and passengers over kabupaten roads, to obtain rates charged per ton and per passenger by distance travelled over road links having such motorized traffic.

The application of such surveys to pre-screening and post-approval, in simple one-page summary reports, provides a basis for comparing the effects with-and-without road improvement, and an index of the relative changes occurring on both kinds of roads. This information is not provided by traffic counts alone, which will themselves measure the year-to-year impact of road treatments upon vehicle volume (does it increase or not, and by how much?). By surveying both the roads with road treatment and those without, a control is established by which the relative amount of change produced by road treatment can be measured against changes which may occur without road treatment. The net difference informs of the probable net influence of the road improvement on aggregate economic activity levels. In company with the transporters' prices, the index will show the relative rate of reduction that may be induced by improved roads, which theoretically is the basis for subsequent increases in farm production (as net income is seen to increase via the new distance between costs of producing-marketing and market price). A unit change in transport price is a direct "benefit"; a subsequent increase in production reflects a transfer of some of these benefits to the rural community in the form of income enhancement and gainful employment.

SURVEY SUMMARY

Kabupaten: _____ Road Link Number: _____ KM of Link: _____

Main crops delivered to market: (average of 3 counts over 3 weeks)

	Rice	Tree crops	Vegetables	Other
KGS:				
RP/KG: (at market)				

TRANSPORTED BY:

BICYCLE				
CART				
PORTER				
VEHICLE				

TRANSPORT PRICE ASKED BY VEHICLE OPERATORS:

	1 km	2 km	3 km	4 km	5 km	6 km	10 km
1 PASSENGER:							
20 KILOGRAMS:							

Shown as a summary of all surveys for each road link above, the form itself is also the basic survey form to introduce individual survey data, house-to-house, or at each market serving the road link. As total tallies are completed, they need merely to be added and averaged to produce the survey summary. Although somewhat spare in content, the form provides the essential data not now contained on alternative pre-screening forms previously used by other donors, and eliminates much of the detail those forms contained which add nothing to project evaluation. Annually, of course, the same farms and same markets should be revisited. This should likely be done by two-person teams, which may be permanent members of the DPUK/DPUP rather than students hired locally (who are not likely to be authority figures to farmers).

A perfect reporting system is not expected, and perfect reports will not be generated. The summary surveys are not themselves local evaluations and do not require local evaluation. But they are useful training instruments which lead to better awareness of the kinds of measures that are appropriate to "developing" areas, and when combined

with traffic counts made by DPUK/DPUP in succeeding years, will show the general basis for monitoring and evaluating their progress in road selection, and in measuring the effects of their maintenance and rehabilitation choices. Much like any control system, the intent is to test the influence of positive action against doing nothing.

Other potentially useful monitoring formats were considered and discarded. These were: 1) school enrollment--with and without road improvement, a premise that poor roads may inhibit normal social standards. However, local social factors such as harvest season employment and unknown legal requirements for obligatory attendance foreclosed this option; 2) average time to travel point-to-point along a road link (km per hour) might measure relative road condition for a standard 4-wheel vehicle. But jeeps and minibuses vary in adaptation to different road conditions, and drivers' habits vary even more, making this an index of questionable value in comparing different road links; and 3) farmgate prices, to measure prices paid by transporters to pick up goods for market, and relative change in price with road improvement. Present evidence indicates that this is not current practice, and that a direct survey of transporters themselves at market would b simpler and more easily repeated on an annual survey basis.

10.3. ORGANIZATIONAL AND STAFFING DEVELOPMENT RECOMMENDATIONS

10.3.1. General Organization and Staffing Recommendations

The road and equipment functions of the DPUP Cabang Dinas and DPUK should be organized uniformly based on the model presented in Figure 4. Many, but not all, are already organized in this fashion.

For the three subsections, the Chief of the Engineering and Planning Subsection should be the senior position, thus creating an advancement ladder within the organization. The subsection would plan, organize and monitor the work of the Maintenance and Construction subsections and serve as a training ground for all types of road-related work in the office as well as the field. This subsection would do all of the planning, organizing and monitoring tasks associated with the maintenance management system. It is preferred that these duties not be mixed with any existing Planning Section for irrigation and buildings.

The Chief of the Maintenance Subsection should be a senior foreman who has demonstrated good leadership and can handle the paperwork duties of checking field reports and data collection.

Similar criteria should be used for evaluating candidates for Chief of the Reconstruction Subsection. Note that the name has been changed from Construction in order to emphasize the work of the project. The chief should be an experienced construction foreman or supervisor, with

good leadership qualities, and the ability to handle the paperwork demands of checking daily field reports and modifying schedules. He must also be able to stand up for what he knows to be good construction practice.

It is recommended that there be at least one Field Reconstruction Crew under the Reconstruction Subsection to execute rehabilitation and betterment work by force account. This unit would satisfy several needs. It would have the equipment to respond to emergencies, serve as a training unit for improved construction work methods for both DPUK/DPUP Cabang Dinas forces and contractors' foremen. As the crew becomes proficient in newer methods, contractors could be invited to observe the work being performed correctly or could subcontract some elements of force account work, over which project TA monitors work and provides on-the-job training. Even after the DRMS Project, reconstruction will continue to be an important program in the kabupatens to rebuild those links which reach the end of their design life. If the design life is 8-10 years, then each year 10%-12% of the network should be considered for reconstruction.

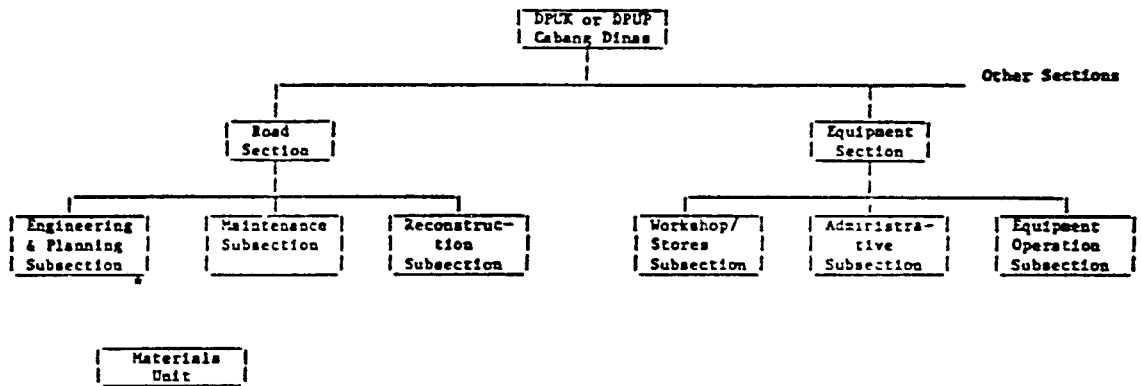
The Reconstruction Crew should also serve as a training ground for construction inspectors and as a model for contractors. The TA should conduct frequent and informal but practical on-the-job training sessions for the kabupaten staffs to demonstrate how and why a particular task must be done in the prescribed manner and what are the consequences if it is not. At times, contractors should be invited to observe the work to learn what will be expected of them.

It is also recommended that a new Materials Unit be formed to be responsible for the materials quality control for both maintenance and reconstruction work. It could also, if time and facilities permit, perform quality control checks for the irrigation and buildings sections. For the DRMS Project it should initially be located within the Road Section so that the TA will have better access to the staff.

Perhaps no more than one or two technicians would be required in the Materials Unit to perform field tests on gradation, field density, and concrete slump tests and prepare cylinders for testing at the DPUP laboratory. Existing training courses available from Diklat Bina Marga are adequate for teaching the basics and the project TA would provide the necessary on-the-job guidance afterwards.

Section 10.3.2 briefly summarizes the responsibilities of the recommended road organization and describes the desired qualifications and tasks for each position. This summary is not intended to be a final list of job descriptions, and should be refined as the project

Figure 4
Model Organization



* = Proposed location for Materials Unit

progresses. This section also gives a breakdown of the permanent staff needed for road related work in the first year of the project.*

There will be some requirements for additional staff to man the recommended structure. The DRMS Project should not require the replacement of existing personnel on the basis of education alone. The need for replacements should be studied carefully because there were several individuals who appeared to be very capable even though they possessed only a lower education. The GOI should, however, recruit any new employees with the recommended education for that level.

A variety of options for seconding staff to kabupatens have been put forward by the GOI. The idea of seconding personnel from the DPUP has some good points. It fills the position with a qualified individual and at the same time creates a connection between the kabupaten and the province for technical cooperation. It also offers a career ladder to the individual, especially in the case of the DPUK.

This alternative is preferred to the intern program which is being started by Bina Marga to place individuals in kabupaten-level positions for the ADB Rural Roads II Project. Since these individuals are sponsored by Bina Marga in Jakarta, they would likely return to Bina Marga when their tour in the kabupaten is completed and thus their experience would be lost to the province. On the other hand, if they were sponsored by the DPUP, their services would still be available to other kabupatens in the province. Individuals who worked in several kabupatens before rising to a provincial-level office would gain a great deal of experience which would be "kept at home" within the province.

10.3.2. Responsibilities of the Kabupaten Road Staff

Road Section - The Chief should be at least a Road Engineer or BRE. His duties should be to manage the following subsections and to advise the Chief of the DPUK/DPUP Cabang Dinas on all road related-issues.

Engineering and Planning Subsection - The Chief should be at least an STM, or preferably a BRE. He should be senior among the Subsection Chiefs. The technical staff ** should be permanent and at least STM graduates. It is estimated that the staff should consist of four or five technicians, each with one or more specific duties from the following list. Responsibilities of the technical staff would include:

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* See Section 11.2, Plan of Action.

** The term technical staff as used here refers to all technicians, office workers, and first-line field supervisors with defined job responsibilities within a Subsection.

- traffic counts;
- road feature inventory;
- road condition survey;
- field investigations (with assistance from the Materials Unit) and engineering designs, planning and budgeting for maintenance and reconstruction (annual work programs, contracts);
- scheduling and allocating resources (labor, equipment, materials);
- monitoring and controlling all maintenance and reconstruction work; and
- other tasks associated with managing the maintenance and reconstruction programs.

Maintenance Subsection - The Chief should be an STM or a very capable SMA. The technical staff should be composed of maintenance foremen (mandors) who are permanent employees and will in turn supervise maintenance workers (pegawai harian). The number of foremen would depend on the number of field crews and materials production crews. Responsibilities of the technical staff would include:

- directing and supervising maintenance workers and summarizing maintenance reports;
- assisting the Engineering and Planning Subsection with traffic counts, inventory, condition surveys as ordered; and
- coordinating with the Materials Unit for quality control.

Reconstruction Subsection - The Chief should be an STM or a very capable SMA. The technical staff should be composed of construction supervisors/foremen who are permanent employees. The number of supervisors would depend on the number of construction contracts. The number of foremen would depend on the number of force account reconstruction crews. Responsibilities of the technical staff would include:

- supervising the work of contractors;
- directing and controlling force account construction workers;
- preparing daily supervision and reconstruction reports; and
- coordinating with the Materials Unit for quality testing.

Materials Unit - The individual in charge should work alone or perhaps have an assistant. He should be a permanent employee and hold an STM, at a minimum. The responsibilities of the unit should be to:

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- check with the Chiefs of the Subsections for Maintenance and Reconstruction in order to schedule the necessary field tests;
- collect the materials samples and perform the appropriate tests;
- prepare the test reports and, in case of any problems, immediately inform the individual in charge of the work so that corrective action can be taken prior to filing the report in the normal manner;
- advise the other officials of the DPUP Cabang Dinas/DPUK on all materials related issues; and
- provide liaison with the DPUP for any materials matters beyond his or his equipment's capability.

Table 39 provides a summary of road staffing requirements.

Table 39
FIRST YEAR PERMANENT ROAD STAFFING REQUIREMENTS
(Average per Kabupaten)

Title	No. Required
PERMANENT	
Road Section	
Chief	1
Engineering Subsection	
Chief	1
Technicians 1/	5
Maintenance Subsection	
Chief	1
Maintenance Foremen	1
Reconstruction Subsection	
Chief	1
Foremen (Reconstruction Crew)	1
Construction Supervisors (inspectors) 2/	1 or 2

1/ Technicians should rotate among different tasks of the maintenance management system, reconstruction design & drafting, DURP preparation, etc.

2/ The number of construction supervisors will depend on the number of contracts in the first year in each kabupaten.

10.3.3. Equipment Related Organization and Staffing Recommendations

10.3.3.1. Organizational Recommendations

The existing organizational structure for equipment in the fourteen kabupatens differs between the two provinces. In South Sulawesi each kabupaten has a distinct structure, varying from being a subsection of the Maintenance and Firefighting Section (Bulukumba) to a full section with three subsections (Equipment, Workshop and Administration) as found in Bone. In NTT the Equipment Sections are the same for each kabupaten. They include Subsections for Equipment, Workshop and Warehouse, but no administrative subsection.

Some minor changes in the existing organizational structure of the Equipment Section in the DPUKs may be necessary. It should be kept in mind that the principal objective of the Equipment Section in the DPUK organization should not only be to control equipment, and manage the servicing, minor repairs and flow of spare parts, but also to compile cost data for the Equipment Management System. It is thus recommended to include an Administrative Section as a support unit within the Equipment Section in order to maintain accurate and up-dated information related to equipment. This use of these data is an essential element for maintenance management.

For equipment, the model structure should be the same as the existing structure in DPUK Bone. For all Cabang Dinas in NTT, this would require combining the existing Workshop Subsections and Warehouse Subsections into a single Workshop/Warehouse Subsection and the creation of a new Administration Subsection. The remaining DPUK in South Sulawesi should also be reorganized to conform to the model.

DPUK Equipment Section Organization

Equipment Section should be headed by an Equipment Engineer who reports directly to the Chief of DPUK. The basic functions for which the Equipment Engineer should be responsible include:

- o Equipment planning and control;
- o Equipment cost data;
- o Servicing and minor repairs of equipment; and
- o Spare parts and materials management.

Workshop/Store Subsection should be headed by a Shop Superintendent with responsibilities for:

- o Assuring that established policies and procedures for equipment preventive maintenance programs are effectively carried out;
- o Scheduling, directing and controlling the servicing and minor repair operations; and

- o Implementing and monitoring systems for inventory control of spare parts, materials and supplies.

Equipment/Operation Subsection should be headed by an Equipment Foreman, with responsibilities for:

- o Maintaining records for control of the equipment fleet and the utilization of equipment;
- o Inspecting all equipment units periodically to verify assignment status, to determine adherence to preventive maintenance schedule, and to evaluate current conditions;
- o Maintaining records on the cost of equipment maintenance, operation and repair; and
- o Maintaining records on fuel and lube consumption.

Administrative Subsection should be a support unit for:

- o Processing reports;
- o Summarizing and analyzing equipment utilization data; and
- o Maintaining files.

10.3.3.2. Equipment Staffing Recommendations

1) The position of Chief, Equipment Section should be held by an Equipment Engineer with a BE degree or higher and should have permanent (Pegawai Tetap) status.

2) The positions of Chief, Workshop/Store Subsection and Chief, Equipment/Operational Subsection should be held by technicians with an STM degree or a minimum of ten years of experience on equipment related activities. They should also be on a permanent status.

3) The position of Chief, Administrative Subsection should be held by an administrator with an SMA or equivalent degree or a minimum of five years of experience on administrative matters. He should also be on a permanent status.

4) The position of Mechanic in a DPUK workshop should be held by a trained person with an STM degree at a minimum. He should also be on a permanent status.

5) The position of Operator should be held by a trained person with an STM degree at a minimum. He should also be on a permanent status.

6) Drivers should have at least an SMP education level and should receive training on vehicle operation. Drivers could be hired and kept on a temporary status basis.

Staffing - Workshops. An analysis of staff as recommended for the maintenance and repair of equipment by type of work done in the workshop, indicates that there are 11 positions that would require a total of 19 persons to perform tasks in each DPUK workshop in the office, warehouse, tool room, and several work sections in the workshop. A list of the recommended personnel according to their title or position is shown in Table 40. A tabulation of the personnel distributed by type of work or section is shown in Table 41.

Table 40
RECOMMENDED STAFF FOR EQUIPMENT SECTION

Title or Position	Quantity
Office	
1. Equipment Section Chief	1
2. Workshop/Store Subsection Chief	1
3. Equipment/Operational Subsection Chief	1
4. Administrative Subsection Chief	1
Workshop and Warehouse	
5. Mechanics/Servicemen	4
6. Mechanic Electrician	1
7. Welder	1
8. Storeman	1
9. Dispatcher	1
10. Helpers	6
11. Typist/File Clerk	1
	19

Table 41
RECOMMENDED STAFF FOR EQUIPMENT SECTION
BY WORKSHOP SECTION

TYPE OF WORK/SECTION	Number of bays/ Rooms	Number of Personnel/Title
OFFICE, Equipment Section Chief	1	1 Equipment Section Chief 1 Administrative Subsection Chief 1 Equipment Foreman (Chief) 1 Typist/File Clerk
SMALL COMPONENT SHOP (Electrical, Injection, Hydraulics) and BATTERY SECTION	2	1 Mechanic Electrician 1 Mechanic 1 Helper
TIRE REPAIR/LUBRICATION	1	1 Servicemen 1 Helper*
EQUIPMENT REPAIR SECTION	2	1 Mechanic 2 Helpers
MACHINE SHOP SECTION	1/2	1 Mechanic
WELDING, SOLDERING SECTION	1/2	1 Welder 1 Helper
WASHING RAMP SECTION	RAMP	1 Helper*
WAREHOUSE))) Subsection	1	1 Storeman 1 Helper
WORKSHOP)	1	1 Shop Superintendent
TOOL ROOM	1	1 Dispatcher
		* = Same person

Staffing - Equipment Operation. The required number of Operators and Drivers will depend on the work program. It is recommended that each piece of equipment be assigned to one Operator or Driver.

The total amount of road equipment and vehicles that will require Operators and Drivers is taken from the Summary of Equipment Requirements (Tables 26 and 27). The total is 258 units of equipment and vehicles necessary for the maintenance and reconstruction road work scheduled (illustratively) for the first year of operations in all fourteen kabupatens. It is subdivided in roughly 133 units in South Sulawesi and 125 units in NTT.

The total of Operators and Drivers currently employed in the fourteen kabupatens is 170. (Available data do not differentiate between the positions of Operator and Driver, so they can only be considered together.) Assuming that each piece of equipment and vehicle is assigned one Operator or Driver, the additional requirement will be 88 Operators and Drivers. NTT currently employs 135 Operators/Drivers and the work program would require 125 units to be operated. In South Sulawesi, 133 pieces of road equipment and vehicles are required to do the work and there are only 35 Operators/Drivers currently employed.

Summarizing,

in South Sulawesi: 133 minus 35 = 98 additional Operators/Drivers required;

in NTT : 125 minus 135 = an excess of 10 Operators/Drivers.

Balance: 88 additional Operators/Drivers required.

The pieces of equipment and vehicles considered to require Operators/Drivers are:

- o Bulldozer
- o Motorgrader
- o Wheel Loader
- o Roller, Vibratory
- o Roller, Rubber-Tired
- o Dump Truck, 5 ton
- o Water Tank Truck
- o Flat Bed Truck
- o Dump Truck, 3.5 ton

Minor pieces of equipment that can be operated by workmen are not considered. Support equipment such as Jeeps and Pick-Up trucks are not considered as needing a full time driver. Motorcycles for field

supervision would be operated by Foremen and the equipment to be based at ALKAL workshops would have ALKAL's own and/or additional drivers. On average, each kabupaten will require 18 Operators/Drivers for all maintenance and reconstruction road work.

10.4. RECOMMENDATIONS FOR EQUIPMENT MANAGEMENT

Control: Bina Marga equipment (including OECF) and DPUP equipment, even if located at the DPUKs for the long-term, are identified and numbered using Bina Marga's 8-digit code. Recently the kabupatens have been instructed to identify DPUK-owned equipment with a Dalam Negeri numbering system (with 23 digits) for inventory purposes. Most DPUK equipment, however, is still not identified in this fashion.

It will be necessary to use a code number for DPUK equipment (new and old) when implementing the maintenance management system. It is recommended that an 8-digit numbering system such as the one used by Bina Marga be adopted and include the letter "K" in the code (for example, 44/001/K01). The first two numbers identify the province in which the equipment is assigned, the second three numbers identify the type of equipment, and the last alpha-numerical code identifies that it is an equipment specifically assigned for kabupaten road works.

Inventory: Not all kabupatens use Bina Marga's K.I.B. form (Inventory Card) for maintaining an inventory control of the equipment assigned to them from Bina Marga or the province. No kabupaten-owned equipment is now registered in an inventory format. It is recommended that for the project, K.I.B. forms be provided to all kabupatens by Bina Marga in sufficient quantity so that all equipment (irrespective of source) can be properly identified and registered. A sample K.I.B. form is found in Annex 2.

Status (condition): Up-to-date records on the condition of equipment are not being kept by most kabupatens. In the past, some DPUKs used the Bina Marga form "Buku Harian Peralatan," which is quite adequate to capture reliable information on the status of the equipment as it is provided directly by the operator (see Annex 3). This practice should be required and all such Bina Marga forms adopted by the kabupaten should be accompanied by instruction booklets on how to use them. The project technical assistance team should assist to ensure that the forms are properly completed and used.

Utilization: Again, there is no consistent record keeping system for the use of equipment. For kabupaten equipment in the kabupatens visited (with the exception of Kupang and Sumba Barat), there was no record keeping at all. Sporadic record keeping on the utilization of OECF, Bina Marga and provincial equipment is done but without established rules or procedures.

The Bina Marga form LBPP (Laporan Bulanan Pemakaian Peralatan) and form LLP5 which are monthly reports summarizing the condition, utilization and fuel/oil consumption of the equipment, should be adopted and implemented during the execution of the project (see Annex 9).

Fuel Control: There is no established kabupaten procedure for controlling fuel allocation. Each kabupaten uses its own system, mostly entries in a simple notebook (many times not identifying the unit in the field) and the date. In Sumba Barat fuel coupons are used for dispensing fuel to vehicles but for heavier equipment (rollers), they simply trust the operators. It would be useful to apply a similar coupon system in other kabupatens.

Maintenance, Servicing and Repairs: In all kabupatens visited, including the ones with OLCF workshops, there was no evidence of any control of labor or parts for equipment maintenance and repair. Forms such as work orders or preventive maintenance programs and schedules are not being used at all; there is no established system for management of the work. Existing Bina Marga forms such as Perintah Kerja Perbaikan Peralatan and Kartu Servis now used at the provincial level should be adopted and implemented in the existing (and future) workshops in the kabupatens. These forms are shown in Annex 8.

Parts Management: Systems for controlling or stocking spare parts are non-existent at the kabupaten level. At the most a storeman keeps a book with entries of parts and supplies acquired. The existing parts management system used in the ALKAL warehouse in Ujung Pandang is quite adequate for adaptation to kabupaten needs.

Parts and Fuel Purchase: Each kabupaten procures parts on its own for the equipment it owns. Funds from INPRES Peningkatan Jalan and INPRES Dati II can be used to acquire spare parts for any type of equipment with no restrictions. Although there is pressure on the DPUK to use as much of the budget as possible for road work rather than for overhead items like parts, it also seems that the policy is not taken advantage of, not known or not quite understood.

The project should encourage the inclusion of funds in roadwork DIPs to cover the true costs of operating the equipment This means that the cost for spare parts should be included in the "rental rates" used to estimate the budget for road work and the amount allowed for parts should

be clearly identified when receiving the funds. An equipment cost accounting system would provide this information.*

Equipment Rental: The renting use of government owned equipment should be discouraged under the project. However, if any rentals of project-supplied equipment are made, provisions should be made so that the unit would only be provided at rates and on terms and conditions comparable to those offered by equipment leasing firms supplying the same type or similar equipment.

An alternative would be to limit biddings for project reconstruction contracts to medium sized firms that are more likely to have the necessary equipment. Government regulations allow tendering of contracts estimated at more than Rp. 200 million to be open not only for kabupaten-based firms but also for firms registered at the provincial level.

Limitations on Equipment Load: Limitations must be set for the type of work executed by different units in order to protect the equipment. The common motorgrader (Komatsu GD31) is designed for road maintenance

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* The allowance made in the equipment unit cost rate (so called "rental rate") for repairs should range from 16 to 20% of the rental rate. And within the allowance for repairs of major equipment, a certain percentage (say 40%) should be for spare parts. Therefore, when budgeting a cost per kilometer of work, some of the funds should already be accounted for and should be reserved for spare parts. As an example: a dump truck (3.5 ton) might have a rental rate of Rp. 5,573/hr. of which 17% (Rp. 955/hr) should be an allowance for repairs. Using an estimate of 40% of the repair costs for spare parts, Rp. 382 should be set aside for every [illegible] that the dump truck works and should be charged to the work as an allowance for spare parts. Fuel and lubricants should also be included in the operating cost of the equipment. This varies as a function of engine power. Thus, a 3.5 ton dump truck with 44 HP should have 36% of the rental rate reserved for fuel and lube costs. If the rental rate were Rp. 5,573/hr, 36% of it (Rp. 2,006) should cover the expenses of fuel and lube. There would be no need for a separate line item or budget for fuel and lube.

work (grading, spreading material, smoothing, scarifying light material). Kabupatens, however, are using them for heavier work such as scarifying or cutting hard material and pushing loads. A bulldozer should be used for this. The common dump trucks (Dyna) are not strong or heavy enough for the type of work required. Their dump body struck capacity is only 1.5 m^3 but they are being loaded with approximately 2.4 m^3 of rock material. The engine (88 HP, 3.2 liters) is not powerful enough to withstand the continuous overloading and to operate in steeper grades found in many kabupaten roads. These trucks would be suitable for lighter work such as transporting their rated capacity of material (sand, cold mix, coarse aggregate, bags of cement or hand tools, etc.) necessary for typical routine maintenance operation and bridge repair work. It is recommended that the existing dump trucks (Toyota Dyna and Isuzu TLD) be reserved strictly for maintenance operations. New units with a G.V.W. (Gross Vehicle Weight) of approximately 9 tons, engines of a minimum of 135 HP, with a dump body of 3.3 m^3 capacity and wheel base of approximately 3.20 m should be purchased for the heavier work encountered in road reconstruction operations.

Reallocation of OECF Equipment: Field observations indicate that few kabupatens are utilizing OECF equipment efficiently and that some units remain idle for long periods. This situation has prompted Bina Marga to reassign some of the OECF units to other activities. A reallocation of the existing OECF equipment among the fourteen kabupatens is recommended here.

Reallocation will greatly reduce the number of new units to be procured. Furthermore, the existing OECF fleet of light dump trucks, motorgraders and wheel loaders could then be assigned to do road maintenance, leaving the heavier reconstruction work to be done by new units. It should be made clear that the kabupatens that are having some of their equipment reallocated will be receiving newer units that will form part of the reconstruction group.

The recommended reallocation of OECF equipment is shown in Table 42. Calculations for the number of reallocated equipment were made taking into consideration the equipment requirements for the first year and the current availability of operating equipment. The balance of equipment requirements after reallocation of OECF equipment is presented in Tables 43 and 44 for South Sulawesi and NTT, respectively.

Table 42
REALLOCATION OF EQUIPMENT

Type of Equipment	Reallocated From	Reallocated To	Number of Units
		SOUTH SULAWESI	
Motorgrader Komatsu GD-31	Pinrang	Gowa	1
	Sidrap	Wajo	1
	Bone	Bulukumba	1
Wheel Loader Kobelco LK300	Bone	Bulukumba	1
	Sidrap	Wajo	1
	Jeneponto	Gowa	1
Dump Truck Toyota Dyna	Bone	Bulukumba	4
	Jeneponto	Gowa	4
	Sidrap	Wajo	4
Rubber Tire Roller Kawasaki KR 200	Pinrang	Gowa	1
	Sidrap	Wajo	1
	Bone	Bulukumba	1
		NTT	
Type of Equipment			
Dump Truck Toyota Dyna	Belu	T.T.S.	4
	Belu	Kupang	4
	Manggarai	Ngada	3
	Manggarai	Sikka	4

TABLE 43

EQUIPMENT REQUIREMENTS AFTER REALLOCATION OF OECF EQUIPMENT
PROVINCE: SOUTH SULAWESI

TYPE OF EQUIPMENT	PINRANG	SIDRAP	WAJO	BONE	GOWA	JENEPONTO	BULU-KUMBA	TOTAL
Bulldozer 100 HP, 12 ton	0	0	1	0	1	0	1	3
Motorgrader 100 HP	1	1	1	1	1	1	1	7
Wheel Loader 1.2 m3	0	0	1	1	1	1	1	5
Roller, Vibratory 6 ton	0	0	0	0	0	0	0	0
Roller, Rubber Tired	0	0	0	0	0	0	0	0
Asphalt Sprayer, 8001	1	1	1	1	1	1	1	7
Dump Truck, 5 ton	4	4	4	4	4	4	4	28
Tailgate Chip Spreader	4	4	4	4	4	4	4	28
Water Tank Truck	1	1	1	1	1	1	1	7
Flat Bed Truck	2	2	2	2	2	2	2	14
Rock Crusher	0	0	1	1	1	0	0	3
Dump Truck, 3.5 ton	0	0	0	0	0	0	0	0
Hand Compactor	0	0	0	0	1	1	0	2
Paddlewheel Mixer	1	1	1	1	1	1	1	7
Concrete Mixer	0	0	1	0	1	0	1	3

TABLE 44

EQUIPMENT REQUIREMENTS AFTER REALLOCATION OF OECF EQUIPMENT
PROVINCE: NTT

TYPE OF EQUIPMENT	KUPANG	TTS	BELU	SUMBA BARAT	MANGGARAI	NGADA	SIKKA	TOTAL
Bulldozer 100 HP, 12 ton	1	1	0	1	0	0	0	3
Motorgrader 100 HP	1	1	0	1	0	1	0	4
Wheel Loader 1.2 m3	1	1	0	1	0	1	1	5
Roller, Vibratory 6 ton	0	0	0	0	0	0	0	0
Roller, Rubber Tired	0	1	1	1	1	0	1	5
Asphalt Sprayer, 8001	1	1	1	1	1	1	1	7
Dump Truck, 5 ton	4	4	4	4	4	4	4	28
Tailgate Chip Spreader	4	4	4	4	4	4	4	28
Water Tank Truck 4000L	1	1	1	1	0	1	1	6
Flat Bed Truck 3.5 ton	2	2	2	2	2	2	2	14
Rock Crusher	0	1	0	1	0	0	0	2
Dump Truck, 3.5 ton	0	0	0	0	0	0	0	0
Hand Compactor	0	1	0	0	0	0	1	2
Paddlewheel Mixer	1	1	1	1	1	1	1	7
Concrete Mixer	1	1	0	1	0	1	1	5

180x

10.5. RECOMMENDATIONS ON ALLOCATION OF MAINTENANCE BUDGETS

Although the flat 25% earmarked for maintenance of INPRES Dati II is administratively simple, it bears no relation to the needs of different kabupaten road networks. Consideration should be given to changing the way in which maintenance is funded. First, the basis of the maintenance portion of Dati II allocation could be determined by an apportionment of x Rupiah per kilometer of network plus an extra amount based on the number of kilometers that are reported to be in good condition. That would provide an incentive to keep the network well maintained. Condition surveys would have to be conducted using a uniform procedure that can be spot-checked.

Second, kabupatens could contribute a portion of their locally raised revenue for road maintenance. This would have the effect of increasing the total maintenance funds and also of making local officials more aware of the importance of cost-effective maintenance.

Ultimately, the key to the maintenance budget should be an annual work program and budget for each kabupaten each year. A direct product of any maintenance management system, it sets the total amount of money required for maintenance. Because it is performance based it directly relates the work to the money. The money needed must be justified by type of work and by resource required. For more information on the annual work program and budget, refer to Section 9.5.

10.6. RECOMMENDATIONS ON IMPLEMENTATION PROCEDURES, FACILITIES, AND EQUIPMENT

10.6.1. Force Account vs Contract

Almost all maintenance activities are now performed by force account (swakelola); most construction activities are performed by contract. The GOI encourages the growth of the construction industry, as can be seen by the large number of small contracting firms who are registered for kabupaten work.

Since most contractors do not have construction equipment, contracts are modified to allow labor intensive methods or renting (sometimes without charge) of the kabupaten's equipment to the contractor. Neither practice produces good results.

The cost of a labor intensive contract is often lower but usually so is the quality of the finished product. The kind of work that can be done with manual labor alone is usually limited to building Telford or macadam gravel roads. These roads are inferior to gravel surfaced roads which require crushed aggregate or select material and a fleet of trucks plus spreading and compaction equipment.

The practice of renting out kabupaten equipment, but usually at a below economic rate or sometimes without charge, does not work well. The contractor has little incentive to utilize the equipment efficiently. Frequently it will sit idle for extended periods while it is under the control of the contractor and unavailable for use elsewhere.

Force account construction work is usually more dependable and the experience of other donors in Indonesia has been that, given training, it yields higher quality work that is completed in a more timely fashion. But there are nevertheless pressures to complete the work as quickly and inexpensively as possible; so many shortcuts are usually taken. Not all the equipment is the right size for the job and there are always problems with spare parts, logistics, etc. Also, if the force account project is a big one, there will be little work done on maintaining the roads because there are usually insufficient personnel to staff a large construction project and perform maintenance at the same time.

Improvements are needed in both systems. During the DRMS Project, there will be a growing requirement for maintenance each year. There will also be more reconstruction work than can be handled by force account crews alone unless those crews are greatly expanded. The DRMS Project will have to work out an arrangement whereby all of the maintenance and reconstruction work is done in the most economical manner.

The kabupaten's need force account crews that can respond quickly to maintenance needs. For example, patching and some bridge work cannot be delayed. However, there are certain maintenance tasks such as drainage, cleaning and vegetation control which do not require quick response. These could easily be contracted if the proper procedures were in place to prepare maintenance contracts and to provide the necessary supervision and control so that the results are acceptable.

Due to the volume of work anticipated under the project, there will be a need for able contractors who can perform the work properly and quickly. They will need to learn new methods and both materials and work methods will need to be controlled more carefully than at present. Specific recommendations are provided in the following two sections.

10.6.1.1. Recommendations for Maintenance

Initially all maintenance should be performed by force account. Gradually as the crews gain experience in improved work methods, production will improve until the marginal improvement becomes very small. At that time the work methods will be close to optimum for the conditions. This may take several years. The foremen will have gained experience and be able to repeat the production figure regularly. They will have learned which techniques work and which ones don't.

It will then be time to experiment with contracting some of the less critical maintenance activities to small local contractors. Production standards will have been established by experience. These should become the standard for maintenance contracts. Force account foremen can be reassigned to supervise contractors because they will have had the experience themselves. Technical assistance may be needed to draw up appropriate formats for maintenance contracts.

With some maintenance being performed by contract, the personnel and equipment required for force account maintenance will not have to grow to match the growth in the number of maintainable kilometers from the reconstruction program. Some maintenance work of the same type as that contracted should still be performed by force account in order to keep a check on the production and unit cost of that particular activity.

10.6.1.2. Recommendations for Reconstruction

The volume of reconstruction under the DRMS Project will rise at the beginning and taper off near the end. It will not justify permanent force account crews to do all the work. Contractors are the logical choice for a relatively short program. However, most contract construction practices need to be improved, e.g., more effective use of equipment, better supervision, better quality control, etc. The DPUK/DPUP Cabang Dinas must also acquire the skills and experience to better manage contractors. Learning by doing is the best teacher and a single force account reconstruction crew will be sufficient to test new methods before they are required of contractors. As in the example of maintenance, this should be the primary training ground for future construction contract supervisors. A steady flow of work should be programmed for force account each year and the balance absorbed by contracts.

Force account on-the-job training for future contractor supervisors should be complemented by supervision training courses. At present there are no ready-to-use packages of training courses for construction supervision or inspection. A start was made during the on-going World Bank Manpower Development Project (IBRD 2258) to produce such courses. Working with the Bidang Diklat Bina Marga of the Department of Public Works, a consultant laid out a complete series of courses on construction supervision for inspectors working on projects funded by APBN. Many of the tasks to be covered by those courses are applicable to kabupaten works as well. One demonstration course (Inspection of Soils and Aggregates) was developed, and according to reports was field tested. A field Handbook for Field Inspectors to serve as a ready reference for inspectors was also begun.

Bidang Diklat Bina Marga should complete the series and create a set of reproducable masters so that they can be implemented at the kabupaten level using local or provincial instructors. The project TA should assist in conducting the courses and assist in the post-training guidance.

Another recommended step to improve contractor reconstruction practices is to change contracts from a lump sum to a unit price format, at least for the tasks which require tight control on materials (e.g., gravel surfacing, chip sealing and DBST, concrete structures and bridges). Inspectors will have greater control by being able to reject specific work without having to reject the entire job. It will also be easier for the contractor to correct specific defects rather than a set length of the work, as implied with lump sum contracts (contractors' progress payments are now typically made on the basis of the total completed length of road).

10.6.2. Certification Recommendations

Certification of kabupaten reconstruction work has been a delicate area under other donor projects and must be planned carefully. First, the ground rules for certification must be clearly established and understood by all parties. Second, the stringency of certification standards should be increased gradually and proper advance notice should be given to contractors and force account crews who will perform the work. That notice should begin with the preparation of project designs and specifications and contract documents. Third, the plans and specifications must be free of ambiguous language and the responsibilities of the work force and the supervision clearly identified in the contract documents. Fourth, those who will perform the work must understand the correct methods. The foremen in charge of force account work must be shown how to do the job properly, using the right type of equipment and materials so that the finished product will be as designed. This will not be too difficult at the start because there will only be a limited number of projects and they should be able to be partially supervised by the project TA.

Specific suggestions for a certification procedure are noted below.

- 1st - The contract documents should contain a clause by which the contractor is bound to complete work according to plans and specifications and that any defects in the work noted by the DPUP Cabang Dinas/DPUK will be corrected before payment for those items can be approved (note that this may require a unit cost contract). In the case of force account the process begins with the next step.

- 2nd - The DPUP Cabang Dinas/DPUK will certify that the work has been performed according to standards except for any noted defects 1) for which the contractor has agreed to repair, or 2) for which payment will be deducted from the money due the contractor and the GOI becomes responsible for correcting the defects. (The money could be used by the GOI to correct the work either by force account or a new contract.)

- 3rd - The TA (local and foreign) will certify that the work which has been declared acceptable is to standard. Payment is therefore justified.

- USAID will reimburse the amount of money associated with the portion of certified work. After the defects on any other portions are corrected, the same process will be followed.

10.6.3. Workshop and Equipment Recommendations

In the Outer Islands of Indonesia, kabupatens that have received donor assistance for kabupaten road programs generally have workshops whereas other kabupatens do not. In the 14 kabupatens considered for the AID project, only kabupatens that were included in the OECF assistance project have some kind of workshop/warehouse facility. Two kabupatens in NTT have OECF workshop buildings: Manggarai and Belu. Four kabupatens in South Sulawesi have such buildings: Jeneponto, Bone, Pinrang and Sidrap (see Tables 45 and 46).

The six OECF workshops are incomplete and will require improvements before they can be fully functional. The workshops are, in effect, only storage sheds for equipment; there are no tools or bench equipment available.

The workshops seen in Manggarai and Jeneponto are far removed from town and lack direct electricity, telephone and water lines which would have to be installed before they can become operational.

Workshops are now being built in Kupang and TTS kabupatens. The workshop seen in Kupang was still under construction but appeared acceptable.

10.6.3.1. Recommendations for Workshops

New workshops will have to be built in six kabupatens: Sumba Barat, Ngada, and Sikka in NTT, and Bulukumba, Gowa, and Wajo in South Sulawesi.

An existing standard building layout, prepared by Bina Marga, is being used under other kabupaten road projects and is adequate. A lay-out sketch of the standard building is shown in Figure 5. It consists of a building of approximately 400m^2, at an estimated cost of Rp. 50 million, containing:

Four work-bay areas (one for lubrication),
Warehouse (for spare parts),
Tool room,
Battery and electric system room,
Soil lab space; and
Office space.

Table 45
DPUK FACILITIES: SOUTH SULAWESI

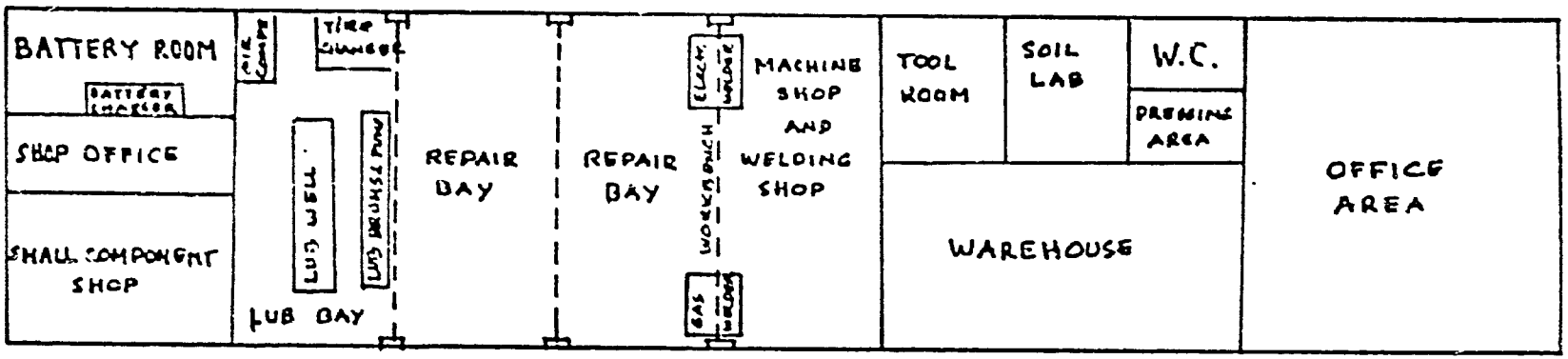
KABUPATEN	WORKSHOP			WAREHOUSE		EQUIPMENT YARD	SPECIFIC PROBLEMS
	CONDITION	LOCATION	YEAR BUILT	CONDITION	LOCATION	OBSERVATION	
JENEPONTO	Fair (ex OECF), area of building: 400 M2,	10 km from the office in a 2 Ha. (20,000 m2) fenced in area.	1983	Fair, area: 144 M2.	Within workshop building	Equipment is kept in the DPUK office yard.	Too far from capital, difficult to control.
GOWA	NO WORKSHOP	-	-	-	-	Equipment is kept in the Pemda's office yard.	-
BONE	Good (ex OECF) area of building: 400 M2	4 km from DPUK's office in a 2 Ha (20,000 M2) fenced in area.	1983	Good, area: 214 M2	Within workshop building.	Equipment is kept in the workshop yard.	OECF workshop location 1 Km from main road, difficult to control.
BULUKUMBA	NO WORKSHOP	-	-	-	-	Equipment is kept in the DPUK's office yard.	-
WAJO	POOR building 200 M2 no fence	in capital town	-	-	-	Equipment is kept in the workshop yard.	Not a real workshop, just a place to store the equipment and materials.
PINRANG	Good (ex OECF), area of building: 400 M2	14 km from DPUK Office in a 2 Ha. (20,000 M2) fenced in area.	1983	Good	Within workshop building	Equipment is kept in the workshop yard.	Poor access road, too far from the office, difficult to control.
SIDRAP	Good (ex OECF) building: 128 M2	Outskirt of capital town in a fenced in area.	1983	Good, area: 93 M2	Within workshop building	In the workshop yard.	All facilities are located at the workshop, including DPUK office.

