Local Government Engineering Department

PAVEMENT DESIGN CATALOGUE

JULY 2003

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FOREWORD

To harmonize the pavement design of different category roads under various project implemented by Local Government Engineering Department (LGED) a Design Harmonization Committee is formed to produce a need-based Pavement Design Catalogue. Actually, the functions of (LGED) includes among others, Planning, Design, Implementation and Monitoring of both Rural & Urban Infrastructure Including Small Scale Water Resources Projects. The overall objective of the Infrastructure Development Projects is to Improvement of Communication System; Facilitate Agricultural Production and Marketing of such goods through Construction & Reconstruction of Upazila, Union and Village Roads along with updated water resources management. To achieve these goals LGED Implements its infrastructure intending to use locally available materials & manpower. Emphasizing that target LGED now think to simplify road construction technology for easy management with ensuring quality of construction work. It is intended that this Pavement Design Catalogue will contribute to improvement of quality of civil work by maintaining uniform design throughout the LGED. Although it is prepared primarily for LGED staff, but it is our hope that other Local Government Institute (LGI) might draw benefit from using it and contribute insight to improve it. This Pavement Design Catalogue is expected to serve as alive document, which is updated with experience and new information comes to light. Any comments related to its improvement will be greatly appreciated and be taken into consideration in subsequent updates.

If the Pavement Design Catalogue can achieve its purpose in serving as a useful resource for planners, designers and users I believe that the efforts worthwhile. It is my sincere wish that the continuous exchange between information and practice in the design arena, towards which we play a part, can lead to long-term benefit and ultimately the sustainable development of Bangladesh.

I express my deep appreciation and thanks to the member of Design Harmonization committee for preparing the LGED Road Pavement Design Catalogue. I would also expect that all engineers of LGED should use the Pavement Design Catalogue in the construction of Upazila, Union and other Roads.

(Md. Shahidul Hassan)
Chief Engineer, LGED

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INTRODUCTION

Bangladesh has characteristics of high population density, high productivity of land, intensive cultivation, small-scale farming and poverty-induced sale of even subsistence level production, search for employment by the under-employed in farms and non-farm activities and an active non-farm sector. All these together generate intensive trading of goods and services in the rural areas and a high level of demand for movement of goods and people which results the level of traffic in the rural areas of Bangladesh comparatively high.

The Roads and Highways Department (RHD) and the Local Government Engineering Department (LGED) share responsibilities for the entire road network of the country. While the former is to manage the National, Regional and Zila Road, the latter is to focus on the Upazila Road, Union Road and Village Road.

Building communication network in the rural areas has become the dire necessity of the time with the ardent objective of stimulating trade and commerce in the rural areas – an inalienable area of the national economy. This paramount responsibility has been bestowed upon LGED which is one of the largest works department in Bangladesh and has a well disciplined organization with a tiny top on a flat base that fully commensurate the government's decentralization policy. As a matter of fact, all implementation responsibilities related to rural infrastructure development are vested with the functionaries of LGED at the Upazila and the District levels. It is thus a demand that the technical people at the field levels become proficient and well competent for producing economically viable quality output. It is a long felt need of LGED that a suitable Pavement Design Catalogue on road design is developed in the context of Bangladesh. With this end in view, Pavement Design Catalogue' 03 has been prepared which will serve as a ease handbook on road pavement and will augment the efficiency of LGED's fully committed field level technical staff.

Importance of Development of Rural Areas in Bangladesh

Population density in Bangladesh is very high. About 80% of the population lives in the rural areas. Poverty is widespread in the country and more so in the rural areas. Development of rural areas has greater role to achieve national goal for poverty alleviation. Because of effectiveness of the program in creating productive employment opportunities and income generation programs, the Government of Bangladesh has given higher priority to rural development sector. The strong initiative of the Government towards the development of concerned programs in rural sector in the latest completed series of National Development Plan serve as a ready reference for designing a cost-effective road pavement.

Local Government Engineering Department

Local Government Engineering Department is Prime engineering Department in perusing rural development programme. LGED's main functions are to provide technical support to the Local Government Institutes, Planning and Implementation of Infrastructure Development Projects in Rural and Urban Areas to improve communication/transport network, employment generation and poverty reduction

Reflecting strong initiatives of Government for pursuing rural prosperity, the total volume of investment program into rural infrastructure has been continuously increasing. In addition to such quantitative aspect, the better and reliable quality of development rural infrastructures is requested to meet the social demand for efficient performance of public investment, LGED has been playing key role for rural infrastructure development with high performance and flexibility on each project component.

LGED ROADS

LGED is entrusted with construction and improvement of three types of Rural Roads as under: -

Upazila Road	Roads connecting Upazila HQ/s with Growth Center/s or one Growth Center with another Growth Center by a single main connection or connecting Growth Center to Higher Road system, through shortest distance/ route.
Union Road	Roads connecting Union HQ/s with Upazila HQ/s, growth centers or local markets or with each other.
Village Road	a) Roads connecting villages with Union HQ/s, local markets, farms and ghats or with each other. b) Road within a village.

THE PAVEMENT DESIGN CATALOGUE

The Pavement Design Catalogue contains pavement cross-sections of Upazila Roads with initial traffic of 500, 300 and 200 commercial vehicle (10.2 ton) and Union Roads with initial traffic of 300, 200 and 100 commercial vehicle (10.2 ton).

This Pavement Design Catalogue also contains sample suggestion for shoulder treatment when roads passing through built-up or market areas.

The Pavement Design Catalogue also provides guidelines for Road Junction, Road Intersection and Road Widening for Bus Stop and rural traffic stand.

The Pavement Design Catalogue contains Pavement cross-sections for Upazila Roads and Union Roads (previously called FRB and Rural Roads) along with shoulder and drainage treatment in Hilly areas.

The Pavement Design Catalogue provides important guidelines for Gradients and Super Elevation for longitudinal profile of roads and extra width of pavement required at horizontal curves.

The Pavement Design Catalogue also provides sample protective measures to road embankment venerable to erosion due to wave action of floodwater in Char and Haor areas.

GEOMETRIC DESIGN CRITERIA OF UPAZILA ROAD AND UNION ROAD

1. Gradients

Gradient is the longitudinal slope of a road. The following gradients for Upazila Roads and Union Roads tentatively recommended:

Table-1
Gradients

Terrain	Ruling grade (Maximum)	Limiting grade (Maximum)
Plains	1 in 30	1 in 20
Hills	1 in 20	1 in 15

a. Ruling gradient: This gradient is the slope of the road, which is adopted in road design and calculations of cuts and fills. This gradient is decided in such ways that slow moving and fast moving, both types of traffic can easily negotiate over this slope.

b. Limiting gradient: This gradient may be used, where topography of a place compels this course or where the adoption of gentler gradients would add enormously to the cost. In such cases, the lengths of the continuous grade line at a grade steeper than the ruling gradient should be limited as far as possible. In hills where limiting gradients have to be used rather frequently, it is important to separate such stretches by providing stretches of level road on easier grades.

2. Super Elevation

It is the inward tilt of the road surface provided at the horizontal curves, to compensate the effect of centrifugal force. It is generally denoted by "e". The value of super elevation depends upon the speed of the vehicle negotiating the horizontal curve and the radius of the curve. Value of super elevation can be calculated from the following formula.

$c = \frac{v2}{126R}$, Subject to a maximum of 0.06° or $\frac{1}{15}$

Super elevation should never be less than the camber appropriate to the type of surface namely.

- Bituminous Carpeting surface 1 in 60
- HBB 1 in 36 to 1 in 48

Table-2
Radius beyond which no Super-elevation is required

Classification of Road	Radius beyond which super-elevation is not required (meters)
Upazila and Union Roads	610

3. Extra Width of Pavement at Horizontal Curves

On all horizontal curves some extra width of the carriage-way is provided. In Table 3 extra widths to be provided are shown. These extra widths are for one lane (3.66m) and two lane (5.46m) pavements.

Table-3

Radius of curve in meters	Up to 60m	61m to 150m	151m to 300m	301m to 900m	Above 900m
Extra width in meters	1.2m	90cm	60 cm	30cm	nil

Extra-widening should be equally distributed on the inner and outer sides except that in the case of sharp curves in hill roads, with radius of curve less than 60m, the widening should be on the inside only.

The widening will start at the beginning or tangent point of the transition curve and progressively increases at the uniform rate till the maximum designed widening is reached at a point in the transition curve, where the full designed super-elevation is reached. Thereafter the same widening will be continued till a similar point in the further transition is reached, where the designed super-elevation starts reducing.

PAVEMENT DESIGN CONFIGURATION FOR UPAZILA ROAD

1.	Axle Loading		:	10.2 Ton
2.	Initial Traffic:	Category I	:	500 CV/Day
		Category II	:	300 CV/Day
		Category III	:	200 CV/Day
3.	Growth rate		:	8%
4.	Design life		:	10 Years.
5.	Sub-Grade CBR		:	Min 4% (Soaked).
6.	Improved Sub-Grade CBR (Sand FM 0.50 min)		:	Min 10%
7.	Base Course 1st layer CBR (WBM Brick or Stone Aggregate, 38mm down graded, LAA<40% and AIV <32%)		:	Min 40%
8.	Base-Course 2nd & 3rd layers CBR (WBM Brick or Stone Aggregate, 38mm down graded, LAA<40% and AIV <32%)		:	Min 80%
9.	Bituminous carpeting		:	40mm BC plus 7mm Seal coat
10.	Single Lane Carriage-Way width		:	3.66m.
11.	Double Lane Carriage-Way width		:	5.46m.
12.	Hard Shoulder	Option I	:	0.90m Design Pavement for Single lane
		Option II	:	0.90m HBB For Single Lane
13.	End Edging			125mm Brick on edge
14.	Earthen Shoulder		:	95% STD Compaction
15.	Crest width		:	7.32m.
16.	Side Slope		:	1: 1.5 for clayey soil Road Embankment
			:	1 : 2 for Sand or silty Sand Road Embankment

UPAZILA ROAD DESIGN PLATES

UPAZILA ROAD IN PLAIN LANDS

Plate UPR-BC1-DL-1

This is a standard option of Upazila Road Pavement. It is a dual carriage-way pavement to support 500 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.

The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UPR-BC1-DL-1A

This is a standard option of Upazila Road Pavement with Pavement Hard shoulder. It is a single carriage-way pavement to support 300 commercial vehicle per day at start. It may be upgraded to dual carriage-way by applying bituminous carpeting over hard shoulders. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.

The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UPR-BC1-HBS-1

This is a standard option of Upazila Road Pavement with HBB Hard shoulder. It is a single carriage-way pavement to support 300 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.

The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UPR-BC1-WHS-1

This is a standard option of Upazila Road Pavement without Hard shoulder. It is a single carriage-way pavement to support 200 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.

The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

PAVEMENT DESIGN COFIGURATION FOR UNION ROAD

1.	Axle Loading		:	10.2 Ton
2.	Initial Traffic:	Category I	:	300 CV/Day
		Category II	:	200 CV/Day
		Category III	:	100 CV/Day
3.	Growth rate		:	8%
4.	Design life		:	10 Years.
5.	Sub-Grade CBR		:	Min 4% (Soaked).
6.	Improved Sub-Grade CBR (Sand FM 0.5min)		:	Min 10%
7.	Base Course 1st layer CBR (WBM Brick or Stone Aggregate, 38mm down graded, LAA<40% and AIV <32%)		:	Min 40%
8.	Base-Course 2nd & 3rd layers CBR (WBM Brick or Stone Aggregate, 38mm down graded, LAA<40% and AIV <32%)		:	Min 80%
9.	Bituminous carpeting		:	40mm BC plus 7mm Seal coat
10.	Single Lane Carriage-Way width		:	3.05m.

11.	Hard Shoulder	:	HBB 0.60m each side.
12.	End Edging	:	125mm Brick on edge
13.	Earthen Shoulder	:	95% STD Compaction
14.	Crest width	:	5.05m.
15.	Side Slope	:	1: 1.5 for clayey soil Road Embankment
		:	1 : 2 for Sand or silty Sand Road Embankment

UNION ROAD DESIGN PLATES

UNION ROAD IN PLAIN LANDS

Plate UNR-BC1-HBS-1

This is a standard option of Union Road Pavement with 600 mm HBB Hard Shoulder. It is a single carriage-way pavement to support 300 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.
The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UNR-BC1-WHS-1

This is a standard option of Union Road Pavement without Hard Shoulder. It is a single carriage-way pavement to support 200 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.

The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UNR-BC2-WHS-1

This is a standard option of Union Road Pavement without Hard Shoulder. It is a single carriage-way pavement to support 100 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 180 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there is another layer of Base Course of 100mm thick with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.

The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

UPAZILA ROAD IN HILLY AREAS

Plate UPR-BC1-HL-1

This is a standard option of Upazila Road Pavement without Hard shoulder through Hills having run-off drainage on both sides. Shoulder treatment may be provided as needed. It is a single carriage-way pavement to support 200 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.
The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UPR-BC1-HL-2

This is a standard option of Upazila Road Pavement without Hard shoulder through shallow Hill-cut having hills on one side. Shoulder treatment may be provided as needed. It is a single carriage-way pavement to support 200 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.
The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UPR-BC1-HL-2A

This is a standard option of Upazila Road Pavement without Hard shoulder through shallow Hill-cut having hills on both sides. Shoulder treatment may be provided as needed. It is a single carriage-way pavement to support 200 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.
The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UPR-BC1-HL-3

This is a standard option of Upazila Road Pavement without Hard shoulder through Deep Hill-cut having hills on one side. Shoulder treatment may be provided as needed. Sub-surface drainage has been provided to drain seepage water. It is a single carriage-way pavement to support 200 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.

The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

Plate UPR-BC1-HL-3A

This is a standard option of Upazila Road Pavement without Hard shoulder through Deep Hill-cut having hills on both sides. Shoulder treatment may be provided as needed. Sub-surface drainage has been provided to drain seepage water. It is a single carriage-way pavement to support 200 commercial vehicle per day at start. It has sub-grade having 4% Soaked CBR and 200 mm Improved Sub-grade with sand compacted to 100 percent STD to achieve 10% soaked CBR. The first layer (100mm) of Base Course is made of 38mm down graded Coarse Aggregate having LAA <40% and AIV <32% and CBR 40% minimum. On the above there are another two layers of Base Course of 75mm thick each with similar aggregate compacted with 5-6 Ton vibratory rollers to achieved 80% CBR value.

The top is carpeted with 40mm bituminous carpeting and 7mm seal coat.

UPAZILA ROAD HBB PAVEMENT IN HILLY AREAS

Plate UPR-HBB-HL-1

This is a HBB standard option of Upazila Road Pavement without Hard shoulder through Hills having run-off drainage on both sides. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB. This is also an option of HBB pavement for Upazila Road in plain lands excluding earth heaps at earthen shoulders.

Plate UPR-HBB-HL-2

This is a HBB standard option of Upazila Road Pavement without Hard shoulder through shallow Hill-cut having hills on one side. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB.

Plate UPR-HBB-HL-2A

This is a HBB standard option of Upazila Road Pavement without Hard shoulder through shallow Hill-cut having hills on both sides. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB.

Plate UPR-HBB-HL-3

This is a HBB standard option of Upazila Road Pavement without Hard shoulder through deep Hill-cut having hills on one side. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB. Sub-surface drainage has been provided to drain seepage water.

Plate UPR-HBB-HL-3A

This is a HBB standard option of Upazila Road Pavement without Hard shoulder through deep Hill-cut having hills on both sides. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB. Sub-surface drainage has been provided to drain seepage water.

UNION ROAD HBB PAVEMENT IN HILLY AREAS

Plate UNR-HBB-HL-1

This is a HBB standard option of Union Road Pavement without Hard shoulder through Hills having run-off drainage on both sides. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB. This is also an option of HBB pavement for Union Road in plain lands excluding earth heaps at earthen shoulders.

Plate UNR-HBB-HL-2

This is a HBB standard option of Union Road Pavement without Hard shoulder through shallow Hill-cut having hills on one side. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB.

Plate UNR-HBB-HL-2A

This is a HBB standard option of Union Road Pavement without Hard shoulder through shallow Hill-cut having hills on both sides. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB.

Plate UNR-HBB-HL-3

This is a HBB standard option of Union Road Pavement without Hard shoulder through deep Hill-cut having hills on one side. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB. Sub-surface drainage has been provided to drain seepage water.

Plate UNR-HBB-HL-3A

This is a HBB standard option of Union Road Pavement without Hard shoulder through deep Hill-cut having hills on both sides. Shoulder treatment may be provided as needed. It is a single carriage-way pavement where quality control is hard to ensure due to deep hills. It is aimed at all weather traffic flow at the initial stage. It has sub-grade having 4% Soaked CBR and 125 mm sand cushioning compacted to 100 percent STD. Another 25mm sand cushioning has been provided in between flat soling and HBB. Sub-surface drainage has been provided to drain seepage water

SHOULDER TREATMENT OF UPAZILA ROADS OR UNION ROADS CROSSING MARKET PLACE OR BUILT-UP AREAS

Plate UPR-UNR-BT-SLD-1

This is a shoulder development option of Upazila Roads and Union Roads crossing market place or built-up areas. This treatment is provided beyond road pavement or hard shoulder.
It is made of brick bonded concrete (BBC) of 1.0 meter wide each side. Beyond BBC, it is proposed brick flat soloing extending up to drain at road boundary line.

Plate UPR-UNR-BT-SLD-2

This is a shoulder development option of Upazila Roads and Union Roads crossing market place or built-up areas. This treatment is provided beyond road pavement or hard shoulder.
It is made of brick bonded concrete (BBC) of 1.0 meter wide each side. Beyond BBC, it is proposed brick kerbstone to provide 1.0m walkway and side drain at depressions.

Plate UPR-UNR-BT-SLD-3

This is a shoulder development option of Upazila Roads and Union Roads crossing market place or built-up areas. This treatment is provided beyond road pavement or hard shoulder.
It is made of HBB of 1.0 meter wide each side. Beyond HBB, it is proposed brick kerbstone to provide 1.0m walkway and side drain at depressions.

Plate UPR-UNR-BT-SLD-4

This is a shoulder development option of Upazila Roads and Union Roads crossing market place or built-up areas. This treatment is provided beyond road pavement or hard shoulder.
It is made of brick bonded concrete of 1.0 meter wide each side. Beyond BBC, it is proposed earthen shoulder maintaining slope for run-off drainage at random.

ROAD JUNCTION AND BUS STOP AT UPAZILA ROAD

Plate UPR-BC1-RJ-1

This is a Upazila Road Junction option with a link road eventually generating Bus Stop and Rickshaw Stand. It needs widening of Upazila Road pavement and construction of pavement on link road up to certain length. It will contribute ease traffic flow at Junction and durability of pavement.

Plate UPR-BC1-RJ-2

This is a Upazila Road Junction option with a cross-link of a road eventually generating Bus Stop and Rickshaw Stand. It needs widening of Upazila Road pavement and construction of pavement on link road up to certain length. It will contribute ease traffic flow at Junction and durability of pavement.

Plate UPR-BC1-BS-1

This is a Upazila Road Bus stop option at mid block location. It needs widening of Upazila Road pavement. It will contribute ease traffic flow at Bus stop and durability of pavement life.

Plate UPR-BC1-BS-2

This is a Upazila Road Bus stop option through a small market place It needs widening of Upazila Road pavement. It will contribute ease traffic flow through market place and durability of pavement life.

Plate UPR-BC1-BS-3

This is a Upazila Road Bus stop option through a large market place or built-up area. It needs widening of Upazila Road pavement. It will contribute ease traffic flow through market place or built-up area and durability of pavement life.

ROAD JUNCTION AND BUS STOP AT UNION ROAD

Similar drawing plates have been provided for road junction treatment and bus stop for Union Roads as well.

ROAD EMBANKMENT PROTECTION AT CHAR AND HAOR AREA

Plate UPR-UNR-EM1-1/2 & 2/2

This is an option of Road Embankment Protection at Haor or waterlogged Areas where tremendous wave action results erosion on the Embankment due to storm and high-speed wind.

Plate UPR-UNR-EM2-1

This is an option of Road Embankment Protection at char area where lands are inundated due to normal floods and wave action results erosion to the Embankment during floods.

Note: If char land remains above normal flood water level, embankment of road shall be lined with clayey soil (0.30m thick), PI value range 8 to 20%. Turfing or seedling with ‘Durba’ grass is a must over lining of side embankment.

ROAD PAVEMENT CONSTRUCTION METHOD

1.0 EARTHWORKS FOR EMBANKMENT

a. REPORTING & MONITORING

The Contractor shall keep a Site Order Book on site at all times. Instructions on the work and all site visits shall be recorded in the Site Order book.

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1.1 EMBANKMENT

a. Description

This work shall consist of the construction of embankment and fill by furnishing, placing, compacting and shaping suitable material of acceptable quality obtained from approved sources in accordance with these specifications and to the lines, levels, grades, dimensions and cross sections shown on the Drawings or as required by the Engineer.

The location of borrow pit shall be approved by the Engineer and must be at a distance of 3.Om or 1.5 times the height of the embankment, whichever is higher from the toe to the designed embankment. The depth of excavation in borrow pits shall not exceed 0.8m under normal conditions.

b. Materials

All fill materials shall be free from roots, sods or other deleterious materials.

Materials for embankments shall be stockpiled outside the working areas. Materials shall be tested and approved by the Engineer.

The selected fill material so stockpiled shall satisfy the following criteria:

- Liquid limit of fraction passing 425 micron sieve shall not exceed 50%

- Plasticity index of fraction passing 425 micron sieve shall not exceed 20%

- The dry density after compaction in embankment layers more than 300mm below sub-grade level shall not be less than 90% of the maximum dry density.

- The dry density after compaction in embankment within 300mm below the top of the sub grade level (or such greater depth if shown in the plans and drawings) shall not be less than 95% maximum dry density

- Soaked (4 days) CBR greater than 4% at 95% MDD (STD).

- The moisture content at the time of compaction shall be the optimum moisture content (Standard Compaction) ± 5%.

In case if the embankment material is sand, side slopes and shoulders shall be covered by cohesive soil of PI value in between 8-20%.

1.1.1 Construction Methods

a. Preparation of Foundation for Embankment

Prior to placing materials for any embankment upon any area, all clearing and grubbing operations shall have been completed.

The original ground surface shall be prepared with scarifying, watering, aerating and compacting. The dry density after compaction shall not be less than 90% of MDD (STD).

Embankments in swamps or water shall be constructed as indicated on the Drawings and as described in these Specifications. The Contractor shall, when ordered by the Engineer, excavate or displace swampy ground and backfill with suitable material. Such backfill shall be river or beach sand unless otherwise directed by the Engineer.

b. Widening Existing Embankment

Where embankment fill is being carried out to widen an existing embankment the new fill material shall be fully keyed into the old embankment by means of benching which shall be in steps each not less than 300mm high and 600mm wide. Steps shall be cut in advance of the filling. Material cut in benches may be used as fill if it compiles with Article 1.1b above or as directed by the Engineer. Sample of stepping construction of widening road Embankment has been shown for Upazila Road in Plate No. URR-EW-WDI and for Union Road in Plate No. UNR-EW-WDI.

c. Embankment Fill from Roadway Excavation

Existing Subgrade within 300mm depth of the existing road level, (or as specified) not having the required percentage of compaction, shall be excavated out.

Provided the excavated material is in accordance with article 1.1b then it shall be reworked and reused in widening or raising the embankment to the specified percentage of compaction and in accordance with paragraph 1.1.1d.

Where the item "embankment fill from roadway excavation" is used and paid for, there shall be no separate payment for sub grade preparation under section 1.2.

d. Compaction of Embankment

Embankment shall be constructed in layer not more than 150mm compacted layers. When necessary, each layer, before being compacted, shall be mixed with dry material or otherwise processed to bring the moisture content to within the limits established in Article 1.1b above. The material shall be so worked as to have a uniform moisture content through the entire layer.

Each layer of material shall' be compacted uniformly by use of adequate and appropriate mechanical compaction equipment. The compaction shall be carried out in a longitudinal direction along the embankment and shall generally begin at the outer edges and progress toward the centre except in the super elevated area in such a manner that each section receives equal compactive effort.

Compaction equipment shall be operated over the full width of each layer as far as practicable.

Samples to determine the compaction shall be taken regularly with a minimum one sample for each full width 100 linear metres of a finished layer or as directed by the Engineer. The Engineer shall test the compacted layer before the Contractor can commence a new layer. If the test results show that the density is less than the required density the Contractor shall carry out further compaction to obtain at least the required density.

e. Additional Filling

To ensure that, the embankment is properly compacted up to the edges of each layer, overfilling and compaction of minimum 300mm horizontally on both sides of the embankment is required, which later on has to be cut and removed. No extra payment will be made for this procedure.

Embankment construction or embankment widening must be completed before box cutting for pavement construction.

1.2 PREPARATION OF SUBGRADE

a. Description

This work shall consist of the preparation of subgrade in embankment in cut by scarifying, watering, aerating, compacting and shaping existing or previously placed material in accordance with these specifications and to the lines, levels grades, dimensions, camber and cross sections shown on the Drawings or as instructed by the Engineer.

b. Materials

All subgrade material shall be suitable material in accordance with the requirements of Article 1.1b.

