The Roads Maintenance Management Program of Zila, Bangladesh

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The overall goals of the Zila roads project are to increase agricultural production, particularly food grains, and to improve rural access by institutionalizing an effective program to maintain and construct low-volume rural roads annually. The work program is being performed by Wilbur Smith and Associates in association with Bangladesh Consultants Ltd. and the Public Administration Service. The scope of this ongoing program encompasses technical assistance in tendering the development of improved standard specifications for road construction, the development of a road construction manual, the oversight of design and construction activities, and an extensive training program that includes formalized training in Bangladesh, on-the-job training, and overseas training in both Bangkok and the United States. One of the main purposes of the project was to formulate road maintenance programs for the Rangpur, Sylhet, and Faridpur districts of Zila. Detailed road inventories were conducted, and performance standards were devised for 22 basic activities. Workloads, in terms of crew-days, equipment, and material resources, were formulated for 13 maintenance areas within the three districts. Resource needs for the maintenance programs were quantified, recommendations were developed for staffing and equipment assignments, and the 13 programs were costed and budgeted for the fiscal year July 1, 1985, to June 30, 1986. A detailed methodology was developed to program, schedule, and execute the work program, including a reporting system and an evaluation of results.

One of the main goals of the Zila Roads Maintenance Improvement Project is to design and install a system to maintain local roads. Regular, periodic maintenance operations are currently not being performed at the local level. So-called maintenance activities relate primarily to the rehabilitation and reconstruction of existing roads. The following steps were followed in the design and implementation of a maintenance management system in each of the three districts of Rangpur, Sylhet, and Faridpur:

- The network of roads to be maintained was defined;
- Information was collected on separate road sections;
- The roads were classified;
- The type of maintenance work required on each road classification was identified;
- A performance standard was determined for each activity;
- The maintenance level to be achieved was established;
- The number of crew-days needed for each activity on each road in an annual cycle was determined;
- Resource requirements, including nonroutine costs, were calculated;
- Unit prices were established and resource requirements were budgeted;
- The budget was approved;
- The crew-day calculations were converted into a work program;
- The work was scheduled according to the seasons and priorities;
- The work was assigned and resources were allocated;
- The work was executed, inspected, and controlled;
- Reports were returned in the same terms as the performance standards; and
- The reports were analyzed and the next program was adjusted.

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NETWORK DEFINITION

A list of the roads in each of the three districts in Zila was made in early 1983 to define and initiate the maintenance program for the fiscal year that started July 1, 1985, and ended June 30, 1986. Individual roads were grouped by geographic area within each district into subdistricts, or maintenance areas.

Physical inventories of the roads commenced in July 1983. Although the inventories were hampered by weather, shortage of vehicles, and other problems, they were mostly complete by the end of the wet season in 1984. The inventories provided data on road lengths, surface type and width, shoulder width, surface condition, and major and minor drainage structures. A copy of the inventory form that was used is shown in Figure 1. A total of 137 active roads were inventoried, the total length of which was 1,094 mi. The number and total lengths of active roads in each district are listed in the following table.

District	*Active Roads*	*Total Length (mi)*
Rangpur	60	641.36
Sylhet	39	175.03
Faridpur	38	277.95
Total	137	1,094.35

The field surveys indicated that a number of road sections were interrupted and sometimes even isolated by unbridged water crossings and other gaps, which made the continuous recording of lengths impossible. This and other factors caused some long routes to be divided into sections with distinct numbers. All gaps within each numbered road were measured to record the uninterrupted length of the road.

A route numbering system was established so that the terminal place names would not have to be called out whenever a road was referred to. A sample road list in which the numbering system is shown can be found in Figure 2.

Road Name: _____ _____ _____

																							ODOMETER READING		
																							BEGIN	END	TOTAL
LOG MILE			SURFACE				SHOULDERS				EMBANKMENT				MAJOR STRUCTURES				MINOR STRUCTURES				SIDE DRAINAGE	TOTAL RATING	REMARKS
Odometer Reading	Actual Mileage	Sect. Length	Type	Cam-ber	Width	Cond (30)	Type	S ~ S Width	Cross Fall	Cond (25)	Fill Ht.	Side Slope	F.L.	Cond (10)	Type	Width	Length	Cond (15)	Type	Size	Length	Cond (10)	Cond (10)	(100)	

SKETCH

EQUIPMENT:

Vehicle with Odometer

Locke Level or Abney Level

Cloth Tape

Magnetic Compass

Clip Board

Level Rod

CATEGORY

Preventive Maintenance ☐

Corrective Maintenance ☐

Road Improvement ☐

Reconstruction ☐

FIGURE 1 Road inventory card.

NILPHAMARI MAINTENANCE AREA

TERMINI	ROAD NO.	SECTION	LENGTH KM.	LENGTH MILES	SURFACE TYPE	CODE
Gakulpur - Chilahati	RNI-4	A	3.15	1.96	EA	45 A
		B	.45	0.28	RP	21
		C	5.15	3.20	EA	45 A
		D	4.40	2.73	EA	45 A
		E	4.50	R&H System		
		F	0.20	0.12	HBB	25
		G	0.60	0.37	RP	21
		H	0.30	0.19	HBB	25
		I	0.25	0.16	RP	21
		J	0.05	0.03	HBB	25
		K	0.55	0.34	RP	21
		L	1.55	0.96	HBB	25
		M	6.65	4.13	EA	45 A
		N	26.70	16.59	EA	45 A
		O	3.40	2.11	EA	45 C
Kishoreganj-Abuliarhat	RNI-11	A	12.05	7.49	EA	45 D
		B	5.90	3.67	EA	45 D
		C	2.80	1.75	EA	45 D
Kishoreganj-Darwani Textile Mill	RNI-12	A	0.05	0.03	HBB	25
		B	1.10	0.68	RP	21
		C	6.80	4.22	EA	45 A
		D	8.75	5.44	EA	45 A
Nilphamari-Ramganjhat	RNI-12X	A	0.05	0.03	WBM	41
		B	7.85	4.88	EA	45 A
WDB Road-Khaimarihat	RNI-19	A	1.45	0.90	HBB	25
		B	6.40	3.98	EA	45 B
Kishoreganj-Bakshiganj	RNI-30	A	6.75	4.19	EA	45 A
		B	2.50	1.55	HBB	25
		C	0.65	R&H System		
		D	5.75	3.57	EA	45 D
		E	1.50	0.93	HBB	25
		F	4.15	2.58	EA	45 A
Kishoreganj-Barobhita	RNI-32	A	5.65	3.51	EA	45 A
		B	0.55	0.34	HBB	25