Table 46
DPUK FACILITIES: NTT

KABUPATEN	WORKSHOP			WARE HOUSE		EQUIPMENT YARD	SPECIFIC PROBLEMS
	CONDITION	LOCATION	YEAR BUILT	CONDITION	LOCATION	OBSERVATION	
MANGGARAI	Good (ex OECF) building: 400 M2,	12 km from capital in a 2 Ha (20,000 M2) fenced in area.	1983	Good	Within workshop building	At the time they kept equipment in yard at office house of Chief DPUK.	Workshop access road is under construction at the moment.
BELU	Good (ex OECF) area of building: 400 M2	in town (capital), in a 2 HA (20,000 M2 fenced in area.	1983	Good, area: 8x10 M2	Capital (in the workshop area)	Equipment is kept in the workshop yard.	-
KUPANG	Temporary 100 M2 (too small)	in the capital town	± 1980	Poor 2x9 M2 = 18 M2 (too small)	In the DPUK's office area	Equipment is kept in the workshop yard (too small)	The new workshop is being built (12 Km from capital)
SUMBA BARAT	NO WORKSHOP	-	-	-	-	At the present time, the equipment is kept at DPUK's staff houses.	-
NGADA	NO WORKSHOP	-	-	-	-	DPUK has a place to keep the equipment in the capital city.	Equipment yard doesn't have fence (security problem).
SIKKA	Fair 8 x 30 M2 = 240 M2	in the capital town	± 1980	Fair (6x12 M2) = 72 M2	Capital	Equipment is kept in the workshop yard.	Not big enough
TTS	Fair (120 M2) (too small)	in the capital town	± 1980	Fair (24 M2)	In the workshop area	In the office yard. Not sufficient to keep all the equipment.	The new workshop is being built (8 km from capital)

Figure 5

STANDARD LAYOUT OF DPUK WORKSHOP



All workshops must include provisions for (installed, tested, and operating) piping for an air compressor, and for electrical, water and sanitary installations. A washing ramp, a loading ramp, a guard shelter, and a masonry and chain link fence should also be included.

Before the workshops are accepted by the project, they must be complete and operational. All workshops should be fully furnished including: desks and chairs, bookshelves, display boards for tools, counters (for toolroom and warehouse), workbenches, racks for spare parts, and racks for tires.

The main function of DPUK workshops should be to serve as the home-base for road maintenance operations. It is therefore advisable to locate them on the outskirts of town where there is access to easy communication with the DPUK office and electricity, telephone and water hook-ups are available. The land area required for a DPUK workshop is approximately 2 ha (20,000 m^2).

10.6.3.2. Type of Work

In its publication Pedoman Pemeliharaan Peralatan, Bina Marga has classified the type of work done in workshops in five levels (see Annex 27):

Level I : Maintenance work done by operators and drivers before and after they operate equipment.

Level II : Preventive maintenance work done by mechanics and serviceman in the workshop area.

Level III : Adjustments and minor repairs done by mechanics in the workshop.

Level IV : Major repairs done by master mechanics in fully equipped workshops. This work includes overhauling engines, transmissions, and changing clutches in heavy equipment.

Level V : Repairs that require fabrication of parts and major rehabilitation of equipment in very damaged condition.

Work to be done at DPUK workshops should be limited to levels II and III. Repairs that necessitate dismantling and assembling units that need setting or adjustments using special tools, equipment or facilities should be done at ALKAL and depot workshops. These are tasks defined under level IV and V. For transporting kabupaten equipment in need of level IV or V repair, ALKAL workshops in Kupang, Ujung Pandang, Ende and Waingapu should be required to use their existing Lo-Bed truck-trailers. These units are now under ALKAL control and upon request can be assigned to provide support to DPUK's workshops, as per directives from Bina Marga.

10.6.3.3. Mobile Workshops

In cases where repairs that are beyond the capability of the kabupatens can be performed in the field without transporting equipment to the AKAL, the AID project should utilize procedures previously established under the OECF project. Current procedure for requesting assistance from the Kanwil ALKAL in Ujung Pandang to provide spare parts and mechanics to repair OECF (Bina Marga-owned) equipment in the kabupatens in South Sulawesi is as follows. Periodically, ALKAL sends a mobile workshop based in Ujung Pandang to each project workshop to check the equipment's condition. Each mobile workshop team consists of a mechanic, a logistics person, and an equipment/spare parts specialist.

The team spends an average of five days in each kabupaten, during which the mechanic examines in detail every piece of equipment and the spare parts specialist helps DPUK equipment personnel to prepare a list of spare parts necessary for any equipment in need of repair. The list of spare parts recorded by the team is then approved and signed by the Kepala DPUK. Upon returning to ALKAL the list is submitted to the equipment coordinator who reviews it and his office prepares a form entitled "Request for Repair" (Permintaan Perbaikan). This signed request is submitted to the repair section at the ALKAL workshop. The repair section issues a work order complete with a request list of spare parts and sends it to the storeroom. The storeman evaluates and checks the list against the inventory of parts acquired by the project and stored at ALKAL. Spare parts are released from the storeroom and given to the mobile workshop mechanic, who upon returning to the kabupaten, proceeds to repair the equipment. A report is made and the work order is closed, signed by both the mechanic and the Chief of the DPUK.

This procedure is being followed for the repair of equipment in all OECF sponsored kabupatens in South Sulawesi has been working satisfactorily. It should be continued during the execution of the AID project.

The ALKAL in Ujung Pandang has three mobile workshop teams attending seven kabupatens with OECF equipment. Adding three more AID-funded kabupatens (Gowa, Wajo and Bulukumba) would total 10 kabupatens and will necessitate the addition of at least one more mobile workshop (this is included in the recommended list of equipment to be procured).

The current practices for purchasing spare parts for OECF equipment in South Sulawesi should also be followed under the AID project. Under these procedures, when spare parts (filters, etc.) requested are not available at the ALKAL, the ALKAL can directly purchase parts if the total cost per kabupaten for the year does not exceed Rp. 1 million. If the total cost exceeds Rp. 1 million, a competitive procurement is held.

Periodically (usually once a year), each DPUK makes a list of spare parts needed for maintaining OECF equipment. The list is then submitted and reviewed by ALKAL, which then purchases in bulk. Parts are received and stored at ALKAL's warehouse and distributed to each DPUK according to its needs. These spare parts are kept in stock for future maintenance use.

Similar procedures should be adopted for providing mechanical work and spare parts on a recurrent basis for all DPUK workshops under the AID project. At present, there are ALKAL workshops or branch workshops established in: Ujung Pandang in South Sulawesi, Kupang in Timor Island, Ende in Flores Island and Waingapu in Sumba Island.

10.6.3.4. Workshop Equipment and Tools

The kabupaten workshops should be provided with tools and equipment for washing, lubricating, changing filters, repairing tires, changing batteries, replacing small parts, repairing minor components such as alternators, starters, water pumps, etc., welding and soldering.

The estimate of workshop equipment required for each kabupaten workshop is:

1. Lubrication Service Equipment	US$ 20,000
2. Tire Service Equipment	20,000
3. Battery and Electric Section Equipment	5,000
4. Diesel Injection and Hydraulic Section Equipment	3,000
5. Repair Section Equipment	15,000
6. Welding, Body and Paint Section Equipment	36,000
7. Machine Shop Section Equipment	7,000
8. Miscellaneous	1,000
	US$ 107,000

A detailed breakdown of this equipment list is provided in Annex 28. For 14 workshops, the total cost would be approximately U.S. $1.5 million. However, OECF workshops seen in Manggarai and Jeneponto had a few pieces of shop equipment such as an air compressor, battery charger, trolley jacks, and one tool box. A detailed final list of workshop equipment and tools should be prepared by a project consultant early in the project so that equipment can be procured while the new workshops are being built.

Equipment for the proposed soil lab should be limited to the simplest equipment that can be taken out in the field, such as slump cones for testing concrete used on drainage structures (box culverts, headwalls) and sieve analysis sieves to control the gradation of aggregate.

10.7. PUBLIC INFORMATION PROGRAM

One of the most important objectives of the project should be to increase the awareness and knowledge of government officials about highway maintenance. As with any new system, there will be resistance to changing the way maintenance is now perceived, planned, and executed. The project should inform officials as fully as possible about the merits of maintenance and managing maintenance in an orderly and logical way. As the officials become better informed, they will participate more openly in the project. Without that participation, it will be very difficult to institutionalize the system in the project kabupatens and almost impossible to carry it forward to other provinces.

It is recommended that USAID begin planning for a program of public information before the long-term project technical assistance team arrives, and should continue the program throughout the project's life. Prior to beginning work on the ground, notices should alert local officials that the project will soon begin and provide information about where, when, how long, how much, why it is being carried out, etc. Topics of general information prior to the beginning of project civil works could be:

- General facts about the program;
- Why maintenance is important for the preservation of capital and for the benefit of the motoring public;
- The basic features of an equipment and maintenance management system; and
- The importance of good construction and materials quality control to the economical life of the highway network.

Short-term consultants could help to write some of the articles or notices.

During the project there will be many opportunities to generate reports on the actual experiences and benefits of carrying out maintenance and reconstruction in a systematic way. Long-term project consultants could assist in preparing occasional articles on maintenance techniques as the project progresses. A recommended method for publicizing the project is to publish articles in two widely-circulated Public Works-sponsored magazines "Majalah Teknik Jalan & Transportasi"

and "Majalah Pekerjaan Umum." During the life of the project, other media such as video clips and newspaper articles should be used to increase public awareness and enlist support for the field work.

10.8. TRAINING RECOMMENDATIONS

10.8.1. Short-Term Technical Training

Short-term technical training should be primarily targeted on force account foremen and on staff who supervise contractors. Short-term technical training should be carried out primarily during the rainy season when road work is stopped. It should be conducted through short courses. Topics for short courses should include the following:

for foremen

1) maintenance work methods
2) crew organization
3) recording and reporting procedures
4) materials handling
5) others, as identified during project implementation.

for contractor supervisors

1) reading designs and specifications
2) supervision techniques
3) others, as identified during project implementation.

Short courses should be kept to a week or less whenever possible. It is suggested that they be held initially at existing training centers (DPUP and Diklat) but, beginning in the second and third years, be gradually moved to the kabupatens themselves. For planning purposes, it could be assumed that 10 to 15 man-days per year of short-term training in these topics would be adequate for each PUK employee in these positions.

Practical and applied techniques should be stressed. For this reason, Public Works staff with long field experience should be utilized as much as possible to assist to prepare and deliver short courses. Holding courses in the kabupatens will assist in promoting a practical, as opposed to a theoretical, tone.

Materials for most short courses already exist within Public Works. For this reason, the project does not require a great deal of preparation of new course materials (slides, films, etc.). Many of the existing materials, however, are scattered about at various training centers; thus a complete inventory and review of all potentially useful existing materials should be conducted as early as possible in order to develop a core set to be used under the project. Financing may be required for minor improvements to existing course materials, but most short course training can begin before any improvements are made.

One topic for which teaching materials do not yet exist is contractor supervision. Preparation of these materials was reportedly begun several years ago but was not completed. Because this is one of the areas where improvement is most needed in the kabupatens, Public Works should be strongly encouraged to complete this work. The adequacy of this and all other core short courses should be reviewed during the project to assure their applicability and usefulness for kabupaten staff.

Although foremen and contractor supervisors should be the primary target, deficiencies of other PUK staff in specific technical skills important to the project (topographical surveying, drafting, etc.) may become apparent as the project is implemented. Funds should be held in reserve for such purposes and existing facilities or courses utilized to address them as the need arises.

10.8.2. Planning for Short-Term Training

The planning procedures adopted by the project will introduce new tasks to kabupaten staff. Few example, kabupaten Public Works staff will need to conduct more sophisticated road/bridge inventory and condition surveys than at present. Very few kabupatens conduct any traffic counts at present, but DPUKs and perhaps Bappeda IIs will be required under the project to measure traffic periodically in order to select links for project-financed reconstruction work. It is not known whether formal courses in any of these topics exist in Public Works (this too should be investigated as early as possible). However, DPUPs and the Sub-directorate for Local Roads have the skills and procedures to conduct these tasks themselves and should assist in introducing them to the kabupatens.

A second category of planning skills that the kabupatens will need to acquire is maintenance planning. These are the procedures required for a maintenance management system and include tasks such as estimating and setting standards for work crew performance. The target group for these skills should be PUK administrators at the Section Chief level and above. On-the-job training by project TA rather than formal coursework is proposed in this case although seminars might be required initially to introduce the logic and procedures of maintenance management.

10.8.3. Long-Term Training

Long-term training should not be the primary focus of the project training program. However, consideration should be given to financing long-term in-country civil engineering training for up to two persons per kabupaten in kabupatens with a relative shortage of staff trained to this level. These persons should only be at the staff level of Section Chief and above. The benefit would be a general improvement in the quality of design and implementation at the kabupaten.

194+

Care should be taken to assure that the absence of staff who are in long-term training does not impede project implementation. One alternative would be to second qualified DPUP staff to DPUK positions during the training period.

10.8.4. Training of Contractors

The bulk of reconstruction and a growing share of maintenance work conducted under the project will be performed by contractors. Historically, problems of low quality of contracted work in Indonesia stem from many factors including inadequate supervision, unrealistically low contract budgets, and contractors' lack of knowledge of some construction techniques and equipment. Contractor training cannot by itself solve all these problems. It has, moreover, proved difficult to administer and evaluate in other countries. Consequently, it is suggested that a formal program of courses for contractors not be undertaken in the AID project. Instead, improved supervision and realistic contract budgets should be combined with a program in which contractors eligible to bid on project contracts must observe the techniques applied by the kabupaten model force account teams which, in turn, will be under the supervision of project consultants.

10.8.5. Selecting Trainees

The selection of trainees must take careful account of the relevance of the training to the ongoing responsibilities of the trainee. It is recommended that during the first year of the project, clear criteria for trainee selection be established.

10.8.6. Financing Training

The consultants were not able to consider training finance issues thoroughly. However, one promising suggestion by GOI counterparts has been to reverse the present system in which short course training opportunities are allocated to kabupaten staff by higher authorities. This system often results in training being provided to persons whose job does not require the skill taught. An alternative would be to provide a small training fund to each DPUK annually with which the DPUK would fund the travel and per diem costs of participants in short courses of its own choosing.

10.8.7. Training for Equipment Related Personnel

The expected increase in the volume and quality of work at the project kabupatens will require a strengthening of existing equipment staff through new hires and training. One of the most promising potential sources of new staff is the secondment of DPUP personnel to the kabupatens. The authority to second has already been provided by a BANGDA letter of instruction (No. 620/975, 1982). If secondment is used

under the project, the equipment-related positions for which it should be considered first are: Chief of the Equipment Section, Chief of the Workshop/Warehouse Subsection, and Chief of the Equipment/Operational Subsection.

Almost all equipment-related employees, whether seconded, new, or existing, will benefit from or require training. The importance of providing training to DPUK personnel will warrant the full-time utilization of a training specialist based in Jakarta to oversee training in both provinces and a (presumed local) training coordinator to assist in the field implementation and administration of the training program.

Training programs should combine formal courses and follow-up on-the-job training. Courses should be designed to train personnel to competency levels consistent with those needed for project equipment support operations. The training should cover the following areas:

1. New equipment familiarization (orientation courses)
2. Field equipment operations for operators/drivers and equipment maintenance/repairs for mechanics;
3. Spare parts identification, ordering and control; and
4. Equipment management.

1. New Equipment Familiarization (Orientation Courses). In-country equipment suppliers should be utilized for this purpose. This can be included in contracts for procuring new equipment. The courses should be given when the equipment is delivered.

Orientation courses should be given to all operators and servicemen (mechanics) of DPUKs and ALKALs on each type of equipment delivered. They should include:

- Equipment characteristics;
- Techniques of operation (operator manuals usage);
- Preventive maintenance services (lube manuals usage);
- Usage of special tools for repair/maintenance; and
- Instruction for repairs (workshop manuals usage).

The training specialist should review and approve the new equipment orientation courses before they are given and should coordinate the details of their presentation with equipment suppliers.

2. Field Equipment Operation and Maintenance (Operation and Maintenance Courses)

Operators/Drivers

Following the orientation courses, DPUK operators should be trained by experienced instructors from the ALKALs in Ujung Pandang and Kupang. These field training programs should be done at the kabupatens, and

should include one-on-one practical sessions that demonstrate: checking the equipment before starting the engine; correct procedures for starting the engine; safe and correct operation of the equipment; work techniques; and the correct manner of shutting down the engine and parking the equipment. Preventive maintenance tasks for which the operators are responsible should also be reviewed.

Costs will involve transportation and per diem for the instructors from each ALKAL. An estimated five days will be required in each kabupaten for a team of three ALKAL instructors.

The local training coordinator should arrange for existing video-cassettes and slide-tape courses on equipment operation to be presented as part of this field training. These courses are available at Diklat offices in Surabaya and Ujung Pandang (see Annex 18).

Mechanics/Servicemen

Following the orientation courses, DPUK mechanics/servicemen should also receive follow-up training from experienced instructors from ALKAL. The training should be conducted in the ALKAL facilities in Ujung Pandang and Kupang upon receiving the new equipment and before distributing it to the kabupatens. Training for mechanics/servicemen should be limited to the type of work defined in the Pedoman Pemeliharaan Peralatan as levels II and III (equipment maintenance and minor repairs).

It is estimated that about six trainees (mechanics/servicemen/welders) from each kabupaten should receive this training (helpers should be trained later on-the-job by their trained supervisors). An estimated two weeks should be planned for this training. The main topics should include trouble shooting fuel systems, cooling systems, electrical systems, brake systems, hydraulic systems, servicing and testing of components. No major repairs or overhauls should be included.

The local training coordinator should help to plan, organize and administer the training program. He should arrange for existing video-cassettes and slide-tape courses on equipment maintenance and minor repairs (see Annex 18) to be presented as a complement to the "hands-on" training.

3. Spare Parts Identification, Ordering and Control Courses. DPUK storemen should be be trained at ALKAL warehouses. The duration of training should be two weeks (including travel time). Training should be "on-the-job," demonstrating the performance of their duties as a daily routine, working side by side with experienced ALKAL storemen. Each trainee should also be fully familiar with the following existing Bina Marga manuals: Pedoman Penyimpanan dan Penyaluran Barang, and Pembukuan Barang Gudang di Lingkungan.

Practice during training should assure that each storeman can manage the forms used in a parts management system, such as:

- Requisition/issue slips,
- Requisition/issue slip registers,
- Requisition and issue vouchers, and
- Requisition and issue voucher registers;

and the forms used for inventory/stock control, such as:

- Bukti Pengeluaran Barang,
- Kartu Persediaan, and
- Kartu Rak.

Samples of these forms are shown in Annex 6.

Effective training for storage bin numbering and spare parts maintenance can easily be done during the same two-week period by simply observing and copying existing ALKAL procedures.

4. Equipment Management. Training in equipment management should be provided to the Chiefs of Equipment Sections on a "one-on-one" and on-the-job basis by the project consultants. This should be preceded by the adaptation of existing Bina Marga procedures for the kabupatens' use in a kabupaten equipment management system. Training should cover the various elements of equipment management such as: equipment control, servicing and repair management, and parts management. Special attention to development of and training in an equipment cost system should be provided by the project consultant equipment engineer.

Training by Private Sources

A possible additional source of training for mechanics/servicemen, workshop foremen and storeman is local firms which represent the vehicle and heavy equipment industry. The following four firms provide training to large fleet owners:

1. Toyota-Astra Motors for Toyota vehicles (trucks, pick-ups, jeeps).

2. P.T. Star Motors for Mercedes Benz vehicles (heavy trucks).

3. P.T. Pantja Motors for Isuzu and G.M. vehicles (trucks, pick-ups).

4. P.T. Trakindo Utama for Caterpillar road equipment (motorgrader, loader, bulldozer).

These equipment suppliers should be contacted to prepare and present proposals for additional training to DPUK personnel. The costs are low, usually limited to transportation and accomodation for trainees. Table 47 summarizes the information available on training by the above firms.

Table 47
TRAINING FOR FLEET OWNERS PERSONNEL BY PRIVATE FIRMS

FIRM and Type of Equipment	Training Directed to	Minimum Educational Level	Duration of Courses	No. of Trainees Per Course	Instructors From	Cost to the Project	Possible Location of Training
TOYOTA-ASTRA MOTORS (Toyota Vehicles)	Mechanics	STM Graduates	2 week courses, in stage system	?	Toyota Astra Motor . Trained in Japan . Manuals	.Transportation .Accomodation for Trainees and Instructors	Jakarta Facilities and at 8 major dealers
P.T. STAR MOTORS (Merc.Benz Heavy Trucks)	Mechanics	STM or SLTA Graduates	3 months	30 Trainees per year	Star Motors Technicians trained in Germany	.Transportation .Pocket Money .7% of direct training costs = (Rp. 75.000)	Jakarta Training Center (has dormitory)
P.T. PANTJA MOTORS (Izusu and G.M. Vehicles)	Mechanics, Service-men, Shop foremen, Supervi-sors	?	?	?	?	?	Jakarta Training Center
P.T. TRAKINDO UTAMA (Caterpillar equip-ment)	Mechanics, Service-men, Spare Parts Storemen	STM Graduates	?	50 Trainees	?	?	?

The training specialist in the technical assistance team should assist in gathering any additional information necessary and coordinate any training provided by private firms.

10.9. THE ROLE OF NATIONAL, PROVINCIAL AND LOCAL ORGANIZATIONS IN THE DRMS PROJECT

The GOI organizations that play important roles in support of the DPUK/DPUP Cabang Dinas are:

- Bagian Pembangunan and BAPPEDA II;
- Sub Dinas Bina Marga, DPUP;
- Bidang Peralatan & Perbekalan (ALKAL), Kanwil;
- Sub-directorate of Local Roads, Dit Jen Bina Marga;
- Ministry of Home Affairs (BANGDA) and the Project Management Unit (PMU), and
- Bidang Diklat Bina Marga

10.9.1. Bagian Pembangunan and BAPPEDA II

These offices at the kabupaten level should continue to work with the DPUK/DPUP Cabang Dinas in the selection of reconstruction projects. Their criteria for selecting particular road links should be broadened to place additional weight on traffic data. They could also begin to analyze the movement of cash crops and to monitor changes in transport prices after road improvements have had time to take effect. Such data would be helpful to measure the broad benefits of good construction and effective maintenance.

10.9.2. Sub Dinas Bina Marga

The provincial Sub Dinas Bina Marga has considerable skilled staff and facilities to offer to kabupaten Public Works institutions. Under the project, both the DPUP Cabang Dinas and the DPUK should establish close working ties with the Sub Dinas Bina Marga. For the DPUP Cabang Dinas in NTT the official connection already exists. For DPUKs there is an instruction letter (No. 620/975, BANGDA) which sets forth five areas of cooperation between the DPUP and the DPUK in: technical guidance, planning, implementation, equipment, and technology transfer.

It would seem that the necessary authority for close cooperation already exists. In fact, the field visits confirmed that there does appear to be a close working relationship between the two which can be strengthened during the project. For the most part it is the DPUP which should give assistance to the DPUK. The flow of assistance will be mostly top/down. Some of the specific functions in which the DPUP should play a more active role are listed below.

Training - The DPUP has the more experienced staff of instructors and has some training facilities. It also has access to a large assortment of training courses and better facilities and equipment. The training coordinator at the DPUP (Pedikprop) has experience in implementing courses.

Materials Quality Control - The laboratory facilities and trained technicians at DPUP should be able to assist in any kind of materials testing or materials consulting advice that kabupatens require.

Engineering Design - The staff of the Sub Dinas includes degreed engineers who could help guide kabupaten technicians in preparing project plans. Kabupaten DURP and DUP plans must now be reviewed by the DPUP before going up to the Governor. At present, however, this review is usually only cursory.

Personnel - The educational and staffing levels of the DPUK/DPUP Cabang Dinas should be improved. There are already many individuals working in the kabupaten who are seconded provincial employees. Ideas have been put forward to have new and/or existing DPUK/DPUP Cabang Dinas personnel receive higher education but that would leave vacancies in the kabupaten for several years. If such a program were started, then there should be a policy established whereby the DPUP would loan employees to the kabupatens until the regular employees return. The policy would also help to strengthen the ties between the two organizations.

In the case of vacancies where the kabupaten is having trouble recruiting qualified personnel, the DPUP could provide a qualified individual for the position on a semi-permanent basis. The DPUP could rotate such personnel (with the approval of the Bupatis) but the responsibility for filling the slot would belong to the DPUP.

10.9.3. Bidang Peralatan & Perbekalan (ALKAL), KANWIL PU

The Bidang Peralatan & Perbekalan (ALKAL) already plays an important role in helping meet the equipment needs of the DPUK/DPUP Cabang Dinas. This role should be enhanced.

The Kanwil/ALKAL could, for example, upon request from the DPUK, send ALKAL technicians to kabupatens for a short period of time to work on particular tasks, perhaps to get workshops organized and running while a permanent kabupaten equipment manager is being recruited or the regular employee is undergong long-term training.

Other areas for ALKAL assistance such as major repairs, special training, storage of spare parts, etc. are covered in Section 9.6.

10.9.4. Sub-directorate of Local Roads

This office is responsible for preparing technical standards and guidelines for DPUKs. Basically it adapts such documents from those already prepared by other sub-directorates within the Directorate of

Planning for national and provincial work. It issues some of the standards and guidelines directly to kabupatens and prepares others for BANGDA (Ministry of Home Affairs) to issue.

As stated in Section 9.1 there are several existing standards and guidelines which should be up-dated and new standards must be developed for the maintenance management system (performance standards, work frequency, etc.). Project TA should assist the Sub-directorate in developing the new maintenance standards.

Experience has shown that a good way for handling that procedure is to form a technical panel which will meet periodically to review new standards as they are developed and to approve them for official use by the DPUK/DPUP Cabang Dinas. The Chairman should be the head of the Sub-Directorate of Local Roads with the core membership of the Panel be kept to a minimum; it should consist of at least one or two other officials from the Sub-Directorate, the TA Project Manager, perhaps one or more chiefs of DPUK/DPUP Cabang Dinas, and perhaps also a representative from BANGDA. Other experts would be invited to sit on the panel as the need for special expertise occurs.

The panel could also review existing standards and guidelines. If any of those affect other donor projects, other donor representatives should be encouraged to submit their suggestions and attend the sessions.

10.9.5. Project Management Unit (PMU)

The PMU should continue in its current role as an expediter of project implementation and disbursements. It has proven successful in these tasks in other donor projects.

10.9.6. Bidang Diklat Bina Marga

The main goal of the DRMS Project is to strengthen the institutional capability to conduct maintenance. Project TA, through on-the-job training, will introduce to the kabupatens new ways of managing road maintenance and equipment and new methods of construction. The principal recipients of the changes will be DPUK/DPUP Cabang Dinas personnel but the TA alone will not be able to instruct all those who must learn new procedures and methods. An effective training program will also be required.

Project consultants should bear primary responsibility for the administrators' and workshop staffs' on-the-job training in how to manage the new systems. Those individuals are relatively few in number. The major targets for formal training programs should be field foremen, supervisors, operators, workers, equipment servicemen and others.

A tentative program of specific courses, some existing and some new, is explained in Section 10.8. Both the development of new courses and their implementation as well as utilization of existing courses will require close coordination between the Bidang Diklat Bina Marga and the project TA.

The Bidang Diklat should do the actual course production of any additional courses required but project TA should assist with course identification, design, and selection of trainees. The Provincial Training Officer can offer valuable assistance in setting up courses, arranging for facilities, equipment, etc. Project TA should also suggest improvements to existing courses and provide valuable feedback to the Bidang Diklat on course effectiveness.

Whatever assistance Bidang Diklat provides will require funding since the organization operates as a project and thus most of its efforts are funded through various DIPs rather than from a routine budget. USAID should consider funding any new course development with the GOI financing course implementation.

11. DRMS PROJECT DESIGN

11.1. INTRODUCTION TO THE MAINTENANCE MANAGEMENT SYSTEM

A maintenance management system provides a framework for planning, organizing, directing and controlling road maintenance. The key elements and their purposes are noted below.

11.1.1. Planning

Up-to-date data and planning standards are used to plan maintenance work. With a list of each distinct maintenance activity in measurable units of work, standards of work frequency, related road inventories of road elements and features, and the average performance per crew-day (performance standards), an annual work program can be formulated. The work program indicates the total amount of work and the required crew-days for each different maintenance activity. By multiplying the number of crew-days by the cost per crew-day (broken down by resource), a budget can be obtained for each of the activities in terms of total work quantity and total crew-days. Multiplying the same crew-days by the crew-day resource cost, the total cost of each resource can be known for each activity as well as the entire work program. The completed document is known as the annual work program and budget.

The work program and budget becomes an effective management tool for planning and justifying the total maintenance program. It allows managers to measure performance by, for example, comparing work crew achievement to the planned work crew performance standard. It can also be adjusted upward or downward to meet the realities of funding and resource availability. It is the basis for the next step.

11.1.2. Organizing

The next step is to prepare the annual work calendar so that the workload is scheduled to be performed at the optimum time and the demands on resources (staff, equipment and materials) are balanced as evenly as possible.

The work calendar is prepared using such variable data as weather, harvest season variations in traffic volume, and availability of temporary personnel. The work calendar then serves as the basis for planning and scheduling training, equipment overhauls, vacation periods, etc.

By balancing the workload, called resource leveling, the rate of use of a major resource (equipment or personnel) can be kept at an even level throughout the year, eliminating periods of excesses or shortages in that resource. The other resources can then be adjusted accordingly.

11.1.3. Directing

Based on the annual work calendar and the ever-changing condition of road features, short-term (bi-weekly, weekly or daily) field work orders can be prepared to suit the circumstances and still accomplish all the work that needs to be done. The performance standards mentioned above guide the scheduling of staff to allocate the resources effectively and allow foremen to perform each activity in the approved manner. The field work order becomes the source document for controlling the work.

11.1.4. Controlling

Work must be controlled to be effective. It must be performed according to scheduled needs and it must be efficient. The maintenance manager must know if the work is being carried out according to the work program and budget. He periodically needs to know how much work has been accomplished and at what average cost.

This information must also reach the manager in time for him to take the appropriate corrective action. If production has slowed dramatically or costs are rising too high, the manager must act quickly and return the situation to normal.

The field work order is the basis for the manager's control and is used to report the work production and resources utilized. That information is summarized and tabulated at the local level and a monthly progress report is presented to the manager. Copies should be sent to higher authorities as well.

The maintenance management system is a continuous cycle which becomes more efficient with time. Lessons learned in the execution of work and the corrective actions taken are used by planners for the next year's maintenance program. Performance standards and work frequency standards are adjusted accordingly and a more realistic work program and budget is prepared for the following year.

Maintenance management systems have been adopted in many countries. They are not complicated and are all based on the pattern described above. Further details are provided in the following publications:

1) National Association of County Engineers
   Action Guide Series - Volume VIII
   Maintenance Management

2) Transportation Research Board
   Transportation Technology Support for Developing Countries
   Synthesis 1 - Maintenance of Unpaved Roads.

11.2. DRMS PROJECT PLAN OF ACTION: PREPARATION AND IMPLEMENTATION

11.2.1. Objectives

The main objective of the DRMS Project is to strengthen the management of district road maintenance. Good maintenance management requires well-trained personnel, the right kind of equipment, and good quality materials. It also requires a maintenance management system that is adaptable to local conditions and can be adjusted as conditions change. Finally, roads must be in acceptable condition for the maintenance work to be effective.

The project will be the first of its kind in Indonesia. There are considerable constraints that the project must overcome, including resistance to change, perceptions of maintenance, the remoteness of some of the locations, and lack of familiarity with modern methods of work and management techniques. Others may include: delays in budget (DIP) approvals causing layoffs of personnel and stoppage of contracts, difficulties in obtaining spare parts, shortages and poor quality of some materials, conflicts of interest between provincial and kabupaten officials, and communications and travel delays. Thus, for the project to serve as a model, its objectives should not be over-ambitious. It should be recognized that improvements will be gradual.

The project should be divided into two phases: preparatory and implementation. The preparatory phase should last approximately twelve months. The implementation phase should last approximately six or seven years (see Figure 6).

It is also recommended that on-the-ground work during the implementation phase begin in a few kabupatens only. It will take time to develop the various elements of the maintenance management system and the local project consultants will need to be trained in how the system works before they can fully assist the staffs of all the kabupatens where they will be assigned. In addition, close supervision by the limited expatriate staff should initially be focused on a few kabupatens in order to concentrate on developing effective force account and contractor work methods that can later be adopted elsewhere.

Last, while the first implementation year (First Year) programs are being tested and developed in the pilot kabupatens, the consultants will be able to guide any reorganization, staffing and equipment redistribution in the other kabupatens which was not completed for the First Year. As soon as these remaining kabupatens fulfill these requirements, they should be incorporated into the project program.

11.2.2. Preparatory Phase

This period would begin after the loan agreement is signed and end when the long-term project technical assistance is on site.

Figure 6

DRMS PROJECT SCHEDULE

CALENDAR YEAR	1986	1987	1988	1989	1990	1991	1992	1993	1994
I.F.Y.	1986/1987	1987/1988	1988/1989	1989/1990	1990/1991	1991/1992	1992/1993	1993/1994	1994/1995
5 YR. PLAN	REPELITA IV			REPELITA V					
Engage PSC consultants	X								
PSC ends		X							
Long-term TA begins		X							
Reconstruction & Maintenance Pgms. begin		X							
Tentative end of the project									X

The principal preparatory task should be the verification of the reconstruction program. Considerable data (traffic counts and road condition) must be collected quickly to verify the scope of the reconstruction program. This, in turn, will be the basis for the final planning of other tasks such as equipment redistribution and procurement, the selection of which will allow the kabupatens to start a full maintenance program in the first implementation year and fulfill their staffing requirements.

Other major tasks include contracting the TA, procuring capital equipment, building new workshops and completing existing ones, and setting up the detailed administrative procedures for directing and controlling all activities. The GOI will need to reorganize and staff the DPUK/DPUP Cabang Dinas, redistribute existing equipment, prepare training courses, etc. Performance standards will also need to be prepared to initiate the maintenance management system in the first implementation year.

The GOI and USAID will require the assistance of a small team of consultants to plan and execute all of these tasks. Three foreign consultants are recommended. Two engineers with at least 10 years' experience are needed, one in the field of low volume road maintenance and construction management, and one in equipment management. They should have previous experience with implementing a maintenance management system. The third should be a senior training specialist with experience in highway and equipment training programs. They must be able to work together as a team, with the highway engineer serving as the team leader.

These consultants should be hired as soon as possible under personal service contracts (PSC). The period required would be approximately nine months. All three should be based in Jakarta but there will be considerable travel to the provinces for the highway and equipment engineers.

Each PSC consultant should have a local consultant as a counterpart. They should have more than six years' experience in their respective fields and should be able to travel with the PSC team. An office furnished by Bina Marga will be required.

A tentative list of specific preparation phase tasks for USAID, the GOI, and the PSC team are listed below.

<u>USAID:</u>

- Prepare TA TOR, tender and negotiate the long-term technical assistance contract;

- Make final the first year plan and engage six PSC consultants [three expatriates plus three Indonesians (highway, equipment, training)] to assist with first year tasks;

- Establish ground rules with the GOI for the reconstruction program;
- Based on more detailed traffic and condition surveys, calculate the reconstruction and maintenance programs and draw up a preliminary plan and budget for GOI funding and USAID reimbursement; and
- Execute tender documents for equipment and tools to be purchased.

GOI (Working with USAID & PSC consultants)

- collect the necessary data to verify the reconstruction program (traffic, inventory update, condition survey update);
- see that the appropriate first year links are selected and reconstruction plans are drawn up in accordance with standard acceptable practice;
- inform potential bidders that contract specifications will be enforced for all work and that payment will not be authorized until all substandard work is corrected;
- reorganize the Roads Divisions of the pilot DPUK/DPUP Cabang Dinas;
- recruit and assign to the pilot kabupaten, permanent staff (managerial, technical, field supervisors, mechanics, operators);
- redistribute existing construction and maintenance equipment to the pilot kabupatens;
- make all required improvements to the pilot kabupaten workshops (plumbing and water supply, electricity wiring, sanitary facilities);
- draw up plans and contract documents for the additional workshops in the other project kabupatens;
- inventory and review existing short-course materials in the fields of maintenance and construction management, and equipment maintenance and operations; and
- begin to develop training courses for any supplemental training.

PSC Highway Consultants (1 Expat + 1 Local)

- Supervise collection of basic road data (traffic, inventory, road condition);

- As the field data become available, verify the reconstruction program and the resulting maintenance program;

- Prepare final list of materials testing equipment and assist the equipment consultants in preparing equipment lists and tender documents;

- Assist the GOI to select the pilot (demonstration) kabupatens (perhaps more than one) in each province, considering: the capacity of present road personnel; the GOI's progress in reorganizing and staffing the road and equipment sections; the amount of km in good condition for the first year maintenance program; the equipment workshop, etc.;

- Review reconstruction drawings and specifications budgets and maintenance plans for the first year of implementation in the pilot and other kabupatens. Assist in establishing the understanding that only those reconstruction projects that meet USAID's requirements will be eligible for certification and reimbursement;

- Advise USAID on the sufficiency of DIP funds; and

- Advise on the acceptability of organizational structures for those kabupatens which do not wish to adopt the model structure.

PSC Equipment Consultants (1 Expat + 1 Local)

- Plan and supervise the collection of an equipment data base (inventory, condition and usage, specifications, vendors, rental companies, rental rates, etc.);

- As the reconstruction and maintenance programs are verified, complete the lists of equipment to be purchased (heavy equipment, shop equipment) and assist in preparing the tender documents;

- Possibly prepare a plan to acquire a limited spread of equipment for the pilot kabupatens in the event that normal tendering procedures will not allow delivery of the equipment in time for the beginning of the full implementation phase;

- Assist the highway consultant in advising on the selection of pilot kabupatens;

- Make sure that sufficient equipment units for reconstruction and maintenance are reassigned and in place in the pilot kabupatens when the implementation phase begins; and

- o Advise on the reorganization and staff of the DPUK/DPUP Cabang Dinas in the pilot and other kabupatens.

PSC Training Specialists (1 Expat + 1 Local)

- o Assist the GOI to review all existing training materials and select those which are useful for the DRMS Project (principally those dealing with work methods, construction and maintenance for foremen, supervisors, operators and mechanics);
- o Help Diklat Bina Marga to collect, catalog and organize a set of reproduceable masters of useful existing training materials;
- o Draw up a plan and budget for the Diklat to develop those courses which will be useful but do not already exist. Work with the highway and equipment consultants to prepare the master list;
- o Assist the Diklat to outline the curricula for new courses which could be prepared;
- o Supervise an inventory of existing training facilities and resources that could be used for project training; and
- o Assist the Diklat to continue the development of the recently initiated series of courses for construction supervisors. (IBRD Manpower Development Project).

11.2.3. Implementation Phase

During this period the major objectives of the project will be met. The kabupatens will adopt the maintenance and equipment management systems, a significant part of the networks will be reconstructed, and both force account crews and contractors will learn improved methods of construction.

The project should plan for modest accomplishments in the early years, which will increase as the project progresses. The recommended reconstruction program will start slowly, but increase gradually in volume for the subsequent three years. The maintenance program should begin by focusing the work on only the acceptable kilometers in the First Year of implementation, increasing as the reconstruction program adds more "good" roads to the network. Training should begin as a modest program concentrating on the pilot kabupatens and spreading to the remaining kabupatens as the courses are evaluated and improved.

A major objective for the first year of implementation should be to develop and begin to apply the maintenance management system for the kabupatens. This is not conceptually difficult nor complex. However, it must proceed in a measured, step-by-step manner and will require PSC and/or long-term TA consultants to guide the process. A detailed explanation of the steps is provided in Annex 29 and summarized below.

1. Orient Staff: explain the purpose and procedures of maintenance management to all GOI personnel who will play a role in the project;

2. Define Work Activities: define each discrete activity required to conduct maintenance and define the units in which the need for each activity will be measured (number of culverts, for example, governs the amount of culvert cleaning activity);

3. Conduct Work Inventories: survey the number, location and condition of all road features for which maintenance may be required;

4. Determine Levels of Effort: estimate the amount of work per year required per unit of activity measurement, e.g., six kilometers of motorgrader per kilometer of maintainable engineered gravel road;

5. Develop Performance Standards: define the optimum crew size, equipment, materials and work methods required for each maintenance activity and calculate the average daily production expected from each crew;

6. Prepare Work Program and Budget: combine an assessmnt of maintenance needs (based on work inventories above) with the assignment of staff, equipment materials, and funds required to address them. Assign priorities to the activities to be performed to adjust the workload to the level of funds available and to the need to level the workload over the fiscal year;

7. Establish a Work Calender: schedule the work, equipment and materials by crew activity and by month to achieve the targets of the work program;

8. Assign Schedules and Report Requirements: each work crew chief is given a schedule of the work to be done and the resources required to do it. These are based on the performance standards above. Periodic report requirements on actual performance are set; and

9. Monitor Performance and Refine Performance Standards Accordingly.

The first year of implementation should also include the initiation of equipment management systems in the pilot kabupatens. Reconstruction should commence, although modestly at first. The lessons learned in the pilot kabupatens should be applied as full project implementation starts in the remaining kabupatens.

Once the systems are being implemented in all project kabupatens, the project consultants should continue to supervise the application of the systems and help to refine their elements. Gradually, however, the kabupaten staffs will take full responsibility for managerial functions in the field and the workshop, identifying where and what kind of corrective action should be taken to keep the systems operating as planned.

As the project nears completion and kabupaten staffs take over, the GOI and consultants should document the maintenance and equipment systems in manuals for permanent use in the project kabupatens and for review as the basis for expanding to other kabupatens. The consultants should also assist in preparing a plan for adopting the systems in other kabupatens.