Any subgrade material in cut or existing old embankment which is found to be unsuitable shall be removed and replaced as directed by the Engineer.

1.2.1 Construction Methods

The subgrade shall be prepared after box cutting for pavement construction. Half width working may be allowed only with the prior written approval of the Engineer.

The subgrade shall be prepared in lengths of not less than 1 00 metres and not more then 500 metres at a time.

When existing subgrade compaction is found less than 95 percent STD, subgrade material shall be excavated to a depth of 150mm and stockpiled and a further 150mm should be scarified and compacted. The excavated top layer material shall then be spread and compacted as specified. But if natural compaction sub grade is 95% STD available, two to three passes of 3-5 ton vibratory roller over natural sub-grade are specified.

When necessary, each layer, before being compacted, shall be allowed to dry or be watered to bring the moisture content with ± 5% of optimum to make possible its compaction to the required density. The material shall be so worked as to have uniform moisture content through the entire layer.

The sub grade material shall be compacted uniformly by use of adequate and appropriate mechanical compaction equipment. The compaction shall be done in a longitudinal direction along the embankment and shall generally begin at the outer edges and progress toward the centre in such a manner that each section receives equal compactive effort.

Samples to determine the compaction shall be taken regularly with at least one satisfactory sample for each 100 linear metres per finished layer or as directed by the Engineer.

The subgrade material will be tested for CBR. The subgrade material shall be compacted to 95% Maximum dry density with at least one satisfactory sample per 100 linear metres per finished layer.

1.3 IMPROVED SUBGRADE

a. Description

This work shall consist of furnishing placing and compacting improved subgrade material on a prepared and accepted subgrade in accordance with these Specifications and to the lines, levels, grades, dimensions and cross sections shown on the Drawings or as instructed by the Engineer.

b. Materials

Material shall be of natural sand, free from vegetable matter, soft particles and excess clay. F. M. of Sand shall not be less than 0.5.

(a) **Plasticity:** The fraction passing the 425 micron sieve shall, have a Plasticity Index not greater than 6.

(b) **CBR:** The material shall have a soaked CBR value not less than 10% when compacted to 100% of maximum dry density.

(c) The material shall be free draining.

1.3.1 Construction Methods

a. Preparation of Subgrade

The subgrade shall be shaped and compacted in conformity with the provisions of Section 1.2 and completed for at least 100 metres ahead of the placing of the improved subgrade material. Notwithstanding any earlier approval of subgrade, any damage to or deterioration of subgrade shall be made good before improved subgrade is laid.

Preparation of the subgrade shall be carried out, unless otherwise agreed by the Engineer, immediately prior to laying the improved subgrade.

b. Spreading

Improved subgrade materials shall be spread in layers, with a compacted thickness up to 150mm subject to approval by the Engineer, and the layers shall be as nearly equal in thickness as possible.

Prior to spreading the improved subgrade materials, full width of shoulder shall be constructed to the elevation of the top of Design Pavement.

c. Sprinkling, Rolling and Compacting

Immediately after each layer has been spread and shaped to camber or super elevation satisfactorily, it shall be thoroughly compacted with mechanical compaction equipment approved by the Engineer. Rolling operations shall begin from the outer edge of roadbed toward the centre, gradually in a longitudinal direction, except on super-elevated curves, where rolling shall begin at the low side and progress towards the high side.

The moisture content at the time of compaction shall be the optimum moisture content (Standard Compaction) ± 3%.

Each layer shall be compacted to at least 100% of the - maximum dry density. If the density measurement falls below the specified density level then further compaction, shall be required, irrespective of the field compaction trial results.

In order to ensure required bearing capacity at the finished improved subgrade level CBR tests shall be made. The CBR shall be such that the Laboratory Value obtained tested at the specified compaction and after 4 days soaking, shall exceed 10 percent. In areas where these requirements are not met, correction shall be made by such measures, as the Engineer deems necessary.

Improved subgrade material that does not contain sufficient moisture to be compacted in accordance with the requirements of this section shall be reworked and watered as directed by the Engineer. The Contractor shall carry out this work at his own expense.
Improved subgrade material containing excess moisture shall be reworked and dried prior to or during compaction. Drying of wet material shall be performed by methods approved by the Engineer, at the expense of the Contractor.

The finished improved subgrade at any point shall not vary more than 20mm above or below the planned grade or adjusted grade. The thickness of the finished improved subgrade shall be on average not less than the required thickness and not thinner than 20mm less than the required thickness at any point and the average of five thickness measurements in any 100 metres of road shall be not thinner than 15mm less than the required thickness. Improved subgrade that does not conform to the above requirements shall be reworked, watered and thoroughly recompacted to conform.

1.4 PREPARATION OF IMPROVED SUBGRADE FOR BITUMINOUS PAVEMENT REPLACING OLD HBB PAVEMENT

a. Description

This item will consist of leveling, dressing, cambering and compacting the existing improved subgrade surface exposed after removal of the brick flat soling, HBB and the edging to receive new base course. Where necessary additional improved subgrade materials shall be added to make the finished compacted improved subgrade as per drawing.

b. Materials

Materials should meet the requirements of Article 1.3b.

1.4.1 Construction Method

The picking up of the brick pavement shall not done for more than 1 00m at a time in order to avoid disturbance to traffic and damage to the subgrade. The salvaged bricks shall be stacked separately from half or broken bricks on such a way that disturbance to traffic is minimized.

Before picking up the brick pavement the contractor must provide base materials ready at the site so that this shall be placed and compacted immediately after preparation of the improved subgrade.

The improved subgrade shall be leveled, graded and cambered according to the design and compacted to 100% of MDD (STD) using an appropriate roller. Where necessary additional improved subgrade materials shall be added to make the finished compacted thickness as per drawing.

2.0 PAVEMENT WORKS

2.1 INTRODUCTION TO PAVEMENT WORKS

a. General

Section 3 of these Specifications covers all requirements for road pavements that will be incorporated in the works.

b. Preparation and Stockpiling of Materials

Materials to be used in pavement works shall be processed and stockpiled only in areas designated by the Contractor as approved by the Engineer. Preparation and storage of materials along the alignment will not be allowed. The Contractor shall make all arrangements and bear all costs associated with the provision of these storage areas.

The designated area shall be cleared of all vegetation and topsoil prior to commencing of work and the arrival of any materials.

Bricks of different frog marks, different materials and size fractions shall be kept in separate stockpiles divided as necessary to prevent contamination.

The site of the stockpile shall be cleared of all vegetation and debris, graded and drained and where the Engineer deems it necessary, the areas shall be surfaced with a 1 00mm layer of approved stone or with brick flat soling.

Each stockpile shall be built with a maximum height of 1.25m or as specified by the Engineer-in-Charge with sufficient space left in between two stacks for easy inspection.

The bottom 50mm layer of aggregate or any contaminated aggregate shall not be used in the work.

c. Brick aggregates/Stone aggregates

Brick aggregates may be replaced by stone aggregates. In case of hard shoulder both crushed and uncrushed stone can be used; in case of base course only crushed stone may be used provided that the quality of the stone satisfies the relevant specifications. Cost of stone aggregate will be determined by the Engineer and approved by concerned higher authority.

2.2 SHOULDERS

2.2.1 Design Pavement Hard Shoulder

a. Description

This shoulder is an option similar to Design Pavement except Bituminous Carpeting. Bituminous Carpeting can be done over Design Pavement Hard Shoulder when traffic volume exceeds 300 CU per day. This Design Pavement Hard Shoulder is constructed at the time pavement construction.

b. Materials

The material shall be same as design pavement up to Base Course.

c. Construction Methods

The construction method shall be similar to design pavement construction up to Base Course.

2.2.2 HBB Hard Shoulder

2.2.2.1 Single Layer Brick Flat Soling

a. Description

This item consists of providing single layer brick flat soling on the subgrade soil for Hard shoulder as directed by the Engineer.

b. Materials

The materials shall consist of First Class or Picked Jhama Bricks, which meet the requirements of Article 3.0b of these Specifications.

c. Construction Methods

The bricks shall be laid flat in one layer or as specified on the Sand Cushion of 75mm over consolidated and prepared surface. Bricks shall be laid in a regular and uniform manner. Interstices of bricks shall be filled with sand of FM 0.5 and water shall be applied by sprinkling. No bricks shall be laid on a foundation or any surface until the same has been inspected and approved by the Engineer. The gaps between two adjacent bricks should not exceed 10mm. The pattern and placing of the bricks shall be as indicated in the drawings.

2.2.2.2 Herringbone Bond Brick (HBB))

a. Description

This work shall consist of a base composed of bricks, laid on edge in a herringbone pattern, placed on a prepared single layer brick flat soling in accordance with these Specifications and to the lines, grades levels, dimensions and cross sections shown in the Drawings and as required by the Engineer.

b. Materials

The materials shall consist of First Class or Picked Jhama Bricks, which meet the requirements of Article 3.0b of these Specifications.

c. Construction Methods

Laying the Bricks

A sand cushion of 25mm thickness (minimum) with sand of F.M. not less than 0.5 will be placed over the brick flat soling. The brick then shall be laid on edge with 125mm across the surface in a single layer in a herringbone pattern to the lines, grades, levels, dimensions and cross section shown on the Drawings and as required by the Engineer. The edge of the layer shall be made with cut bricks to produce a line, which is compatible with brick edging. The joints shall be filled with sand of FM 0.5 brushed in and the completed layer shall be sprinkled liberally with water.

2.2.3 Earthen Shoulder

a. Description

This work consists of the provision of specified wide strips of shoulders adjacent to the pavement on either side. The shoulders shall be constructed in accordance with the lines, levels, dimensions and cross sections shown on the Drawings and as directed by the Engineer.

b. Materials

The material used shall meet the same requirements as that shown in Sections 1.1b.

c. Construction Methods

Pre-work measurement should be taken just before commencing the work. The material shall be spread in layers of uniform thickness to achieve 150mm of compacted thickness and sprinkled with water. After approval by the Engineer, compaction shall be carried out by approved mechanical plant. The material shall be compacted to a density of 95% of the maximum dry density. Samples to determine the compaction shall be taken regularly with a minimum one sample for each 100 linear metres per layer of each finished shoulder or as decided by the Engineer. Such density tests will be carried out. The Engineer shall approve the compacted layer before the Contractor can commence a new layer. If the test results show that the density is less than the required density the Contractor shall carry out further compaction to obtain at least the required density.

3.0 BRICK ON END EDGING

a. Description

This work consists of provided and placing brick on end edging along the road adjacent to the side of the pavement of single layer brick flat soling and herringbone bond brick or of water bound macadam and bitumen carpet.

b. Materials (Bricks)

The materials shall consist of First Class or Picked Jhama Bricks that should meet the requirements given below. First Class Bricks shall be made from good brick earth free from saline deposits, and shall be sand moulded. They shall be thoroughly burnt by coal without being vitrified, of uniform and good colour shall be regular and uniform in size, shape and texture with sharp square edges and parallel faces. They must be homogeneous in texture and emit a clear metallic ringing sound when struck one against the other. They shall be free from flaws, cracks, chips, stones, modules of lime or canker and other blemishes. A first Class Brick shall not absorb more than 16% of its weight of water after being soaked for one hour, and shall show no sign of efflorescence on drying.

Picked Jhama bricks are those that are so over-burnt as to become vitrified. Those bricks may be broken and used for aggregate in road works provided the vitrified mass has not become porous or spongy as a result of over-burning and the aggregate satisfies the requirements of those Specifications.

First Class Bricks should have the following dimensions after burning: 250mm x 120mm x 70mm. Picked Jhama Bricks may have dimensions slightly below those for other brick but not less than 235mm x 110mm x 70mm. The unit weight of First Class Bricks shall not be less than 1100 kg per m^3 and the unit weight of picked Jhama Bricks shall not be less than 1200 kg per m^3.

The crushing strength of bricks shall be tested and the average crushing strength of Bricks shall not be less than 17 N/m m^2.

c. Construction Methods

Bricks shall be laid on end edging with their longest side vertical and 75mm/125mm side as shown in the Drawing across the road including necessary excavation filling and ramming to the satisfaction of the Engineer. The completed work shall be true to line and level and grade as indicated on the Drawings. Interstices between brick edging and adjacent paving or brushing in sand until voids are filled shall fill soling; the edging shall be sprinkled then with water. End Edging shall be done before commencing Base Course.

4.0 HBB PAVEMENT

4.1 Single Layer Brick Flat Soling

a. Description

This item consists of providing single layer brick flat soling on the subgrade or improved subgrade as directed by the Engineer.

b. Materials

The materials shall consist of First Class or Picked Jhama Bricks, which meet the requirements of Article 3.0b of these Specifications.

c. Construction Methods

The bricks shall be laid flat in one layer or as specified on the Sand Cushioning of 125mm over consolidated and prepared surface. Bricks shall be laid in a regular and uniform manner. Interstices of bricks shall be filled with sand of FM 0.5 and water shall be applied by sprinkling. No bricks shall be laid on a foundation or any surface until the same has been inspected and approved by the Engineer. The gaps between two adjacent bricks should not exceed 10mm. The pattern and placing of the bricks shall be as indicated in the drawings.

4.2 Herringbone Bond Brick Pavement

a. Description

This work shall consist of a base composed of bricks, laid on edge in a herringbone pattern, placed on a prepared single layer brick flat soling in accordance with these Specifications and to the lines, grades levels, dimensions and cross sections shown in the Drawings and as required by the Engineer.

b. Materials

The materials shall consist of First Class or Picked Jhama Bricks that meet the requirements of Article 3.0b of these Specifications.

4.2.1 Construction Methods

a. Laying the Bricks

A sand cushion of 25mm thickness (minimum) with sand of F.M. not less than 0.5 would be placed over the brick flat soling. The brick then shall be laid on edge with 125mm across the surface in a single layer in a herringbone pattern to the lines, grades, levels, dimensions and cross section shown on the Drawings and as required by the Engineer. The edge of the layer shall be made with cut bricks to produce a line that is compatible with brick edging. The joints shall be filled with sand of FM 0.5 brushed in and the completed layer shall be sprinkled liberally with water.

b. Surface Tolerance

In those areas in which pavement is to be placed, any deviation in excess of five millimetres from the specified surface within 3 metre shall be corrected by removal, reshaping and relaying.

5.0 WATER BOUND MACADAM BASE COURSE

a. Description

This work shall consist of providing, laying, watering and compacting water bound macadam base course on the prepared and accepted sub-base to the lines, levels, dimensions, and cross profiles shown on the Drawings or as directed by the Engineer in charge.

b. Materials

The base course material shall consist of crushed first class brick and/or picked Jhama brick aggregates well-graded and of desired strength, mechanically "Keyed" or locked by rolling and cemented or bounded together by the application of water.

The aggregate shall be crushed Picked Jhama or mixed with First class bricks. The crushed bricks shall comply with the following requirements:

- Water absorption shall not exceed 16%
- Maximum nominal size of aggregate shall be 38mm according to ASTM-C-131
- Los Angeles Abrasion Test (AASHTO Designation T-96) with a percentage of wears less than 40 at 500 revolutions.
- Flakiness index as per BS-812-15%
- Aggregate Impact Value of not more than 32% (According to BS-812)

Material shall conform to the grading envelope shown in the Table 5.1 and compacted to have a soaked CBR value not less than 40% for first layer of maximum 100mm (compacted) thickness and not less than 80% for second layer and third layer of maximum 100mm (compacted) thickness each.

Grading Requirements for Water Bound Macadam Base Course

Table 5.1

SIEVE SIZE	% PASSING BY WEIGHT
38mm	100
20mm	60-80
10mm	40-60
4.8mm	25-45
2.4mm	15-32
600 micron	10-20
75 micron	0-15

The material shall be well graded with the envelope having no excess or deficiency in any size.

The Engineer may change the above grading when the laboratory results of the above proportion do not meet the quality requirements of the specification.

5.1 Construction Methods

The materials shall be spread in layers and the compacted thickness of which shall not exceed 100mm

A power roller weighing 8 to 10 tons or equivalent vibratory roller should do rolling. Rolling shall begin at the outer edge with the rear wheel overlapping the shoulder. When the broken aggregates become firm, the roller will be shifted to the opposite side of the road and the operation will be repeated. After both edges rolled modestly firm, the roller will be gradually moved towards the centre by overlapping 150mm of the rolled width until the entire base course thoroughly compacted.

The base course shall be compacted to have soaked CBR as specified in Article 5.0b. The field density shall be checked at least once every 100 linear metre of base course surface.

The finished surface of the base course shall in no place be more than ±l0mm from the designed level and the mean of five measurements of thickness taken in any 200 metres long section shall be equal to or more than the required base course thickness.

6.0 GENERAL REQUIREMENTS FOR BITUMINOUS SURFACING

6.1 Description

a. General

This work shall cover the general requirements that are applicable to all types of bituminous bound surfacing irrespective of gradation of mineral aggregate, grade and amount of bituminous materials used. Deviations from these general requirements are indicated in the specific requirements as set forth in the respective sections for each type.

The work shall consist of one or more courses of pre-mixed bituminous mixtures constructed on a prepared and accepted base course or other road bed in accordance with these Specifications and the specific requirements of the type under Contract, and in conformity with the required lines, levels, grades, dimensions and typical cross sections.

b. Composition of Mixtures

The bituminous mix shall be composed basically of coarse mineral aggregate, fine mineral aggregate, filler and bituminous binder. The several mineral constituents shall be sized, uniformly graded and combined in such proportions that the resulting blend meets the grading requirements for the specific type under the Contract. To such composite blended aggregate shall be added bitumen within the percentage limits set in the specifications for the specific type. Grading of coarse aggregate shall conform Article 9.2.

6.2 Construction

6.2.1 Weather Limitation

Bituminous mixtures shall be placed only when the surface is dry, when the weather is not rainy and when the prepared roadbed is in a satisfactory condition. However, the Engineer may permit, in case of sudden rain, the placing of mixture then in transit if laid at roper temperature and if the roadbed is free from pools of water.
Such permission shall in no way relax the requirements for quality and smoothness of surface.

6.2.2 Progress of Work

No work shall be performed when there is insufficient hauling, spreading or finishing equipment or labour to ensure progress at a rate consistent with meeting proper temperatures and rates of compaction.

6.2.3 Equipment

a. **Equipment for preparation of bituminous binder**

Tanks or kettles for storage of bituminous binder shall be capable of heating the binder under effective control at all times, to a temperature within the range specified. Bitumen shall not be heated in open pans or drums. Suitable means shall be provided for maintaining the specified temperature of the bituminous binder at all times. Generally Tar boilers with thermometer are used to heat the bitumen.

b. **Thermometric Equipment**
Armoured thermometers in good condition reading from 50^0 C to 200^0C shall be available at the sites of mixing and laying at all times.

c. Equipment for hauling bituminous mixtures shall have tight, clean and smooth metal sides that have been sprayed with soapy water, thinned fuel oil, paraffin oil or lime solution to prevent the mixture from adhering to the beds. The amount of sprayed fluid shall however be kept to the practical minimum. Any equipment causing excessive segregation of material by its suspension or other contributing factors, or that shows oil leaks in detrimental amount or that causes undue delays, shall upon direction of Engineer be removed from the site until such conditions are corrected.

d. The equipment for spreading and finishing shall be capable of spreading and finishing the mixture true to the lines, grades, levels dimensions and cross sections.

e. The Contractor shall provide suitable means for keeping all small tools clean and free from accumulation of bituminous material. He shall provide and have ready for use at all times enough tarpaulins or covers, as may be directed by the Engineer, for use in any emergency such as rain, chilling wind, or unavoidable delay, for the purpose of covering or protecting any material that may have been dumped and not spread.

6.2.4 Preparation and Placing

a. Preparation of Existing Surface

Where the existing road bed is broken or shows instability, the unstable material shall be removed and disposed off as directed by the Engineer and be replaced with the same mixture as specified for the next course, compacted to the standard and elevation of the adjacent surface. The surface upon which the mixture is to be placed shall be swept thoroughly and cleaned of all loose dirt and other objectionable material immediately before spreading the bituminous mixture' If directed by the Engineer Tack coat is to be applied before placing the next layer. If this has become necessary due to delays caused by the contractor in starting the next layer this will not be paid.

b. Preparation of Bituminous Binder

The bituminous binder shall be heated to the specified temperature (140^OC-155^0C for 60/70 or 80/100 penetration bitumen) in Tar boiler, kettle or tanks so designed as to avoid local overheating and to provide a supply of the bituminous binder at a uniform temperature at all times.

c. Preparation of Mineral Aggregate

The aggregates produced, whether by machine or by manual methods should be screened into the major component sizes prior to recombining in the correct proportions.
The mineral aggregates for the mixture shall be dried and heated to a temperature of between 150^0C-170^0C before mixing. The aggregates shall be heated to the temperature specified in the applicable section.

d. Preparation of Mixture

The heated mineral aggregate prepared above, shall be combined in the amount of each fraction of aggregate required to meet the mix formula for the particular mixture. The bituminous material shall be measured or gauged and introduced into the mix in the amount determined by the Engineer. Only sufficient heat shall be applied during mixing to maintain the temperature of the mix without increasing the temperature. The proper amount of bituminous material shall be distributed over the mineral aggregate and the whole thoroughly mixed for a period of at least 60 seconds, or longer if necessary to produce a homogeneous mixture in which all particles of the mineral aggregate are coated uniformly. Mixing should not be carried out on fire.

e. **Transportation and Delivery of Mixture**

The mixture shall be transported from the mixer to the point of use in equipment conforming to the requirements of Article 10.2. Loading and transporting shall be such that spreading; compaction and finishing shall all be carried out during daylight hours unless the Contractor provides satisfactory illumination.

f. **Spreading and Finishing**

'Upon arrival at the point of use, the mixture shall be spread and struck off to the grade, elevation, and cross-section shape intended, either over the entire width or over such partial width as may be practicable. The mixture shall be laid upon prime coated and an approved surface for new pavement and tack-coated surface for old pavement and only when the Engineer considers weather conditions suitable.

g. **Compaction of Mixture**

(i) **General:** Immediately after the mixture has been spread and struck off, the surface shall be checked and any inequalities adjusted. The mixture shall then be thoroughly and uniformly compacted by rolling. Each course shall be rolled as soon after being placed, as the material will support the roller without undue displacement or cracking.

(ii) All rollers shall be self propelled, capable for being reversed without backlash. Each roller shall be in good condition and worked by a competent and experienced operator. Generally Tandem roller is suitable for B.C work; in addition Tyre roller is also needed.

(iii) Rolling shall start longitudinally at the sides and proceed toward the centre of the pavement except that on super-elevated curves rolling shall begin at the low side and progress toward the high side. Successive trips of the roller and alternative trips shall not terminate at the same point.

Rolling shall start with a temperature of at least 130^0C and shall be discontinued if temperature falls below 90^0C.

The speed of the rollers shall not exceed four kilometers per hour for steel wheeled rollers and 6 kilometers per hour for pneumatic tyred rollers and shall at all times be slow enough to avoid displacement of the hot mixture. Any displacements occurring as a result of reversing the direction of the roller or from any other cause shall at once be corrected with rakes and fresh mixture where required. Care shall be exercised in rolling not to displace the line and grade of the edges.

Rolling shall progress continuously as may be necessary to obtain uniform compaction while the mixture is in a workable condition and until all roller marks are eliminated.

To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened, but excess water will not be permitted.

Heavy equipment or rollers shall not be permitted to stand on the finished surface until it has thoroughly cooled or set.

Any petroleum products dropped or spilled from the vehicles or equipment employed by the Contractor upon any portion of the pavement under construction is a cause for the removal and replacement of the contaminated pavement by the Contractor. The surface of the mixture after compaction shall be smooth and true to the established crown and grade within the tolerance specified. Any mixture that becomes loose and broken, mixed with dirt, or which is defective in any way, shall be removed and replaced with fresh hot mixture, which shall be compacted immediately to conform to the surrounding area. Any areas of one square metre or more showing an excess or deficiency of bituminous material shall be removed and replaced. All high spots, high joints, depressions, and honeycombs shall be adjusted as directed by the Engineer.

h. **Joints**

Both longitudinal and transverse joints in successive courses shall be staggered so as not to be one above the other. Longitudinal joints shall be arranged so that the longitudinal joint in the top course shall be at the location of the line dividing the traffic lanes. Lateral joints shall be staggered a minimum of 250 millimeters and shall be straight.

The edges of the pavement shall be straight and true to the required lines. Any excess material shall be cut off after final rolling and disposed off by the Contractor at the end of a day's work.

Just prior to recommencing operations, the sides of all longitudinal and transverse joints shall be painted with hot bitumen to ensure a satisfactory bond between the old and new work.

7.0 PRIME COAT

a. Description

This work shall consist of the careful cleaning of the surface of the granular base material to be primed and furnishing and applying bituminous material in accordance with these Specifications to the areas shown on the Drawings and as directed by the Engineer.

7.1 Materials

a. Bituminous Materials

Bituminous prime coat material shall be cut back bitumen, conforming to the requirements of ASTM/ AASHTO.

