every week, the Health and Family Planning Department and DPHE visit once a month, and BRAC, which runs the National Nutrition Program, visits the Union almost every day. However, LGED officials, UP Chairperson, and UP Member interviewed suggested that most services are provided directly to the residents at the village level, adding that there is no scope to provide services at the current UP building, as space and facilities are lacking or inadequate.

The UP Chairperson and the UP Member also revealed that regular meetings were scheduled on the 8^{th} of every month, which relevant government officials were supposed to attend. However, only four to six officials usually attend each time.

The situation is similar in Adabaria and Chitalmari Unions. Similar services are provided, but government officials had not visited the UP building frequently, as there was no facility reserved for them. For the UP Chairperson and the UP Member interviewed, the Agriculture, and the Health and Family Planning Departments were the two most visible departments at the current UP office in both Unions.

(6) Problems regarding the services provided by government line departments at the current UP office

The problems regarding the services provided by government line departments at the current UP offices, identified by the stakeholders interviewed, are summarized in Table 18. Basically, no services are being provided at the current UP office in all three Unions selected. The obvious reason is the lack of space for officers to work. However, many informants suggested that the government line department officers lack the motivation to provide services to the people at the Union level. For Chitalmari Union, because there is an Upazila office within its administrative boundary, government services are provided at the Upazila office. The government line officials who do provide services do so generally by directly visiting the residents.

Table 18 Problems regarding services provided by government line departments

Union Parishad	Problems
Domain	Services hardly provided at UP office
	People often need to visit Upazila office
	Officers directly visit residents or visit UP Chairperson's office
	Lack of coordination with UP; government line departments frequently do not respond to UP's requests
	Officers lack motivation to perform duties
Adabaria	Officers hardly visit UP office
	One officer is in charge of many Unions, and regular visits are impossible
	Officers lack motivation to perform duties
	Lack of coordination with UP
Chitalmari	Officers never sit at UP office
	Services are usually provided from Upazila office, as it is located within the Union
	Lack of coordination with UP

(7) Problems faced by UP and government line departments in providing services to local people at the current UP office

The problems faced by UP and government line departments in providing services to local people at the current UP office are summarized in Table 19. Lack of space and offices for both UP and government line departments are the major problems hindering the provision of services at the current UP office. Informants in Chitalmari Union suggest that, due to the existence of the Upazila office within its administrative boundary, seats do not need to be reserved for government line departments at the UP office.

Problems not directly related to the current conditions of the UP offices were also identified by the informants. Problems include: 1) UP lack funds to meet the needs of their residents; 2) UP and government line departments lack coordination; 3) access to villages is difficult due to road conditions; 4) transport means are limited for officers to travel; and 5) officers are overloaded with work.

Table 19 Problems faced by UP and government line departments in providing services

Union Parishad	Problems	
	UP	Government line departments
Domain	Office space is insufficient	UP office is closed most of the time No working space for officers
Adabaria	Office space is insufficient	No working space for officers
Chitalmari	Current building is dilapidated and not suited to work in	No working space for officers UP Chairperson and Members are frequently unavailable

(8) Facilities required at UPC

In Table 20, the facilities deemed necessary at UPC by the informants are listed. The facilities listed include separate rooms for male and female UP Members, and government line departments, toilets, and tubewells, which are usually provided when a UPC is constructed. Other facilities such as office furniture, a room for NGOs, a room for village court, and library, which are not always provided, are also required, according to some of the informants. Office furniture in particular was requested by many.

Table 20 Facilities required at UPC

Union Parishad	Facilities
Domain	Separate rooms for male and female UP Members and for government line departments Storeroom for keeping relief materials and goods Toilets for males and females Office furniture
Adabaria	Separate rooms for male and female UP Members and for government line departments Storeroom for keeping relief materials and goods Room for NGOs Office furniture Boundary wall UPC should be able to function as cyclone shelter as well

Union Parishad	Facilities
Chitalmari	Separate rooms for male and female UP Members and for government line departments Separate room for village court Storeroom for keeping relief materials and goods Office furniture Library Toilets for males and females Deep tube well Notice board Boundary wall

4 Conclusions

The number of visitors to the three selected UP offices ranges from 150-200 to 300-400 per week. Those who come to the UP office do so frequently, although women tend to visit less frequently than men. One third of the respondents in the sample survey revealed that they come to the UP office more than once a week. However, it is not clear how often the general population visits the UP office, as respondents were limited to people who came to the UP office on the day of the survey.

The most important function of the UP office, from the residents' point of view, is the registration of deaths and births and the issuance of relevant certificates. The second most important function is the arbitration of conflicts. Residents rely on the village court and on the UP Chairperson and Members to resolve local conflicts. The UP office also functions as a venue for formal meetings organized by UP, government line departments, and NGOs, and as a gathering place to socialize. For the poor, the distressed, the old, and the disadvantaged, the UP office is a focal point for collecting allowances and relief goods.

However, service provision at the UP office tends to be poor. In all three Unions surveyed, the UP office is not open regularly, the UP Chairperson, Members, and Secretary are frequently absent, service provision by the UP is irregular, and service provision by government line departments is almost non-existent at the UP office. Sometimes services are provided from the UP Chairperson's house. For government line departments that do provide services, they either work out of the Upazila office or directly visit the residents. This situation has left many UP users discontent. Although more than half of the UP office visitors expressed that they are satisfied with the current services provided by the UP, 42 % are dissatisfied. Discontent over the service provision by government line departments is higher, with 75 % dissatisfied.

Lack of physical facilities at the UP office is a major reason for the lack of regular service provision. More specifically, the building is old and dilapidated, working space is insufficient, facilities such as toilets and tubewells are lacking or out of order, and office furniture is lacking. Particularly, there is no room for government line department officers to work in at any of the three UP offices surveyed. Moreover, nearly all of those interviewed expressed that the current facilities were insufficient and required improvement.

Clearly, a safe building with sufficient space and facilities is required if public service delivery is to be improved. Construction of a UPC is most likely to contribute to the improvement of service provision by the UP and government line departments and make the UP office a more comfortable place for residents to visit.

A meeting room and workspace for the UP Chairperson, Members, and Secretary are definitely required. Workspace for government line department officials, who are mandated to provide services at the Union level, is also required, although for Unions where Upazila headquarters is located, such space may not be essential. Water supply and separate sanitation facilities for men and women should be provided. A storage room is essential for stocking goods, as the Project area is particularly prone to natural calamites, and the UP office is expected to function as a relief center in case of disasters.

Along with the development of the physical facilities mentioned above, the capacity of those who are mandated to provide public services to the local people must be enhanced. This is because the UPs and the government line departments have insufficient capacity to deliver the expected services. For example, according to the informants, most UP Members are illiterate and are not aware of their responsibilities. Coordination is lacking within UP and between UP and government line departments. Service provision is poor, and tax is rarely collected.

In addition to the problems regarding the UP building itself, road access to and from the UP office is a major problem for many people. More than half of the current UP office users have difficulty in reaching the office due to the poor condition of roads and the lack of transport means. Similarly, government line department officers have difficulty in reaching the residents to provide services. Thus, together with the development of UPCs and capacity development of public service providers, the development of rural roads is an integral element in improving access to and delivery of public services.

Finally, despite the need for UPCs, establishment of UPCs may be challenging. Lack of suitable land and disputes over site selection for UPC construction are prominent in two of the three Unions surveyed. Both Domain and Chitalmari UPs do not have sufficient khash lands to accommodate the construction of a UPC. Furthermore, in Domain UP, two groups, each headed by the present and the former UP Chairpersons, are fighting over where the UPC should be established. In Chitalmari UP, disputes over land have hampered the development of a UPC, which was initiated by RDP-25. Land issues may become a major obstacle to the establishment of a UPC.

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FINAL REPORT

ANNEX 15

Review of designs and specifications for Upazila and Union roads, and associated structures

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CHAPTER 1 Road design standards of LGED

1.1 Road Design Standards: Rural Road 2005

1.1.1 Key features of Road Design Standards: Rural Road 2005

LGED carries out the construction and maintenance of rural roads in accordance with the specifications of Road Design Standards: Rural Road 2005 (RDS/2005). RDS/2005 was developed with the technical assistance of JICA and bases its provisions on Road Design Standards 2004 (RDS/2004), designed by the Planning Commission in May 2004. RDS/2004 was designed after the reclassification of rural roads in December 2003 which the Planning Commission undertook to accommodate the standards with the nation's growing demand for rural transportation development.

The technical specifications of RDS/2005 comply with the road design standards provided by the Road Pavement Design Manual 1999 (RPDM/1999), developed by the Rural Employment Sector Program-III. RPDM/1999 itself is based on the road design standards of India, Britain, and the US, and incorporates provisions adapted to the regional characteristics of Bangladesh. For example, the flexible pavement design in RDS/2005 conforms with the Indian Road Congress (IRC) Method and Road Note 31 (Fourth Edition) of Britain, both of which are broadly adopted in neighboring countries. Its soil property standards comply with those set forth by the American Association of State Highway and Transportation Officials (AASHTO).

In Bangladesh, Roads are classified into the following road classes: 1) National Highway, 2) Regional Highway, 3) Zila Road, 4) Upazila Road, 5) Union Road, and 6) Village Road.[1] Among these, 1), 2), and 3) are managed by the Roads and Highways Department, while LGED and local government oversee 3), 4), and 5).

Table 1-1 lays out the design type, geometric design, and design life that should be applied to each road class. Road types 4, 5, and 6 are typically applied to Upazila roads, and road types 7 and 8 are typically applied to Union roads. Design lives of 10 years are recommended for both Upazila Roads and Union Roads.

Table 1-1 Recommended geometric design standards

Road class	Design type	Geometric design				Expected design life (years)
		Carriageway (m) / (ft)	Hard shoulder (m) / (ft)	Verge (m) / (ft)	Crest width (m) / (ft)	
Upazila road	4	5.5 / 18	0.0 / 0	2.15 / 7	9.8 / 32	10
	5	3.7/ 12	0.9 / 3	0.90 / 3	7.3 / 24	10
	6	3.7 / 12	0.0/ 0	1.80 / 6	7.3 / 24	10
Union road	7	3.7 / 12	0.0/ 0	0.90 / 3	5.5 / 18	10
	8	3.0 / 10	0.0/ 0	1.25 / 4	5.5 / 18	10

Source: RDS/2005

[1] These road classes do not include roads belonging to Pourshavas and City Corporations.

The following are a few key points of the standards defined in RDS/2005:

1) RDS/2005 divides the country's regions into two geographic categories -- hilly areas and plain lands -- and specifies different typical cross-sections of Upazila Roads and Union Roads for each category.
2) The application of road design types are determined by traffic volume. Upazila Roads are to take either Design type 4, 5, or 6, while Union Roads are to take either Design type 7 or 8.
3) For Design type 8, HBB is used for rural roads where traffic volume is typically low or where the bearing capacity of soil does not meet the standards.

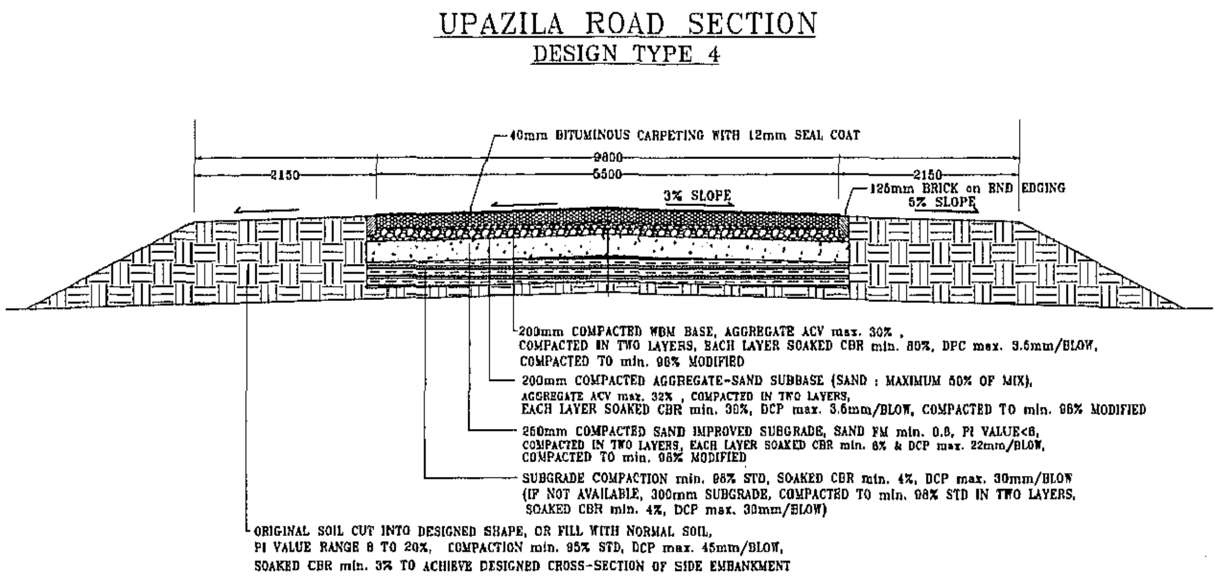
1.1.2 Pavement structure

Because the Project area belongs to the "plain area" category in RDS/2005, the pavement structure stipulated for plain areas will be applied to Upazila and Union road upgrading. The pavement design standards and cross-sections to be applied to each design type in plain areas are shown in the following table and figures: Table 1-2, Figure 1-1, Figure 1-2, Figure 1-3, Figure 1-4, and Figure 1-5.

Table 1-2 Pavement design standards

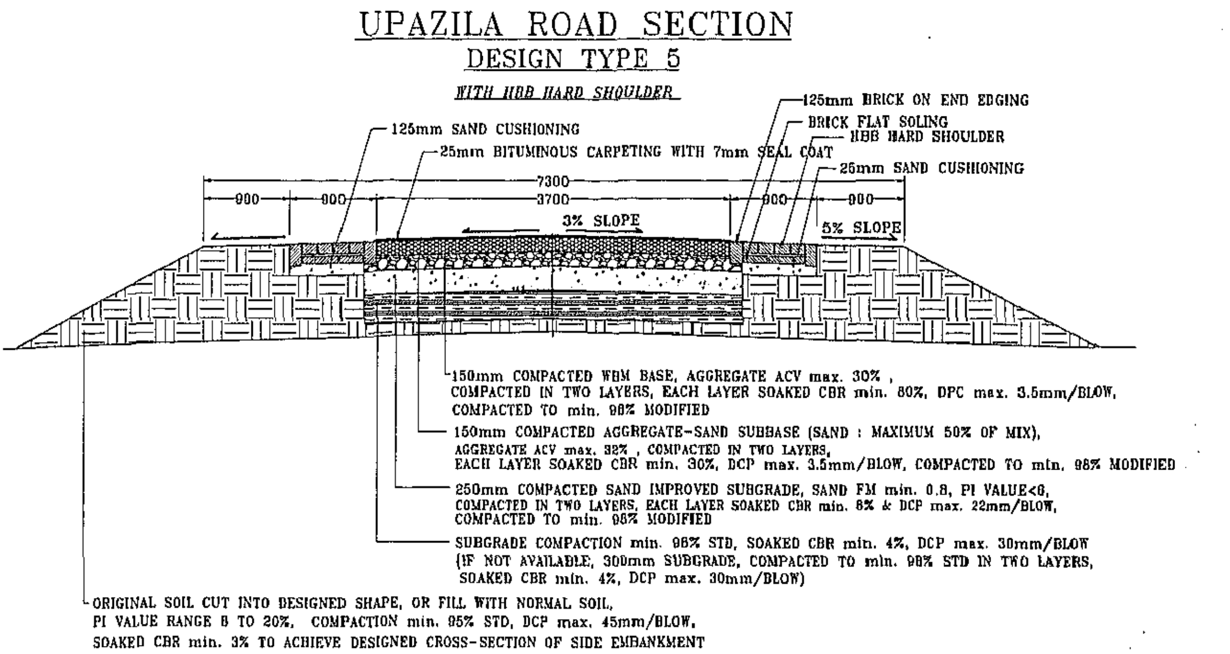
Road class	Design type	Sub-grade (mm)	Improved sub-grade (mm)	Sub-base (mm)	WBM-base (mm)	Bituminous Carpeting (mm)
Upazila	4	300	250	200	200	40
	5	300	250	150	150	40
	6	300	250	150	150	25
Union	7	300	250	150	150	25
	8	300	250	150	150	25