ANNEXES

ENGINEERING AND ECONOMIC CONSIDERATIONS FOR THE DISTRICT ROADS MAINTENANCE SYSTEMS PROJECT

Parsons, Brinckerhoff International

August 1986

214

CONTENTS

1. Summary by Kabupaten of Maintenance Equipment Requirements for Years One and Four

2. Sample Bina Marga Equipment Inventory Sheets

3. Sample DPUP Equipment Inventory Sheets

4. Sample Bina Marga Equipment Use Record Book

5. Sample Bina Marga Equipment Service Card

6. Sample Bina Marga Equipment Issue Slip

7. Sample Bina Marga Stock Card

8. Sample Bina Marga Work Order Form for Equipment Repair

9. Sample Bina Marga Form LBPP for Equipment Monthly Utilization Reporting

10. Existing Bina Marga Form No. LLP5 for Equipment Repair Reporting

11. Existing Bina Marga Worksheets for Equipment Repair Reporting

12. Existing Bina Marga Instructions and Worksheets for Equipment Use Control

13. Sample Technical Specifications for Workshop Equipment

14. Sample Public Works Technical Specifications for Reconstruction Equipment and Recommended Performance Specifications for Reconstruction Equipment

15. Sample Technical Specifications for Support Equipment

16. Sample Technical Specifications for Maintenance Equipment

17. Sample Rental Rates for Kabupaten-Owned Equipment

18. List of Recorded Video Cassette and Slide-Tape Courses for Equipment and Work Methods

19. Worksheet Calculations by Kabupaten of Maintenance Equipment Requirements for Years One and Seven

20. Sample Observations of Utilization of OECF Equipment

21. Nairn Report Excerpt: AWCAS vs. Macadam

22. Facilities of Local Representatives of Major Equipment Manufacturers

23. Economic Tables

24. Unit Cost Calculations

25. Technical Support to Kabupatens by BANGDA

26. Letters from Director General of BANGDA (June 24, 1982) and Director General of Bina Marga (January 27, 1986)

27. Bina Marga Work Classifications for Workshops

28. Recommended Kabupaten Workshop Equipment

29. Steps for Developing and Implementing a Maintenance Management System

30. Procedure for Deriving Interpolated Values in Reconstruction Selection Table (Table 38)

31. History of Contract and Force Account Roadwork Implemented by the Fourteen Study Kabupaten

32. Recommended Technical Assistance

ANNEX 1

SUMMARY BY KABUPATEN OF
MAINTENANCE EQUIPMENT REQUIREMENTS
FOR YEARS ONE AND FOUR

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: PINRANG
Province : SULSEL

ITEM NO.	TYPE OF EQUIPMENT	Required at Beginning of 1st year	Required at Beginning of 4th year
1	Dump Trucks, 3.5 ton	6	7
2	Motorgrader, 100 HP	1	2
3	Wheel loader, 1.2 m3	1	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 1st year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: SIDRAP
Province : SULSEL

ITEM NO.	TYPE OF EQUIPMENT	Required at Beginning of 1st year	Required at beginning of 4th year
1	Dump Trucks, 3.5 ton	3	10
2	Motorgrader, 100 HP	1	1
3	Wheel Loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	3
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

219

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: WAJO
Province : SULSEL

ITEM NO.	TYPE OF EQUIPMENT	Required at	
		Beginning of 1st year	Beginning of 4th year
1	Dump Trucks, 3.5 ton	2	7
2	Motorgrader, 100 HP	1	2
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: BONE
Province : SULSEL

ITEM NO.	TYPE OF EQUIPMENT	Required at beginning of 1st year	Required at beginning of 4th year
1	Dump Trucks, 3.5 ton	3	9
2	Motorgrader, 100 HP	1	3
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	2
5	Water Tank Truck, 4.000 lt.	1	2
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	2
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

221

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: GOWA
Province : SULSEL

ITEM NO.	TYPE OF EQUIPMENT	Required at beginning of 1st year	Required at beginning of 4th year
1	Dump Trucks, 3.5 ton	2	7
2	Motorgrader, 100 HP	1	1
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: JENEPONTO
Province : SULSEL

ITEM NO.	TYPE OF EQUIPMENT	Required at	
		Beginning of 1st year	Beginning of 4th year
1	Dump Trucks, 3.5 ton	7	8
2	Motorgrader, 100 HP	2	3
3	Wheel loader, 1.2 m3	1	1
4	Roller, Vibratory, self-propelled, 6 ton	1	2
5	Water Tank Truck, 4.000 lt.	1	2
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	2
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 1st year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: BULUKUMBA
Province : SULSEL

ITEM NO.	TYPE OF EQUIPMENT	Required at Beginning of 1st year	Required at Beginning of 4th year
1	Dump Trucks, 3.5 ton	2	7
2	Motorgrader, 100 HP	1	2
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: KUPANG
Province : NTT

ITEM NO.	TYPE OF EQUIPMENT	Required at Beginning of 1st year	Required at Beginning of 4th year
1	Dump Trucks, 3.5 ton	6	7
2	Motorgrader, 100 HP	1	2
3	Wheel loader, 1.2 m3	1	1
4	Roller, Vibratory, self-propelled, 6 ton	1	2
5	Water Tank Truck, 4.000 lt.	1	2
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer, 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 1st year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: T.T.S.
Province : NTT

ITEM NO.	TYPE OF EQUIPMENT	Required at beginning of 1st year	Required at beginning of 4th year
1	Dump Trucks, 3.5 ton	2	7
2	Motorgrader, 100 HP	1	2
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	2
5	Water Tank Truck, 4.000 lt.	1	2
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: BELU
Province : NTT

ITEM NO.	TYPE OF EQUIPMENT	Required at Beginning of 1st year	Required at Beginning of 4th year
1	Dump Trucks, 3.5 ton	1	6
2	Motorgrader, 100 HP	1	1
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: SUMBA BARAT
Province : NTT

ITEM NO.	TYPE OF EQUIPMENT	Required at beginning of 1st year	Required at beginning of 4th year
1	Dump Trucks, 3.5 ton	1	6
2	Motorgrader, 100 HP	1	1
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: MANGGARAI
Province : NTT

ITEM NO.	TYPE OF EQUIPMENT	Required at Beginning of 1st year	Required at Beginning of 4th year
1	Dump Trucks, 3.5 ton	2	7
2	Motorgrader, 100 HP	1	2
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	2
5	Water Tank Truck, 4,000 lt.	1	2
6	Flat Bed Truck, 4.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: NGADA
Province : NTT

ITEM NO.	TYPE OF EQUIPMENT	Required at beginning of 1st year	Required at beginning of 4th year
1	Dump Trucks, 3.5 ton	1	6
2	Motorgrader, 100 HP	1	2
3	Wheel loader, 1.2 m3	0	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 4th year.		

230

EQUIPMENT REQUIREMENTS
ROAD MAINTENANCE EQUIPMENT

Kabupaten: [illegible]
Province : NTT

ITEM NO.	TYPE OF EQUIPMENT	Required at beginning of 1st year	Required at beginning of 4th year
1	Dump Trucks, 3.5 ton	5	6
2	Motorgrader, 100 HP	1	1
3	Wheel loader, 1.2 m3	1	1
4	Roller, Vibratory, self-propelled, 6 ton	1	1
5	Water Tank Truck, 4.000 lt.	1	1
6	Flat Bed Truck, 3.5 ton	1	1
7	Hand Compactor	1	1
8	Paddlewheel Mixer 0.5 m3	1	1
9	Concrete Mixer, 0.25 m3	1	1
	Obs. - Regraveling operation starts at the beginning of 1st year.		

ANNEX 2

SAMPLE BINA MARGA EQUIPMENT INVENTORY SHEETS

DEPARTEMEN PEKERJAAN UMUM
PENGUASA BARANG: .....

KARTU INVENTARIS BARANG
(KIB)

KELOMPOK : Alat besar darat/apung/bengkel bermesin *)
SUB KELOMPOK : .....
SUB SUB KELOMPOK : .....

a. No. KIB : .....
b. No. Register : .....
c. No. Register lama : .....
d. No. Sensus : .....

I. URAIAN BARANG

a. Nama jenis : .....
b. Merk : ..... c. Type/Th : .....
d. No. Seri/Rangka : ..... e. Pabrik/Negara : .....
f. Kapasitas/Daya kerja : [1] HP [2] KVA [3] Ton per detik [4] Ml per detik [5] Jp [6] Kg/Cm² [7] Pa [8] Ml [9] Cu M [10] Kg [11] Ton [12] Hm [13] Cm [14] M [15] Inch [16] Feet [17] .....

II. KONSTRUKSI/SISTEM

a. Sistim operasi : [1] manual [2] hydrolis [3] pneumatis/angin [4] Hydraulis [5] .....
b. Dudukan peralatan : [1] terpasang tetap [2] transportable [3] mobile [4] .....
c. Power train : [1] direct [2] power shift [3] .....

III. BAGIAN UTAMA: MOTOR UTAMA (TERBESAR)

a. Merk : ..... b. Type/Tahun : .....
c. No. Seri : ..... d. Kapasitas/daya : .....
e. Pabrik/Negara : ..... f. Sistim pendingin : [1] Air [2] Ub [3]
g. Sistim pembakaran/kerja : [1] diesel [2] bensin [3] listrik [4] pneumatis/angin
h. Sistim Start : [1] mekanis [2] listrik [3] pneumatis/angin

IV. BAGIAN BAGIAN/PERLENGKAPAN/PERTELENGKAPAN

	[1]	[2]	[3]
a. Nama			
b. Merk			
c. Model/Tahun			
d. Pabrik/Negara			
e. Kapasitas/Daya			
f. No. Seri			
g. Sistim pembakaran/kerja			

V. PENGADAAN

a. Cara perolehan : [1] beli [2] hibah [3] hadiah [4] dibuat sendiri [5] .....
b. Dari : .....
c. Berdasarkan : [1] Kontrak [2] S.P.K. [3] Surat pesanan/order [4] Surat keputusan
d. Berita Acara serah terima : Nomor : ..... Tanggal : .....
Nomor : ..... Tanggal : .....
e. Kondisi perolehan: [1] Baik dan baru [2] Baik [3] Rusak ringan [4] Rusak berat [5] Rusak NS
[1] Berfungsi [2] Berfungsi kurang sempurna [3] Tak berfungsi
f. Harga perolehan : Harga dasar ..... = Rp. .....
Biaya pengurusan = Rp. .....
Harga keseluruhan (Harga perolehan) = Rp. .....
g. Dasar harga : [1] c & f [2] CIF [3] FOB [4] Ex. Factory (EX) [5] Total [6] Taksiran
h. Sumber dana : [1] APBN [2] Kredit Grant/Aid [3] Non budgeter.
i. Surat surat/dokumen lainnya : No. .....

VI. PENGURUS BARANG

a. Nama : .....
b. Alamat : .....

VII. KEADAAN FISIK SAAT PENCATATAN

a. Kondisi barang : [1] Baik [2] Rusak ringan [3] Rusak berat [4] Rusak sama sekali
[1] Berfungsi [2] Berfungsi kurang sempurna [3] Tak berfungsi
b. Perlengkapan : [1] Terpasang .....
[2] Cadangan .....
c. Lokasi/Alamat barang : .....

CATATAN PENGISI

.....
.....
.....

Disetujui tanggal : ..... Diisi tanggal : .....
Nama : ..... Nama : .....
Jabatan : ..... Jabatan : .....
Tanda tangan : ..... Tanda tangan : .....

*) Coret yang tidak perlu

DEPREUDPUS

2-1

333

CATATAN MUTASI / PERUBAHAN

No. Urut	Mutasi Perubahan		Keterangan data pendukung
	Tanggal	Uraian	

DEPARTEMEN PEKERJAAN UMUM
PENGUASA BARANG: .....

KARTU INVENTARIS BARANG
(KIB)

KELOMPOK : Alat Angkutan
SUB KELOMPOK : .....
SUB SUB KELOMPOK : .....

a. No. KIB : .....
b. No. Register : .....
c. No. Register lama : .....
d. No. Sensus : .....

I. UMUM BARANG

a. Nama jenis : .....
b. Merk : ..... c. Type/Ukuran : .....
d. No. Seri/No. Rangka : .....
e. Pabrik/Negara : ..... g. No. Polisi : .....
f. Perakitan/Negara : .....
h. Kapasitas/Daya muat : [1] Penumpang [2] Ton [3] [4] [5] dll/lain

II. KONSTRUKSI/SISTEM

a. Bau : Hk ..... x ..... (ukuran)
b. Sistim penggerak : [1] Obdhwand [2] Achterwd [3] Enjhdhydrs [4] four wheel drive [5] long wheel drive [6] .....
c. Rem/Pengendalian : [1] na. Lamp. [2] hydrdlis [3] pneumatis [4] ..... [1] dmm [2] disc [3] kombi baling baling mesin
d. Kaging : [1] kombi plat [5] ..... [1] Lemp [2] bazalt [3] langsung [4] .....

III. MOTOR PENGGERAK

a. Merk : ..... b. Type/Hk : .....
c. Kapasitas : ..... HP d. Pabrik/Negara : .....
e. No. Seri : ..... f. Silinder : CC
g. Sistim pendingin : [1] Udara [2] Air [3] .....
h. Sistim Start : [1] na Lantrum [2] pneumatis/angin [3] Manual [1] listrik
i. Sistim pendekatan : [1] diesel [2] bensin [3] ..... [1] 4 tak [2] 2 tak [3] .....

IV. BAGIAN BAGIAN LAIN/PERLENGKAPAN

a. Nama	b. Merk/Type/Ukuran	c. Banyaknya	Keterangan
1.	.....	.....	.....
2.	.....	.....	.....
3.	.....	.....	.....
4.	.....	.....	.....

V. PENGADAAN

a. Cara perolehan : [1] beli [2] hibah [3] hadiah [4] dibuat sendiri [5] .....
b. Dari : .....
c. Berdasarkan : [1] Kontrak [2] SPK [3] Surat perintah/order [4] Surat keputusan
Nomor : ..... Tanggal : .....
d. Berita Acara serah terima : Nomor : ..... Tanggal : .....
e. Kondisi perolehan : [1] Baik dan baru [2] Baik [3] Rusak ringan [4] Rusak berat [5] Rusak SS [1] Bertungsi [2] Bertungsi kurang sempurna [3] Tak bertungsi
f. Harga perolehan : Harga dasar ..... = Rp. .....
Biaya pengurusan = Rp. .....
Harga keseluruhan (Harga perolehan) = Rp. .....
g. Dasar harga : [1] C & F [2] CIF [3] FOB [4] Ex. Factory (EF) [5] Lokal [6] Lainnya
h. Sumber dana : [1] APBN [2] Kredit/Grant/Aid [3] Rutin budgeter
i. Surat surat/dokumen lainnya : No. .....

VI. PENGURUS BARANG

a. Nama : .....
b. Alamat : .....

VII. KEADAAN FISIK SAAT PENCATATAN

a. Kondisi barang : [1] Baik [2] Rusak ringan [3] Rusak berat [4] Rusak sama sekali [1] Bertungsi [2] Bertungsi kurang sempurna [3] Tak bertungsi
b. Perlengkapan : [1] Lengkap ..... [2] Cadangan .....
c. Lokasi/Alamat barang : .....

CATATAN PENGISI

.....
.....

Disetujui tanggal : ..... Diisi tanggal : .....
Nama : ..... Nama : .....
Jabatan : ..... Jabatan : .....
Tanda tangan : ..... Tanda tangan : .....

2-3

232

CATATAN MUTASI / PERUBAHAN

No. Urut.	Mulai Berlaku		Keterangan dari pencat
	Tanggal	Uraian	

ANNEX 3

SAMPLE DPUP EQUIPMENT INVENTORY SHEETS

PROPINSI DAERAH TINGKAT I : NUSA TENGGARA TIMUR
KABUPATEN/KOTAMADYA DT. II : TIMUR TENGAH UTARA
UNIT :
SATUAN KERJA :
NO. KODE LOKASI : 11.16.01.05

KARTU INVENTARIS BARANG (KIB)
C. KENDARAAN BERMOTOR

Model : Inven. B.

NO REGISTER : 001
NO KODE BARANG : 02.01.03.01.

Jenis Barang / Nama Barang	Merk	Type	CC	Warna	Nomor Rangka	Nomor Mesin	Tahun Pembuatan	Tahun Pembelian	Nomor Polisi	BPKB Tanggal	BPKB Nomor	Asal Usul	Harga	Keterangan
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FLAT BED TRUCK	DATSUN	620-GRUT		MERAH	620-091812	B-043619	1980	1980	DH 5072 KA			Pembelian	Rp. 4.755.000,-	

MENGETAHUI :
KEPALA UNIT / SATUAN KERJA

( )
NIP :

19
KEPALA BAGIAN / PENGURUS BARANG

( )
NIP :

238

3-2

CATATAN MUTASI

Nomor urut	Tanggal Pencatatan	Pemakai		Berita Acara Penyerahan		Keterangan
		Nama	Jabatan	Tanggal	Nomor	
1	2	3	4	5	6	7

MENGETAHUI :

KEPALA UNIT/SATUAN KERJA

( )

NIP :

- Kehilangan
- Kerusakan tabrakan
- Dijual berdasarkan peraturan yang berlaku

KEPALA BIDANG/PENGURUS BARANG

( )

NIP :

PROPINSI DAERAH TINGKAT I : NUSA TENGGARA TIMUR
KABUPATEN/KOTAMADYA DT II :
U N I T : DINAS PEKERJAAN UMUM
SATUAN KERJA : S.B. PIANG BIRU BUSA
NO. KODE LOKASI : 11.16.00.05.

KARTU INVENTARIS BARANG (KIB)

D. BARANG INVENTARIS LAINNYA

Model INV. 3

No Urut	Kode Barang	Nama Barang / Jenis barang	Nomor Register	Merk	Type	Bahan	Tahun Pembelian	Nomor Pabrik	Jumlah/ Ukuran	Satuan	Asal usul/cara Pembelian	Harga (Ribuan Rp.)	Keterangan
1	2	3	4	5	6	7	8	9	10	11	12	13	14
001.	08.01.02.02.	BULLDOZER	001	KOMATSU	4-D-155	BESI	1971				Pembelian / DS APBD I	8.000.–	

MENGETAHUI :
KEPALA UNIT/SATUAN KERJA

( )
NIP :

19
KEPALA BAGIAN/PENGURUS BARANG

( )
NIP :

240

C A T A T A N M U T A S I

No Urut	Nomor Code Barang	Tanggal Pemakaian	Pemakai	Dasar Penggunaan			Dasar Mutasi			Keterangan
				Surat	Tanggal	Nomor	Surat	Tanggal	Nomor	
1	2	3	4	5	6	7	8	9	10	11

MENGETAHUI
KEPALA UNIT SATUAN KERJA

( )
( )

Ia
KEPALA BAGIAN/PENGURUS BARANG

( )
NIP

ANNEX 4

SAMPLE BINA MARGA EQUIPMENT USE
RECORD BOOK

KODE UNIT PERALATAN

SEGERALAH MELAPOR PADA PENGAWAS
MINTALAH BUKU HARIAN YANG BARU

BUKU HARIAN PERALATAN

KODE UNIT PERALATAN

TAHUN	BULAN

NAMA PROYEK/SUB PROYEK

KODE PROYEK

JENIS PROYEK

LOKASI POOL

CATATAN HARIAN PERALATAN

TANGGAL KM/HM

LOKASI (RUAS)

JAM KERJA EFEKTIF	TIDAK BEKERJA (PILIH SALAH SATU)			
	RUSAK	NGANGGUR	IKLIM	LAIN-2

	PEMAKAIAN BAHAN	SATUAN	JUMLAH
1	BENSIN	LT.	....
2	SOLAR	LT	....
3	OLI MESIN	LT	...
4	OLI TRANSMISI	LT.	..
5	OLI HIDROLIS	LT	...
6	GEMUK	KG	....
7	FILTER BAHAN BAKAR	BH	....
8	FILTER OLI MESIN	BH.	...
9	FILTER HIDROLIS	BH	....
10	FILTER UDARA	BH.	....

HASIL KERJA HARI INI

OPERATOR	NAMA	PARAF
PENGAWAS	NAMA	PARAF

PINDAHKAN KE LAPORAN PEMAKAIAN PERALATAN | HAL 1

CATATAN HARIAN PERALATAN

TANGGAL ..... KM/HM .....

LOKASI (RUAS) .....

JAM KERJA EFEKTIF	TIDAK BEKERJA (PILIH SALAH SATU)			
	RUSAK	NGANG-GUR	IKLIM	LAIN-2

PEMAKAIAN BAHAN	SATUAN	JUMLAH
1. BENSIN	LT.	....
2. SOLAR	LT.	....
3. OLI MESIN	LT.	....
4. OLI TRANSMISI	LT.	....
5. OLI HIDROLIS	LT.	....
6. GEMUK	KG.	....
7. FILTER BAHAN BAKAP	BH.	....
8. FILTER OLI MESIN	BH.	....
9. FILTER HIDROLIS	BH.	....
10. FILTER UDARA	BH.	....

HASIL KERJA HARI INI

OPERATOR	NAMA	PARAF
PENGAWAS	NAMA	PARAF

PINDAHKAN KE LAPORAN PEMAKAIAN PERALATAN — HAL. 2

CATATAN HARIAN PERALATAN

TANGGAL ..... KM/HM .....

LOKASI (RUAS) .....

JAM KERJA EFEKTIF	TIDAK BEKERJA (PILIH SALAH SATU)			
	RUSAK	NGANG-GUR	IKLIM	LAIN-2

PEMAKAIAN BAHAN	SATUAN	JUMLAH
1. BENSIN	LT.	....
2. SOLAR	LT.	....
3. OLI MESIN	LT.	....
4. OLI TRANSMISI	LT.	....
5. OLI HIDROLIS	LT.	....
6. GEMUK	KG.	....
7. FILTER BAHAN BAKAP	BH.	....
8. FILTER OLI MESIN	BH.	....
9. FILTER HIDROLIS	BH.	....
10. FILTER UDARA	BH.	....

HASIL KERJA HARI INI

OPERATOR	NAMA	PARAF
PENGAWAS	NAMA	PARAF

PINDAHKAN KE LAPORAN PEMAKAIAN PERALATAN — HAL. 3

CATATAN KONDISI PERALATAN

(DIISI OLEH PENGAWAS/MONTIR LAPANGAN)

☐ GOOD .....

.....

☐ FAIR .....

.....

☐ POOR .....

.....

☐ SCRAP .....

.....

NAMA	JABATAN	TANGGAL	PARAF

PINDAHKAN KE LAPORAN PEMAKAIAN PERALATAN | HAL 32

CATATAN OPERATOR

HAL 33

CATATAN OPERATOR

HAL 36

ANNEX 5

SAMPLE BINA MARGA EQUIPMENT SERVICE CARD

KARTU SERVICE
Jenis peralatan

SERVICE TERAKHIR
TANGGAL _____
KM / HR _____
SERVICE KEMBALI
BERAT / RINGAN

KM / HR
TANGGAL

CATATAN PELUMASAN	PENJELASAN
GANTI OLI MESIN	
GANTI OLI PERSNELING	
GANTI OLI GARDAN	
GANTI OLI STEER	
GANTI OLI REM	
GANTI OLI KOPLING	
GANTI LAIN² OLI/dll	
SARINGAN OLI	
SARINGAN B BAKAR	
SARINGAN Hydr /dll	
Bulanan 125 Jam / 3000 Km	
3 Bulanan 250 Jam / 6000 Km	
6 Bulanan 500 Jam / 12000 Km	
Tahunan 1000 Jam / 25000 Km	

CATATAN :

Form BM No. 009B

KARTU SERVICE
Jenis peralatan.
....
....

SERVICE TERAKHIR
TANGGAL :
KM/HR :
SERVICE KEMBALI
BERAT/RINGAN.

KM / HR : _____
TANGGAL : _____

CATATAN PELUMASAN	PENJELASAN
GANTI OLI MESIN	
GANTI OLI PERSNELING	
GANTI OLI GARDAN	
GANTI OLI STEER	
GANTI OLI REM	
GANTI OLI KOPLING	
GANTI LAIN² OLI/dll	
SARINGAN OLI	
SARINGAN B.BAKAR	
SARINGAN Hydr/dll.	
Bulanan 125 Jam/3000 Km	
3 Bulanan 250 Jam/6000 Km	
6 Bulanan 500 Jam/12000 Km	
Tahunan 1000 Jam/25000 Km	

CATATAN :

Form BM No. 009B.

ANNEX 6

SAMPLE BINA MARGA EQUIPMENT ISSUE SLIP

DEPARTEMEN PEKERJAAN UMUM

BUKTI PENGELUARAN BARANG

NOMOR SERI	KODE GUDANG	TANGGAL	NO PERINTAH KERJA	KODE UNIT PERALATAN
K 6S625 1 - 6	7 - 9	10 - 15	16 - 21	22 - 31

NO STOCK 32 - 40	NAMA BARANG	SATUAN 57 - 58	JUMLAH 59 - 61	HARGA DALAM RP SATUAN	JUMLAH
		KG	2	[illegible]	10 [illegible]

JUMLAH RP

	DIBERIKAN	DITERIMA	DIPUNCH :
TANGGAL			
NAMA			
TANDA TANGAN			

FORM NO 05 BM Lemparan 1 (Laporan Pengeluaran ke Komputer)

ANNEX 7

SAMPLE BINA MARGA STOCK CARD

DEPARTEMEN PEKERJAAN UMUM — KARTU PERSEDIAAN — A

NO STOCK	NOMER ONDERDEL	KODE PABRIK	KODE PERALATAN	SATUAN PENGE-LUARAN	JUMLAH SETIAP BUNGKUS	KATALOG/TANGGAL/HAL/PANGKA	LOKASI
NO STOCK PENGGANTI	NAMA BARANG					TINGKAT MAXI MUM (3 BULAN KEBUTUHAN RUTIN)	
						TINGKAT MINI MUM (1 BULAN KEBUTUHAN RUTIN)	

KARTU KE : .....

YANG AKAN DITERIMA

TANGGAL	NOMER TANDA BUKTI	KODE PEMBERI	JUMLAH	DITERIMA / KEKURANGAN	DITERIMA / KEKURANGAN	DITERIMA / KEKURANGAN

KEKURANGAN

TANGGAL	NOMER TANDA BUKTI	PEMINTA	JUMLAH	DIPENUHI / KEKURANGAN	DIPENUHI / KEKURANGAN	DIPENUHI / KEKURANGAN

PENERIMAAN DAN PENGELUARAN

TANGGAL	NOMER TANDA BUKTI	KODE MINTA	JUMLAH DITERIMA	JUMLAH KEBUTUHAN RUTIN	JUMLAH KEBUTUHAN LUAR BIASA	JUMLAH DIKELUARKAN	JUMLAH PENGE-LUARAN AKHIR

FORM NO 06 BB

HALAMAN 1

7-1

382

KARTU KE . 7-2.... .

YANG AKAN DITERIMA

TANGGAL	NOMER TANDA BUKTI	KODE PEMBERI	JUMLAH	DITERIMA / KEKURANGAN	DITERIMA / KEKURANGAN	DITERIMA / KEKURANGAN

KEKURANGAN

TANGGAL	NOMER TANDA BUKTI	PEMINTA	JUMLAH	DAPENI / KEKURANGAN	DAPENI / KEKURANGAN	DAPENI / KEKURANGAN

PENERIMAAN DAN PENGELUARAN

TANGGAL	NOMER TANDA BUKTI	KODE PEMINTA	JUMLAH DITERIMA	JUMLAH KEBUTUHAN		JUMLAH DIPERGUNAKAN	JUMLAH PERSEDIAAN AKHIR
				RUTIN	LUAR BIASA		

FORM NO 56 88

ANNEX 8

SAMPLE BINA MARGA WORK ORDER FORM
FOR EQUIPMENT REPAIR

PERINTAH KERJA PERBAIKAN PERALATAN

KODE BENGKEL	NO. PERINTAH KERJA	NO. PERMINTAAN	KODE UNIT PERALATAN
1 – 3	42727 (4 – 9)	10 – 15	16 – 23

TGL. PERINTAH KERJA	KM30 [1] JAM 31 [2]	PERALATAN DIATAS DIPAKAI DI	KODE
24 – 29	32 – 36		37 – 38

URAIAN PEKERJAAN :

A	SERVICE	N	CRUSHER
B	ENGINE	O	SCREENING
C	ELECTRICAL SYSTEM	P	CONVEYOR/ELEVATOR
D	FUEL SYSTEM	Q	MIXER
E	HYDRAULIC SYSTEM	R	BOILER/HEATER/BURNER
F	CLUTCH & T. CONVERTER	S	DRYER
G	TRANSMISSION	T	BATCHING
H	STEERING SYSTEM	U	SPRAYING SYSTEM
I	BRAKE SYSTEM	V	WINCH/HOIST SYSTEM
J	AXLE/FINAL DRIVE	W	AUGER/FEEDER SYSTEM
K	WHEEL/TRACK	X	SCREED SYSTEM
L	AIR SYSTEM	Y	ATTACHMENT
M	FRAME/BODY/CHASSIS	Z	EQUIPMENT OVERHAUL

KLASIFIKASI YANG DIKERJAKAN

39 – 46

ESELON PERBAIKAN (LIHAT HALAMAN SEBELAH)

ESELON 1
ESELON 2 ✓
ESELON 3 ✓
ESELON 4
ESELON 5

47

	DIPERIKSA OLEH INSPEKTUR		KEPALA BENGKEL
MASUK	TANGGAL	TANDA TANGAN	TANDA TANGAN
SELESAI	TANGGAL (48 – 53)	TANDA TANGAN	TANDA TANGAN

PERINCIAN BIAYA RP.			KODE KOREKSI	HIC
SUKU CADANG	54 – 61		0 HAPUS DATA	
BAHAN-BAHAN	62 – 69		1 DATA BARU	
UPAH PEKERJA	70 – 77		2 KOREKSI	H
			79	80

Form BM No. 004 B

Lembar ke–1 : dikirim ke Dit. Pelan Ditjen. Bina Marga
ke–2 : dikirim ke Depot Wilayah.
ke–3 : Arsip
ke–4 : dikirim ke Depot Wilayah.
ke–5 : dikirim ke Dit. Pelan Ditjen. Bina Marga

ESELON PERBAIKAN .

ESELON I :

Service	Meliputi pekerjaan pelumasan dan penggemukan serta penggantian saringan bahan bakar & saringan minyak pelumas (fuel filter & oil filter)
Penyetelan ringan	Meliputi pekerjaan penyetelan antara lain pada Fan belt, platina, pengapian, rem, carburator, kelep mesin, kompresi, wheel alignment jaw/Roll/Cone Opening V belt Crawler etc

ESELON II

Perbaikan ringan	Meliputi pekerjaan perbaikan antara lain pada water pump, carburator, Fuel pump electric system, Master Clutch Cylinder, Master brake Cylinder Wheel brake Cylinder, oil pump
Penggantian	Platina, Condensor, distributor Cup, rotor, spark plug, injector, radiator hose timing Chain/belt, timing gear, oil pump, Carburator alternator Starter motor, glow plug, shoe & brake lining, shock absorber, leaf/coil spring, exhaust pipe & muffler, track shoe, jaw/ Roll liner/cone, screen belt Conveyor etc

ESELON III :

Perbaikan sedang	Meliputi pekerjaan perbaikan antara lain pada Fuel injection pump, gerinda klep & dudukan klep mesin, transmisi, P T O , Differential, Final drive Clutch, torque convertor ketok & cat hydraulic system hydraulic motor & pump alternator starter motor electric motor, control valve hydraulic ram jaw/Roll liner/cone/impact hammer, sprocket idler roller, hoist system
Penggantian	Fuel injection pump, transmissin, P T O torque Convesterm main bearing, piston ring valve, cutting adge, toggle plate & seat

ESELON IV .

Perbaikan berat	Meliputi pekerjaan overhaul antara lain pada engine, transmission, P.T.O torque convertor, under carriage, chassis, jaw crusher, cone crusher, impact crusher, rebuild dan modifikasi peralatan jalan

ESELON V .

Rebuild/ membangun kembali.	Rebuild atau membangun kembali peralatan, serta modifikasi peralatan

ANNEX 9

SAMPLE BINA MARGA FORM LEPP
FOR EQUIPMENT MONTHLY UTILIZATION REPORT

DEPARTEMEN PEKERJAN UMUM DIREKTORAT JENDERAL BINA MARGA	FORM **LBPP**	**LAPORAN BULANAN PEMAKAIAN PERALATAN**

TAHUN	NAMA PROYEK/SUB PROYEK	TOTAL PANJANG	NO KUP
	KODE PROYEK	TOTAL TARGET	JENIS PERALATAN
BULAN	JENIS PROGRAM	LOKASI POOL	KAPASITAS

TANGGAL	LOKASI KERJA (RUAS)	JAM KERJA EFEKTIF	JAM TIDAK KERJA				PEMAKAIAN BAHAN										CATATAN
			RUSAK	MENUNG GU	HUJAN	LAIN-LAIN	BAHAN BAKAR		OLI MESIN LT	OLI PS LT	OLI HYDT	GEMUK KG	FIL BB BH	FIL OLI BH	FIL HYD BH	FIL UD BH	
							SOLAR LT	BENSIN LT									
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
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22																	
23																	
24																	
25																	
26																	
27																	
28																	
29																	
30																	
31																	
JUMLAH																	

KONDISI UMUM	DILAPORKAN OLEH	DIKETAHUI OLEH	DITERIMA OLEH	Catatan KM/HR
☐ GOOD ☐ FAIR ☐ POOR ☐ SCRAP				Awal bulan Akhir bulan .

Distribusi

- Lembar 1 & 2 ke Bengkel Prop/Ass Peralatan Proyek.
- Lembar 3 Arsip Sub Proyek

ANNEX 10

SAMPLE BINA MARGA FORM NO. LLP 5
FOR EQUIPMENT UTILIZATION REPORTING

DEPARTEMEN PEKERJAAN UMUM

DIREKTORAT JENDERAL BINA MARGA

B A B : III

BENTUK NO IIP 5.

LAPORAN PEMAKAIAN PERALATAN

Tanggal [ ][ ] 1 2 bulan [ ][ ] 3 4 Tahun [ ][ ] 5 6

LOKASI PEMAKAIAN :

1161 Nama Proyek/Sub Proyek :

1200 Satuan Penanganan :

Kode [ ] [ ][ ] [ ] [ ][ ] 7–12

Kode [ ][ ][ ][ ][ ] 13–18

No. Urut	PERALATAN YANG DIPAKAI			JUMLAH PEMAKAIAN BULANAN SETIAP UNIT PERALATAN			KETERANGAN
	Kode Unit Peralatan	JENIS PERALATAN	kondisi	Jam kerja efektif (jam)	Bahan bakar (liter)	Pelumas (liter)	
	19 – 28		29	30 – 32	33 – 37	38 – 41	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							

	Nama	Jabatan	Tanda-tangan	Tanggal	Catatan :
Dilaporkan / Diterima : Oleh					Kode Kondisi 1. = Baik 2. = Rusak ringan 3. = Rusak berat 4. = Scrap

10-1

1096

ANNEX 11

EXISTING BINA MARGA WORKSHEETS
FOR EQUIPMENT REPAIP REPORTING

SUMMARY
(Unofficial Translation)

I. Form PF 10.HD (Progress and Cost Report for Maintenance by Level of Maintenance)

Instructions: Fill in the name of the workshop and the level of maintenance in the appropriate block and the month of which the report is done. There are 11 columns: 1) numbering; 2) type of equipment, manufacture, code number; 3) type of work; 4) work completed or not completed; 5) man hours; 6) wage; 7) value of parts in rupiah; 8) value of other material used for maintenance in this month in rupiah; 9) total cost; 10) equipment work hours from odometer/hourmeter; 11) name of the user.

II. Form PF 10.GD (Progress and Cost Report for Maintenance Completed in This Month)

Instructions: Fill in name of the workshop and month of report. There are 12 columns: 1) numbering; 2) type of equipment, manufacture, code number; 3) level of maintenance; 4) when started; 5) when completed; 6) person hour; 7) wage; 8) value of parts used in rupiah, 9) value of other material used for maintenance in rupiah; 10) total cost, 11) km/hour worked of the equipment; 12) name of the user.

III. Form PF 10.GHD (Monthly Progress Report on Maintenance Underway).

Instructions: Fill in name of workshop and month of the report. There are 10 columns: 1) numbering; 2) type of equipment; 3) amount of equipment being maintained/repaired; 4) amount of equipment completed; 5) amount of equipment not yet completed; 6) availability of mechanics; 7) availability of tools; 8) availability of parts; 9) availability of funds; 10) equipment waiting for maintenance.

1.

PETUNJUK PENGISIAN

[illegible]

FORMULIR PP [illegible]

FORMULIR PP [illegible] (Laporan rejustasi dan biaya pemeliharaan peralatan tiap tingkat pemeliharaan)

Pembukaan	Cukup jelas.
Tingkat Pemeliharaan	Beri tanda (✓) pada kotak tingkat pemeliharaan yang dilaporkan, sesuai dengan Pedoman Kriteria Pemeliharaan yang berlaku di Departemen Pekerjaan Umum.
B u l a n	Diisi status bulan laporan.
Kolom Nomor Urut	. Cukup jelas.
Kolom Jenis, Merek/Type, Kode Unit Peralatan	Diisi. jenis alat merek/type alat Nomor Kode Unit Peralatan Direktorat Jenderal Bina Marga Contoh Dump Truck Isuzu TLD.545 AL/212/1049
Kolom uraian pekerjaan	Diisi jenis perbaikan yang dilakukan.
Kolom tahap penyelesaian	: Diisi "Selesai" untuk pekerjaan yang sudah selesai dikerjakan diisi "belum" untuk pekerjaan yang belum selesai dikerjakan.
Kolom waktu (orang jam)	· Diisi jumlah jam orang yang diserap untuk pemeliharaan peralatan dalam bulan laporan, tidak termasuk waktu menunggu suku cadang/bahan. Contoh: 5 orang mekanik melakukan overhaul engine selama 20 jam dalam bulan laporan. Jumlah jam orang 5 x 20 jam = 50 jam.
Kolom upah kerja	. Diisi nilai upah yang dihitung sebagai berikut: Jumlah jam orang yang diserap untuk melakukan pekerjaan dalam bulan laporan x upah (take home pay) per jam. Contoh. Upah seorang mekanik Rp 60.000,- per bulan Jumlah jam kerja per bulan = 150 jam Upah per jam = $\frac{\text{Rp } 60.000,-}{150}$ = Rp 400,-
Kolom nilai Suku Cadang	· Diisi nilai rupiah dari suku cadang yang dipakai untuk perbaikan peralatan dalam bulan laporan.
Kolom nilai bahan	· Diisi nilai rupiah dari bahan yang dipakai untuk perbaikan/pelumasan peralatan dalam bulan laporan. Kawat las, besi pelat, besi siku, minyak pelumas, gemuk, dll.
Kolom jumlah biaya	: Cukup jelas.
Kolom kerja alat	: Diisi km/Jam alat yang ditunjukan oleh Odometer/Hourmeter.
Kolom instansi pemakai	: Cukup jelas.

FORMULIR...../2.

FORMULIR nr 11 (Laporan nat 1 dar biaya pemeliharaar peralatan yang selesai dikerjakan pada bulan laporan)

Bengkel	Cukup jelas.
B u l a n	Diisi status bulan laporan.
Kolom Nomor Urut	Cukup jelas.
Kolom Jenis, Merek/ Type, Kode Unit Peralatan	. Diisi jenis alat merek/type alat Nomor Kode Unit Peralatan Direktorat Jenderal Bina Marga Contoh: Dump Truck Isuzu TLD.545 AE/212/1049
Kolom tingkat pemeliharaan	· Diisi tingkat pemeliharaan peralatan yang dikerjakan, sesuai dengan Pedomar Kriteria Pemeliharaan yang berlaku d. Departemen Pekerjaan Umum.
Kolom mulai (tgl.)	Diisi tanggal dimulainya pekerjaan pemeliharaan peralatan.
Kolom akhir (tgl)	Diisi tanggal selesainya pekerjaan pemeliharaan peralatan
Kolom waktu (orang jam)	Diisi jumlah jam orang yang diserap untuk menyelesaikan suatu pekerjaan, tidak termasuk waktu menunggu suku cadang/bahan. Contoh: 3 orang mekanik menyelesaikan pekerjaan overhaul engine selama 40 jam. Jumlah jam orang = 3 x 40 jam = 120 jam.
Kolom upah (Rp.)	: Diisi nilai upah yang dihitung sebagai berikut: jumlah jam orang yang diserap untuk menyelesaikan pekerjaan x upah (take home pay) per jam. Contoh Suatu pekerjaan pemeliharaan peralatan dilakukan oleh 3 orang (A, B, dan C), selesai dalam waktu 136 jam orang. (A.50 jam, B.50 jam, dan C.36 jam) Upah A per bulan Rp 60.000,- Upah B per bulan Rp 75.000,- Upah C per bulan Rp 90.000,- Jumlah upah untuk pekerjaan tersebut: $50 \times \frac{Rp\ 60.000,-}{150} + 50 \times \frac{Rp\ 75\ 000,-}{150} +$ $36 \times \frac{Rp\ 90.000\ -}{150}$ = (Rp 20.000,- + Rp 25.000,- Rp 21.600,-) = Rp 66.600,
Kolom nilai suku cadang	: Diisi nilai rupiah dari suku cadang yang dipakai untuk menyelesaikan pemeliharaan peralatan.
Kolom nilai bahan	. Diisi nilai rupiah dari bahan yang dipakai untuk menyelesaikan pemeliharaan peralatan.
Kolom jumlah biaya	: Cukup jelas.
Kolom kerja alat KM/Jam	. Diisi km/Jam alat yang ditunjukan oleh Odometer/Hour meter.

Kolom ...../3.

3.

Kolom instansi pemakai : Cukup jelas.

FORMULIR PL 16-GrD (Laporan bulanan kegiatan dan hasil pemelinaraan peralatan)

Bengkel — Cukup jelas.

Bulan — Diisi status bulan laporan.

Kolom Nomor Urut — Cukup jelas.

Kolom jenis peralatan — Cukup jelas.

Kolom kegiatan pemelinaraan dalam bulan laporan — Diisi jumlah seluruh peralatan yang sedang dipelinara per tingkat pemelinaraan dalam bulan laporan. (PPPP sudah diterbitkan)

Kolom hasil pemelinaraan/pekerjaan selesai/berakhir pada bulan laporan — Diisi jumlah peralatan yang selesai dipelihara/diperbaiki per tingkat pemelinaraan dalam bulan laporan.

Kolom dapat/belum sempat dikerjakan — Diisi jumlah peralatan yang belum selesai/belum sempat dilaksanakan per tingkat pemelinaraan dalam bulan laporan.

Kolom mekanik — Diisi (X) apabila terbatasnya tenaga mekanik yang menyebabkan pekerjaan pemelinaraan peralatan belum dapat dikerjakan/diselesaikan dalam bulan laporan.

Kolom peralatan bengkel — Diisi (X) apabila tidak tersedianya peralatan bengkel tertentu yang menyebabkan pekerjaan pemeliharaan belum dapat dikerjakan/diselesaikan dalam bulan laporan.

Kolom Suku Cadang — Diisi (X) apabila tidak tersedianya/kelambatan pengadaan suku cadang atau sulitnya dicari dipasaran setempat, yang mengakibatkan pekerjaan pemelinaraan peralatan belum dapat dikerjakan/diselesaikan dalam bulan laporan.

Kolom dana : Diisi (X) apabila tiadanya atau terbatasnya dana suku cadang, yang menyebabkan pekerjaan pemelinaraan Peralatan belum dapat dikerjakan/diselesaikan dalam bulan laporan.

Kolom tunggu giliran — Diisi (X) apabila pemelinaraan peralatan belum dapat dikerjakan/diselesaikan dalam bulan laporan, disebabkan oleh hal-hal lain.

HASIL DAN BIAYA PEMELIHARAAN PERALATAN YANG SELESAI DIKERJAKAN BERAKHIR PADA BULAN LAPORAN

BENGKEL : _____

BULAN : _____

NO.	JENIS, MERK/TYPE KODE UNIT PERALATAN	[illegible]	WAKTU PENGERJAAN DAN JUMLAH SELURUH BIAYA SAMPAI PERGERJAAN SELESAI								INSTANSI TERTAKI
			MULAI (Tgl)	AKHIR (Tgl)	WAKTU (O-J)	JAM PEKERJA (Rp)	N I L A I SUKU CADANG	NILAI BAHAN (Rp)	JUMLAH BIAYA 7 + 8 + 9	PERJA AKAI RP/JAM	
1	2	3	4	5	6	7	8	9	10	11	12
	J U M L A H :										

Mengetahui dan menyetujui :

....

KEPALA SEKSI BENGKEL :

11-5

267

IF 10 - OHP

LAPORAN BULANAN KEGIATAN DAN HASIL PEMELIHARAAN PERALATAN

DENGAN : _____

BULAN : _____

NO.	JENIS PERALATAN	PEKERJAAN DIBAGAI TINGKAT PEMELIHARAAN (TKPI)/TINGKAT PEMELIHARAAN																PENYEBAB BELUM DAPAT / BELUM SEMPAT DIKERJAKAN					KETERANGAN
		KEGIATAN PEMELIHARAAN DALAM BULAN LAPORAN (PF 10 - CD)						HASIL PEMELIHARAAN / PEKERJAAN SEBELUM BERAKHIR PADA BULAN LAPORAN (PF 10-HD)						BELUM DAPAT/BELUM SEMPAT DIKERJAKAN				TENAGA	PERALATAN BENGKEL	SUKU CADANG	DANA	TUNGGU GILIRAN	
		I	II	III	IV	V	JML	I	II	III	IV	V	JML	III	IV	V	JML						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	JUMLAH :																						

2484

KEGIATAN DAN BIAYA PEMELIHARAAN PERALATAN DALAM BULAN LAPORAN

FF 10 - 95.

