রেজিস্টার্ড নং ডি এ-১

"জাতির পিতা বঙ্গবন্ধু শেখ মুজিবুর রহমানের জন্মশতবার্ষিকী উদ্‌যাপন সফল হোক"

বাংলাদেশ গেজেট

অতিরিক্ত সংখ্যা

কর্তৃপক্ষ কর্তৃক প্রকাশিত

সোমবার, আগস্ট ১৬, ২০২১

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিকল্পনা কমিশন
ভৌত অবকাঠামো বিভাগ
সড়ক পরিবহন উইং

প্রজ্ঞাপন

তারিখ : ০৭ জুলাই ২০২১

নং **২০.০৩.০০০০.৭০২.১৪.৫১৪.১৯-১১০**—একই শ্রেণীর সড়ক পুনঃনির্মাণ, নতুন নির্মাণ, প্রশস্তকরণ ও মজবুতিকরণের ক্ষেত্রে সংস্থা ভেদে সড়কের ডিজাইন, কাজের মান এবং ব্যয়ের বিদ্যমান তারতম্য পরিহারের লক্ষ্যে জেলা, উপজেলা ও ইউনিয়ন সড়ক, সেতু ও কালভার্টসমূহের মান (Standards) ও ব্যয় নির্ধারণ করে সরকার কর্তৃক "Road Design Standards" অনুমোদনপূর্বক ০৫ সেপ্টেম্বর ২০০৪ তারিখে গেজেটে প্রকাশ করা হয়।

২। উক্ত গেজেট অনুসরণে সড়ক ও জনপথ অধিদপ্তর (সওজ) এবং স্থানীয় সরকার প্রকৌশল অধিদপ্তর (এলজিইডি) স্ব-স্ব সংস্থার নীতিমালা অনুযায়ী তাদের আওতাধীন সড়ক নির্মাণ, পুনঃনির্মাণ, প্রশস্তকরণ ও মজবুতিকরণ কার্যক্রম পরিচালনা করছে।

৩। বর্তমানে এলজিইডি'র আওতাধীন সড়কসমূহে যানবাহনের সংখ্যা এবং এক্সেল লোড পূর্বের তুলনায় বৃদ্ধি পাওয়ায় এলজিইডি'র আওতাধীন সড়কের বিদ্যমান রোড ডিজাইন হালনাগাদপূর্বক সরকার "Road Design Standards of LGED" অনুমোদন করেছে। এতদ্বারা অনুমোদিত "Road Design Standards of LGED" এলজিইডি কর্তৃক অনুসরণের জন্য জনস্বার্থে জারী করা হলো।

৪। অনুমোদিত "Road Design Standards of LGED" ০৫ সেপ্টেম্বর ২০০৪ তারিখে জারীকৃত "Road Design Standards" এর সাথে "এলজিইডি'র জন্য প্রযোজ্য" মর্মে সংযোজিত হবে।

৫। ইহা গেজেটে প্রকাশের তারিখ হতে কার্যকর বলে গণ্য হবে।

রাষ্ট্রপতির আদেশক্রমে

মীর্জা মোহাম্মদ আলী রেজা
উপপ্রধান (উপসচিব)।

মূল্য : টাকা ৪৮.০০

1 Introduction

1.1 Road transportation plays a vital role in providing accessibility and mobility that contributes to the socio-economic development of a country. Bangladesh has around 3,75,000 km road network comprising National highway, Regional highway, Zila road, Upazila road, Union road, and Village road. The latter three category rural roads are developed and maintained by the Local Government Engineering Department (LGED). For the design purpose, LGED generally follows the road design standards gazette published on 5 September 2004.

1.2 Bangladesh's economy has made remarkable progress and economic activities have increased manifold in the last decade. Both the number and axle load of the traffic on roads have increased significantly. In some areas, Union and/or Village roads experience more axle load than Upazila roads because of rapid industrialization. Besides, due to the impact of global climate change, the variation of rainfall pattern and temperature over the years are now prominent and natural calamities like flash floods, tidal surges are more frequent in Bangladesh. In this backdrop, to support and accelerate the development pace, the upgrading of rural road design standards has been indispensable.

1.3 In order to upgrade the existing design standards of rural roads, LGED engaged the Bureau of Research, Testing and Consultation (BRTC) of Bangladesh University of Engineering & Technology (BUET). The composition of the BRTC, BUET team has been listed in Appendix-A. The team reviewed the existing manual, visited topographically and geographically dissimilar areas of the country, collected traffic data, measured soil's bearing capacity, conducted necessary tests, and finally after detail technical analysis submitted the upgraded standards. Subsequently, upon request of LGED, the upgraded standards were reviewed by an International Expert, Dr. John Rolt from Transport Research Laboratory (TRL), UK who is one of the writers of Overseas Road Note 31, a globally used guideline for designing roads in tropical and sub-tropical areas. Moreover, under the National Resilience Programme, the United Nations Office for Project Services (UNOPS) reviewed the standards through resilience perspective and their recommendations have been addressed accordingly.

1.4 The report on upgraded standards were placed to the Physical Infrastructure Division of Planning Commission through the Local Government Division under the Ministry of Local Government, Rural Development & Cooperatives (LGRD&C) for gazette notification. The standards were discussed in the Committee for Classification, Ownership, Responsibility Fixation, and Dispute Resolution of Roads under the Physical Infrastructure Division of the Planning Commission (list of committee members has been mentioned in Appendix - B). The committee conducted three meetings in this regard. Besides, the Hon'ble Minister of LGRD&C also chaired two meetings in this connection and reviewed the standards. After incorporating the decisions of different meetings, the standards were placed in the Road Design Standards Committee (list of committee members and ToR have been mentioned in Appendix - C) for recommending for gazette notification.

2 Summary of Issues Covered

2.1 The committee overviewed the design standards for new construction of all types of rural roads namely Village Road, Union Road, & Upazila Roads, and concluded that the key design criteria for all roads will be based on traffic volume, axle loads, and CBR (California Bearing Ratio) of subgrade.

2.2 It was agreed to consider fourteen design templates to form a logical progression in terms of road width and pavement thickness based on traffic and soil considerations. The agreed design standards will guide LGED in selecting the appropriate design of new roads following the traffic and soil data.

2.3 In addition to the fourteen templates, the committee recommended LGED for customized designing of roads on a case by case basis when feasible or situation demands.

3 Glossary

A list of technical terminology used in the standards has been listed alphabetically in Appendix - D with their definitions.

4 Principle of Design Standards

4.1 The existing design standards were limited to a few templates considering small variations in the Commercial Vehicles per Day (CVD) and soil's bearing capacity i.e. sub-grade CBR.

4.2 To overcome the limitations of the existing standards and to cover all possible scenarios, the geometric and structural design of rural roads has been suggested based on the traffic volume, axle load, subgrade CBR, environment & climate change scenario.

4.3 The extent of the road damage caused by vehicles depends on their axle loads. The damaging intensity of axles is related to a standard axle of 8.2 tons using equivalence factors derived from empirical studies. Due to the change in traffic patterns throughout the country, the equivalence factors for different axle loads have been changed from the previous standard as mentioned in Appendix - E. The loads imposed by private cars are not significant for structural damage and therefore only the total number and axle loading of heavy vehicles that the road will experience during the design period have been considered for structural design.