Source: RDS/2005



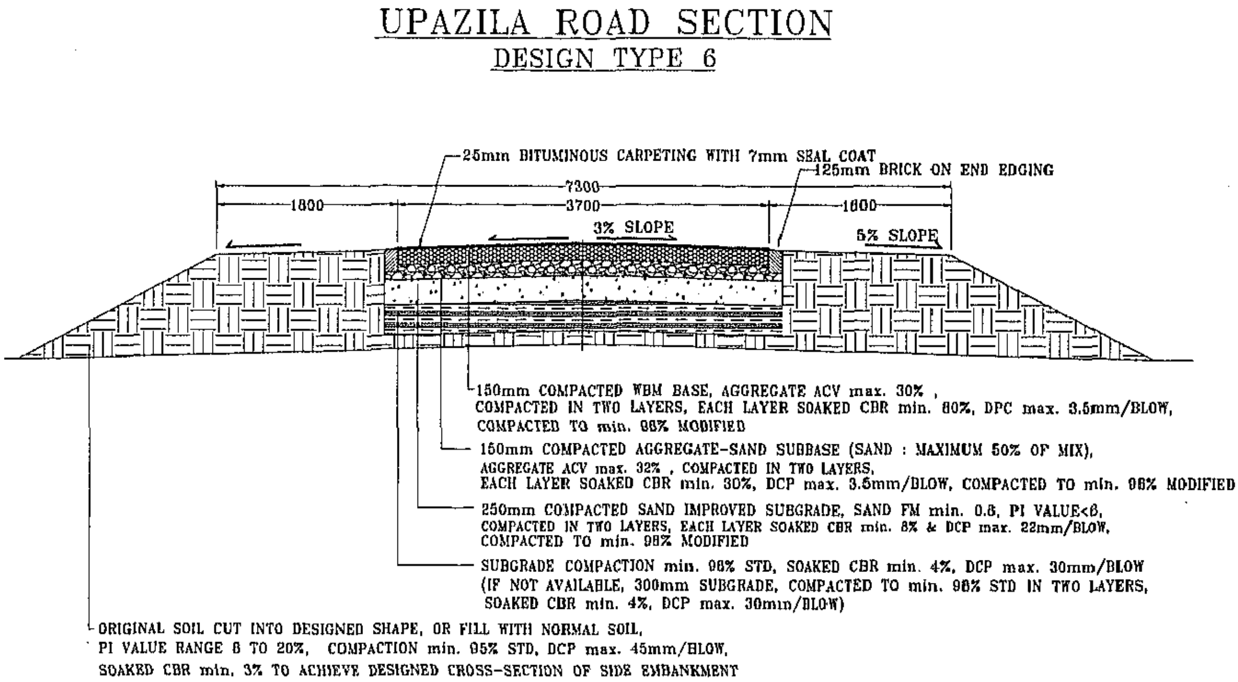
Source: RDS/2005

Figure 1-1 Road cross section of Type 4 for Upazila road



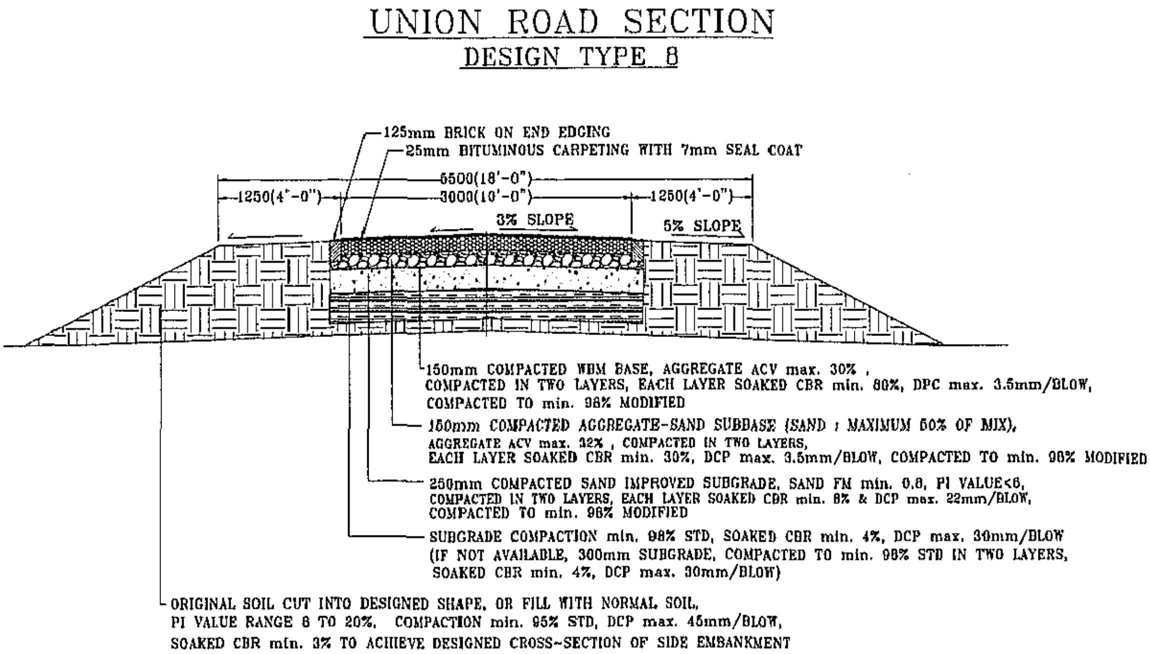
Source: RDS/2005

Figure 1-2 Road cross section of Type 5 for Upazila road



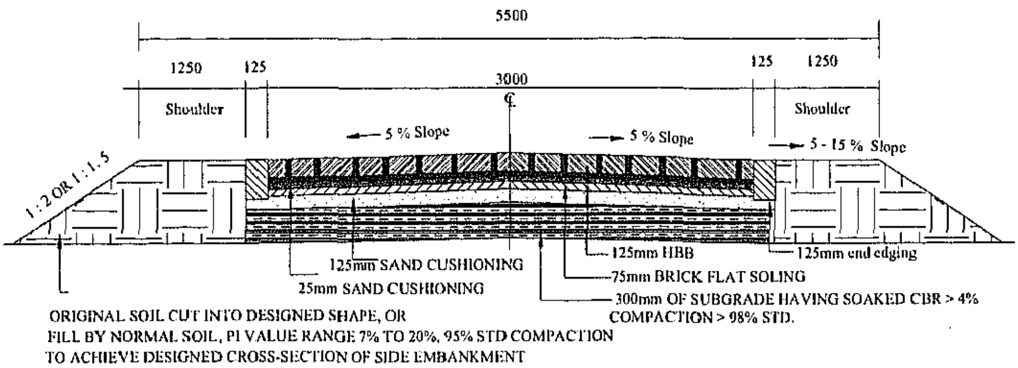
Source: RDS/2005

Figure 1-3 Road cross section of Type 6 for Upazila road



Source: RDS/2005

Figure 1-4 Road cross section of Type 8 for Union road



Source: RDS/2005

Figure 1-5 Road cross section of Type 8 (HBB version)

1.2 Review of RDS 2005 and issues to be considered

Based on a review of the origins of RDS/2005, past experiences of its application, practices on the ground, and field observations, the SAPROF team concludes that RDS should be an appropriate standard specification for road construction and maintenance. It covers the items necessary to guide road-related operations, e.g., methods for determining design types, construction materials, construction techniques, and typical cross-sections. It also reflects the current situations of Bangladesh. The standards set forth are not only economical; they are adapted to the geographic and socio-economic characteristics of the areas where rural roads are to be constructed. For example, RDS/2005 recommends that bricks be substituted for stones as they are scarce in most parts of the country.

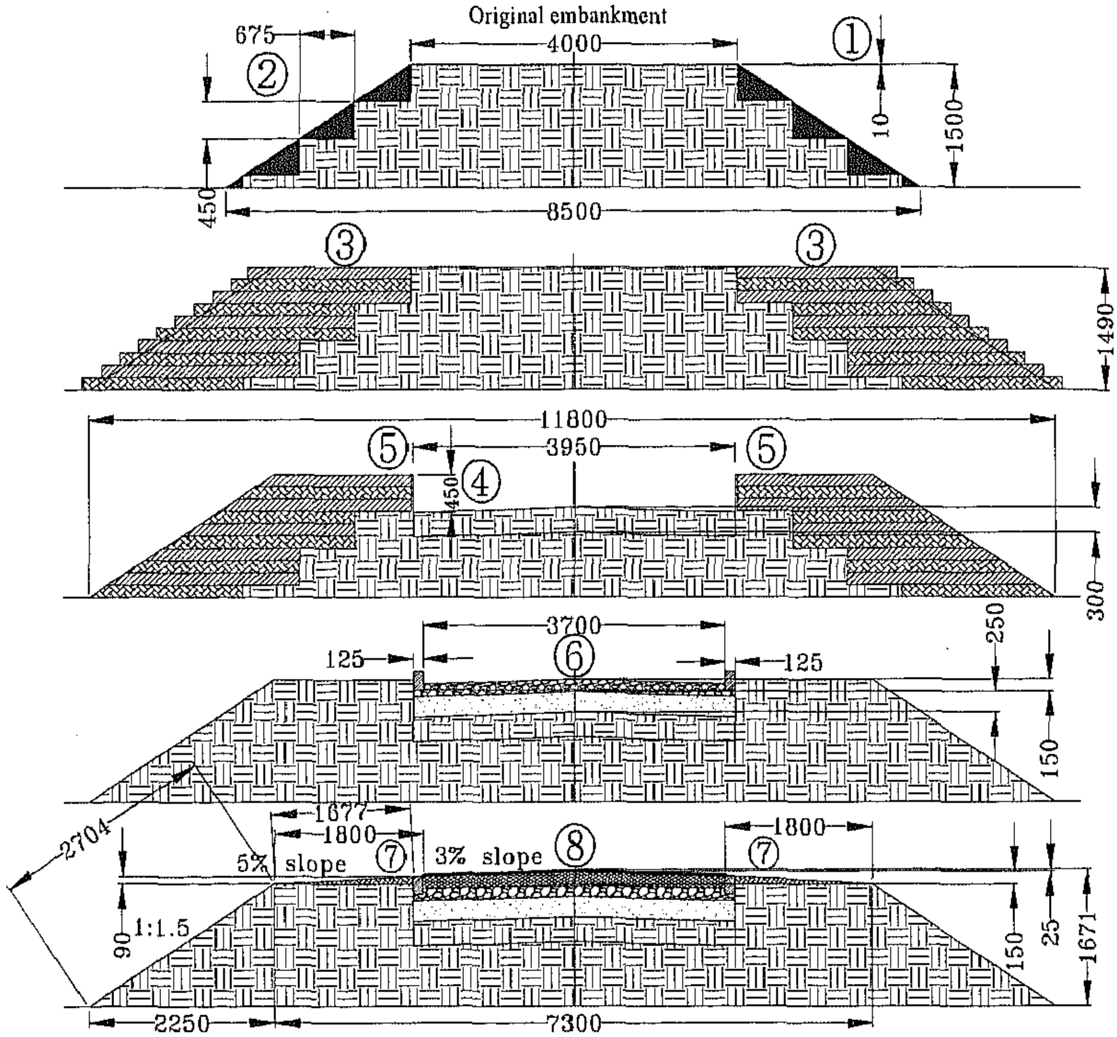
The SAPROF team conducted interviews with LGED engineers to evaluate the technical adequacy of the modifications made to RDS/2004 and the design lives prescribed in RDS/2005. Major issues considered in the review and the results are described as follows.

(1) Shape of pavement structure

RDS/2005 specifies a rectangular pavement structure, while RDS/2004 stipulates that pavement structures should be trapezoidal in shape. Interviewees gave the following reasons for this modification.

a) Issues related to construction

- The standards of RDS/2004 were originally established by RHD to guide the construction of large-scale roads such as national and regional roads, and then were applied to smaller-scale rural roads. The application of these standards to rural roads is not appropriate with respect to costs and local contractors' levels of mechanization and construction skill.
- Compared to trapezoidal sub-bases, the use of rectangular sub-bases by box cutting is more appropriate to the road construction practices of the Project area. Unique to this area is that roads are usually built on existing embankments which have been compacted by traffic. In this case, vertically excavating the soil of the embankment and filling it with sub-grade, sub-base and WBM-base material can be considered as an inexpensive and practical method (Figure 1-6) without significantly compromising the quality of construction. The box cutting reduces earthwork, and inexpensive compared to the method witch involves removal of an entire section of an existing embankment.
- One of drawbacks of this box cutting method is that the edges of the box cutting become loose and the shoulders become weak. To mitigate this problem partially the box cutting is made 250mm wider than the width of the carriageway (Figure 1-6). Because the box cutting is filled with improved sub-grade and sub-base material with proper compaction, bearing capacity can be improved due to this additional use of the materials.
- Regarding the low-levels of contractor's technical capacity, LGED plans to continue fostering local contractors and to match its standards to advancements in contractors' competence levels.



①: Original embankment stripped and benched for widening existing embankment. Material cut in benches may be used as fill if it complies with the standards.
② and ③: Embankment shall be constructed in layer not more than 150 mm compacted layers. Overfilling and compaction of minimum 300mm horizontally on both sides of the embankment is required, which later on has to be cut and removed at contractors' cost.
④: Box cutting of 450mm is curried out. Original compacted soil is used for sub-grade without cutting and compaction.
⑤: Edges of box cutting are strengthened by placing additional 250mm (125mm x 2) improved sub-grade and sub-base.
⑥: 250mm improved sub-grade and 150mm sub-base filling and compaction, and placement of end edging.
⑦: Earthwork to complete shoulders.
⑧: 150mm water bound macadam base filling and compaction, establishment of bituminous carpeting with 7mm seal coat.

Figure 1-6 Procedure for forming rectangular pavement structure

b) Issues related to typical traffic patterns

- Rectangular sub-bases should be able to support the expected vehicle loads of Upazila roads. The estimated traffic volume for type 6 roads, for example, is equivalent to maximum 33-66 trucks or buses per day. This suggests that trucks and buses will not cross one another frequently, will generally run on the center of roads, and thus will rarely stray onto the road shoulders. For instance, if a large vehicle of 2 meter width were to run on a road with a 3.7 m pavement width, the vehicle would apply the heaviest load to the sections approximately 1 m inward from the pavement edge. Given such traffic patterns, the pavement edges would not be subjected to heavy loads and would not require trapezoidal sub-bases.

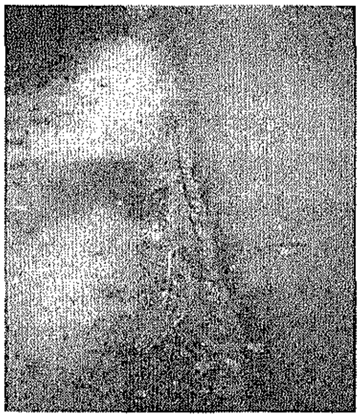
Based on the above interview results, the SAPROF team decided that the adoption of rectangular sub-bases would be appropriate for road construction under the Project for the following reasons:

1) LGED was aware that adoption of the rectangular sub-base would reduce the durability of the road against heavy loads.
2) The decision to adopt the rectangular sub-base design was reached after consideration of the essential factors: degree of reduction in road durability, expected traffic volume of rural roads, and technical and managerial capacities of local contractors. LGED concluded that this design would facilitate construction and maintenance of roads to be built under the Project.

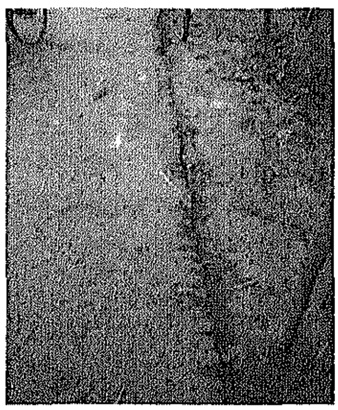
(2) Brick on end edging

The provision specifying the placement of brick on end edging was newly introduced in RDS/2005. LGED's view of its utility is as follows.

1) Laying brick on end edging is an appropriate means of pavement edge treatment. Local contractors, at their current technical levels, would have difficulty constructing pavements with straight, uniform edges. When poorly treated, pavement edges crack easily and eventually fall apart. Brick on end edging would prevent such damage.
2) If all layers of the pavement structure are properly compacted, the durability of the pavement edge against erosion is higher with brick on end edging than without it.



Photograph 1-1 End edging and soft shoulder of Upazila road (Barguna District)



Photograph 1-2 End edging and soft shoulder of Upazila road (Bhola District)

JICA technical assistance project experts and local consultants who were also interviewed agreed with LGED's view. Moreover, during a field investigation on Upazila roads improved under RDP-25 in 2005/06, no damages of the brick end edging and the shoulders were observed (Photograph 1-1 and Photograph 1-2). Based on the interview results and field observation, the SAPROF team concludes that the Project should adhere to the RDS/2005 provision on brick on end edging.

(3) Expected design life

RDS/2005 sets the expected design life at 10 years, which means that roads are designed based on the expected traffic volume 10 years ahead of the base year. The Road Pavement Design Manual 1999 recommends that a growth rate of 7.5 % per year, which is the average traffic growth rate in rural areas of Bangladesh, be used for traffic forecasts. Following this recommendation, LGED applies a 7.5-8.0 % growth rate. This means that the traffic volume is estimated to become more than double in 10 years. If the expected design life is 20 years, the traffic volume will be more than four times, and the road construction will be too costly, since the higher road specifications will be adopted. In addition, the expected design life of 20 years will increase uncertainty. On the other hand, if the life is 5 years, the estimated traffic volume will increase by 40 %. This should be underestimated in reference to the increase rate of the traffic volume after the completion of road improvement under RDP-25. It is therefore concluded that the expected design life of 10 years should be appropriate for road construction in Bangladesh.

(4) Flood tolerance

The heights of road surfaces are set based on the high water level (HWL) of a 10 or 20 year return period. The Road Pavement Design Manual 1999 recommends that this HWL value be determined using river stage data collected at two nearby gauge stations.[2] The road height is then set to 0.6 to 1 m above the HWL. Thus, rural roads developed by LGED are designed to withstand floods that are likely to occur at 10-year intervals[3]. The SAPROF team concludes that this practice is appropriate, as it is in line with the expected design life of rural roads.