Cut back bitumen may be prepared by cutting back 60/70 or 80/100 penetration grade straight run bitumen with kerosene/diesel in the ratio of 100 parts by volume of bitumen to 40-60 parts by volume of kerosene depending on the porosity of the surface and will be decided by field trials or as directed by the Engineer. The correct amount is the quantity that is completely absorbed within 24 hours. The spraying temperature of the cutback bitumen shall be 100^0C to 120^0C.

b. Blotting Material

Blotting material shall be clean, dry, free-flowing sand not containing any cohesive materials or organic matter. Not more than 1 0 percent of the sand shall be finer than the 75-micron sieve.

7.2 Construction Methods

a. Weather Limitations

Prime coat work shall not be carried out when the weather conditions are, in the opinion of the Engineer, likely to adversely affect the stability of wet prime coat material. Such conditions may include but shall not necessarily be limited to rain, low temperatures or storms.

b. Cleaning Surface

Immediately before applying the prime coat material, all loose stones, dirt and other objectionable materials shall be removed from the surface with a broom or blower as appropriate. When so directed by the Engineer, a light application of water shall be made just before the application of the prime coat.

c. Application of Prime Coat

Prime coat material shall be applied by mechanical distributor or manually at a uniform rate between 1.00 and 1.20 litres/square metre as directed by the Engineer, and at a temperature between 100^0C to 120^0C. Additional primer shall be applied where surface conditions indicate this to be necessary as per decision of the Engineer. No further coatings shall be applied until the prime coat has been cured.

The contractor may be required to lay a trial section of prime coat for the approval of the Engineer with regard to the method of operations and to establish the optimum spray rate for the prime coat to achieve adequate penetration. Following the approval of the Engineer in writing of such trial section (s), the prime coat works may then be carried out strictly in accordance with the approved method and spray rates and the specification.

The surfaces of structures and trees adjacent to the areas being treated shall be protected in such a manner as to prevent their being splattered or marred. No bituminous material shall be discharged into a borrow pit, gutter or kerb.

d. Maintenance and Opening to Traffic

After application of the prime coat there shall be a curing period of 48 hours or more, when traffic shall not be permitted to move on the coated surface. In case of any damage caused by traffic, the surface shall be rectified at the cost of the contractor. The period of curing shall be extended if necessary till the bituminous material has penetrated and dried and, in the opinion of the Engineer, will not be picked up by traffic. At the end of the curing period, minor areas where prime coat material is still not dry shall be treated by sprinkling, blotting sand as necessary to avoid picking up of prime coat material before allowing traffic to use the coated areas. For existing roads, the work shall be done over half width at a time, the other half being used to carry the traffic.

8.0 TACK COAT

a. Description

This work shall consist of the cleaning and preparation of the bituminous surface specified, or otherwise as directed by the Engineer, together with the furnishing and application of the tack coat in accordance with these Specifications to the areas shown on the Drawings and as directed by the Engineer.

Tack Coat should be applied only in between two bituminous surfaces.

b. Materials

Bituminous tack coat material shall be 60/70 or 80/100 penetration grade straight run bitumen complying with the requirements of ASTM / AASHTO.

8.1 Construction Methods

a. Weather Limitations

Tack coat work shall not be carried out when the weather conditions are, in the opinion of the Engineer, likely to adversely affect the stability of wet tack coat material. Such conditions may include but shall not necessarily be limited to rain, low temperatures or storms.

b. Cleaning Surfaces

Immediately before applying the tack coat all loose stone dirt and other objectionable material shall be removed from the surface with a broom or blower as appropriate.

c. Application of Tack Coat

Tack coat material shall be applied by mechanical distributor or manually at a rate of 0.5 litreS/m^2 and at a temperature between 135^0C and 155^0C. Additional tack coat shall be applied where surface conditions indicate this to be necessary, if the Engineer so directs.

The surfaces of structures and trees adjacent to the areas being treated shall be protected in such a manner as to prevent their being splattered or marred. No bituminous material shall be discharged into a borrow pit, gutter or kerb.

9.0 BITUMINOUS CARPETING (BC)

a. Description

This work shall consist of a bituminous carpet of a bituminous macadam type of material constructed on a prepared and primed granular base course in accordance with these Specifications and to the lines, levels, grades, dimensions and cross-sections shown on the Drawings and as directed by the Engineer. The bituminous carpeting shall consist of a compacted single layer of surfacing of thickness as shown on the drawings.

9.1 Materials

a. Bituminous Material

Bituminous material shall be 60/70 or 80/100 penetration grade straight run bitumen complying with the requirement of ASTM / AASHTO.

b. Coarse Aggregate

The coarse aggregate shall be the material component fully retained on an 4.75mm sieve and shall consist of clean crushed rock or crushed gravel or blended combinations of both, free from decomposed stone, organic matter, shale, clay and any other substances which, in the opinion of the Engineer, may be deleterious to the mixture. Coarse aggregate shall satisfy the following physical characteristics when tested:

- Aggregate Crushing Value or AIV of not greater than 30 or LAA value of 40
- Bulk specific gravity not less than 2.50
- Flakiness index not greater than 35% except where specially approved by the Engineer.

The course aggregate shall have weight loss not more than 12% when subjected to 5 alternations of the sodium sulphate soundness test, AASHTO: T. 104.

Not less than 75% by weight of the particles of course aggregate shall have at least two fractured faces.

c. Fine Aggregate

The portion of the aggregate passing a 4.75mm sieve shall be known as fine aggregate and shall consist of natural sand, stone screenings, or a combination of both. Fine aggregate shall be composed of clean, hard durable particles, rough surfaced and angular, free from vegetable matter, soft particles, clay balls or other objectionable material.

9.2 Overall Aggregate Grading

The mix of the coarse and fine aggregates combined shall comply with the following grading given in Table 9.1.

Table 9.1

Serve Size	For 25mm B.C.	For 40mm B.C.
	% By Weight Passing	% By Weight Passing
25mm	100	100
20mm	100	75-100
16mm	100	-
12.5mm	75-100	60-80
10mm	60-80	-
6.3mm	-	-
4.75mm	35-55	35-55
2.4mm	20-35	20-33
600 micron	10-20	6-18
75 micron	2-8	2-8
Bitumen Content % by weight of total mix.	5.5% $\pm$ 0.3% (5.2% to 5.8%)	5.2% $\pm$ 0.3% (4.9% to 5.5%)

Required bitumen content should be determined by trials.

9.3 Bituminous Mixture Requirements

The resultant density of the compacted bituminous mixture shall be between 2250 and 2400 kg/m^3. The bitumen content and stability of mixture shall be as per specification or as decided by the Engineer.

9.4 Construction Methods

a. Preparation of the road base

A prime coat shall be applied and cured to the surface of the granular base material in accordance with Section 3.8 before spreading the premixed aggregates, or a tack coat shall be applied to the existing bituminous surface.

b. Mixing of Bituminous Material

Prior to heating, the various sizes of aggregate shall be thoroughly mixed together to give a stockpile of aggregate of the required grading of sufficient quantity for at least one day's surfacing work.

The bitumen and the aggregates shall be separately heated to a temperature between 140°C to 155°C and 150°C to 170°C for bitumen and aggregate respectively before mixing. The temperature of bitumen aggregate mixture should be within 140°C to 160°C. Bitumen, or bitumen aggregate mixture, which has been overheated at any time, shall be rejected. The percentage of bitumen in the mix shall be between 5.2% and 5.8% by weight of total mix for 25mm BC and between 4.9% and 5.5% by weight of total mix for 40mm BC.

The final combined grading shall be within the limits of the specification and the actual bitumen content shall be determined on the basis of laboratory tests by the Engineer and the final grading of the combined aggregates and the bitumen content shall be approved by the Engineer.

The laying temperature of the mixture shall not be less than l3O°C.

The mixed materials shall be laid to a uniform thickness. The thickness and proper camber shall be maintained by the use of steel angle screeds of the correct size. The sides of the angle shall be at least 25% greater than the compacted thickness specified and as shown on the drawings or as directed by the Engineer.

c. Rolling

After laying, the materials shall immediately be compacted using a power driven road roller. The initial pass of the roller on the bituminous premix shall be at temperatures specified above and shall be carried out with these steel angles in position. Subsequent passes of the roller may be made with these steel angles removed.

When the temperature of the bituminous premix falls below 90^0C no further compaction should be permitted.

The bituminous premix shall be compacted using an approved roller (preferably a pneumatic tyre roller) and a minimum of five passes shall be made, or as directed by the Engineer from time to time. Material that falls below the minimum working temperature of 90^0C, that has not been compacted as described, may be rejected and shall be replaced by new material to the required specification and compaction by the contractor at his own expenses.

The premix carpeting shall be fully compacted maintaining the proper grade and camber. The compacted thickness as shown in the drawing and as provided in the Bill of Quantities shall be uniformly maintained all along the road surface.

Rollers and other mechanical plant shall not be allowed to stand on newly laid material that may be deformed thereby. Sections of newly finished work shall be protected from traffic of any kind until the mixture has cooled to ambient air temperature.

The finished surface shall be within a tolerance of ± 5mm or of the elevation shown in the drawings and it shall no where vary more than 5mm from the straight edge 3m long applied to the surface both longitudinally and transverse.

d. Open to Traffic

When the initial rolling is completed, commercial traffic could be allowed in the surfaced area. The speed of traffic shall be temporarily reduced to avoid the damage to the surface. Maximum speed limit of 30-40 km/hour shall, therefore, be enforced during the first month after construction (by speed breaker as an example or any other method approved by the Engineer.)

10.0 BITUMINOUS SEAL COAT 7MM THICK

a. Description

This work shall consist of premix bituminous seal coat applied to a prepared and primed granular base course or over the bituminous surfacing in accordance with these Specifications or as directed by the Engineer. The thickness of premix bituminous seal coat shall be 7mm.

10.1 Materials

a. Bituminous Material

Bituminous material shall be of 60/70 or 80/100 penetration grade straight run bitumen complying with the requirements of ASTM AASHTO.

b. Aggregate

The aggregates shall consist of 6.3mm down graded stone or gravel free from any organic matter, clay and any other objectionable matter.

Where required to achieve the specified grading the aggregate shall be mixed with natural sand. Sand shall be non-plastic, clean and free from any deleterious substances. The minimum F.M. of sand for the sealing premix shall be between 2.00 to 2.50 and that of sand to be spread over the seal coat as blotting material shall be within 0.80 to 1.00.

10.2 Overall Aggregate Grading

The mix of the aggregates and sand combined shall comply with the following grading given in Table 10.1

Table 10.1

Grading Requirements for 7mm Bituminous Seal Coat

Sieve Six	% By Weight Passing Sieve
6.3mm	100
4.75mm	80-100
2.4mm	70-95
600 micron	20-50
75 micron	5-15

10.3 Construction Methods

Bitumen and aggregates shall be heated separately at the following temperatures:

Only Bitumen	:	Within 140°C to 155°C (Max)
Only Aggregate	:	Within 150°C to 170°C
Mix of Bitumen & Aggregate	:	Within140°C to 160°C

Material that has been over-heated at any time shall be rejected. No mixing of pre-heated bitumen and aggregate should be done on fire. 0.01 M3 of aggregate will be mixed with 1 litre of bitumen and shall be laid on 1 (one) square metre of road surface.

The aggregate mixed with bitumen shall be laid over the bituminous carpeting or over the primed granular base to a uniform thickness which shall be at least 25% greater than the compacted thickness and immediately compacted fully with a power driven road roller to the satisfaction of the Engineer. Temperature of bitumen and aggregate mix at the time of starting of rolling should not be less than 130°C.

IMPORTANT NOTES ON ROAD PAVEMENT CONSTRUCTION

1. Turfing or seedling with “Durba” grass seed is a must at side slopes after dressing.
2. Regional Superintending Engineer, LGED and Design & Supervising Consultant, if any, shall determine thickness of improved sub-grade of the road segment where designed soaked CBR value (4%) of sub-grade can not be achieved with site soil, even mixing any portion of sand with site soil. In that case approval from higher authority is a pre-requisite before preparation of scheme or commencing execution as applicable.
3. Initially applied bituminous carpeting (BC) shall have another overlay of 40mm thick BC with 7mm seal coat within 3 to 5 years after completion of construction for achieving durability of pavement for 10 years.
4. Special precautionary measures to be taken for drainage of surface run-off stagnant at depressions along longitudinal profile during construction as well as maintenance.
5. Earthen shoulder needs all-weather surfacing with bricks and concrete for road segment across market places and built up areas.
6. Run-off drainage along build-up areas may need special structural provision.
7. Drainage structure along hillock or hill-cut may be designed as per site condition.

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PAVEMENT DESIGN PLATE CATALOGUE

UPAZILA ROAD
IN PLAIN LANDS

Plate UPR-BC1-DL-1

Plate UPR-BC1-DL-1A

Plate UPR-BC1-HBS-1

Plate UPR-BC1-WHS-1

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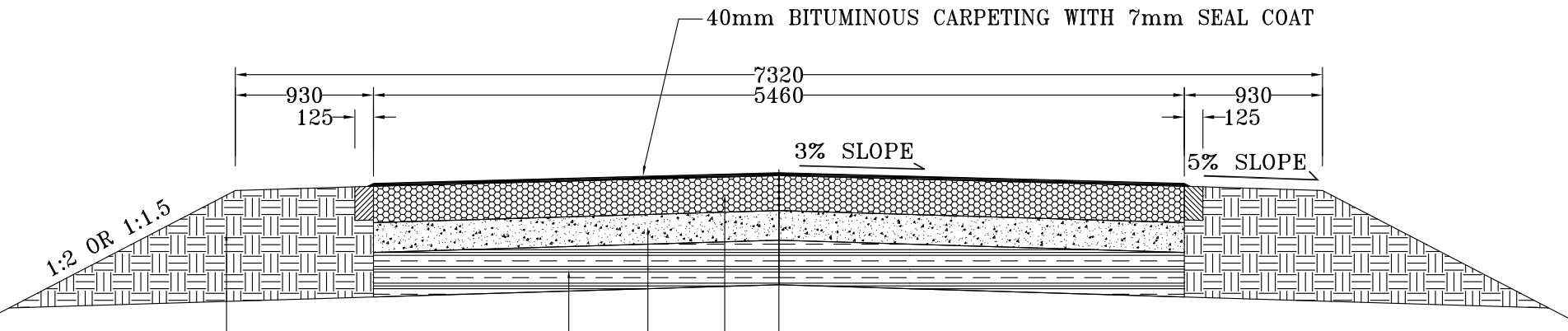
UPAZILA ROAD SECTION

STANDARD OPTION

FOR 500 CV PER DAY



WBM, 250mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN THREE LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 75mm (CBR>80%), 3RD LAYER 75mm (CBR>80%) COMPACTED WITH 8–10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 200mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 100mm, COMPACTED WITH 3–5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3–5 TON (min) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

ORIGINAL SOIL CUT INTO DESIGNED SHAPE, OR FILL BY NORMAL SOIL, PI VALUE RANGE 7 TO 20%, 95% STD COMPACTION TO ACHIEVE DESIGNED CROSS-SECTION OF SIDE EMBANKMENT

PLATE NO. UPR-BC1-DL-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA ROAD SECTION STANDARD OPTION FOR TRAFFIC VOLUME 500 CV PER DAY	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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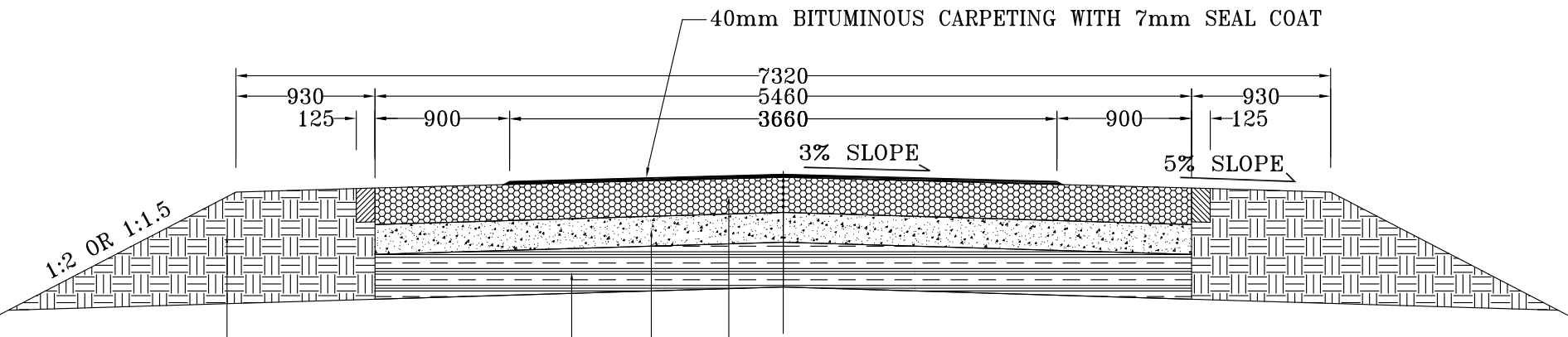
UPAZILA ROAD SECTION

FOR 300 CV PER DAY

STANDARD OPTION WITH DESIGN PAVEMENT HARD SHOULDER



WBM, 250mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN THREE LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 75mm (CBR>80%), 3RD LAYER 75mm (CBR>80%) COMPACTED WITH 8-10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 200mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 100mm, COMPACTED WITH 3-5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3-5 TON (min) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

ORIGINAL SOIL CUT INTO DESIGNED SHAPE, OR FILL BY NORMAL SOIL, PI VALUE RANGE 7 TO 20%, 95% STD COMPACTION TO ACHIEVE DESIGNED CROSS-SECTION OF SIDE EMBANKMENT

PLATE NO. UPR-BC1-DL-1A

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA ROAD SECTION STANDARD OPTION WITH DESIGN HARD SHOULDER FOR TRAFFIC VOLUME 300 CV PER DAY	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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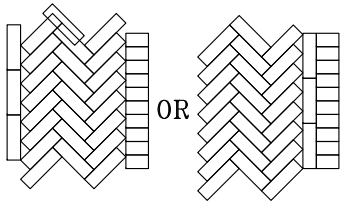
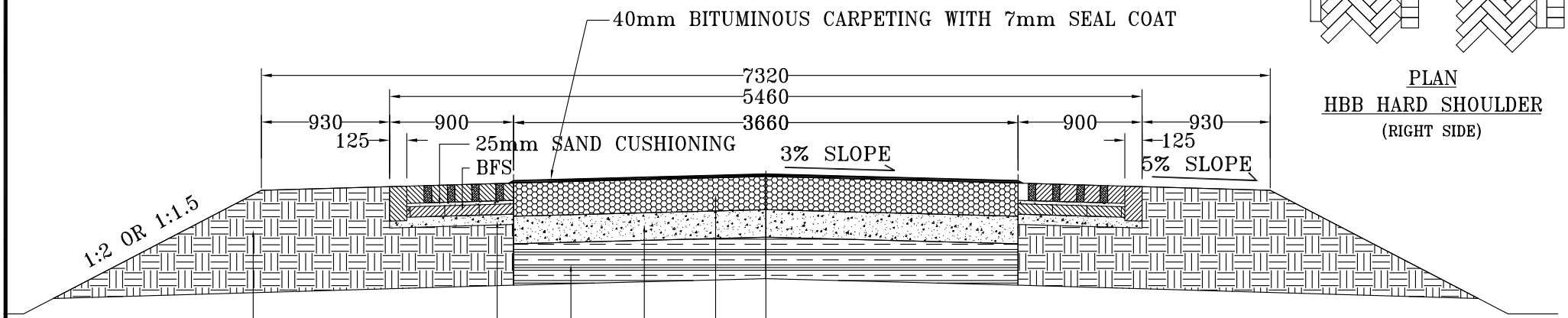
UPAZILA ROAD SECTION

FOR 300 CV PER DAY

STANDARD OPTION WITH HBB HARD SHOULDER



PLAN
HBB HARD SHOULDER
(RIGHT SIDE)



75mm SAND CUSHIONING

WBM, 250mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN THREE LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 75mm (CBR>80%), 3RD LAYER 75mm (CBR>80%) COMPACTED WITH 8-10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 200mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 100mm, COMPACTED WITH 3-5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3-5 TON (min) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

ORIGINAL SOIL CUT INTO DESIGNED SHAPE, OR FILL BY NORMAL SOIL, PI VALUE RANGE 7 TO 20%, 95% STD COMPACTION TO ACHIEVE DESIGNED CROSS-SECTION OF SIDE EMBANKMENT

PLATE NO. UPR-BC1-HBS-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UPAZILA ROAD SECTION STANDARD OPTION WITH HBB HARD SHOULDER FOR TRAFFIC VOLUME 300 CV PER DAY	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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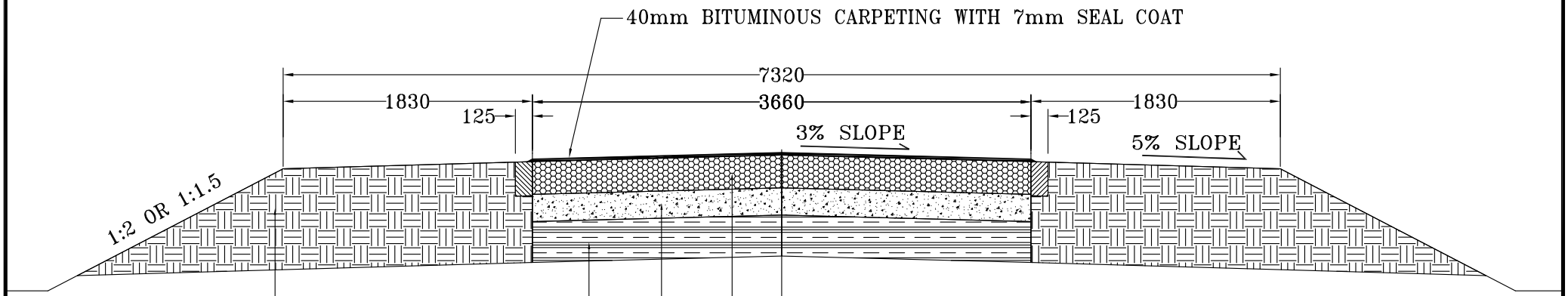
UPAZILA ROAD SECTION

FOR 200 CV PER DAY

STANDARD OPTION WITHOUT HARD SHOULDER



WBM, 250mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN THREE LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 75mm (CBR>80%), 3RD LAYER 75mm (CBR>80%) COMPACTED WITH 8-10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 200mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 100mm, COMPACTED WITH 3-5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3-5 TON (min) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

ORIGINAL SOIL CUT INTO DESIGNED SHAPE, OR FILL BY NORMAL SOIL, PI VALUE RANGE 7 TO 20%, 95% STD COMPACTION TO ACHIEVE DESIGNED CROSS-SECTION OF SIDE EMBANKMENT

PLATE NO. UPR-BC1-WHS-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA ROAD SECTION STANDARD OPTION WITHOUT HARD SHOULDER FOR TRAFFIC VOLUME 200 CV PER DAY	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD
IN HILLY AREA

Plate UPR-BC1-HL-1

Plate UPR-BC1-HL-2

Plate UPR-BC1-HL-2A

Plate UPR-BC1-HL-3

Plate UPR-BC1-HL-3A

Plate UPR-HBB-HL-1

Plate UPR-HBB-HL-2

Plate UPR-HBB-HL-2A

Plate UPR-HBB-HL-3

Plate UPR-HBB-HL-3A

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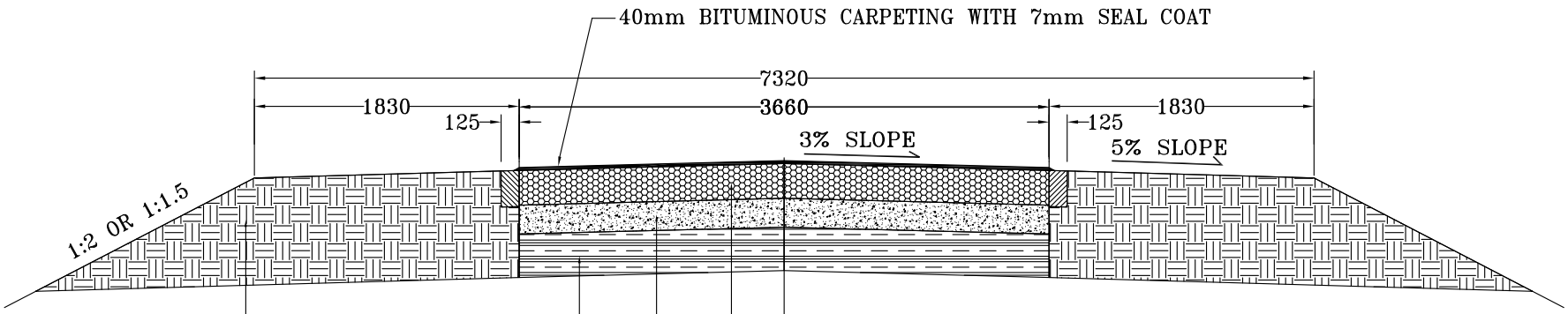
UPAZILA ROAD SECTION THROUGH HILLS
HAVING RUN-OFF DRAINAGE ON BOTH SIDES