BENGKEL : _____

TINGKAT PEMELIHARAAN : ☐ I ☐ II ☐ III ☐ IV ☐ V

BULAN : _____

NO.	JENIS, MERK/TYPE KODE UNIT PERALATAN	URAIAN PEKERJAAN	TAHAP PENYELESAIAN SLS/BLN	PENGERJAAN DAN PEMBIAYAAN DALAM BULAN LAPORAN (1 BULAN)						INSTANSI PELAKSI
				WAKTU ORANG JAM	UPAH PEKERJA (Rp)	N I L A I SUKU CADANG	NILAI BAHAN (Rp)	JML BIAYA (Rp) (6)+(7)+(8)	KERJA ALAT RP/JAM	
1	2	3	4	5	6	7	8	9	10	11
		J U M L A H :								

Mengetahui dan menyetujui :

....

KEPALA SEKSI BENGKEL :

269

ANNEX 12

EXISTING BINA MARGA INSTRUCTIONS AND
WORKSHEETS FOR EQUIPMENT USE CONTROL

4664a

SUMMARY

(Unofficial Translation)

Old Practice: Equipment maintenance was done at province workshops, depots, Cabang Dinas Bina Marga's and at project sites. The Directorate General Bina Marga could only monitor maintenance work done at province workshops and depots due to the design of the old forms used for monitoring i.e. Forms LLP.05 and LBPP.

New Practice (introduced in this document): Bina Marga will monitor all equipment maintenance wherever it is done. Therefore modified forms LLP.05A and LBPP are introduced. Purpose of these modified forms is to know:

- maintenance and operation cost of a particular type of equipment at a certain time;
- production of particular units;
- deterioration of each unit;
- effective work hours of each unit;
- how equipment is being utilized.

These data are useful to analyse the performance and utilization efficiency of the equipment.

The new forms LLP.05A and LBPP are attached including the instructions on how to fill in the forms.

PETUNJUK PENGISIAN

LAPORAN PENYIAPAN PERALATAN

VII

DIREKTORAT JENDERAL BINA MARGA

DIREKTORAT PERALATAN JALAN

X

272

PETUNJUK PENGISIAN
FORMULIR LLP.05A DAN LBPP
(Yang disempurnakan)

I. PENDAHULUAN

Peralatan merupakan investasi pemerintah yang sangat besar nilainya, oleh karena itu agar peralatan dapat dipakai sampai batas umur ekonomisnya, maka perlu dipelihara secara teratur sesuai dengan petunjuk pemeliharaan dari pabrik pembuatnya, serta dipakai secara tepat guna dan berdayaguna.

Untuk itu perlu dilakukan pengawasan pelaksanaan pemeliharaan peralatan di Bengkel Propinsi, Bengkel Depot Peralatan Jalan Wilayah, Seksi Dinas Pekerjaan Umum Propinsi, dan Proyek Jalan/Jembatan serta pemakaiannya secara berkesinambungan.

Mengingat dengan sistim Perbengkelan yang berlaku di Direktorat Jenderal Bina Marga, hanya dapat memonitor pelaksanaan pemeliharaan peralatan di bengkel Propinsi dan Bengkel Depot Peralatan Jalan Wilayah, maka perlu diciptakan sarana untuk memonitor pelaksanaan pemeliharaan peralatan di Seksi Dinas Pekerjaan Umum Propinsi dan di Proyek Jalan/Jembatan.

Ada 2 alternatif sarana untuk memonitor pelaksanaan pemeliharaan peralatan, yaitu

1. Membuat formulir laporan bentuk baru.
2. Menyempurnakan formulir laporan yang sudah ada (formulir LLP.05 dan LBPP)

Mengingat tambahan formulir laporan akan menambah beban pekerjaan pembuatan laporan pada Seksi DPUP dan Proyek Jalan/Jembatan, maka kami memilih alternatif 2 (menyempurnakan formulir LLP.05 dan LBPP)

II. MAKSUD DAN TUJUAN

Penyempurnaan formulir LLP.05 (menjadi LLP.05A) dan formulir LBPP bertujuan untuk.

1. Mengetahui secara pasti besarnya biaya pemeliharaan dan operasi suatu unit peralatan tertentu, dalam kurun waktu tertentu.
2. Mengetahui secara nyata besarnya produksi suatu unit peralatan tertentu, dalam kurun waktu tertentu.
3. Mengetahui dan mengikuti perobahan kondisi suatu peralatan tertentu, dalam kurun waktu tertentu.
4. Mengetahui jam kerja efektif suatu unit peralatan tertentu, dalam kurun waktu tertentu.
5. Memonitor pemakaian peralatan.

Data tersebut diperlukan untuk membuat analisa berikut.

a. Apakah suatu peralatan tertentu masih dapat dipakai secara ekonomis.
b. Apakah suatu peralatan tertentu dipakai secara tepat guna dan berdayaguna.

III. PELAPORAN PEMAKAIAN PERALATAN

1. Pengisian formulir laporan pemakaian peralatan (LLP.05A dan LBPP) hendaknya seobyektif mungkin.
2. Agar pemakaian peralatan dapat dimonitor secara berkesinambungan, laporan pemakaian peralatan (LLP.05A dan LBPP) harus dikirim ke Direktorat Peralatan Jalan setiap bulan, dengan tembusan ke Depot Peralatan Jalan Wilayah dan ke Bidang Alkal Kanwil Dep. PU Propinsi yang bersangkutan, selambat-lambatnya tanggal 5 bulan berikutnya.

4. PETUNJUK PENGISIAN FORMULIR LLP.05A DAN LBPP

PETUNJUK PENGISIAN LLP.05A

1. Tujuan	: Untuk memonitor produktivitas peralatan serta biaya pemeliharaan dan operasinya.
2. Cara pengisian	
Tanun anggaran	: cukup jelas
Status tanggal	cukup jelas
Nama Bagian Provek/ Proyek	: cukup jelas
K o d e	diisi Kode Bagian Provek/Proyek vang melaporkan.
Kolom (1)	: diisi Kode Unit Peralatan Ditjen Bina Marga Contoh: AE/212/2345 AE/001/0015
Kolom (2)	diisi Jenis Peralatan Conton Bulldozer Motor Grader Dump Truck
Kolom (3)	: diisi Kondisi Peralatan pada tanggal laporan
Kolom (4)	: diisi Jumlah Jam kerja peralatan selama produksi (tidak termasuk waktu menunggu dan transportasi/ mobilisasi dari pool ke site)
Kolom (5)	: cukup jelas
Kolom (6)	: cukup jelas
Kolom (7)	: diisi Jumlah Bahan Bakar vang dipakai selama jam kerja efektif (dalam rupiah)
Kolom (8)	: diisi Jumlah Pelumas dan Minvak Hidrolik pengganti/tambahan selama satu bulan (dalam rupiah)
Kolom (9)	: diisi Harga Filter pengganti selama satu bulan (dalam rupiah)
Kolom (10)	diisi Nilai Suku Cadang yang dipakai untuk perbaikan selama satu bulan (dalam rupiah)
Kolom (11)	: diisi Gaji/Upah mekanik vang melakukan perbaikan dan pelumasan peralatan.
Kolom (12)	: diisi biava perbaikan bila peralatan diperbaiki di Bengkel Agen Tunggal atau Swasta lainnva.
Kolom (13)	: diisi Gaji/Upah operator dan pembantu operator.
Kolom (14)	: cukup jelas

DEPARTEMEN PEKERJAAN UMUM

DIREKTORAT JENDERAL BINA MARGA

BENTUK NO. LLP – 05 A

Halaman

LAPORAN REALISASI PEMAKAIAN PERALATAN JALAN BINA MARGA

Status Tanggal Tgl [ ] Bl [ ] Th [ ]

TAHUN ANGGARAN [ ]/[ ]

Nama Bag/Pro/Proyek

Kode . [ ] [ ] [ ] [ ]

KODE UNIT PERALATAN	JENIS PERALATAN *)	Kondisi **)	Jam Kerja Efektif (Jam)	PRODUKSI Volume	PRODUKSI Satuan ***)	BIAYA OPERASIONIL Bahan Bakar (Rp.)	Pelumas & M. Hidrolik (Rp.)	Filter (Rp.)	Suku Cadang (Rp.)	Gaji/Upah (Rp.)	Jasa Perbaikan (Rp.)	Lain lain (Rp.)	Pemakai Peralatan ****)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)

Dilaporkan / Disetujui Oleh	Nama	Jabatan	Tanda Tangan	Tanggal

Catatan : Petunjuk pengisian pada halaman selanjutnya.

*) Jenis Peralatan diisi dengan nomor Peralatan yang ada di Proyek

**) Kondisi peralatan diisi dengan: 1 = Baik
2 = Barang ringan
3 = Rusak berat
4 = Sucat

***) [illegible]

****) Pemakai peralatan diisi dengan:
1 = Proyek Bina Marga
2 = Proyek/proyek Pengairan/ Cipta Karya
3 = Proyek Pemerintah Daerah
4 = Instansi Pemerintah Lainnya
5 = Kontraktor Bina Marga
6 = Kontraktor Lainnya.

DITERUSKAN UNTUK :
- Lembar ke 1 ke Dit. Peln Jakarta
- Lembar ke 2 ke Dejal Peln Wil. yab.
- Lembar ke 3 ke Dit. Alkal Kwall yab.
- Lembar ke 4 ke Arsip Bag. Proyek/ Proyek yab.

A – 0

DEPARTEMEN PEKERJAAN UMUM

DIREKTORAT JENDERAL BINA MARGA

BENTUK NO. : LLP – 05 A

Halaman :

LAPORAN REALISASI PEMAKAIAN PERALATAN JALAN BINA MARGA

Status Tanggal : Tgl [0 1] Bln [0 6] Th [8 5]

TAHUN ANGGARAN : [8 4 / 8 5]

Nama Bag/Pro/Proyek : UPCA Unit II Jawa Barat di Cisokan

Kode : [ ] [ ] [ ] [ ] [0]

KIRK UNIT PERALATAN	JENIS PERALATAN *)	Kondisi **)	Jam Kerja Efektif (Jam)	PRODUKSI Volume	PRODUKSI Satuan ***)	BIAYA OPERASIONIL Bahan Bakar (Rp.)	Pelumas & M. Hidrolik (Rp.)	Filter (Rp.)	Suku Cadang (Rp.)	Gaji/Upah (Rp.)	Jasa Perbaikan (Rp.)	Lain-lain (Rp.)	Pemakai Peralatan ****)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
AE/052/0012	Wheel Loader	1	115	4570	M3	379.500	–	50.000	325.000	15.000	–	250.000	1

	Nama	Jabatan	Tanda Tangan	Tanggal
Dilaporkan Oleh :				
Disetujui				

Catatan : Petunjuk pengisian pada halaman sebaliknya.

*) Jenis Peralatan diisi dengan semua Peralatan yang ada di Proyek

**) Kondisi peralatan diisi dengan: 1 = Baik
2 = Rusak ringan
3 = Rusak berat
4 = Scrap

***) Satuan Volume Produksi diisi dengan Ton/M3/M2.

****) Pemakai peralatan diisi dengan:
1 = Proyek Bina Marga
2 = Proyek/proyek Pengairan/Cipta Karya
3 = Proyek Pemerintah Daerah
4 = Instansi Pemerintah Lainnya
5 = Kontraktor Bina Marga
6 = Kontraktor Lainnya.

12-7

2774

PETUNJUK PENGISIAN LBPP

1. Tujuan · Monitoring Harian Pemakaian Peralatan untuk mengisi formulir LLP.05A

2. Cara pengisian

Tanun	cukup jelas
Bulan	· cukup jelas
Nama Proyek/Bagian Proyek	: cukup jelas
Lokasi Proyek	· cukup jelas
Jenis Program	: cukup jelas
Merk/Type	: diisi Merk dan Type peralatan yang bersangkutan.
Tahun pembuatan	diisi Tanun Pembuatan peralatan yang bersangkutan.
KM/HM awal	· diisi KM/Hour Meter pada tanggal 1 bulan yang bersangkutan.
akhir	: diisi KM/Hour Meter pada akhir bulan yang bersangkutan.
Nomor Kode Unit Peralatan	: diisi Nomor Kode Unit Peralatan yang bersangkutan Contoh AE/212/2345 AE/001/0015
Jenis Peralatan	diisi Jenis Peralatan Contoh Bulldozer Motor Grader Dump Truck
Kapasitas	diisi Kapasitas alat sesuai spesifikasi pabrik pembuatnya.

K o l o m

Tanggal	. cukup jelas
Lokasi kerja	cukup jelas
Jam Kerja Efektif	. diisi Jumlah Jam Kerja peraltaan selama produksi (tidak termasuk waktu menunggu dan transportasi/mobilisasi dari pool ke site)
Jam tidak kerja	
Rusak	· cukup jelas
Nganggur	. cukup jelas (menunggu hujan berhenti)

Lain-lain	. cukup jelas	
	Contoh:	
	Jam Kerja Efektif	3 jam
	Rusak	2 jam
	Iklim	2 jam
	Jam Kerja per hari	7 jam
Pemakaian Bahan		
Bahan Bakar	. diisi Jumlah Bahan Bakar yang dipakai selama Jam Kerja Efektif.	
Oli Mesin, Oli Trasmisi, Oli Hidrolik, dan Gemuk	: cukup jelas	
Filter	. diisi Jumlah Filter yang diganti.	
Suku Cadang	diisi Nilai Suku Cadang yang dipakai untuk perbaikan (dalam rupiah)	
Produksi	: diisi produksi alat selama jam kerja efektif	
Kondisi Umum	: diisi (✓) pada salah satu kotak kondisi.	
Dilaporkan oleh	: cukup jelas	
Diketahui oleh	: cukup jelas	

DEPARTEMEN PEKERJAN UMUM DIREKTORAT JENDERAL BINA MARGA	FORM LBPP	LAPORAN BULANAN PEMAKAIAN PERALATAN

TAHUN	NAMA PROYEK/ BAGIAN PROYEK :	MERK/TYPE :	NOMOR KUP. / /
BULAN	LOKASI PROYEK :	TH.PEMBUATAN :	JENIS PERALATAN
	JENIS PROGRAM :	KM/HM AWAL : AKHIR :	KAPASITAS

TANGGAL	LOKASI KERJA (RUAS)	JAM KERJA EFEKTIF	JAM TIDAK KERJA				PEMAKAIAN BAHAN						SUHU CADANG (Fr. 10^3)	FREKWENSI (HZ/MS/HZ)	CATATAN
			RUSAK	KERUSAKAN	BELIM	LAIN-LAIN	BAHAN BAKAR (LITER)	OLI MESIN (LITER)	OLI TRANS. (LITER)	OLI HIDRO. (LITER)	GEMUK (KG)	FILTER-FILTER			
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
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25															
26															
27															
28															
29															
30															
31															
J U M L A H															

KONDISI UNIT	DILAPORKAN OLEH:	DIKETAHUI OLEH	DITERUSKAN UNTUK:
☐ BAIK ☐ RUSAK RINGAN ☐ RUSAK BERAT ☐ HAPUS/SKRAP			- Lembar ke 1 ke Dit. Pelan Jakarta - Lembar ke 2 ke Depot Pelan Wilayah yso. - Lembar ke 3 ke Bidang Alkal Kamwil yso. - Lembar ke 4 ke Arsip Bagian Proyek/ Proyek yso.

CATATAN : Harga setempat

1. Oli Mesin/Transmissi : Rp /liter.
2. Oli Hidrolik : Rp /liter.
3. Filter : Rp
4. Bahan Bakar : Rp /liter.
5. Gemuk : Rp /kg.

28

DEPARTEMEN PEKERJAN UMUM DIREKTORAT JENDERAL BINA MARGA	FORM LBPP	LAPORAN BULANAN PEMAKAIAN PERALATAN

TAHUN: 89
BULAN: 6

NAMA PROYEK/ : UPCA Unit II Jawa Barat
LOKASI PROYEK : Cisokan
JENIS PROGRAM : Peningkatan Jalan

MERK/TYPE : Kobelcoik 300
TH. PEMBUATAN : 1981
HM AWAL : 3150
AKHIR : 3300

NOMOR KUP. : AE. 052 /0032
JENIS PERALATAN : Wheel loader
KAPASITAS : 1.5 m3

TANGGAL	LOKASI KERJA (RUAS)	JAM KERJA EFEKTIF	JAM TIDAK KERJA: RUSAK	JAM TIDAK KERJA: MENGGANGGUR	JAM TIDAK KERJA: HUJAN	JAM TIDAK KERJA: LAIN-LAIN	PEMAKAIAN BAHAN: BAHAN BAKAR (LITER)	PEMAKAIAN BAHAN: OLI MESIN (LITER)	PEMAKAIAN BAHAN: OLI TRANS. (LITER)	PEMAKAIAN BAHAN: OLI HIDROL. (LITER)	PEMAKAIAN BAHAN: GREEK (KG)	PEMAKAIAN BAHAN: FILTER-FILTER	SISTU CADANGAN (Rp. 10^3)	PRODUKSI	CATATAN
1	Cisokan	5			2		75							200	melayani AMP & Stive Crusher
2	Cisokan	6				1	90							240	sda
3	Cisokan	-													
4	Cisokan	4	3				60						50	160	sda
5	Cisokan	7					105							280	sda
6	Cisokan	5				2	75	20	10		1	4		200	sda
7	Cisokan	7					105							280	sda
8	Cisokan	7					105							280	sda
9	Cisokan	7					105							280	sda
10	Cisokan	-													
11	Cisokan	3		4			45							120	sda
12	Cisokan	2		5			30							60	sda
13	Cisokan	4			3		60							160	sda
14	Cisokan	2	5				30							70	sda
15	Cisokan		7											-	Perbaikan
16	Cisokan		7										250	-	perbaikan
17	Cisokan	-													
18	Cisokan	5			2		75							200	melayani AMP & Crusher
19	Cisokan	4			3		60							160	sda
20	Cisokan	7					105							280	sda
21	Cisokan	5		2			75							200	sda
22	Cisokan	6			2		90							240	sda
23	Cisokan	5				2	75							200	sda
24		-													
25	Cisokan	4				3	60							160	sda
26	Cisokan	5	2				75						25	200	sda
27	Cisokan	5		2			75							200	sda
28	Cisokan	6				1	90							240	sda
29	Cisokan	4			3		60							160	sda
30		-													
31															
JUMLAH		115	24	13	24	9	1725	20	10	-	1	4	325	4570	

KONDISI UMUM
- [ ] BAIK
- [ ] RUSAK RINGAN
- [ ] RUSAK BERAT
- [ ] RAPUS/SKRAP

DILAPORKAN OLEH:

DIKETAHUI OLEH

DITERUSKAN UNTUK:
- Lembar ke 1 ke Dit. Pelaksana Jakarta
- Lembar ke 2 ke Dekot Pelaksana Wilayah yad.
- Lembar ke 3 ke Bidang Alkal Kanwil yad.
- Lembar ke 4 ke Arsip Bagian Proyek/ Proyek yad.

CATATAN : Harga setempat

1. Oli Mesin/Transmisi : Rp /liter.
2. Oli Hidrolik : Rp /liter.
3. Filter : Rp
4. Bahan Bakar : Rp /liter.
5. Gemuk : Rp /kg.

ANNEX 13

SAMPLE TECHNICAL SPECIFICATIONS
FOR WORKSHOP EQUIPMENT

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : ELECTRIC GENERATING SET 3000 WATT Engine driven electric generating set of at least 3000 Watt, Single phase, 110 Volt, 50 Hz Complete with necessary gauges and indicating lamps.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : HIGH PRESSURE GREASE BUCKET PUMP (20 Lt.) High pressure grease bucket pump with 20 Kgs. bucket capacity of at least 250 Kg/cm^2 output pressure, and 4 grams output volume per stroke. Complete with baked enamel container, grease gun, 2 meter hose, and rubber wheel carrier.	

284

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : HIGH PRESSURE OIL BUCKET PUMP (20 lt.) High pressure oil bucket pump with 20 lt. bucket capacity of at least 40 CC output volume per stroke. Complete with baked enamel container, nozzle, 2 meter vinyl hose, and rubber wheel carrier.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : HAND GREASE GUN. Hand operated lever type grease gun to handle all types of lubricants. Utility steel construction 500 CC capacity, 500 Kg/Cm^2 pressure. Hydraulic fitting.	

28e

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : ROTARY HAND PUMP. Rotary vane fuel pump 36 (thirty six) inches long suction pipe Approximately 6 (six) feet lenght of 1/4 inch acid resistant hose with nozzle hose, hanger, and 1 1/2 to 2 (two) inches bung adapter.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : SUCTION PUMP FOR OIL RECOVERY 500 CC capacity suction pump with 350 mm steel flexible hose for removing oil from transmission, gear box etc. All steel construction.	

288X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : OIL MEASURING CAN 1 LTR. Metal oil measuring can of 1 (one) liter capacity.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : OIL MEASURING CAN 2 LTR. Metal oil measuring can of 2 (two) liter capacity.	

290X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : FUNNEL 300 MM DIAMETER. Metal funnel with flexible hose of 300 mm diameter.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : OILER 250 CC Aluminium alloy oiler of 250 CC capacity.	

292X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : BUNG WRENCH Wrench to fit all standard bungs for gasoline and oil drums.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : OIL FILTER WRENCH Chain type oil filter wrench.	

2947

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : DRAIN PLUG WRENCH. Drain plug wrench for loosing and tightening plug size up to 20 mm.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
UNIT : METRIC TOOL SET	
Consist of :	
Open end Wrench Set.	
1 (one) 6 x 7 mm	
1 (one) 8 x 9 mm	
1 (one) 10 x 11 mm	
1 (one) 12 x 13 mm	
1 (one) 14 x 15 mm	
1 (one) 16 x 17 mm	
1 (one) 18 x 19 mm	
1 (one) 20 x 22 mm	
1 (one) 21 x 23 mm	
1 (one) 24 x 27 mm	
1 (one) 25 x 28 mm	
1 (one) 30 x 32 mm	
Double Offset Ring Spanners	
1 (one) 6 x 7 mm	
1 (one) 8 x 9 mm	
1 (one) 10 x 11 mm	
1 (one) 12 x 13 mm	
1 (one) 14 x 15 mm	
1 (one) 16 x 17 mm	
1 (one) 18 x 19 mm	
1 (one) 20 x 22 mm	
1 (one) 21 x 23 mm	
1 (one) 24 x 27 mm	
1 (one) 25 x 28 mm	
1 (one) 30 x 32 mm	
combination Wrench Set	
.....2/.	

294

TECHNICAL SPECIFICATION ITEM NO. .

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
UNIT : METRIC TOOL SET	
Combination Wrench Set.	
1 (one) 8 mm	
1 (one) 9 mm	
1 (one) 10 mm	
1 (one) 11 mm	
1 (one) 14 mm	
1 (one) 17 mm	
1 (one) 19 mm	
1 (one) 22 mm	
½ inch Square drive socket set.	
1 (one) 10 mm 12 point socket	
1 (one) 11 mm 12 " "	
1 (one) 12 mm 12 " "	
1 (one) 13 mm 12 " "	
1 (one) 14 mm 12 " "	
1 (one) 15 mm 12 " "	
1 (one) 16 mm 12 " "	
1 (one) 17 mm 12 " "	
1 (one) 18 mm 12 " "	
1 (one) 19 mm 12 " "	
1 (one) 20 mm 12 " "	
1 (one) 21 mm 12 " "	
1 (one) 22 mm 12 " "	
1 (one) 23 mm 12 " "	
1 (one) 24 mm 12 " "	
1 (one) 25 mm 12 " "	
1 (one) 26 mm 12 " "	
1 (one) 27 mm 12 " "	
1 (one) 30 mm 12 " "	
1 (one) 32 mm 12 " "	
1 (one) 250 mm Reversible ratchet	
1 (one) 300 mm Sliding T-handle	
.....3/.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
UNIT : METRIC TOOL SET ½ inch square drive socket set. 1 (one) 125 mm Extension bar 1 (one) 250 mm Extension bar 1 (one) Universal joint. ¼ inch square drive socket set. 1 (one) 4 mm 6 point socket 1 (one) 4.5 mm 6 " " 1 (one) 5 mm 6 " " 1 (one) 5.5 mm 6 " " 1 (one) 6 mm 6 " " 1 (one) 7 mm 6 " " 1 (one) 8 mm 6 " " 1 (one) 9 mm 6 " " 1 (one) 10 mm 6 " " 1 (one) 11 mm 6 " " 1 (one) 140 mm Reversible ratchet. 1 (one) 155 mm Spinner handle. 1 (one) 115 mm Sliding T-handle. 1 (one) 100 mm Extension. 1 (one) set of 8 pieces ignition spanner complete with screw driver, feeler gauge, and contact file on ring. 1 (one) set of 8 pieces Hex Head Wrench on ring, sizes : 2 mm, 2.5 mm, 3 mm, 4 mm, 5 mm. 6 mm, 8 mm, and 10 mm. 1 (one) spark plug Wrench for 14 and 18 mm spark plug. 2 (two) 500 mm long Tyre lever, straight parttern. 1 (one) Wheel Nut Wrench 24 x 27 mm 1 (one) Tommy bar for above Wheel Nut Wrench. .....4/.	

298X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
UNIT : METRIC TOOL SET	
1 (one) 210 mm long Adjustable Wrench.	
1 (one) 190 mm long Water pump plier.	
1 (one) 240 mm long Water pump plier. (insulated handle)	
1 (one) 200 mm long Long nose plier, straight with side cutter.	
1 (one) 200 mm long Long nose plier, bent with side cutter.	
1 (one) 260 mm Brake Spring Plier.	
1 (one) 160 mm long Heavy Duty Front Cutting Nipper.	
1 (one) 165 mm long Diagonal Side Cutting Nipper.	
1 (one) 185 mm long Combination Plier.	
1 (one) 255 mm long Grip plier, Curved Jaw with wire cutter.	
1 (one) 100 mm blade length Heavy Duty Standard tip, screw driver	
4 x 0.6 mm width of tip, wood handle	
1 (one) 150 mm blade length Heavy Duty Standard tip, screw driver.	
6.5 x 1.0 mm width of tip, wood handle	
1 (one) 200 mm blade length Heavy Duty Standard tip, screw driver	
10 x 1.6 mm width of tip, wood handle	
1 (one) 65 mm blade length Standard Tip, screw driver	
2.5 x 0.4 mm width of tip, plastic handle	
1 (one) 100 mm blade length heavy duty standard tip, screw driver	
4 x 0.6 mm width of tip, plastic handle	
1 (one) 150 mm blade lenght Standard Tip, Chubby screw driver.	
6.5 x 1 mm width of tip, plastic handle.	
.....5/.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
UNIT : METRIC TOOL SET	
1 (one) 30 mm blade length Standard Tip, snubby screwdriver. 3.5 x 0.8 mm width of tip, plastic handle	
1 (one) 85 mm blade length Phillips No.1 screw driver, wood handle.	
1 (one) 115 mm blade length Phillips No.2 screw drive, wood handle.	
1 (one) 30 mm blade length Phillips No.1 screw drive, plastic handle.	
1 (one) Set of 6 pieces Chisels, Consist of:	
120 x 10 x 10 mm Flat Chisel.	
150 x 12 x 18 mm Flat Chisel.	
120 x 4 x 10 mm Cape Chisel.	
120 x 3 x 10 mm Drift Punch.	
120 x 4 x 12 mm Drift Punch.	
120 x 10 mm Center Punch.	
1 (one) Set of 6 pieces Screw Extractor, for screw 3 to 6 mm, 6 to 8 mm, 8 to 11 mm, 11 to 14 mm, 14 to 18 mm, and 18 to 24 mm.	
1 (one) Set of 20 pieces Feeler gauge, 0.05 up to 1.00 with 0.05 graduation.	
1 (one) Adjustable Hacksaw, Heavy Duty type,	
1 (one) Soft face hammer, 35 mm face diameter with 1 set of spare tip.	
1 (one) 0.500 kg Ball pein Hammer.	
1 (one) 250 mm long Flat File, bastard cut.	
1 (one) 200 mm long Flat File, 2 nd cut.	
1 (one) 200 mm long Round File, 2 nd cut.	
1 (one) 250 cc plastic oil can.	
All above tool should be supplied metal cabinet.	

300X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : AIR COMPRESSOR. Electric motor driven air compressor. Free air delivery of at least 40 ^{l}/minute Rated pressure of at least 100 psi. Tank capacity of at least 50 liters. Single phase 110 volt, 50 Hz. ACCESSORIES 1. Pressure gauge. 2. Safety valve. 3. Hose coupling. 4. 15 (fifteen) m hose. 5. Tyre pressure gauge.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : VULCANIZING UNIT. Unit for patch vulcanizing inner tubes. 500 Watt electric coil heating unit for use on 110 Volt, single phase, 50 Hz.	

302X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : HUB NUT WRENCH. Heavy duty hub nut wrench 3/4" square and 36 mm.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : TYRE PRESSURE GAUGE. Heavy duty tyre pressure gauge of at least 12 (twelve) Kg/cm^2 capacity.	

304X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : TYRE TOOL SET. Set of tyre tools, consist of: 2 (two) curve pattern tyre lever 600 mm long. Similar to Elora No. 186. 2 (two) straight pattern tyre lever 600 mm long. Similar to Elora No. 165. 2 (two) pry bars. Similar to Elora No. 164. 1 (one) tyre bead breaker.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : HOT PATCH. Set of hot patch consist of: 30 pieces of 47 mm x 23 mm oval type. 40 pieces of 65 mm x 35 mm oval type. 20 pieces of 60 mm diameter round type.	

300

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : ELECTRIC DRILL 1/2" Portable Palm Grip Rotary Heavy Duty Industrial Grade Electric Drill. Equipped with Jacob's Chuck and Chuck key 110 Volt. 50 Hz single phase, Approx 500 Watt Together with a set of High Speed Steel Industrial Grade Drill Bits. 21 pieces from 3 mm to 13 mm in 0.5 mm steps.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : ELECTRIC ANGLE DISC GRINDER Electric disc grinder single phase, 110 Volts 50 Hz not less than 1000 Watts. High power with spindle lock not less than 6000 Rpm. Grinding Disc not less than 150 mm diameter ACCESSORIES 4 (four) spare resinoid wheel for each unit.	

308X

TECHNICAL SPECIFICATION ITEM NO. _____

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : ELECTRIC SOLDERING IRON. Electric soldering iron of 60 Watt, 110 Volts 50 Hz. 1/4 inch copper screw driver tip.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
UNIT : HYDRAULIC JACK 10 TON 10 Ton Capacity Standard type hydraulic jack with head screw. Closed hight 240 mm. Lifting Stroke 150 mm. Length of head screw 90 mm.	

310X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : AXLE STANDS/SAFETY STAND Pair of axle stand (5 tons total capacity) 4 (four) leg or round design with safety locking device. Height adjustment not less than 8 (eight) inches	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
UNIT : ARBOR PRESS. Lever type arbor press 2 (two) tons capacity. 5 (five) inch throat depth 8 (eight) inch clearance over table. Leverage ratio 35 (thirty five) to 1 (one)	

312X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : SWIVEL BENCH VISE 5 INCH HEAVY DUTY 5 (five) inch, jaw width. opening 8 (eight) inch.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
UNIT : 6 TON 2-WAY/3-WAY ADJUSTABLE JAW PULLER 6 ton capacity Adjustable Puller set, for pulling a gear off a hub, reach 4 1/2" and Spread 8", Consist of : 1 (one) Detachable Tip. 3 (three) Pivot Pin. 1 (one) Forcing Screw. 1 (one) 2-way/3-way crossarm 7" 3 (three) jawblock. 9 (nine) Lockscrew. 3 (three) Reversible jaw 4 1/2 inch reach. Supplied in metal box.	

314X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T - WORKBENCH Steel workbench with cabinet and drawers of 100 cm long, 60 cm wide, and 85 cm high.	

ANNEX 14

SAMPLE PUBLIC WORKS TECHNICAL SPECIFICATIONS
FOR RECONSTRUCTION EQUIPMENT AND
RECOMMENDED PERFORMANCE SPECIFICATIONS
FOR RECONSTRUCTION EQUIPMENT

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : BULLDOZER CONSTRUCTION 1. Operating weight not less than 12 ton. 2. Open steel frame canopy, with heat insulated steel roof. 3. Radiator guard. 4. Crankcase guard. 5. Transmission guard. 6. Engine side cover left and right. POWER UNIT 1. Diesel engine. 2. Flywheel horse power not less tahn 95 HP at manufacturer's recommeded RPM for intended application. 3. Direct electric starting. 4. Engine shall have hourmeter and fuel line water trap. POWER TRANSMITTING SYSTEM 1. Torque converter, full power shift transmission. 2. Steering clutch: wet, multiple disc, hand operated. 3. Steering brake: wet, contracting band, foot operated. UNDER CARRIAGE 1. Shoe: single grouser approx. 0.6 Kg/cm^2 ground pressure. 2. Sprocket: rim segment type. ATTACHMENT 1. Straight-tilt blade. 2. Hydraulically controlled. RIPPER 1. The unit shall be provided with multy shank ripper (3 shanks), hydraulically operated. 2. Digging depth not less than 400 mm.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
LIGHTINGS Front and rear lights for night operation and travelling, controlled through switches from operator's seat. ACCESSORIES 1. Standard manufacturer's tool kit for each unit. 2. Two instruction/operating manuals, two part catalogues and one workshop repair manual for each unit. 3. Instruction plate for daily maintenance in Indonesian language. 4. Adjustable soft cushioned operator's seat. 5. Locking cap with securing chain for fuel tank, radiator, and hydraulic oil tank. 6. Fuel tank with inlet screen and drain plug. 7. Engine oil filter, air cleaner element, fuel filter, and hydraulic oil filter for one year operation, should be supplied for each unit.	

318X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : MOTOR GRADER	
CONSTRUCTION	
1. Open type steel canopy with insulated heat steel roof.	
2. Transmission and engine guard, engine side cover (left and right)	
3. Operating weight not less than 8.50 ton.	
OPEN UNIT	
1. Diesel engine.	
2. Fly wheel horse power not less than 90 HP at manufacturer's recomended RPM for intended application.	
3. Direct electric starting of 12 or 24 volt electric system.	
4. Engine shall have hourmeter and fuel line filter water trap.	
TRANSMISSION	
1. According to standard manufacturer's production.	
2. Max. speed not less than 30 Km/h.	
STEERING	
Articulated frame steering.	
TYRES	
Type and size according to manufacturer's standard production.	
FRONT AXLE	
1. Heavy duty type.	
2. Hydraulically leaning.	
REAR AXLE	
1. Full floating.	
2. All wheel tandem drive.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
BRAKE 1. Service brake: hydraulic, on at least rear drive wheel. 2. Parking brake: mechanical. MOLBOARD 1. Approx. 3.1 m long x 0.5 m high x 0.016 m thick. 2. Roll away type with replaceable cutting edges and end bits. 3. Blade shall be easy to be positioned for bank cutting from operator's seat. 4. Hydraulically controlled. SCARIFIED 1. The equipment shall be fitted with scarifier of replaceable teeth. 2. Scarifier load approx. 3.5 ton. 3. Heavy duty type. LIGHTINGS Necessary lighting for operation and travelling, controlled through switches from operator's seat. ACCESSORIES 1. Standard manufacturer's tool kit for each unit. 2. Two instruction/operation manuals, two part catalogues and one workshop repair manual for each equipment. 3. Instruction plate for daily maintenance in the Indonesian language. 4. Engine oil filter, air cleaner element, fuel filter, and hydraulic oil filter for one year operation, should be supplied for each unit. 5. One spare t e and rim should be supplied for each unit.	

320

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : WHEELED LOADER, 1.2 M^3	
CONSTRUCTION	
1. Operating weight minimum 7.5 Ton.	
2. Open steel frame canopy, with heat insulated steel roof.	
3. Radiator guard, engine side cover (left and right)	
PERFORMANCE	
1. Bucket capacity (struck) not less than 1.2 (one point two) cubic meter.	
2. Tipping load at full turn not less than 4,500 Kgs.	
3. Dumping clearance at full lift and 45° discharge angle, not less than 2,700 mm.	
4. Dumping reach at full lift and 45° discharge angle not less than 800 mm.	
POWER UNIT	
1. Diesel engine.	
2. Flywheel horse power not less than 80 HP at manufacturer's recommended RPM for intended application.	
3. Direct electric starting.	
4. Engine shall have hourmeter and fuel line water trap.	
TRANSMISSION	
1. Torque converter, full power shift transmission of at least 3 speed forward and 3 speed reverse.	
2. Travelling speed not less than 30 Km/H.	
DRIVING SYSTEM	
Four wheel drive system.	
STEERING SYSTEM	
1. Articulated frame steering system.	
2. Maximum turning radius not more than 6,000 at out side bucket.	

TECHNICAL SPECIFICATION ITEM NO. _____

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
TYPE 1. Tyre and tube, 1-2 type 2. Size according to manufacturer's standard production. BRAKE SYSTEM 1. Service brake on all four wheels, air or hydraulic actuated. 2. Mechanical parking brake. ATTACHMENT 1. High strength wear resistance general purpose bucket with detachable teeth. 2. Hydraulically operated. LIGHTINGS Necessary lighting for night operation and travelling, controlled through switches from operator's seat. ACCESSORIES 1. Standard manufacturer's tool kit for each unit. 2. Two instruction/operating manuals, two part catalogues, and one workshop repair manual for each unit. 3. Instruction plate for daily maintenance in Indonesian language. 4. Rear vision mirrors. 5. Locking cap with securing chains for fuel tank, radiator, and hydraulic oil tank. 6. Fuel tank with inlet screen and drain cock. 7. Adjustbale soft cushioned operator's seat. 8. Engine oil filter, air cleaner element, fuel filter and hydraulic oil filter for one year operation should be supplied for each unit.	

322X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : VIBRATION COMPACTOR 6 TON TANDEM CONSTRUCTION 1. Self propelled vibrating tandem roller. 2. Static weight not less than 6000 Kgs. 3. All steel open frame canopy (ROP specification) with heat insulated steel roof. 4. Robust lifting point. POWER UNIT 1. Diesel engine. 2. Fly wheel horse power not less than 65 HP at manufacturer's recomended RPM for intended application. 3. Direct electric starting with 12 or 24 V. electric system. 4. Engine shall have hourmeter. TRANSMISSION Hydrostatic transmission. STEERING Articulated frame steering. DRIVE All wheel drive. BRAKE 1. Hydrostatic service brake. 2. Mechanical parking brake. ROLLER DRUM 1. Drum width of not less than 1300 mm. 2. Linear static pressure not less than 22 Kg/cm each drum.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
3. Vibration on both drums with maximum frequency of not less than 50 Hz or 3000 vpm. 4. Centrifugal force per drum: Not less than 3500 Kgs at low amplitude, and not less than 5000 Kgs at high ampli tude. 5. Scraper on both drums. 6. Pressurized water sprinkler on both drums LIGHTING Necessary lighting for operation and travelling, controlled through switches from operator's seat. GAUGES Direct reading gauges and warning lights, covering oil pressure, hydralic pressure, fuel capacity, water temperature, alternator, and other necessary gauges and warning lights. ACCESSORIES 1. Standard manufacturer's tool kit including special tools for each unit. 2. Two operation manuals, two part manuals, and one workshop repair manual should be supplied for each unit. 3. Heavy duty rear vision mirrors. 4. Cushioned adjustable operator's seat. 5. Locking caps with securing chain for fuel tank, radiator, oil filter, and hydraulic tank. 6. Fuel tank with inlet screen and drain cock 7. Instruction plate for daily maintenance in Indonesian language. 8. Engine oil filter, air cleaner element, fuel filter, and hydraulic oil filter for one year operation should be supplied for each unit.	

324

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : REAR DUMP TRUCK, 5 (FIVE) TON CAP.	
CONSTRUCTION	
1. Cab and chassis all steel with safety glass throughout.	
2. Two heavy duty axles with rear wheel drive.	
3. Shock absorber on front axle.	
4. Right hand drive.	
5. Re-inforced frame particularly suitable for tipper type application.	
6. Wheel base shall be approx. 3.6 (three point six) metres.	
7. Driver's door not to be self-locking type.	
POWER UNIT	
1. Diesel engine.	
2. Flywheel horse power not less than 140 HP at manufacturer's recommended RPM for intended application.	
3. Engine shall have fuel filter and oil filter fitted on safe place to avoid damage.	
4. Direct electric starting of 12 volts or 24 volts electric system.	
5. Rain cap for exhaust pipe in case of upward opening of exhaust pipe.	
CLUTCH	
1. Heavy duty dry type.	
2. Clutch plate shall have spring vibration damper.	
TRANSMISSION	
1. Manual shift, minimum four forward and one reverse.	
2. Synchromesh or constanmesh, except in first and reverse gear, direct drive in top gear.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
FRONT AXLE 1. Heavy duty construction. 2. Minimum capacity 3.7 (three point seven) tons. REAR AXLE 1. Heavy duty construction. 2. Single reduction, full floating axle. 3. Minimum capacity 7.3 (seven point three) tons. 4. Fitted with auxiliary spring. ELECTRICAL SYSTEM 1. 12 volt or 24 volt electrical system. 2. Heavy duty battery. 3. Sealed beam, dip to left head lights. 4. Fuse panel in glove box, dome light. 5. Turn signals left and right for rear and front. 6. Dual stop, tail and back up lights. 7. Traffic hazard switch. 8. Dual wind screen wipers. 9. Dual horns. 10. Front clearance and indentification lamps. 11. Speedometer with odometer in metric. BRAKE 1. Service brake shall be of hydraulic with vacuum power booster on all wheels. 2. Vacuum reserve tank with gauge and warning light. 3. Hand operated parking brake.	

326

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
TYRE AND WHEEL 1. Single front and dual rear wheel, with spare wheel. 2. Heavy duty hanging for spare wheel. 3. 8.25 x 20 tube & tyre type cast steel rims. DUMP BODY 1. Heavy duty rear dump, steel dump body of 4 (four) milimeter thickness steel plate with fixed sides and all welded re-inforcing members. 2. Capacity of dump body minimum 3 (three) M3 struck. 3. Double acting tailgate with spreader chains and tailgate control mounted right side that can be operated from cab. 4. Dumping angle minimum 50° (fifty degrees) 5. Cab protector shall be of approx. 4.5 (four point five) milimeter thick steel plate. HOIST SYSTEM 1. Heavy duty, operation raise, hold and lower, inside cab control. 2. Positive displacement pump minimum 10 (ten) tons capacity. 3. Rear power take off. ACCESSORIES 1. Rear view mirrors on left and right side cab. Also inside cab. 2. Standard manufacturer's tool kit included special tools, 10 ton hydraulic jack, and wheel spanner for each unit. 3. Two instruction manuals, two service manuals, one workshop manual, two part catalogs for each unit. 4. Instructions plate for daily maintenance in the Indonesian language. 5. Engine oil filters, air cleaner elements, and fuel filters for one year operation, should be supplied for each unit.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : TAIL GATE CHIP SPREADER CONSTRUCTION 1. This chip spreader is capable of being fitted to the back of 5 (five) tons Dump Truck. 2. Spreading capacity should be from 40 up to 140 square meter per cubic meter of screened aggregate sizes between 5 mm and 20 mm, in proportion to the speed of vehicle to which it is fitted. 3. Aggregate feed auger should be driven by a gasoline engine through speed reducer. FEED GATE Overall width 2.160 mm Feed gate opening 100 mm width of gate plate 180 mm number of gate plate 12 Each gate plate is connected with the operating handle through each gate lever and gate operating rod, so that all gates can be opened and closed independently or together as one gate. BAFFLE PLATE Baffle plate should be provided for gradually and evenly charging the material on the dump truck into the spreader hopper. SPREADING WIDTH Spreading width can be adjusted in 180 mm increment by disconnecting each gate plate lever from the gate opening rod. FEED AGITATOR Detachable agitator should be provided. ACCESSORIES 1. Manufacturer's standard tool kit should be provided for each unit. 2. Two set of tripods with jacks, hydraulically operated.	