FIGURE 2 Basic road list—Rangpur district.

The road inventory provided the basic data needed to develop the first maintenance program. Because changes were being made on some routes under other aspects of the work program, such as rehabilitation, widening, and new bridge construction, the new characteristics were used in all cases in which improvements were funded and would be completed by May 1985.

ROAD CLASSIFICATION

Many factors affect the types and amounts of maintenance work needed on a road segment. Paved surfaces require different activities than unpaved surfaces; old pavements need more maintenance than newer pavements. Therefore, the roads had to be classified by factors that affected maintenance activity.

The climate in Bangladesh is sufficiently uniform that this factor would not generate differences in types of work by climatic region. The small variations in topography also can be ignored, with one exception. Longitudinal ditch maintenance was required in the rolling terrain of Sylhet that was not required in the other two districts, in which roads are almost always on embankments. Little variation was consequently anticipated in classes of maintenance as a result of differences in climate and topography. Major characteristics that had to be taken into account were the type and width of surfacing on a section of road, and the age and condition of that surfacing. Seven distinct surface types were identified, including the following:

- Rigid pavement (portland cement concrete),
- Flexible pavement (bituminous),
- Herringbone bond (brick on edge),
- Single-layer pavement (cobble or brick),
- Waterbound macadam,
- Gravel or other selected material, and
- Earth.

All of the rigid pavement on the Zila roads (25.37 mi) was over 10-years old, and most of it was in poor condition and deteriorating. A single category was established for rigid pavement and designated surface type (ST) 21.

The bituminous paved roads (175.01 mi) ranged in condition from new to destroyed. Several subclassifications were considered that were based on age or construction method, but they were discarded as impracticable because insufficient data existed to establish the date of construction or last rehabilitation, and because several combinations of base and surface types existed. Although traffic volumes, and especially truck loadings, are important factors in projecting maintenance, little information was on record for the roads in Zila. Therefore, it was decided to establish two broad categories of flexible pavement, good condition and poor condition, for which different patching rates and other work could be forecast. These categories were designated ST 22A and ST 22B, respectively.

The herringbone brick (HBB) pavements formed a total length of 89.76 mi, most of it in the Rangpur district (65.50 mi). Surface Type 25 was assigned to HBB. Little single-layer pavement existed in the three districts. The cobble surface, or boulder soling, of two road sections in Sylhet was designated ST 26A, and the brick soling of shorter sections in Sylhet and Faridpur was designated ST 26B.

A few sections of waterbound macadam that totaled 10.77 mi in length were designated ST 41. Some of the 11.11 mi of gravel surfacing (ST 43) in Sylhet appeared to be deteriorated waterbound macadam that developed a loose surface.

The earth-surfaced roads that were included in the inventories showed a wider range of characteristics. Some that were constructed of better soils remained usable even in the wet season. Others became impassable during the wet season, although they performed well enough to carry heavy vehicles when dry. Still others could only be used for light vehicles such as jeeps even in the dry season because of narrow travelways and other deficiencies. Finally, a fourth category was determined for roads that were unsuitable for any motor vehicles. These roads were used only by pedestrians and animal traffic. The four earth roads were designated as follows:

- 45A—all vehicles, all seasons;
- 45B—all vehicles, 7 months a year;
- 45C—jeeps only; and
- 45D—carts and pedestrians only.

All pavement shoulders were constructed of earth, except for a short road section in the Rangpur district that had a shoulder of brick soling. In some cases, short and narrow strips of HBB had been placed on the shoulder, but this appeared to serve primarily to widen curves. Earth shoulders were designated Shoulder Type 30. All surface and shoulder types and their identification codes are listed in Table 1.

The road types in each of the districts are summarized in Table 2. Of the total roadway network in the three districts, 71 percent consist of earth roads, 2 percent are gravel, brick, cobble, or macadam, and about 27 percent are surfaced (about 16 percent bituminous and 8 percent HBB).