5 Geometric Design

5.1 The geometric dimensions of roads shall be sufficient enough to carry all traffic (vehicles and pedestrians) efficiently and safely. The suggested combination of carriageway widths of LGED road pavement and PCU factors for LGED road vehicles are summarized in Appendix - F. To simplify the selection of road carriageway, surveys were performed in many locations of the country and established the best possible approximation of PCU/hr and CVD.

5.2 The existing and recommended geometric dimensions of roads have been mentioned in the following Table 1 and Table 2 respectively.

Design Type	Corresponding CVD	Carriage Way	Crest
Type-8	0-50	3m / 10ft	5.5m / 18ft
Type-7	51-100	3.7m / 12ft	5.5m / 18ft
Type-6	101-200	3.7m / 12ft	7.3m / 24ft
Type-5	201-300	5.5m / 18ft	7.3m / 24ft
Type-4	301-600	5.5m / 18ft	9.7m / 32ft

Table 1: Existing Geometric Dimensions

The existing standards suggested design Type- 7 & 8 for Union road and Type– 4, 5, & 6 for Upazila road.

Design Type	Corresponding CVD	Carriage Way	Crest
Type-8	0-50	3m / 10ft	5.5m / 18ft
Type 7	51-100	3.7m / 12ft	6.7m / 22ft
Type 6	101-200	5m / 16ft	8.7m / 28.5ft
Type-5	201-300	5.5m / 18ft	9.2m / 30ft
Type-4B	301-400	6.1m / 20ft	11m / 36ft
Type-4A	401-500	6.1m / 20 ft	11m / 36ft
Type-4S-B	501-750	6.7m / 22ft	9.7m / 32ft
Type-4S-A	751-1000	7.3m / 24ft	11m / 36ft

Table 2: Recommended Geometric Dimensions

5.3 CVD shall be the main criterion for the selection of geometric dimensions of roads. If the CVD of any category road is found higher than its corresponding CVD, then the geometric dimensions mentioned against that CVD will govern. For instance, if any village road's CVD is more than 50 but less than 101, then its carriageway will be 12 ft instead of 10 ft. However, it is anticipated that in most of the cases design Type- 8 will be applicable for the Village roads, design Type- 7 & 8 will be applicable for the Union roads, and design Type- 4A, 4B, 5 & 6 will be applicable for the Upazila roads. Design type 4S-A & 4S-B will be applicable for roads in heavy traffic areas i.e. CVD>500. For the hilly area, six (6) types of design templates have been recommended that will be selected based on the CVD values of roads. The roads with traffic volumes where CVD>1000 will be designed on a case-by-case basis.

5.4 In case of special and/or unavoidable situations, e.g. unavailability of land, site criticality, etc., LGED will take case-specific decisions regarding carriageway, shoulder, and other dimensions.

5.5 LGED shall take necessary actions to acquire the required land lawfully to ensure the geometric standards of roads. The roads will have sufficient sight distance and the number of curves per kilometer will be as low as possible. Adequate land shall be acquired to provide necessary widening at the curve, intersection, and, wherever needed from the safety and level of service point of view. Nevertheless, in general, efforts will be made to keep land acquisition as minimum as possible.

6 Pavement Designs

6.1 The pavement is the main element of a road and therefore, careful consideration shall be given to the choice of pavement type and its design. Different factors like initial (construction) cost, availability of good materials, maintenance or rehabilitation cost, technology requirement and its availability govern the selection of the type of pavement.

6.2 The options of pavement available are:

- Flexible/bituminous pavement (BC);
- Reinforced cement concrete (RCC) pavement;
- Block pavement;
- Composite pavement.

Characteristically selection of pavement will be guided by several other factors, such as type and strength of soil along the alignment; availability of good aggregates, availability of contractors, drainage conditions, etc.

6.3 Flexible Pavement

6.3.1 At large, the number of Commercial Vehicles per Day (CVD) shall be the main criterion for the selection of design templates of roads. If the CVD of any category is found higher than its corresponding CVD, then the structural design mentioned against that CVD will govern.

6.3.2 The structural design of pavement for roads with heavy traffic (CVD>500) shall be based on the forecast cumulative number of Equivalent Standard Axles (ESAs) that the road will experience over its lifetime. It has been recommended that roads with CVD>1000 and/or ESA>20 million shall be designed on a case by case basis.

6.3.3 It has been recommended to prepare and use customized structural design of road pavements on a case by case basis wherever feasible and/or deemed necessary.

6.3.4 The recommended flexible pavement design templates (eight no) for different CVD values (0-1000) have been shown in the following pages. Besides, six additional templates recommended for roads in hilly areas have been shown in Appendix - G. A graphically illustration of the existing and proposed pavement thickness considering 4% subgrade CBR and maximum 5.5 million ESA for Type– 4SA & 4SB shows a logical progression of increasing pavement thickness with traffic volume in Figure 1.