3284

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
3. Two operating manuals and two part manuals of each item of the unit should be supplied for each unit.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : WATER TANK TRUCK 4.000 LITRES	
CONSTRUCTION	
1. All steel, welded, minimum 4 (four) millimeters thick shell.	
2. Tank has at least 2 (two) cross section surge plate.	
3. Tank to be elliptical and shall have cat walks left side and top with steel ladder.	
4. Mannole at top centre of tank, minimum diameter 400 millimeters with hinged cover having quick locking device.	
SPRAYBAR	
1. Pressurized water spray through 7.6 (seven point six) cm diameters x 2.2 (two point two) metre long spraybar, with pipe caps on ends to facilitate cleaning and splash plate under each outlet.	
2. Cab control of quick opening valve mounted right side.	
LOADING SYSTEM	
1. Water pump of adequate capacity driven by heavy duty power take off from truck transmission, controlled from inside cab through clutch.	
2. Suction hose of minimum lenght 7.5 (seven point five) metres with foot valve and screen.	
3. Discharge pipe fitted with coupling at pump outlet.	
BASIC TRUCK	
1. Cab and chassis all steel with safety glass through out.	
2. Two heavy duty axles with rear wheel drive.	
3. Shock absorber on front axle.	

330 X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
4. Right hand drive. 5. Reinforced frame suitable for water tank application. 6. Wheel base 3.6 (three point six) metres. 7. Driver door's not to be self locking type. POWER UNIT 1. Diesel engine. 2. Fly wheel horse power not less than 140 HP at manufacturer's recommended RPM for intended application. 3. Engine shall have fuel filter and oil filter fitted on safe place to avoid damage. CLUTCH 1. Heavy duty, dry single plate. 2. Clutch plate shall have spring vibration damper. TRANSMISSION 1. Manual shift, minimum four forward and one reverse. 2. Synchromesh or constantmesh in all gears, except in first gear and reverse, direct drive in top gear. FRONT AXLE 1. Heavy duty construction. 2. Capacity not less than 4 (four) tons. REAR AXLE 1. Heavy duty construction. 2. Single reduction, full floating axle. 3. Capacity not less than 8 (eight) tons. 4. Fitted with auxiliary spring.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
TYRES AND WHEELS 1. Single front and dual rear wheel, with spare wheel. 2. Heavy duty hanging for spare wheel. 3. 8.25 x 20 tube and tyre, cast steel rims. BRAKES 1. Service brake shall be hydraulically operated with vacuum power booster on all wheels. 2. Vacuum reserve tank with gauge and warning light. 3. Hand operated mechanical parking brake. ACCESSORIES. 1. Rear view mirrors on left and right side cab also inside cab. 2. Standard manufacturer's tool kit, 10 tons hydraulic jack, and wheel spanner for each unit. 3. Two instruction manuals, two service manuals, one workshop repair manual, two part catalogues for each unit. 4. Instruction plate for daily maintenance in Indonesian language. 5. Engine oil filter, air cleaner element, and fuel filter for one year operation, should be supplied for each unit.	

332X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : ASPHALT SPRAYING MACHINE 800 LITRES CONSTRUCTION 1. Tow type asphalt spraying machine for asphalt with penetration number 60/70 including cutback for spraying asphalt from 0,50 litre per squaremeter up to 5 litres per squaremeter. 2. Mounted on 4 (four) pneumatic tyre wheels, with retractable drawbar. 3 U-welded chassis with laminated springs. The machine consist of the following components: 1 (one) Fifth wheel with tachometer, can be read by the driver of towing vehicle during operation, 1 (one) Exterior kettle, 1 (one) Heating boiler being arranged within the exterior kettle, 1 (one) Patented heating chambers accommodating two binder barrels; 1 (one) Barrel hoist with hand operated winch should have thrust bearing to support the load, and mechanical device to swing the load, 1 (one) Pump for binder, 1 (one) Air compressor of 6 ata; 1 (one) Pressure tank, 1 (one) Fuel firing burner; 1 (one) Diesel engine of not less than 5 FWHP, driving the compressor, and asphalt pump. BRAKE Service and parking brake, hand operated and over-run type operated from trailer drawbar eye CAPACITY 1. Boiler capacity of 800 (eight hundred) litres 2. Plus preheating capacity for 2 (two) drums of approx. 200 (two hundred) litres.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
SPRAYER 1. Adjustable height, 2 (two) m long including right and left extension of 40 cm long. 2. Spraybar should be 8" height. 3. Fan type spray nozzle, at least 50% over lap. 4. Nozzle could be shut off independently. ACCESSORIES 1. Dip stick for estimating asphalt quantity in the tank and chart showing the volume of asphalt each cm. 2. Two hand spray equipment of heavy duty type, heavy duty metal re-inforced lance hoses securely fixed to the pressure system and lance. 3. Thermometer, red mark at pressure 6 (six) absolute atm. and 3 (three) absolute atm. 4. Manometer, reading between 15°C and 250°C. 5. Standard manufacturer's tool kit included special tools for each machine. 6. Two instruction manuals, two service manuals and two part catalogs for each machine. 7. Engine oil filter, air cleaner element, and fuel filter for one year operation should be supplied for each unit.	

TECHNICAL SPECIFICATION

ITEM No.: .....

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : ROCK CRUSHER/SCR. CONSTRUCTION 1. Mobile crushing plant. 2. Two stage crusher, with jaw crusher as primary, and cone crusher as secondary crusher. 3. Output capacity shall not less than 30 T/H. 4. To accept up to 30x30 cm material. 5. To be fitted with a primary feed bin of 3 M3 minimum capacity and reciprocating feeder. PERFORMANCE 1. Shall give 100% crushed of 40 mm minus aggregate of 4 product sizes approx : - 5mm (-3/16") =10% 5 mm - 10 mm (3/16" - 1/8") = 19% 10 mm - 20 mm (3/8" - 3/4") = 24% 20 mm - 30 mm (3/4" -1½") = 47% 2. Suitable for crushing either quarried rock or river gravel, with all necessary interplant and stock piling conveyors for finished product. S C R E E N 1. Vibrating screen, three decks type. 2. Steel screen meshes 5mm,10mm,20mm, 40 mm supplied. POWER UNIT 1. Diesel powered electric generating set, sufficient capacity to operate all plant and accessories, such as crushers, screens, conveyors, etc at least 30% above total power required. Three phases, 220/380 volt, 50 Hz.	

TECHNICAL SPECIFICATION

ITEM No.: .....

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
2. Electrical system shall be completed with control panel and switch board, cables, plugs and sockets required to connect with plant, located minimum 35 metres from the generating set.	
3. The diesel powered electric generating set should be skid mounted and in lockable steel plate box.	
ACCESSORIES	
1. All necessary conveyors such as joint conveyors, return conveyor, and stock piling conveyors should be supplied.	
2. One spare tyre with wheel rim for each trailer.	
3. All necessary cables, electric motors, control panel, and switch board for operating the crusher should be supplied.	
4. All other necessary components shall be completed to operate the crushing plant.	
5. Standard manufacturer's tool kit for each unit.	
6. Hydraulic jack and stands in case of stationary installation should be supplied for each unit.	
7. Two installation manuals, two operating and sevice manual, two part catalogues and one workshop repair manual for each unit.	
8. Instruction plate for daily maintenance in Indonesian language.	
9. One set of spare screen to be provided for each unit.	
10. Two set of spare movable and fixed jaw and one set of spare mantle and concave should be provided for each unit.	
11. Engine oil filter, fuel filter, and air cleaner element for one year operation, should be supplied for each unit.	

336*

TECHNICAL SPECIFICATION

ITEM No : .....

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
N O T E 1. Weight of each unit not more than 10 tons or can be reduced to 10 tons. 2. Maximum height of the unit shall be 2.5 metres or can be reduced to 3.5 metres. 3. Chassis length not more than 7 metres	

RECOMMENDED PERFORMANCE SPECIFICATIONS
RECONSTRUCTION EQUIPMENT

1)	Bulldozer	95 HP min., Diesel engine 11 ton operating weight Power-shift Angle blade, hydraulically controlled Ripper attachment (3 shanks), hydraulically operated
2)	Motorgrader	90 HP min., Diesel engine 8.5 ton basic operating weight min. Transmission: 6 FWD/6 REV Articulated frame steering Moldboard approx. 3.1m long blade, hydraulically operated Scarifier V-type
3)	Loader	80 HP min., Diesel engine 7.5 ton operating weight min. 1.2 m3 bucket capacity (struck), hydraulically operated Articulated frame
4)	Roller, Vibratory, self-propelled, 6 ton	65 HP min., Diesel engine 6 ton basic operating weight Hydrostatic transmission Articulated frame Drum width = 1300mm min.
5)	Roller, Rubber-Tired self-propelled	80 HP Diesel engine 7 ton empty weight Hydrostatic transmission Min. 7 wheels Rolling width = 1800mm

6) Dump Trucks

140 HP Diesel engine
5 ton capacity min.
Manual transmission
Axles: Front 3.7 tons min.
Rear 7.7 tons min.
Heavy duty (min. 4mm steel plate) dump body with double acting tail gate
HD hoist system, 10 ton min.

7) Tail Gate Chip Spreader (to fit 5 ton Dump Truck)

Spreading capacity: 40-140 m2/m3
Feed auger driven by gasoline engine
Overall width 2160mm
Number of gate plates: 12
Baffle plate

8) Water Tank Truck with spray bar

140 HP Diesel engine
4000 l. tank capacity
Manual transmission
Axles: Front 4 ton capacity
Rear, 8 ton capacity
HD steel tank (4mm shell)
Water pump driven by PTO

9 Flat Bed Truck

44 HP Diesel engine
3.5 ton capacity
Manual transmission
High side body

10) Asphalt Sprayer towed, with spray bar

800 l. capacity
Mounted on 1 or 2 axles
Air compressor/asphalt pump driven by Diesel engine
1 burner
Fifth wheel
Barrel hoist

11) <u>Rock Crusher/Screen Plant mobile</u>

30 TPH rated output capacity

2 stage crusher:

Primary - Jaw crusher

Secondary - cone crusher

Screen: 3 deck type

Electric generating set, 3 phase

220/300 Volt, 50 Hz

Conveyors

ANNEX 15

SAMPLE TECHNICAL SPECIFICATIONS
FOR SUPPORT EQUIPMENT

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : PICK-UP TRUCK 3/4 - 1 TON	
CONSTRUCTION	
1. All steel cab with safety glass through-out	
2. Open bed all steel body with hinged tail gate.	
3. Front and rear bumpers	
4. Grill guard protecting radiator and headlights.	
5. Capacity 3/4 ton to 1 ton.	
6. Right hand drive.	
7. Wheel drive 4 x 2	
8. Wheel base minimum 2,6 m	
POWER UNIT	
1. Water cooled diesel engine.	
2. Flywheel horsepower not less than 60 HP at manufacturers recomended RPM for intended application.	
3. Direct electric starting with 12 volt electric system	
TRANSMISSION	
1. Direct drive, heavy duty 4 forward and one reverse.	
2. Synchromesh on all gear except first gear and reverse.	
3. Floor manual shift,	
C L U T C H	
1. Dry single plate, heavy duty type.	
SUSPENSION	
1. Front and rear double acting shock absorber, hydraulic telescopic, heavy duty.	
2. Over load spring on the rear	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
BRAKE 1. Hydraulic for all four wheels. 2. Parking brake. **INSTRUMENTS** 1. Kilometer speedometer/odometer, water temperature gauge, oil pressure gauge. 2. Other necessary gauge or indicators for operation and travel. 3. Single or double sealed beam headlamps. 4. Combination tail and stop lamps. 5. Direction (turning) signals front and rear. 6. Automatic traffic hazards flasher with separate switch to operate with ignition on and off. 7. One electric outlet shall be provided. 8. Dual electric windshield wipers. 9. Dual horns 10. Rear view mirror. **TANK** 1. Fuel tank capacity at least 60 (sixty) liters. **TYRES** 1. Four of 750 x 16 - 6 PR or smaller size, front and rear, tyre and tube type. 2. One spare wheel.	

3d3X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
ACCESSORIES 1. Front and rear tow hook. 2. Standard manufacturer's tool kit included special tools plus one hydraulic jack 2 ton cap, one wheel lug wrench (cross rim) for each unit. 3. Two sets of instruction manuals, two sets of workshop manuals, two sets of part catalogs for each unit. 4. Instruction plate for daily maintenance in the Indonesian languange.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : JEEP, 4 WHEEL DRIVE	
CONSTRUCTION	
1. All steel passenger carrying body with safety glass throughout.	
2. Channel section reinforced frame.	
3. Front and rear bumpers.	
4. Grill guard protecting radiator and headlights.	
5. Seating 6 passengers.	
6. Right hand drive.	
7. Wheel drive 4 x 4	
8. Wheel base minimum 2.3 m.	
9. Swing out rear doors.	
10. Fold down rear seats.	
11. Body and frame should be coated against rust.	
POWER UNIT	
1. Water cooled diesel engine.	
2. Horsepower minimum 130 HP.	
3. Direct electric starting with 12 volt electric system.	
4. Dry type air cleaner.	
TRANSMISSION	
1. Direct drive, heavy duty 3 or 4 forward and one reverse.	
2. Synchromesh on all gears except first gear and reverse.	
3. Manual gear changer.	
CLUTCH	
1. Dry single plate, heavy duty type.	
2. Hydraulically operated.	

345X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
SUSPENSION	
1. Front and rear double acting shock absorber, hydraulic telescopic heavy duty.	
2. Heavy duty leaf springs.	
BRAKE	
1. Hydraulic for all four wheels vacuum boosted.	
2. Parking brake.	
INSTRUMENTS	
1. Speedometer/odometer, water temperature gauge, oil pressure gauge.	
2. Other necessary gauges or indicators for operation and travel.	
ELECTRICAL	
1. Sealed beam headlights.	
2. Combination stop and tail lamps.	
3. Automatic traffic hazard flasher with separate switch to operate with ignition on and off.	
4. Direction (turning) signals front and rear.	
5. Dual electric windshield wipers.	
TANK	
Fuel tank capacity at least 60 (sixty) litres.	
TYRES	
1. Tyres front, rear and spares suitable for on and off highway service.	
2. Spare wheel complete with tyre, spare wheel carrier with locking device.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
ACCESSORIES 1. Front and rear tow hook. 2. Standard manufacturer's tool kit included special tools plus one hydraulic jack 2 tons capacity, one wheel nut spanner. 3. Rear view mirrors. 4. Two sets of instruction manuals, one sets of workshop manuals, two sets of parts catalogues for each unit. 5. Underbody proof coat protection. 6. Lockable fuel filter cap. 7. Safety chains on all filter caps. 8. Winshield washers. 9. High tone horn. 10. Lap and sash seat belts for driver and passengers. 11. Internal sun visors for driver and passengers. 12. 1.4 Kg. BCF dry type fire extinguisher bracket mounted. 13. Instruction plate dor daily maintenance in the Indonesian language.	

347X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : LUBE TRUCK BASIC TRUCK 1. All steel cab with wide safety windshield. 2. Two heavy duty axle with dual rear wheel drive. 3. Right hand drive and adjustable driver seat. 4. Re-inforced frame particularly suitable for truck application. 5 Wheel base not less than 3000 mm. 6. Driver's door not to be of selflocking type. POWER UNIT 1. Water cooled diesel engine. 2. Fly wheel horse power not less than 70 HP at manufacturer's recomended RPM for intended application. 3. Engine shall have fuel filter and oil filter fitted on safe place to avoid damage. 4. Direct electric starting of 12 volt or 24 volt electric system. CLUTCH 1. Heavy duty, dry single plate. 2. Clutch plate shall have cushioning (vibration) damper. TRANSMISSION 1. Manual shift, floor mounted. 2. Minimum four forward and one reverse. 3. Synchromesh or constantmesh on all forward gear, except in reverse and the first gear.	

Same as 3.5 Ton

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
FRONT AXLE 1. Heavy duty construction. 2. Capacity of not less than 1.5 (one point five) tons. REAR AXLE 1. Heavy duty construction. 2. Full floating axle, single reduction. 3. Capacity of not less than 3.5 (three point five) tons. BRAKE 1. Hydraulic with vacuum assisted service brake. 2. Hand operated mechanical parking brake. SUSPENSION 1. Leaf spring for front and rear suspension. 2. Double acting telescopic shock absorber at front and rear. TYRE AND WHEEL 1. Dual rear drive wheel. 2. Spare tyre with rim, with heavy duty hanging. 3. tyre and tube type cast steel rims. 4. Tyre size 7.00 - 15 -10 PR ELECTRICAL SYSTEM 1. 12 volt or 24 volt electric system. 2. Main sealed beam headlight. 3. Fuse panel in glove box, dome light. 4. Indicator lamps for turn signals, main beam, parking brake. 5. Meter for fuel, water temperature, warning lamp for charging.	

349 X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
6. Speedometer with odometer in metric. 7. Traffic hazard switch. 8. Dual stop, tail and back up lights. 9. Dual wind screen wipers. 10. Dual horns. 11. Identifications lamps on front and rear. ACCESSORIES 1. Rear view mirrors on left, right and inside cab. 2. Standard manufacturer's tool kit, included special tools in tool box. 3. Hydraulic jack approx. 7.5 (seven point five) ton capacity, and cross wheel spanner for each unit. 4. Two instruction/operating manuals, two service manuals, one workshop manuals, two parts catalogs for each unit. 5. Instruction plate for daily maintenance in the Indonesian language. 6. Engine oil filter, air cleaner element, fuel filter, and hydraulic oil filter for one year operation, should be supplied for each unit. VAN 1. Van body : aluminium 2. Window : 3 windows each side 2 windows rear 1 window front 3. Outside dimension: Overall length approx 3.500 mm Overall width approx 2.000 mm 4. Door: Two open type doors at the rear end with padlock. 5. Folding ladder at rear end.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED		SPECIFICATION OFFERED
TOOLS AND WORKSHOP EQUIPMENTS according to specification attached		
	Q'TY	
1. High pressure grease bucket pump (20 Kgs)	1	
2. High pressure oil bucket pump (20 lt)	1	
3. Hand grease gun heavy duty	1	
4. Suction pump for oil recovery	1	
5. Oil measuring can 1 ltr.	1	
6. Oil measuring can 2 l r.	1	
7. Funnel 300 mm diameter	1	
8. Oiler (aluminium alloy) 250 CC	2	
9. Rotary hand pump 2 l/min.	2	
10. Drum/Bung wrench	1	
11. Oil filter wrench chain type	1	
12. Drain plug wrench	1	
13. Metric tools set	1	
14. Air compressor engine driven 40 l/min 100 psi, 50 lt tank cap	1	
15. Vulcanizing unit	1	
16. Tyre tools set	1	
17. Hot patch set	1	
18. Electric hand drill 1/2"	1	
19. Electric disc grinder	1	
20. Electric soldering iron	1	
21. Hydraulic jack 10 ton	1	
22. Axle stand	4	
23. Arbor press	1	
24. Bench vise 5" opening	1	
25. 6 ton puller	1	
26. Electric generating set 3000 watt	1	
27. Workbench with cabinet and drawers size 100cm x 60cm x 85cm	1	
28. Hub nut wrench	1	
29. Pressure gauge	1	

351

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : FLATBED WITH CRANE 3 TON. BASIC TRUCK 1. Cab and chassis all steel with safety glass throughout. 2. Two heavy duty axle with rear wheel drive. 3. Shock absorber on front axle. 4. Right hand drive. 5. Re-inforced frame particularly suitable for flatbed type application. 6. Maximum wheel base 4.4 (four point four) meters. 7. Driver's door not to be self-locking type. POWER UNIT 1. Diesel engine. 2. Engine shall have fuel filter and oil filter fitted on safe place to avoid damage. 3. Rain cap for exhaust pipe in case of upward opening of exhaust pipe. 4. Direct electric starting. CLUTCH 1. Heavy duty dry type. 2. Clutch plate shall have spring vibration dampers. TRANSMISSION 1. Manual shift, minimum four forward and one reverse. 2. Synchromesh or constantmesh, except in reverse and first gear direct drive in top gear.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
FRONT AXLE 1. Heavy duty construction. 2. Minimum capacity 2.7 (two point seven) tons. REAR AXLE 1. Heavy duty construction. 2. Single reduction, full floating axle. 3. Minimum capacity 7.3 (seven point three) tons. 4. Fitted with auxiliary spring. ELECTRICAL SYSTEM 1. 12 volt or 24 volt electrical system. 2. Heavy duty battery. 3. Sealed beam, dip to left headlights. 4. Fuse panels in glove box, dome light. 5. Turn signals left and right for rear and front. 6. Dual stop, tail and back up lights. 7. Traffic hazard switch. 8. Dual wind screen wipers. 9. Dual horn. 10. Front clearance and identification lamps. 11. Speedometer with odometer in metric. BRAKE 1. Service brake shall be of hydraulic with vacum power booster on all wheels. 2. Vacum reserve tank with gauges and warning light. 3. Hand operated parking brake.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
TYRE AND WHEEL 1. Single front and dual rear wheel, plus spare wheel. 2. Heavy duty hanging for spare wheel. 3. 8.25 x 20 tube and tyre type, cast steel rims. FLATBED 1. Platform size 2.2 (two point two) meters by 3.7 (three point seven) meters. 2. Steel frame and steel sills with 50 mm thick wooden deck, and bulkhead cab protector with rear view opening. 3. Stake slote provided, minimum 4 on each side and 2 on rear. HYDRAULIC CRANE 1. Hydraulically operated crane by hydraulic pump driven through PTO, maximum lifting capacity 3 (three) tons. 2. Crane should be mounted at center between cabin and platform, with 2 (two) hydraulically operated outtriggers. 3. Operating handle shall be at right side, and could be operated easily by the truck driver. 4. Lifting capacity with outtriggers on, 2 (two) tons at 3 (three) meters radius. 5. Box type two staged hydraulic telescopic boom of at least 7 (seven) meters maximum length, with telescopic speed not less than 180 mm/sec. 6. The crane shall be 360° rotation (swing), with slewing speed 3 rpm at engine idling rotation. 7. Hook speed not less than 9 m/minute --	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
ACCESSORIES 1. Rear view mirrors on left and right side of the cab, also inside cab. 2. Standard manufacturer's tool kit, including special tools, 10 ton hydraulic jack, and wheel spanner for each unit. 3. Two operating manuals, two part manuals, one workshop repair manual for each unit. 4. Instruction plate for daily maintenance in Indonesian language. 5. Engine oil filter, air cleaner element, fuel filter, and hydraulic oil filter for one year operation, should be supplied for each unit.	

ANNEX 16

SAMPLE TECHNICAL SPECIFICATIONS FOR MAINTENANCE EQUIPMENT

TECHNICAL SPECIFICATION ITEM NO. _____

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : WHEELED LOADER, 1.2 M^3	
CONSTRUCTION	
1. Operating weight minimum 7.5 Ton.	
2. Open steel frame canopy, with heat insulated steel roof.	
3. Radiator guard, engine side cover (left and right)	
PERFORMANCE	
1. Bucket capacity (struck) not less than 1.2 (one point two) cubic meter.	
2. Tipping load at full turn not less than 4,500 Kgs.	
3. Dumping clearance at full lift and 45° discharge angle, not less than 2.700 mm.	
4. Dumping reach at full lift and 45° discharge angle not less than 800 mm.	
POWER UNIT	
1. Diesel engine.	
2. Flywheel horse power not less than 80 HP at manufacturer's recommended RPM for intended application.	
3. Direct electric starting.	
4. Engine shall have hourmeter and fuel line water trap.	
TRANSMISSION	
1. Torque converter, full power shift transmission of at least 3 speed forward and 3 speed reverse.	
2. Travelling speed not less than 30 Km/H.	
DRIVING SYSTEM	
Four wheel drive system.	
STEERING SYSTEM	
1. Articulated frame steering system.	
2. Maximum turning radius not more than 6,000 at cut side bucket.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
TYPE 1. Tyre and tube, L-2 type 2. Size according to manufacturer's standard production. BRAKE SYSTEM 1. Service brake on all four wheels, air or hydraulic actuated. 2. Mechanical parking brake. ATTACHMENT 1. High strength wear resistance general purpose bucket with detachable teeth. 2. Hydraulically operated. LIGHTINGS Necessary lighting for night operation and travelling, controlled through switches from operator's seat. ACCESSORIES 1. Standard manufacturer's tool kit for each unit. 2. Two instruction/operating manuals, two part catalogues, and one workshop repair manual for each unit. 3. Instruction plate for daily maintenance in Indonesian language. 4. Rear vision mirrors. 5. Locking cap with securing chains for fuel tank, radiator, and hydraulic oil tank. 6. Fuel tank with inlet screen and drain cock. 7. Adjustbale soft cushioned operator's seat. 8. Engine oil filter, air cleaner element, fuel filter and hydraulic oil filter for one year operation should be supplied for each unit.	

358X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : MOTOR GRADER [illegible]	
CONSTRUCTION	
1. Open type steel canopy with insulated heat steel roof.	
2. Transmission and engine guard, engine side cover (left and right)	
3. Operating weight not less than 8.50 ton.	
OPEN UNIT	
1. Diesel engine.	
2. Fly wheel horse power not less than 90 HP at manufacturer's recomended RPM for intended application.	
3. Direct electric starting of 12 or 24 volt electric system.	
4. Engine shall have hourmeter and fuel line filter water trap.	
TRANSMISSION	
1. According to standard manufacturer's production.	
2. Max. speed not less than 30 Km/h.	
STEERING	
Articulated frame steering.	
TYRES	
Type and size according to manufacturer's standard production.	
FRONT AXLE	
1. Heavy duty type.	
2. Hydraulically leaning.	
REAR AXLE	
1. Full floating.	
2. All wheel tandem drive.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
BRAKE 1. Servise brake: hydraulic, on at least rear drive wheel. 2. Parking brake: mechanical. MOLBOARD 1. Approx. 3.1 m long x 0.5 m high x 0.016 m thick. 2. Roll away type with replaceable cutting edges and end bits. 3. Blade shall be easy to be positioned for bank cutting from operator's seat. 4. Hydraulically controlled. SCARIFIED 1. The equipment shall be fitted with scarifier of replaceable teeth. 2. Scarifier load approx. 3.5 ton. 3. Heavy duty type. LIGHTINGS Necessary lighting for operation and travelling, controlled through switches from operator's seat. ACCESSORIES 1. Standard manufacturer's tool kit for each unit. 2. Two instruction/operation manuals, two part catalogues and one workshop repair manual for each equipment. 3. Instruction plate for daily maintenance in the Indonesian language. 4. Engine oil filter, air cleaner element, fuel filter, and hydraulic oil filter for one year operation, should be supplied for each unit. 5. One spare tyre and rim should be supplied for each unit.	

360x

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : WATER TANK TRUCK 4.000 LITRES 10 [illegible] CONSTRUCTION 1. All steel, welded, minimum 4 (four) milimeters thick shell. 2. Tank has at least 2 (two) cross section surge plate. 3. Tank to be elliptical and shall have cat walks left side and top with steel ladder. 4. Manhole at top centre of tank, minimum diameter 400 milimeters with hinged cover having quick locking device. SPRAYBAR 1. Pressurized water spray through 7.6 (seven point six) cm diameters x 2.2 (two point two) metre long spraybar, with pipe caps on ends to facilitate cleaning and splash plate under each outlet. 2. Cab control of quick opening valve mounted right side. LOADING SYSTEM 1. Water pump of adequate capacity driven by heavy duty power take off from truck transmission, controlled from inside cab through clutch. 2. Suction hose of minimum lenght 7.5 (seven point five) metres with foot valve and screen. 3. Discharge pipe fitted with coupling at pump outlet. BASIC TRUCK 1. Cab and chassis all steel with safety glass through out. 2. Two heavy duty axles with rear wheel drive. 3. Shock absorber on front axle.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : TANDEM ROLLER	
CONSTRUCTION	
1. Self propelled vibrating tandem roller.	
2. Static weight not less than 6000 Kgs.	
3. All steel open frame canopy (ROP specification) with heat insulated steel roof.	
4. Robust lifting point.	
POWER UNIT	
1. Diesel engine.	
2. Fly wheel horse power not less than 50 HP at manufacturer's recomended RPM for intended application.	
3. Direct electric starting with 12 or 24 V. electric starting.	
4. Engine shall have hourmeter.	
TRANSMISSION	
Hydrostatic transmission	
STEERING	
Hydrostatic or hydraulically actuated.	
DRIVE	
All wheel drive.	
BRAKE	
1. Hydrostatic service brake.	
2. Mechanical parking brake.	
ROLLER DRUM	
1. Drump width of not less than 1200 mm.	
2. Linear static pressure not less than 22 Kg/cm on each drum.	

362X

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
3. Vibration on rear drum with maximum frequency of not less than 50 Hz or 3000 vpm. 4. Centrifugal force: not less than 3500 Kgs at low amplitude, and not less than 5000 Kgs at high amplitude. 5. Scraper on both drums. 6. Pressurized water sprinkler on both drums LIGHTING Necessary lighting for operation and travelling, controlled through switches from operator's seat. GAUGES Direct reading gauges and warning lights, covering oil pressure, hydraulic pressure, fuel capacity, water temperature, alternator, and other necessary gauges and warning lights ACCESSORIES 1. Standard manufacturer's tool kit including special tools for each unit. 2. Two operation manuals, two part manuals, and one workshop repair manual should be supplied for each unit. 3. Heavy duty rear vision mirrors. 4. Cushioned adjustable operator's seat. 5. Locking caps with securing chain for fuel tank, radiator, oil filter, and hydraulic tank. 6. Fuel tank with inlet screen and drain cock 7. Instruction plate for daily maintenance in Indonesian language. 8. Engine oil filter, air cleaner element, fuel filter, and hydraulic oil filter for one year operation should be supplied for each unit.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
4. Right hand drive. 5. Reinforced frame suitable for water tank application. 6. Wheel base 3.6 (three point six) metres. 7. Driver door's not to be self locking type. POWER UNIT 1. Diesel engine. 2. Fly wheel horse power not less than 140 HP at manufacturer's recommended RPM for intended application. 3. Engine shall have fuel filter and oil filter fitted on safe place to avoid damage. CLUTCH 1. Heavy duty, dry single plate. 2. Clutch plate shall have spring vibration damper. TRANSMISSION 1. Manual shift, minimum four forward and one reverse. 2. Synchromesh or constantmesh in all gears, except in first gear and reverse, direct drive in top gear. FRONT AXLE 1. Heavy duty construction. 2. Capacity not less than 4 (four) tons. REAR AXLE 1. Heavy duty construction. 2. Single reduction, full floating axle. 3. Capacity not less than 8 (eight) tons. 4. Fitted with auxiliary spring.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
TYRES AND WHEELS 1. Single front and dual rear wheel, with spare wheel. 2. Heavy duty hanging for spare wheel. 3. 8.25 x 20 tube and tyre, cart steel rims. BRAKES 1. Service brake shall be hydraulically operated with vacuum power booster on all wheels. 2. Vacuum reserve tank with gauge and warning light. 3. Hand operated mechanical parking brake. ACCESSORIES. 1. Rear view mirrors on left and right side cab also inside cab. 2. Standard manufacturer's tool kit, 10 tons hydraulic jack, and wheel spanner for each unit. 3. Two instruction manuals, two service manuals, one workshop repair manual, two part catalogues for each unit. 4. Instruction plate for daily maintenance in Indonesian language. 5. Engine oil filter, air cleaner element, and fuel filter for one year operation, should be supplied for each unit.	

TECHNICAL SPECIFICATION ITEM NO.

SPECIFICATION REQUIRED	SPECIFICATION OFFERED
U N I T : CONCRETE MIXER MINIMUM CAPACITY 250 LITERS CONSTRUCTION 1. Tilting or counter rotation discharge type, heavy duty construction, mixing capacity not less than 250 liters. 2. Welded steel frame with abrasive resisting steel drum. 3. Towable, 2 (two) axles with steel wheel, swivelling front axle with drawbar, towing eye of aprox 8 mm and fitted with safety chains. 4. Lockable engine cover. 5. Renewable drum ring gear and pinion in enclosed casing with acces for lubrication maintenance. 6. All gears and drive chains safely guarded. POWER UNIT 1. Diesel engine of adequate power to drive drum mixer. 2. Engine shall have fuel filter and dry type air cleaner. ACCESSORIES 1. Standard manufacturer's tool kit including special tools for each unit. 2. Two operator/intruction manual's, two service manuals, one workshop manual, two part catalogue's for each item of equipment including for engine. 3. Fuel tank to be fitted with filter inlet screen, dipstick or level gauge and drain cock. 4. All filler caps to be safely chained and vandalism protected. 5. Unit to be fitted with lifting point. 6. Engine oil filter, air cleaner element, and fuel filter for one year operations should be supplied for each unit.	

ANNEX 17

SAMPLE RENTAL RATES FOR
KABUPATEN-OWNED EQUIPMENT

I. RENTAL REGULATIONS IN SOUTH SULAWESI (only for equipment owned by Kabupaten/DPUK)

KABUPATEN	TYPE OF LETTER	TYPE OF EQUIPMENT CAN RENT OUT	AUTHORITY	TERMS
PINRANG	Kabupaten regulation made by Bupati and DPRD and approved by Governor	Road roller	Bupati	- Rental rate Rp. 125/m^2 per lap, not including operator fuel and oil - Maximum time 8 hours/day - Down payment 50% from Contract Cost - Damage : . The Contractor has to pay repairing cost for less than Rp. 50,000, and the rest will be paid by Kabupaten (for any damages not caused by Contractor negligence) . Any damages caused by contractor negligence will be the responsibility of the Contractor.
BONE	Kabupaten regulation made by Bupati and DPRD and approved by Governor	Road roller	Bupati	- Rental rate for subgrade compaction Rp. 36/m^2 - Rental rate for subbase compaction Rp. 36/m^2 - Rental rate for base compaction Rp. 72/m^2 - Rental rate for surface compaction Rp. 18/m^2 - The Contractor should pay for security, driver, fuel, oil and damages up to Rp. 50,000 (doesn't have explanation - for a day or for what ?)
GOWA	Kabupaten regulation made by Bupati, copy to: - Home Affair Minister - Governor South Sulawesi - DPRD Gowa - Chief of DPUK	Road roller, Truck, Bulldozer and Stone Crusher	Chief of DPUK (approved by Bupati)	- Road roller Rp. 300,000/km Rp. 20,000/day Rp. 65/m^2 - Bulldozer Rp. 50,000/day - Truck Rp. 10,000/day - Stone Crusher Rp. 450,000/month Rp. 15,000/day

II.

KABUPATEN	TYPE OF LETTER	TYPE OF EQUIPMENT CAN RENT OUT	AUTHORITY	TERMS
GOWA (Contin.)				- Down payment 5% from contract cost - Damage : . The Contractor has to pay repairing cost for repairs of less than Rp. 50,000 , and the rest will be paid by Kabupaten and Contractor (for any damages not caused by contractor negligence) . Any damages caused by Contractor negligence will be responsibility of the Contractor
JENEPONTO	Kabupaten regulation made by Bupati and DPRD	Truck Road roller Stone crusher	Bupati	- truck Rp. 15,000/day) not including - road roller Rp. 20,000/day) operator, fuel, Rp. 200,000/Km) oil and repairing - stone crusher Rp. 15,000/day) cost - Down payment 50% from Contract cost - Damage . The Contractor has to pay repairing cost for less than Rp. 50,000 ,and the rest will be paid by Kabupaten (for any damages not caused by Contractor negligence) . Any damages caused by Contractor negligence will be responsibility of the Contractor
BULUKUMBA	Kabupaten regulation made by Bupati and DPRD	Road roller Vibrating roller	Bupati	- Road roller Rp. 15,000/day - Vibrating roller Rp. 10,000/day - Maximum time 6 hours/day - Down payment 60% from contract cost - Any damages caused by Contractor negligence will be responsibility of the Contractor

3494

III.

KABUPATEN	TYPE OF LETTER	TYPE OF EQUIPMENT CAN RENT OUT	AUTHORITY	TERMS
WAJO	Kabupaten regulation made by Bupati and DPRD	Road roller Bulldozer Truck Compactor	Bupati	- Road roller Rp. 35,000/day - Bulldozer Rp. 25,000/day - Truck Rp. 25,000/day - Compactor Rp. 5,000/day Doesn't have Clarification (like damage etc).
SIDRAP	Kabupaten regulation made by Bupati	Road roller Vibrating roller Stone crusher Bulldozer Excavator Shovel Dump truck	Bupati	

	In Kabupaten Area	Out from Kabupaten
- Road roller	Rp. 30,000/day	Rp. 40,000/day
- Vibrating roller	Rp. 15,000/day	Rp. 20,000/day
- Stone crusher	Rp. 15,000/day	Rp. 30,000/day
- Bulldozer	Rp. 40,000/hour	Rp. 45,000/hr
- Excavator	Rp. 40,000/hour	Rp. 50,000/hr
- Shovel	Rp. 30,000/hour	Rp. 40,000/hr
- Dump truck	Rp. 20,000/day	Rp. 30,000/day

- The rental rate does not include Operator, fuel, oil and small repairing cost
- Maximum time 8 HRS/day
- Down payment 50 % from contract cost
- Damage :
  - . The Contractor has to pay repairing cost for less than Rp. 100,000, and the rest will be paid by Kabupaten (for any damages not caused by Contractor negligence)
  - . Any damages caused by Contractor negligence will be responsibility of the Contractor.

ANNEX 18

LIST OF RECORDED VIDEO CASSETTE AND SLIDE-TAPE COURSES FOR EQUIPMENT AND WORK METHODS

LIST OF RECORDED VIDEO CASSETTE

No.	Symbol		Title	Source	Language
1.	C-1	Soil Test	(1) Sample Preparation, Specific Gravity, etc.	Slide	Indonesian
2.	C-2	Ditto	(2) Grain Size Analysis, Liquid Limit, etc	Slide	"
3.	C-3	Ditto	(3) California Bearing Ratio Test (CBR)	Slide	"
4.	C-4	Ditto	(4) Base Course, CBR at Site	Slide	"
5.	C-5	Earth Work	(1) Selection of Material, Construction Planning	Slide	"
6.	C-6	Ditto	(2) Earth Moving	Slide	"
7.	C-7	Surveying	(1) Length, Height and Angle	Slide	"
8.	C-8	Ditto	(2) Plane Table, Levelling	Slide	"
9.	C-9	Asphalt Test	(1) Marshal Stability Test	Slide	"
10	C-10	Ditto	(2) Asphalt Extraction Test	Slide	"
11.	C-11	Pavement	(1) General	Slide	"
12.	C-12	Ditto	(2) Base Course	Slide	"
13.	C-13	Ditto	(3) Materials and Mixture	Slide	"
14.	C-14	Ditto	(4) Construction of Binder Course and Surface	Slide	"
15.	C-15	Road Maintenance	(1) General	Slide	"
16.	C-16	Ditto	(2) Document procedure and Cautions at Job-Site	Slide	"
17.	C-17	Foundation	(1) Introduction	Slide	"
18.	C-18	Ditto	(2) Behavior of Foundation	Slide	"
19.	C-19	Ditto	(3) Piles	Slide	"
20.	C-20	Concrete	(1) General, Materials	Slide	"
21.	C-21	Ditto	(2) Mixture Design	Slide	"
22.	C-22	Ditto	(3) Construction Execution	Slide	"

No.	Symbol	Title	Source	Language
23.	Computer-1	Daily life with computers	Film	English
24.	Computer-2	Personal computers. The Beginning of a Whole New way of Life	Film	"
25.	Computer-3	System Engineering for Computer System Installation and Development	Film	"
26.	M-1	Maintenance (General)	Slide	Indonesian
27.	M-2	Maintenance for Komatsu Bulldozer	Slide	"
28.	M-3	Maintenance of GD600 Series	Slide	"
29.	M-4	Inspection and Maintenance for Bulldozer	Film	"
30.	M-5	Importance of Maintenance and Management of Machineries	Slide	"
31.	M-6	Devices of Maintenance and Management of Machineries	Slide	"
32.	M-7	Komatsu 4D92 Diesel Engine	Slide	"
33.	M-8	Failure Analysis (Engine)	Slide	"
34.	M-9	Komatsu Diesel Engine	Slide	"
35.	M-10	How to Diagnose Bearing Trouble	Slide	"
36.	M-11	Fuel System for S1D155, S6D155	Slide	"
37.	M-12	Disassembly of Torque Converter for D65A	Slide	"
38.	M-13	Final Drive for D65A-6	Slide	"
39.	M-14	Disassembly of Steering Clutch for D65A	Slide	"
40.	M-15	Steering System of Crawlers	Slide	"
41.	M-16	Dismounting Bevel Gear and Shaftframe	Slide	"
42.	M-17	Bevel Gear and Shaft for D65A-6	Slide	"
43	M-18	Brake System for Bulldozer and Shovel	Slide	"
44.	M-19	Final Drive System for Motor Grader	Slide	"
45	M-20	A Longer Life for Your Undercarriege	Slide	"
46.	M-21	An Ounce of prevention	Slide	"

No.	Symbols	Title	Source	Language
47.	M-22	Essential Knowledge on Lubrication Oil	Slide	Indonesian
48.	M-23	Essential Knowledge on Fuel	Slide	"
49.	M-24	Structure and Function of D31A	Slide	"
50.	M-25	Komatsu Undercarriage Service Part-I	Slide	"
51.	M-26	Inspection and Adjustment of Electrical System	Film	"
52.	M-27	Devices of Maintenance and Management of Machineries based upon its Programme	Slide	"
53.	M-28	Bulldozer Operation	Film	"
54.	M-29	Knowledge of Wheel Loader's Tire	Slide	"
55.	O-30	Operation of Wheel Loaders	Film	"
56.	O-31	Operation of Motor Graders	Film	"
57.	O-32	Operation of Bulldozers	Film	"
58.	O-33	Indespensible knowledge on the Basis of Driving and Operation of Machineries	Slide	"
59.	O-34	Safety Operation Devices "accidents are shooting you"	Slide	"
60.	O-35	Operation Manual for Bulldozer	Film	"

No.	No.Casset	Judul Casset	Jumlahnya		Keterangan
1.	101/-	Perbaikan Pondasi Jalan	6.	Buah	
2.	102/-	Pemadatan Penetrasi	3.	"	
3.	103/-	Pemadatan Aspal Butas	5.	"	
4.	104/-	Pemeliharaan Badu Jalan	4.	"	
5.	105/-	Pemeliharaan Selokan	4.	"	
6.	106/-	Pemeliharaan Gorong2	3.	"	
7.	107/-	Perbaikan Erosi	4.	"	
8.	108/01	Pemeriksaan Jembatan	3.	"	
9.	108/02	Pemeliharaan Jembatan	3.	"	
10.	109/-	Penggunaan Aspal dengan Tenaga	5.	"	
11.	203/01	Apakah Pengambilan Contoh itu	4.	"	
12.	203/02	Bagaimana Pengujian dilakukan	3.	"	
13.	203/10	Contoh dari Timbunan	4.	"	
14.	203/13	Contoh dari Truk	3.	"	
15.	203/14	Contoh dari Pengangkutan	3.	"	
16.	203/16	Memirah & Memperempat	5.	"	
17.	203/20	Contoh Aspal dari Drum	3.	"	
18.	203/21.	Pengambilan Contoh Aspal dari Tangki	5.	"	
19.	203/31	Contoh Air untuk Beton	3.	"	
20.	203/33	Contoh Beton	3.	"	
21.	203/34	Contoh Beton Cylinder	3.	"	
22.	203/35	Contoh Beton Kubus	2.	"	
23.	203/40	Dasar Analisa Gradeni di Lapangan	2.	"	
24.	203/41	Pemeriksaan Kadar Air Di Lapangan	3.	"	
25.	203/42	Pemeriksaan Kepadatan	3.	"	
26.	203/43	Pengukuran CBR Lapangan	2.	"	
27.	203/51	Pengujian SLUMP dilakukan	2.	"	
28.	203/70	M e n i m b a n g	2.	"	
29.	205/10	Penyelidikan Campuran Butas dingin	4.	"	
30.	209/-	Pemangunan Gorong2	2.	"	
31.	216/05	Pelapisan Butas dingin	3.	"	
32.	304/01	Penggunaan Kompressor Udara	5.	"	
33.	304/02	Penggunaan Jack Hamer	5.	"	
34.	305/01	Penyemprotan Aspal	4.	"	
35.	305/02	Penyemprotan Aspal Ersont	4.	"	
36.	305/03	Penyemprotan Aspal Linnhoff	2.	"	
37.	305/04	Penyemprotan Aspal Hanta	5.	"	
38.	313/-	Penggunaan Roda Besi	2.	"	
39.	314/-	Penggunaan Pnumatik	2.	"	
40.	315/-	Pemadatan dengan Kaki Kambing	1.	"	
41.	316/-	Penggunaan Tangki Air	2.	"	
42.	317/-	Penyemprotan Aspal dengan Alat Tangan	1.	"	
43.	318/-	Dasar2 Penggunaan Loder	2.	"	
44.	319/-	Lanjutan Penggunaan Loder	2.	"	
45.	322/01	Dasar2 Penggunaan Dozer	2.	"	
46.	322/02	Lanjutan Penggunaan Dozer	2.	"	
47.	324/-	Pengantar Motor Grader	1/	"	
48.	325/-	Perataan Tanah	1.	"	
49.	326/-	Motor Grader Perbaan Batuan	3.	"	
50.	328/-	Perataan Campuran Aspal	3.	"	
51.	329/-	Penggalian Selokan & Talud	2.	"	
52.	402/01	Pemeriksaan Kendaraan	5.	"	
53.	402/02	Pemeriksaan Peralatan	5.	"	
54.	402/03	Pemeriksaan Felter	4.	"	
55.	403/-	Pemasangan Ban dalam	5.	"	
56.	404/01	Pemeliharaan Accu	5.	"	
57.	405/01	Pengantar cara Penggantian Kompnen	5.	"	
58.	405/03	Penggantian Kompnen sistem Pandihgin	5.	"	
59.	405/08	Penggantian Kompnen Reem	5.	"	
60.	406/-	Keterampilan Kerja Bangku	2.	"	
61.	407/-	Dasar2 Ketrampilan Mesin Perkakas	2.	"	
62.	412/01	Penggantian Oli pada Kendaraan	5.	"	
63.	413/02	Penggantian Oli Pada Peralatan	5.	"	
64.	413/03	Pengecekan	5.	"	

Operators

Spesialisasi (Mechanics)

375

No.	No. Casset	Judul Casset	Banyaknya	Keterangan
65.	410/02	Penggemukan di Bengkel	2. Buah	
66.	411/-	Dasar2 Penyelaman	5. "	
67.	412/-	Pemotongan Legum	3. "	
68.	501/-	Pengaturan Lalu-lintas Daerah Kerja	5. "	

@ Surabaya

(List obtained at Pkg Trg. Center - Piklat Wilayah Pusablat)
(M. Marsad)

No. Code.	NAMA KURSUS DAN JADWAL	Jumlah	Keterangan
301	- Peraturan Lalu - lintas		
302	- Penggunaan Mesin Gergaji		
303	- Penggunaan Alat Pemadatat Getar		
304 - 01	- Penggunaan Kompresor Udara	5	
304 - 02	- Penggunaan Jack Hammer	7	
305 - 01	- Penyemprot Aspal	8	
305 - 02	- Penyemprot Aspal Ernont	7	
305 - 03	- Penyemprot Aspal Linnhoff	8	
305 - 04	- Penyemprot Aspal Kanta	2	
306	- Penggunaan Mesin Kompresor		
307	- Penggunaan Mesin Pompa		
308	- Penggunaan Alat Pengaduk Beton		
309	- Pencucian Batuan		
310	- Penyapuan		
311	- Mengemudikan Truk		
312	- Lanjutan Penggunaan Truk		
313	- Penggilasan Roda Besi	5	
314	- Penggilasan Roda Ban	3	
315	- Pemadatan Mesin Gilas Kaki Kambing O/= 3	2	
316	- Penyiran Air	1	
317 - 01	- Penyemprot Aspal Dengan Alat Tangan	7	
317 - 02	- Penyemprot Aspal		
318	- Dasar Penggunaan Loader		
		71	

OPERATORS

319. .....