IDENTIFICATION OF MAINTENANCE ACTIVITIES

It is useful to list roadway elements as a step in identifying the type of maintenance activities that must be performed. The maintenance activities that were identified for the roads in Zila are listed as follows:

Pavements
Portland cement concrete
Bituminous asphalt
Herringbone brick
Single-layer cobble or brick
Shoulders Along Pavements
Herringbone brick
Soling only; brick or other
Earth
Unpaved Roadways
Waterbound macadam
Gravel or other selected materials
Earth
Drainage
Primary ditches (longitudinal)
Secondary ditches (crown, intercept, and bleeder)
Culverts (ring, box, arch, and multiple box)
Culvert channels
Bridge channels

TABLE 1 ZILA ROADS SURFACE MAINTENANCE CLASSIFICATIONS

Type	Code	Surface Description
21	RP	Portland cement cncrete pavement
22A	BIT	Bituminous pavement; good condition
22B	BIT	Bituminous pavement; poor condition
25	HBB	Herringbone brick pavement
26A	SOL	Single-layer cobble pavement
26B	SOL	Single-layer brick pavement
41	WBM	Waterbound macadam
43	GRV	Gravel or other selected material surface
45A	EA	Earth; all vehicles, all seasons
45B	EA	Earth; all vehicles, 7 mo/yr
45C	EA	Earth; jeep only (no trucks)
45D	EA	Earth; cart and pedestrian only
Shoulder Classifications		
25	HBB	Herringbone brick
26A	SOL	Soling only; brick or other
30	EA	Earth

TABLE 2 SUMMARY OF ROAD TYPES BY DISTRICT

		Number of Miles By District			
Code	Surface Type	Rangpur	Sylhet	Faridpur	Total
21	Portland cement concrete pavement	16.09	6.21	3.07	25.37
22A	Bituminous pavement; good condition	31.88	28.01	49.36	109.25
22B	Bituminous pavement; poor condition	20.90	43.80	1.06	65.76
25	Herringbone brick pavement	65.50	0.19	24.07	89.76
26A	Single-layer cobble pavement	0	2.33	0	2.33
26B	Single-layer brick pavement	0	0.28	0.20	0.48
41	Waterbound macadam	4.31	5.84	0.62	10.77
43	Gravel or other selected material surface	0	11.11	0	11.11
45A	Earth; all vehicles, all seasons	230.49	46.05	0	276.54
45B	Earth; all vehicles, 7 mo/yr	115.90	13.74	52.96	182.60
45C	Earth; jeep only (no trucks)	46.53	2.70	74.72	123.95
45D	Earth; cart and pedestrian only	109.76	14.77	71.90	196.43
Total		641.36	175.03	277.96	1,094.35

Right-of-Way
Travel way
Embankment slopes
Cut slopes
Borrow Areas
Structures
Bridges
Retaining walls and bank protection
Traffic Control Devices
Signs (controls, warning, and information)
Signals (electric or manual)
Railroad crossing protection
Pavement markings
Guardrail (not on bridges)
Edge and curve markers; mileposts

The maintenance activities are grouped under the general categories of pavements, shoulders along pavements, unpaved roadways, drainage, right-of-way, structures, and traffic control devices. By analyzing this list of elements, it is possible to calculate the problems that can occur in each activity and the actions that are necessary to resolve them in general terms. Examples of maintenance activities in response to adverse conditions on certain highway elements are shown in Table 3.

PERFORMANCE STANDARDS

After all maintenance activities that might be required on various Zila roads were identified, the next step was to decide how each activity should be performed. Decisions had to be made on which procedures to use, which tasks had to be completed, what the best crew size was, what materials and equipment were needed, how the finished work should be measured, and how much the crew should complete in a day. These questions all related to how the work was to be performed. The answers were recorded on a single form for each activity. The completed form then became a Performance Standard.

TABLE 3 EXAMPLES OF MAINTENANCE RESPONSES

Condition of Road Element	Maintenance Activity
Pavements	
Serious spalls and broken areas in portland cement concrete	Clean and patch
Potholes in bituminous pavement	Trim and patch
Surface wear, surface cracking, or oxidation of bituminous pavement	Seal coat
Local base failure in any pavement	Remove and replace base; patch surface
Moderate deformations in bituminous pavement	Place level course or overlay
Abrupt settlements in any pavement	Excavate and repair base; patch surface
Serious wear or breakage in brick surface	Remove and replace worn brick
Extensive surface failure on short sections of rigid or flexible pavement	Overlay with bitumen mix
Extensive surface or base failure on long sections of any pavement	Advise higher office for reconstruction
Unpaved Roadways	
Potholes or short raveled sections in waterbound macadam	Patch or repair with similar materials
Roughness or potholes in gravel or other selected material roadways	Grade or fill low areas with similar material; grade to drain and compact
Thin gravel or WBM surfacing rutting through	Replace lost surfacing, grade to drain, and compact
Rutted, settled, or deformed earth surface	Grade to drain
Muddy, unstable earth surface	Drain if possible
Narrow roadway (embankment sloughed)	Restore width
Encroaching vegetation	Trim, cut, or remove to restore width; grade to drain.
Paved Shoulders	
For similar conditions, the same maintenance procedures apply as for other pavements	

Not all maintenance activities that were identified as necessary had an established Performance Standard. Some activities, such as bridge maintenance, were so variable that the work could not be simply described. All activities had to have an identifying number. This number was used to estimate and budget needed work, and to report the costs of work, labor, equipment, and materials.

Performance Standards were written only for basic, repetitive activities. A total of 22 Performance Standards were developed in the initial maintenance plan. A typical example of a Performance Standard is shown in Figure 3. They detailed, for example, how to regrade an earth road or shoulder and how to patch the surface of a gravel or pavement. The Performance Standards were based on preliminary findings from the pilot maintenance work that was performed on the project; they will be verified, adjusted, and revised as the maintenance program proceeds.

MAINTENANCE LEVELS

Modest maintenance levels were established for the Zila roads for two major reasons. First, new sources of funds will have to be found by the government to initiate the work program. Second, the roads are local by definition and carry modest volumes of traffic. Proposed maintenance levels are listed in Figure 4. The amount of activity required to perform these routine and periodic tasks is expressed as a percentage of the road surface area, amount per mile, repetitions per year, or cycle of years. The estimated maintenance levels must be reviewed each year and adjusted to actual experience.