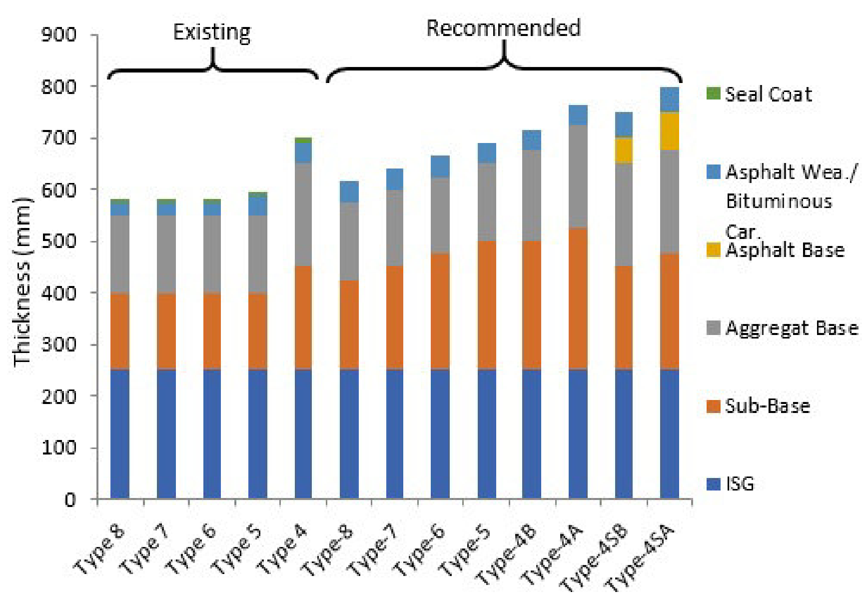
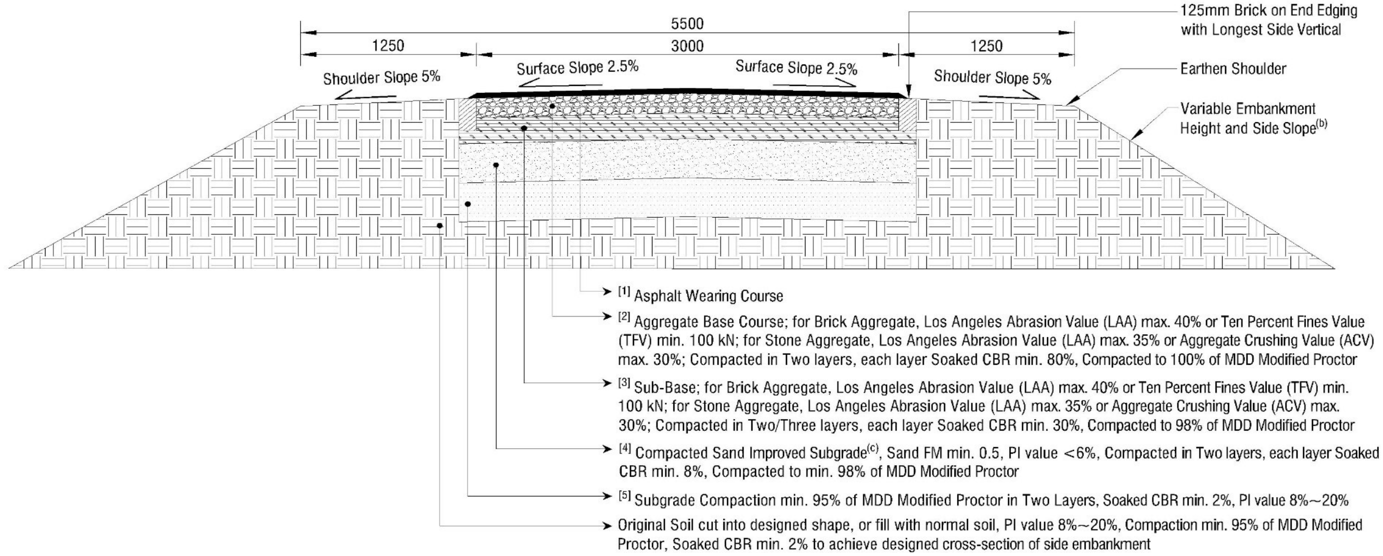


Figure 1: Comparison of Pavement Thickness

PAVEMENT DESIGN TEMPLATE FOR CVD 0-50

Type-8



NOTES:

(a) All dimensions are in millimeter unless otherwise specified;

(b) Side Slope Protection method will vary for different conditions;

(c) The local sand can be used as ISG subject to approval of LGED if the sand satisfies the following two conditions:

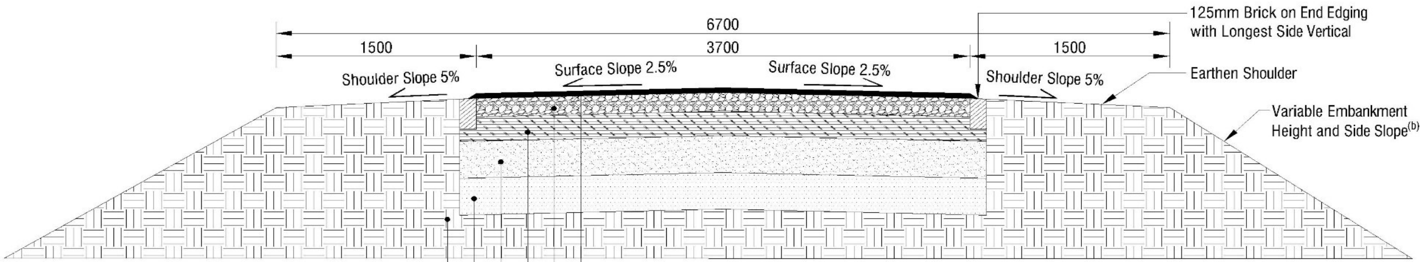
(i) Passing # 200 sieve (Not more than 15%) and

(ii) CBR Value: 8% or above.

Subgrade Soaked CBR (%)	Wearing Course (mm) [1]	Base Course (mm) [2]	Sub-base Course (mm) [3]	Improved subgrade (mm) [4]	Subgrade (mm) [5]
2	40	150	250	300	300
3	40	150	225	300	300
4	40	150	175	250	300
5	40	150	175	225	300
6	40	150	175	200	300
≥7	40	150	150	-	300

PAVEMENT DESIGN TEMPLATE FOR CVD 51-100

Type-7



[1] Asphalt Wearing Course

[2] Aggregate Base Course; for Brick Aggregate, Los Angeles Abrasion Value (LAA) max. 40% or Ten Percent Fines Value (TFV) min. 100 kN; for Stone Aggregate, Los Angeles Abrasion Value (LAA) max. 35% or Aggregate Crushing Value (ACV) max. 30%; Compacted in Two layers, each layer Soaked CBR min. 80%, Compacted to 100% of MDD Modified Proctor

[3] Sub-Base; for Brick Aggregate, Los Angeles Abrasion Value (LAA) max. 40% or Ten Percent Fines Value (TFV) min. 100 kN; for Stone Aggregate, Los Angeles Abrasion Value (LAA) max. 35% or Aggregate Crushing Value (ACV) max. 30%; Compacted in Two/Three layers, each layer Soaked CBR min. 30%, Compacted to 98% of MDD Modified Proctor

[4] Compacted Sand Improved Subgrade(c), Sand FM min. 0.5, PI value <6%, Compacted in Two layers, each layer Soaked CBR min. 8%, Compacted to min. 98% of MDD Modified Proctor

[5] Subgrade Compaction min. 95% of MDD Modified Proctor in Two Layers, Soaked CBR min. 2%, PI value 8%~20%

Original Soil cut into designed shape, or fill with normal soil, PI value 8%~20%, Compaction min. 95% of MDD Modified Proctor, Soaked CBR min. 2% to achieve designed cross-section of side embankment

NOTES:

(a) All dimensions are in millimeter unless otherwise specified;

(b) Side Slope Protection method will vary for different conditions;

(c) The local sand can be used as ISG subject to approval of LGED if the sand satisfies the following two conditions:

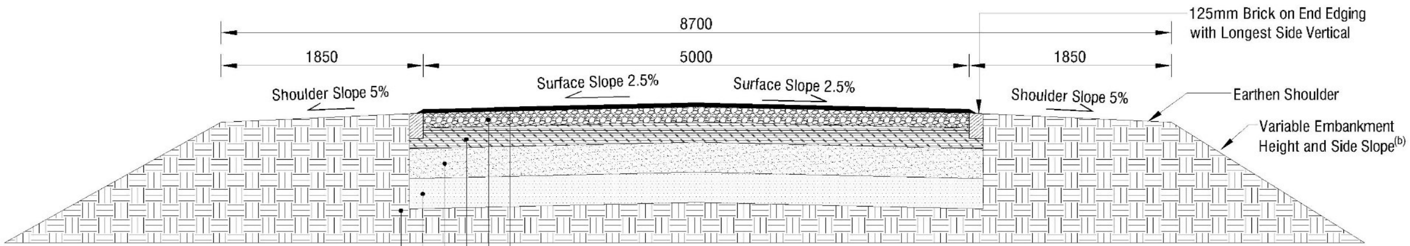
(i) Passing # 200 sieve (Not more than 15%) and

(ii) CBR Value: 8% or above.