WBM, 250mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN THREE LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 75mm (CBR>80%), 3RD LAYER 75mm (CBR>80%) COMPACTED WITH 8-10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 200mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 100mm, COMPACTED WITH 3-5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3-5 TON (min) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

ORIGINAL SOIL CUT INTO DESIGNED SHAPE, OR FILL BY NORMAL SOIL, PI VALUE RANGE 7 TO 20%, 95% STD COMPACTION TO ACHIEVE DESIGNED CROSS-SECTION OF SIDE EMBANKMENT

PLATE NO. UPR-BC1-HL-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD THROUGH SHALLOW HILL-CUT HAVING HILL ON ONE SIDE

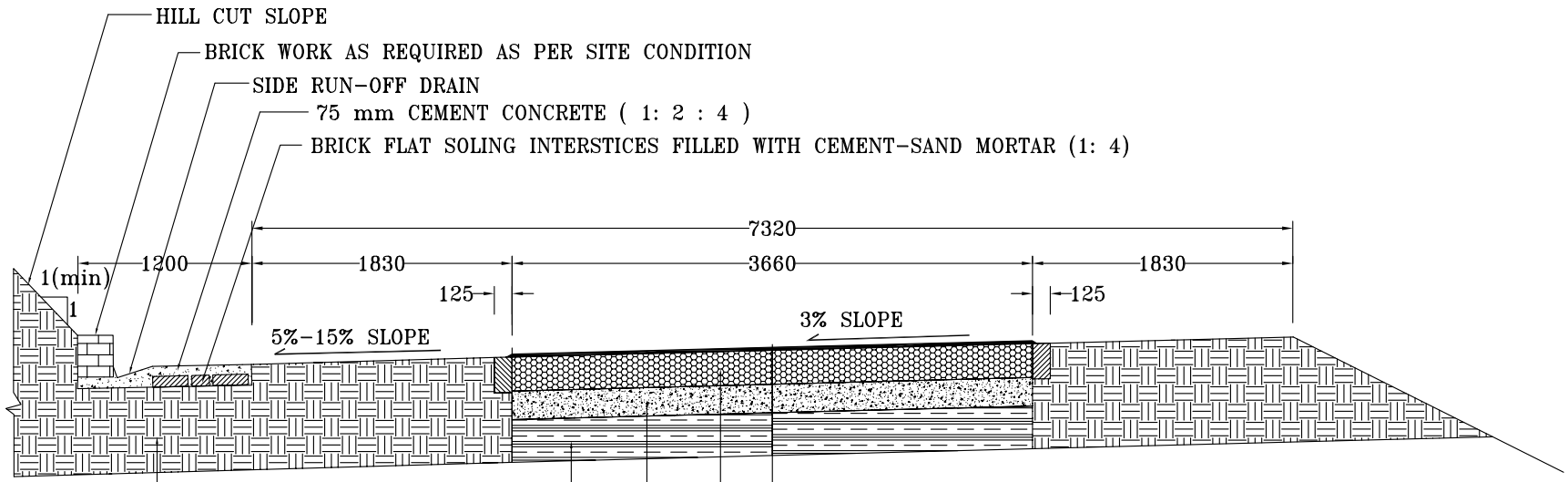

PLATE NO. UPR-BC1-HL-2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD THROUGH SHALLOW HILL-CUT HAVING HILL ON BOTH SIDES

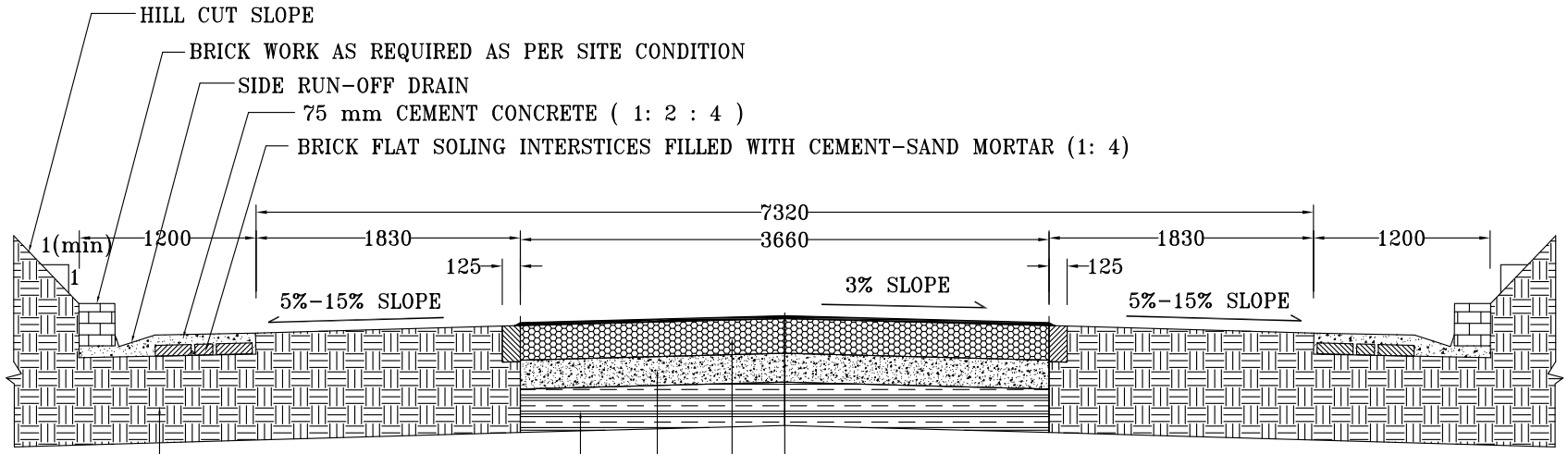

PLATE NO. UPR-BC1-HL-2A

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD THROUGH DEEP HILL-CUT HAVING HILL ON ONE SIDE

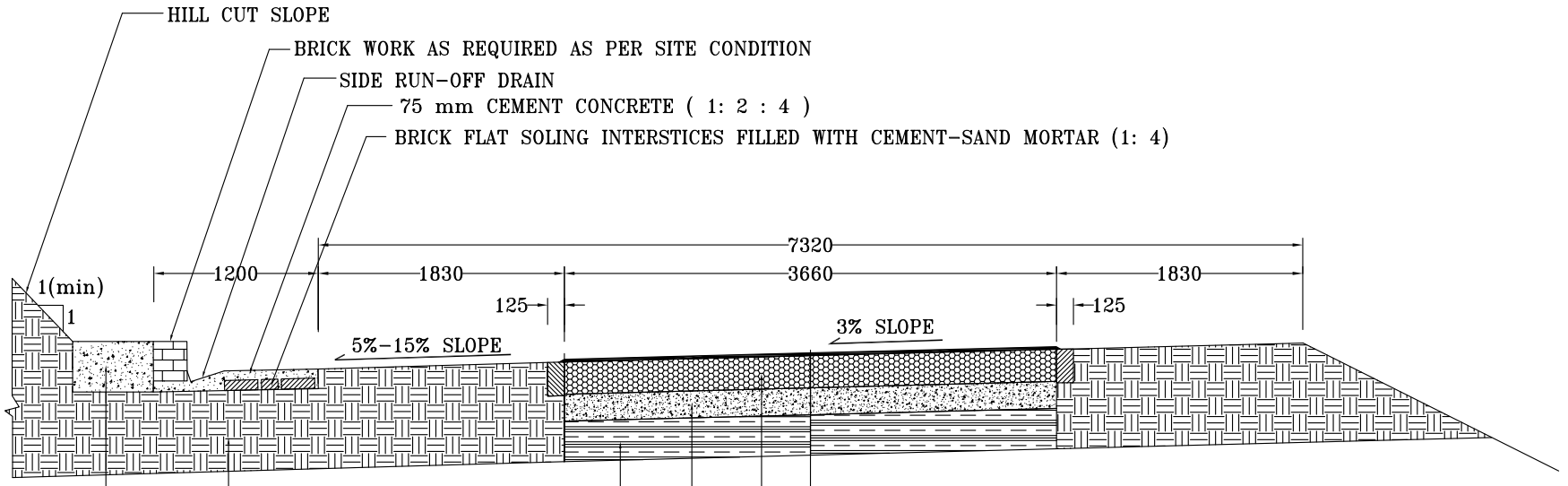

PLATE NO. UPR-BC1-HL-3

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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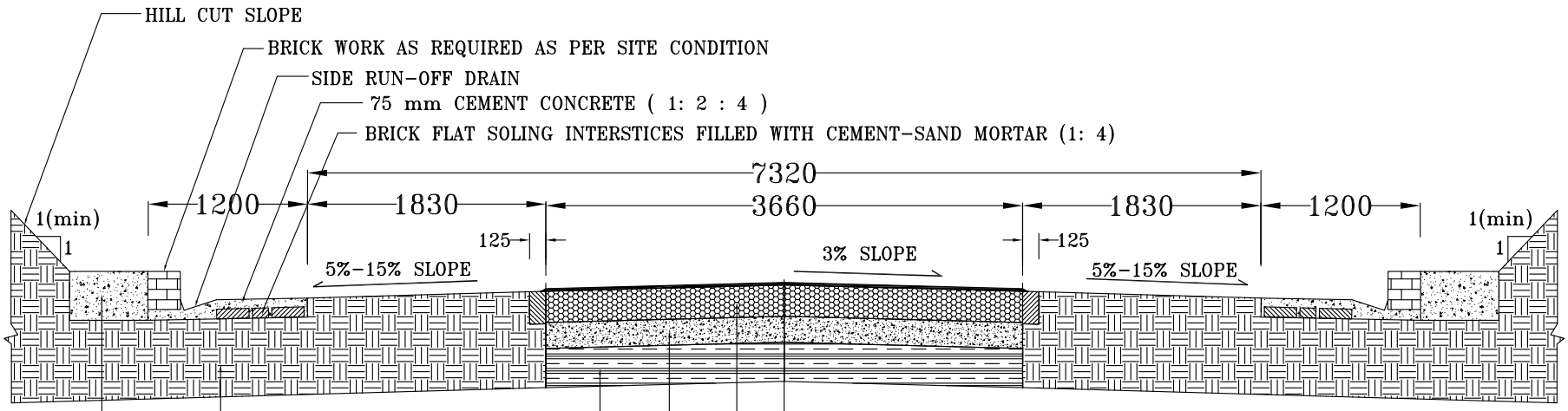
UPAZILA ROAD THROUGH DEEP HILL-CUT HAVING HILL ON BOTH SIDES



WBM, 250mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN THREE LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 75mm (CBR>80%), 3RD LAYER 75mm (CBR>80%) COMPACTED WITH 8-10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 200mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 100mm, COMPACTED WITH 3-5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3-5 TON (min) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

NATURAL SOIL CUT INTO SHAPE

600mmX375mm SUBSURFACE COARSE AGGREGATE DRAIN (AGGREGATE 20 mm DOWN GRADED) ALONG HILL-CUT SIDE LONGITUDINALLY FOR SEEPAGE WATER DRAINAGE.

PLATE NO. UPR-BC1-HL-3A

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD SECTION THROUGH HILLS
HAVING RUN-OFF DRAINAGE ON BOTH SIDES

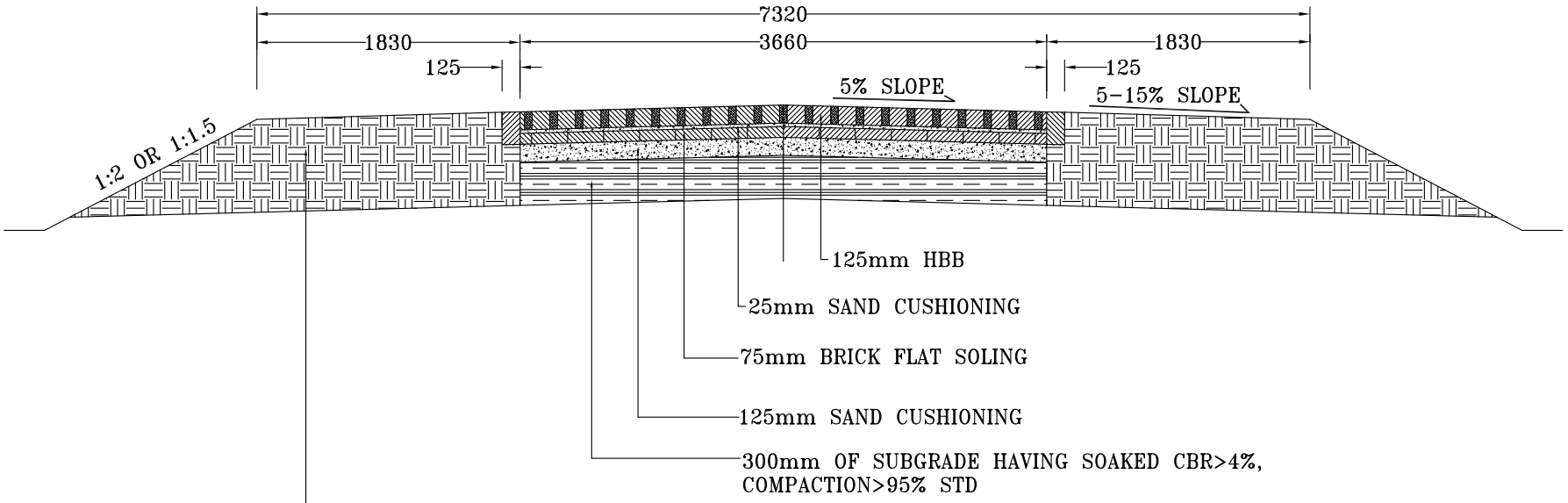

PLATE NO. UPR-HBB-HL-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD THROUGH SHALLOW HILL-CUT HAVING HILL ON ONE SIDE

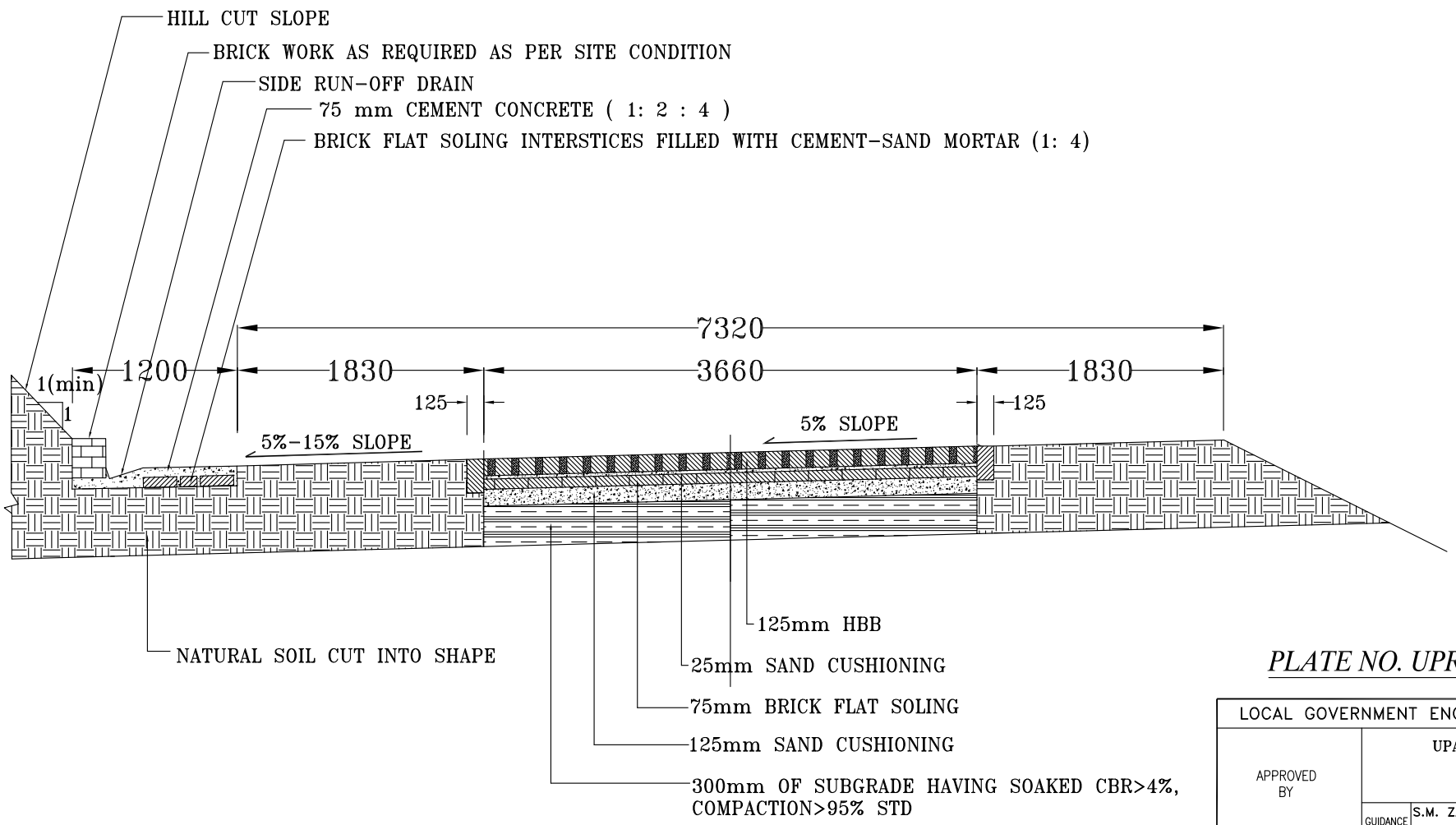

PLATE NO. UPR-HBB-HL-2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD THROUGH SHALLOW HILL-CUT HAVING HILL ON BOTH SIDES