377

No : Code.	NAMA KURSUS DAN JADWAL	Jumlah	Keterang
7	Aggregate dan Penggunaannya pada Kruk.	Jalan	Buku
319	- Lanjutan Penggunaan Louder		
320	- Pembuatan Timbunan		BUKU ✓
322 - 01	- Penggunaan Dozer	1	
322 - 02	- Lanjutan Penggunaan Dozer	1	
323	- Menggurok dan Mencampur		
324	- Mengantar Motor Grader	4	
9 325	✓ - Perataan Tanah dgn Motorgrader	5	OPERATOR
7 326	✓ - Perataan Batuan dgn Motorgrader	4	OPERATOR
328	- Perataan Campuran Aspal	5	
K 329	- Penggalian Selokan dan Talud - talud	3	
330	- Dasar 2 Penggunaan Excavator		
331	- Lanjutan Dasar2 Penggunaan Excavator		
332	- Dasar2 Penggunaan Crane		
333	- Lanjutan Dasar Penggunaan Crane		
335	- Penggunaan Pabrik Pembuatan Aspal		
	JUMLAH :	20	

D A F T A R S I S W A .

Code.	NAMA KURSUS DAN JADWAL	Jumlah	Keterang
401	- Keselamatan Kerja di Bengkel		
402 - 01	- Pemeriksaan Kendaraan	[illegible]	
402 - 02	- Pemeriksaan Peralatan	[illegible]	
402 - 03	- Pemeriksaan Filter	[illegible]	
403	- Perbaikan Ban	6	
404 - 01	- Pemeliharaan Accu	[illegible]	
404 - 02	- Alat Cart Accu		
405 - 01	- Pengantar Cara Penggantian Komponen	12	
405 - 02	- Penggantian Komponen 2 Sistim Bahan Bakar Bensin		
405 - 03	- Penggantian Komponen 2 Sistim Pendingin		
405 - 04	- Penggantian Komponen Sistim Kelistrikan		
405 - 05	- Penggantian Komponen2 Sistim Kopling		
405 - 06	- Penggantian Komponen2 Persneling		
405 - 07	- Penggantian Komponen2 As Belakang dan Penggerak		
405 - 08	- Penggantian Komponen2 Rem	7	
405 - 09	- Penggantian Komponen2 Suspensi		
405 - 10	- Penggantian Komponen2 Kelistrikan		
406	- Dasar2 Ketrampilan Kerja Bangku	2	
407	- Dasar2 Ketrampilan Kerja Mesin Perkakas	2	
408 - 01	- Penyetelan Pada		
409 - 02	-	[illegible]	

No. Code.	NAMA MATERI DAN JADWAL	Jumlah	Keterangan
408 - 02	- Penyetelan Kilalang		
409	- Dasar2 Teori Mesin		
410 - 01	- Membaca Gambar		
410 - 02	- Pengukuran di Bengkel		
411	- Dasar2 Penyoderan		
412	- Pemotongan Logam		
413	- Penggemukan 413 [01 Pengamatan alat pd. Kend. 02 Pemeliharaan Pelaksanaan 03. Penggemukan.]		
421	- Penggunaan mesin Bubut		
423	- Pembuatan Roda Gigi dan Air		
426	- Perkakasan dan Pememperan		
428	- Teknik Mesin Perkakas		Buk. Pedoman
429	- Lanjutan Mesin Perkakas		Inst. Penerm
432	- Penjelasan Baja		
433	- Pengelasan Besi Tuang & Metal nonpern		
435	- Membentuk, mengisi dan Mengetok.		
438	- Teknik Pengelasan		
439	- Lanjutan Pengelasan		Buk. Pedoman
441	- Perbaikan Body		Inst. Peneran
443	- Cat Semprot		
444	- Pembuatan Huruf dan Tanda		
445	- Pemasangan Kaca Dan Perlengkapan		
449	- Teknik Bengkel Body		Buk . Pedom
451	- Dasar Kelistrikan Pada Kendaraan		Buku Kerja
452	- Pemasangan Lampu-Pada Kendaraan Dan Kabel		Kerja Bengk
453	- Sistym Penyalaan		"
454	- Generator dan motor		"
455	- Diagnosa Kesalahan Kelistrikan		Sok Ulangan
456	- Perbaikan Radio		Buk Pedoman
457	- Perbaikan Fabrik Pembangkit Tenaga		Buk Pedoman
	458.	27	

No. Code.	NAMA MATERI DAN JADWAL	Jumlah	Keterangan
450	- Teknik Kelistrikan pada Kendaraan		Lab. Kamp.
453	- Lanjutan Kelistrikan pada Kendaraan		Sekolah
471	- Sistem Pendingin		Kerj. Beng
472	- Sitem Kemudi		"
473	- Sitem Suspensi dan As Roda		"
474	- Kopling, Penggerak dan Transmisi		"
475	- Transmisi Otomatis		"
476	- Sitem Rem		"
477	- Sitim Bahan Bakar Mesin		"
478	- Sytem Bahan Bakar Solar		"
479	- Sysitem Hydrolis		
480	- Sysitem Truk		
481	- Sysitem Pompa Tanah dan Sentrifugal		
482	- Tlangan Sysitem		
483	- Pembongkaran Bagian Atas Mesin		
484	- Sysitem Kruk As		
485	- Pemasangan Mesin		
486	- Pengujian, Penyetelan, Penelitian mesin		
487	- Teknik Perbaikan Kendaraan		
488	- Pengujian Mesin Elektronik		
491	- Mencari Kerusakan Mesin		
492	- Lanjutan Montir Kendaraan		
	J U M L A H :		

ANNEX 19

WORKSHEET CALCULATIONS BY KABUPATEN
OF MAINTENANCE EQUIPMENT
REQUIREMENTS FOR YEARS ONE AND SEVEN

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Pinrang Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.9	1.9	-	-	-	-	-	1.9	1.9	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.5	-	0.5	-	0.5	0.5 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		5.9	1.0	0.2	0.7	0.7	1.0	1.9	1.9	1.0
	Total Assigned		6	1	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

383

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Pinrang Year: 7 th

Maintenance Activity		Number of crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	2.6	2.6	-	-	-	-	-	2.6	2.5	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.7	-	0.7	-	0.7	0.7 1/	-	-	-	-
4	Regraveling	0.3	4 2/	0.3	0.3	0.3	0.3	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.6	1.3	0.3	1.0	1.0	1.0	2.6	2.6	1.0
	Total Assigned		7	2	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

384

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Sidrap Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.1	1.1	-	-	-	-	-	1.1	1.1	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0	-	0	-	0	0 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		1.1	0	0	0	0	1.0	1.1	1.1	1.0
	Total Assigned		3	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

383

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Sidrap Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	5.6	5.6	-	-	-	-	-	5.6	5.6	-
2	Smoothing	0.1	-	0.1	-	-	-	-	-	-	-
3	Reshaping	0.2	-	0.2	-	0.2	0.2 1/	-	-	-	-
4	Regraveling	0.1	4 2/	0.1	0.1	0.1	0.1	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		9.6	0.4	0.1	0.3	0.3	1.0	5.6	5.6	1.0
	Total Assigned		10	1	1	1	1	1	3 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

3280

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Wajo Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	0	0	-	-	-	-	-	0	0	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0	-	0	-	0	0 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		0	0	0	0	0	1.0	0	0	1.0
	Total Assigned		2	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Wajo Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	2.2	2.2	-	-	-	-	-	2.2	2.2	-
2	Smoothing	0.4	-	0.4	-	-	-	-	-	-	-
3	Reshaping	0.8	-	0.8	-	0.8	0.8 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.6	1.4	0.2	1.0	1.0	1.0	2.2	2.2	1.0
	Total Assigned		7	2	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

3284

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Bone Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	T i t l e		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.0	1.0	-	-	-	-	-	1.0	1.0	-
2	Smoothing	0.2	-	0.2	-	-	-	-	-	-	-
3	Reshaping	0.4	-	0.4	-	0.4	0.4 1/	-	-	-	-
4	Regraveling	0.1	0.1 2/	0.1	0.1	0.1	0.1	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		1.1	0.7	0.1	0.5	0.5	1.0	1.0	1.0	1.0
	Total Assigned		3	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Bone Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	T i t l e		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	4.5	4.5	-	-	-	-	-	4.5	4.5	-
2	Smoothing	0.6	-	0.6	-	-	-	-	-	-	-
3	Reshaping	1.3	-	1.3	-	1.3	1.3 1/	-	-	-	-
4	Regraveling	0.3	4 2/	0.3	0.3	0.3	0.3	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		8.5	2.2	0.3	1.6	1.6	1.0	4.5	4.5	1.0
	Total Assigned		9	3	1	2	2	1	2 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

360

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sul. Kabupaten: Gowa Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	0.6	0.6	-	-	-	-	-	0.6	0.6	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0.1	-	0.1	-	0.1	0.1 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		0.6	0.1	0	0.1	0.1	1.0	0.6	0.6	1.0
	Total Assigned		2	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

391

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Gowa Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	2.2	2.2	-	-	-	-	-	2.2	2.2	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.5	-	0.5	-	0.5	0.5 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.2	1.0	0.2	0.7	0.7	1.0	2.2	2.2	1.0
	Total Assigned		7	1	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

19-10

323x

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sul. **Kabupaten:** Jeneponto **Year:** 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	2.2	2.2	-	-	-	-	-	2.2	2.2	-
2	Smoothing	0.4	-	0.4	-	-	-	-	-	-	-
3	Reshaping	0.8	-	0.8	-	0.8	0.8 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.2	1.4	0.2	1.0	1.0	1.0	2.2	2.2	1.0
	Total Assigned		7	2	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

392

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Jeneponto Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	3.6	3.6	-	-	-	-	-	3.6	3.6	-
2	Smoothing	0.6	-	0.6	-	-	-	-	-	-	-
3	Reshaping	1.3	-	1.3	-	1.3	1.3 1/	-	-	-	-
4	Regraveling	0.4	4 2/	0.4	0.4	0.4	0.4	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		7.6	2.3	0.4	1.7	1.7	1.0	3.6	3.6	1.0
	Total Assigned		8	3	1	2	2	1	2 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx, one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

364

Equipment Needs for Annual Road Maintenance Program

Province: Sul, Sul. Kabupaten: Bulukumba Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	0.1	0.1	-	-	-	-	-	0.1	0.1	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0	-	0	-	0	0 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		0.1	0	0	0	0	1.0	0.1	0.1	1.0
	Total Assigned		2	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

395

Equipment Needs for Annual Road Maintenance Program

Province: Sul. Sel. Kabupaten: Bulukumba Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	T i t l e		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	2.3	2.3	-	-	-	-	-	2.3	2.3	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.6	-	0.6	-	0.6	0.6 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.3	1.1	0.2	0.8	0.8	1.0	2.3	2.3	1.0
	Total Assigned		7	2	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

3962

Equipment Needs for Annual Road Maintenance Program

Province: NTT Kabupaten: Kupang Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.0	1.0	-	-	-	-	-	1.0	1.0	-
2	Smoothing	0.2	-	0.2	-	-	-	-	-	-	-
3	Reshaping	0.3	-	0.3	-	0.3	0.3 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		5.0	0.7	0.2	0.5	0.5	1.0	1.0	1.0	1.0
	Total Assigned		6	1	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: NT Kabupaten: Rejang Year: [illegible]

Maintenance Activity		Number of Crews	Equipment - For Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat bed Truck	Hand Compact	Drible Wheel Mixer	Concrete Mixer
1	Routine Activities	2.9	2.9	-	-	-	-	-	2.9	2.9	-
2	Smoothing	0.6	-	0.6	-	-	-	-	-	-	-
3	Reshaping	1.1	-	1.1	-	1.1	1.1 1/	-	-	-	-
4	Regraveling	0.4	4 2/	0.4	0.4	0.4	0.4	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.9	2.1	0.4	1.5	1.5	1.0	2.9	2.9	1.0
	Total Assigned		7	2	1	2	2	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: NTT

Kabupaten: T.T.S.

Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	0	0	-	-	-	-	-	0	0	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0	-	0	-	0	0 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		0	0	0	0	0	1.0	0	0	1.0
	Total Assigned		2	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

311

Equipment Needs for Annual Road Maintenance Program

Province: NTT Kabupaten: T.T.S. Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	2.5	2.5	-	-	-	-	-	2.5	2.5	-
2	Smoothing	0.6	-	0.6	-	-	-	-	-	-	-
3	Reshaping	1.1	-	1.1	-	1.1	1.1 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.5	1.9	0.2	1.3	1.3	1.0	2.5	2.5	1.0
	Total Assigned		7	2	1	2	2	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

1004

Equipment Needs for Annual Road Maintenance Program

Province: NTT

Kabupaten: Belu

Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	0	0	-	-	-	-	-	0	0	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0	-	0	-	0	1.1 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		0	0	0	0	0	1.0	0	0	1.0
	Total Assigned		1	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: NTT Kabupaten: Belu Year: 7 th.

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.3	1.3	-	-	-	-	-	1.3	1.3	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.5	-	0.5	-	0.5	0.5 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		5.3	1.0	0.2	0.7	0.7	1.0	1.3	1.3	1.0
	Total Assigned		6	1	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: NTT

Kabupaten: Sumba Barat

Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact.	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	0	0	-	-	-	-	-	0	0	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0	-	0	-	0	0 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		0	0	0	0	0	1.0	0	0	1.0
	Total Assigned		1	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: NTT Kabupaten Timor Barat Year: 7 th

Maintenance Activity		Number of Crews	Equipment - per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Pneumatic Wheel Roller	Concrete Mixer
1	Routine Activities	1.4	1.4	-	-	-	-	-	1.4	1.4	-
2	Smoothing	0.2	-	0.2	-	-	-	-	-	-	-
3	Reshaping	0.5	-	0.5	-	0.5	0.5 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		5.4	0.9	0.2	0.7	0.7	1.0	1.4	1.4	1.0
	Total Assigned		6	1	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: NTT Kabupaten: Manggarai Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	0.1	0.1	-	-	-	-	-	0.1	0.1	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0	-	0	-	0	0 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated */		0.1	0	0	0	0	1.0	0.1	0.1	1.0
	Total Assigned **/		2	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

1105

Equipment Needs for Annual Road Maintenance Program

Province: NTT | Kabupaten: Manggarai | Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	2.4	2.4	-	-	-	-	-	2.4	2.4	-
2	Smoothing	0.5	-	0.5	-	-	-	-	-	-	-
3	Reshaping	1.0	-	1.0	-	1.0	1.0 1/	-	-	-	-
4	Regraveling	0.2	4 2/	0.2	0.2	0.2	0.2	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		6.4	1.7	0.2	1.2	1.2	1.0	2.4	2.4	1.0
	Total Assigned		7	2	1	2	2	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

4004

Equipment Needs for Annual Road Maintenance Program

Province: NTT

Kabupaten: Ngada

Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle wheel Mixer	Concrete Mixer
1	Routine Activities	0	0	-	-	-	-	-	0	0	-
2	Smoothing	0	-	0	-	-	-	-	-	-	-
3	Reshaping	0	-	0	-	0	0 1/	-	-	-	-
4	Regraveling	0	0 2/	0	0	0	0	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		0	0	0	0	0	1.0	0	0	1.0
	Total Assigned		1	1	0	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: NTT Kabupaten: Ngada Year. 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.5	1.5	-	-	-	-	-	1.5	1.5	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.8	-	0.8	-	0.8	0.8 1/	-	-	-	-
4	Regraveling	0.1	4 2/	0.1	0.1	0.1	0.1	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		5.5	1.2	0.1	0.9	0.9	1.0	1.5	1.5	1.0
	Total Assigned		6	2	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment Needs for Annual Road Maintenance Program

Province: NTT

Kabupaten: Sikka

Year: 1 st

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.1	1.1	-	-	-	-	-	1.1	1.1	-
2	Smoothing	0.2	-	0.2	-	-	-	-	-	-	-
3	Reshaping	0.3	-	0.3	-	0.3	0.3 1/	-	-	-	-
4	Regraveling	0.1	4 2/	0.1	0.1	0.1	0.1	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		5.1	0.6	0.1	0.4	0.4	1.0	1.1	1.1	1.0
	Total Assigned		5	1	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

Equipment needs for Annual Road Maintenance Program

Province: NTT

Kabupaten: Sikka

Year: 7 th

Maintenance Activity		Number of Crews	Equipment - Per Crew								
Item	Title		Dump Truck	Motor Grader	Wheel Loader	Vibrat. Roller	Water Truck	Flat Bed Truck	Hand Compact	Paddle Wheel Mixer	Concrete Mixer
1	Routine Activities	1.3	1.3	-	-	-	-	-	1.3	1.3	-
2	Smoothing	0.3	-	0.3	-	-	-	-	-	-	-
3	Reshaping	0.5	-	0.5	-	0.5	0.5 1/	-	-	-	-
4	Regraveling	0.1	4 2/	0.1	0.1	0.1	0.1	-	-	-	-
5	Other	1.0	-	-	-	-	-	1.0	-	-	1.0
	Total Calculated		5.3	0.9	0.1	0.6	0.6	1.0	1.3	1.3	1.0
	Total Assigned		6	1	1	1	1	1	1 3/	1 4/	1

1/ Water Tank Truck is not needed for Reshaping activity when the surface is moist.

2/ Dump Trucks are needed for Regraveling as a complete group of 4 units.

3/ Hand Compactors are needed as approx. one-half of number of crews for Routine Activities.

4/ Paddlewheel Mixer is estimated as one unit per kabupaten.

ANNEX 20

SAMPLE OBSERVATION OF

UTILIZATION OF OECF EQUIPMENT

Based on a sample of information supplied from one kabupaten, an analysis of the operation of its OECF equipment is summarized below.

- During a whole month, the equipment was assigned to work on the Regravelling and Road Stabilization Project (Number 37.54.0.15) in Kabupaten Pinrang (Road No. 37).

- The equipment fleet consisted of:

  11 Dump Trucks 5.5 ton G.V.W. (Toyota Dyna BU30)
  1 Bulldozer (Komatsu D50E)
  2 Motorgraders 110 HP (Komatsu GD 31 RC)
  2 Wheel Loaders 1.2 m^3 capacity (Kobelco LK300)
  2 Tire Rollers 8.5 - 11 ton capacity (Kawasaki KR-200)
  1 Stone Crusher 20 ton/Hr capacity (Barata DDVI)
  1 Concrete Mixer

- Dump Trucks:

  Utilization: 3 out of 11 trucks worked less than 17 days and 8 trucks worked 17 days or more in the month; the average was 17.6 days/month. Reported effective hours worked were 8 hours per day, thus, the average hours worked were 141 hours in a month.

  Reported average production was 16.8 m^3/day per truck. At an estimated capacity of 2.5 m^3, an average of 6.7 trips per day were taken. An average of 8.72 trucks were used each day.

  Fuel Consumption:
  Average fuel consumption was 2.5 liters/hour (based on reported 8 hours of "effective" work per day), or 20 liters per day. Real fuel consumption rate is 7 liters/hour, which indicates that each truck had its engine running for less than 3 hours on each day of operation.

- Bulldozer:
  Utilization: The only bulldozer in the project was reported in a "rusak berat" condition for the whole month. This fact raises the questions:

A/12

- How long was this essential piece of equipment allowed to remain in an inoperable condition?
- Did the Mobil Workshop unit and crew from ALKAL Ujung Pandang go to Pinrang to repair it?
- Could the work progress without the utilization of a dozer in the quarry?
- Was it necessary to rent a replacement dozer from a private source?
- Did the work in the quarry proceed with the wheel loaders loading the material from the bank?

- Motorgraders:

Utilization: One of the two motorgraders available was used for 25 days in the month. The other was idle. Reported hours of "effective" work were 8 hours per day or 200 hours in the month for the one grader.

Fuel Consumption:

Fuel consumption reported was 3.7 liters/hour, based on reported 8 hours of "effective" work per day, or 29.6 liters per day. Real fuel rate is 17.5 liters/hour, which indicates that the motorgrader had its engine running for less than 2 hours daily. It confirms that there was much idle time.

Observation: Kabupaten Pinrang had, during the whole month, one motorgrader KOMATSU GD-31 that was not used at all! It was reported as idle. It raised the question:

- Couldn't this motorgrader be asigned to do routine maintenance work such as reshaping maintainable road links in this kabupaten?

  According to PT Hasfarm reports, Pinrang has 108 km of gravel roads in good condition, which should be receiving routine maintenance. Also, the existing 94 km of earth roads in moderate condition could surely use a motorgrader for reshaping (reestablishing a crown) and/or cutting ditches.

1/13

- Wheel Loaders:

Utilization: There were 2 units operating in the project. One operated for 25 days, the other for 24 days. Reported average production was 1,794 m^3/per month or 73 m^3/day per loader. The average production of dump trucks was 16.8 m^3/day per truck. Thus, daily, each loader loaded each truck 4.4 times.

If we assume a loading cycle of 4 minutes per truck, it means that a loader would spend 17.6 minutes of the day actually loading each truck. An average of 8.72 trucks were used each day. Therefore, 17.6 minutes x 8.72 trucks/day = 2-1/2 hours per day of "actual" loading time was spent by each loader. Reported "effective" hours worked was 8 hours. This raises the questions:

- Is it necessary to keep two loaders for working only 2-1/2 hours/day loading 8.72 trucks 4.4 times a day?

- Also noted is that the work progressed without interruption on Sundays. Is it normal for operators to work on Sundays? Was it necessary?

Fuel Consumption:

Average 4.3 liters/hour, based on reported 8 hours of "effective" work per day, or 34.4 liters for each loader per day. Real rate is 14 liters/hour, indicating that each loader had its engine running for about 2-1/2 hours on each day of operation.

- Tire Rollers:

Utilization: One of two tire rollers available was used for 22 days in the month. The other was idle. Reported hours of "effective" work were 8 hours per day or 176 hours in the month for the one machine.

Fuel Consumption:

Average 2.9 liters/hour, based on 8 hours of "effective" work per day, or 23.2 liters per day. Real rate is 12.5 liters/hour, which indicates that it had its engine running for less than 2 hours daily.

- Stone Crusher and Concrete Mixer:
  - Utilization: Both units were not used at all during the month.

In sum, the equipment actually worked for only two to three hours per day. Much idle time occurred and too much equipment was used. With effective management, more production could have been obtained, on a 5-hour effective work day, with a much smaller fleet consisting of one motorgrader, one loader, four dump trucks, and 1 tire roller.

ANNEX 21

NAIRN REPORT EXCERPT:

AWCAS VS. MACADAM

DEVELOPMENT ADMINISTRATION GROUP
Institute of Local Government Studies
University of Birmingham

Central-Local Financial Relations Review
for the
Government of INDONESIA

Sectoral Study No. 4

FINANCING ROADS AND BRIDGES

by

Bob Nairn

September 1981

Chapter Four: TECHNICAL FACTORS IN THE ROAD SECTOR

4.1 Introduction

This chapter is devoted to a discussion about technical engineering matters. Its main purpose is to identify technical constraints and priority conflicts, which are tending to restrict the degree to which road and bridge building responsibilities can be devolved on Regional Governments and on the Kabupaten in particular.

The general picture that emerges is that, along with the growth of finance for road-building for Regional Governments, there is an accelerating responsibility for Bina Marga and the Dinas P.U. to train staff at all levels of responsibility if this regional finance is to be wisely and efficiently spent and not wasted.

This chapter attempts to explain, in engineering terms, why Bina Marga has issued certain technical guidelines and, in some cases, why these guidelines have been questioned by Kabupaten during the course of this study.

4.2 Macadam or AWCRS?

The primary objective of Bina Marga is to upgrade the entire defined network of roads in Indonesia to stable condition using AWCRS (all weather crushed aggregate surface) construction sequences, by the conclusion of the Repelita III period.

AWCRS construction implies a sequence of gradual upgrading as follows:

(a) The preparation of an earth-formed road sub-grade with proper drainage, width and alignment standards,

(b) The addition of laboratory tested and controlled material, such as creek-gravel, so that the surface can support vehicle loadings in all weather. This is referred to as sub-base.

(c) The addition of laboratory tested and controlled base-course material of higher specification and of designed thickness and grading, so that the surface can be sealed with bitumastic or asphaltic treatments. This is referred to as AWCRS treatment.

(d) The addition of bitumastic or asphaltic surface treatments to provide a hard-wearing surface and protect the base against water intrusion. This is referred to as seal-coat.

The AWCRS construction sequence can be suspended at any stage, depending on traffic and funding, and can be maintained by grading and some surface material replacement until its final asphaltic treatment.

1184

The entire sequence of AWCRS construction therefore, provides the opportunity to provide maintainable roads with reasonable surface smoothness and travel speeds, which can be sequentially upgraded as traffic demands and funds permit.

This AWCRS construction sequence is a very different matter than "Macadam" construction. A Macadam base consists of large angular (not rounded) stones of approximately 20-30 cm. size, which are hand-placed so that they interlock with each other to form a road base. This inter-locking is assisted by spreading sand into the gaps and consolidating the sand by water-washing.

Since the surface of this Macadam base is very rough, travel speeds are very low - of the order of 25-35 Km./hr. - and the surface cannot be smoothed with a grader, which would dislodge large stones.

Therefore, the Macadam base must soon be given its asphaltic surface treatment - usually a "penetration" seal, which does not completely eradicate the surface roughness problem. In order to obtain travel speeds comparable to AWCRS construction, say 50-75 Km./hr., then the Macadam road must be given additional asphaltic treatments, such as asphaltic concrete or hotmix.

A Macadam road-base contains many crevices and unfilled air-pockets, (approximately 30% voids), which permit air to come into contact with the bitumen in the asphaltic surface treatment. The bitumen, therefore, rapidly oxidises and hardens to a brittle surface, which easily cracks, particularly under the jarring action of wheels running on a rough surface. AWCRS construction typically only has air voids of 3% and the resilience of the bitumen is more easily retained.

A Macadam bitumastic surface treatment is, therefore, only likely to last 3-5 years, whereas the same treatment over AWCRS could last 7-10 years before retreatment.

Furthermore, if a Macadam base is damaged, then it cannot simply be graded like AWCRS, but requires repair by replacing base-stones and re-setting them. Similarly it is difficult to successfully widen a narrow Macadam base without eventual surface distortion or cracking. For all of these reasons , it is difficult or expensive to upgrade a Macadam road by widening or strengthening for heavier loads.

Nevertheless, Macadam road construction requires little scientific laboratory control, which is essential to successful AWCRS construction, and, in addition, it is the traditional road construction method particularly on Jawa, but also throughout other areas of Indonesia, and there are many more road-builders who are familiar with this form of construction than with AWCRS.

Therefore, the Bina Marga guidelines for Inpres Jalan, which specify AWCRS construction, are unpopular in some Kabupaten. The Kepala P.U. Kabupaten may argue as follows:

(a) The Kabupaten does not have the machinery, laboratories or technical expertise to build AWCRS, but is familiar with Macadam,

(b) Macadam is labour-intensive relative to AWCAS,

(c) Macadam can be more easily specified for contract relative to AWCAS,

(d) Macadam will, of necessity, result in obtaining an asphaltic surface faster, which is more politically acceptable than dusty unsealed AWCAS roads.

In most areas of Indonesia, all of these arguments are true but weakened by their very short-term implications.

A suitable reply could be argued as follows:

(a) Every time a new Macadam base is constructed represents an opportunity lost to establish the necessary machinery and laboratory expertise. Both Bina Marga and the Provinces provide training for plant operators, machines and laboratory technicians and the sooner the Kabupaten avail themselves of this training, the sooner they will become independent of the need for technical supervision from other levels of Government.

(b) In most Provinces of Indonesia, outside Jawa there are labour-shortages and, in addition, labour-intensive methods are invariably slower than plant-intensive methods. Delays in road-building may slow down other economic development programmes.

(c) Growth in the road-building programme must be matched with growth in "Force-account" construction. Innovations or new techniques for road-building should typically be tried out "in-house" before adequate contracts can be properly controlled and supervised.

(d) Macadam construction leads to earlier and more expensive maintenance. Deep "pot-holes" in a road which is only 3 or 4 years old, are politically unpopular and dust from an unsealed AWCAS construction can be reduced by good material control and by water spraying in township areas.

Furthermore, the argument could be continued as follows:

(e) AWCAS provides higher travelling speeds, which reduces delays in carrying goods to market, and provides a smoother surface, reducing breakages and damage in transit and vehicle maintenance, tyre damage and fuel consumption.

(f) Greater lengths of roads can be constructed to all-weather standard and maintained in suitable condition using AWCAS sequences than by building Macadam which leads to premature costly asphaltic treatment and provides problems for future up-grading as traffic volumes and weights demand or funds permit.

ANNEX 22

FACILITIES OF LOCAL REPRESENTATIVES OF MAJOR EQUIPMENT MANUFACTURERS

EQUIPMENT AGENTS' FACILITIES

AGENT	MANUFACTURER / COUNTRY	TYPE OF EQUIPMENT	LOCATIONS	AVAILABILITY OF					CONTACT
				SERVICE	WORKSHOP	SPAREPART	TRAINING	OTHER	
UNITED TRACTORS	KOMATSU/JAPAN	Motor Grader	Jakarta	V	V	V	V		Siswoyo(sales
INDONESIA		Bulldozer	Surabaya	V	V	V	V		Dept)
		Wheel Loader	Ujung Pandang	V	V	V	V		883-083
TRAKINDO UTAMA	CATERPILLAR/USA/	Bulldozer	Jakarta	V	V	V	V		Ir.Kiky M(Mgt)
	JAPAN	Wheel Loader	Surabaya	V	V	V	V		781-093
		Excavator	Ujung Pandang	V	V	V	V		
		Motor Grader							
MEKASINDO DHARMA	GALION /USA	Motor Grader							341-021 can't
		Road Roller							contact
TRACTOR NUSANTARA	DYNAPAC MASKINAB	Vibrating Roller	Jakarta	V	V	V	V		Dody Zaenudin
	/SWEDEN		Surabaya	V	V	V	V		493-180
			Ujung Pandang	V	V	V	V		495-475
BUKAKA	BUKAKA/INDONESIA	Asphalt Sprayer	Jakarta	V	V	V	V		Bukaka will
(one company with		Stone Crusher	Surabaya	-	-	-	-		send Operator
Hadji Kalla)		Mobile Lubrication	Ujung Pandang		-	-	-		or Mechanic to
		Mobile Workshop							erect the
		Semi Trailer							stone crusher
									351-034-Salim
									/Sales Mgr.

EQUIPMENT AGENTS' FACILITIES

AGENT	MANUFACTURER / COUNTRY	TYPE OF EQUIPMENT	LOCATIONS	AVAILABILITY OF SERVICE	WORKSHOP	S.PART.	TRAINING	OTHER	CONTACT
HADJI KALLA	KOBELCO/JAPAN	Wheel Loader	Jakarta	-	-	-	V	Hadji Ka	Salim(Sales
			Surabaya	-	-	-	-	lla has	Manager347-481)
			Ujung Pandang	-	-	-	-	only Me-	
								chanic/	
								Operator	
								who	
								could be	
								sent to	
								the Pro-	
								ject to	
								give	
								training	
ALL TRACK 1978	FIAT ALLIS/	Loader	Jakarta	V	V	V	V		Ibu Nuri(Sales
	USA(JAPAN)	Grader	Surabaya	-	-	-	-		Dept)773-377
			Palu	-	-	-	-		773-476
									773-155
P.T.KRAMA YUDHA	MITSUBISHI/	Dump Truck	Jakarta	V	V	V	If nece-		Hidayat (Sales
	JAPAN		Surabaya	V	V	V	ceasary		Manager)
			Ujung Pandang	V	V	V	they can		489-1608
			Den Pasar	V	V	V	give the		
							training		
							on the		
							workaite		

4423

EQUIPMENT AGENTS' FACILITIES

AGENT	MANUFACTURER/ COUNTRY	TYPE OF EQUIPMENT	LOCATIONS	AVAILABILITY OF					CONTACT
				SERVICE	W.SHOP	S.PART	TRAINING	OTHER	
PANCA MOTOR	ISUZU/JAPAN	Dump Truck	Jakarta	v	v	v	If nece-		Taslim(Sales
	(Indonesia)		Surabaya	v	v	v	ssary		Manager)
			Denpasar	v	v	v	they can		674-936
			Ujung Pandang	v	v	v	give the		
							training		
							on the		
							worksite		
TOYOTA ASTRA	TOYOTA DYNA	Dump Truck	Jakarta	v	v	v	If nece-		Ferdi Herma-
	/Japan		Surabaya	v	v	v	ssary		wan(Marketing
	(Indonesia)		Denpasar	v	v	v	they can		Division)
			Ujung Pandang	v	v	v	give the		492-345
							training		
							on the		
							worksite		
P.T.NATIONAL	HINO/Japan	Dump Truck	Jakarta	v	v	v	if nece-		Fredi(Sales
MOTORS			Surabaya	v	v	v	ssary		Dept)630-280
			Denpasar	v	v	v	they can		
							give the		
							training		
							on the		
							worksite		

ANNEX 23

ECONOMIC TABLES

ECON - 1
VEHICLE OPERATING COST ESTIMATES

Road Class and Condition	Car (Rupiah/km)	Pickup Minibus	Light Truck	Motor-Cycle	Cart	Bicycle
Asphalt						
Good	104.7	86.2	85.4	15.9	21.8	6.6
Fair	125.5	101.0	98.0	18.2	24.9	7.4
Poor	164.1	135.2	138.5	22.8	35.4	10.1
Bad	222.1	202.0	205.0	29.1	53.2	15.2
Gravel						
Good	125.7	101.4	102.5	18.5	24.9	7.4
Fair	145.0	124.6	127.1	21.1	29.2	8.6
Poor	198.6	172.6	178.4	27.1	43.5	13.1
Bad	242.7	228.9	231.2	31.8	64.8	18.4
Earth						
Fair	201.8	180.0	185.1	28.0	43.5	13.1
Poor	240.7	218.2	225.8	31.8	53.2	15.2
Bad	264.9	278.0	281.7	35.5	65.4	18.7

COMPARATIVE COSTS PER KILOMETER OF ALTERNATIVE ROAD TREATMENTS
(30 Kabupaten Average)

Major Treatment	Road Class	Rupiah 000 per km	US$ Equivalent	ADT Implied
Seal (initial)	Gravel	27,600	24,640	200
Overlay Seal	Sealed	22,400	20,000	200-500
Gravel (initial)	Earth	20,000	17,860	50-200
Reseal	Sealed	17,000	15,200	200-500
Regravel	Gravel	15,000	13,400	50-200
Routine Repair and Maintenance				
Unsealed Roads		298	266	50
		406	363	50-200
		606	541	200-500
Sealed Roads		359	321	200
		528	471	200-500
		590	527	500

Source: Local Roads Component, Main Report, March 1985, Hoff & Overgaard and Kampsax (Central Java, NTB, Bali), for ADB 8th loan.

FOOT - 2

REQUIRED LEVELS OF ADT TO JUSTIFY MAJOR ROAD TREATMENT COSTS *

(Rp.000/Km) Base Year Rehabilitation/Upgrade costs:

IRR %	8960	11200	13440	15680	17920	20160	22400	25200	28000	30800	33600	36400	39200
	Base year ADT volume:												
6	46	58	70	82	94	105	110	128	146	160	173	186	199
7	49	62	75	87	99	111	118	137	155	170	184	198	212
8	52	65	79	92	105	118	126	145	164	180	195	210	225
9	55	69	83	97	111	124	134	154	173	190	206	222	238
10	58	72	87	102	116	131	145	164	182	200	217	234	251
11	60	76	92	107	122	137	151	171	191	210	228	246	265
12	63	80	96	112	128	143	155	177	199	219	239	259	279
13	66	83	100	117	134	150	167	188	208	229	250	271	291
14	69	87	105	122	139	156	175	196	217	239	261	283	304
15	72	90	109	127	145	163	185	206	226	249	272	295	317

* motorized vehicles only

(10-year period, ADT growth rate 5% implied, Rp. 1120 = US$1)

ECON - 3

TRAFFIC VOLUMES (ADT) ON KABUPATEN ROADS IN PROJECT AREA

KABUPATEN	NUMBER OF ROAD LINKS	NUMBER OF LINKS IN DIFFERENT ADT RANGES									
		0	1-10	11-30	31-50	51-100	101-200	201-300	435	500	600
SOUTH SULAWESI											
TAKALAR	43	1	31	11	0	0	0	0			
BONE	30	0	9	8	8	4	1	0			
SIDRAP	38	3	16	19	0	0	0	0			
PINRANG	36	2	24	10	0	0	0	0			
JENEPONTO	45	1	8	25	11	0	0	0			
GOWA	60	4	5	4	3	18	17	6	1	1	1
TOTAL:	252	11	93	77	22	22	18	6	1	1	1
% :	100	4	37	31	9	9	7	2			
NTT											
MANGGARAI	8	0	7	1	0	0	0	0			
BELU	21	3	18	0	0	0	0	0			
SUMBA BARAT	35	1	6	17	7	2	1	1			
NGADA	50	11	15	8	6	6	2	0			
SIKKA	3					2	1	(High counts only)			
KUPANG	6		1	3	1	1		(High counts only)			
TIMOR TENGAH S.	5		4	1				(High counts only)			
TOTAL:	128	15	51	30	14	11	4	1			
% :	100	12	40	23	11	9	3	1			

ECO ' - 4
TRAFFIC VOLUMES BY ROAD CLASS

ADT DESIGN STANDARD:	EARTH 50	GRAVEL 50-200	SEAL 200-500	ASPHALT 500
NUMBER OF ROAD LINKS WITHIN STANDARD:				
SOUTH SULAWESI:	203	40	7	2
NTT:	110	15	1	0
TOTAL:	313	55	8	2
% :	82	14	2	1

MINIMUM ADT LEVELS REQUIRED FOR ECONOMIC FEASIBILITY[1)]

(REHABILITATION):	FROM EARTH TO GRAVEL	REGRAVEL OF GRAVEL	FROM GRAVEL TO SEAL	RESEAL OF SEAL
COSTS (Rp. 000)	20,000	15,000	27,600	22,400
	DAILY TRAFFIC LEVEL MINIMUM			
FOR 10% RETURN:	203	100	569	406
FOR 12% RETURN:	222	109	623	444
FOR 15% RETURN:	247	124	768	505

1) From Sec. 3 analysis of motorized and non-motorized traffic from 210 traffic counts in 20 Kabupaten in Central Java, Bali, and NTB, for the ADB 8th Loan project evaluations.