Subgrade Soaked CBR (%)	Wearing Course (mm) [1]	Base Course (mm) [2]	Sub-base Course (mm) [3]	Improved subgrade (mm) [4]	Subgrade (mm) [5]
2	40	150	275	300	300
3	40	150	250	300	300
4	40	150	200	250	300
5	40	150	200	225	300
6	40	150	200	200	300
≥7	40	150	150	-	300

PAVEMENT DESIGN TEMPLATE FOR CVD 101-200

Type-6



[1] Asphalt Wearing Course

[2] Aggregate Base Course; for Brick Aggregate, Los Angeles Abrasion Value (LAA) max. 40% or Ten Percent Fines Value (TFV) min. 100 kN; for Stone Aggregate, Los Angeles Abrasion Value (LAA) max. 35% or Aggregate Crushing Value (ACV) max. 30%; Compacted in Two layers, each layer Soaked CBR min. 80%, Compacted to 100% of MDD Modified Proctor

[3] Sub-Base; for Brick Aggregate, Los Angeles Abrasion Value (LAA) max. 40% or Ten Percent Fines Value (TFV) min. 100 kN; for Stone Aggregate, Los Angeles Abrasion Value (LAA) max. 35% or Aggregate Crushing Value (ACV) max. 30%; Compacted in Two/Three layers, each layer Soaked CBR min. 30%, Compacted to 98% of MDD Modified Proctor

[4] Compacted Sand Improved Subgrade(c), Sand FM min. 0.5, PI value <6%, Compacted in Two layers, each layer Soaked CBR min. 8%, Compacted to min. 98% of MDD Modified Proctor

[5] Subgrade Compaction min. 95% of MDD Modified Proctor in Two Layers, Soaked CBR min. 2%, PI value 8%~20%

Original Soil cut into designed shape, or fill with normal soil, PI value 8%~20%, Compaction min. 95% of MDD Modified Proctor, Soaked CBR min. 2% to achieve designed cross-section of side embankment

NOTES:

(a) All dimensions are in millimeter unless otherwise specified;

(b) Side Slope Protection method will vary for different conditions;

(c) The local sand can be used as ISG subject to approval of LGED if the sand satisfies the following two conditions:

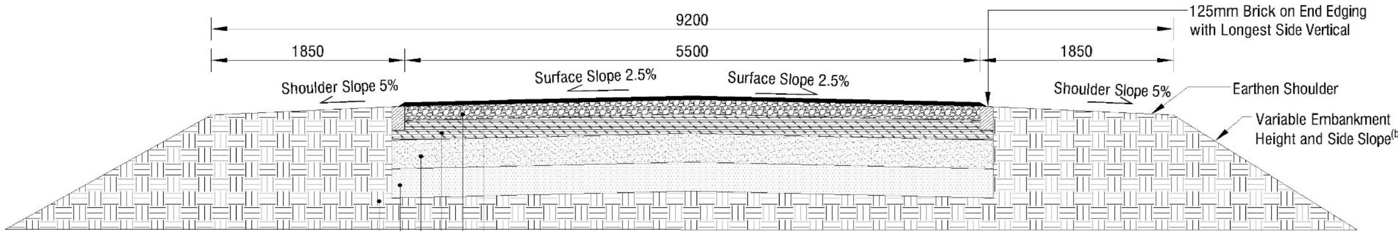
(i) Passing # 200 sieve (Not more than 15%) and

(ii) CBR Value: 8% or above.

Subgrade Soaked CBR (%)	Wearing Course (mm) [1]	Base Course (mm) [2]	Sub-base Course (mm) [3]	Improved subgrade (mm) [4]	Subgrade (mm) [5]
2	40	150	300	300	300
3	40	150	275	300	300
4	40	150	225	250	300
5	40	150	225	225	300
6	40	150	225	200	300
≥7	40	150	175	-	300

PAVEMENT DESIGN TEMPLATE FOR CVD 201-300

Type-5



[1] Asphalt Wearing Course

[2] Aggregate Base Course; for Brick Aggregate, Los Angeles Abrasion Value (LAA) max. 40% or Ten Percent Fines Value (TFV) min. 100 kN; for Stone Aggregate, Los Angeles Abrasion Value (LAA) max. 35% or Aggregate Crushing Value (ACV) max. 30%; Compacted in Two layers, each layer Soaked CBR min. 80%, Compacted to 100% of MDD Modified Proctor

[3] Sub-Base; for Brick Aggregate, Los Angeles Abrasion Value (LAA) max. 40% or Ten Percent Fines Value (TFV) min. 100 kN; for Stone Aggregate, Los Angeles Abrasion Value (LAA) max. 35% or Aggregate Crushing Value (ACV) max. 30%; Compacted in Two/Three layers, each layer Soaked CBR min. 30%, Compacted to 98% of MDD Modified Proctor

[4] Compacted Sand Improved Subgrade(c), Sand FM min. 0.5, PI value <6%, Compacted in Two layers, each layer Soaked CBR min. 8%, Compacted to min. 98% of MDD Modified Proctor

[5] Subgrade Compaction min. 95% of MDD Modified Proctor in Two Layers, Soaked CBR min. 2%, PI value 8%~20%

Original Soil cut into designed shape, or fill with normal soil, PI value 8%~20%, Compaction min. 95% of MDD Modified Proctor, Soaked CBR min. 2% to achieve designed cross-section of side embankment

NOTES:

(a) All dimensions are in millimeter unless otherwise specified;

(b) Side Slope Protection method will vary for different conditions;

(c) The local sand can be used as ISG subject to approval of LGED if the sand satisfies the following two conditions:

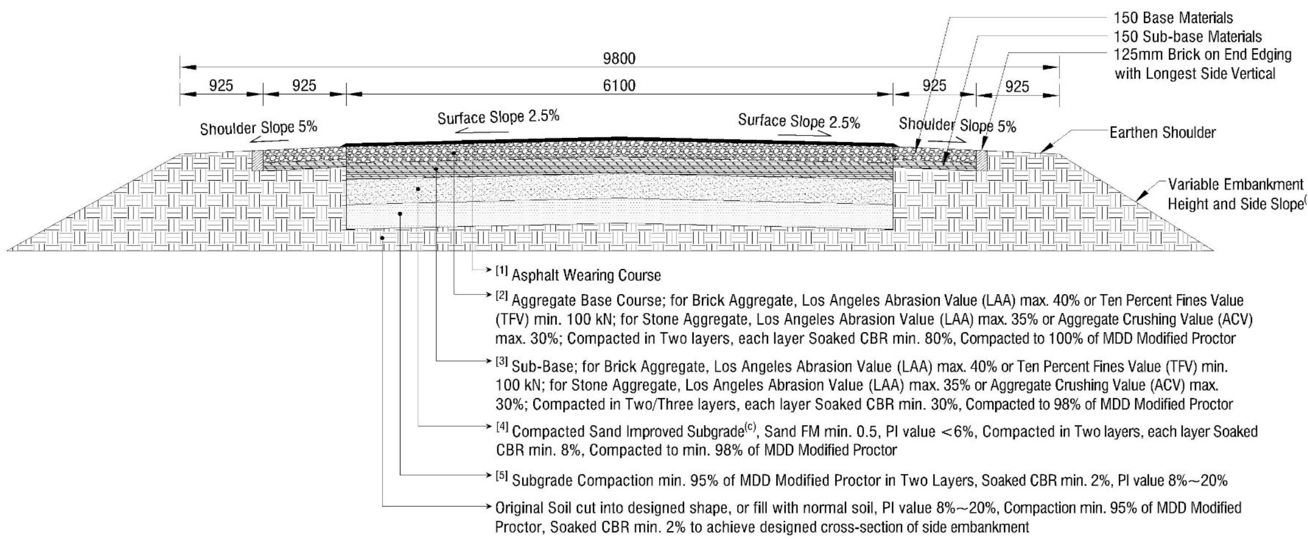
(i) Passing # 200 sieve (Not more than 15%) and