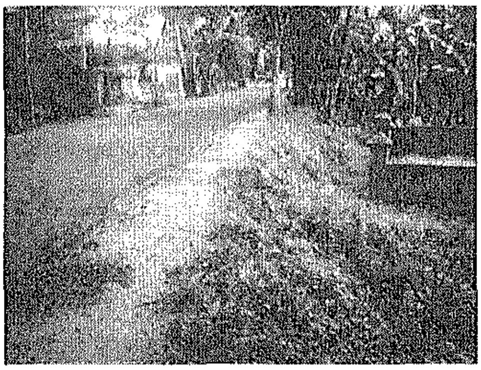
(5) Shoulder type

RDS recommends use of the soft shoulder for design types 4, 6, and 8. Generally speaking, the soft shoulder is less durable than the hard shoulder. In particular, because the quality of soil in the Project area tends to be poor, the soft shoulder may be susceptible to damage. On the other hand, if appropriate measures are taken, i.e. embankment materials are well-selected, measures to enhance the quality of soil are properly undertaken, compaction is done with proper construction machinery, and suitable vegetation cover is carried out, damage from rainfall and vehicles should be adequately prevented.

[2] In many cases, due to the lack of gauge stations, the HWL is determined based on water levels of past floods recalled by local residents.

[3] Indeed, the observed return period of recent major floods in Bangladesh is roughly 10 years: major floods have occurred in 1974, 1984, 1988, 1998, and 2007. Nevertheless, the intensity of the floods differs each time and varies by location. Accordingly, the severity of flood damage is location-specific. Therefore, road sections in some areas often are more severely damaged than others that have been hit by the same floods.

In order to examine the durability of the soft shoulder in compliance with the RDS/2005 specifications, Upazila roads built by RDP-25 in 2005/06 were sampled and investigated. There were no significant damages observed in the soft shoulder (Photograph 1-3 and Photograph 1-4). In consideration with the relatively low traffic volume reported in the area, use of the soft shoulder should not increase the risk of damage to Upazila roads in the Project area. Therefore, it is technically sound to adopt soft shoulder in the Project.



Photograph 1-3 Soft shoulder on Upazila road (Barguna District)

Photograph 1-4 Soft shoulder of Upazila road protected by vegetation cover (Bhola District)

(6) Soil specification and quality of embankment materials in the Project area

Table 1-3 shows the properties of granular materials used for pavement layers specified by RDS/2005. Embankment construction for rural roads should follow the basic parameters for embankment materials specified in the table.

Road construction sites within the Project area have limited access to embankment materials that meet RDS/2005 standards. Soil in the coastal areas is often fine silt, which does not satisfy RDS/2005 specifications and will not be used as embankment material. If the quality of soil available near the construction sites is of insufficient quality, measures to achieve the required road strength will need to be undertaken.

According to RDS/2005, for road sections where the designed soaked CBR value (4%) of the sub-grade cannot be achieved with the soil at-site, the thickness of the improved sub-grade is to be increased. Similarly, where the designed soaked CBR value (8%) of the improved sub-grade cannot be achieved with locally available sand, the thickness of the sub-base is to be increased. Although these measures cannot raise the CBR values of the different layers, they are adequate for improving the bearing capacity of the road to the required level. Indeed, observations during field visits confirmed that some soils in Barisal failed to meet the required values of RDS/2005. The thickness of the improved sub-grade was increased to achieve the required bearing capacity level. Therefore, the SAPROF team concludes that, instead of transporting embankment materials from other areas, the measures stipulated in RDS/2005 should be adopted for increasing the bearing capacity of roads.

Table 1-3 Properties of granular materials use for pavement layers specified by RDS/2005

Pavement Layer	Minimum CBR % (Lab. Test after 4 *days soaking*)	Maximum Field DCP Test mm/ *blow*	Maximum Aggregate Crushing Value	Required Compaction	Typical Materials Likely to meet specification.
Base Type I	80%	3.5 mm/ blow	30%	98% Vibrating Hammer / Heavy Compaction (*Modified Proctor**)	Graded stone or graded stone with some brick or brick if it can meet specification
Base Type Ia	80%	3.5 mm/ blow	30%	98% Vibrating Hammer / Heavy Compaction (Modified)	Brick if it can meet specification
Sub base	30%	9.0 mm/ blow	32%	98% Vibrating Hammer / Heavy Compaction (Modified)	Graded materials consisting of brick or brick sand mixtures. Re-cycled pavement materials such as brick, broken concrete, old surfacing etc.
Improved Sub-grade	8%	22 mm/ blow	---	98% Vibrating Hammer / Heavy Compaction (Modified)	Usually locally occurring fine sand
Sub-grade (compacted min. 300mm thickness)	4%	30 mm/ blow	---	98% Standard Compaction	Natural soil of low plasticity
Earthwork in Embankment	3%	45 mm/ blow	---	95% Standard Compaction	Natural soil of low/ medium plasticity

Source: RDS/2005

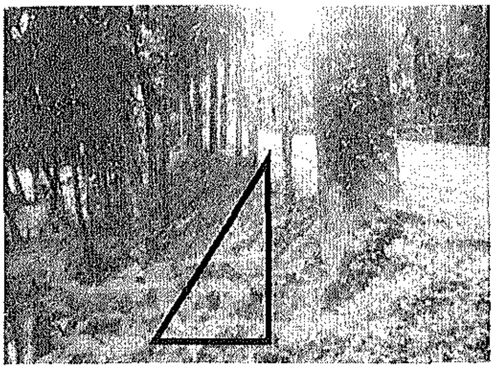
(7) Slope gradient

RDS/2005 specifies three gradient levels, each of which corresponds to a type of embankment material. However, the observed slope gradients were steeper than the recommended gradients (Photograph 1-5 and Photograph 1-6). Slope erosion was observed where the slope exceeds 1 : 1.0 (Photograph 1-5). To prevent such damage, the Project will need to supervise the design and construction of roads so as to ensure compliance to RDS/2005 specifications.

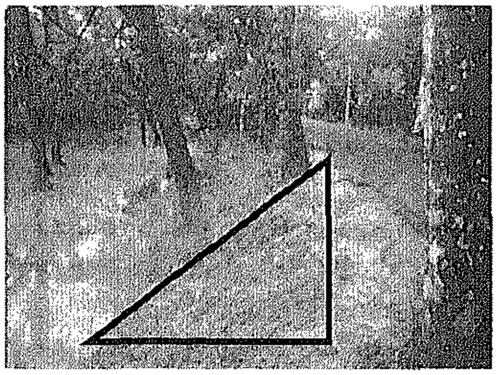
Table 1-4 Recommended side slope

Embankment Material	Slope
Clayey soil	1 : 1.5
Clayey sand	1 : 2.0
Sand or silty sand	1 : 3.0

Source: RDS/2005



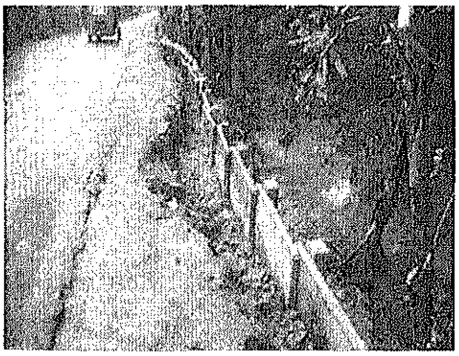
Photograph 1-5 Eroded slope with gradient 1:0.5 (Barguna District)



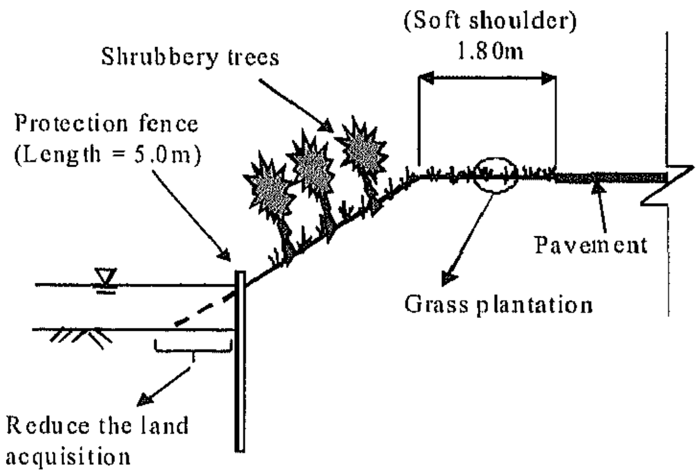
Photograph 1-6 Slope gradient 1:1.2 (Barguna District)

(8) Slope protection

Several factors make road slopes in the Project area especially susceptible to erosion. For example, the wave motion occurring in canals, small reservoirs, and shrimp farms located adjacent to roads erode the slopes. Road slopes are also easily damaged by floods and cyclones. The installation of palisades and retaining walls, and vegetation cover on slopes are typically adopted as mitigation measures against the effects of erosion.



Photograph 1-7 Palisade works (Bhola District)



Source: SAPROF Team

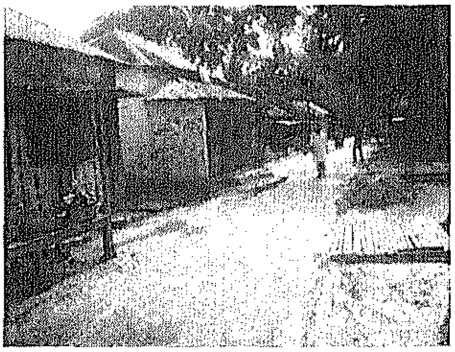
Figure 1-7 Slope protection measures

Field observations revealed that the above-mentioned measures are effective in mitigating the effects of slope erosion (Photograph 1-7). However, damage to the inside of palisades, caused by poor embankment construction and compaction, was occasionally observed. Proper construction supervision should be required to prevent such damage.

Slope damage was also observed where wind had toppled over large trees on the slopes during last year's Cyclone Sidr. Since many of the selected roads are located in saline areas, small-sized tree species with maturity heights of approximately 10 m and high resistance to saline environments should be selected for vegetative protection.

(9) Crest width in town areas

Crest widths in town areas are specified by RDS/2005 as follows: 9.80 m for type 4, 7.30 m for type 5, and 5.50 m for types 7 and 8. In practice, houses are built right along road sections in town or village areas, which make the extension of crest widths difficult. Widening the crest widths often requires land acquisition and donation, and the relocation of residents. To avoid such measures, for roads in town and village areas, the Project may need to allow incompliance with the standards related to crest width of RDS/2005, but will at least retain the carriageway widths meeting RDS/2005 specifications. Carriageway widths are specified by RDS/2005 as follows: 5.50 m for type 4, 3.70 m for types 5 and 7, and 3.00 m for type 8.

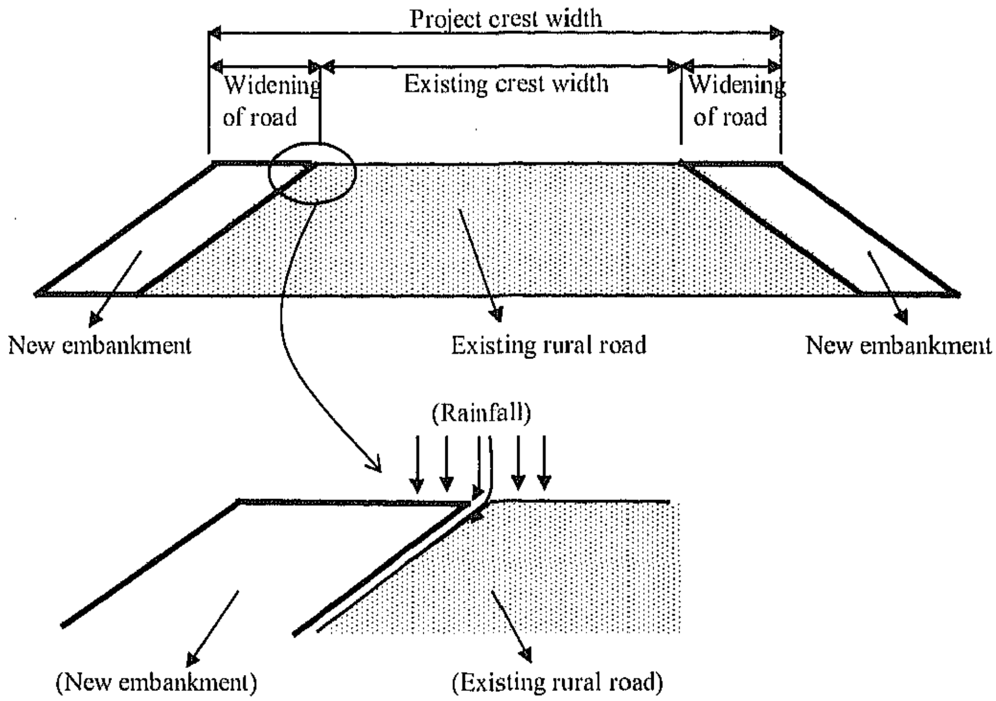


Photograph 1-8 Houses and shops standing near Upazila road (Rajbari District)

Photograph 1-9 Houses and shops standing near Upazila road (Madaripur District)

(10) Crest widening works

Most upgrading works of Upazila roads and Union roads of the Project will involve the widening and upgrading of existing roads. RDS/2005 does not specify construction methods for crest widening. Road widening entails the risk of erosion caused by the infiltration of rainwater into the space between the existing embankment and the new embankment (Figure 1-8). Thus, the new embankment should be sufficiently compacted, as prescribed in RDS/2005.

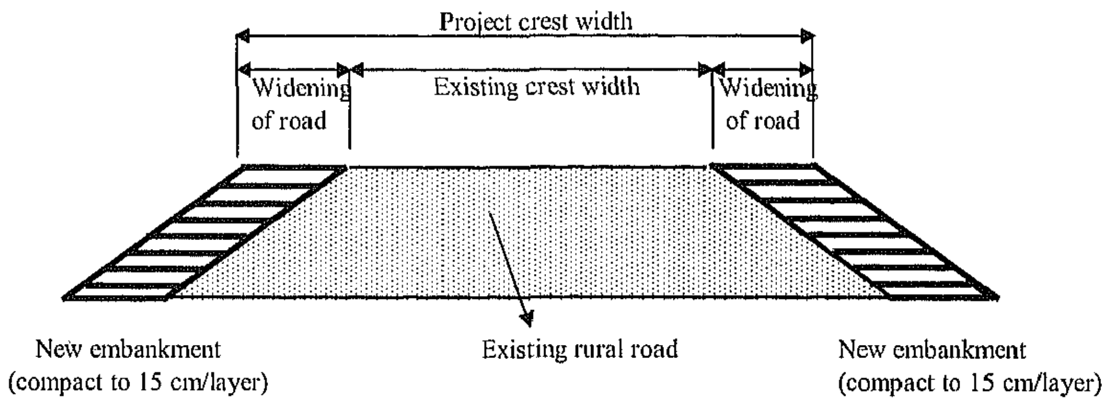


Source: SAPROF Team

Figure 1-8 Earthwork for embankment using existing rural road

The following steps should be taken for crest widening works.

1) Remove vegetation on embankment slopes of existing rural roads.
2) Divide new embankment into several layers, and compact each layer with road rollers. Each layer needs to be compacted to 15 cm (Figure 1-9).
3) Conduct soil tests at the compaction stage to assess whether the soil quality meets RDS/2005 specifications.



Source: SAPROF Team

Figure 1-9 Construction method of crest widening works

1.3 Application of Road Design Standards

(1) Introduction

According to RDS/2005, design types of Upazila and Union roads are to be selected in accordance with traffic volume. The carriageway width is typically determined based on forecasts of traffic volume and vehicle types. Traffic volume is assessed based on passenger car units (PCU). PCU is the standard unit, and traffic volumes for each vehicle type are assessed and converted into PCUs by applying PCU factors. Table 1-5 shows the PCU factors assigned to each vehicle type.

Table 1-5 Vehicle type and passenger car unit (PCU) factor

Vehicle Type	PCU factor
Car	1.0
Bus	3.0
Truck	3.0
Auto rickshaw	0.5
Bicycle	0.3
Rickshaw	1.0
Motor Cycle	0.3
Tempo	1.0
Bullock Cart	4.0

Source: RDS/2005

According to RDS/2005, typical application of road design types is based on measurement of peak hour maximum PCUs or Maximum Daily Commercial Vehicles (MDCV). For estimation of MDCV, only traffic PCU measurements of trucks and buses are used. The relationships among design types, the peak hour maximum PCUs, and MDCV are shown in Table 1-6. These are used to determine the typical application of a road design type. Road design type 5 is to be used for roads with an MDCV equivalent to 201-300 PCUs, while design type 6 is to be applied when the MDCV is 101-200 PCUs. Design type 8 is to be used only when the value is less than or equal to 50.

Design type 4 is an exception, as all vehicle types are considered in the measurement of traffic volume. It is to be applied when the total peak hour maximum is 291-530 PCUs.

Table 1-6 Traffic criteria for design purposes

Road design type	Peak hour maximum passenger car units (for all vehicles) (PCU)	Maximum Daily Commercial Vehicles (MDCV) (for trucks and buses only) (PCU)
Type 4	291-530	301-600
Type 5	(211-290)	201-300
Type 6	(131-210)	101-200
Type 7	(91-130)	51-100
Type 8	(<=90)	<=50

Note: For road design types 5, 6, 7, and 8, the criterion should be MDCV. For Type 4 the criterion should be peak hour PCU(s). Figures in parentheses are estimates for low-volume roads.
Source: RDS/2005

As indicated in Table 1-6, design applications for Upazila and Union roads are determined based on traffic volume. The criteria described here, also adopted in Japan, should be appropriate for deciding the application of road design types.

(2) Design type application for Upazila roads

Traffic forecasts of all proposed Upazila roads are calculated based on estimates of MDCV. For type 4 roads, estimates of MDCV are substituted for Peak Hour Maximum PCUs due to the lack of data.