ECON - 5
WEIGHTED AVERAGE COST PER COMPOSITE VEHICLE ON PROJECT ROADS WITHOUT ROAD MAINTENANCE

Ten-Year Forecast: (Rp/Km)	Sealed Roads			Unsealed Roads		
	Asphalt	Seal	Gravel	Gravel	Gravel[1)]	Earth
ADT Standard	> 500	200-500	50-200	200-500	50-200	< 50
ACTUAL:	550	364	127	364	127	29
1.	58.0	71.6	77.7	72.8	77.7	97.8
2.	64.9	83.7	93.1	104.0	98.9	114.9
3.	72.6	97.9	111.7	148.5	126.0	134.9
4.	81.3	114.4	133.9	180.3	160.5	158.4
5.	91.0	133.8	160.5	218.9	182.4	186.1
6.	101.9	145.1	176.4	265.7	207.4	218.6
7.	114.0	157.4	194.0	322.6	235.8	256.7
8.	127.6	170.7	313.3	391.7	268.0	301.5
9.	135.2	185.2	234.5	475.6	304.7	354.1
10.	143.3	200.8	257.8	577.4	346.4	415.9
Avg. Annual %	17.14	21.72	26.64	51.99	35.52	18.96
(Expected life of road is underlined)						
DERIVED FROM: Rp/Km by Vehicle Type (Unit Cost weighted by % composition)						
Good Condition						
car/jeep	24.1	35.1	35.2	35.2	35.2	48.4
minibus	12.9	11.1	11.1	11.1	11.1	3.6
truck	13.7	17.6	24.6	18.5	24.6	29.6
m'cycle	7.3	7.8	6.8	8.0	6.8	16.2
Total	58.0	71.6	77.7	72.8	77.7	97.8
Bad Condition						
car/jeep	51.1	62.2	68.0	68.0	68.0	63.6
minibus	30.3	22.2	25.2	.25.2	25.2	5.6
truck	32.8	36.9	55.5	41.6	55.5	45.1
m'cycle	13.4	12.5	11.8	13.7	11.8	20.6
Total	127.6	133.8	160.5	148.5	160.5	134.9

1) This road case has been dropped from the evaluation.

ECON - 6

UNMAINTAINED ROAD FORECAST OF VEHICLE OPERATING COSTS ANNUALLY
(using Project area vehicle compositions)

(Rp.000/km)

	SEALED ROADS			UNSEALED ROADS	
	Asphalt	Seal	Gravel	Gravel	Earth
ADT:	550	364	127	364	29
	(Growth rate is 1.7% annually)				
1	11,841	9,674	3.630	9,837	1,053
2	13.250	11.309	4.389	14.052	1.237
3	14.822	13.228	5.266	20.065	1,452
4	16,598	15,457	6,312	24,362	1,705
5	18,579	18,079	7,566	29,577	2,003
6	20,804	19,606	8,316	35,901	2,353
7	23,275	21,268	9,145	43,589	2,763
8	26,051	23,065	10,055	52,926	3,246
9	27,603	25,024	11,055	64,262	3,812
10	29,256	27,132	12,153	78,017	4,477

ANNUAL COSTS PER KILOMETER OF ROAD MAINTENANCE
(Average of 30 Kabupatens)
(Central Java, NTB, Bali)

(Rp.000/Km)

	SEALED ROADS			UNSEALED ROADS	
	Asphalt	Seal	Gravel	Gravel	Earth
ADT:	>500	>200	< 200	< 200	< 50
Routine Maintenance:					
	589.5	528.1	359.1	606.1	298.5
Periodic Maintenance: (reshape and re-surface)					
	2.857.0	2.223.0	2.709.0	2.709.0	1.224.0

ECON - 7

MAXIMUM SAVINGS LEVELS WITH ROUTINE AND PERIODIC MAINTENANCE, AND SUGGESTED MAINTENANCE INTERVALS (SEALED ROADS)

(Rp. 000/Km)

	Asphalt (ADT 500)					Seal (ADT 364)					Gravel (ADT 127)				
	Routine = 590			Periodic = 2857		Routine = 529					Routine = 360			Periodic = 2709	
Year	S	%	VOC	S	VOC	S	%	VOC	S	VOC	S	%	VOC	S	VOC
1	-	-	11841			-	-	9674			-	-	3630		
2	819	6.2	12431			1106	9.8	10203			399	9.1	3990		
3	982	6.6	13413	(2857-590)		1393	10.5	11833	(2223-529)		916	17.4	4350	(2709-360)	
4	1186	7.1	15412			1700	11.0	13757	24*	12039	1602	25.4	4710		
5	1391	7.5	17188			2093	11.6	15986	2984-529	13002	2496	33.0	5070	(2068)*	4790
6.	1635	7.9	19169			998	5.1	18606	4564-529	14042	2886	34.7	5430	400-360	5030
7	1881	8.1	21394			1135	5.3	20133	4968-529	15165	3335	36.5	5810	528-360	5282
8	2186	8.4	23865	(160)*	21758	1268	5.5	21797	426+3002*	18795	3885	38.6	6170	571-360	5599
9	962	3.5	26641	3795-590	22846	1433	5.7	23594	3295-529	20299	4525	40.9	6530	763-360	5767
10	1063	3.6	28193	2834-590	25359	1579	5.8	25553	3630-529	21923	5263	43.3	6869	967-360	5923

*Net balance after input of Periodic Maintenance, plus or minus Savings generated by input.

Net Periodic:	2267	1694	2349
Total Savings:	2107	1718	280

In year 8: (1694)+426 surplus + 3002 generated

ECON - 8

MAXIMUM SAVINGS LEVELS WITH ROUTINE AND PERIODIC MAINTENANCE, AND SUGGESTED MAINTENANCE INTERVALS (UNSEALED ROADS)

(Rp. 000/Km)

	Gravel (ADT 364)					Earth (ADT 29)				
	Routine = 606			Periodic = 2709		Routine = 300			Periodic = 1224	
Year	S	%	VOC	S	VOC	S	%	VOC	S	VOC
1	-	-	9837			-	-	1053		
2	3609	25.7	10443			(116)	(9.4)	1145		
3	5407	26.9	14658	(2709-606)		7	0.5	1245		
4	3691	15.1	20671	978*	17590	160	9.4	1354		
5	4609	15.6	24968	3869-606	21279	349	17.4	1472		
6	5718	15.9	30183	4452-606	25731	581	24.7	1600	(862)*	1538
7	7082	16.2	36507	6100*	28304	863	31.2	1739	201-300	1607
8	8731	16.5	44195	7945-606	36250	1207	37.2	1891	284-300	1679
9	10730	16.7	53532	8641-606	44891	1621	42.5	2055	376-300	1754
10	13149	16.8	64868	12936*	49829	2122	47.4	2234	480-300	1833

*Net balance after input of Periodic Maintenance, plus or minus Savings generated by input.

Net Periodic:		2103	924
Total Savings:	1	3081	986
	2	8203	
	3	15093	

1133

ANNEX 24

UNIT COST CALCULATIONS

SUMMARY

ROAD MAINTENANCE UNIT COSTS: ROUTINE AND PERIODIC

Calculate Possible Working Days per Year

Calender Days	-	Sundays and Holidays	-	Fridays .5 day	-	Lost Days	=	Annual Working Days
365	-	65	-	26	-	54	=	220

SUMMARY OF ESTIMATED MAINTENANCE UNIT COSTS

Type of Road / Type of Maintenance	Sealed Roads km/Yr	Sealed Roads Rp(000)/km	Gravel Roads km/Yr	Gravel Roads Rp(000)/km	Earth Roads km/Yr	Earth Roads Rp(000)/km
o ROUTINE - Routine	60	510	100	360	125	150
- Smoothing	-		400	70	400	70
Subtotal Routine Cost (Incl. in allowance for emergency work)		510		430		220
o PERIODIC - Resealing	350	680	-	-	-	-
- Regraveling	-	-	450	800	-	-
- Remaning	-	-	200	255	200	255
Subtotal Periodic Cost		680		1055		255
o TOTAL MAINT. COST Routine + Periodic		1,190		1,485		475

Average cost of Resealing: 50% Chip Seal (using # 4 stone) Rp(000) 475/km
50% DBST (using 3/8" & #4 stone) Rp(000) 890/km

Average Unit Cost Rp (000)680/km

Average production for Resealing:
50% Chip Seal 100 km/yr per 400 km inventory
50% DBST 50 km/yr per 300 km inventory

Average Production: 30 km/yr per 350 km inventory

UNIT COST: ROUTINE MAINTENANCE - SEALED ROAD

60 km/yr

ROUTINE ACTIVITIES

Labor	Daily Rate	Daily Cost x Days	TOTAL COST Rp (000)
(1) Foreman	3,500	Rp. 3,500	
(1) Driver	3,000	= 3,000	
(10) Workers @ 1,700	1,700	= 17,000	
SUBTOTAL LABOR:		Rp. 23,500 x 365 =	8,580

Equipment	Daily Rate	Daily Cost	Days	
(1) 3.5 T Dump Truck	Rp. 33,440	Rp. 33,440		
(1) Hand opr. comp.		10,856		
SUBTOTAL EQUIPMENT:		Rp. 44,296	x 220 =	9,745

Materials

o Pothole patching with cold mix	Qty	Unit Price	
- Cold mix: 1.5 m^3/day x 80 days =	120 m^3/yr @	Rp. 96,000/m^3 =	11,520
- Asphalt prime: 12 1/m^3 mix =	1440 1/yr	@ 450/1 =	650
	TOTAL ANNUAL COST		Rp. 30,495
		say UNIT COST	Rp. 510/km

Cold mix calculation

Assume: Asphalt 7% weight

Stone = 100 lbs/ft^3 x 35.3 ft^3/m^3 = 3,530 lbs/m^3 mix

Asphalt = 0.07 x 3,530 lbs/m^3 mix = 247 lbs/m^3 mix

247 lbs/m^3 mix - 2.86 lbs/1 = 86,36 1/m^3 mix

Cost:		
Stone	1/m^3 @ Rp. 19,000/m^3	= 19,000
Asphalt	86 1/m^3 @ 450 1/m^3	= 38,700
Equipment	- estimate	= 30,000
Labor	- estimate	= 8,300
	Cost per m^3	Rp. 96,000

JI-3/7

Worksheet

o Routine Maintenance Crew - Routine Activities

Inventory Qty	Labor	Equipment
60 km 20 Bridges (1 bridge/3 km)	(1) Foreman (1) Driver (10) Workers	(1) Stake body or 2.5 m^3 dump 3 ton (1) Hand operator compactor

	Kinds of Activities/Tasks	Production/day x	Days/yr =	Inventory/yr
	- Pavement (patching, depressions)	0.75 km/day	80	60 km
C	- Drainage (ditches, culverts, drains)	0.75 km/day	80	60 km
C	- Roadside	2.0 km/day	30	60 km
	- Miscellaneous	6.0 km/day	10	60 km
	- Bridges (cleaning, inspecting)	1.0 Bridge/day*	20	20 Bridges
			220	

* Effective rate; production actually 2 bridges/day twice a year

Note: C indicates possible maintenance tasks for contract

UNIT COST: PERIODIC MAINTENANCE - SEALED ROAD

3.5 m wide = 0.5 km/day = 100 km/yr. on 400 km of inventory

1a. CHIP SEAL using #4 (3/16" - 5 mm) stone

	Labor	Daily Rate	Daily Cost	x Days =	TOTAL COST Rp. (000)
(1)	Foreman	Rp. 3,500	Rp. 3,500		
(2)	Operators	3,900	7,800		
(2)	Drivers	3,000	6,000		
(2)	Skilled	2,500	5,000		
(2)	Semi-skilled	2,000	4,000		
(10)	Workers	1,700	17,000		
	SUBTOTAL LABOR:		Rp.43,300	x 365 =	15,805

	Equipment	Daily Rate	Daily Cost	Days
(1)	Tractor (farm)*	Rp. 41,427	Rp. 41,427	
(1)	Broom Attch.*	15,240	15,240	
(1)	Asphalt sprayer	16,230	16,230	
(1)	3.5 T Dump Trk.	45,330	45,330	
(2)	Tailgate spreader		3,720	
(1)	Pneu. Roller	13,258	79,530	
(1)	Asphalt tank*	10,000	10,000	
(1)	Flatbed trk	31,650	31,650	

SUBTOTAL EQUIPMENT: Rp.243,127 x 220 = 53,490

(If the crew can produce more work a second dump trk is needed)

Materials	Unit Price	Daily Cost	Days
(10) m^3 Chips (6 mm-#4; 0,005 m^3/m^2)	Rp.19,000/m^3	Rp.190,000	
(800) l Asphalt binder (75%; 0.45 l/m^2)	Rp450/l	360,000	

SUBTOTAL MATERIALS: Rp.550,000 x 220 = 121,000

Annual Cost (ea 4 yrs)
Rp. 475,000/yr
100 km work
400 km inventory

TOTAL ANNUAL COST: Rp.190,295

SAY: UNIT COST: Rp. 475/km

Optional

UNIT COST: PERIODIC MAINTENANCE - SEALED ROAD

3.5 m wide @ 0.5 km/day = 100 km/yr on 400 km inventory

1b. CHIP SEAL using 3/8" (9.5 mm) stone			TOTAL COST Rp(000)
Labor			
normal spread using Ø4 stone			15,805
add 1 Driver @ 3,000/day	x 365	+	1,095
	SUBTOTAL LABOR:		16,900
Equipment			
normal spread using Ø4 stone			53,490
add 1 3.5T Dump Trk @ + Rp. 45,330/day x 220		+	9,975
	SUBTOTAL EQUIPMENT:		63,465

Materials	Unit Price	Daily Cost	Days
(20) m^3 Chips (9 mm- 3/8"; .010 m^3/m^2)	Rp. 16,000/m^3	Rp. 320,000	
(1,600) l Asphalt binder (75% - 0.90 l/m^2)	450/l	720,000	

SUBTOTAL MATERIALS: Rp. 1,040,000 x 220 = 228,800

TOTAL ANNUAL COST: Rp.309,165

Annual Cost (ea 4 yrs)
770/km too high!

SAY UNIT COST: Rp. 770/km

UNIT COST PERIODIC MAINTENANCE - SEALED ROAD

3.5 wide = .275 km/day = 60 km/yr on 300 km inventory

2. DBST using 3/8" (9.5 mm) first course + #4 (3/16" - 5 mm) second course

Labor	Daily Rate	Daily Cost x	Days =	TOTAL COST Rp(000)
(1) Foreman				
(2) Operators				
(3) Drivers	same as Chip Seal 3/8" stone			
(2) Skilled				
(2) Semi-skilled				
(10) Workers				
		SUBTOTAL LABOR:		16,465

Equipment	Daily Rate	Daily Cost	Days
(1) Tractor (farm)*			
(1) Broom attach*			
(1) Asphalt sprayer			
(2) 3.5 T Dump			
(2) Tailgate spreader		same as Chip Seal 3/8" stone	
(1) Pneu. Roller			
(1) Asphalt tank*			
(1) Flatbed trk			
		SUBTOTAL EQUIPMENT:	Rp. 63,465

Materials	Unit Price	Daily Cost	Days
(10) m^3 stone 3/8"	Rp. 16,000/m^3	Rp. 160,000	
(870) l Asphalt	450/l	391,500	
(5) m^3 Chips #4	19,000/m^3	95,000	
(450) l Asphalt	450/l	202,500	
	SUBTOTAL MATERIALS:	Rp. 849,000 x 220 =	186,780

Annual Cost (ea 5 yrs)
Rp. 890/km
60 km work
300 km inventory

TOTAL ANNUAL COST: Rp.266,710

Say UNIT COST Rp. 890/km

* Optional

1146

UNIT COST: ROUTINE MAINTENANCE - GRAVEL ROAD

1. ROUTINE ACITIVITIES: 3.5 m wide = 0.5 km/day = 100 km/yer on 400 km of inventory

	Labor	Daily Rate	Daily Cost	x	Days	=	TOTAL COST Rp(000)
(1)	Foreman	Rp. 3,500	Rp. 3,500				
(3)	Drivers	3,000	3,000				
(10)	Workers	1,700	17,000				
	SUBTOTAL LABOR:		Rp.23,500	x	365	=	8,580

	Equipment	Daily Rate	Daily Cost		Days		
(1)	3.5 T Dump	Rp. 33,440	Rp. 33,440				
(1)	Hand opr. comp.	10,856	10,856				
	SUBTOTAL EQUIPMENT		Rp. 44,296	x	220	=	9,745

Materials	Unit Price	Daily Cost		Days		
(4.2) m^3 well-graded crushed aggregate	Rp. 19,000	Rp. 79,800				
SUBTOTAL MATERIALS		Rp. 79,800	x	220	=	17,555

TOTAL ANNUAL COST: Rp. 35,880

SAY Rp. 360/km

2. GRADER SMOOTHING 3.6 km/day = 800 km/yr (ea time) - 2 times per year = 400 km inventory

Labor	(1) Operator @ Rp. 3,900 x 365	=	1,425
Equipment	(1) Grader @ Rp. 123,500 x 220	=	27,170

TOTAL ANNUAL COST : Rp. 28,595

Performed 2x/yr
Effective Prod. = 400 km/yr

SAY UNIT COST: Rp. 70/km

Worksheet

1. Routine Maintenance Crew - Routine Activities

Inventory Qty	Labor	Equipment
100 km road 20 Bridges (1 bridge/5 km)	(1) Foreman (10) Workers (1) Driver	(1) Dump Truck 2.5 m^3 (1) Hand operator compactor

	Kinds of Activities/Tasks	Production/day x	Days/yr =	Inventory/yr
-	Roadway (patching, depressions)	1.3 km/day	75	100 km
C -	Drainage (ditches, culverts, drains)	1.1 km/day	90	100 km
C -	Roadside (vegetation, shoulders)	4.0 km/day	25	100 km
-	Miscellaneous	10.0 km/day	10	100 km
-	Bridges (cleaning, inspecting)	1.0 Bridge/day*	20	20 Bridges
			220	

2. Grader Smoothing Crew

Inventory Qty	Labor	Equipment
400 km	(1) Operator	(1) Grader

Kinds of Activities/Tasks	Production/day x	Days/yr =	Inventory/yr
- Blade the loose material from the edges to the center while smoothing out the small irregularities - Blade the collected material across roadway keeping the crown	3.6 km/day 2 x per year	220	400 km

Note: C indicates possible maintenance tasks for contract

UNIT COST: PERIODIC MAINTENANCE - GRAVEL ROAD

0.7 km/day = 150 km/yr per 450 km inventory

REGRAVELING: Use well graded crushed aggregate
assume: 3.5 m wide x .7 km/day &
: replenish 6 cm = 150 m^3/km

	Labor	Daily Rate	Daily Cost x	Days =	TOTAL COST Rp(000)
(1)	Foreman	Rp. 3,500	Rp. 3,500		
(3)	Operators	3,900	11,700		
(4)	Drivers	3,000	12,000		
(1)	Driver	3,000	3,000		
(4)	Workers	1,700	6,800		
	SUBTOTAL LABOR:		Rp. 37,000 x	365 =	13,505

	Equipment	Daily Rate	Daily Cost	Days
(1)	Grader 100 hp	Rp. 123,500	Rp. 123,500	
(1)	Loader 1.2 m^3	79,530	79,530	
(1)	Vib. roller	45,325	45,325	
(4)	3.5 T Dump Trk	31,650	126,600	
(1)	Water Truck	35,160	35,160	
(6 hr/day)	SUBTOTAL EQUIPMENT		Rp. 410,115 x	220 =	90,225

Materials	Unit Price	Daily Cost	Days
(150) m^3 well-graded crushed aggregate	Rp. 19,000	Rp.2,850,000	
SUBTOTAL MATERIALS		Rp.2,850,000 x	220 = 627,000

TOTAL ANNUAL COST: Rp.730,730

Lasts 3 yrs
Rp. 1,624,000 per 450 kms each year
Too expensive! Use select material

SAY UNIT COST: Rp. 1,624/km

Assume: Gravel stockpiled ea 20 km, average haul dist = 5 km
3 trips/hr (including travel @ 15 min + load, spot, dump + posit. 5 min)
150 m^3 - 3 trips/hr - 6 hr/day - 2.1 m^3/trk = say 4 trucks

UNIT COST: PERIODIC MAINTENANCE - GRAVEL ROAD

0.7 km/day = 150 km/yr per 450 km inventory

1. REGRAVELING: (Alternate) Use select material, all other assumptions, Labor cost and Equipment cost remain the same as for the normal method using well-graded crushed aggregate

				TOTAL COST Rp(000)
Labor	(same as normal method)			13,505
Equipment	(same as normal method)			90,225
Materials	Unit Price	Daily Cost	Days	
(150) m^3 selected material	Rp. 7,700	Rp.1,155,000	220	254,100

TOTAL ANNUAL COST: Rp.357,830

1x ea 3 yrs

Say UNIT COST Rp. 800/km

Rp. 800,000 x 450 kms

UNIT COST: PERIODIC MAINTENANCE - GRAVEL ROAD

0.9 km/day = 200 km/yr

2. RESHAPING: No material required

	Labor	Daily Rate	Daily Cost x	Days =	TOTAL COST Rp(000)
(.5)	Foreman	Rp. 3,500	Rp. 1,750		
(2)	Operators	3,900	7,800		
(1)	Driver	3,000	3,000		
(2)	Workers	1,700	3,400		
	SUBTOTAL LABOR:		Rp. 15,950 x	365 =	5,821
	Equipment	Daily Rate	Daily Cost	Days	
(1)	Grader 125 hp	Rp. 123,500	Rp. 123,500		
(1)	Vib. roller	45,325	45,325		
(1)	Water Truck*	35,160	35,160		
	SUBTOTAL EQUIPMENT		Rp.203,985 x	220 =	44,877

Materials None

TOTAL ANNUAL COST: Rp. 50,700

Say UNIT COST Rp. 255/km

* Not needed if the reshaping is performed when the surface material is moist

UNIT COST: PERIODIC MAINTENANCE - EARTH ROAD

1.8 km/day = 125 km/yr

1. ROUTINE ACTIVITIES

	Labor	Daily Rate	Daily Cost x	Days =	TOTAL COST Rp'000)
(1)	Foreman	Rp. 3,500	Rp. 1,750		
(1)	Driver	3,000	3,000		
(10)	Workers	1,700	17,000		
	SUBTOTAL LABOR:		Rp. 23,500 x	365 =	8,580

	Equipment	Daily Rate	Daily Cost	Days	
1	3.5 T Dump	Rp. 33,440	Rp. 33,440		
1	Hand Op. Comp.	10,856	10,856		
	SUBTOTAL EQUIPMENT		Rp. 44,296 x	220 =	9,745

Materials None

TOTAL ANNUAL COST: Rp. 18,325

Say UNIT COST: Rp. 146

2. GRADER SMOOTHING 3.6 km/day = 800 km/yr per 400 km inv.

Labor: 1 Operator @ Rp. 3,900 x 365 days = 1,425

Equipment: 1 Grader @ Rp. 123,500 x 220 days = 27,170

TOTAL ANNUAL COST: Rp. 28,170

Performed 2x/yr
Effective Prod. = 400 km/yr

UNIT COST Rp. 70/km

Worksheet

1. Routine Maintenance Crew - Routine Activities

Inventory Qty	Labor	Equipment
125 km earth road	(1) Foreman	(1) Stake body truck
12 Bridges (1 bridge/10 km)	(10) Workers	(1) Hand operator compactor
	(1) Driver	

	Kinds of Activities/Tasks	Production/day	x	Days/yr	=	Inventory/yr
	- Roadway Surface	1.5 km/day		85		125 km
C	- Drainage	1.3 km/day		95		125 km
C	- Roadside	8.0 km/day		15		125 km
	- Miscellaneous	(estimated)		13		125 km
	- Bridges	1.0 Bridge/day		12		12 Bridges
				220		

2. Grader Smoothing Crew

(same as for gravel roads)

Note: C indicates possible maintenance tasks for contract

SUMMARY OF DAILY LABOR RATES BY KABUPATEN

(Source: P.T. Hasfarm reports data, provided by PU of each Kabupaten)

KABUPATEN	Foreman/ Mandor	Skilled labor	Unskilled labor	Carpenter	Operator	Mechanic
Sulawesi Selatan						
1. Pinrang	2,250	2,000	1,750	2,750	4,750	2,500
2. Sidenreng Rappang	2,500	2,500	2,000	3,000	5,000	5,000
3. Wajo	2,500	2,250	2,000	2,500	2,750	2,750
4. Bone	2,500	2,000	1,400	3,000	4,000	3,500
5. Bulukumba	2,250	1,750	1,500	2,500	2,500	2,500
6. Jeneponto	2,000	2,500	1,250	3,000	3,500	2,500
7. Gowa	2,250	2,000	1,750	2,500	3,000	2,500
Average	2,500	2,200	1,700	2,800	3,700	3,100
N.T.T						
1. Belu	6,000	2,500	1,500	2,500	7,500	3,000
2. TTS	2.500	2,500	1,250	2,500	2,500	5,000
3. Kupang	4,500	3,000	2,500	3,000	3,500	3,000
4. Sumba Barat	2,500	1,750	1,500	2,500	3,000	3,000
5. Manggarai	5,000	4,000	1,500	2,000	4,000	4,000
6. Ngada	2,000	1,500	1,250	2,500	3,500	3,500
7. Sikka	1,500	1,250	1,100	2,500	3,000	3,000
Average	3,500	2,400	1,600	2,500	3,900	3,500

Rates used for unit costs average indicated by ========

21187

SUMMARY OF MATERIALS UNIT PRICES BY KABUPATEN

(Source: P.T. Hasfarm reports data, provided by PU of each Kabupaten)
(Rp/unit)

KABUPATEN	Select Mtrl, pit-run (m^3)	Select Mtrl, River-run (m^3)	Crushed rock 3/5 cm (m^3)	Crushed rock 1/2 cm (m^3)	Crushed rock 0.5/1 cm (m^3)	Sand, found (m^3)	Cutback asphalt (m^3)	Conc. pipe @ 80 cm (m^3)
Sulawesi Selatan								
1. Pinrang	9,000	8,500	-	-	-	4,250	281	-
2. Sidenreng Rappang	5,000	9,000	9,000	10,000	12,000	7,000	300	18,000
3. Wajo	8,000	9,000	-	-	-	5,000	-	-
4. Bone	6,000	6,500	8,000	10,000	11,000	6,000	-	2,500
5. Bulukumba	7,000	8,000	13,000	14,000	15,000	7,500	300	-
6. Jeneponto	4,000	5,000	3,000	2,000	4,500	4,000	-	17,500
7. Gowa	4,250	4,500	6,500	8,000	10,000	3,000	-	30,000
Average	6,200	7,300	7,900	11,000	12,500	5,300	300	22,700
N.T.T								
1. Belu	1,500	7,500	10,000	15,000	15,000	5,000	450	75,000
2. TTS	5,000	7,500	15,500	17,500	18,500	8,000	400	20,000
3. Kupang	6,500	7,000	13,000	17,500	20,000	7,500	-	100,000
4. Sumba Barat	1,500	1,500	12,500	12,500	25,000	8,000	-	30,000
5. Manggarai	6,000	7,500	11,000	12,500	15,000	7,500	-	15,000
6. Ngada	6,500	7,500	12,500	-	-	8,000	-	-
7. Sikka	10,000	15,000	17,500	20,000	20,000	5,000	450	30,000
Average	5,300	7,700	13,200	15,900	19,000	7,000	450	45,000

Unit prices used for unit costs average indicated by ========

149

SOURCE: Kupang, NTT

Rural Road Study Report for
5 Yr. Road Programs 1984-1989
by Subdit Jalan Lokal & ENEX Jan. 84

EQUIPMENT RENTAL RATES

Daily Rate: use hourly rate x 6 hours

TABLE OF DERIVED HIRE CHARGES FOR KABUPATEN EQUIPMENT (31.1.84)

PROVINCE (.....	1.0	Original Price	PROVISIONAL COST OF CAPITAL RECOVERY				OTHER OWNERSHIP		CONSUMPTION				OPERATING		TOTAL	DAILY
KABUPATEN(.....	.74	Life hr*	13,500	9,000	2,700	Depreci-tion	COSTS (annual)		diesel	.158	220	TOTAL	STORES	tyr	TOTAL	OWNERSHIP HIRE RATE
DESCRIPTION OF	1.2	Life yr*	12.0	6.0	3.6	allow*	INTEREST	INSURANCE	benzin	.167	350	RUNNING	12.0	COST/hr	COST/hr	CHARGE 6.0
INPUT RESOURCES:	1.6	Days-week	COST	Total life in	*	10.00	15.0	3.0	lubricn	.006	1750	COST Rp	30.0	Rupiah	Rupiah	Rupiah BRT-HIRE
PLANT & HEAVY EQUIPMENT	CODE	US$	Rp(US$)	years	* hours	* Rp/hour	percent	percent	INDONESIA	Rp/FUEL	LUBRIC	per hour	4.0	per hour	per hour	per hr Rp/day

Based on exchange rates 9950p/US$1 .995 — 24.76 50.15 10.500p/l/HP/h 80.0 ind degrn

Bulldozer 110HP	E001	150,000	49,750	6.0	9,000	4975	4975	995	110	3024	1155	4179	3980	8959	10945	19,904	95,518			
Bulldozer 65HP	E003	130,000	27,850	6.0	9,000	2785	2785	557	65	2258	683	2912	2328	5330	6567	11,897	57,105			
Motor grader 125HP	E010	150,000	49,750	6.0	9,000	4975	4975	995	125	4345	1313	5658	3980	9638	10945	20,583	102,913	E010	Motor Grader 125 HP	
Excav.hydr,1.3m3 125HP	E020	150,000	49,750	6.0	9,000	4975	4975	995	125	4345	1313	5658	3980	9638	10945	20,583	102,913			
Crusher 40-50t/h,210HP	E031	2765,000	263,675	6.0	9,000	26368	26368	5274	210	7200	2205	9505	21094	30599	30009	60,607	363,036			
Crusher 15-20t/h, 60HP	E032	1100,000	109,150	6.0	9,000	10915	10915	2183	60	1980	628	2608	8734	10564	21879	32,443	162,217			
Crusher 10t/h,all 25HP	E033	350,000	49,750	6.0	9,000	4975	4975	995	25	1463	257	1720	3980	5700	10945	16,645	83,255			
Screening plant 80HP	E040	660,000	65,780	6.0	9,000	6578	6578	876	80	6674	810	5516	5262	9016	9632	18,650	93,250			
Loader tracked 125HP	E051	150,000	49,750	6.0	9,000	4975	4975	995	125	4345	1313	5658	3980	9638	10945	20,583	102,913			
Loader wheeled 95HP	E052	150,000	29,850	6.0	9,000	2985	2985	597	95	3302	998	4300	2388	6688	6567	13,255	66,274	E052	Loader 95 HP	
Tractor wheeled 80HP	E053	111,000	30,915	6.0	9,000	3095	3095	619	80	2781	840	3621	876	4496	2408	6,904	34,522	E053	Tractor 80HP	
Roller,3-wheel 8-10t	E080	150,000	29,850	6.0	9,000	2985	2985	597	37	1286	387	1675	2388	4063	6567	10,630	53,148			
Roller,tandem 6-10t	E081	125,000	24,875	6.0	9,000	2488	2488	498	40	1390	420	1810	1990	3800	5473	9,273	46,365			
Roller,vibr.self-p 10t	E082	120,000	19,900	6.0	9,000	1990	1990	398	35	1217	368	1586	1592	3178	4378	7,556	37,778	E082	Vib.roller	
Roller,towed vibr 2-3t	E083	110,000	17,910	12.0	13,500	1791	2238	428	6	251	63	314	955	1269	1060	2,329	11,645			
Roller,pneumatic 8-15t	E084	130,000	29,850	6.0	9,000	2985	2985	597	15	3302	998	4300	2388	6688	6567	13,255	66,274	E084	Pneu.roller	
Roller,vibr-ped 500kg	E087	15,000	4,975	6.0	9,000	498	498	100	7	243	74	317	398	715	1095	1,809	9,047			
Tamper,vibr. plate 1HP	E088	1100	597	6.0	9,000	60	60	12	1	234	42	276	48	324	131	455	2,275			
Concrete vibrator 1HP	E089	1600	597	6.0	9,000	60	60	12	1	234	42	276	48	324	131	455	2,275			
Chip spreader	E130	12,000	1,910	12.0	13,500	133	265	53	0	0	83	83	106	189	451	640	3,224	E130	Chip spreader	
Sprayer,selfprop.(1000)	E152	140,000	45,770	12.0	13,500	3051	6103	1222	48	2364	714	3078	2441	5519	10325	15,843	79,209	E152	Asph. distrib	
Asp.sprayer,towed 750l	E155	18,000	7,160	6.0	9,000	796	796	159	7	243	74	317	637	954	1751	2,705	13,524	E155	Asph. sprayer	
Asph.mixing plant30t/h	E155	1185,000	181,075	12.0	13,500	12272	24543	4909	125	4345	1313	5658	9817	15475	12771	27,999	139,994			
Asph.mixing plant10t/h	E156	465,000	44,775	12.0	13,500	2985	5970	1194	50	1738	525	2263	2388	4651	10945	15,600	55,500			
Asphalt finisher 1.8m	E157	130,000	29,850	12.0	13,500	1990	3980	796	30	1043	315	1358	1592	2950	6566	9,716	36,434			
Fuel tank truck 10KL	E172	118,000	17,910	6.0	9,000	1791	1791	358	66	2364	714	3078	1433	4510	3910	8,151	42,253			
Water tank truck 10KL	E182	117,000	16,915	12.0	13,500	1628	3255	651	68	2364	714	3078	1302	3980	3834	7,814	39,307	E182	Water Truck	
Trailer,towed 1t	E191	11,500	1,193	12.0	13,500	100	199	40	0	0	63	63	80	143	336	481	2,403			
Low loader/tractor 40HP	E192	175,000	24,875	12.0	13,500	1658	3317	663	40	2364	714	3078	1327	4404	5838	10,243	37,460			
Dump truck, 3.5t/110HP	E211	162,000	31,195	6.0	9,000	3119	3119	239	55	1529	462	1991	955	2947	2677	5,573	27,867	E211	3.5T Dump	
Dump truck, 5.0t/180HP	E212	115,000	19,925	6.0	9,000	1993	1993	299	80	2364	714	3078	1194	4272	3344	7,555	37,776	E212	5.0T Dump	
Flatbed truck 3.5t/110HP	E221	112,000	18,715	6.0	9,000	1871	1871	249	55	1529	462	1991	874	2857	2108	5,775	28,875	E221	Flatbed 3.5T	
Pickup truck 3100	E222	95,000	4,975	6.0	9,000	498	498	100	33	2200	410	2610	398	3007	1095	4,102	20,508			
Jeep wheel drive 63HP	E223	18,000	8,955	6.0	9,000	896	896	179	45	2844	515	3359	716	4075	1970	6,045	30,225			
Flatbed truck 5t/80HP	E224	115,000	19,125	6.0	9,000	1913	1913	299	60	2364	714	3078	1194	4272	3281	7,555	37,776	E224	Flatbed trk 5T	
Flatbed trk with crane	E225	120,000	19,900	6.0	9,000	1990	1990	398	68	2364	714	3078	1592	4670	4378	9,048	45,238			
Motorcycle 6HP	E226	1800	796	6.0	9,000	80	80	16	4	351	83	434	64	477	175	653	3,263			
Mobile workshop 110HP	E231	135,000	31,825	6.0	9,000	3183	3183	637	68	2364	714	3078	2786	5864	7662	13,525	67,624			
Lube truck 80HP	E232	120,000	27,860	6.0	9,000	2786	2786	557	68	2364	714	3078	2229	5306	6129	11,436	57,178			
Conc. mixer 0.5m3/20HP	E252	120,000	19,900	3.6	2,700	6633	3980	796	20	1448	210	1659	5307	6966	11101	18,065	45,238			
Compressor,air 150m3/h	E301	18,000	7,160	12.0	13,500	531	1063	212	50	1738	525	2263	425	2688	1804	4,492	22,461			
Generator, 1.5-3kVA	E311	11,500	1,193	12.0	13,500	100	199	40	10	505	105	610	80	769	338	1,107	5,535			
Pump,water(5cm) 30m3/h	E341	1100	398	3.6	2,700	133	80	16	8	140	84	352	106	458	228	686	2,275			
Pump,water(10cm)40m3/h	E342	11,000	995	3.6	2,700	332	199	40	10	505	105	610	265	875	570	1,375	6,873			
Jackhammer compnt etc.	E351	13,500	3,183	3.6	2,700	1061	637	131	8	0	32	32	127	160	1917	2,077	7,392			
Tractor equipment etc.	E401	13,000	2,785	3.6	2,700	995	597	119	0	0	32	32	114	146	1771	2,531	6,317			

2511

ANNEX 25

TECHNICAL SUPPORT TO KABUPATENS BY BANGDA

In accordance with instruction letter number 620/975/Bangda, dated June 24, 1982 addressed to all Governors and Bupatis throughout Indonesia and signed by the Director General of BANGDA, guidelines have been established regarding technical and administrative matters in the implementation of kabupaten roadwork programs. Because of its importance and influence in determining personnel requirements, a summary of this letter is presented here and a copy of the letter is shown in Annex 26.

"In line with the efforts to improve capability of Kabupaten staff in road building - these should be considered:

1. Technical Guidance:

- o DPUP should assist DPUK staff with technical matters.
- o DPUP staff must be seconded to DPUK.
- o Training to DPUK staff should be provided.

2. Planning:

- o DPUK must collect field data for making road project proposals.
- o Design drawings for roads must be done by DPUK staff with assistance from DPUP or from Pusat if necessary.
- o Training in road design for DPUK staff should be done to improve DPUK staff capability.
- o Training must be done by Bina Marga.

3. Implementation:

- o Bupati is responsible for all road projects constructed through Force Account or Contractor.
- o Project Manager is responsible for the utilization of the equipment used in the project.

4. Equipment:

- o Maintenance Equipment is provided by Ministry of Home Affairs.
- o Equipment for road works can be borrowed from DPUP. The project is responsible for the maintenance of the equipment. However, kabupaten can only repair broken down equipment of level I through III and if necessary with the assistance of province mechanics.
- o Funds for equipment maintenance must be provided by the project.

5. Technology Transfer:

- o Seconded DPUP staff at DPUK must transfer their technical knowledge to DPUK staff."

Similarly, a letter from the Director General of Bina Marga dated January 27, 1986 addressed to all Kanwil PU offices establishes guidelines for control and maintenance of equipment in the Kabupatens. A summary of this letter is presented below and a copy of the original letter is part of Annex 26.

This letter from Dept. Public Works supports the Guidelines issued by Dirjen Bangda, Dept. of Home Affairs described in the letter referred to above. In short:

- o ALKAL should act as coordinator in the mobilization and utilization of kabupaten equipment in their area of authority.
- o Kabupaten equipment may also be used by PU Seksi.
- o Controlling the condition of the equipment and providing training on equipment maintenance can be done by ALKAL.
- o Maintenance may be done at ALKAL as stated in Bangda's letter No. 620/975/Bangda and Public Works No. PW 030101 / DJ 585/BM/1986 of June 26, 1982.

The letter is signed by the Director General of Bina Marga and sent to all Kanwils, cc to Minister of Public Works, Dir. Gen. Bangda, all Governors, Directors in Bina Marga, DPUPs and Bupatis.

ANNEX 26

LETTERS FROM DIRECTOR GENERAL OF
BANGDA (JUNE 24, 1982) AND
DIRECTOR GENERAL OF BINA MARGA
(JANUARY 27, 1986)

DEPARTEMEN DALAM NEGERI
REPUBLIK INDONESIA

Jakarta, 24 Juni 1982.

Nomor : 620/975/Bangdes.
Sifat :
Lampiran :
Perihal : Pedoman Pembinaan Teknis dan Tata-laksana Pembinaan Jalan Kabupaten.-

Kepada Yth. :

1. Gubernur Kepala Daerah Tingkat I Cq. Kepala Dinas Pekerjaan Umum Propinsi Daerah Tingkat I di seluruh Indonesia.
2. Bupati Kepala Daerah Tingkat II Cq. Kepala Dinas Pekerjaan Umum Kabupaten Daerah Tingkat II di seluruh Indonesia.

Diberitahukan dengan hormat bahwa untuk meningkatkan kemampuan penyelenggaraan jalan Kabupaten, perlu diambil langkah-langkah untuk mengatur pembinaan teknis atas Dinas Pekerjaan Umum Kabupaten dan Tatalaksana Pembinaan Jalan Kabupaten.

Pembinaan teknis tersebut diatas sesuai dengan maksud dari lampiran Instruksi Presiden Republik Indonesia tentang Pedoman Pelaksanaan Bantuan Pemunjangan Jalan Kabupaten yang antara lain menyatakan bahwa Menteri Pekerjaan Umum bertanggung jawab atas pemeliharaan dan pembinaan teknis Bantuan Pemunjangan Jalan Kabupaten, sebagai usaha untuk mengembangkan kemampuan Dinas Pekerjaan Umum Kabupaten dalam melaksanakan tugas pembinaan di bidang jalan, yang antara lain mencakup usaha-usaha pemberian bantuan personil, peralatan, pendidikan dan latihan, masukan teknologi, serta bimbingan teknis dibidang jalan.

Untuk mencapai tujuan tersebut diatas dengan hasil semaksimal mungkin perlu diperhatikan hal-hal sebagai pedoman teknis

dibawah .....

dibawah ini :

1. Pembinaan Teknis.

1.1. Guna meningkatkan kemampuan Dinas Pekerjaan Umum Daerah Tingkat II, maka Dinas Pekerjaan Umum Tingkat I memberikan pembinaan teknis atas Dinas Pekerjaan Umum Daerah Tingkat II dengan melakukan pembinaan dan pemberian bimbingan teknis atas pelaksanaan pembinaan jalan Kabupaten yang dilaksanakan oleh Dinas Pekerjaan Umum Kabupaten Daerah Tingkat II termasuk proyek-proyeknya.

1.2. Dalam penyelenggaraan pembinaan teknis tersebut Dinas Pekerjaan Umum Propinsi wajib melakukan konsultasi dengan Bupati Kepala Daerah Tingkat II dan memberikan laporan kepada Gubernur Kepala Daerah Tingkat I.

1.3. Direktorat Jenderal Bina Marga melakukan pembinaan teknis atas Dinas Pekerjaan Umum Propinsi c.q. Bagian Bina Marga dan Dinas Pekerjaan Umum Kabupaten.

1.4. Guna mengisi kelengkapan tenaga yang memenuhi persyaratan pada Dinas Pekerjaan Umum Daerah Tingkat II diadakan kemungkinan untuk mempekerjakan atau memperbantukan pegawai Direktorat Jenderal Bina Marga atau pegawai Dinas Pekerjaan Umum Propinsi kepada Bupati Kepala Daerah Tingkat II untuk dipekerjakan atau diperbantukan dilingkungan Dinas Pekerjaan Umum Kabupaten, yang pelaksanaannya sesuai peraturan perundangan yang berlaku.

1.5. Direktorat Jenderal Bina Marga melalui Dinas Pekerjaan Umum Propinsi membantu usaha peningkatan kemampuan tenaga pelaksana Dinas Pekerjaan Umum Kabupaten dengan jalan memberikan bimbingan atas tugas pelaksanaan fisik proyek jalan dan menyelenggarakan pendidikan dan latihan. Penyelenggaraan pendidikan dan latihan tersebut dilaksanakan sesuai dengan ketentuan dan pedoman yang ditetapkan Direktur Jenderal Bina Marga.

1.6. Kepala Dinas Pekerjaan Umum Propinsi menyampaikan laporan kegiatan bimbingan serta penyelenggaraan pendidikan dan latihan kepada Gubernur Kepala Daerah Tingkat I dan

Bupati .....

1564

Bupati Kepala Daerah Tingkat II yang bersangkutan, Menteri Pekerjaan Umum dan Menteri Dalam Negeri.

2. Perencanaan.

2.1. Dinas Pekerjaan Umum Kabupaten melakukan pengumpulan data jalan lokal setiap tahun anggaran sesuai dengan pedoman dan petunjuk yang diberikan/ditetapkan oleh Direktorat Jenderal Bina Marga melalui Dinas Pekerjaan Umum Propinsi.

2.2. Hasil pengumpulan data jalan lokal sebagaimana dimaksud dalam 2.1. digunakan sebagai bahan penyusunan usulan program jaringan jalan lokal.

2.3. Usulan program sebagaimana dimaksud dalam 2.2. disusun oleh :

- Kepala Dinas Pekerjaan Umum Kabupaten dalam segi teknis pelaksanaan dan biaya.
- Ketua BAPPEDA Tingkat II dalam segi perencanaan makro serta koordinasi dengan proyek-proyek lain dalam lingkup Kabupaten yang bersangkutan.
- Sekretaris Wilayah Daerah Tingkat II c.q. Kepala Bagian Pembangunan dalam segi administrasi.