(ii) CBR Value: 8% or above.

Subgrade Soaked CBR (%)	Wearing Course (mm)	Base Course (mm)	Sub-base Course (mm)	Improved subgrade (mm)	Subgrade (mm)
	[1]	[2]	[3]	[4]	[5]
2	40	175	300	300	300
3	40	175	275	300	300
4	40	150	250	250	300
5	40	150	250	225	300
6	40	150	250	200	300
≥7	40	150	200	-	300

PAVEMENT DESIGN TEMPLATE FOR CVD 301-400

Type-4B



NOTES:

(a) All dimensions are in millimeter unless otherwise specified;

(b) Side Slope Protection method will vary for different conditions;

(c) The local sand can be used as ISG subject to approval of LGED if the sand satisfies the following two conditions:

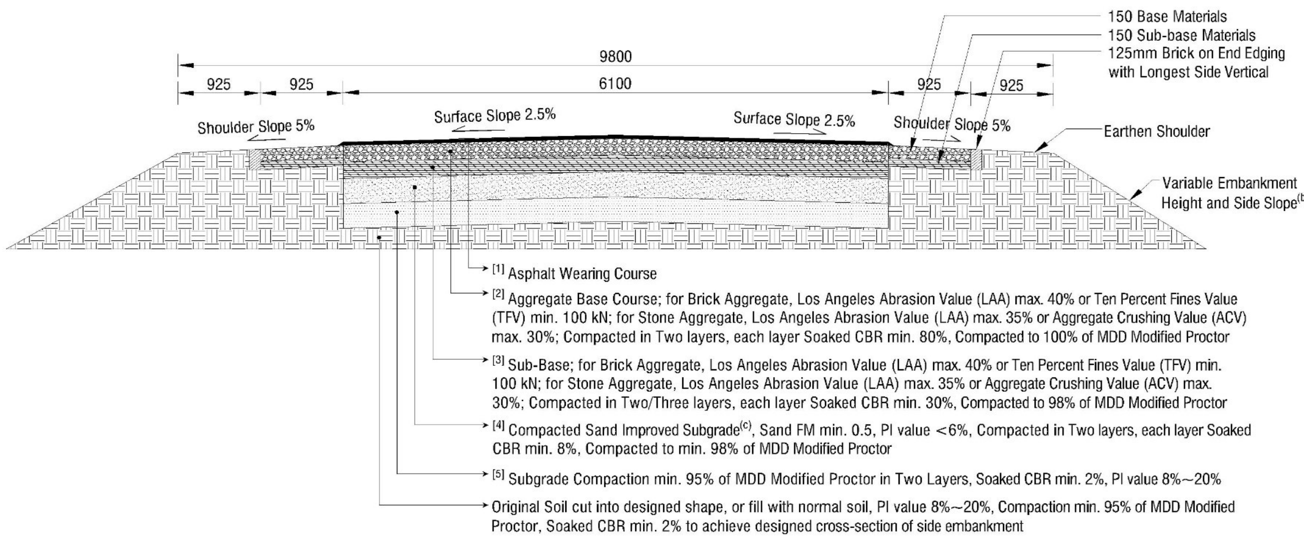
(i) Passing # 200 sieve (Not more than 15%) and

(ii) CBR Value: 8% or above.

Subgrade Soaked CBR (%)	Wearing Course (mm) [1]	Base Course (mm) [2]	Sub-base Course (mm) [3]	Improved subgrade (mm) [4]	Subgrade (mm) [5]
2	40	200	300	300	300
3	40	200	275	300	300
4	40	175	250	250	300
5	40	175	250	225	300
6	40	175	250	200	300
≥7	40	175	200	-	300

PAVEMENT DESIGN TEMPLATE FOR CVD 401-500

Type-4A



NOTES:

(a) All dimensions are in millimeter unless otherwise specified;

(b) Side Slope Protection method will vary for different conditions;

(c) The local sand can be used as ISG subject to approval of LGED if the sand satisfies the following two conditions:

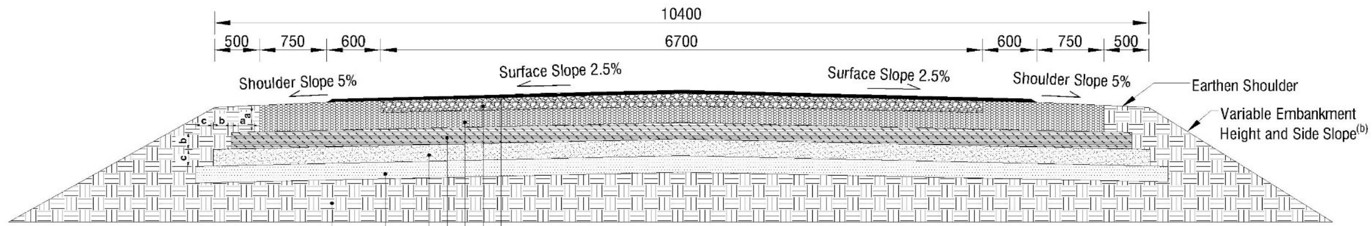
(i) Passing # 200 sieve (Not more than 15%) and

(ii) CBR Value: 8% or above.