In regions in which the climate is dry and the traffic volume is low, seal coating may only be needed at intervals as long as 8 to 10 years if the bituminous pavements are well constructed with good materials and the patches are sealed. Unfortunately, these conditions do not apply to Zila roads and sealing must therefore be performed every 5 years on 22A pavements and every 3 years on 22B pavements. The patching rates shown for all types of surfaces were intended to reflect low maintenance levels. It was assumed that the road surface would have deteriorated significantly before it was repaired. The low percentage rate for the regrading or recambering of gravel roads was based on experience in Sylhet, the only district with gravel roads. These roads held their shape very well. For all categories of earth roads, the regrading rates in Sylhet are less than those for Rangpur and Faridpur because the condition of soil was better in Sylhet. The reshaping of earth shoulders along paved roads is set at a higher rate than for earth roads because they are often damaged by vehicles and other traffic. It is also important that they be in usable condition and shaped to drain water away from the pavement.

WORKLOAD

Data sheets were made from the Basic Road List (see Figure 2) for each maintenance group. The data sheets listed the individual road sections and their corresponding surface type

ZILA ROADS MAINTENANCE
AND IMPROVEMENT PROJECT

PERFORMANCE STANDARD

ACTIVITY NAME	NUMBER	WORK UNIT
Patch surface on bituminous pavement	22.02	Square foot (sft)

DESCRIPTION AND PURPOSE

Patching of failed areas in bituminous pavements (or similar paved shoulders) using bitumen premix or other materials to repair or correct potholes, settlements, edge breakage, ravelling and other deficiencies.

MAINTENANCE CRITERIA

CONDITION

Vertical difference of 1" or more in travelway (or shoulder). Well-defined holes or depressions which require filling and leveling.

OBJECTIVE

Restore the integrity and smoothness of the pavement.

PERSONNEL

NOS:HRS	CODE
1:4 Work Assistant	WKA
1:8 Driver	TDR
1:8 Gang Leader	GAL
5:8 Labourers	LAB

EQUIPMENT

NOS:HRS	CODE
1:8 Flatbed Truck	02
1:8 Vibrating plate tamper	05

AVERAGE QUANTITIES

MATERIALS PER DAY	CODE
42 cft (loose) bitumen premix	PRMX
20 lbs. 80-100 bitumen (tack)	BITU

DAILY PRODUCTION

200 sft

MATLS. PER WORK UNIT	CODE
0.208 cft (loose) bitumen premix	PRMX
0.100 lb. 80-100 bitumen (tack)	BITU

YIELD RATE

3.333 sft per man-hour

DATE	DATE REVISED
December 1, 1984	

FIGURE 3 Typical Performance Standard and instruction sheet.

METHOD AND PROCEDURE NUMBER 22.02

1. Place warning signs or flagmen.
2. Trim and shape hole to be patched, using pick and shovel. Excavate to solid, stable material on bottom and cut near vertical sides around the outside of the failure, with a minimum depth of 1-1/2". It is not necessary or desirable to give the hole a rectangular shape. Clean out all loose and broken material with shovel and broom. For depressions, clean surface well. The surfaces must be dry. Do not block shoulder or ditch drainage with material removed.
3. Paint the sides and bottom of the hole very lightly with heated tack coat, covering not more than 50% of the area. Tack surface of settled areas in the same manner.
4. Fill hole or depression with bitumen premix, raking the material to get a uniform density and a level surface just high enough to allow for compacting the patch to the same height as the surrounding pavement. On large patches, use string line or screed board to ensure a smooth surface.
5. Compact the mix thoroughly in the hole with vibrating plate and hand tamper, or hand tamper alone. The finished patch should be level with the adjacent pavement or up to 1-1/2" higher, but never lower. If dry aggregate is used for a macadam patch, it should be thoroughly compacted to final shape before applying bitumen and fine aggregate.
6. After completing all patching in a work area, remove warning signs or flagmen.

TO BE REPORTED

1. The work location, by road route and section.
2. All labour and equipment hours, and the materials actually used, in pounds of tack coat and cubic feet of bitumen premix (loose measure), or cubic feet of dry aggregate plus pounds of bitumen for macadam patching.
3. The work completed each day, in square feet, measured.

FIGURE 3 continued.

classification. The lengths and widths gathered from the inventories were entered on the data sheets and used to compute surface and shoulder areas. Information on vegetation control, lengths of ditches, volumes of culvert cleaning, and number of bridges were added to the sheet. A typical data sheet is shown in Figure 5.

The information for each maintenance group was summarized on a Workload Base Sheet, which combined all groups of the same surface type, and other work quantities. These sheets represented the total areas and other quantities to which activities were to be applied according to the maintenance level that was established. A typical Workload Base Sheet is shown in Figure 6.

The maintenance group workload, or number of crew-days for each standard activity, is the base quantity of the element times the annual rate of the maintenance level, divided by the daily production figure of the Performance Standard. This calculation can be simplified by arranging a worksheet with similar surface types in horizontal groups so that activities that apply to more than one type can be summed in the right-hand column, as shown in Figure 7.

RESOURCE REQUIREMENTS

When the annual workload is known, the resources needed for the program can be calculated. Resource requirements are quantified in terms of labor hours, equipment hours, and quantity of materials. The quantification of the base activities is simple because the required data are written into the Performance Standards.

Two worksheets were developed to quantify resources. One was developed to compute labor and equipment hours, and the other to quantify materials. Examples of these worksheets are shown in Figures 8 and 9. Resources also include the number of workers and pieces of equipment that must be available to do the maintenance work, as opposed to the total hours for each. Materials, of course, are the third component.