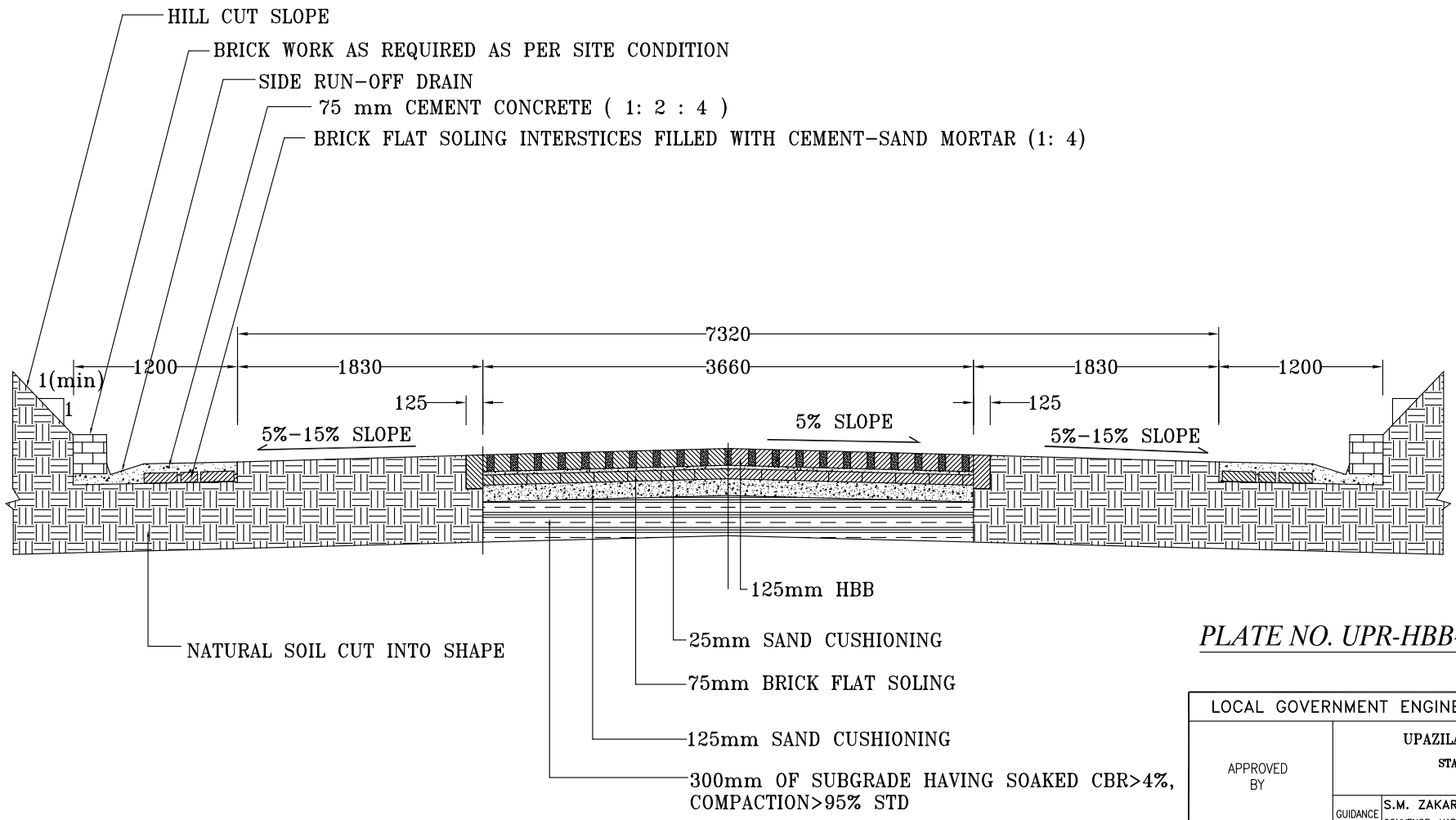

PLATE NO. UPR-HBB-HL-2A

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

APPROVED BY	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD THROUGH DEEP HILL-CUT HAVING HILL ON ONE SIDE

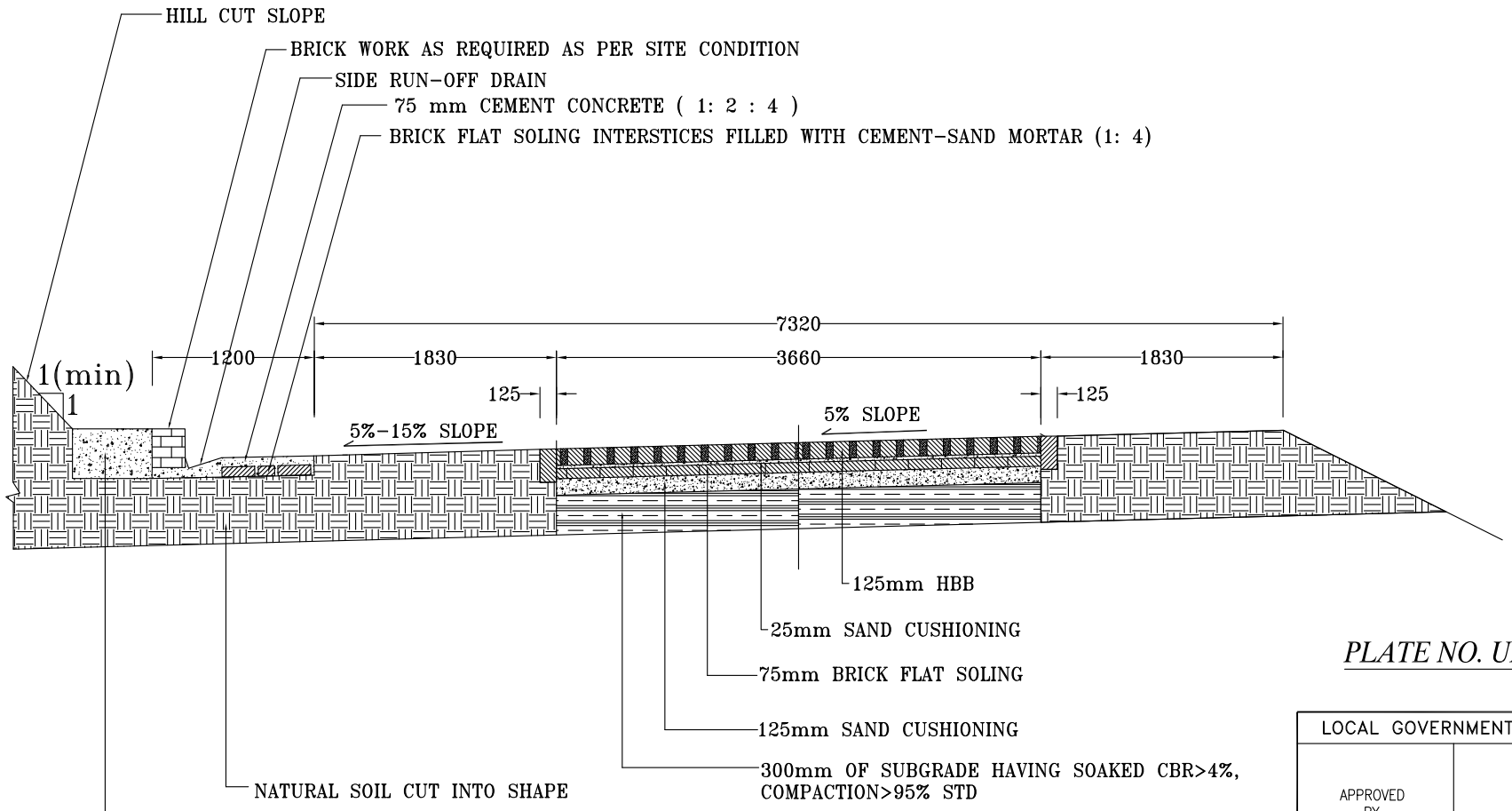

PLATE NO. UPR-HBB-HL-3

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UPAZILA ROAD THROUGH DEEP HILL-CUT HAVING HILL ON BOTH SIDES

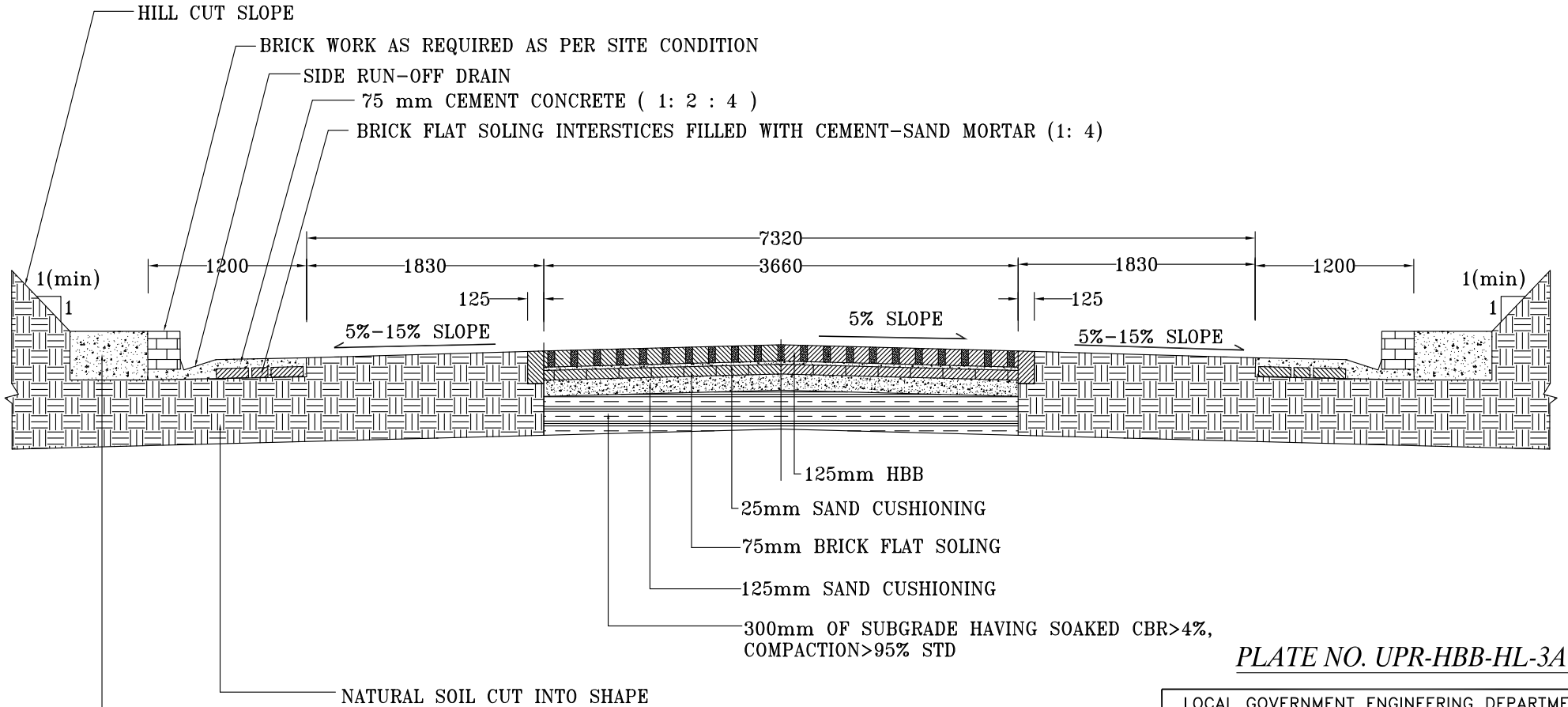

PLATE NO. UPR-HBB-HL-3A

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UPAZILA ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UNION ROAD
IN PLAIN LANDS

Plate UNR-BC1-HBS-!

Plate UNR-BC1-WHS-!

Plate UPR-BC2-WHS-1

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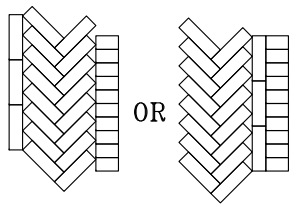
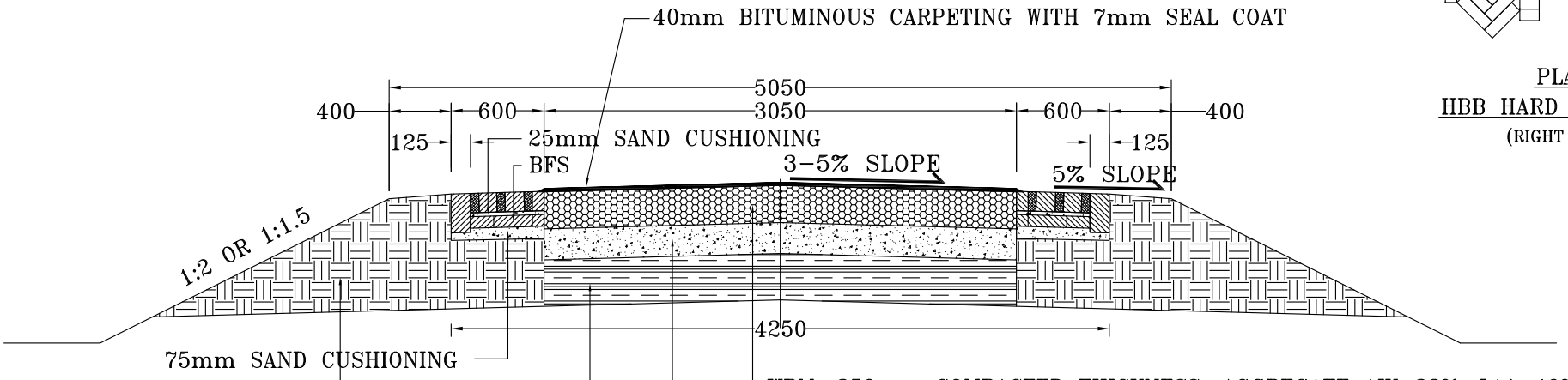
UNION ROAD SECTION

STANDARD OPTION WITH HBB HARD SHOULDER

FOR 300 CV PER DAY



PLAN
HBB HARD SHOULDER
(RIGHT SIDE)



WBM, 250mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN THREE LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 75mm (CBR>80%), 3RD LAYER 75mm (CBR>80%) COMPACTED WITH 8-10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 200mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 100mm, COMPACTED WITH 3-5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3-5 TON (min) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

ORIGINAL SOIL CUT INTO DESIGNED SHAPE, OR FILL BY NORMAL SOIL, PI VALUE RANGE 7 TO 20%, 95% STD COMPACTION TO ACHIEVE DESIGNED CROSS-SECTION OF SIDE EMBANKMENT

PLATE NO. UNR-BCI-HBS-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UNION ROAD SECTION STANDARD OPTION WITH HBB HARD SHOULDER FOR TRAFFIC VOLUME 300 CV PER DAY	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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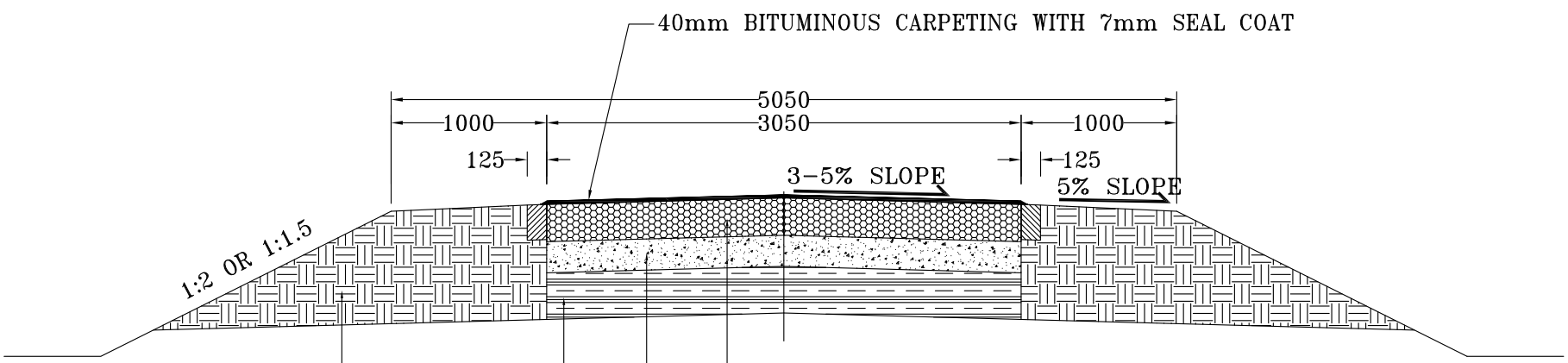
UNION ROAD SECTION

FOR 200 CV PER DAY

STANDARD OPTION WITHOUT HARD SHOULDER



WBM, 250mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN THREE LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 75mm (CBR>80%), 3RD LAYER 75mm (CBR>80%) COMPACTED WITH 8-10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 200mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 100mm, COMPACTED WITH 3-5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3-5 TON (min) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

ORIGINAL SOIL CUT INTO DESIGNED SHAPE, OR FILL BY NORMAL SOIL, PI VALUE RANGE 7 TO 20%, 95% STD COMPACTION TO ACHIEVE DESIGNED CROSS-SECTION OF SIDE EMBANKMENT

PLATE NO. UNR-BC1-WHS-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UNION ROAD SECTION STANDARD OPTION WITHOUT HARD SHOULDER FOR TRAFFIC VOLUME 200 CV PER DAY	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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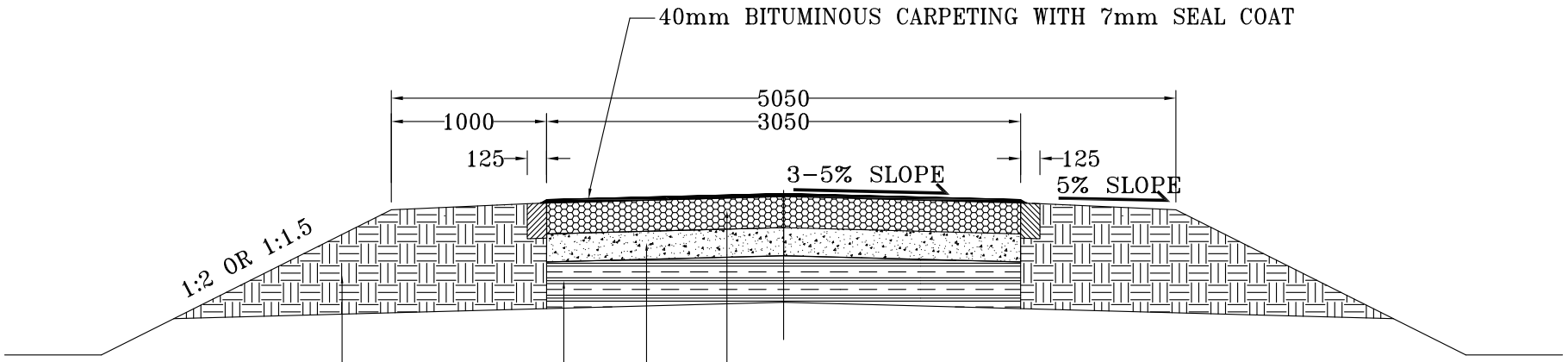
UNION ROAD SECTION

FOR 100 CV PER DAY

STANDARD OPTION WITHOUT HARD SHOULDER



WBM, 200mm COMPACTED THICKNESS, AGGREGATE AIV<32%, LAA<40%, COMPACTED IN TWO LAYERS, 1ST LAYER 100mm (CBR>40%), 2ND LAYER 100mm (CBR>80%), COMPACTED WITH 8-10 TON (min) STATIC ROLLER

IMPROVED SUBGRADE, 180mm COMPACTED THICKNESS, FM>0.5, PI VALUE<6, SOAKED CBR>10%, COMPACTION>100% STD, COMPACTED IN TWO LAYERS, EACH LAYER 90mm, COMPACTED WITH 3-5 TON (min) VIBRATORY ROLLER

SUBGRADE, 300mm, TO BE COMPACTED WITH 3-5 TON (MIN) VIBRATIRY ROLLER, SOAKED CBR>4%, COMPACTION>95% STD

ORIGINAL SOIL CUT INTO DESIGNED SHAPE, OR FILL BY NORMAL SOIL, PI VALUE RANGE 7 TO 20%, 95% STD COMPACTION TO ACHIEVE DESIGNED CROSS-SECTION OF SIDE EMBANKMENT

PLATE NO. UNR-BC2-WHS-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UNION ROAD SECTION STANDARD OPTION WITHOUT HARD SHOULDER FOR TRAFFIC VOLUME 100 CV PER DAY	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UNION ROAD
IN HILLY AREA

Plate UNR-HBB-HL-1

Plate UNR-HBB-HL-2

Plate UNR-HBB-HL-2A

Plate UNR-HBB-HL-3

Plate UNR-HBB-HL-3A

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UNION ROAD SECTION THROUGH HILLS
HAVING RUN-OFF DRAINAGE ON BOTH SIDES

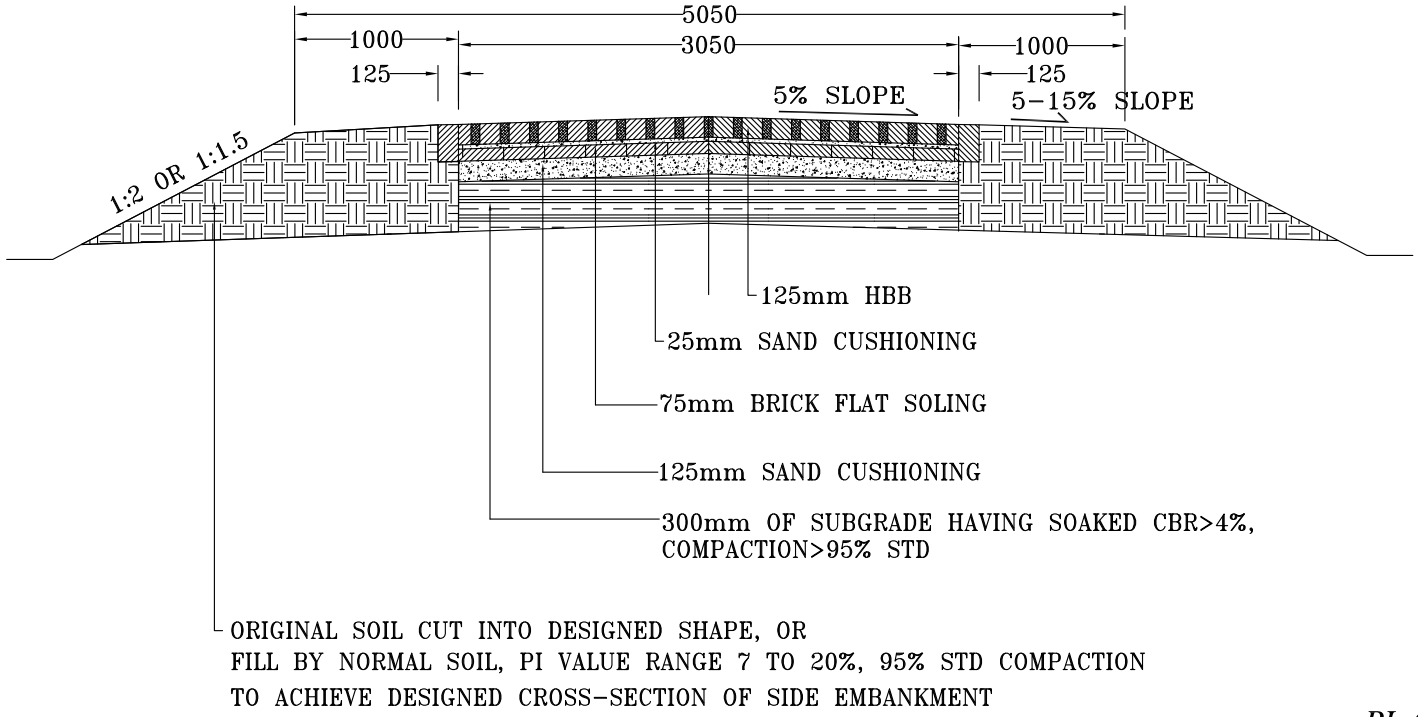

PLATE NO. UNR-HBB-HL-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UNION ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UNION ROAD THROUGH SHALLOW HILL-CUT HAVING HILL ON ONE SIDE

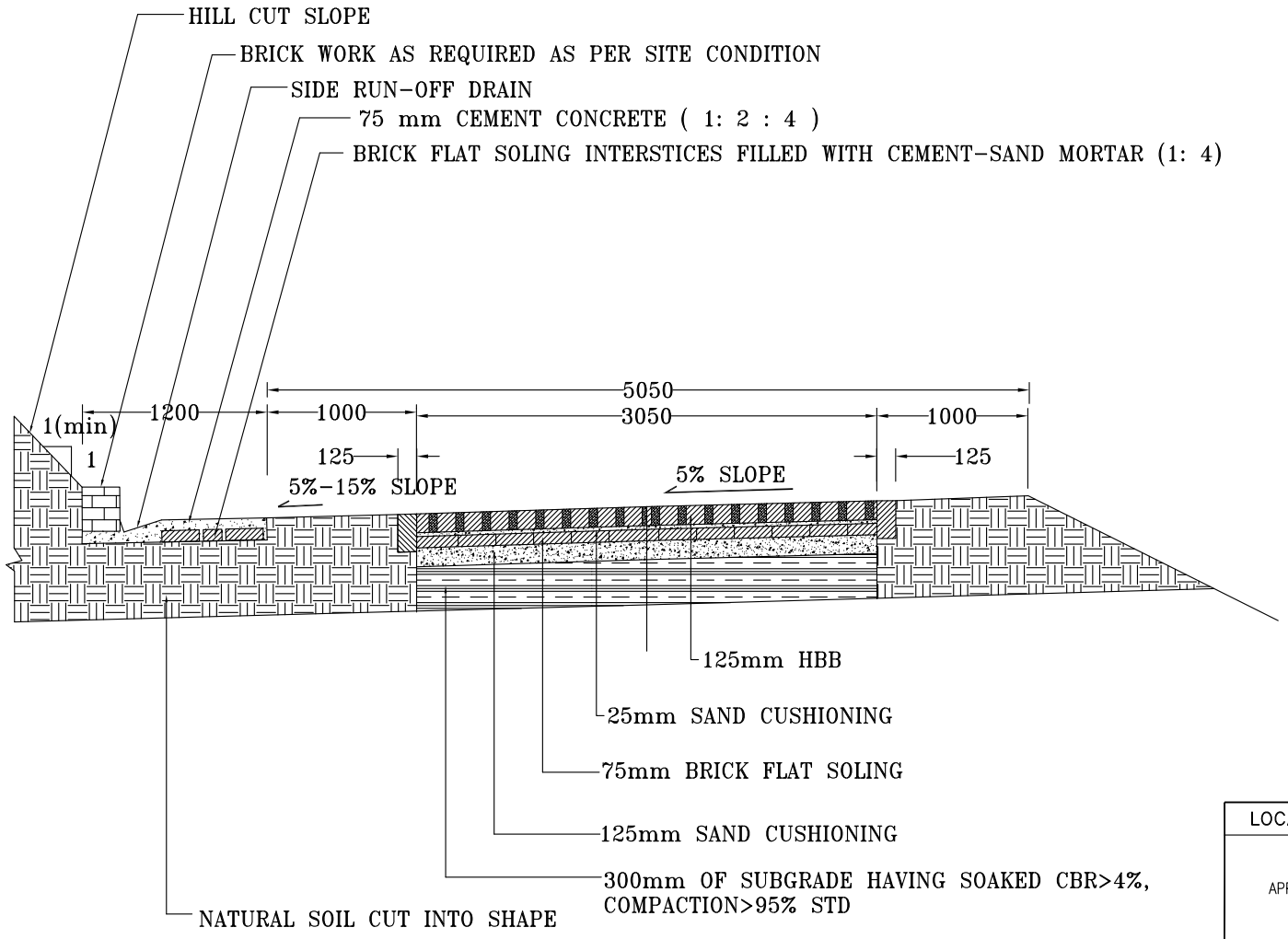

PLATE NO. UNR-HBB-HL-2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UNION ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UNION ROAD THROUGH SHALLOW HILL-CUT HAVING HILL ON BOTH SIDES

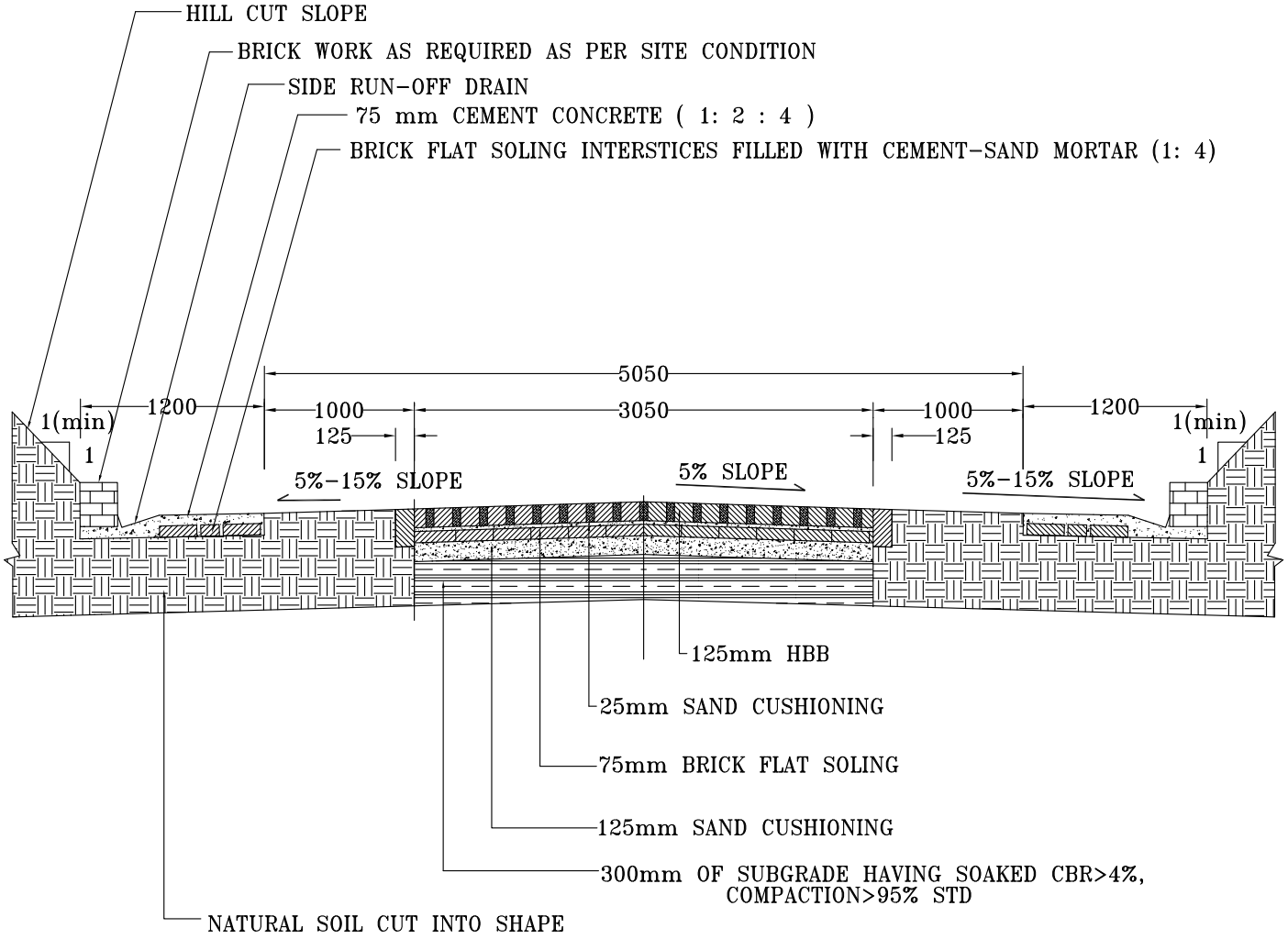

PLATE NO. UNR-HBB-HL-2A

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UNION ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UNION ROAD THROUGH DEEP HILL-CUT HAVING HILL ON ONE SIDE