Table 1-7 is a summary of design types to be applied to 90 Upazila roads proposed for upgrading, based on their MDCV. Table 1-8 shows MDCV values calculated based on data provided in the F/S on traffic volume per hat day. The results reveal that there are three, two, and 16 Upazila roads that fall into Upazila road design types 4, 5, and 6, respectively. Thirty-five and 34 Upazila roads fall into Union road design types 7 and 8, respectively. Barisal Division exhibits a relatively large number of proposed Upazila roads categorized into the Union road design types.

Specifications of the design type 4 and 6 will be applied to the roads categorized into type 4 and 6 respectively. In terms of the two roads which fall into type 5, specifications of the design type 6 should be employed. This is because the volume of exceeded MDCV of the two over MDCV of type 6 is so slight that specifications of the design type 6 will be able to accommodate the traffic volume on the two roads even without hard shoulders. Specifications of the design type 6 should be also applied to the roads categorized as type 7 and 8, taking into account an expected increase in traffic volume after upgrading. In sum, the SAPROF team recommends that the specifications of road design type 4 be applied to three Upazila roads, and those of design type 6 be applied to the rest.

Table 1-7 Summary of design type for Upazila roads

Division/G. District District	Design Type					Road with no traffic data	Total
	Upazila road			Union road			
	Type 4	Type 5	Type 6	Type 7	Type 8		
Barisal Division			**6**	**15**	**18**	**27**	**66**
Barguna				2	3	3	8
Barisal			4	5	1	6	16
Bhola				2	5	1	8
Jhalokathi				1	3	3	7
Patuakhali				4	2	9	15
Pirojpur			2	1	4	5	12
Greater Faridpur	**1**		**3**	**11**	**11**	**8**	**34**
Faridpur	1		2	4	1	2	10
Gopalganj				1	4	1	6
Madaripur				2	2		4
Rajbari			1	2	1	2	6
Shariatpur				2	3	3	8
Greater Khulna	**2**	**2**	**7**	**9**	**5**	**12**	**37**
Bagerhat		2	3	2	1	6	14
Khulna	2		1	5	2	6	16
Satkhira			3	2	2		7
Total	**3**	**2**	**16**	**35**	**34**	**47**	**137**

Source: SAPROF Team

Table 1-8 Estimation of maximum daily traffic volume for Upazila roads

Division/Greater District/District/ Upazila	Road Code (Gazette)	Road name	MDCV	Design type
Barisal Division				
Barguna				
Amtali	504092001	Amtali-Gazipur	-	
Amtali	504092007	Gazipur GC-Dhankhali GC via Tepura Hat & H/O Kanai Mridha	24	Type 8
Bamna	504192004	Kholpatua G.C (Ramna Launchghat)-Fuljhuri G.C	30	Type 8
Barguna Sadar	504282001	Barguna-Ayla GC-Chandukhali GC Road	63	Type 7
Barguna Sadar	504282007	Barguna-Lakurtala-Dhupati-Chandukhali GC.	-	
Betagi	504472002	Niamoti-Dasantorkati Via DC Hat	48	Type 8
Betagi	504472004	Badnikhali GC-Fuljhuri GC	-	
Patharghata	504852002	Patharghata-Kalmegha	96	Type 7
Barisal				
Agailljhara	506022005	Agailjhara H/Q to Illa Bus stand (NHW) via Rajhihar bazar & Bashail hat (UZR #508)	93	Type 7
Babuganj	506032003	Barisal-Dhaka RHD.-Barisal Cadet Collage-Madabpasa Rd.	84	Type 7
Bakerganj	506072006	Halta GC-Charamaddi Mia Bari GC via Ranir hat.	-	
Bakerganj	506072010	Barisal-Patuakhali RHD to Bahcrchar GC Kalaskati Hat, Chairman Hat &Kastoganj	111	Type 6
Banaripara	506102001	Chowmohana GC to Banaripara H/Q via Biserkandi Umarerper Baitakghata Wazedia Baisari.	117	Type 6
Barisal Sadar	506512004	Taltali Kheya Ghat to Sayestabad Bazar(Fakir Bari Road) (UZR #515)	57	Type 7
Gaumadi	506322006	Illah Bus stand (NHW) to Agailjhara H/Q via Bakai bazar and Rajhihar bazar(including Notun bazar connecting road) (UZR #508)	126	Type 6
Hizla	506362001	Taker Bazar-Aligong bazar.	-	
Hizla	506362004	Memania Taker Hat-Aligong bazar.	63	Type 7
Mehendiganj	506622005	Paterhat GC-Kazirhat GC.	132	Type 6
Mehendiganj	506622006	Patar hat GC-Aliganj Gc (Hizla).	-	
Muladi	506692003	Muladi to Kutubpur via Nazirpur GC & Mollar hat GC.	21	Type 8
Wazirpur	506942003	SANUHAR-DHAMURA-SATLA(via-Jalla) (UZR #-522)	-	
Wazirpur	506942004	Dhamra GC-Harta GC-Satla GC Paisarhat GC(Upto Agailjhara Upazila Start from Dhamura College)	-	
Wazirpur	506942005	Dhamura-Sholak-Batajore(UptoGournadiUpazila boarder)	66	Type 7
Wazirpur	506942011	Jaysree-Chowmohoni-Barakotha Central Road-Otra Road. (UZR #530)	-	
Bhola				
Bhola Sadar	509182012	Ilisha RHD-Roder hat-Santir hat-Wapda closer bazer (UZR #583)	60	Type 7
Burhanuddin	509212004	Mirzakalu GC (Near Chowdhury Bari)-Fakirhat Dalal Bazar R&H Road	30	Type 8
Char Fasson	509252007	Chairman Bazar G.C.-Char Aicha Bazar G.C.	27	Type 8
Daulat Khan	509292006	Azad Nagar-Noormiar hat Daulatkhan shibpur (miar hat-Mridher hat). (UZR #584)(Daulatkhan 3rd Part) (Mridhar Bridge to Miar hat road)	24	Type 8
Lalmohan	509542002	Dawri Bazer-Raychand Bazer.	27	Type 8
Manpura	509652001	Hazirhat-Koralia Road	54	Type 7
Manpura	509652002	Hazirhat HQ-Ramnawaj GC Rd.	-	
Tazumuddin	509912004	Shasigonj Bazer to Chatta dowri via Godown	39	Type 8
Jhalakati				
Jhalakati Sadar	542402003	Panjiputhipara GC-Manpasha GC via Chamta bazar	6	Type 8
Jhalakati Sadar	542402004	Jhalokati R&H-Panjiputhipara GC via Kirtipasa, Bhimruli bazar	-	
Kanthalia	542432009	Amua UP office-Battala Bazer via Amribunia Bazer Road. (UZR #544)	12	Type 8
Nalchity	542732003	Manpasha GC-Taltala-Bhabanipur via Nachanmohal UP(Fultala-Taltala-Nachonmohal road)	54	Type 7
Nalchity	542732004	Sarkarbari-Chowrangi-Sikdarhat-Polashpur-Ranapasha Road (UZR #000)	-	
Rajapur	542842005	Bagri GC-Mirer Hat GC via Badnikathi Hat & Baroia UP Comp	45	Type 8
Rajapur	542842009	Mirer hat-Nizamia-Boroia-Niamoti (Included Kacharibari Hat Connection)	-	
Patuakhali				
Bauphal	578382003	Mominpur GC-Kalaiya GC.	-	
Bauphal	578382004	Boga GC (Shaplakhali R&H)-Kanakdia hat-Surjamoni-Kalisuri GC	72	Type 7
Dashmina	578522003	Dasmina-Hazir hat Launchghat	-	
Dashmina	578522005	Dashmina H.Q.-Rangopaldi hat-Ulania GC. (UZR #574)	57	Type 7
Dashmina	578522006	Alipur GC-Ulania GC	-	
Dumki	578962002	Moukoron GC-khataltali GC Via Hazirhat Rd.	-	

Table 1-8 Estimation of maximum daily traffic volume for Upazila roads (continued)

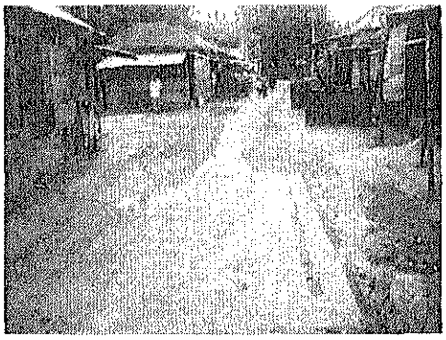
Division/Greater District/District/ Upazila	Road Code (Gazette)	Road name	MDCV	Design type
Dumki	578962003	Muradia UP Office & GC-Patuakhali (laukhati) GC. Via Muradha High School, South Khali G.P.S. & Vak-bari .	66	Type 7
Dumki	578962004	Dumki Upazila HQ(janata Collage)-Muradia GC Via Ahamad Shisu Sadon , Nissi mondal,Kodamtala Bazar ,Basiria Madrasha.	-	
Galachipa	578572002	Galachipa-Char Biswas Rd.	-	
Galachipa	578572004	Kalagachia G.c.-Alipur G.C.	45	Type 8
Kalapara	578662001	Kalapara-Dhankhali Hat	-	
Kalapara	578662002	Kalapara-Chapli Bazar.	-	
Kalapara	578662004	Kalapara-Tarikata R&H	87	Type 7
Mirzaganj	578762005	Subidkhali H/Q-Chatra-Deuli Bazar-Kakrabunia GC-HRS at Malkerbari Rd.	24	Type 8
Patuakhali Sadar	578952010	Patuakhali H/Q to Badura GC	-	
Pirojpur				
Bhandaria	579142005	Telikhali GC-Tushkhali GC Road (with Harinpala kotcha connected)	-	
Bhandaria	579142006	Bhandaria-Gazipur-Banai-Mathbria road (upto Bhagrathpur bazar) road	-	
Bhandaria	579142009	Bhandaria Purbo Dhawa Road (Dhawa Bazar-Rajpasha Sadrarhat) Manikmia College-Meddarshi RHD	105	Type 6
Kawkhali	579472001	Kawkhali GC to Pangasia GC	36	Type 8
Mathbaria	579582003	Tuskhali GC-Sapleza GC Via Barromasua Bazar-Betmore Bazar & Amragachia Bazar	102	Type 6
Nazirpur	579762004	Sreeramkati GC-Pachpara GC Road (Up to Chalitabari)	51	Type 7
Nazirpur	579762005	Digirgan GC-Matabanga GC	-	
Nazirpur	579762006	Nazirpur H/Q-Gazalia GC (Nazirpur Part)	-	
Nesarabad	579872004	Jaganathkati-Juluhar via Jalabari, Sashid, Sagorkanda	33	Type 8
Nesarabad	579872008	Chandkati GC-Sreramkati G.C	-	
Nesarabad	579882004	Zia nagor-Telikhali GC via Darul huda Kheyaghat	39	Type 8
Pirojpur Sadar	579802006	Hularhat GC-Panchpara GC.	42	Type 8
G. Faridpur				
Faridpur				
Alfadanga	329032006	Gopalpur GC to Boalmari GC via Berrir Hat GC Road(Alfadanga Portion)	126	Type 6
Bhanga	329102005	Kalamirdha GC-R&H at Pulia	597	Type 4
Boalmari	329182006	Boalmari GC to BhagatGC via Gohaibari GC road(Boalmari portion) .	120	Type 6
Char Bhadrasan	329212004	Gozaria R&H to Krishnapur GC via Azzadha high school road	81	Type 7
Faridpur Sadar	329472011	Bhakunda R&H- Bilnalia Road.(Roshulpur GC)	-	
Faridpur Sadar	329472012	Bakunda GC- Hazigonj GC via Hat Gazaria GC Road.	96	Type 7
Faridpur Sadar	329472013	Khalil Mondoler Hat GC to KhanKhanapur GC via Laxmidasher hat-Boshantapur bazar road (Sadar Part)	-	
Madukhali	329562009	Madhukhali R&H-Bhimpur GC Road via Makrail Bazar Starting from Mesordia (	69	Type 7
Nagarkanda	329622020	Chandibardi R&H-Kalinagar GC Via Baushkhali Bazar,Jadunandi College road.	66	Type 7
Sadarpur	329842009	Piajkhali GC-Charbharason GC via Lohertek bazar-Monikotha bazar rd	33	Type 8
Gopalganj				
Gopalganj Sadar	335322008	Boultali GC-Balakair-Kathi GC Road.	-	
Gopalganj Sadar	335322015	Satpar-Patkel bari-Boultali GC Rd.	21	Type 8
Kashiani	335432008	Ramdia-Satpar R&H Road (UZR #650)	33	Type 8
Kotalipara	335512004	Nagra R & H-Bandabari-Ramshil-Shashikor GC Road. (UZR #633)	51	Type 7
Muksudpur	335582011	Batikamari UP Office-Pererchar GC via Haldiaviata Bazer	27	Type 8
Tungipara	335912005	Bashbaria GC to Chowmohoni GC via Karfa	48	Type 8
Madaripur				
Kalkini	354402005	Khoajpur Takerhat R&H-Khasherhat GC via Laxmipur up & Surjamoni hat	18	Type 8
Madaripur Sadar	354542005	Trivagdi GC-Mithapur Hat-Habiganj hat-Mollahat-Shekhpur RHD	57	Type 7
Rajoir	354802008	Kadambari GC-Hizalbari-Tatul Bari-KaliGonj GC (Kotalipara)	24	Type 8
Shib Char	354872008	Chanderchar G.C. to Bahadurpur R & H road via Dityakhanda FWC & Choto Kutubpur Hat.	66	Type 7
Rajbari				
Baliakandi	382072001	Jamalpur GC-Sonapur GC Rd. via Baharpur Hat	99	Type 7
Baliakandi	382072007	Narua GC.-Sonapur GC.Rd. Via Kamardha	-	
Goalandaghat	382292007	Uttar Daulotdia at NHW-Ujanchar G.C.Via chardaulotdia	24	Type 8
Pangsha	382732012	Habaspur G.C.-Arungong G.C. Road	135	Type 6

Table 1-8 Estimation of maximum daily traffic volume for Upazila roads (continued)

Division/Greater District/District/ Upazila	Road Code (Gazette)	Road name	MDCV	Design type
Pangsha	382732014	Bagduli GC-LangolbundhGC via Tebaria-Sawrail up-Alamdamnga	-	
Rajbari Sadar	382762009	Banibaha GC-Chandani R&H	66	Type 7
Shariatpur				
Bhedarganj	386142001	Bhedorgonj-Shakhipur-Kasempur Rd.	-	
Bhedarganj	386142003	Mollarhat GC-Balarhat GC Road.	21	Type 8
Damoudya	386252003	Subachani-Nagerpara Raod.	-	
Damoudya	386252006	Shidulkura Bazar GC-Nagerpara GC Road via Charatalia & Munsirhat.	21	Type 8
Naria	386652004	Ghaisar GC-Golar Bazar GC Road.	69	Type 7
Shariatpur Sadar	386692006	Chandrapur GC-Gonga Nagar GC road.	30	Type 8
Shariatpur Sadar	386692008	Shariatpur-Burirhat (Town bipass road)	-	
Zanjira	386942004	Khalek SeritiShangha (R & H)-Joynagar G.C.	99	Type 7
G. Khulna				
Bagerhat				
Bagerhat Sadar	201082008	Jattrapur GC-Fakirhat-Chitalmari RHD.	-	
Bagerhat Sadar	201082009	Depara R&H-Kachua GC via Taleswar hat	204	Type 5
Bagerhat Sadar	201082012	Chulkathi-Ranjeetpur Guchchagram road.	183	Type 6
Bagerhat Sadar	201082014	Daratana-Gotapara road.	-	
Chitalmari	201142003	Durgapur RHD-Khaserhat GC-Kaligonj GC-Gazalia GC(CHT. Part)	-	
Fakirhat	201342009	Lockpur-Betaga	159	Type 6
Mollahat	201562004	Singati-Chandpur-Shiali (Mollahat Portion) (UZR #427)	168	Type 6
Mongla	201582009	Mongla Paurasova-Shalabunia-Baiddamary Bazar	-	
Mongla	201582010	DhalirKhanda Bridge-Geodhara Bazar	42	Type 8
Morrelganj	201602008	Morrelganj-Tetulbaria hat-Dewatala-Mithakhali GC (Morel Part)	-	
Rampal	201732005	Ronsen-Gouromba bazar Road	51	Type 7
Rampal	201732007	Bhaga RHD-Kapasdanga-Kaigardashkati-Chalnahat GC (Rampal portion) (UZR #395)	72	Type 7
Sarankhola	201772001	Rayenda GC-Rasulpur GC Road	-	
Sarankhola	201772007	Tafalbari GC-Rasulpur GC-Rajapur GC-Pollanbari RHD	210	Type 5
Khulna				
Batiaghata	247122007	Katianangla-Roypur via Sukdara Bazar , Baro Bhuiyan & Kechrabad Road	51	Type 7
Dacope	247172005	Kalinagar GC-Mongla port (Banisanta Bazar) Road.	519	Type 4
Dacope	247172010	Dacope Upazila H/Q (Achuva)-Batbunia GC Road.	0	Type 8
Dualatpur	247402004	Mazirgati-Bamondanga-Katenga GC	15	Type 8
Dumuria	247302003	Kharnia GC-Boruna GC-Jamira GC	-	
Dumuria	247302004	Baniakhali GC-Sharafpur-Kaiya GC	-	
Dumuria	247302005	Kathaltola-Magurkhali-Kapilmuni GC	519	Type 4
Koyra	247532002	R&H (Deara)-Hoglahat GC-Ghugrakati GC Road.	60	Type 7
Koyra	247532004	Upazila HQ (Dighirpar)-Golkhali Road (UZR #375)	-	
Paikgachha	247642006	kopilmuni GC-Samukputa bazer-Katamari bazer-Jamtala bazer-Baraitala G.C.(paikgacha portion) (UZR #376)	-	
Paikgachha	247642007	Chandkhali G.C-Gazalia Club Bazar-Alamtala Bazar-Baintala Bazar-Minaz bazar-Garaikhali G.C.	108	Type 6
Paikgachha	247642009	Dacope-Batbunia-Jhalbunia-Garaikhali-Hatiardanga-Koyra Road (Paikgacha Portion) (UZR #371)	-	
Paikgachha	247642011	Batiaghata(Hatbatihat)-Baroaria-Latar Hat-Paikgacha Road(Paikgacha Portion) (UZR #384)	75	Type 7
Rupsha	247752006	Rupsha Thana H/Q-Mansa GC	96	Type 7
Terokhada	247942008	Chagladah Bazar-Nagarkandi G C via Kushla Road.	-	
Terokhada	247942009	Terokhada R & H to Chagladah Bazar G C via Upazila H/Q via Nachunia ghat Road.	81	Type 7
Satkhira				
Assasuni	287042008	Kadakati-Protapnagar via Goaldanga	36	Type 8
Debhata	287252006	Gazirhat GC-Budhata GC via Badartala	42	Type 8
Kalaroa	287432008	Sona baria GC (UP Office)-Gopinathpur R&H (via Boalia-Goalchator bazar) road	102	Type 6
Kaliganj	287472007	Nazimgonj GC-Debhata Via Khanjia Bazaar	96	Type 7
Satkhira Sadar	287822005	Satkhira R&H(Narkeltala)-Jhawdanga via Akhrakhola bazar Balli UP Raipur Bazar & Pathorghata road	72	Type 7
Shyamnagar	287862004	Noabenki-Garez Hat-Harinagar Hat	123	Type 6
Tala	287902006	Dalua G.C.-Kadakati GC(Ashasuni) Road.	120	Type 6