In the case of labor, adjustments were made for nonworking days, legal holidays, and leave time, as appropriate, for permanent employees. Laborers and gang leaders earned no leave or other benefits, so the required hours were converted to man days directly. A total of 245 average working days a year, or 1,960 available hours, were calculated for work assistants, roller drivers, and truck drivers. Equipment availability was adjusted by a factor of 75 percent to reflect servicing and repair, which reduced the assumed number of available hours a year to 1,758. The resource recommendations that were developed from these computations are shown in Figure 10. Casual labor hours and material quantities were omitted from these sheets because it was assumed that such resources would be provided as required. The conversion to total numbers of men and machines provided the basis for staffing and equipment allocations to the maintenance groups in the three districts.

Although it was intended that the recommended maintenance methods for Zila roads be highly labor-oriented and equipment

Shown as Percent of Road Surface Area,
Amount per Mile, Repetitions per Year
or Cycle of Years Between Repetitions

ACTIVITY	UNIT	21 P C C Pavement	22A Bit. Pavement Good Condition	22B Bit. Pavement Poor Condition	25 H B B Pavement	26A Cobble / 26B Soling Single Pavement	41 W B Macadam Surface	43 Gravel Surfacing	45A Earth--All Vehicles, All Seasons	45B Earth--All Vehicles 7 Months Per Year	45C Earth--Jeep Only (No Trucks)	45D Earth--Cart and Pedestrian Only
		QUANTITY										
21.03 Repair PCC with Bit. Mix	% Surface	0.75										
22.02 Patch Bit. Surface	% Surface		0.75	1.50								
22.03 Repair Base and Surface	% Surface	0.25	0.25	0.50								
22.04 Bituminous Overlay	% Surface			0.25								
22.05 Seal Small Areas	% Surface	1.25	1.25	2.50								
22.06 Seal Coat (Periodic)	Cycle-Years		5	3								
25.01 Patch Surface H B B	% Surface				0.25							
25.02 Patch Base and Surface H B B	% Surface				0.25							
26.01 Patch Soling or Cobble Pavement	% Surface					0.50						
30.01 Re-grade Earth Shoulders	% Surface	75	75	75	75	75	75	75				
41.01 Patch W B Macadam Surface	% Surface						0.50					
41.02 Replace W B M Surface (Periodic)	Cycle-Years						8					
43.01 Patch Gravel Surface	% Surface							0.80				
43.02 Replace Gravel Surface (Periodic)	Cycle-Years							5				
43.03 Re-grade Gravel Surface	% Surface							10				
45.01 Patch Earth Surface	% Surface								1.00	1.00	0.50	0.25
45.02 Re-grade Earth Surface — Sylhet	% Surface								20	20	10	5
45.02 Re-grade Earth Surface — Other Districts	% Surface								50	50	25	10
50.01 Clean Ditches	rft/mile	40	40	40	40	40	40	40	40	40	40	20
50.02 Clean Culverts	cft/mile	10	10	10	10	10	10	10	10	10	10	5
60.01 Trim Weeds or Brush	Repetitions	1	1	1	1	1	1	1	1	1	1	1

FIGURE 4 Maintenance levels and annual amounts sheet.

Road Identification and
Base Working Quantities

Units: Length-miles
Width-feet
Area-000sft

District: RANGPUR Date: Nov. 10, 1984

Maint. Area: Nilphamari

ROAD NO. & SECTION	LENGTH (Miles)	SURFACE			SHOULDER			VEGETATION		DITCH		CULVERT		NO. OF BRIDGES
		TYPE	WIDTH	AREA	TYPE	TOTAL WIDTH	TOTAL AREA	sft/ MILE	TOTAL AREA	rft/ MILE	TOTAL AREA	cft/ MILE	TOTAL cft	
RNI-4A	1.96	45A	10.4	107.63										
B	0.28	21	10.0	14.78	30	15.4	22.77							
C	3.20	45A	23.0	388.61										
D	2.73	45A	18.6	268.11										
E		R & H SYSTEM												
F	0.12	25	10.5	6.65	30	10.8	6.84							
G	0.37	21	10.0	19.54	30	11.2	21.88							
H	0.19	25	10.0	10.03	30	13	13.04	0.6	18.64	40	1242	20	621	10
I	0.16	21	14.0	11.83	30	12.8	10.81							
J	0.03	25	10.0	1.58	30	12	1.90							
K	0.34	21	10.0	17.95	30	17.1	30.70							
L	0.96	25	10.0	50.69	30	17.9	90.73							
M	4.13	45A	25.2	549.52										
N	16.59	45A	26.7	2338.79										
O	2.11	45C	14.3	159.31				0.3	0.63	20	42	10	21	
RNI-11A	7.49	45D	15.8	624.84										
B	3.67	45D	15.7	304.23				0.3	3.87	20	258	10	129	5
C	1.74	45D	19.2	176.39										
RNI-12A	0.03	25	10.0	1.58	30	14	2.22							
B	0.68	21	14.0	50.26	30	12	43.08	0.6	6.22	40	415	20	207	5
C	4.22	45A	15.4	343.14										
D	5.44	45A	19.4	557.23										

FIGURE 5 Road inventory data sheet.