Subgrade Soaked CBR (%)	Wearing Course (mm) [1]	Base Course (mm) [2]	Sub-base Course (mm) [3]	Improved subgrade (mm) [4]	Subgrade (mm) [5]
2	40	225	300	300	300
3	40	225	275	300	300
4	40	200	275	250	300
5	40	200	250	225	300
6	40	200	250	200	300
≥7	40	200	200	-	300

PAVEMENT DESIGN TEMPLATE FOR HEAVY TRAFFIC AREA (CVD 501 - 750)

Type-4S(B)



- [1] Asphalt Wearing Course
- [2] Asphalt Base Course
- [3] Aggregate Base Course; for Stone Aggregate Los Angeles Abrasion Value (LAA) max. 35% or Aggregate Crushing Value (ACV) max. 30%; Compacted in Two layers, each layer Soaked CBR min. 80%, Compacted to 100% of MDD Modified Proctor
- [4] Sub-Base; for Brick Aggregate, Los Angeles Abrasion Value max. 40% or Ten Percent Fines Value min. 100 kN; for Stone Aggregate, Los Angeles Abrasion Value max. 35% or Aggregate Crushing Value max. 30%; Compacted in Two/Three layers depending on layer thickness (Max. 100mm/layer), each layer Soaked CBR min. 30%, Compacted to 98% of MDD Modified Proctor
- [5] Compacted Sand Improved Subgrade (ISG)(c), Sand FM min 0.5, PI value <6%, Compacted in Two layers, each layer Soaked CBR min. 8%, Compacted to min. 98% of MDD Modified Proctor
- 300 mm Subgrade Compaction min. 95% of MDD Modified Proctor in Two Layers, Soaked CBR min. 2% or 4% or 7% as per Subgrade Design CBR, PI value 8%~20%
- Original Soil cut into designed shape, or fill with normal soil, PI value 8%~20%, Compaction min. 95% of MDD Modified Proctor, Soaked CBR min. 2% to achieve designed cross-section of side embankment

NOTES:

(a) All dimensions are in millimeter unless otherwise specified;

(b) Side Slope Protection method will vary for different conditions;

(c) The local sand can be used as ISG subject to approval of LGED if the sand satisfies the following two conditions:

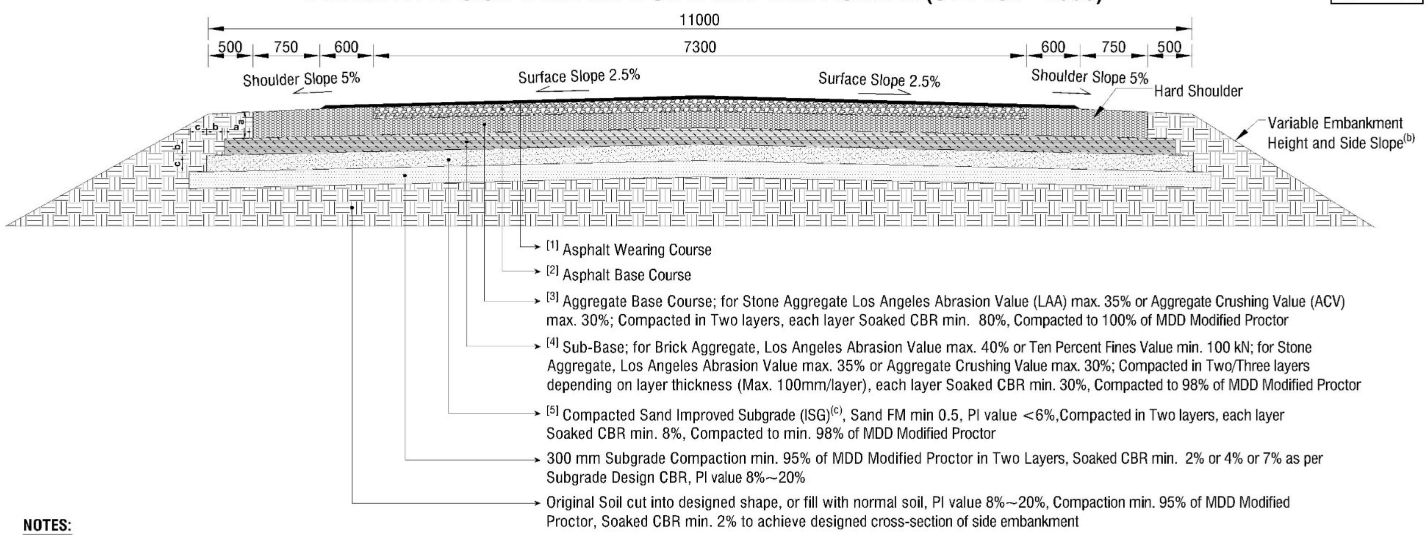
(i) Passing # 200 sieve (Not more than 15%) and

(ii) CBR Value: 8% or above.

Traffic in ESA (Millions)	Layer Thickness for Subgrade Soaked CBR 2% - 3%					Layer Thickness for Subgrade Soaked CBR 4% - 6%					Layer Thickness for Subgrade Soaked CBR ≥7%				
	Pavement Thickness in mm					Pavement Thickness in mm					Pavement Thickness in mm				
	[1]	[2]	[3]	[4]	[5]	[1]	[2]	[3]	[4]	[5]	[1]	[2]	[3]	[4]	[5]
	Asphalt Wearing Course	Asphalt Base Course	Base Course	Sub-Base Course	Improved Sub-Grade	Asphalt Wearing Course	Asphalt Base Course	Base Course	Sub-Base Course	Improved Sub-Grade	Asphalt Wearing Course	Asphalt Base Course	Base Course	Sub-Base Course	Improved Sub-Grade
2.5-5.5	50	50	200	250	300	50	50	200	200	250	50	50	200	200	---
5.6-10.5	50	75	225	275	300	50	75	200	225	250	50	75	200	225	---
10.6-20.0	50	100	250	275	300	50	100	225	225	300	50	100	225	250	---

PAVEMENT DESIGN TEMPLATE FOR HEAVY TRAFFIC AREA (CVD 751 - 1000)

Type-4S(A)



NOTES:

(a) All dimensions are in millimeter unless otherwise specified;

(b) Side Slope Protection method will vary for different conditions;

(c) The local sand can be used as ISG subject to approval of LGED if the sand satisfies the following two conditions:

(i) Passing # 200 sieve (Not more than 15%) and

(ii) CBR Value: 8% or above.

Traffic in ESA (Millions)	Layer Thickness for Subgrade Soaked CBR 2% - 3%					Layer Thickness for Subgrade Soaked CBR 4% - 6%					Layer Thickness for Subgrade Soaked CBR ≥7%				
	Pavement Thickness in mm					Pavement Thickness in mm					Pavement Thickness in mm				
	[1]	[2]	[3]	[4]	[5]	[1]	[2]	[3]	[4]	[5]	[1]	[2]	[3]	[4]	[5]
	Asphalt Wearing Course	Asphalt Base Course	Base Course	Sub-Base Course	Improved Sub-Grade	Asphalt Wearing Course	Asphalt Base Course	Base Course	Sub-Base Course	Improved Sub-Grade	Asphalt Wearing Course	Asphalt Base Course	Base Course	Sub-Base Course	Improved Sub-Grade
2.5-5.5	50	50	200	250	300	50	50	200	200	250	50	50	200	200	---
5.6-10.5	50	75	225	275	300	50	75	200	225	250	50	75	200	225	---
10.6-20.0	50	100	250	275	300	50	100	225	225	300	50	100	225	250	---

6.4 Rigid Pavement

6.4.1 Rigid pavements offer an alternative to flexible pavements especially where the soil strength is poor, the aggregates are costly, mobilization of heavy construction equipment is difficult and drainage conditions are poor. Rigid pavement has been recommended for the submersible roads in Haor areas and road segments across hat-bazar, growth center, and built-up areas where water logging is a common phenomenon. The geometric and structural design of rigid pavement will generally depend on CVD values. Design templates for rigid pavement for various scenarios have been suggested in Appendix- H.