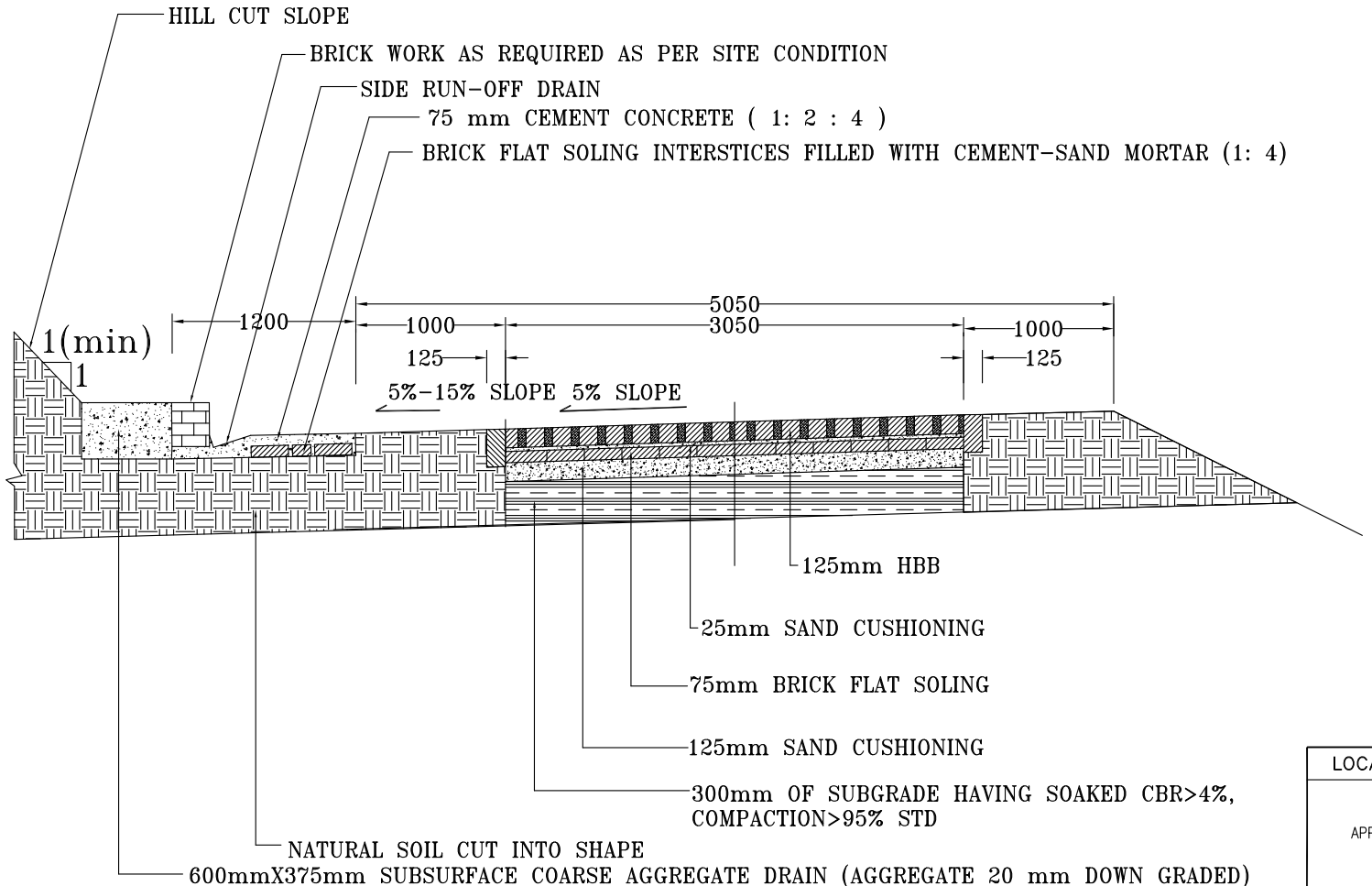

PLATE NO. UNR-HBB-HL-3

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UNION ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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UNION ROAD THROUGH DEEP HILL-CUT HAVING HILL ON BOTH SIDES

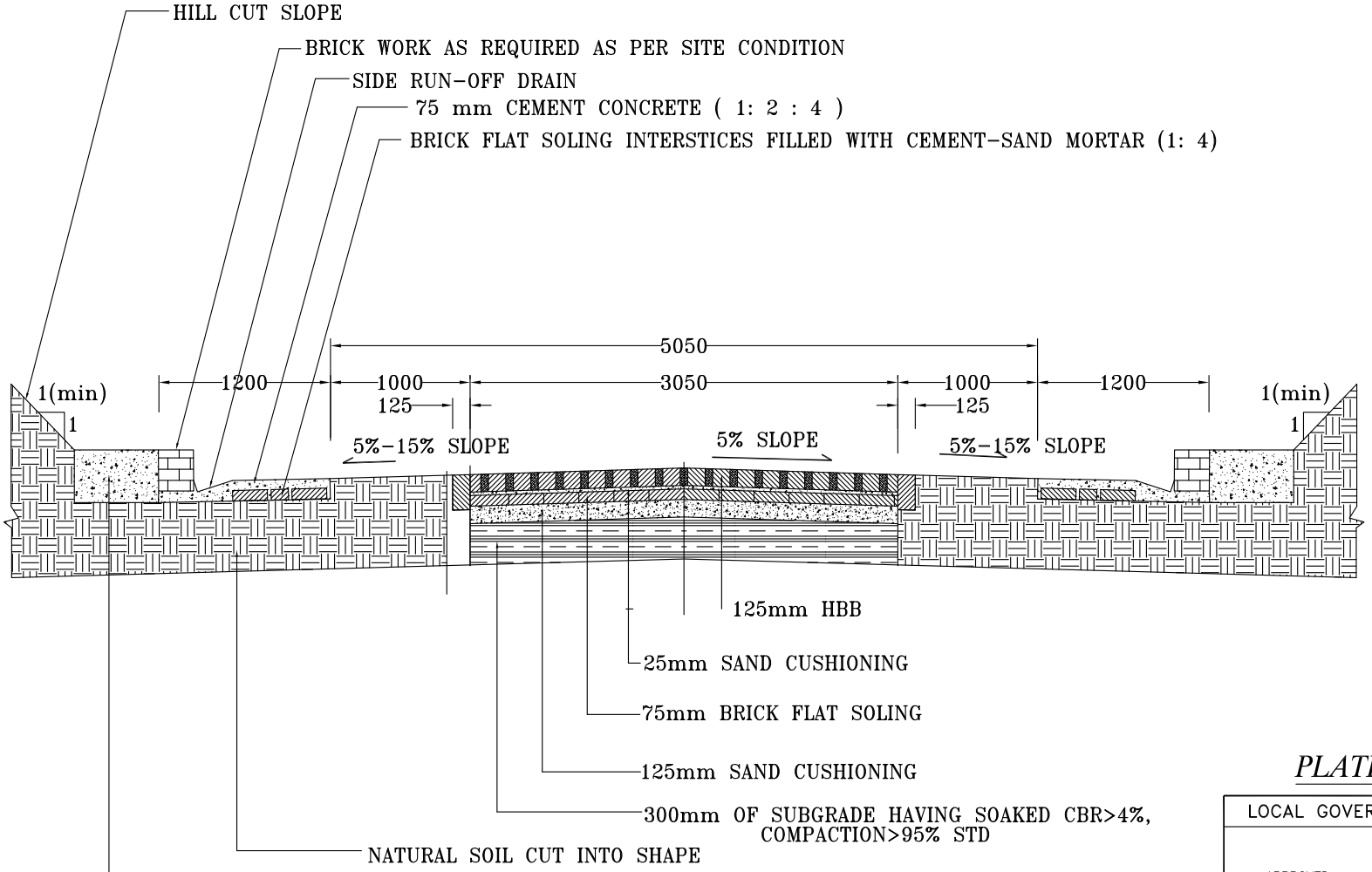

PLATE NO. UNR-HBB-HL-3A

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UNION ROAD SECTION STANDARD OPTION	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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SHOULDER TREATMENT OF UPAZILA ROADS OR UNION ROADS CROSSING MARKET PLACES OR BUILT-UP AREAS

Plate UPR-UNR-BT-SLD-1

Plate UPR-UNR-BT-SLD-2

Plate UPR-UNR-BT-SLD-3

Plate UPR-UNR-BT-SLD-4

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SHOULDER TREATMENT OF UPAZILA OR UNION ROAD CROSSING MARKET PLACE / BUILT-UP AREA

OPTION-1

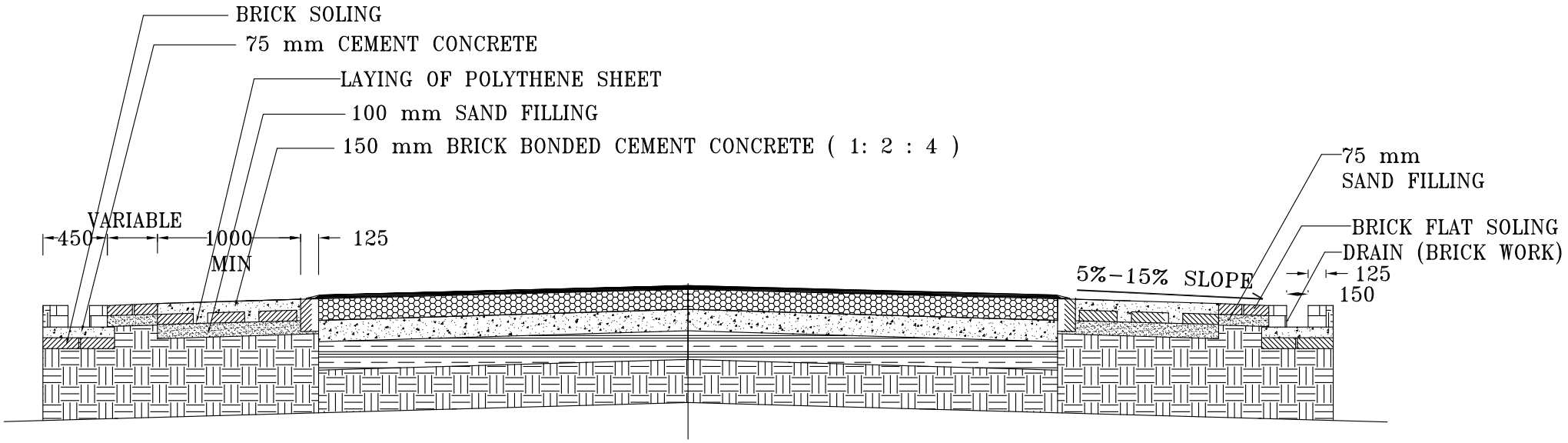

PLATE NO. UPR-UNR-BT-SLD-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA & UNION ROAD SECTION EARTHEN SHOULDER TREATMENT CROSSING BUILT-UP AREA	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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SHOULDER TREATMENT OF UPAZILA OR UNION ROAD CROSSING MARKET PLACE / BUILT-UP AREA

OPTION-2

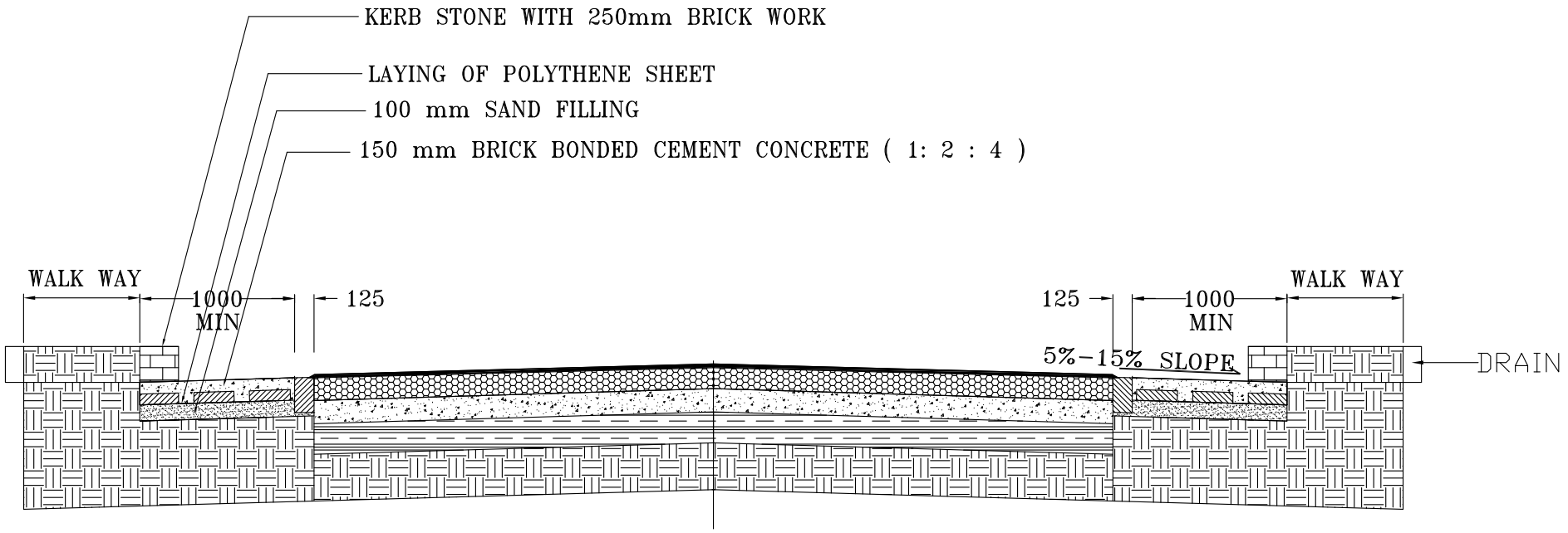

PLATE NO. UPR-UNR-BT-SLD-2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UPAZILA & UNION ROAD SECTION EARTHEN SHOULDER TREATMENT CROSSING BUILT-UP AREA	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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SHOULDER TREATMENT OF UPAZILA OR UNION ROAD CROSSING MARKET PLACE / BUILT-UP AREA

OPTION-3

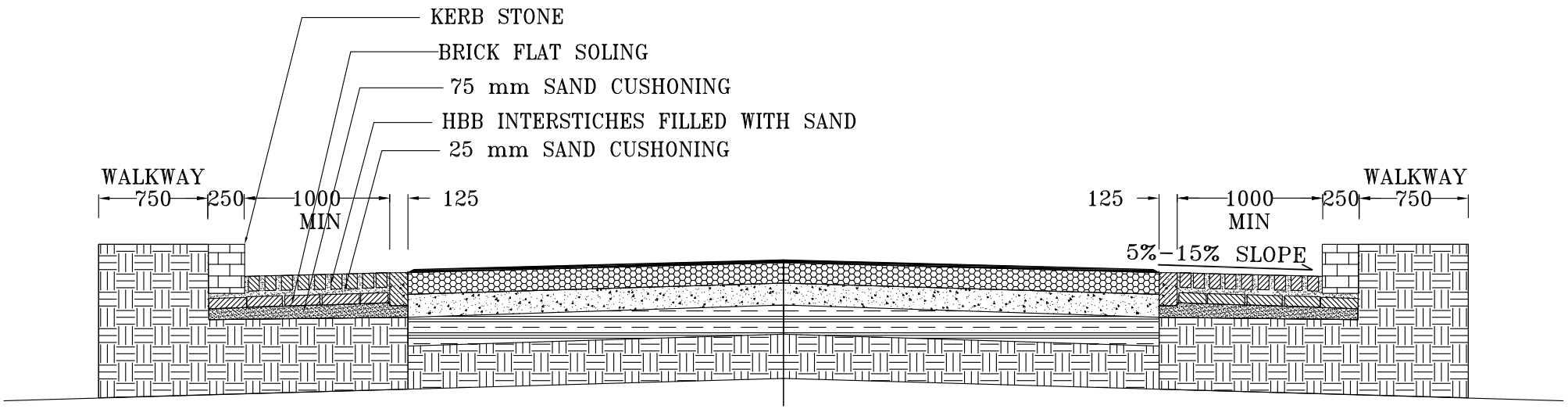

PLATE NO. UPR-UNR-BT-SLD-3

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	UPAZILA & UNION ROAD SECTION EARTHEN SHOULDER TREATMENT CROSSING BUILT-UP AREA	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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SHOULDER TREATMENT OF UPAZILA OR UNION ROAD CROSSING MARKET PLACE / BUILT-UP AREA

OPTION-4

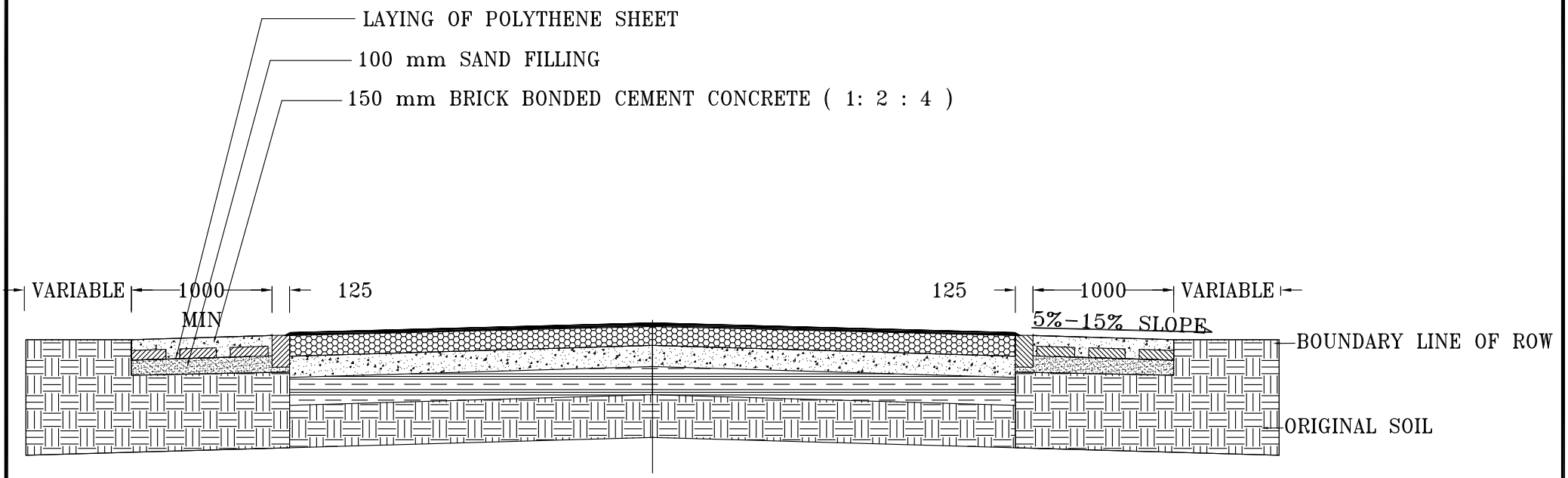

PLATE NO. UPR-UNR-BT-SLD-4

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	UPAZILA & UNION ROAD SECTION EARTHEN SHOULDER TREATMENT CROSSING BUILT-UP AREA	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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ROAD JUNCTION AND INTERSECTION TREATMENT OF UPAZILA ROADS

Plate UPR-BCI-RJ-1

Plate UPR-BCI-RJ-2

Plate UPR-BCI-BS-1

Plate UPR-BCI-BS-2

Plate UPR-BCI-BS-2

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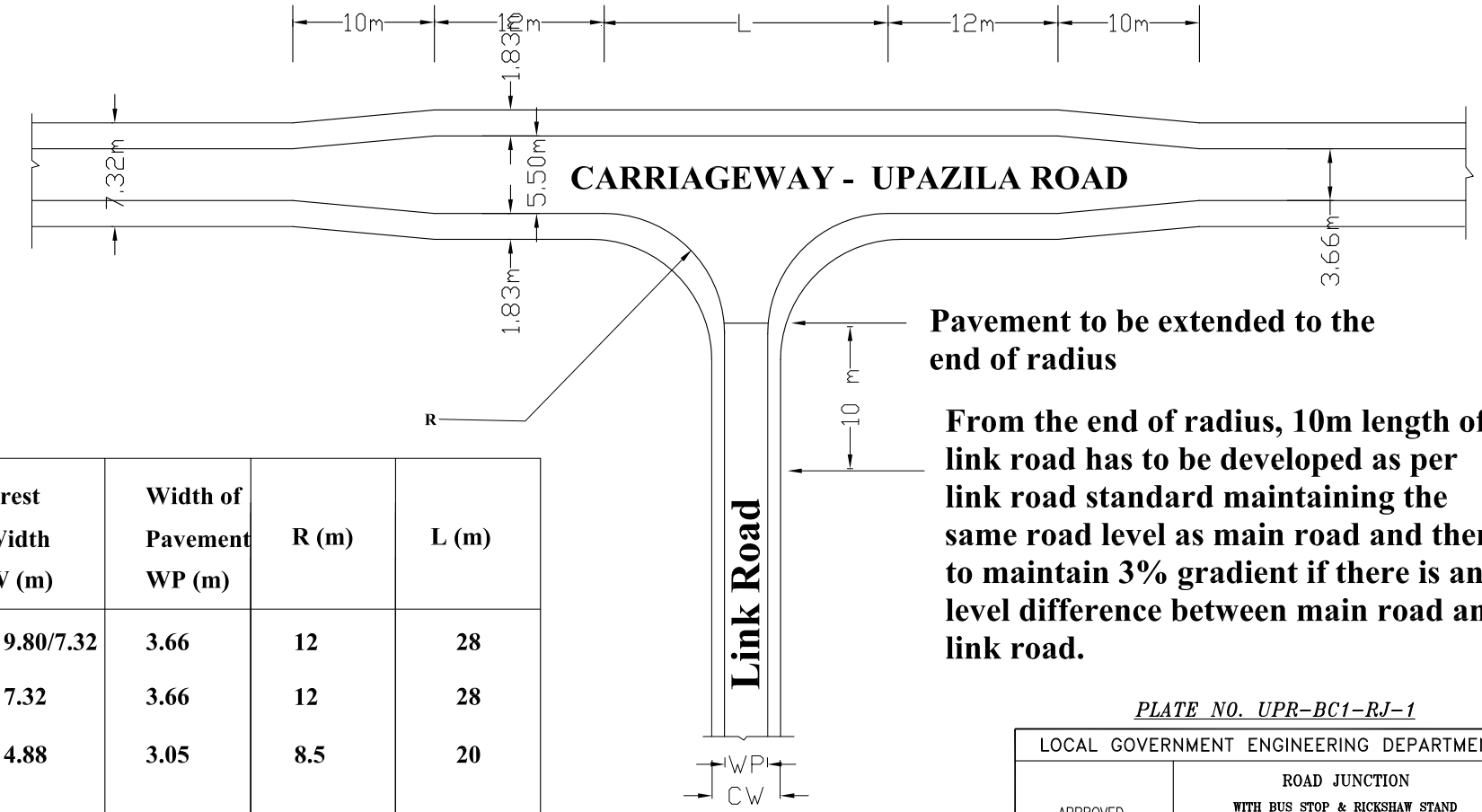
UPAZILA ROAD JUNCTION TYPE – 1

(With Bus Stops & Rickshaw Stand)



Pavement to be extended to the end of radius

From the end of radius, 10m length of link road has to be developed as per link road standard maintaining the same road level as main road and then to maintain 3% gradient if there is any level difference between main road and link road.