Road Surface Areas and Other Quantities by Maintenance Areas

SURFACE AREAS, OR OTHER QUANTITIES	UNITS	NILPHAMARI	KURIGRAM AND LALMONIRHAT	RANGPUR	GAIBANDHA
Type 21	000 sft	147.57	51.32	316.57	404.29
22A		66.66	194.31	1313.16	194.20
22B		282.70	0	417.08	404.95
25		1757.73	299.70	1564.86	357.39
26A		0	0	0	0
26B		0	0	0	0
41		1.55	0	239.08	0
43		0	0	0	0
45A		10,393.52	1839.45	7483.20	4545.40
45B		357.24	0	10,108.05	1313.09
45C		159.31	0	4276.72	0
45D		3869.83	503.50	4311.47	822.19
30 Shoulder		2235.37	520.09	3810.53	1125.49
26B Shoulder		0	0	0	45.95
Vegetation Clearing		94.79	17.63	1154.74	52.30
Ditch Cleaning	rft	6317	1176	11,547	3488
Culvert Cleaning	cft	3158	588	5775	1754
Bridges	nos	58	5	119	37

FIGURE 6 Workload base sheet—Rangpur district.

use be kept to a minimum, it was the consultant's opinion that some power equipment was necessary and warranted. Compaction equipment in small and medium sizes is considered essential for good results in some maintenance and construction activities. Trucks are also desirable to carry fairly large amounts of loose or sticky materials to various work sites.

Staffing requirements that were derived from the analyses indicated that several maintenance groups did not have a large enough maintenance workload to become separate organizations with their own staff and facilities. Some inconsistencies were also found between the initial equipment acquisition program and equipment requirements for the recommended maintenance program. There were not enough flatbed trucks, but more than enough four-by-four pickup trucks. A serious shortage of rollers was also indicated. The number of vibrating plate compactors was exact; six were called for and six were acquired.

It was recommended that some additional equipment that was not included in the current acquisition program be made available to the Zila road maintenance program. Overall, it was found that the resource needs that were quantified in the proposed maintenance program were reasonable and practical. Required staffing levels for permanent employees generally conformed to the organizational charts proposed by the local government's engineering bureau for the pilot maintenance program.

BUDGETING

Once unit rates were developed or adopted for the three basic cost elements, they were applied to the quantified resource needs of each maintenance group on a Cost Calculation Sheet (see Figure 11). The following assumptions were made:

- At least one work assistant was assigned to each maintenance group even if the quantified hours were less than 1,960.
- If the annual hours were above 750, a full-time position was assumed for roller drivers and truck drivers. If the annual hours were less than about 700, it was assumed that drivers would be hired temporarily when required.
- Emergency maintenance was assumed to require labor hours that totaled about 1 percent of regular labor or personnel costs.

An example of a proposed road maintenance budget for a typical maintenance group is shown in Figure 12.

PROGRAMMING AND SCHEDULING

The annual programs of routine maintenance were derived directly from the rounded crew-days for each activity, as shown on the Calculation of Resource Needs sheets (see Figure 8).

Program Year: 1985/86 District: SYLHET
Date: DEC. 4, 1984 Maint. Area.: SYLHET SADAR

MAINT. ACTIVITY	DAILY PROD.	MAINT. LEVEL	WORK QUANTITY	CREW DAYS	MAINT. LEVEL	WORK QUANTITY	CREW DAYS	MAINT. LEVEL	WORK QUANTITY	CREW DAYS	MAINT. LEVEL	WORK QUANTITY	CREW DAYS	TOTAL CREW DAYS
		Surface Type 22A 6,52,160 sft			Surface Type 22B 10,26,520 sft			Surface Type 26A 57,020 sft			Type 30 Shoulder 14,39,970 sft			
22.02	200	0.75%	4,891	24.4	1.50%	15,398	77.0							101.4
22.03	100	0.25%	1,630	16.3	0.50%	5,133	51.3							67.6
22.04	600				0.25%	2,566	4.3							4.3
22.05	600	1.25%	8,152	13.6	2.50%	25,663	42.8							56.4
22.06	1,800	20%	1,30,432	72.5	33.3%	3,41,831	189.9							262.4
26.01	80							0.50%	285	3.6				3.6
30.01	2,000										75%	10,79,978		540.0
		Surface Type 41 2,960 sft			Surface Type 43 3,98,340 sft									
41.01	300	0.50%	15	0.1										0.1
41.02	100	12.5%	370	3.7										3.7
43.01	350				0.80%	3,187	9.1							9.1
43.02	200				20%	79,668	398.3							398.3
43.03	4,000				10%	39,834	10.0							10.0
		Surface Type 45 11,54,870 sft			Surface Type 45B 3,16,900 sft			Surface Type 45C 1,14,050 sft			Surface Type 45D 1,77,540 sft			
45.01	1,000	1.00%	11,549	11.5	1.00%	3,169	3.2	0.50%	570	0.6	0.25%	444	0.4	15.7
45.02	10,000	20%	2,30,974	23.1	20%	63,380	6.3	10%	11,405	1.1	5%	8,877	0.9	31.4
		Ditch Cleaning												
50.01	500	100%	62,762 rft	125.5										125.5
		Culvert Cleaning												
50.02	120	100%	1,005 cft	8.4										8.4
		Vegetation Clearing												
60.01	2,000	100%	2,74,920 sft	137.5										137.5
71.09	General	Bridge Maintenance												
	Annual	man-hours = No. Bridges = 26 x 10.5 =			x 10.5 272 m.h.									

FIGURE 7 Crew-day calculation sheet.

Listed in the second column are the estimated number of accrued days of the activity that will be necessary during the year if it is performed in compliance with the performance standards. The work programs have to be issued in a way that they can be understood and communicated at all levels. The method that appeared to work best to initiate maintenance in the Zila road districts was to issue program cards. One card was made for each repetition of each activity called for in the program.

The number of cards issued represented the number of days the work was expected to be performed during the year. The cards were created at the beginning of the program year, and should have been accounted for by serial numbers or logs to ensure that work performed had conformed to the program and budget. One advantage of this method was that the same cards that were used to record the work at the time it was done were used to report information needed for control and evaluation. The same cards can also be used for basic payroll and equipment usage data in some accounting systems. The recommended format for the card is shown in Figure 13, in which a sample card is filled out that indicates the status after a day's work is completed.