6.4.2 To construct a durable rigid pavement in coastal regions that withstands the aggressive marine environment, composite cement of appropriate type, high range water reducing admixture, and fusion bonded epoxy coated reinforcing bar will be used.

6.5 The design templates for the Flexible/Bituminous pavement (BC) and Reinforced Cement Concrete (RCC) pavement have been recommended in the standards. LGED shall design Block Pavement, Composite Pavement and HBB (Herringbone Bond) roads on a case by case basis.

7 Design Period

7.1 The design period or design life is usually defined as the number of years until the first major reconstruction is anticipated. It has been considered appropriate that roads in rural areas shall be designed for a design period of 10 years. But rigid pavements designed and constructed as per recommendations contained in this document shall have a design life of not less than 20 years.

7.2 However, the design life of pavement may be affected by various environmental factors such as moisture, humidity, salinity, rainfall intensity, wind, temperature fluctuations, and solar radiation. It may also be affected by factors like maintenance practices, usage intensity, overloading of vehicle, flash flood, tidal surge etc.

8 Road Drainage

8.1 The drainage of the road surface, road pavement layers, and subgrade are some of the most important aspects of road construction. The road surface will be designed to shed water as quickly as possible during the rainfall.

8.2 To prevent the rapid deterioration of pavement layers and to maintain the subgrade at or above the design strength, it is essential that any water entering the pavement layers be allowed to drain away as quickly as possible. Not only standing water in the pavement layers reduce the pavement strength but also the high pore-water pressures developed under the action of traffic loads rapidly lead to a disintegration of surfacing. The pavement will drain the water away through channels on both sides. The drainage material must be of a size that allows the passage of the water; not be too large to allow fines to be washed away from the pavement.

9 **Side-slope Protection**

9.1 Stabilizing the roadside slope is very important for ensuring the sustainability and durability of road embankments. The rural roads will adopt different methods to stabilize side-slopes for different scenarios with different side slope ratios (V: H). The methods recommended for side slope protection work in rural roads have been mentioned in Appendix - I which include but are not limited to grass turfing, geo-jute, gunny bags, synthetic geotextiles, gabions, long-rooted vegetation, concrete blocks, and palisading work with concrete posts. Designers will select or customize the protection method considering cost-effectiveness, the availability of construction materials, and skilled workers. A side slope ratio from 1:1.5 to 1:2 has been recommended. However, designers may apply their engineering judgment to optimize the side slope ratio for better stabilization in a particular field condition. A summary of the recommended slope protection methods with preferable scenarios is given in Table 3.

Sl. No.	Method	Preferable Scenario
01	Slope Protection work with Long Routed Grass Turfing	General Road Embankments
02	Slope Protection Work for High Embankment (Above 4.5 m) with Long Rooted Grass	High Embankments, Haor/Coastal Areas
03	Slope Protection Work with Grass Turfing & Jute Geotextile on Slope for Sandy Soil	Sandy Soil
04	Slope Protection work with Grass Turfing, Jute Geotextile & Geo-Bags on Slope for Clayey Soil	Clayey Soil
05	Slope Protection work with Long Rooted Grass Turfing & Jute Geotextile on Slope for Hilly Areas	Hilly Areas
06	Slope Protection work with Gunny Bagged Riprap	General Road Embankments

Sl. No.	Method	Preferable Scenario
07	Slope Protection work with Gabions	Haor Areas/Coastal Areas
08	Slope Protection work with Long Rooted Grass, Vegetation, Block and Gabions	Haor Areas/Coastal Areas
09	Slope Protection work with Masonry Brick and Pre-Cast RCC Post	General Road Embankments

Table 3: Methods of Side Slope Protection

10 Road Safety

10.1 The roads will be designed with effective and adequate road furniture, for instance, road marking, guard rails, traffic signage, etc. Sufficient offset distance from natural roadside features will be maintained and sharp curves will be widened in the inner sides. Passing lanes and bus bays will be provided wherever convenient. Properly designed traffic calming devices like speed humps, rumble strips, etc. will be used wherever applicable.

10.2 The road intersections will be channelized with the provision of stacking lanes and adequate turning radii. In the case of LGED and RHD road intersection, the traffic will entry and exit through slip lanes with acceleration and deceleration lanes. The typical sections have been shown in Appendix– J.

11 Environment & Climate Change

11.1 The standards have addressed the environment and climate change issues. Climatic vulnerabilities have been taken care of in designing slope protection works and surface drainage systems. For quick run-off surface water, 2.5% cross-fall in camber and 5% cross slope in shoulder have been prescribed.

11.2 It has been recommended to preserve a freeboard of 0.9 m from the bottom of the sub-grade to the Highest Flood Level (HFL) on 20 years' return period. The 20-year return period has been suggested to increase to 30 years in the flood-prone areas to prevent the subgrade saturation. Based on the site condition, the designers will apply their engineering judgment in this regard.

11.3 The harder grades of bitumen with higher viscosity (e.g. VC 30, VC 40) has been suggested in the area with prolonged intense rainfall and high projected traffic volumes. Besides, the Polymer Modified Bitumen (PMB) has been suggested using on a pilot basis for wearing courses at those sections of the road only where extreme traffic volume is expected.

11.4 In addition, LGED will apply on a pilot basis any other environmentally conducive new or improved technology/practice and subsequently scale up based on the findings/results to have a competitive advantage.

12 Culverts and Bridges

12.1 Bridges shall be designed for a period of at least 75 years. The latest version of 'AASHTO LRFD Bridge Design Specifications' will be used as design standards for LGED bridges. For the vehicular live load of bridges, the AASHTO HL-93 loading shall be followed.

12.2 The designers shall design on a case by case basis for culvert and bridge. In general, the width of bridge and/or culvert will be equal to or more than the crest width of the carriageway. The vertical and horizontal navigational clearance of bridges shall be in accordance with the guideline of BIWTA (Bangladesh Inland Water Transport Authority).

12.3 Other necessary clearances, if requirement arises in future, for roads, overpass and bridges shall have to be received from relevant government organizations.

12.4 This standard is subject to future review in every five year.

13 Cost

The cost of engineering interventions shall be estimated based on the schedule of rates of LGED to ensure optimal utilization of resources. The rates of different items vary regionally because of the availability of local construction material, labor, equipment, difficulties and distance of transporting construction material in remote & inaccessible areas, etc. The schedule of rates will be updated regularly to cope with the latest scenarios.

14 Conclusions

LGED is responsible to construct, maintain/rehabilitate and upgrade the rural roads i.e. Upazila road, Union road & Village roads in Bangladesh which are the lifeline of fast expanding rural economy. The standards shall guide LGED in constructing new roads in a sustainable way. The recommended standards have considered the growing traffic volume, varying subgrade condition of different geographic areas, climate change and other relevant aspects. The standards were originally prepared by BRTC, BUET and critically reviewed/revised by various stakeholders. It can be expected that the upgraded design standards will contribute in the sustainable development of the country.