Type of Link Road	Crest Width CW (m)	Width of Pavement WP (m)	R (m)	L (m)
ZILA ROAD	9.80/7.32	3.66	12	28
UPAZILA ROAD	7.32	3.66	12	28
UNION ROAD	4.88	3.05	8.5	20
VILLAGE ROAD	3.66	2.44	6	16
VILLAGE ROAD	2.44		3	6

PLATE NO. UPR-BC1-RJ-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

APPROVED BY	ROAD JUNCTION WITH BUS STOP & RICKSHAW STAND UPAZILA ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	SR. ADVISER, RDP-16/23
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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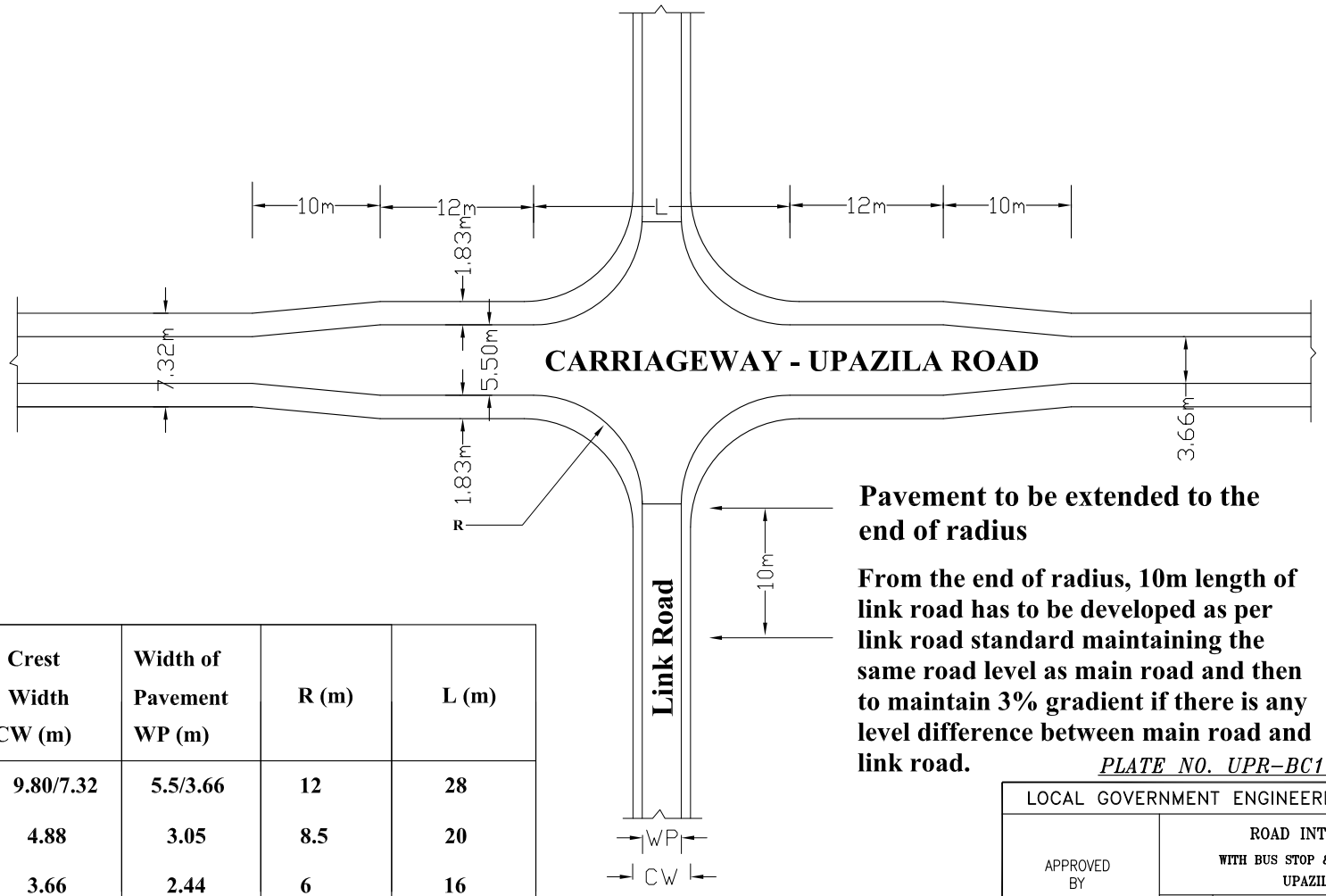
UPAZILA ROAD INTERSECTION, TYPE – 1
(With Bus Stops & Rickshaw Stand)



Type of Link Road	Crest Width CW (m)	Width of Pavement WP (m)	R (m)	L (m)
ZILA / UPAZILA ROAD	9.80/7.32	5.5/3.66	12	28
UNION ROAD	4.88	3.05	8.5	20
VILLAGE ROAD	3.66	2.44	6	16
VILLAGE ROAD	2.44		3	6

Pavement to be extended to the end of radius

From the end of radius, 10m length of link road has to be developed as per link road standard maintaining the same road level as main road and then to maintain 3% gradient if there is any level difference between main road and link road.

PLATE NO. UPR–BC1–RJ–2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

APPROVED BY	ROAD INTERSECTION WITH BUS STOP & RICKSHAW STAND UPAZILA ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	SR. ADVISER, RDP–16/23
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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TYPICAL BUS STOP – AT MID BLOCK LOCATION
(Wih Bus Stop & Rickshaw Stand)

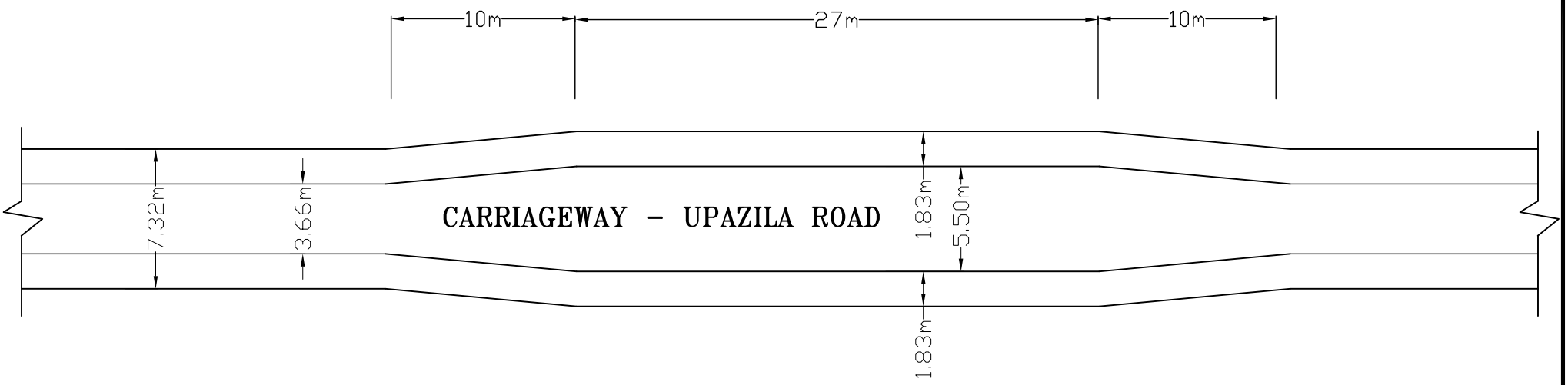

PLATE NO. UPR–BC1–BS–1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	PAVEMENT WIDENING BUS STOP UPAZILA ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	SR. ADVISER, RDP–16/23
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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PAVEMENT WIDENING THROUGH MARKET AREA TYPE-1

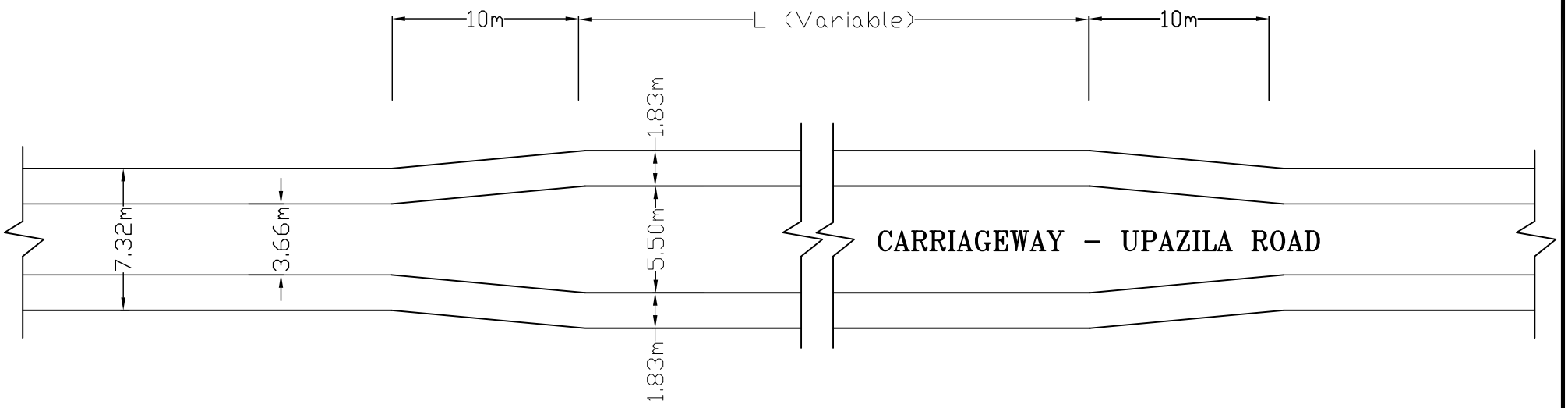

PLATE NO. UPR-BC1-BS-2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	PAVEMENT WIDENING THROUGH SMALL MARKET PLACE UPAZILA ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	SR. ADVISER, RDP-16/23
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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PAVEMENT WIDENING THROUGH MARKET AREA TYPE-2

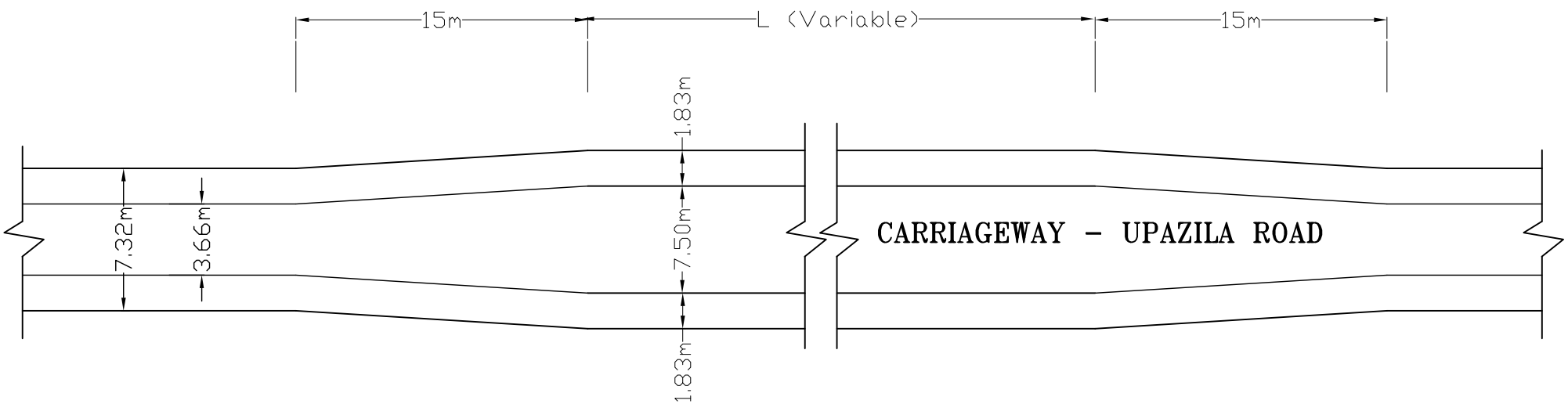

PLATE NO. UPR-BC1-BS-3

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	PAVEMENT WIDENING THROUGH MARKET PLACE UPAZILA ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	SR. ADVISER, RDP-16/23
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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ROAD JUNCTION AND INTERSECTION TREATMENT OF UNION ROADS

Plate UNR-BCI-RJ-1

Plate UNR-BCI-RJ-2

Plate UNR-BCI-BS-1

Plate UNR-BCI-BS-2

Plate UNR-BCI-BS-2

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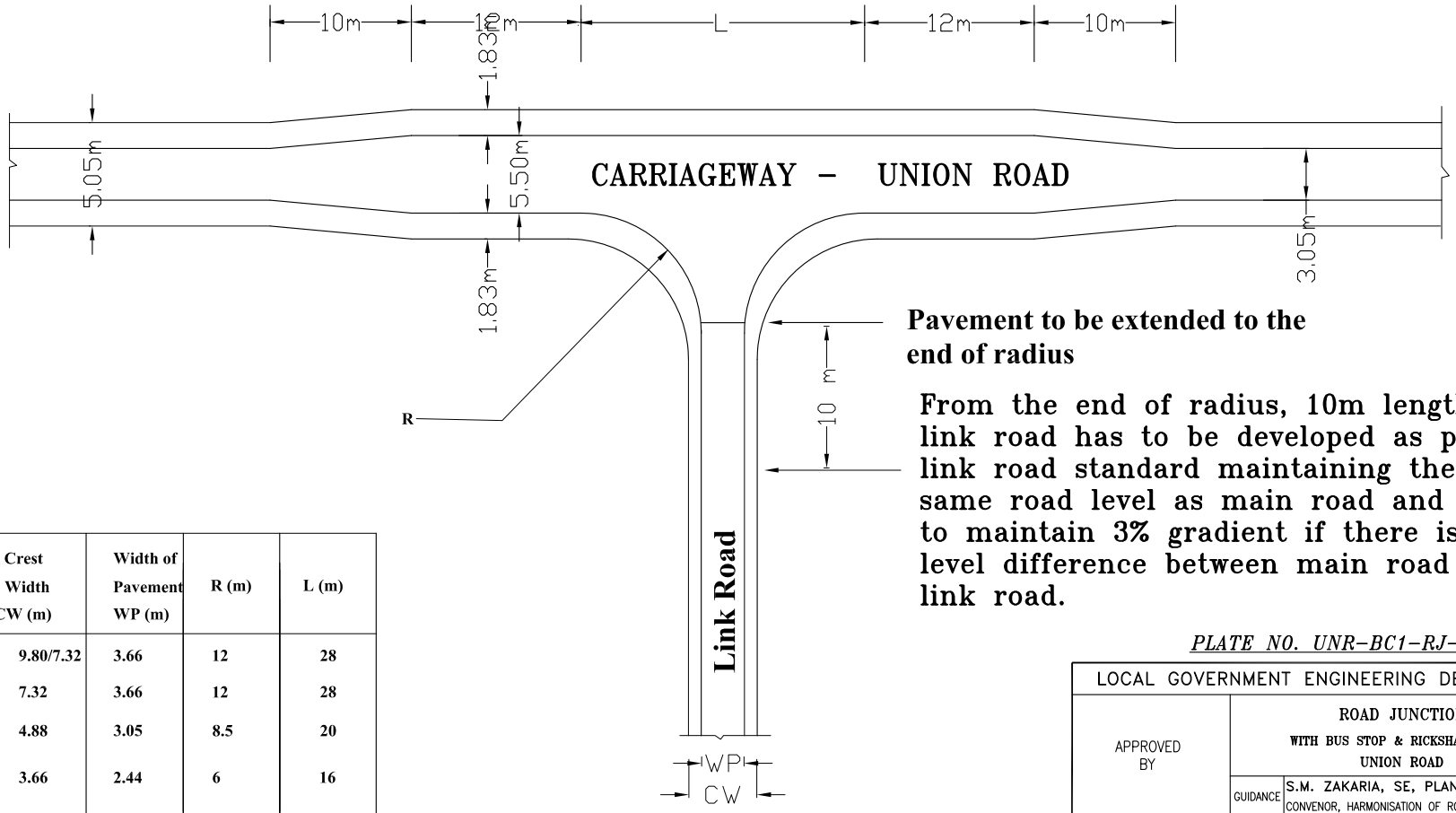
UNION ROAD JUNCTION, TYPE – 1

(With Bus Stops & Rickshaw Stand)



Pavement to be extended to the end of radius

From the end of radius, 10m length of link road has to be developed as per link road standard maintaining the same road level as main road and then to maintain 3% gradient if there is any level difference between main road and link road.

Type of Link Road	Crest Width CW (m)	Width of Pavement WP (m)	R (m)	L (m)
ZILA ROAD	9.80/7.32	3.66	12	28
UPAZILA ROAD	7.32	3.66	12	28
UNION ROAD	4.88	3.05	8.5	20
VILLAGE ROAD	3.66	2.44	6	16
VILLAGE ROAD	2.44		3	6

PLATE NO. UNR–BC1–RJ–1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

APPROVED BY

MD. SHAHIDUL HASSAN
CHIEF ENGINEER

ROAD JUNCTION
WITH BUS STOP & RICKSHAW STAND
UNION ROAD

GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
PROCESS	MD. ENAMUL HOQUE, AE/DU

MAY, 2003

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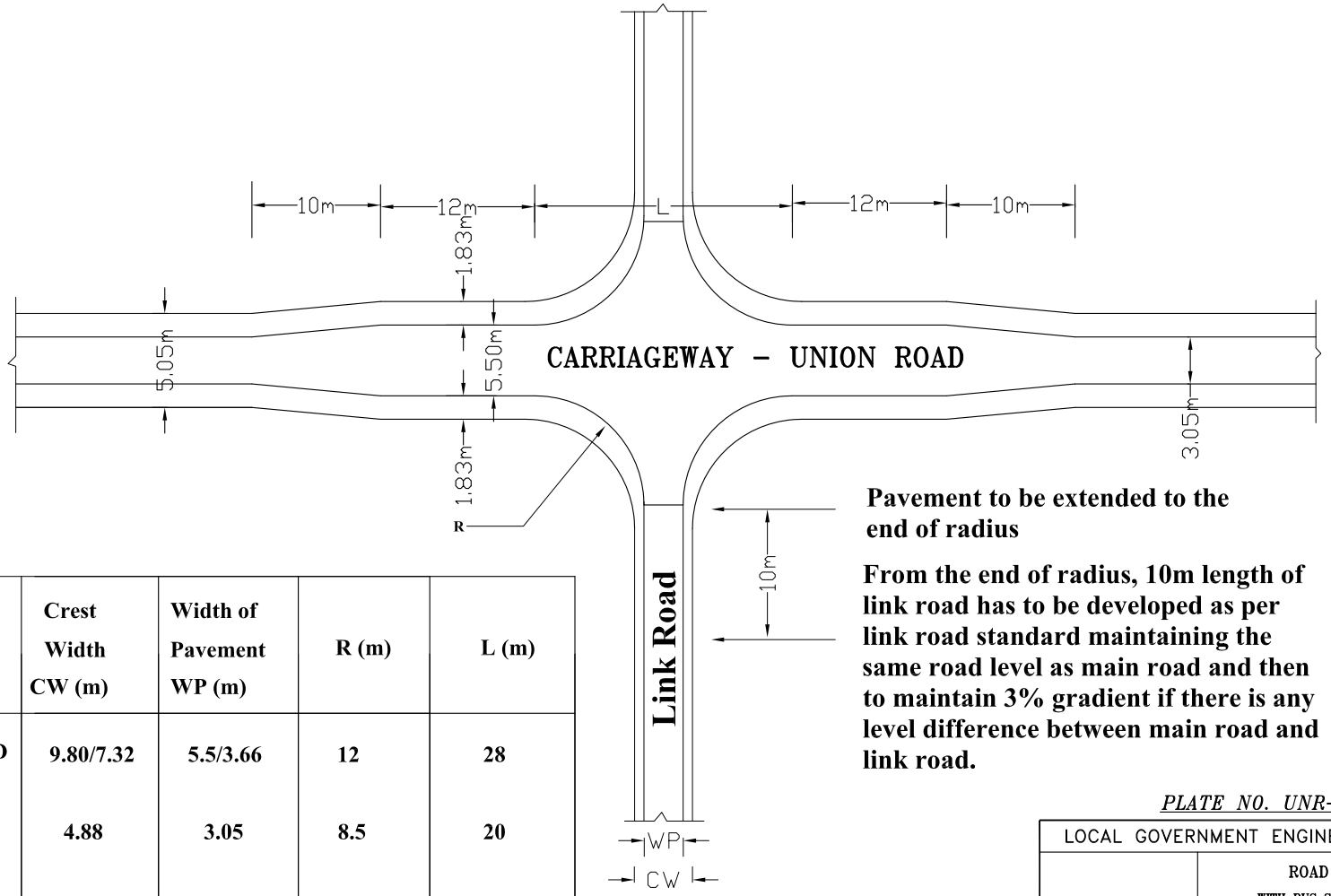
UNION ROAD INTERSECTION, TYPE – 1
(With Bus Stops & Rickshaw Stand)



Type of Link Road	Crest Width CW (m)	Width of Pavement WP (m)	R (m)	L (m)
ZILA / UPAZILA ROAD	9.80/7.32	5.5/3.66	12	28
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VILLAGE ROAD	3.66	2.44	6	16
VILLAGE ROAD	2.44		3	6

Pavement to be extended to the end of radius

From the end of radius, 10m length of link road has to be developed as per link road standard maintaining the same road level as main road and then to maintain 3% gradient if there is any level difference between main road and link road.

PLATE NO. UNR–BC1–RJ–2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT

APPROVED BY

MD. SHAHIDUL HASSAN
CHIEF ENGINEER

ROAD INTERSECTION
WITH BUS STOP & RICKSHAW STAND
UNION ROAD

GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
PROCESS	MD. ENAMUL HOQUE, AE/DU

MAY, 2003

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TYPICAL BUS STOP – AT MID BLOCK LOCATION
(Wih Bus Stop & Rickshaw Stand)

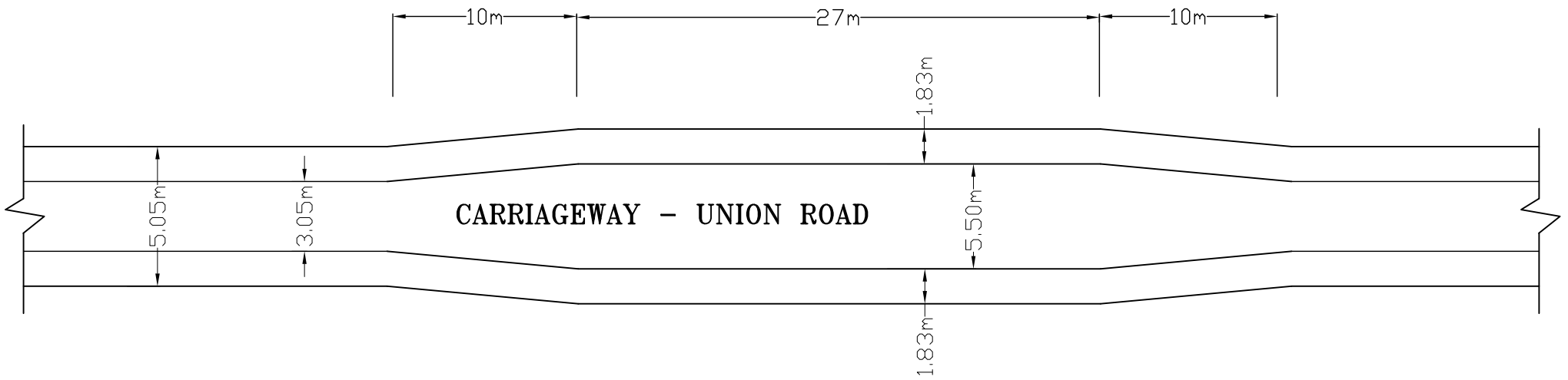

PLATE NO. UNR–BC1–BS–1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	PAVEMENT WIDENING BUS STOP UNION ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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PAVEMENT WIDENING THROUGH MARKET AREA TYPE-1

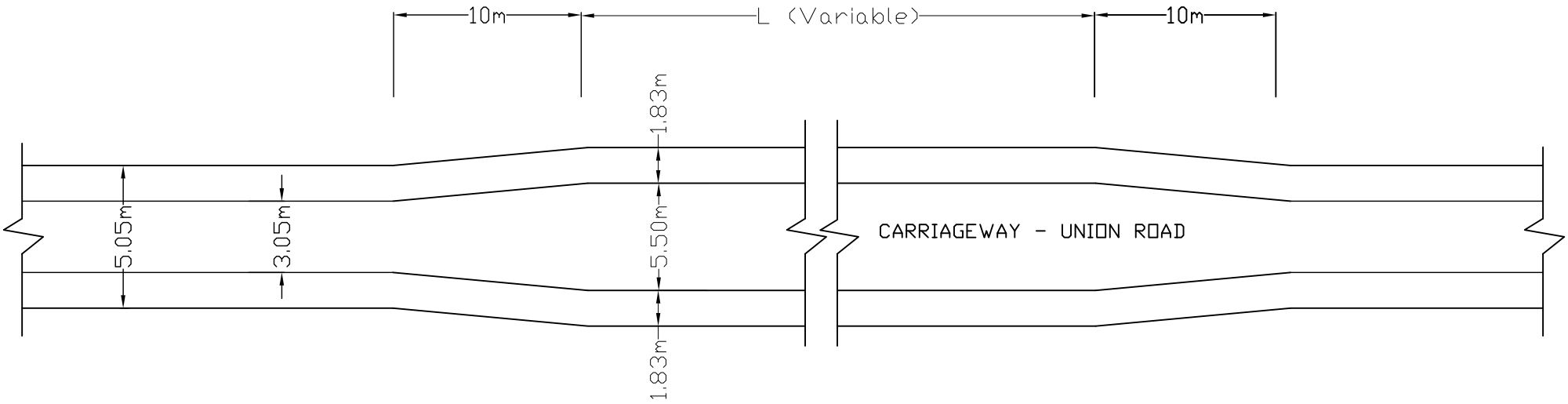

PLATE NO. UNR-BC1-BS-2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	PAVEMENT WIDENING THROUGH SMALL MARKET PLACE UNION ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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PAVEMENT WIDENING THROUGH MARKET AREA TYPE-2

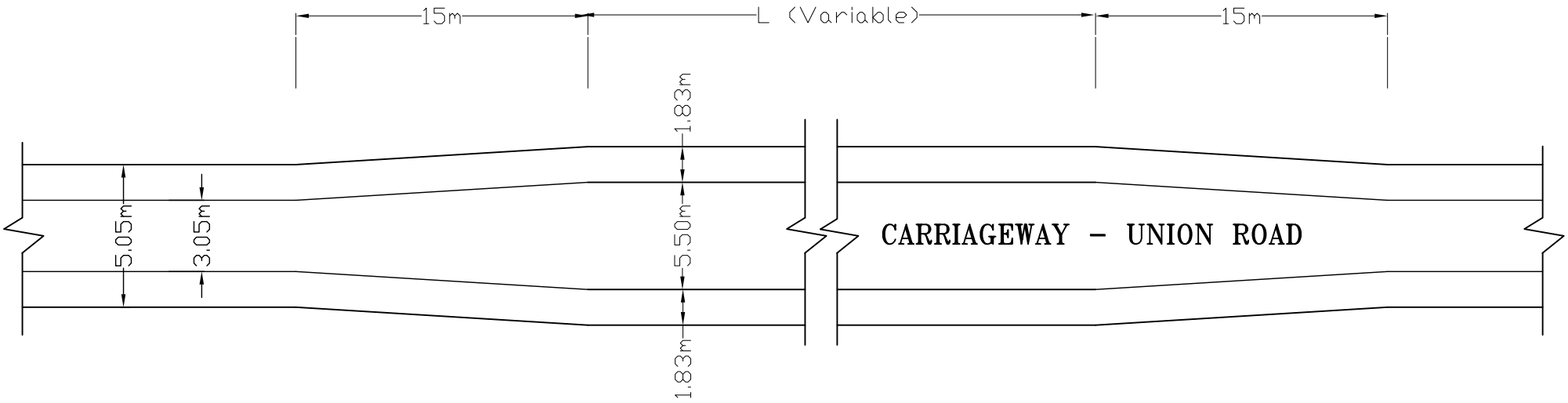

PLATE NO. UNR-BC1-BS-3

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	PAVEMENT WIDENING THROUGH MARKET PLACE UNION ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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ROAD EMBANKMENT PROTECTION AT CHAR AND HAOR AREA