The field office work schedule ensures that the work will get done and the work force will be occupied most of the time. Although some jobs must be performed at fairly regular intervals throughout the year, others can be done when the

Program Year: 1985/86 District: RANGPUR

Date: DEC. 11, 1984 Maint. Area: NILPHAMARI

ACTIVITY	TOTAL CREW DAYS	PERSONNEL										EQUIPMENT							
		WKA HOURS		RDR HOURS		TDR HOURS		GAL HOURS		LAB HOURS		01 HOURS		02 HOURS		03 HOURS		05 HOURS	
		PER C-D	TOTAL	PER C-D	TOTAL	PER C-D	TOTAL	PER C-D	TOTAL	PER C-D	TOTAL	PER C-D	TOTAL	PER C-D	TOTAL	PER C-D	TOTAL	PER C-D	TOTAL
21.03	6	4	24	-		8	48	8	48	40	240	-		8	48	-		8	48
22.02	24	4	96	-		8	192	8	192	40	960	-		8	192	-		8	192
22.03	20	4	80	-		8	160	8	160	40	800	-		8	160	-		8	160
22.04	2	8	16	4	8	8	16	8	16	56	112	4	8	8	16	-		-	
22.05	17	4	68	-		8	136	8	136	32	544	-		-		8	136	8	136
22.06	60	8	480	8	480	8	480	8	480	72	4,320	8	480	8	480	-		-	
25.01	44	4	176	-		2	88	8	352	32	1,408	-		2	88	-		-	
25.02	110	4	440	-		2	220	8	880	24	2,640	-		2	220	-		-	
26.01		4		-		8		8		24		-		8		-		-	
30.01	839	4	3,356	-		-		8	6,712	56	46,984	-		-		-		-	
41.01	1	4	4	-		8	8	8	8	40	40	-		-		-	8	8	8
41.02	2	4	8	8	16	8	16	8	16	40	80	8	16	8	16	-		-	
43.01		4		-		8		8		40		-		8		-		-	
43.02		4		8		8		8		40		8		8		-		-	
43.03		4		8		8		8		56		8		8		-		-	
45.01	118	2	236	-		-		8	944	32	3,776	-		-		-		-	
45.02	581	4	2,324	-		-		8	4,648	56	32,536	-		-		-		-	
50.01	13	2	26	-		-		8	104	40	520	-		-		-		-	
50.02	27	2	54	-		-		8	216	40	1,080	-		-		-		-	
60.01	48	2	96	-		-		8	384	40	1,920	-		-		-		-	
82.01	6	8	48	-		-		8	48	16	96	-		-		-		-	
82.02	18	8	144	-		-		8	144	32	576	-		-		-		-	
	TOTAL		7,676		504		1,364		15,488		98,632		504		1,220		144		544

FIGURE 8 Calculation of resource needs sheet.

Program Year: 1985/96 District: RANGPUR

Date: DEC. 11, 1984 Maint. Area: NILPHAMARI

ACTIVITY	TOTAL CREW DAYS	BITU (lb) PER C-D	BITU (lb) TOTAL	KERO (gal) PER C-D	KERO (gal) TOTAL	MC 25 (lb) PER C-D	MC 25 (lb) TOTAL	PRMX (cft) PER C-D	PRMX (cft) TOTAL	BASE (cft) PER C-D	BASE (cft) TOTAL	JHAM (nos) PER C-D	JHAM (nos) TOTAL	BRST (cft) PER C-D	BRST (cft) TOTAL	SCRN (cft) PER C-D	SCRN (cft) TOTAL	SND3 (cft) PER C-D	SND3 (cft) TOTAL	SND 5(cft) PER C-D	SND 5(cft) TOTAL TOTAL
21.03	6	20	120					42	252												
22.02	24	20	480					42	1,008												
22.03	20	10	200					21	420	63	1,260										
22.04	2	60	120					125	250												
22.05	17	60	1,020															9	153		
22.06	60	180	10,800															27	1,620		
25.01	44											500	22,000							6	264
25.02	110									18	1,980	312	34,320							5	550
26.01										37		224								2	
41.01	1													32	32	6	6				
41.02	2													125	250	25	50				
43.01										88											
43.02										230											
43.03										50											
Subtotal	PRMX								1,930												
82.01	6	1,350	8,100	60	360																
82.02	18					567	10,206							108	1,944						
	TOTAL		20,840		360		10,206				3,240		56,320		2,226		56		1,773		814

FIGURE 9 Calculation of resource needs and materials sheet.

Program Year: 1985/86 District: Rangpur
Date: Dec. 21, 1984 Maint. Area: Nilphamari

Description	Quantified Hours	Equivalent Unit Days	Equivalent Units[a]	Recommendation
Work Assistant	7,676	959.5	3.9	Staff 4 WKR
Roller Driver	504	63.0	0.3	Temporary hire, or share
Truck Driver	1,364	170.5	0.7	Staff 1 TDR
Steel-Wheel Roller	504	63.0	0.3	Rent, or share
Flatbed Truck	1,220	152.5	0.7	Assign 1 truck
4 x 4 Pickup	144	18.0	0.1	Substitute
Vibrating Plate Tamper	544	68.0	0.3	Rent, share or substitute

[a]At 1,960 available hours per year for personnel, and 1,758 hours per year for machines.

FIGURE 10 Resource recommendations sheet.