(3) Design type application for Union roads

RDS/2005 stipulates that design types for Union roads (Photograph 1-10 and Photograph 1-11) should be determined based on MDCV values, expressed in PCUs. Because traffic volume data on Union roads was not provided in the F/S (Nov. 2007), the SAPROF team conducted field observation and simplified measurement on the proposed Union roads for upgrading. One or two vehicles (trucks and buses) were observed per hour, which corresponds to an MDCV of less than 50. Most frequently seen were light vehicles such as motor cycles, bicycles, and rickshaws. The previous section mentioned that most of the proposed Upazila roads fall into Union road design types 7 and 8. This also infers that the current traffic volumes of Union roads are relatively small. The team recommends that type 8 be applied to Union road upgrading.

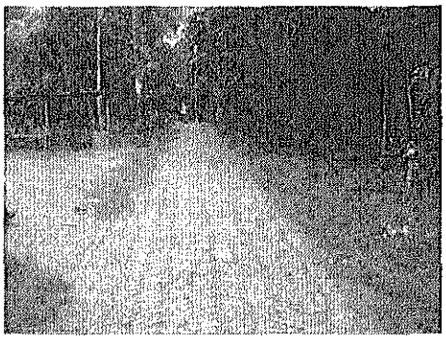


Photograph 1-10 Union Road in Rajbari

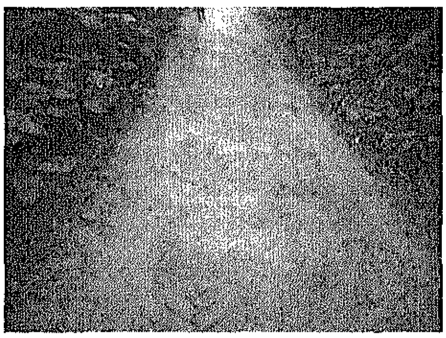
Photograph 1-11 Union Road in Pirojpur

(4) Type 8 HBB pavement design application for Upazila roads

RDS/2005 specifies that a variant of design type 8, constructed with HBB pavement, should be used in areas where soil bearing capacity is too low to meet the required standards, where low traffic volume is forecasted, or where quality control of earthwork is expected to be difficult. This design type is to be applied to Upazila and Union roads where one of these conditions is met.



Photograph 1-12 HBB pavement road in Khulna

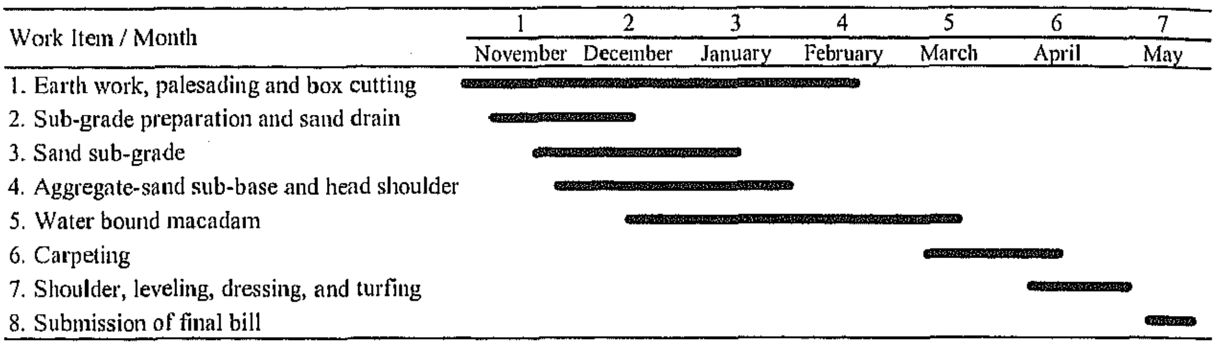


Photograph 1-13 HBB pavement road in Rajbari

1.4 Typical construction schedule for Upazila roads

A typical construction schedule for upgrading of Upazila roads is shown in Table 1-9. The table is based on an execution plan that was used for a construction package of three kilometers.

Table 1-9 Typical construction schedule for Upazila roads



1.5 Bridges and culverts

(1) Specifications for bridges and culverts

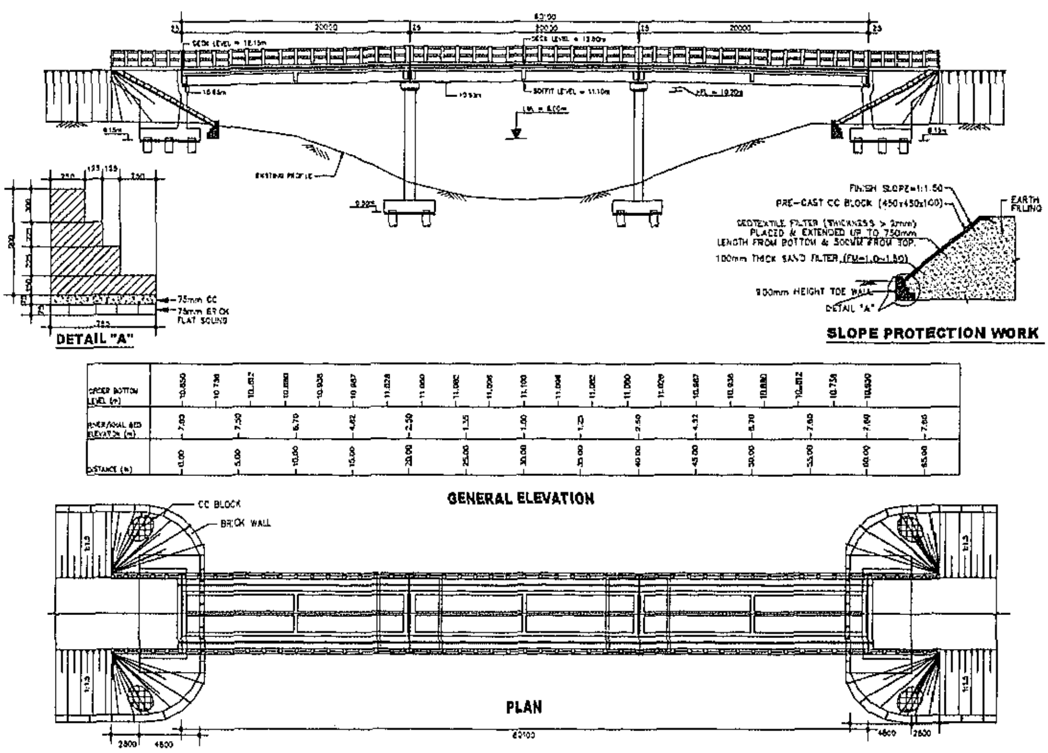
The carriageway width of most existing bridges is set at 3.70 m. If an increase in traffic volume is expected, bridges are to be built with wider carriageways. RDS/2005 specifies the carriageway widths of bridges and culverts as indicated in Table 1-10.

Table 1-10 Recommended bridge and culvert carriageway widths

Design Type	Road class	Lane Type	Length less than 30.00m (m)	Length greater than 30.00m (m)
6, 5, 4	Upazila	Double lane	5.50	5.50
8, 7	Union	Single lane	3.70	5.50

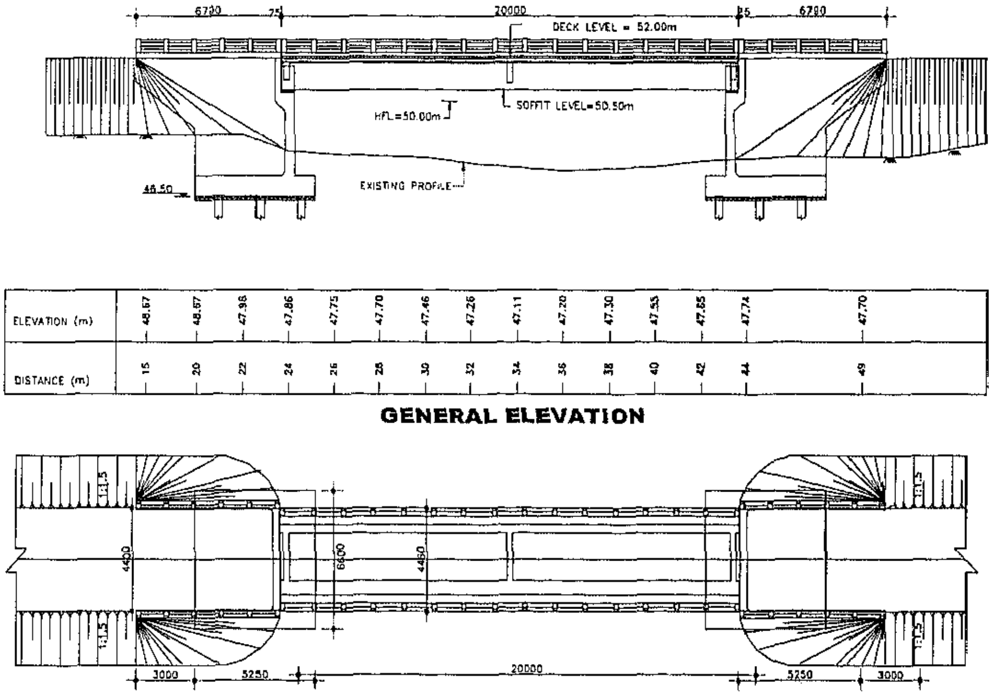
Source: RDS/2005

Figure 1-10, Figure 1-11, Figure 1-12, Figure 1-13 show the typical cross-sections to be applied to bridges and culverts on Upazila and Union roads.



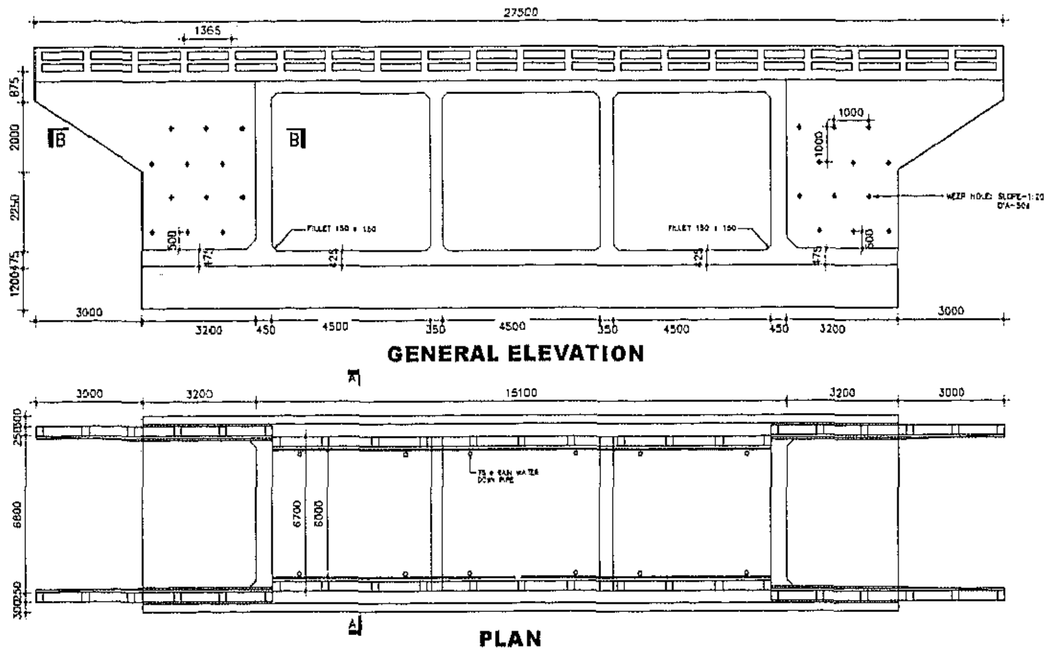
Source: LGED

Figure 1-10 Plan of RCC bridge with double lanes (Upazila road)



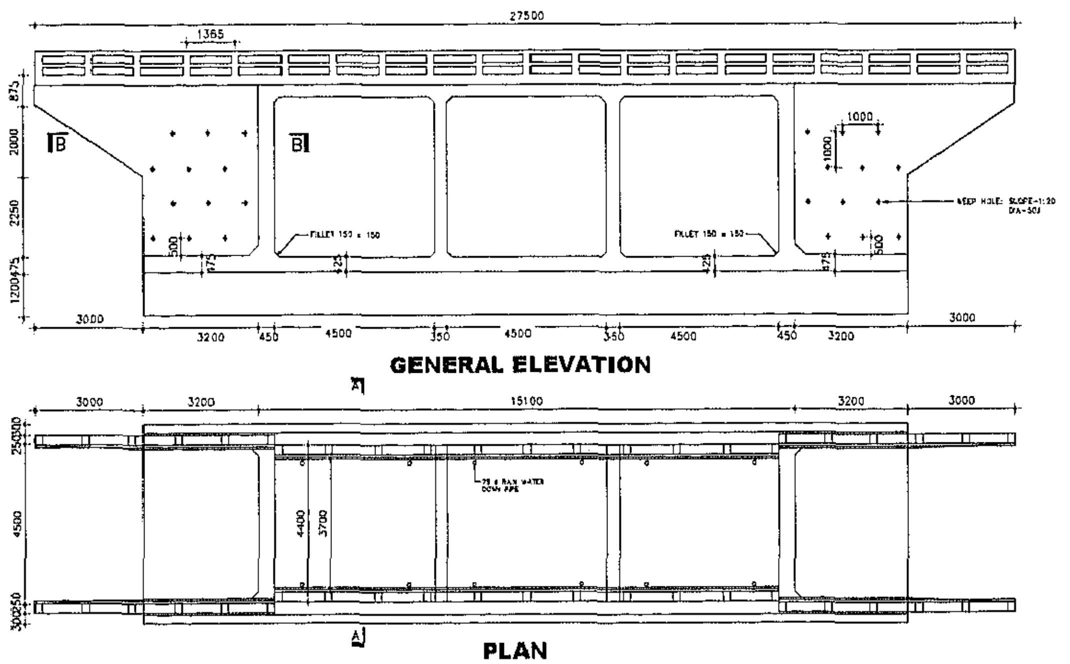
Source: LGED

Figure 1-11 Plan of RCC bridge with single lane (Union road)



Source: LGED

Figure 1-12 Plan of culvert with double lanes (Upazila road)



Source: LGED

Figure 1-13 Plan of culvert with single lane (Union road)

(2) Application of specifications for bridges and culverts

There are three types of bridges: culverts, RCC bridges, and portable steel bridges. Table 1-11 *outlines* the advantages and disadvantages of each structure type.