Plate UPR-UNR-EM1-1/2

Plate UPR-UNR-EM1-2/2

Plate UPR-UNR-EM2-1

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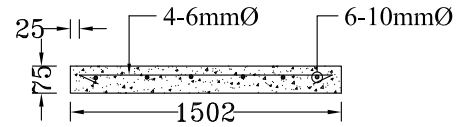
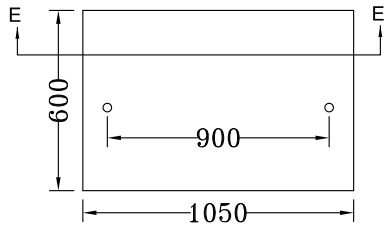
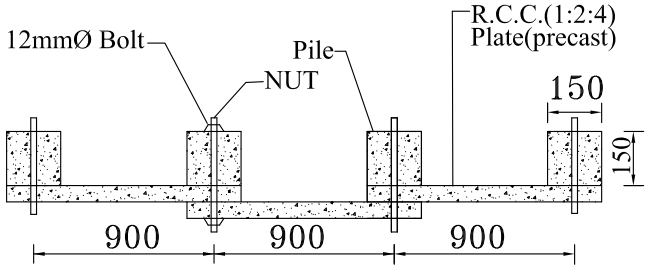
ROAD EMBANKMENT PROTECTION IN HAOR & WATER-LOGGED AREA



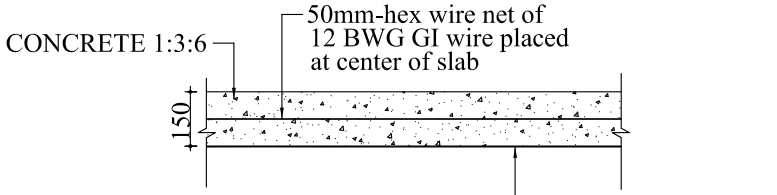
SECTION E-E



PLAN OF PLATE



PLAN OF PILE AND PLATE JOINT AT SEC 2-2



DETAIL-C

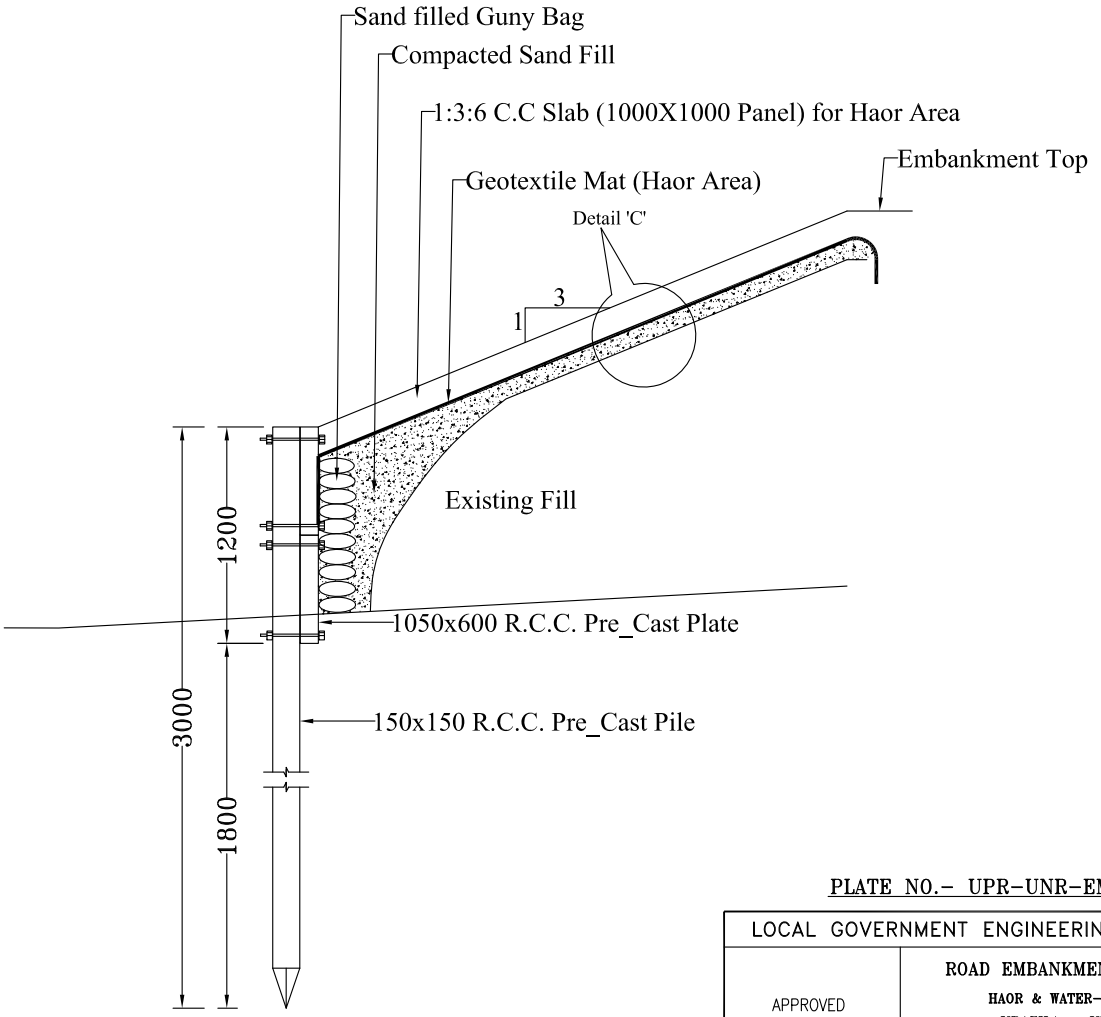


PLATE NO.- UPR-UNR-EM1-1/2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	ROAD EMBANKMENT PROTECTION HAOR & WATER-LOGGED AREA UPAZILA - UNION ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	MD. MOKSED ALAM, [SR. CONST, LGED]
	PROCESS	MD. SAIFUL ISLAM, [AE, DU, LGED]
	MAY, 2003	

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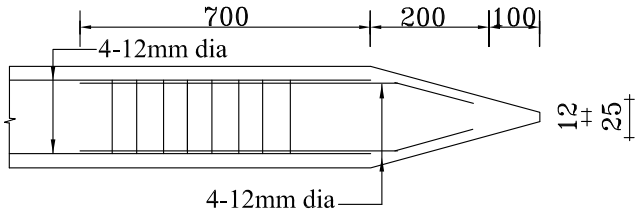
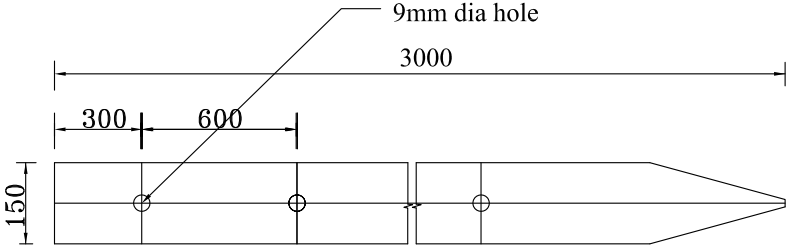
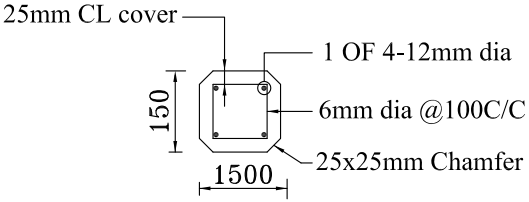
ROAD EMBANKMENT PROTECTION IN HAOR & WATER-LOGGED AREA



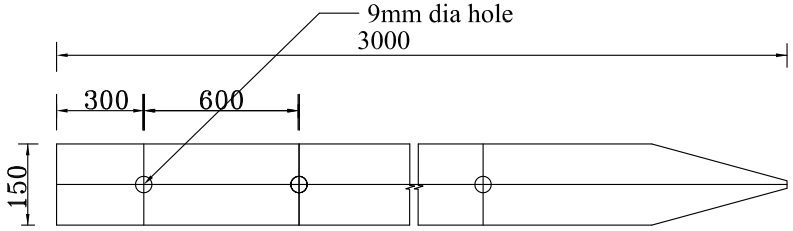
PILE SHOE DETAIL



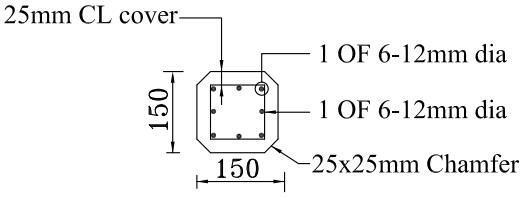
LOCATION OF HOLE
(Under the cap)



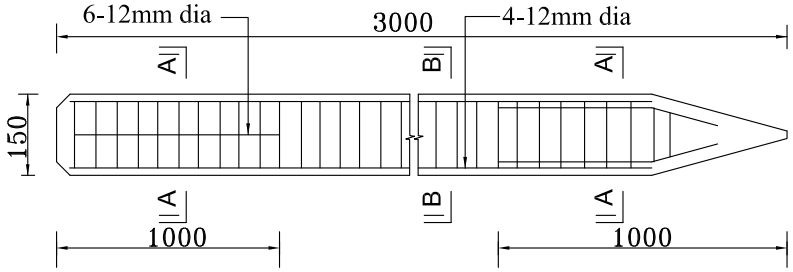
SEC. B-B



LOCATION OF HOLE
(WITHOUT CAP)



SEC. A-A



LONG SEC OF PILE

Details OF Pile for 3.00m Length

PLATE NO.- UPR-UNR-EM1-2/2

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY MD. SHAHIDUL HASSAN CHIEF ENGINEER	ROAD EMBANKMENT PROTECTION HAOR & WATER-LOGGED AREA UPAZILA - UNION ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
	DESIGN	MD. MOKSED ALAM, [SR. CONST, LGED]
	PROCESS	MD. SAIFUL ISLAM, [AE, DU, LGED]
	MAY, 2003	

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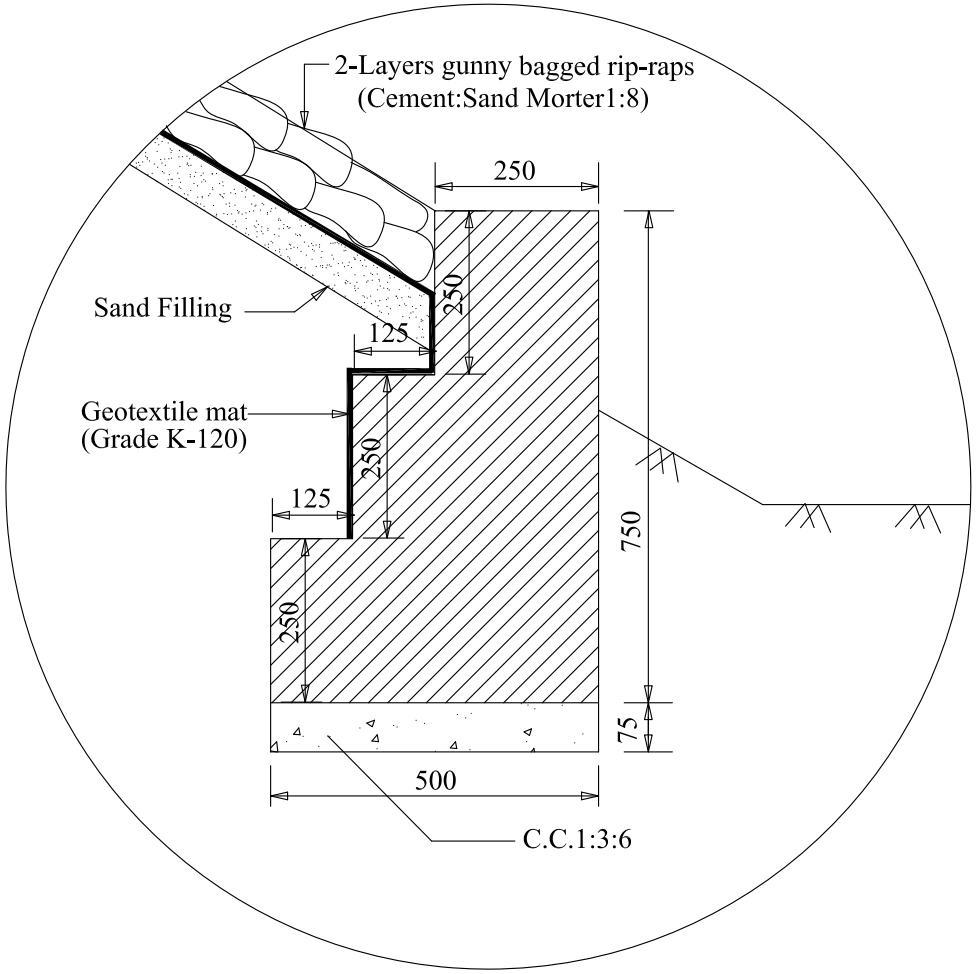
SLOPE PROTECTION WORK
ROAD EMBANKMENT IN CHAR AREA



DETAIL-A

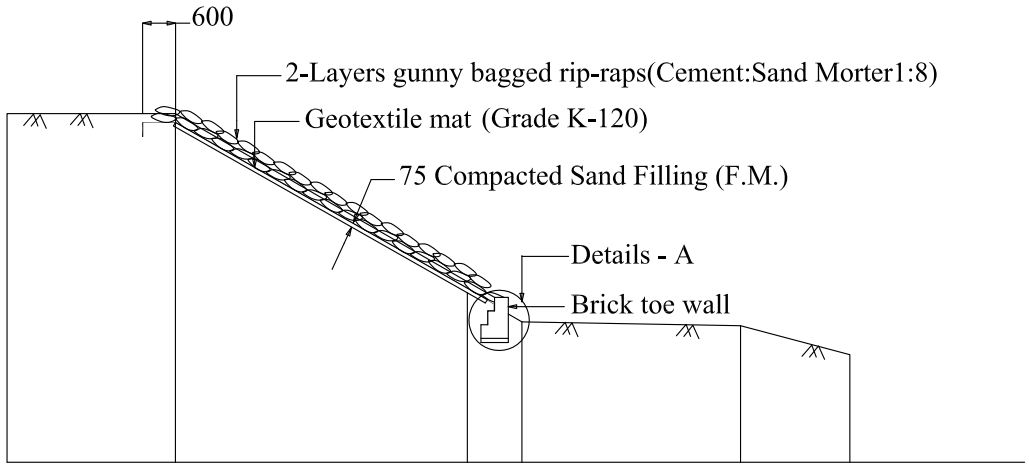


PLATE NO.- UPR-UNR-EM2-1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	ROAD EMBANKMENT PROTECTION 'CHAR' AREA UPAZILA – UNION ROAD	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	MD. MIZANUR RAHMAN, [DY. CONST, LGED]
	PROCESS	SYEDA BADRUNNESA, [SAE, DU, LGED]
	MAY, 2003	

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ROAD EMBANKMENT WIDENING

Plate UPR -EW1-1

Plate UNR-EW1-1

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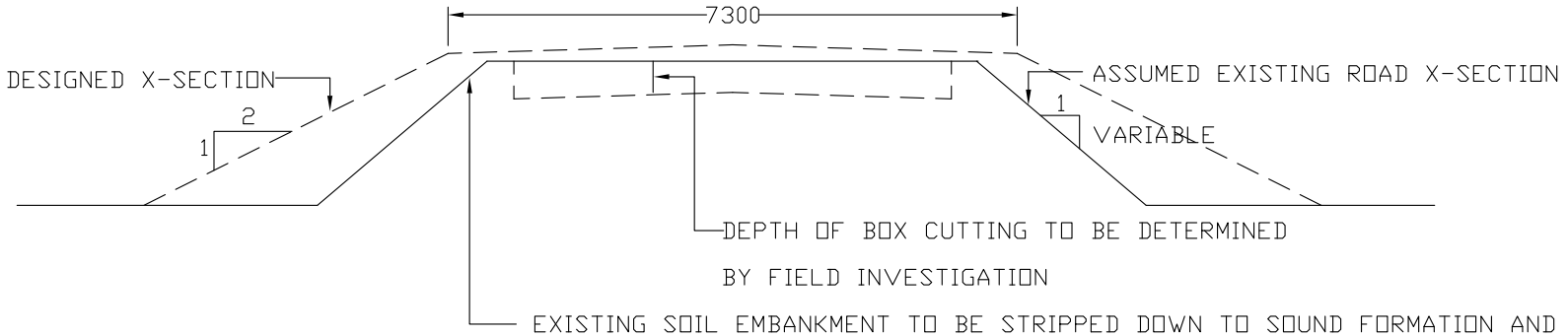

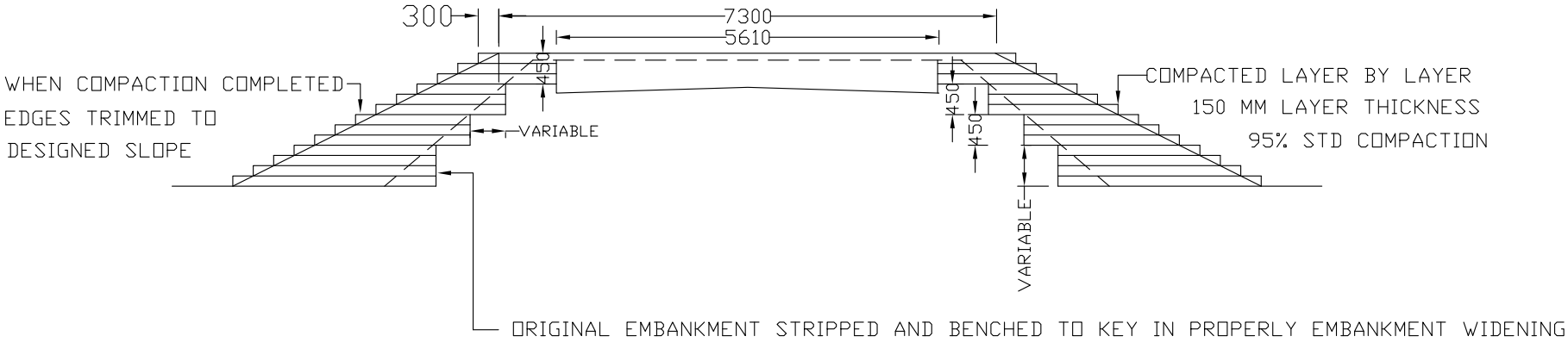

METHOD OF EARTHWORK FOR EMBANKMENT WIDENING

PLATE NO. UPR-EW-WD1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	TYPICAL ROAD CROSS SECTION UPAZILA ROAD FOR EMBANKMENT WIDENING	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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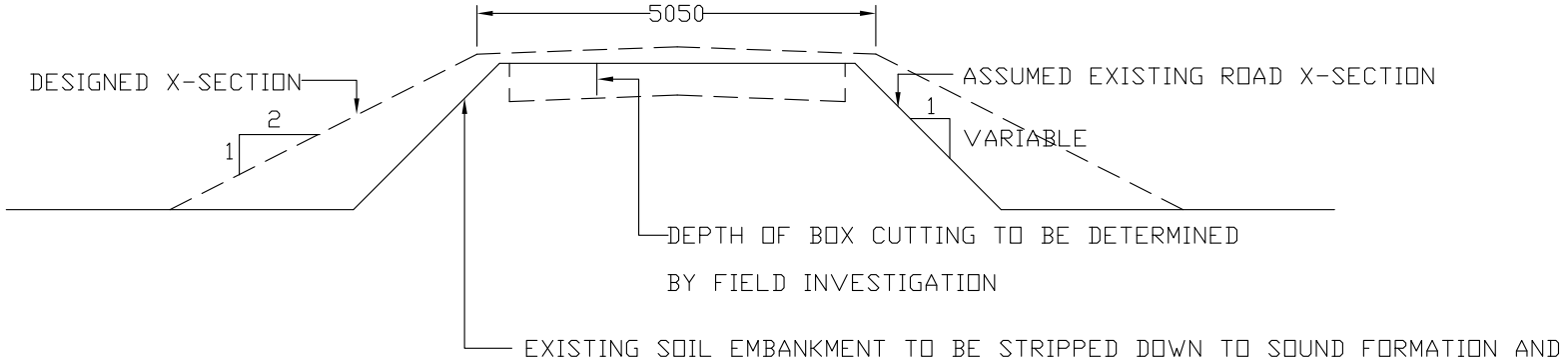

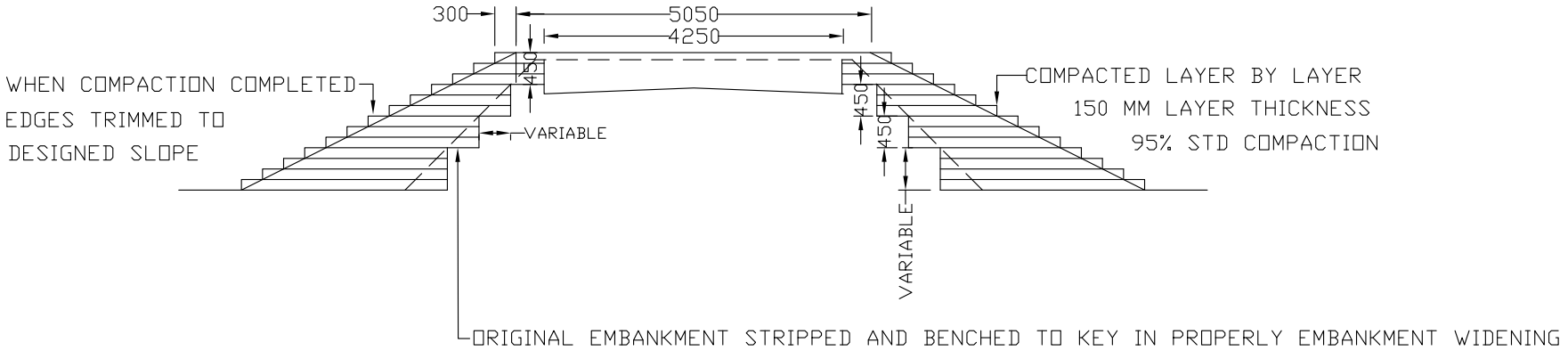

METHOD OF EARTHWORK FOR EMBANKMENT WIDENING

PLATE NO. UNR-EW-WD1

LOCAL GOVERNMENT ENGINEERING DEPARTMENT		
APPROVED BY	TYPICAL ROAD CROSS SECTION UNION ROAD FOR EMBANKMENT WIDENING	
	GUIDANCE	S.M. ZAKARIA, SE, PLANNING & DESIGN CONVENOR, HARMONISATION OF ROAD PAVEMENT DESIGN
MD. SHAHIDUL HASSAN CHIEF ENGINEER	DESIGN	A. B. M. NAZRUL ISLAM, SDS/DU
	PROCESS	MD. ENAMUL HOQUE, AE/DU
	MAY, 2003	

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DESIGN HARMONISATION COMMITTEE

1.	Mr. S. M. Zakaria, SE, (Planning and Design)	Convenor.
2.	Mr. Md. Abdul Gaffar, SE, (Urban Management)	Member.
3.	Mr. Dhali Abdul Jalil, PD, RDP-22	Member.
4.	Mr. Md. Zahangir Alam ,PD, Low Cost B/C Project	Member.
5.	Mr. Md. Haider Ali , PD, LBC Project	Member.
6.	Mr. Md. Azizul Hoque, PD, RDP-11	Member.
7.	Mr. Md. Abdus Shaheed, PD, Greater Jessore Project	Member.
8.	Mr. Amir Azam, Executive Engineer, (Maintenance)	Member.
9.	Mr. Md. Harunur Rashid, Executive Engineer, GIDP	Member.
10.	Mr. Roushan Ali Pramanik, Executive Engineer, RDP-20	Member.
11.	Mr. Kazi Golam Moshtafa, Assistant Engineer, (Planning and Monitoring	Member
12.	Mr. Md. Mokshed Alam, Sr. Design Consultant	Member.
13.	Mr. A.B.M. Nazrul Islam, Sr. Design Specialist	Member.
14.	Mr. Md. Mizanur Rahman, Design Consultant	Member.
15.	Mr. S.M. Salim, Executive Engineer, (Planning and Monitoring)	Member Secretary.