Program Year: 1985/86 District: RANGPUR
Date: DEC. 23, 1984 Maint. Area: NILPHAMARI

LABOUR

TITLE	QUANTITY	RATE, TK	ANNUAL AMOUNT, TK
Work Assistant	4 men	17,117 per year	68,468
Roller Driver	504 m-h	8.3 per m-h	4,400
Truck Driver	1 man	17,117 per year	17,117
Gang Leader	1,936 m-d	35 per m-d	67,760
Day Labourer	12,329 m-d	30 per m-d	3,69,870
Bridge Labour	1,450 m-h	4.05 per m-h	5,873
		Subtotal	5,33,488
Emergency Maint.	Lump Sum	1.0%	5,335
		SUBTOTAL LABOUR	5,38,823

EQUIPMENT

TYPE	HOURS	RATE, TK	ANNUAL AMOUNT, TK
01 Roller	504	212	1,06,848
02 Flatbed Truck	1,220	231	2,81,820
03 4 x 4 Pickup	144	86	12,384
05 Plate Tamper	544	21	11,424
		Subtotal	4,12,476
Emergency Maint.	Lump Sum	1.0%	4,125
		SUBTOTAL EQUIPMENT	4,16,601

MATERIAL

ITEM	QUANTITY/UNIT	PRICE, TK	ANNUAL AMOUNT, TK
Bitumen	20,840 lb	4.50	93,780
Kerosene	360 gal	40	14,400
Granular Base	3,240 cft	15.50	50,220
Jhama Brick	56,320 nos	1.50	84,480
Broken Stone (3/4")	2,226 cft	20.00	44,520
Screening	56 cft	6.00	336
Sand 3 (F.M. 1.0-1.5)	1,773 cft	5.00	8,865
Sand 5 (F.M. 0.5-0.8)	814 cft	3.00	2,442
		Subtotal	2,99,043
Emergency Maint.	Lump Sum	1.0%	2,990
		SUBTOTAL MATERIAL	3,02,033
		GRAND TOTAL	12,57,457

FIGURE 11 Cost calculation sheet.

Date: Dec. 31, 1984 District: Rangpur
Maint. Area: Nilphamari

Major Object of Expenditure	Actual Previous Year	Estimated Current Year	Proposed Budget
Personal Services and Related Benefits			TK 5,38,823
Contractual Services			
Materials and Supplies			3,02,033
Equipment Cost			4,16,601
Capital Outlay			
Total Direct Expenditures			TK 12,57,457

FIGURE 12 Proposed 1985/86 district road maintenance budget sheet.

Activity No.: 60.01 Name: TRIM WEEDS AND BRUSH

Date of Work: 10 SEPT 85 Maint. Area: RANGPUR - NILPHMARI

Route No. RNI-35 Sect. D Card No. 04 Total 85/86 48

RESOURCES USED

LABOR			EQUIPMENT		
CODE	HOURS	NAMES STD CREW ___	CODE	ID NUMBER	HOURS
WKA	3	Mr. Anthony			
GAL	8	Abdul Gani		None	
LAB	8	Jalil			
	8	Rashid			
	8	Ismed			
	8	Moin			
	8	Abdul			

MATERIALS

CODE	DESCRIPTION	QUANTITY	UNIT
	None		

WORK COMPLETED

Unit of Work Sft Amount Done 1,850

FIGURE 13 Program and report of work card.

opportunity arises. Some activities, such as seal coating, require dry conditions. Alternate activities for moderately wet conditions could be the repair of brick roads and shoulders, brush cutting, and breaking and hauling aggregates over hard-surfaced roads. Ditches can also be cleaned while the drainage is being checked during rainy weather.

Culvert repairs or channel work can only be performed when the water is low. Warm, dry conditions are required when bitumen is being used in major activities. These conditions were considered when the work schedules for the proposed maintenance activities were developed. However, it was recognized that maintenance is not suited to close and rigid scheduling, but must be flexible enough to allow for unexpected work.

STATUS REPORTS

Reporting the status of work accomplished is almost automatic with the use of the Program and Report of Work Card. No other forms are needed to record work, although some types of summary and analysis forms could be useful. It is important that the report of work completed be reasonably accurate, and that the work be measured in the same manner and the same units indicated on the Performance Standards for that activity.

The information that is reported back to headquarters, and gathered through inspections, must be analyzed to answer the broad questions of whether or not the management system is ensuring that roads are adequately maintained, and whether or not it can be improved.

It is anticipated that the classification of surface types will be reviewed periodically to ensure that it covers all required cases and to determine if any types can be eliminated or combined to simplify the list. The activities list can be changed whenever it is found that another category is needed, or that one of the major series should be deleted.

When enough information is accumulated at the end of the maintenance year, the Performance Standards should be compared with reports of how the work was actually performed and its results. All elements of the standards must be checked, including the resources and procedures that were employed and the production rate. Standards should be adjusted, especially if different materials and new equipment are substituted.

Another crucial evaluation is whether or not the assumptions on maintenance levels were satisfactory. The first question is whether or not all programmed maintenance work was performed. The second is whether or not that amount of work was enough or more than necessary. This evaluation should be made through inspections and judgments to determine if the conditions of the different road elements were preserved or if the roads have deteriorated. The maintenance levels can then be adjusted according to the requirements of the roads and the resources available. It is anticipated that these activities will be undertaken in an extension of the project, the paperwork for which is now under way.

CONCLUSION

An outline was presented of the maintenance management plan that was developed and initiated in Bangladesh on the Zila local road system. The various steps of the plan were detailed. The maintenance management system is in place and it appears that the consultant will have the opportunity to evaluate the results and participate in desirable changes and revisions.

Now that the system has been installed with successful initial results, it appears that a regular, periodic maintenance program can be institutionalized for the Zila road system in Bangladesh. It is anticipated that the system will be extended gradually to all other districts throughout the country.