Table 1-11 Characteristics of bridges and culverts

Type of Structure	Advantages	Disadvantages	Maximum span length (m) *All figures are only indicative.
Box Culvert	• Pile foundation is generally not required. • Construction is relatively easy. • Construction takes relatively little time. • Initial construction costs are relatively low. • Heights required for structures and roads are low, as top slab thickness is thin.	• Not suited for navigation. • Not suited for long span lengths. • Structure is relatively unstable. • Not suited for deep canals or canals with high flow velocity.	• Max. total span: 20 m • Max. individual span: 6 m
RCC Bridge	• Generally constructed on a pile foundation • Can be constructed over large gaps and rivers. Can be constructed with long individual spans. • Boats can navigate across and along rivers. • Can be constructed over deep gaps and rivers.	• Construction is difficult and time-consuming. • Construction costs are high. • Maximum individual span length is less than 20.0m. • Not suited for long span lengths.	• Max. total span: 200 m • Max. individual span: 20 m
Steel Bridge	• Generally constructed on a pile foundation. • Boats can navigate across and along rivers. • Bridge structure is relatively stable. • Construction is easy and not time-consuming. • Maintenance costs are relatively low.	• Initial construction costs are very high. • Clear carriageway width is very limited.	• Maximum total span: 200 m+ • Max. individual span: 40 m

Source: SAPROF Team

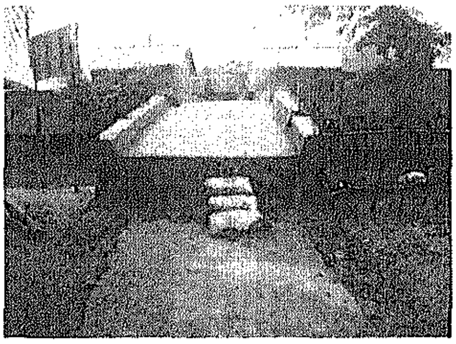
In line with RDS/2005, the Box Culvert structure should be used if the gap is equal to or less than 6 m, while the RCC bridge structure should be applied when the gap exceeds 6 m. It is recommended for SWBRDP that the maximum bridge-span length should be 200 m, and for gaps exceeding 200 m, ghats are to be constructed to facilitate waterway transportation.

Bridges and culverts on Upazila roads should be constructed with two lanes and a carriageway width of 5.50 m to accommodate future increases in traffic volume. On the other hand, bridges and culverts on Union roads should have single lanes with a carriageway width of 3.70 m, as traffic volume is limited.

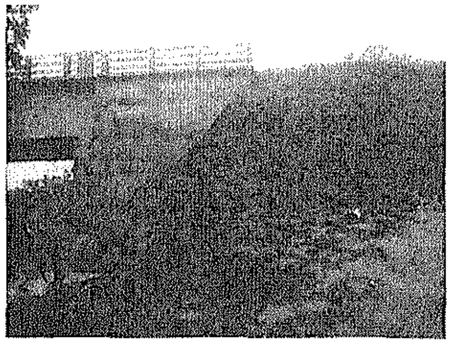
Field investigations revealed that subsidence and erosion caused by floods frequently occur on approach roads to bridges. Among others, one of the main causes of these problems is the difference in design life of bridges (50 years) and Upazila and Union roads (10 years). The consequent difference in the HWLs of bridges and roads makes them susceptible to damage. The compaction of embankment materials as per specifications and revetment work of the road section should be carried out for protection against such damage.

(3) Footpaths

The footpath width should be 0.90 m for bridges on Upazila roads with spans exceeding 30 m and carriageway widths of 5.50 m. The footpath should be 0.45 m wide for bridges on Union roads with spans exceeding 30 m and carriageway widths of 5.50 m.



Photograph 1-14 Bridge under construction and approach road (Pirojpur District)



Photograph 1-15 Bridge under construction and approach road (Pirojpur District)

(4) Revetments

Concrete revetments should be built for protecting bridge piers and approach roads from flood damage.

1.6 Pilot of Rural Development Engineering Center Project

Rural Development Engineering Center (RDEC) Project Phase II is a technical assistance project supported by JICA. The RDEC Project is piloting a number of standard development activities. According to Mr. Yamada, Chief Advisor of the RDEC Project, the following pilot activities for standards development are currently being implemented. If LGED approves the newly developed standards / technologies developed by the project, SWBRDP will benefit from the application of such technologies. LGED may select subprojects under SWBRDP to conduct field tests of the proposed standards / technologies.

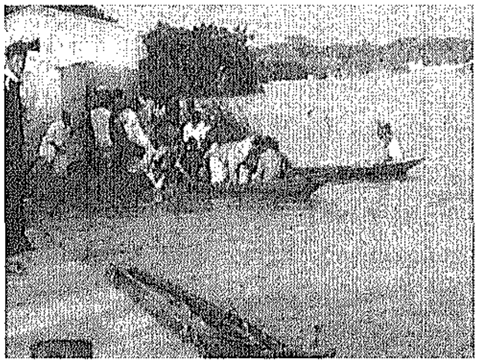
- Development of standards for double lane bridges:
  The standards will be proposed by March, 2009 for field tests.
- Revision of standards for single lane bridges:
  The schedule for revision is yet to be determined.
- Use of sand with FM value lower than 0.5:
  According to experiment results, sand with FM values lower than 0.5 can be used to improve sub-grade and sub-grade for road construction in South-Western Bangladesh. The Project will propose the revision of RDS/2005 after the report of this experiment is published in March 2008. It is estimated that approximately 10% of road construction costs can be reduced if sand with an FM value lower than 0.5 is used.
- Road slope protection measures:
  The RDEC Project is conducting trials of various road slope protection measures such as the installation of retention walls. However, these protection measures tend to be expensive, and supervision by LGED to ensure the quality of construction work may be more cost-effective for improving the durability constructed roads.

CHAPTER 2 Road structures not specified by RDS

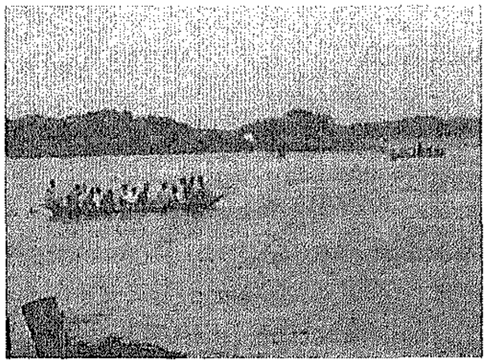
2.1 Ghats

(1) Need for ghat construction

Boats are used as a major means of water transport in the Project area where Upazila and Union roads are interrupted by gaps (Photograph 2-1 and Photograph 2-2). The construction of ghats is recommended where widths of gaps such as rivers and canals are more than 200 m. Bridges more than 200 m in length will not be constructed under SWBRDP. Ghat construction is also recommended in locations that could potentially serve as links between roads and water transport. Locations and designs of ghats should be selected carefully in order to enhance safety and volume of transportation.



Photograph 2-1 Ghat (Bhola District)



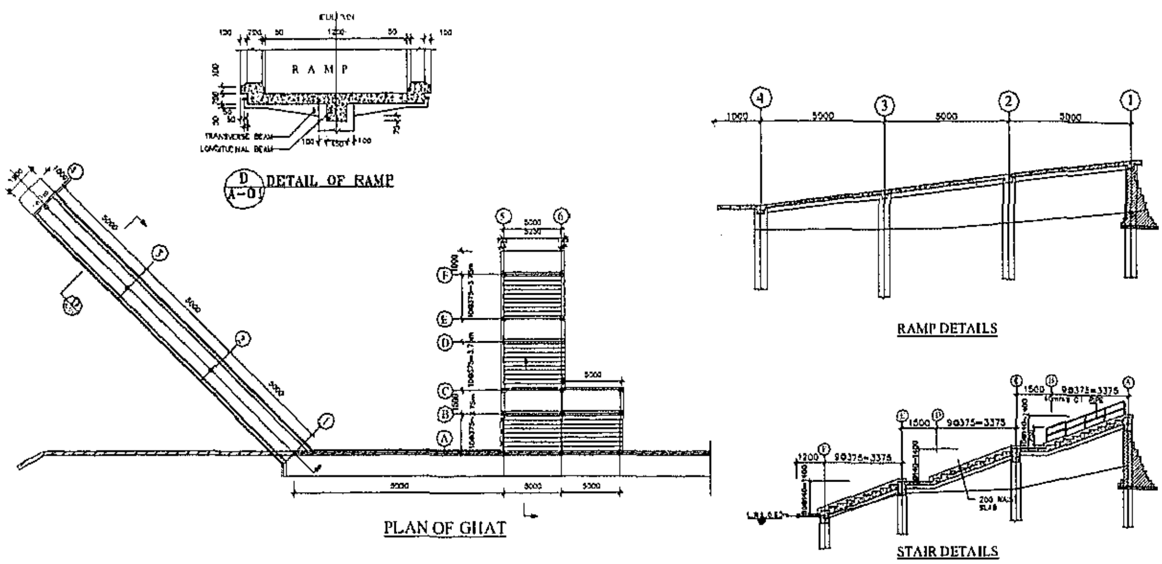
Photograph 2-2 River crossing by boat (Bhola District)

(2) Specifications for ghats and their application

A ghat is constructed by placing an RCC terrace as the upper structure on a foundation structure built on a bank slope. The use of ghats is classified into the following two categories:

1) Ghats for market access
- Ghats are to be built near markets for the purpose of improving accessibility.
- Ghats should not interrupt boat traffic, especially on hat days when traffic increases.
- Ghats should be large enough so that users can get on and off safely, and load and unload goods with ease.
- Ghats should be designed to accommodate changes in water levels.

2) Ghats for gaps on roads
- Ghats are to be built where gaps exceed 200 m where bridge construction is too costly.
- Ghats should be built where there is enough water traffic, and it is economically viable.
- Ghats should be large enough so that users can get on and off safely, and load and unload goods with ease.
- Ghats should be sufficiently elevated to accommodate changes in water level of rivers.



Source: LGED

Figure 2-1 Plan of ghat

2.2 Safety measures

2.2.1 Construction of bus bays and their specifications

(1) Need for bus bay construction

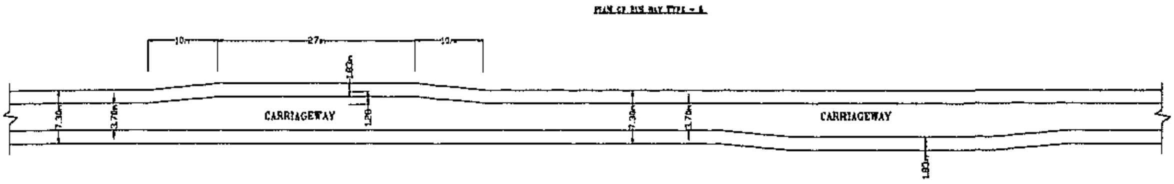
Bus bays are constructed along roads to facilitate the loading and unloading of passengers and baggage, and to serve as turnouts in case of accidents. At present, there are very few bus bays, and their absence threatens the safety of users. For example, when making temporary stops, vehicles stray onto opposing traffic lanes or must park on the soft shoulder. The shoulder may be easily damaged if vehicles park frequently at a particular road section. Bus bays should be constructed to ease such problems.

Photograph 2-3 Boarding / exiting bus on Upazila road (Barguna District)

Photograph 2-4 Parking on Upazila road (Pirojpur District)

(2) Specifications for bus bays and their application

RDS/2005 specifies that a bus bay is to be constructed by extending the crest widths on both sides of the road. However, the SAPROF team recommends extending the crest width and constructing the bus bay on only one side of the road in order to minimize land acquisition. Figure 2-2 shows the basic design of a bus bay. One bus bay per kilometer is to be constructed on one side of the road. The approach road extending to and from the bus bay should each be 10 m long and have carriageway widths of 3.7 m. The bus bay itself is to be 27 m long and have a 4.6 m carriageway width.



Source : LGED

Figure 2-2 Plan of bus bay

Bus bays are to be installed on Upazila roads with high traffic volume, at major bus and tempo stops, and where trucks frequently load / unload. The selection of installation sites is to be based on interview results and budget considerations. Bus bay construction is not recommended on Union roads, as they are utilized less by heavy vehicles, e.g., buses and trucks, compared to lighter vehicles, e.g., rickshaws, auto-rickshaws, motorcycles, and tempos.

2.2.2 Installation of guard posts and their specifications

(1) Need for guard post installation

Most of the existing Upazila and Union roads are located in flatland areas. The average embankment height is approximately 1.5 m, while the maximum embankment height is 3 m. Only a few road sections are located in areas with embankment heights exceeding 2 m. Thus, raising embankment heights is not recommended as a safety measure against accidents. Instead, the installation of guard posts is recommended as a traffic safety measure on approach roads to bridges and curved road sections in order to prevent traffic accidents at these places.

Photograph 2-5 Guard post (Barguna District)

Photograph 2-6 Sign board (Barguna)

(2) Specifications for guard posts and their application

The Project will follow the standard specifications set forth in the "Rural roads and culverts maintenance activities completion manual" published by LGED in June 2008. The guard posts are to be built in RCC on the soft shoulder, 1.2 m apart from each other. They should be 2.2 m in height, with 1.00 m above ground, and have red and white stripes to make them easily-noticeable.

The following installation standards, based on existing guard posts, should be applied.

- As alignment information for each route is unavailable, the number of guard posts to be installed on curved road sections is to be set at fifteen guard posts per kilometer.
- Two guard posts each are to be built to the front, back, right, and left of approach roads to RCC bridges with spans exceeding 6 m. Thus, eight guard posts will be required for every bridge.

2.2.3 Installation of traffic signs and their specifications

(1) Need for traffic sign installation

Traffic signs are divided into three categories according to their functions: regulatory signs, warning signs, and information signs. They are designed to instantaneously attract the attention of drivers and pedestrians.

Since the proposed Upazila and Union roads pass through town areas, warning signs are to be installed around schools and hospitals to alert drivers to school children and hospital patients. They should also be installed around markets to protect their users. In addition to signs around schools, hospitals, and markets, warning signs for speed control will be installed where are easily noticed.

(2) Specifications for traffic signs and their application

The Project will follow the size, shape, and content of traffic signs stipulated by the "Rural roads and culverts maintenance activities completion manual." Two traffic signs are to be installed at each market, school, hospital, etc.

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ANNEX 16

Growth center and rural market design standards

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1 Recommendations for installation of basic market facilities

Recommendations for design standards for basic growth center and rural market facilities are made based on a review of the specifications applied by ongoing projects and information obtained through field investigations by the SAPROF team.

LGED has no established standard specifications for rural markets and growth centers and their facilities. This is most likely because growth centers and rural markets vary by location in their area, size, and number of users. Thus, donor-funded projects typically formulate and apply their own specifications. For example, the Greater Faridpur Rural Infrastructure Development Project (GFRIDP), a JBIC project implemented in 2000, divided rural markets into three size categories and established investment standards for each (Table 1).

Table 1 Classification of rural market

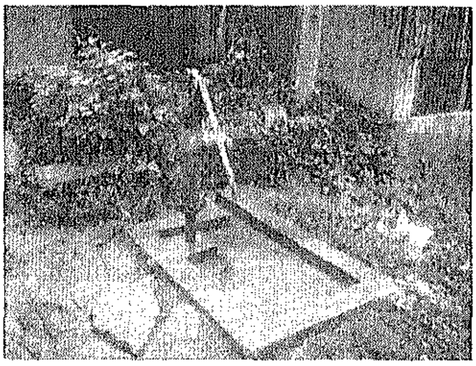
Classification	Small	Medium	Large
Size	< 1.0 hectare	1.0 – 2.0 hectare	> 2.0 hectare
Investment (Tk.)	2.0 – 3.0 million	3.0 – 4.0 million	4.0 – 6.0 million

Source: SAPROF Report of GFRIDP 2000

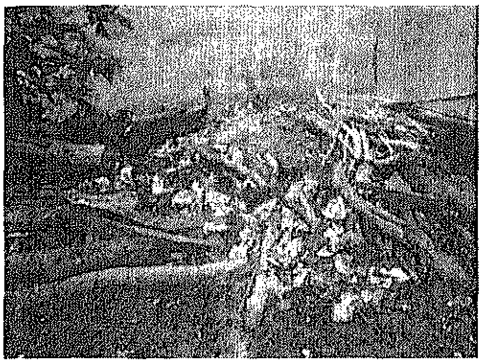
The SAPROF team carried out field investigations on the issues related to and resources available for growth center and rural market development. Most growth centers already possessed the basic resources on which market improvement and expansion could build on, e.g., public electricity supplies and water-supply pumps (Photograph 1 and Photograph 2). On the other hand, the following were raised as issues that still require attention.