2.4. Usulan program yang disusun sebagaimana dimaksud dalam 2.3. setelah diketahui Bupati Kepala Daerah Tingkat II yang bersangkutan dikirimkan kepada Gubernur Kepala Daerah Tingkat I untuk disyahkan dengan terlebih dahulu diteliti oleh :

- Kepala Dinas Pekerjaan Umum Propinsi dalam segi teknis pelaksanaan dan biaya ;
- Ketua BAPPEDA Tingkat I dalam segi perencanaan makro serta koordinasi dengan proyek-proyek lain dalam lingkup Propinsi ;
- Sekretaris Wilayah Daerah Tingkat I c.q. Kepala Biro Pembangunan dalam segi administrasi.

2.5. Setiap unit proyek sedapat-dapatnya harus dilengkapi dengan dokumen perencanaan teknik berupa persyaratan umum,

457

persyaratan teknik dan gambar rencana yang sudah mendapat persetujuan dari Bupati Kepala Daerah Tingkat II.

2.6. Sebelum memberikan persetujuan terhadap dokumen perencanaan teknik dari unit proyek, Bupati Kepala Daerah Tingkat II dapat meminta bantuan saran teknik dari Dinas Pekerjaan Umum Propinsi untuk melakukan pemeriksaan terhadap kesesuaian dokumen perencanaan teknik tersebut dilihat dari segi program keseluruhan, keadaan setempat dan pembiayaan.

2.7. Untuk kepentingan dokumentasi ditingkat Propinsi, gambar kerja yang secara fisik akan dilaksanakan disimpan diruang arsip Dinas Pekerjaan Umum Propinsi untuk dapat dimanfaatkan oleh pihak berkepentingan.

2.8. Penyiapan dokumen teknik dapat dibuat oleh teknisi unit proyek/teknisi Dinas Pekerjaan Umum Kabupaten dengan bimbingan dari Dinas Pekerjaan Umum Propinsi berdasarkan pedoman standar yang dikeluarkan oleh Direktorat Jenderal Bina Marga.

2.9. Apabila penyiapan dokumen perencanaan teknik memerlukan bantuan laboratorium ataupun keahlian khusus yang belum terdapat diunit proyek ataupun di Dinas Pekerjaan Umum Kabupaten, maka bantuan tersebut dapat diusahakan oleh Dinas Pekerjaan Umum Propinsi dengan cara memperbantukan teknisinya, atau mendapatkannya dari pihak lain ataupun bantuan tenaga dari Direktorat Jenderal Bina Marga.

2.10. Peningkatan kemampuan, keahlian dan ketrampilan tenaga proyek maupun Dinas Pekerjaan Umum Kabupaten dalam hal perencanaan teknik dilakukan oleh Direktorat Jenderal Bina Margamelalui penyelenggaraan pendidikan dan latihan.

3. Pelaksanaan.

3.1. Sesuai dengan pasal 12 ayat 1 Undang-undang Nomor 13 Tahun 1980 tentang jalan, Bupati Kepala Daerah Tingkat II sebagai pembina jaringan jalan lokal di Daerah Tingkat II bertanggung jawab terhadap pelaksanaan fisik program jalan lokal di Daerah Tingkat II yang bersangkutan.

4584

3.2. Dalam melaksanakan tanggung jawab sebagaimana dimaksud 3.1., Bupati Kepala Daerah Tingkat II mengangkat Pemimpin Proyek Jalan Lokal yang bertanggung jawab terhadap tugas pelaksanaan fisik Proyek Jalan Lokal di Daerah Tingkat II yang bersangkutan, baik yang diselenggarakan secara swakelola maupun secara borongan.

3.3. Bupati Kepala Daerah Tingkat II mengangkat dan memberhentikan Pemimpin Proyek Jalan Lokal, setelah mendengar pendapat atau usul Kepala Dinas Pekerjaan Umum.

3.4. Dalam melaksanakan tugasnya, Pemimpin Proyek dibantu oleh Staf Dinas Pekerjaan Umum Kabupaten. Bagian Jalan dan Jembatan.

3.5. Untuk melaksanakan pekerjaan secara borongan Pemimpin Proyek bertanggung jawab terhadap penyelenggaraan pelelangan dan pengadaan kontrak dengan persetujuan Bupati Kepala Daerah Tingkat II.

3.6. Rencana Kerja, rencana penggunaan peralatan, dan rencana anggaran biaya disusun oleh Pemimpin Proyek Jalan Lokal dan diketahui oleh Bupati Kepala Daerah Tingkat II yang bersangkutan.

3.7. Rencana-rencana dimaksud dalam 3.6. diteliti oleh :

- Kepala Dinas Pekerjaan Umum Propinsi dalam segi teknis pelaksanaan dan biaya ;
- Ketua BAPPEDA Tingkat I dalam segi perencanaan makro serta koordinasi dengan proyek-proyek lain ;
- Sekretaris Wilayah Daerah Tingkat I c.q. Kepala Biro Pembangunan dalam segi administrasi.

yang selanjutnya menyetujui dan disyahkan oleh Gubernur Kepala Daerah Tingkat I yang bersangkutan.

3.8. Pemimpin Proyek Jalan Lokal wajib melaksanakan tugasnya sesuai dengan persyaratan teknis yang tercantum dalam ketentuan dan pedoman yang ditetapkan oleh Direktur Jenderal Bina Marga.

3.9. ———

3.9. Pemimpin Proyek Jalan Lokal bertanggung jawab atas pengoperasian serta pemeliharaan peralatan dan penyediaan biaya untuk keperluan penggunaan maupun pemeliharaan peralatan selama pelaksanaan program.

3.10. Biaya penggunaan dan pemeliharaan peralatan dimaksud 3.9. dibebankan kepada masing-masing proyek Jalan Lokal Daerah Tingkat II yang bersangkutan.

3.11. Dalam melaksanakan tugasnya Pemimpin Proyek Jalan Lokal wajib mengadakan konsultasi dengan Dinas Pekerjaan Umum Propinsi untuk dapat dengan segera mengambil langkah tepat baik yang dapat dilakukan apabila timbul permasalahan yang bersifat teknis selama masa pelaksanaan pekerjaan.

4. Peralatan.

4.1. Untuk melaksanakan pekerjaan jalan, kepada Pemerintah Daerah Tingkat II dapat diberikan bantuan Peralatan dari Departemen Pekerjaan Umum dan Departemen Dalam Negeri yang terdiri dari 2 (dua) satuan :

- Satuan peralatan pemeliharaan jalan, digunakan untuk pemeliharaan jalan yang dapat digunakan langsung oleh Dinas Pekerjaan Umum Kabupaten yang bersangkutan.
- Satuan peralatan penunjangan jalan, digunakan untuk penunjangan jalan yang penggunaannya dilakukan oleh Dinas Pekerjaan Umum Kabupaten melalui koordinasi Dinas Pekerjaan Umum Propinsi yang bersangkutan.

4.2. Direktur Jenderal Bina Marga atas nama Menteri Pekerjaan Umum menetapkan seorang pejabat dari masing-masing Dinas Pekerjaan Umum Propinsi Daerah Tingkat I sebagai Koordinator peralatan untuk membantu Kepala Dinas Pekerjaan Umum Propinsi didalam mengkoordinasikan peralatan sebagaimana dimaksud dalam 4.1..

4.3. Koordinasi peralatan dimaksud dalam 4.2. meliputi pengawasan terhadap :

- Penerimaan dan penyaluran peralatan.

460

- Efektifitas pemakaian peralatan.
- Pemeliharaan peralatan.

4.4. Pemimpin Proyek Jalan Lokal bertanggung jawab terhadap pemeliharaan peralatan sebagaimana dimaksud 4.1. sesuai dengan pedoman penggunaan dan pemeliharaan peralatan sebagai berikut :

- Pemeliharaan peralatan tingkat II dan III meliputi pemeriksaan harian, pelumasan dan perbaikan ringan dilaksanakan di lapangan dan atau bengkel Dinas Pekerjaan Umum Kabupaten yang bersangkutan.
- Pemeliharaan tingkat IV meliputi perbaikan berat di bantu oleh bengkel Dinas Pekerjaan Umum Propinsi yang bersangkutan.
- Pemeliharaan peralatan tingkat V meliputi pemugaran kembali (rebuilt) dibantu oleh bengkel Depot Peralatan Jalan Direktorat Jenderal Bina Marga wilayah yang bersangkutan.

4.5. Biaya penggunaan dan pemeliharaan peralatan dimaksud dalam 4.1. dan biaya pemeliharaan peralatan dimaksud 4.3. dibebankan kepada proyek yang bersangkutan.

4.6. Pemimpin Proyek Jalan Lokal berkewajiban melaporkan penggunaan dan pemeliharaan peralatan dimaksud dalam 4.1. secara berkala kepada Bupati Kepala Daerah Tingkat II yang bersangkutan dan tembusannya disampaikan kepada Koordinator Peralatan.

4.7. Laporan dimaksud dalam 4.4. setelah diteliti oleh Bupati Kepala Daerah Tingkat II yang bersangkutan selanjutnya disampaikan kepada Gubernur Kepala Daerah Tingkat I yang bersangkutan dan Direktur Jenderal Bina Marga serta tembusannya kepada Dinas Pekerjaan Umum Propinsi.

4.8. Penerjaan peralatan dimaksud dalam 4.1. kepada Instansi lain/koordinator pelaksana Proyek yang bersangkutan, harus seizin Direktur Jenderal Bina Marga dan harus sesuai dengan prosedur dan tata cara yang berlaku pada Direktur Jenderal Bina Marga.

5. Masukan Tekhnologi.

5.1. Dalam usaha untuk meningkatkan mutu hasil kerja dari waktu kewaktu harus terus menerus dilakukan masukan tekhnologi pada saat persiapan proyek, selama proyek berlangsung dan sesudah proyek selesai.

5.2. Masukan tekhnologi pada saat persiapan proyek dapat berupa pedoman-pedoman yang dikeluarkan oleh Direktur Jenderal Bina Marga, literatur dan informasi lain, bimbingan teknis baik dari Dinas Pekerjaan Umum Propinsi setempat ataupun dari Direktorat Jenderal Bina Marga.

5.3. Masukan tekhnologi selama proyek berlangsung dapat berupa pengendalian mutu pelaksanaan yang dikerjakan oleh tekhnisi laboratorium lapangan dan laboratorium Propinsi setempat.

5.4. Masukan tekhnologi sesudah proyek selesai adalah pengamatan secara berkala atas hasil proyek, agar supaya dapat dimanfaatkan sebagai pengalaman bagi proyek lain serta mencegah kerusakan-yang lebih lanjut apabila terjadi kelainan kelainan selama pelaksanaan.

5.5. Untuk tugas pelaksanaan masukan tekhnologi, dapat dilakukan oleh tekhnisi setempat dengan bimbingan dari Dinas Pekerjaan Umum Propinsi. Dalam hal khusus yang menyangkut tekhnologi tinggi dan keahlian yang belum dipunyai Dinas Pekerjaan Umum Kabupaten, Dinas Pekerjaan Umum Propinsi dapat mengusahakan bantuan dari pihak lain ataupun dari Direktorat Jenderal Bina Marga.

5.6. Kelengkapan sarana untuk masukan tekhnologi berupa alat-alat laboratorium dan alat-alat pemeriksaan lapangan lainnya akan diusahakan dan dibantu oleh Direktorat Jenderal Bina Marga.

5.7. Peningkatan kemampuan, keahlian dan ketrampilan tenaga unit proyek maupun Dinas Pekerjaan Umum Kabupaten dalam hal masukan tekhnologi akan dilakukan oleh Dinas Pekerjaan Umum Propinsi melalui penyelenggaraan program Pendidikan

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dan Latihan.

Demikianlah untuk diketahui, agar pedoman teknis tersebut diatas dapat dilaksanakan dengan sebaik-baiknya.-

MENTERI DALAM NEGERI
DIREKTUR JENDERAL PEMBANGUNAN DAERAH,

Drs. SIBARO.-

TEMBUSAN :

1. Yth. Sdr. Sekretaris Jenderal Departemen Dalam Negeri.
2. Yth. Sdr. Direktur Jenderal Pemerintahan Umum dan Otonomi Daerah, Departemen Dalam Negeri.
3. Yth. Sdr. Inspektur Jenderal Departemen Dalam Negeri.
4. Yth. Sdr. Direktur Jenderal Bina Marga Departemen Pekerjaan Umum.-

DEPARTEMEN PEKERJAAN UMUM
DIREKTORAT JENDERAL BINA MARGA
JALAN PATTIMURA NO 20 PERC. 7 TELP 711530 - 711535 - 772806 P O BOX 2731
KEBAYORAN BARU - JAKARTA

Nomor : PW 0201-01-08/BC-2 Jakarta, 27 Januari 1986
Lampiran:

Kepada Yth.
Kepala Kantor Wilayah Departemen
Pekerjaan Umum Propinsi (terlampir)

Perihal : Pengawasan dan pembinaan serta pemeliharaan peralatan bantuan kepada Kabupaten.

Sebagaimana Saudara ketahui bahwa dalam rangka peningkatan penanganan jaringan jalan Kabupaten, kepada beberapa Kabupaten telah disalurkan bantuan peralatan yang berasal dari bantuan Luar Negeri maupun dari Direktorat Jenderal Bina Marga.

Untuk meningkatkan efisiensi penggunaan peralatan serta peningkatan pemeliharaan peralatan dimaksud, dengan memperhatikan surat Direktur Jenderal Pembangunan Daerah nomor 620/975/Bangda tanggal 4 Juni 1982, dengan ini kami harap perhatian Saudara terhadap hal-hal sebagai berikut:

1. Lebih mengaktifkan Kepala Bidang Peralatan dan Perbekalan Kanwil Dep. PU dalam hubungan sebagai Koordinator Peralatan Kabupaten sesuai Surat Keputusan Direktur Jenderal Bina Marga nomor 20/KPTS/BM/1982, nomor 176/KPTS/B/1983, nomor 16/KPTS/Dd/1985 dalam hal pengaturan dan penggunaan peralatan Kabupaten di Wilayah Saudara, dalam rangka memperbesar kemungkinan penggunaan untuk/oleh Dinas Pekerjaan Umum Seksi untuk mempertinggi effisiensi serta lingkup penggunaan peralatan, sesuai pengarahan Bapak Menteri Pekerjaan Umum.

2. Meningkatkan pengawasan terhadap kondisi peralatan serta meningkatkan pembinaan pemeliharaan peralatan, dengan sejauh mungkin memanfaatkan fasilitas bengkel yang tersedia antara lain bengkel Kanwil Dep. PU sebagaimana telah diatur dalam surat Direktur Jenderal Pembangunan Daerah nomor 620/975/Bangda tanggal 24 Juni 1982 tersebut di atas dan surat Direktur Jenderal Bina Marga nomor PW 03 01 01 / DJ. 685/BM/1982 tanggal 26 Juni 1982.

Demikian untuk dimaklumi dan atas perhatian Saudara kami ucapkan terima kasih.

DIREKTUR JENDERAL BINA MARGA

SURYATIN SASTROMIJOYO
NIP. 110005350

Tembusan disampaikan kepada Yth.

1. Bapak Menteri Pekerjaan Umum.
2. Sdr. Direktur Jenderal Pembangunan Daerah, Departemen Dalam Negeri.
3. Sdr. Gubernur Kepala Daerah Tingkat I seluruh Indonesia.
4. Sdr. para Direktur dilingkungan Ditjen Bina Marga dan Sekretaris Ditjen Bina Marga.
5. Sdr. Kepala Dinas Pekerjaan Umum Propinsi di seluruh Indonesia.
6. Sdr. Bupati Kepala Daerah Tingkat II seluruh Indonesia.

LAMPIRAN

Surat Direktur Jenderal Bina Marga

Nomor : 1W.03 07 07 - 08/BOC

Tanggal : 27 Januari 1986

Disampaikan kepada Kepala Kantor Wilayah Dep. PU

1. Propinsi D.I. Aceh di Banda Aceh
2. Propinsi Sumatera Utara di Medan
3. Propinsi Sumatera Barat di Padang
4. Propinsi Riau di Pekanbaru
5. Propinsi Jambi di Jambi
6. Propinsi Bengkulu di Bengkulu
7. Propinsi Sumatera Selatan di Palembang
8. Propinsi Lampung di Tanjungkarang
9. Propinsi DKI Jakarta Raya di Jakarta
10. Propinsi Jawa Barat di Bandung
11. Propinsi Jawa Tengah di Semarang
12. Propinsi D.I. Yogyakarta di Yogyakarta
13. Propinsi Jawa Timur di Surabaya
14. Propinsi Kalimantan Barat di Pontianak
15. Propinsi Kalimantan Tengah di Palangkaraya
16. Propinsi Kalimantan Selatan di Banjarmasin
17. Propinsi Kalimantan Timur di Samarinda
18. Propinsi Bali di Denpasar
19. Propinsi Nusa Tenggara Barat di Mataram
20. Propinsi Nusa Tenggara Timur di Kupang
21. Propinsi Timor Timur di D i l i
22. Propinsi Sulawesi Utara di Manado
23. Propinsi Sulawesi Tengah di P a l u
24. Propinsi Sulawesi Tenggara di Kendari.
25. Propinsi Sulawesi Selatan di Ujung Pandang
26. Propinsi Maluku di Ambon
27. Propinsi Irian Jaya di Jayapura.

DIREKTUR JENDERAL BINA MARGA

SUHYATIN SASTROMIJOYO

NIP. 110005350

ANNEX 27

BINA MARGA WORK CLASSIFICATIONS FOR WORKSHOPS

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Level I: Maintenance work done by operators and drivers before and after they operate equipment, such as:

- o Checking on the outer body of the equipment, for cracks, loose bolts, etc.;
- o Checking oil levels, fuel, cooling system, battery, fan belt tension and adding oil if necessary;
- o Checking the gauges after cranking the engine, checking brakes, the steering wheel, attachments, etc.

Level II: Preventive maintenance work done by mechanics and servicemen in the workshop, such as:

- o Changing engine oil, transmission oil, hydraulic oil, greasing and battery maintenance;
- o Changing/cleaning fuel filters, oil filters, air filters, etc.;
- o Repairing tires.

Level III: Adjustments and minor repairs done by mechanics in the workshop, such as:

- o Making adjustments to brakes, clutch, contact points, carburator, etc.;
- o Making minor repairs, without performing a complete overhaul, such as changing parts which are damaged or leaking;
- o Changing nozzles, fan belts, hoses, etc.;
- o Replacing complete components such as alternators, starter motor, radiator, etc.;

Level IV: Major repairs done by master mechanics in fully-equipped workshops. This type of work consists of overhauling engines, transmissions, changing clutch in heavy equipment, etc.

Level V: Repairs that require fabrication of parts and major rehabilitation of equipment in very damaged condition.

ANNEX 28

RECOMMENDED KABUPATEN WORKSHOP EQUIPMENT

1. LUBRICATION SERVICE EQUIPMENT

4 Handgrease guns HD
2 Grease pumps (16 kg drums)
2 Oil pumps (20 l. drums)
6 Rotary hand oil pumps
2 Dial indicator gauges and accessories
6 Oil cans
1 Steam cleaner outfit
1 Water jet cleaner
6 Fuel cans with nozzles
1 Air compressor, electric 15 cfm
1 Air filter element tester

2. TIRE SERVICE EQUIPMENT

1 Tire changer, air operated
3 Tire pressure gauges HD
1 Tire repair equipment & tools set
1 Vulcanizing unit
1 Wheel balancer, electronic

3. BATTERY AND ELECTRIC SECTION EQUIPMENT

2 Battery chargers, engine starters
6 Hydrometers
1 Distributor tester
1 Battery tester, 600 amp. capacity
1 Automotive electrical analyzer & tester
1 Battery service tools set

4. DIESEL INJECTION AND HYDRAULIC SECTION EQUIPMENT

1 Fuel pump vice
1 Nozzle tester
1 Injector stand
1 Injector dismantling jig
1 Hydraulic tester
1 Hydraulic hose installer

5. REPAIR SECTION EQUIPMENT

2 Hydraulic jacks, 10 tons
2 Trolley jacks, 4 tons
1 Mobile floor crane, 1 ton
4 Axle stands, 10 tons
2 Chain hoists, 1 ton
2 Engine lifting slings
1 Puller, 10 ton

1 Hydraulic press, 10 tons
1 Timing light
1 Compression tester
1 Spark plug cleaner
5 Feeler gauge sets
2 Mechanic creepers
4 Engineer's vices, bench mounted

Vehicle Service Tool Kits (Metric):

1 Portable Cabinet
4 Mechanic boxes

Equipment Service Tool Kit (Metric):

1 Portable Cabinet
1 Pipe and adjustable wrench set
2 Torque wrenchs

Brake Service Equipment & Tools:

1 Bearing/gear puller set
1 Riveting tools set

6. WELDING, BODY AND PAINT SECTION EQUIPMENT

1 Welding machine, 250 amps, portable engine operated, complete
1 Welding/cutting acetylene gas set
1 Blow torch set
1 Body and panel repair set
1 Surface grinder
2 Electrical drills, various sizes
1 Painting equipment set
1 Electric soldering iron and gun set
1 Electric generating set, 3000 watts, 3-phase, 110 V, 50 Hz., engine driven, complete

7. MACHINE SHOP SECTION EQUIPMENT

1 Drilling machine, pillar
1 Saw machine
1 Grinder machine, bench type
1 Grinder machine, disc type
1 Micrometer set
4 Measuring rule
1 Taps and dies set, metric
1 Tube bending machine

8. MISCELLANEOUS

4 Fire extinguishers
1 Carpenter tools set

A set of general technical specifications for the main items described above is given in Annex 13.

ANNEX 29

STEPS FOR DEVELOPING AND IMPLEMENTING
A MAINTENANCE MANAGEMENT SYSTEM

STEPS TO DEVELOP AND IMPLEMENT A MAINTENANCE MANAGEMENT SYSTEM FOR KABUPATEN ROADS IN INDONESIA

Project Objectives. The objective of the project should be to develop and implement a work management system for maintenance that meets the needs of the Kabupatens. The following considerations should be kept in mind:

1. The work program must accord priority to the relatively small number of maintenance work activities that are significant;

2. Resources must be allocated according to program needs;

3. The program work quantities must be scheduled and controlled;

4. The work management system must be accepted, understood and operated easily by DPUP Cabang Dinas/DPUK personnel;

5. The application of work program calculations to annual budget requests must be understood and accepted by the kabupaten planning organizations (Bappeda II and Bagian Pembangunan);

6. A steering committee consisting of GOI top management should periodically review and approve maintenance policy and procedure improvements; and

7. A technical panel should be established -- consisting of knowledgeable GOI and consultant personnel. The panel should provide data for and review improvements in work methods, workmanship levels and other technical matters.

The objectives expressed above are best met by the eleven-step work plan described below.

Step One -- Orientation

A general orientation should be conducted for the various levels of the GOI involved in the project. All project maintenance work steps should be reviewed and discussed and project maintenance objectives explained.

Step Two -- Work Activities

The maintenance work to be done should be defined, activity by activity. The purpose of this step is to analyze the total workload, defining work in the same increments needed to schedule and direct operations. Appropriate measures of the amount of each kind of work should be selected and each activity should be related to specific

physical features. These features, of course, generate the need for the maintenance activity. For example, the number of culverts governs the amount of cleaning.

This step is done by first interviewing experienced field engineers to make sure all significant activities are identified and that all terminology and measures are suitable to the agency. The activity list should then be reviewed by the technical panel.

Step Three -- Work Inventories

Maintenance feature inventories and data on current practices should be reviewed. Every item to be maintained -- as defined in Step Two -- should be identified and inventoried. For example, the number of km of each type of road should be measured; the number of bridges requiring maintenance should be shown; culverts needing cleaning should be counted; and counts or measures should made of every other item that represents a significant amount of maintenance work. An updated condition survey should also be prepared based on a uniform rating criterion.

In this step, the consultant and DPUP personnel should train and supervise kabupaten personnel to perform the actual inventory and condition survey. The results should be summarized along the lines of managerial responsibility, giving a tabulation of the kinds and amounts of each type of feature each supervisor must maintain.

Certain other data are needed on employee leave patterns, past expenditure patterns, and related personnel and accounting policies and procedures. These data should also be identified and collected.

Step Four -- Levels of Effort

The levels of effort -- that is, the amounts of services to be provided -- should be determined for all activities. This is a decision-making step that must involve reviews by the technical panel. The data should be taken primarily from past records, and project staff and panel member experience. The final levels of effort should be reviewed and approved by the technical panel.

Step Five -- Performance Standards

Performance and other new planning standards should be developed for each work activity. Work costing standards already exist and can thus serve as a starting point. The performance standards should indicate the optimum crew size, equipment, materials, and work procedures for each activity and the average daily production for an optimum crew should be estimated for each.

The following three sub-steps should be used in developing all of the new standards:

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1. Draft standards should be prepared by the consultants. These will come from a combination of field observations, interviews with field supervisors and experience with other agencies.

2. The draft standards should be reviewed with experienced GOI road engineers to make sure the proposed methods and average daily production values are practical and realistic.

3. The performance standards along with the workload planning standards should then be reviewed by the technical panel. At this standard-setting meeting, the decisions would be made regarding work quantities and performance standards to be used in a "first draft" work program and budget.

Step Six -- Work Program and Budget

A maintenance work program and budget should then be prepared using a combination of data from the maintenance feature inventory and the decisions made at the standards-setting meeting. The reconstruction work program should be included in the total yearly program. The combined work programs and budgets should be revised as needed to 1) identify those activities where emphasis must be changed to fit the funds and personnel available, and 2) distribute the workload over the year.

The combination of the revised work program and budget and the workload distribution should then be reviewed. To the extent possible, shifts will be made in the activities in order to have a leveled workload.

Step Seven -- Work Calendar

Based on the results of Step Six, a work plan and schedule -- a work calendar -- should be prepared. The work calendar will show the approved workload in terms of the number of crew days of work needed for each activity, month by month, in order to execute the work plan successfully.

At the same time the work calendar is prepared, equipment and material requirements should also be computed -- class-by-class, type-by-type, and month-by-month.

Step Eight -- Schedules and Reports

A management information sub-system should be developed. Schedules should be developed so that foremen and contractors will know the objectives and amounts of work expected of them. The schedules should define work to be done, when and where it should be done, and the resources that should be used. This information is based mainly on the performance standards.

Reports should be developed to provide management with information on resource utilization, work performance, productivity and costs of each work crew or each maintenance contractor.

Step Nine -- Implementation

The work management system should be implemented through the following sub-steps:

- o A work management system manual should be prepared;
- o Kabuparen personnel should be trained in general management techniques, work method improvements and the work management system;
- o Scheduling meetings for foremen and supervisors should be set up and conducted by the kabupaten staff. Consultant staff should guide and assist in these meetings until their participation is no longer needed; and
- o Work should be monitored closely by the consultant staff for an initial period, to ensure that the management system is being understood and used, and that work-method improvements are being incorporated into the work. Gradually, the kabupaten staffs should become able to direct and control the work themselves.

Step Ten -- Refinements

Following the system implementation, refinements in system elements should be made, based on findings of the consultant staff. The final work management system should be documented. Standardized training packages should be completed by the GOI under the guidance of the consultant staff for future implementation in other kabupatens.

Step Eleven -- Follow-up

Consultant staff should provide advice on the follow-up adjustments to implementation to ensure that the plan is compatible with needs and personnel.

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ANNEX 30

PROCEDURE FOR DERIVING INTERPOLATED
VALUES IN RECONSTRUCTION SELECTION TABLE (TABLE 38)

Although traffic counts have been reported for roads in the project area, the composition of this traffic has been reported for only three kabupatens: Sumba Barat, Ngada, and Gowa. A fairly large sample of 145 road links is represented, which indicates the average composition of minibuses, cars, light trucks, motorcycles, and jeeps. It is not known if this vehicle distribution is representative of all 14 kabupatens, however. These vehicle distributions change only slightly between ADT road classes in the grouping >500, 200-500, and 50-200 (see Table 38 and Annex 23). But for the earth road class <50, motorcycles rise to 58% of the total vehicle flow. This relative proportion imparts a special characteristic to the already low level of unit vehicle operating costs: still larger levels of ADT are now required to produce the desired IRR. The effects of vehicle composition and costs and savings upon ADT and IRR levels are immediate and direct. More will be said about this later, when a method is introduced to modify some of this sensitivity in order to generalize the approach to project area roads.

Section 9.4 attempted to measure the comparative differences between the kabupaten road class design-level ADT volumes and the IBRD-indicated level of IRR which would be obtained from a specified level of cost for reconstruction and a specified composition of traffic. In that analysis, the question asked was: what level of ADT is needed to make feasible the rehabilitation and/or upgrading cost associated with asphalt, seal, gravel or earth at a 15% IRR? And, is that level of ADT the same as the existing standard now in use at the kabupaten level? This section will pursue the same analytic form, through the IBRD tables, but will use the sample survey field data from the project area (the three kabupatens reporting traffic composition), and will broaden the range of costs of rehabilitation/upgrading, while at the same time reducing the IBRD tables, by extrapolations, to a selected range of cases which apply most usefully to the project study area. The changes introduced here are:

1) Sample survey data from the project area will supplant the prior analysis which used survey data from 20 kabupatens in Java, Bali, and NTB. ADT volume and composition of traffic will change fractionally.

2) A new vehicle cost and vehicle savings basis will be used, which for each road type compares a "good" condition with a "bad," rather than the previous use of "fair" and "poor" which were endorsed by ADB 8th Loan and OECF in field analyses of expected rehabilitation works. The basis for this choice apparently rested with minimum standards and the recognition of no follow-on maintenance programs. A further reason for the use of these terms for VOC is that observed roads in the study area and contemplated works projects provide this basis for analysis. VOCS will, therefore, be greater than previously shown; ADT needs will be less, and more important, the Section 9 forecast will be now supplemented with greater detail of cost and ADT values which now relate wholly to the project study area. Such internal

consistency will provide a back-up to the forecasts of Section 9, which used these same vehicle costs, traffic compositions by class of road, and vehicle savings levels.

Initial Interpolation Results

At project start-up, and during the court of the project, field surveys will expect to find roads in all road classes that are designated "bad" but which have some level of traffic. Rehabilitation or upgrading of the roads will place them in good condition, which should be maintained thereafter. The relative cost range for vehicles can be identified as follows:

	Sealed			Unsealed	
	Asphalt	Seal	Gravel	Gravel	Earth
Apparent ADT:	> 500	>200	< 200	50-200	< 50
(Rp/Km) Composite (weighted average) Vehicle Operating Costs:					
Good:	58.0	71.6	72.8	77.7	97.8
Bad :	127.6	133.8	148.5	160.5	134.9
% change:	54.5	46.5	51.0	51.5	27.5
Bad condition: (US$ equiv.)	.114	.119	.133	.143	.120

(VOC on seal is taken at fair asphalt VOC)

The vehicle operating costs which are given above relate exclusively to the findings of the sample survey on project study area roads. They are the product of vehicle costs/km obtained from the ADB 8th Loan project evaluations and the vehicle compositions found in the project area. The vehicle distributions are:

	Sealed			Unsealed	
	Asphalt	Seal	Gravel	Gravel	Earth
Apparent ADT:	> 500	> 200	< 200	50-200	< 50
(Rp/Km) Composite (weighted average) vehicle operating costs:					
(%) car/jeep	23	28	28	28	24
minibus	15	11	11	11	2
lt. truck	16	18	18	24	16
motorcycle	46	43	43	37	58
% 4-wheel:	54	57	57	63	42

The skewed distribution of motorcycle traffic on earth roads has the simultaneous effects of minimizing both VOC and VOCS, i.e., the percentage savings to vehicles in going from bad to good is only 27.5%, as compared to much higher savings for vehicles in other road classes which have fewer motorcycles in the traffic flow.

Because entry into the IBRD tables first requires identification of the unit vehicle operating costs (in US$ equivalent), based upon average ADT, the above five road classes have been merged into asphalt/seal, gravel/gravel, and earth composites, preliminary to further averaging. This averaging is consistent with the aim of obtaining a single ADT figure which incorporates explicit VOC and VOCS--and therefore describes the IRR which may be attained under different levels of road investment cost.

This merger of VOC and VOCS further simplifies entry into the tables of IRR, and broadens the base of analysis by relaxing the rigidly specified vehicle compositions shown above. By this device, other existing vehicle distributions, also found in the same approximate levels of traffic in the project area, may be accommodated in the "average" traffic flow, and be reflected in vehicle costing and savings levels. The effects are shown below:

	Asphalt/Seal	Gravel/Gravel	Earth
VOC (US$):	.114	.133	.120
	.119	.143	
Average	.1165	.138	.120
VOCS (%):	54.5	51.0	27.5
	46.5	51.5	
Average	50.5	51.25	27.5
4-wheel %:	50.5	60.0	42.0
Motorcycle %:	49.5	40.0	58.0

It can now be said that the sample survey incorporates within its system of vehicle operating costs a somewhat broader range of the likely composition of these costs, and is therefore more representative of the more heavily trafficked roads in the 50 to +500 road classes (asphalt/seal/gravel). But the earth road cost system remains isolated, fixed at levels which condemn it to a meager rate of VOCS (savings) only slightly more than one-half the level of rehabilitated gravel.

Section 9.4 forecast that vehicle costs for the five road classes will continue to rise between year one (good) and the year in which expected service life and/or intervention by rehabilitation interrupted that rise. For the unmaintained roads, arrival at the end of service life meant arrival at "bad" VOC levels, and for four road classes,

"worse" VOC could be forecast at one-half the rate of annual increase thereafter. But for the earth road case, no moderation in the rate of vehicle cost levels would spare the road from ruin by the end of the ten-year forecast period. Field observations since that forecast suggest that the composition of traffic and its present tabulation above (in a range from good to bad) do not fully account for the passage of the sampled earth road into the range of bad-to-worse. That is, the sampled statistics on earth road traffic characteristics, reviewed against pictures of these roads stated to be in moderate, poor, and bad condition, would confirm that "bad" is an understatement as a statistical data base. Four-wheel vehicles on such roads, which have generally not been maintained as a matter of policy, would quickly be supplanted by motorcycle traffic as the principal mode able to travel the road.

If deteriorated earth roads inhibit the use of 4-wheel vehicles, the vehicles distribution is unrepresentative of the vehicle flows to be expected on restored earth roads, and is unrepresentative of the traffic which may have operated on some of these earth roads when they were new. To provide another index of VOC on earth roads, similar to the averaging above of asphalt with seal, and low-volume gravel with higher-volume gravel, one can re-examine the cost levels between seal-gravel-earth (.1165-.138-.120) to see that the rate of cost increase does not reflect the higher costs of vehicle operation on earth roads normally associated with 4-wheel vehicle traffic. The rise in VOC between seal and gravel is 18%; higher costs on earth roads, in equal amount, would place earth road VOC at .163 (if the vehicle composition had not been altered).

This increase for costs on earth roads would also make sense because many sections of Telford cobble (gravel) roads are deteriorated to earth standards, which makes distinctions between "gravel" and earth more difficult. Restoration to an earth or gravel standard is a later choice which will be determined by relative ADT and the relevant costs of restoration. The distinction that must be made between earth and gravel roads is more difficult. While VOCs are normally higher on earth roads than on gravel, the VOC savings produced by restoration of earth roads will be less, as a rate, than those achieved by going from Telford cobble to engineered gravel. This rate is likely to be 90% of gravel, or a 46.1% cost change induced by earth road restoration, compared to 51.25% induced by gravel road restoration.

If this new (higher) VOC level and its related VOC savings level are forecast for earth road traffic, interpolated for various IRRs, and combined with the earth road ADT requirements given by the skewed distribution of motorcycle traffic, the following comparisons may be made between the average ADT levels needed for a range of investment costs:

Road Costs: (Rp 000)

Apparent Road Class:	8960	11200	20160	22400	28000	39200
	ADT levels needed		10% IRR			
Asphalt/seal	53	66	120	133	167	234
Gravel	47	58	105	116	146	205
Earth	74	93	168	186	233	315
Average:	58	72	131	145	182	251
			12% IRR			
Asphalt/seal	58	73	132	146	183	256
Gravel	51	64	115	128	160	224
Earth	81	102	183	203	254	357
Average:	63	80	143	155	199	279
			15% IRR			
Asphalt/seal	66	83	150	167	208	291
Gravel	58	72	131	146	182	255
Earth	93	115	209	243	289	406
Average:	72	90	163	185	226	317

This test result may be interpreted as follows: 1) earth road class traffic levels, for less than 50 vehicles per day, require a higher ADT at any restoration cost level than do traffic levels which fall in the gravel road class of 50-200 ADT; present traffic levels on roads in the asphalt/seal class, or +200 ADT, also require less ADT than earth roads but slightly higher levels than gravel road traffic; 2) this cost configuration reflects traffic composition on different road links that carry traffic at different levels which place these links in certain kabupaten road classes; 3) the actual class of road is not known with certainty; if the road links here in fact been upgraded in accordance with the road design standards for kabupaten roads, then they will reflect the road classes and corresponding ADT levels shown by traffic counts in the project study area (as above); and 4) the average ADT levels needed are therefore also shown, combining all apparent road classes as one; this merges traffic compositions into a single aggregate representative of the total traffic distribution found by the sample survey.

The average is believed to be more important than the individually stated "asphalt," "seal," "gravel" or "earth" categories, which wholly relate to probable road classes but not necessarily to the level of specific restoration cost which may be found to be appropriate to any of these ADT levels. By fusing the ADT levels into a single figure, and by broadening the scope of possible restoration costs, interpolated values of ADT can be found at alternative and marginally different cost levels which reflect generalized vehicle compositions (VOC and VOCS) and the narrow cost ranges expected to apply to new surfacing, resurfacing, or upgrading associated with a road re-build activity.

ANNEX 31

HISTORY OF CONTRACT AND FORCE ACCOUNT
ROADWORK IMPLEMENTED BY THE FOURTEEN STUDY KABUPATENS

HISTORY OF CONTRACT AND FORCE ACCOUNT

ROADWORK IMPLEMENTED BY THE FOURTEEN STUDY KABUPATENS (1

SULSEL	Fiscal Year	FORCE ACCOUNT Proj. (2	Km	Rp. (3	CONTRACT Proj.	Km	Rp.	TOTAL Proj.	Km	Rp.
PINRANG	83/84	3	9.9	128.8	10	25.9	316.6	13	35.8	445.4
	84/85	4	26.9	169.9	9	38.9	368.1	13	65.8	538.0
	85/86	4	28.3	207.0	8	12.4	354.5	12	40.7	561.5
	TOTAL	11	65.1	505.7	27	77.2	1,039.2	38	142.3	1,544.9
	Avg.	4	22	169	9	26	346	13	47	515
SIDENRENG RAPPANG	83/84	2	37.0	354.1	9	12.9	241.1	11	49.9	595.2
	84/85	-	-	-	12	43.7	458.2	12	43.7	458.2
	85/86	4	44.3	320.0	8	9.0	195.4	12	53.3	515.4
	TOTAL	6	81.3	674.1	29	65.6	894.7	35	146.9	1,568.8
	Avg.	4	27	225	10	22	298	12	49	523
WAJO	83/84	2	6.0	58.9	13	67.0	640.4	15	73.0	699.3
	84/85	1	89.0	112.5	14	41.8	421.9	15	130.8	534.4
	85/86	2	166.0	161.5	11	35.6	408.8	13	201.6	570.3
	TOTAL	5	261.0	332.9	38	144.4	1,471.1	43	405.4	1,804.0
	Avg	2	87	111	13	48	490	14	135	601
BONE	83/84	3	29.5	154.7	15	66.9	559.4	18	96.4	714.1
	84/85	4	63.8	415.9	9	46.5	566.5	13	110.3	982.4
	85/86	1	40.4	213.6	10	41.3	548.6	11	81.7	762.2
	TOTAL	8	133.7	784.2	34	154.7	1,674.5	42	288.4	2,458.7
	Avg.	3	45	261	11	52	558	14	96	820
BULUKUMBA	83/84	-	-	-	14	52.4	525.8	14	52.4	525.8
	84/85	-	-	-	13	46.4	478.0	13	46.4	478.0
	85/86	-	-	-	11	50.1	489.0	11	50.1	489.0
	TOTAL				38			38	148.9	1,492.8
	Avg.	0	0	0	13	50	498	13	50	498
JENEPONTO	83/84	-	-	-	9	35.7	362.7	9	35.7	362.7
	84/85	5	12.0	88.1	9	33.5	332.6	14	45.5	420.7
	85/86	7	12.3	208.9	9	21.3	218.2	16	33.6	221.1
	TOTAL	12	24.3	297.0	27	90.5	913.5	39	114.8	1,004.5
	Avg.	4	8	99	9	30	305	13	38	335
GOWA	83/84	-	-	-	13	40.0	512.4	13	40.0	512.4
	84/85	-	-	-	16	4. 7	621.5	16	43.7	621.5
	85/86	-	-	-	9	25.3	415.1	9	25.3	415.1
	TOTAL				48	109.0	1,549.0	48	109.0	1,549.0
	Avg.	0	0	0	16	36	516	13	36	516
THREE YEARS PROVINCE TOTAL	TOTAL	42	565.4	2,593.9	241	790.3	9,034.8	283	1,355.7	11,628.7
AVG. EACH YEAR PER KABUPATEN	Avg.	2	27	124	12	38	430	14	65	554
AVG. UNIT COST			Rp. 4.5/km			Rp. 11.3/km			Rp. 8.5/km	

5815

	Fiscal Year	FORCE ACCOUNT			CONTRACT			TOTAL		
		Proj. (2	Km	Rp. (3	Proj.	Km	Rp.	Proj.	Km	Rp.
N.T.T. (4										
	83/84	4	8.5	66.4	44	280.8	2,583.6	48	289	2,650.0
	84/85	15	102.5	1,171.5	27	139.8	1,690.2	42	242	2,861.7
	85/86	14	97.1	1,004.3	35	127.1	1,917.9	49	224	2,922.2
THREE YEARS PROVINCE TOTAL	TOTAL	33	208.1	2,242.2	106	547.7	6,191.7	139	755	8,433.9
AVG. EACH YEAR PER KABUPATEN	Avg.	2	10	107	5	26	295	7	36	402
AVG. UNIT COST		Rp. 10.7/km			Rp. 11.3/km			Rp. 11.2/km		

Notes:

1) Road work only, does not include bridges. Source of data: P.T. Hasfarm reports
2) Project = number of discrete projects financed that year
3) Rp. millions
4) Breakdown by kabupaten was not made for NTT because several of the project listings did not indicate the km.

1182

ANNEX 32

RECOMMENDED TECHNICAL ASSISTANCE

TECHNICAL ASSISTANCE

Calendar Years	1986	1987	1988	1989	1990	1991	1992	1993	1994	
Project Years	1986/1987	1987/1988	1908/1989	1989/1990	1990/1991	1991/1992	1992/1993	1993/1994	1994/1995	
Jakarta										
Foreign									Foreign	Local
1 Sr. Hwy Engr/Proj. Mgr.									72 MM	
1 Bridge Engr.									48	
1 Training Spec.									36	
1 Cost Accountant									36	
Local										
1 Sr. Hwy Engr./Loc.Ldr.										72 MM
1 Training Spec.										48
1 Cost Accountant										48
7 Total Jakarta										
Provinces (2 each)										
Foreign										
1 Hwy Const. Engr.									144	
1 Hwy Mtce. Engr. Ldr.									144	
1 Equipment Engr.									144	
6 Subtotal Foreign										
Local										
7 Hwy Engr. (1 each/kab)										1008
1 Bridge Engr.										144
3 Equipment Engr.										432
22 Subtotal Local										
28 Total Provinces									624	1752 MM

2886