1) Poor waste management: Waste produced in the market are dumped without being incinerated (Photograph 3)
2) Lack of appropriate toilet facilities: Toilet facilities are unsanitary or unusable for other reasons (Photograph 4)
3) Shed roofs destroyed by cyclones: Shed roofs destroyed by cyclones are left unrepaired and remain covered with plastic sheets (Photograph 5 and Photograph 6)
4) Poor drainage systems: Drainage systems are poorly managed and do not function properly during the rainy season when waste tends to accumulate (Photograph 7 and Photograph 8)
5) Lack of ghats: Loading and unloading of passengers and luggage are unsafe where markets do not have ghats (Photograph 9)
6) Internal earthen roads: All internal roads within markets are earthen, except for the main roads which are paved with asphalt or HBB. Earthen roads tend to become flooded during the rainy season, which obstructs the passage of road users (Photograph 10)

Photograph 1 Vegetable shop with electricity (Khulna District)

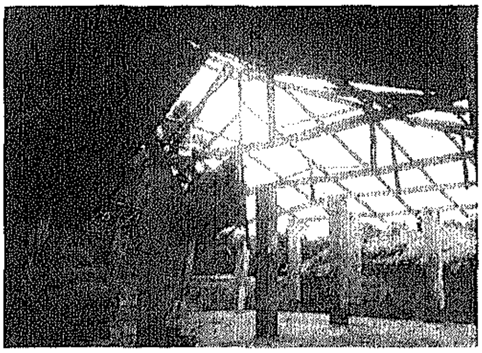


Photograph 2 Water-supply pump (Rajbari District)

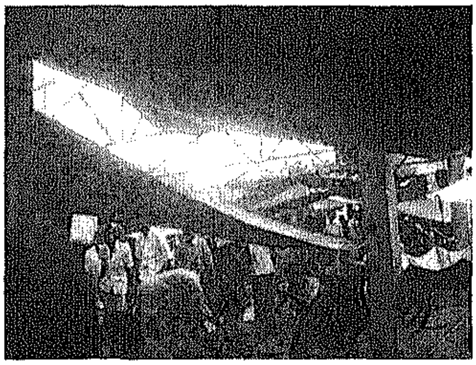


Photograph 3 Waste dump in growth center (Pirojpur District)

Photograph 4 Unsanitary toilet facility (Khulna District)



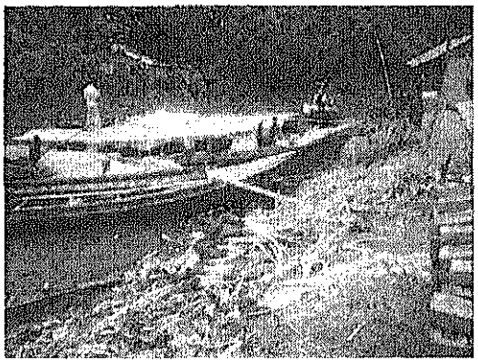
Photograph 5 Shed roof destroyed by cyclone (Bagerhat District)



Photograph 6 Shed covered with plastic sheet (Rajbari District)

Photograph 7 Drainage in rural market
(Bagerhat District)

Photograph 8 Drainage in growth center
(Bagerhat District)



Photograph 9 Growth center without ghat
(Barguna District)

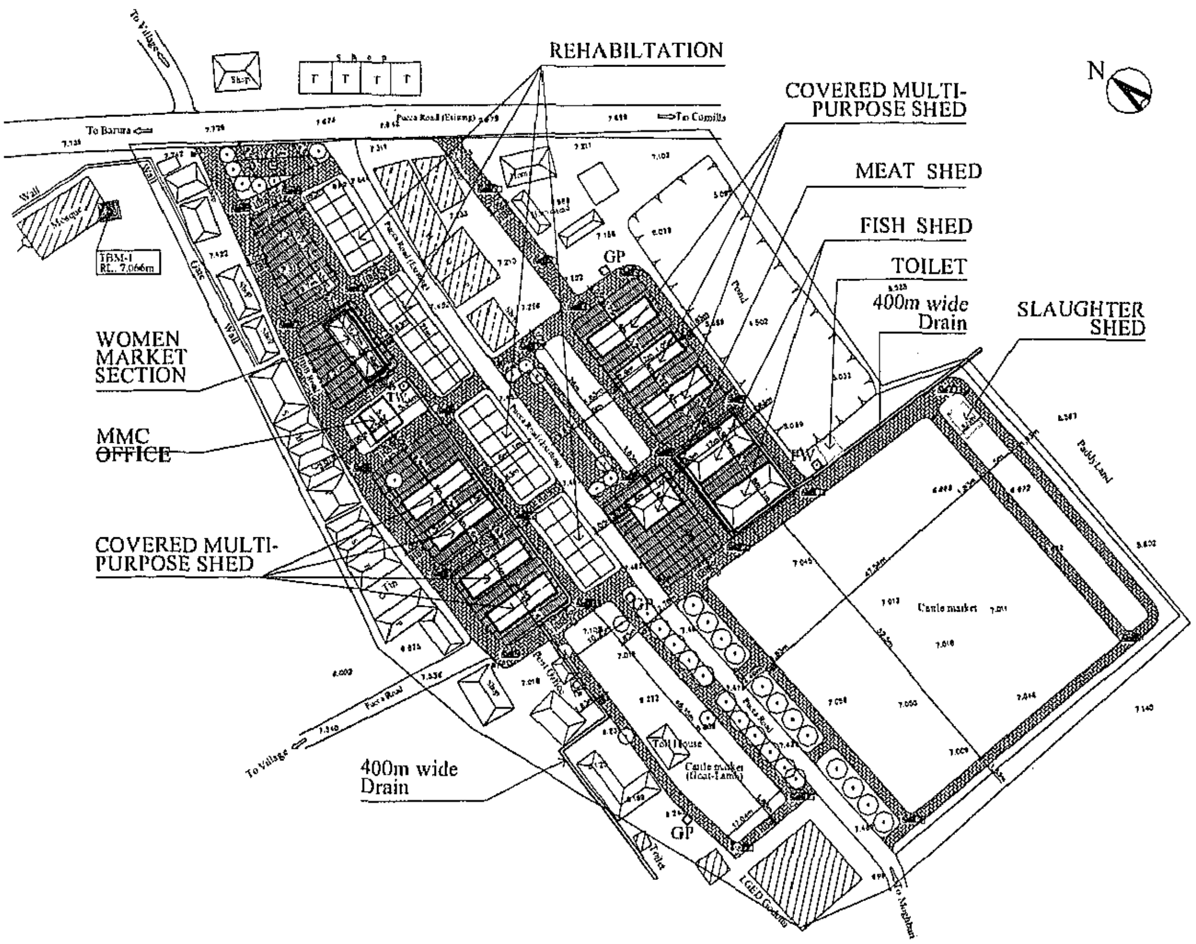
Photograph 10 Internal road in growth center
(Rajbari District)

Development of growth centers and rural markets should take the above-mentioned issues into consideration, along with the land conditions, dimensions, number of users, and size specific to each site. The following facilities should be constructed as a part of the improvement work.

- Drainage system
- Ghats
- Market section for women
- Multipurpose sheds
- Parking area
- Paved internal roads
- Sanitary toilet facilities
- Waste disposal facilities
- Water supply facilities
- Cyclone shelter shed
- MMC offices

2 Recommended specifications for basic market facilities

The following are the recommended specifications for the installation of each facility. Structural drawings will be provided as necessary. The typical layout of a growth center is presented in Figure 1.



Source: LGED

Figure 1 Typical layout of growth center

2.1 Drainage system

Drainage systems should be able to efficiently drain off rainwater during the rainy season. The drainage structure should have a concrete finish and a suitable cross-sectional area and gradient.

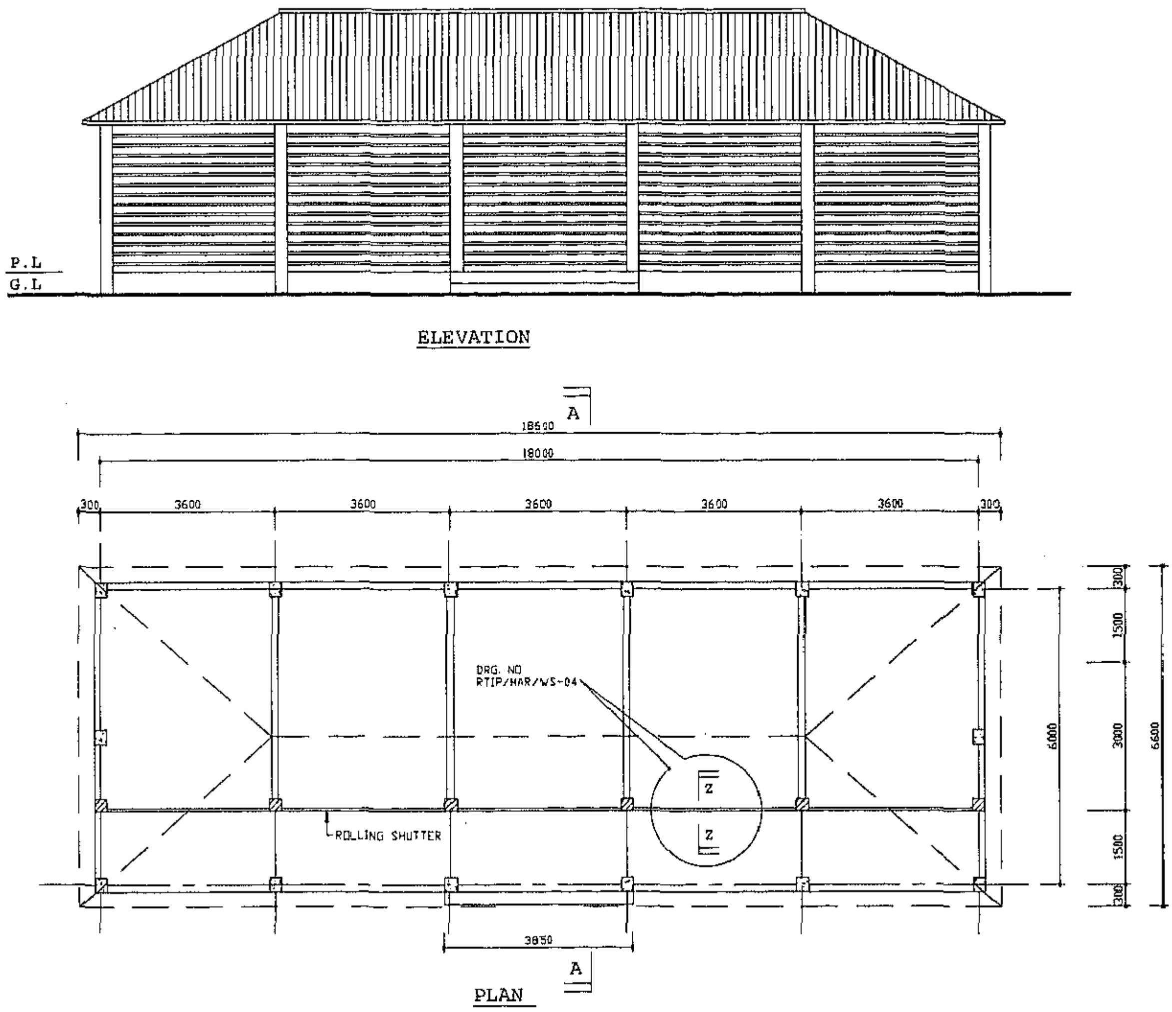
2.2 Ghats

Ghats should be built at markets along dams and rivers to improve the efficiency and safety of water transport. They should be built on gentle slopes for the safe loading and unloading of goods and passengers.[1]

[1] See Annex 15 for a cross-section.

2.3 Market section for women

Electricity and shutters should be installed in market sections for women for their convenience and safety. These sections should follow the structure of multipurpose sheds and be built with concrete foundation structures and tin roofs. In addition, toilet facilities for women should be built nearby (Figure 2).

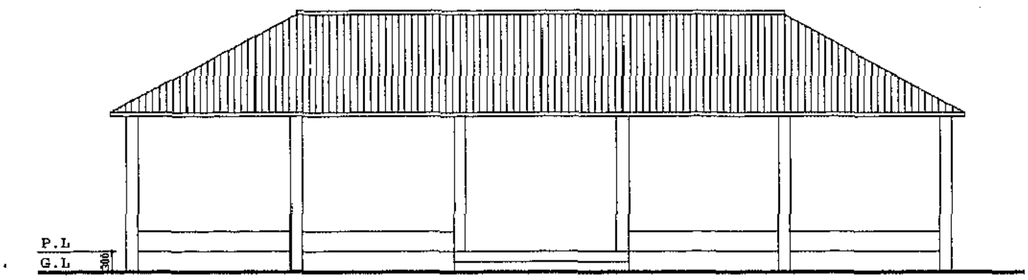


Source: LGED

Figure 2 Typical design of women's shed

2.4 Multipurpose sheds

Sheds for selling daily food products such as rice, milk, vegetables, fish, and meat should be hygienically-maintained. Multipurpose sheds should be built with concrete foundation structures and tin roofs (Figure 3).



Source: LGED

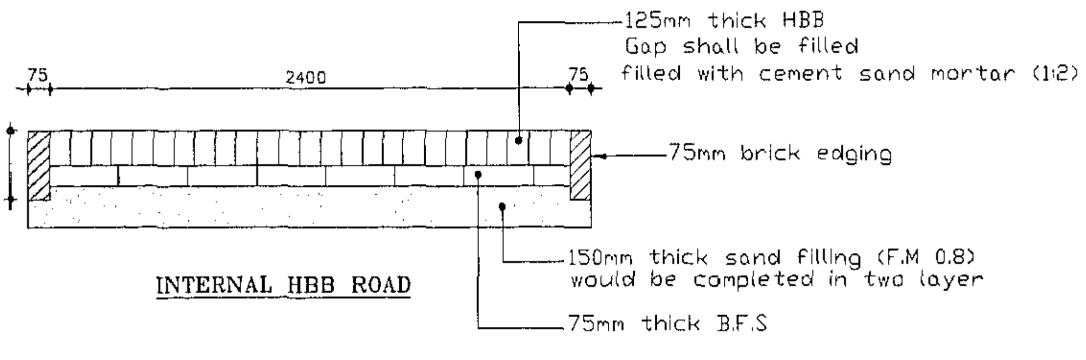
Figure 3 Typical design of multipurpose shed

2.5 Parking area

Parking areas are required for loading and unloading trucks and cars. They should be built adjacent to a main road near the market entrance where they would not obstruct passage within the market.

2.6 Internal roads

Internal earthen roads should be upgraded to HBB to ease the passage of market users, especially on hat days and during the rainy season.

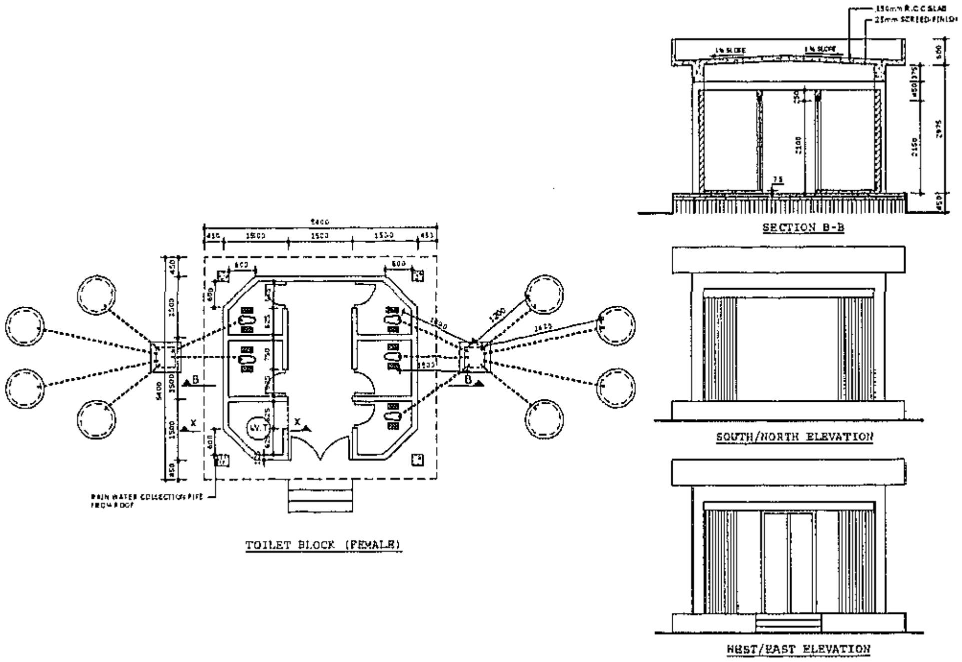


Source: LGED

Figure 4 Typical design of internal road with HBB

2.7 Sanitary toilet facilities

Toilet facilities should have flush toilets with storage tanks, and be partitioned by stalls with doors. Separate facilities should be installed for men and women. Water-supply pumps should be built nearby for hand-washing.

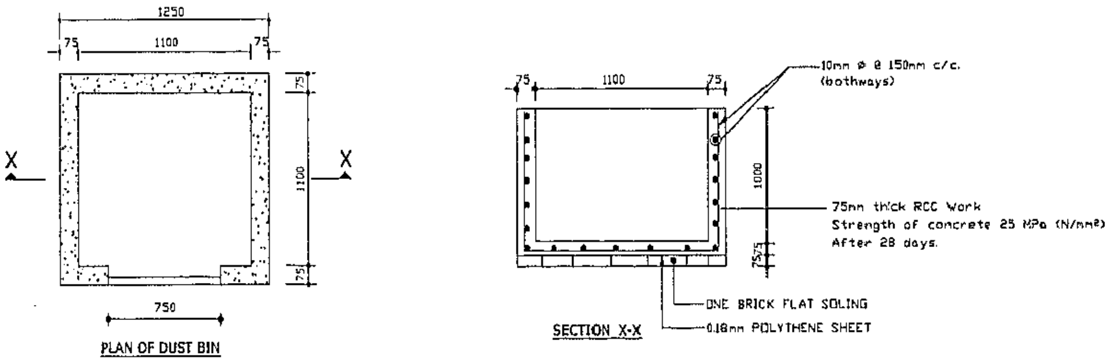


Source: LGED

Figure 5 Typical design of female toilet facilities

2.8 Waste disposal facilities

To improve sanitation within the market, waste dumps made of concrete blocks should be installed in several locations. The locations should be selected where they would not negatively affect the market during incineration.

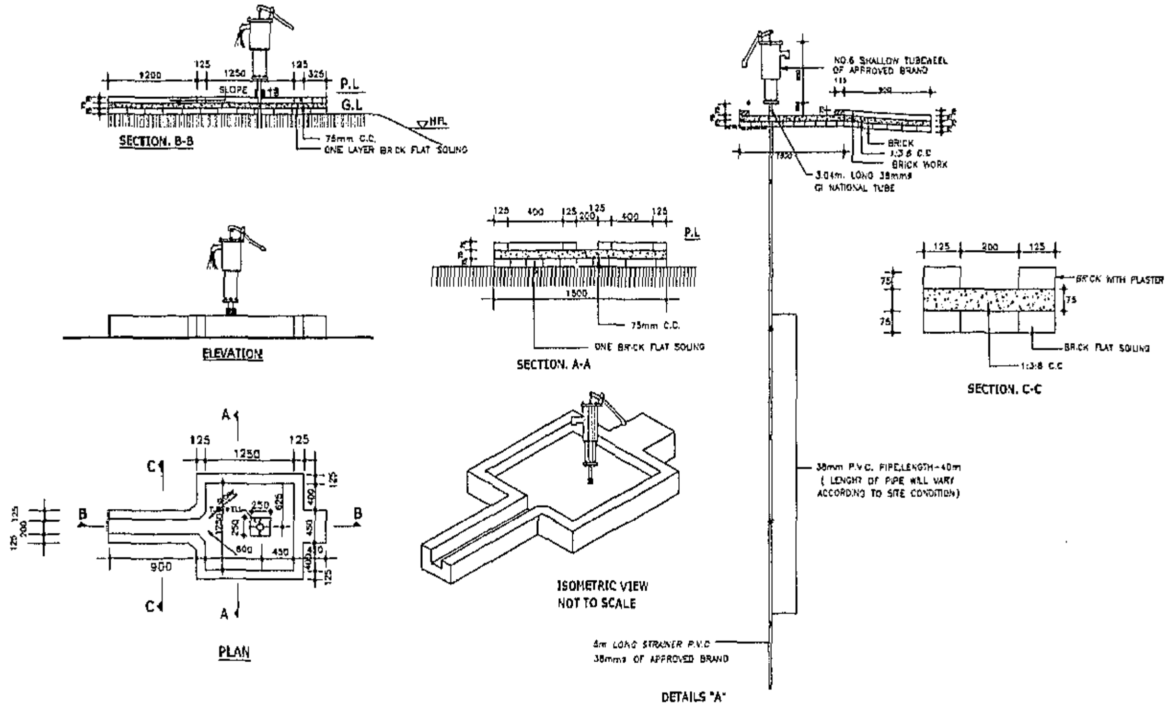


Source: LGED

Figure 6 Typical design of waste disposal facilities

2.9 Water supply facilities

Water supply facilities with hand pumps should be built to supply market users and nearby residents with free groundwater. Although underground water distribution systems could provide better-quality water, the Project would not be able to afford the necessary construction and maintenance costs within the tk. 3 million budget limit. Therefore, hand pumps are to be installed to supply water in markets.

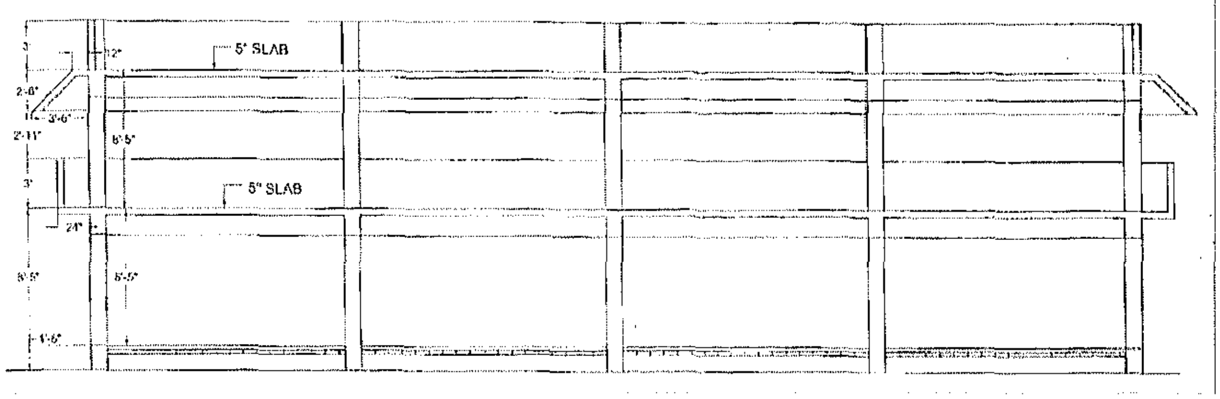


Source: LGED

Figure 7 Typical design of water supply facilities

2.10 Cyclone-resistant multipurpose market shed

Cyclone-resistant multipurpose market sheds with two stories will be developed in the selected growth centers situated in the flood-prone coastal Districts. The first and second floors of the shed will serve as trading areas, but during severe floods, when the first floor submerges under water, the second floor will be used as a shelter for local residents. The sheds should be built with reinforced concrete.

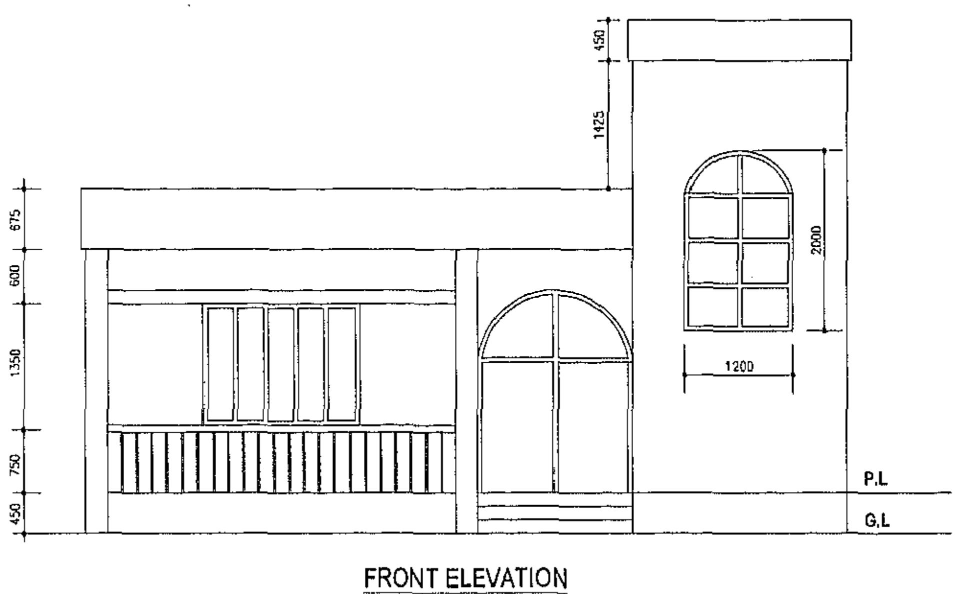


Source: LGED

Figure 8 Typical design of cyclone-resistant multipurpose market shed

2.11 Market Management Committee office

An MMC office should be built in each market to facilitate and stimulate the activities of MMC. Each office should be accompanied by a storage room, meeting room, and toilet facility.



Source: LGED

Figure 9 Typical design of Market Management Committee office

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ANNEX 17

Results of ranking calculation and characteristics of Upazila and Union roads selected for upgrading

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1 Upazila road

1.1 Prioritization criteria and results of Upazila road ranking calculation

The proposed Upazila roads are ranked according to the set of prioritization criteria and weighting scheme shown in Table 1. The road-by-road results of Upazila road ranking calculations are presented in Table 2.

Table 1 Prioritization criteria and weighting scheme for Upazila road ranking

	Evaluation criteria	Weighting scheme
A. National and basic selection policy		
A1	Category given to the road: Upazila Road	N.A.
A2	Selection of at least one Upazila road per Upazila	N.A.
B. Evaluation criteria for ranking		
B1 Level of development		**35%**
B1-1	Poverty: The Headcount Index (i.e., the proportion of the population that is counted as poor) in the Upazila where the Upazila Road is located (Data source: Bangladesh Bureau of Statistics, 2005)	10%
B1-2	Education: average years of schooling of adult household members in the Upazila where the Upazila Road is located (Data source: Bangladesh Bureau of Statistics, 2005)	5%
B1-3	District-wide GDP per capita in USD (Data source: Bangladesh Bureau of Statistics, 2000)	10%
B1-4	District-wide percentage of undeveloped Upazila roads (Data source: LGED, 2008)	10%
B2. Economic potential		**45%**
B2-1	Population density in the Upazila where the Upazila Road is located (Data source: Bangladesh Bureau of Statistics, 2005)	10%
B2-2	Revised EIRR (Data source: SAPROF team)	15%
B2-3	Number of growth centers and rural markets per kilometer adjacent to the Upazila Road (Data source: LGED, 2008)	10%
B2-4	Percentage of length of earthen segments to the total length of the Upazila Road (Data source: LGED, 2008)	10%
B3. Social impact		**5%**
B3-1	Number of schools, clinics, and cyclone shelters per kilometer adjacent to the Upazila Road (Data source: LGED, 2008)	5%
B4. Cost and difficulty of construction		**15%**
B4-1	Volume of earthwork estimated from the current width and height of alignment (Data source: LGED, 2008)	10%
B4-2	Total length of gaps per kilometer (Data source: LGED, 2008)	5%
Total		**100%**

The scoring schemes for the prioritization criteria are summarized below.

B1-1 and B1-2: All Upazilas in the project area are ranked according to severity of poverty and education level. Each Upazila is given a score ranging from 4 for the poorest or least educated quartile to 1 for the wealthiest or most educated quartile.

B1-3 and B-4: All Districts in the project area are ranked according to GDP per capita and progress of Upazila road development by LGED. Each District is given a score ranging from 1 for the quartile with the largest GDP per capita or the highest percentage of developed Upazila roads to 4 for the quartile with the smallest GDP per capita or the lowest percentage of developed Upazila roads.

B2-2 to B2-4 and B3-1: All proposed Upazila roads are ranked from highest to lowest. Each Upazila road is given a score ranging from 1, for the lowest quartile, to 4, for the highest quartile.

B4-1 and B4-2: All proposed Upazila roads will be ranked from highest to lowest. Each Upazila road is given a score ranging from 1, for the highest quartile, to 4, for the lowest quartile.

For all criteria: If data is not available, a score of 2 is given.

Table 2 Results of Upazila road ranking calculations

Division/Greater District / District / Upazila	Road Code (Gazetted)	Selected and to be financed by:	Initial ranking	Ranking in Upazila	Final ranking	Score	Poverty index		Years of edu-cation		Per capita GDP (USD)		Upazila Road upgraded		Population density (pop./km^2)		EIRR		Markets /km		Percentage of earthen road		Schools & social facility /km		Amount of earth-work		Gaps/km	
							V*1	Q*2	V*1	Q*2	V*1	Q*2	V*1	Q*2	V*1	Q*2	V*1	Q*2	V*1	Q*2	V*1	Q*2	V*1	Q*2	V*1	Q*2	V*1	Q*2
Barisal Division																												
Barguna																												
AMTALI	504092001	Loan	40	1	30	2.65	36.1	2	3.3	3	336	1	35%	4	360	1	37.2%	4	0.23	3	9.7%	1	0.39	2		4		4
AMTALI	504092007		125	2	113	2.05	36.1	2	3.3	3	336	1	35%	4	360	1	20.8%	1	0.13	1	87.3%	4	0.25	1	4.25	2		4
BAMNA	504192004	Loan	132	1	88	1.95	22.6	1	5.1	1	336	1	35%	4	691	2	26.8%	1		1	100.0%	4		1	2.60	3	1.28	2
BARGUNA-S	504282001	Loan	89	1	63	2.40	29.9	2	4.3	2	336	1	35%	4	523	1	31.1%	2	0.20	2	39.4%	3	0.39	2		4		4
BARGUNA-S	504282007		133	2	117	1.95	29.9	2	4.3	2	336	1	35%	4	523	1	30.8%	2		1	24.8%	2	0.17	1	2.90	3	1.26	2
BETAGI	504472002		124	2	112	2.05	26.7	1	4.5	2	336	1	35%	4	712	2	28.2%	2	0.14	1	52.2%	3	0.58	3	5.90	1		4
BETAGI	504472004	Loan	92	1	65	2.35	26.7	1	4.5	2	336	1	35%	4	712	2	37.8%	4	0.17	2		1	0.28	1	3.30	3		4
PATHARGHATA	504852002	Loan	53	1	38	2.60	24.1	1	4.7	1	336	1	35%	4	418	1	35.1%	3	0.64	4	30.7%	2	1.50	4		4		4
Barisal																												
AGAILJHARA	506022005	Loan	36	1	27	2.70	29.5	2	4.7	1	286	2	28%	4	1,001	4	39.4%	4	0.45	4		1	0.22	1	5.15	1		4
BABUGANJ	506032003	Loan	11	1	11	3.00	29.7	2	4.5	2	286	2	28%	4	890	3	38.3%	4	0.24	3	51.9%	3	0.96	4	3.47	2		4
BAKERGANJ	506072006	Loan	31	1	24	2.75	27.9	1	4.7	1	286	2	28%	4	857	3	34.3%	3	0.46	4	90.4%	4	0.80	4	5.85	1	0.90	3
BAKERGANJ	506072010		134	2	118	1.95	27.9	1	4.7	1	286	2	28%	4	857	3	21.2%	1	0.21	2	30.1%	2	0.42	2	4.62	2	43.59	1
BANARIPARA	506102001	Loan	122	1	85	2.10	26.1	1	4.4	2	286	2	28%	4	1,134	4	16.8%	1	0.16	1	40.2%	3	0.52	2	3.42	2	35.22	1
BARISAL-S	506512004	Loan	59	1	43	2.60	22.2	1	6.0	1	286	2	28%	4	1,458	4	38.5%	4		1	57.6%	3		1	4.55	2		4
GOURANADI	506322006	Loan	73	1	53	2.50	28.7	1	5.1	1	286	2	28%	4	1,250	4	46.7%	4		1		1	0.58	3	4.03	2		4
HIZLA	506362001	Loan	60	1	44	2.60	54.8	4	3.1	4	286	2	28%	4	339	1	35.5%	3	0.11	1	86.5%	4	0.32	1	5.59	1		4
HIZLA	506362004		127	2	114	2.05	54.8	4	3.1	4	286	2	28%	4	339	1	25.4%	1		1	58.3%	3	0.25	1	6.45	1	11.83	1
MEHENDIGANJ	506622006	GOB	84	2	102	2.40	45.1	3	3.4	3	286	2	28%	4	698	2	29.5%	2		1	25.7%	2		1	3.03	3		4
MEHENDIGANJ	506622005 & 506622002	Loan	39	1	29	2.70	45.1	3	3.4	3	286	2	28%	4	698	2	39.6%	4	0.28	3	34.5%	2		1	4.24	2	4.01	2
MULADI	506692003	Loan	100	1	72	2.30	38.4	3	4.1	2	286	2	28%	4	702	2		2	0.19	2		1	0.24	1		4	6.33	1
UZIRPUR	506942003	Loan	9	1	9	3.05	29.1	2	4.7	1	286	2	28%	4	972	4	34.9%	3	0.30	3	46.9%	3	0.81	4		4	0.13	3
UZIRPUR	506942004	GOB	29	2	93	2.75	29.1	2	4.7	1	286	2	28%	4	972	4	35.8%	3	0.18	2	16.2%	2	0.18	1		4		4
UZIRPUR	506942011		43	3	122	2.65	29.1	2	4.7	1	286	2	28%	4	972	4	29.5%	2	0.37	4	45.6%	3	0.47	2	6.66	1		4
UZIRPUR	506942005 & 506322011		57	4	130	2.60	29.1	2	4.7	1	286	2	28%	4	972	4	32.1%	3	0.30	3		1	1.33	4	4.72	1		4
Bhola																												
BHOLA-S	509182012	Loan	7	1	7	3.05	47.9	4	3.4	3	320	2	62%	2	988	4	31.9%	3	0.42	4	32.5%	2		1		4		4
BORHANUDDIN	509212004	Loan	111	1	80	2.20	51.2	4	2.9	4	320	2	62%	2	858	3	24.8%	1	0.10	1	58.0%	3	0.10	1	4.25	2	1.87	2
CHARFASSION	509252007	Loan	87	1	61	2.40	51.6	4	2.9	4	320	2	62%	2	287	1	27.9%	2	0.22	2	100.0%	4	0.45	2	9.10	1		4
DAULATKHAN	509292006		62	99	135	2.55	48.3	4	2.9	4	320	2	62%	2	547	1		2	0.63	4		1	0.63	3	2.58	3		4
LALMOHAN	509542002	Loan	85	1	60	2.40	54.3	4	2.5	4	320	2	62%	2	698	2	21.1%	1	0.20	2	60.9%	3	0.52	3	3.60	2		4
MONPURA	509652001	Loan	83	1	59	2.40	45.5	4	2.7	4	320	2	62%	2	180	1	20.9%	1	0.22	2	27.6%	2	0.60	3		4		4
MONPURA	509652002		81	99	137	2.40	45.5	4	2.7	4	320	2	62%	2	180	1		2	0.22	2		1	0.44	2		4		4
TAZUMUDDIN	509912004	Loan	66	1	48	2.55	60.1	4	2.3	4	320	2	62%	2	234	1	25.7%	1	0.35	4	79.4%	4	0.52	2	3.64	2		4
Jhalakati																												
JHALOKATHI-S	542402003	Loan	38	1	28	2.70	23.5	1	5.2	1	256	4	36%	4	979	4	24.9%	1	0.23	2	75.8%	4	0.68	3	2.95	3	0.41	3
JHALOKATHI-S	542402004	GOB	103	2	106	2.30	23.5	1	5.2	1	256	4	36%	4	979	4	25.9%	1	0.08	1	31.6%	2		1	0.46	4	11.49	1

Note: 1) "V" means value and "Q" means quintile value.