Appendix–A

Composition of the BRTC, BUET team engaged in upgrading of the Standards

Sl. No	Name of Professor	Position Assigned	Area of Expertise
1.	Prof. Dr. Md. Mizanur Rahman	Team Leader and Senior Material Specialist	Highway Materials, Geometric design of pavement, Traffic survey
2.	Prof. Dr. Hasib Mohammed Ahsan	Senior Transport Planning and Safety Specialist	Transportation and Land use planning, Road safety
3.	Prof. Dr. Md. Shamsul Hoque	Senior Road Management Specialist	Geometric design of pavement, Road planning, Road management, Concrete block pavement
4.	Prof. Dr. Md. Moazzem Hossain	Senior Pavement Design Specialist	Structural design of Rigid and Flexible pavement
5.	Prof. Dr. Tanweer Hasan	Senior Pavement Design Specialist	Structural design of Rigid and Flexible pavement
6.	Prof. Dr. Abdul Jabbar Khan	Senior Geotechnical Specialist	Embankment Slope protection, Geo-jute and Geo-material
7.	Prof. Dr. Md. Hadiuzzaman	Traffic Survey and Modelling Specialist	Traffic survey, Traffic modeling and Traffic simulation

Appendix- B

Members of the Committee for Classification, Ownership, Responsibility Fixation and Dispute Resolution of Roads

1. Member, Planning Commission (Physical Infrastructure Division) – Convener;
2. Representative, Ministry of Road, Transport & Bridges / Local Government Division;
3. Representative, Planning Commission (Rural Institution Wing);
4. Representative, Roads and Highways Department / Local Government Engineering Department.

Terms of Reference

The committee will recommend for approval and gazette notification on the Road Design Standards of LGED.

Appendix- C

Road Design Standards Committee

Members

1. Chief, Physical Infrastructure Division, Planning Commission - Convener
2. Representative from Implementation, Monitoring and Implementation Division (IMED)
3. Representative from Roads and Highways Department (RHD)
4. Representative from Local Government Engineering Department (LGED)
5. Representative from Bangladesh Water Development Board (BWDB)
6. Representative from Bangladesh Institute of Development Studies (BIDS)
7. Representative from Bangladesh University of Engineering and Technology (BUET)
8. Representative from Department of Geography & Environment, University of Dhaka

Terms of Reference

The committee will review the Road Design Standards of LGED and recommend to the ‘Committee for Classification, Ownership, Responsibility Fixation and Dispute Resolution of Roads’ for finalizing.

Appendix- D

Glossary

Asphalt	An adhesive substance that is used in road construction as a binder material.
Asphalt Base Course	The base course underneath the wearing course of a flexible pavement which is treated with asphalt, is asphalt base course.
Asphalt Concrete (AC)	A mixture to predetermined proportions of aggregate, filler and bituminous binder material plant mixed and usually placed by means of a paving machine.
Asphalt Surfacing	The layer or layers of asphalt concrete constructed on top of the base course, and, in some cases, the shoulders.
Asphalt Wearing Course	The top course of an asphalt surfacing or, for gravel roads, the uppermost layer of construction of the roadway made of specified materials.
Average Annual Daily Traffic (AADT)	The total yearly traffic volume in both directions divided by the number of days in the year.
Average Daily Traffic (ADT)	The total traffic volume during a given time period in whole days greater than one day and less than one year divided by the number of days in that time period.
Base Course	This is the main component of the pavement contributing to the spreading of the traffic loads. In many cases, it will consist of crushed stone or gravel, or of good quality brick chips.
Bitumen	The most common form of bitumen is the residue from the refining of crude oil after the more volatile material has been distilled off. It is essentially a very viscous liquid comprising many long-chain organic molecules.
Carriageway	That portion of the roadway including the various traffic lanes but excluding shoulders.
Commercial Vehicle	A specific classification of vehicles is suggested by Bangladesh Planning Commission to be considered for survey and design purpose; among the enlisted vehicles, vehicles itemized sequentially from “delivery vehicle” to “7 Axle vehicle” are defined as commercial vehicle.
Crest	Peak formed by the junction of two gradients.
Design Period	The period of time that an initially constructed or rehabilitated pavement structure will perform before reaching a level of deterioration requiring more than routine or periodic maintenance.

Equivalent Standard Axles (ESAs)	A measure of the potential damage to a pavement caused by a vehicle axle load expressed as the number of 8.2 tons single axle loads that would cause the same amount of damage.
Equivalent Single Axle Load (ESAL)	Summation of equivalent 8.2 tons single axle loads used to combine mixed traffic to calculate the design traffic loading for the design period.
Fill	Material of which a man-made raised structure or deposit such as an embankment is composed, including soil, soil-aggregate or rock.
Flexible Pavements	Pavement with a bituminous surfacing and with a base course layer and a sub-base course layer.
Heavy Vehicle	Those having an unloaded weight of 6577 kg or more.
Passenger Car Unit (PCU)	A measure of the impedance offered by a vehicle to the passenger cars in the traffic stream. Usually quoted as the number of passenger cars required to offer a similar level of impedance to the cars in the stream.
Shoulder	Part of the road outside the carriageway, but at substantially the same level, for accommodation of stopped vehicles for emergency use, for lateral support of the carriageway.
Side Slope	Area between the outer edge of shoulder or hinge point and the ditch bottom.
Sub-base	The layer of material of specified dimensions on top of the subgrade and below the road base. The secondary load-spreading layer underlying the base course.
Subgrade	The surface upon which the pavement structure and shoulders are constructed.
Subsurface Drain	Covered drain constructed to intercept and remove subsoil water, including any pipes and permeable material in the drains.
Super elevation	Inward tilt or transverse inclination given to the cross section of a carriageway throughout the length of a horizontal curve to reduce the effects of centrifugal force on a moving vehicle; expressed as a percentage.
Traffic Volume	Volume of traffic usually expressed in terms of average annual daily traffic (AADT).

Appendix-E

Equivalence Factors for Different Axle Loads

Types Classification	ESA Factor
7 Axle 3PM4T 44T	6.7
6 Axle 3PM3T 41T	3.8
5 Axle 3PM2T 38T	4.6
5 Axle 2PM3T 35T	2.9
4 Axle 2PM2T 33T	5.0
4 Axle 2PM2T 32T	4.4
4 Axle 2R4 30T	3.4
4 Axle 2R4 25T	1.4
3 Axle 2PM1T 25T	6.7
3 Axle 2R3 22T	2.7
2 Axle 2R2 15T	4.6
Truck Medium (Two or Three Axle Rigid > 3.5 Ton pay-loads)	4.62
Truck Medium (Two Axle Rigid > 3.5 Ton pay-loads)	4.62
Bus Medium (>40 seats and > 36 Feet Seats)	1
Bus Mini (16-39 seats and < 36 Feet Seats)	0.5
Bus Light (< 16 seats)	0.5
Utility (Land rover/Jeep type vehicles)	0.5
Delivery Vehicle (Panel Van, Pickup Truck)	0.5

Table 4: ESA Factors for different Axle Loads

Note: For local vehicles in different areas used as commercial vehicles, the ESA factor can be assumed by applying engineering judgment.

Appendix-F

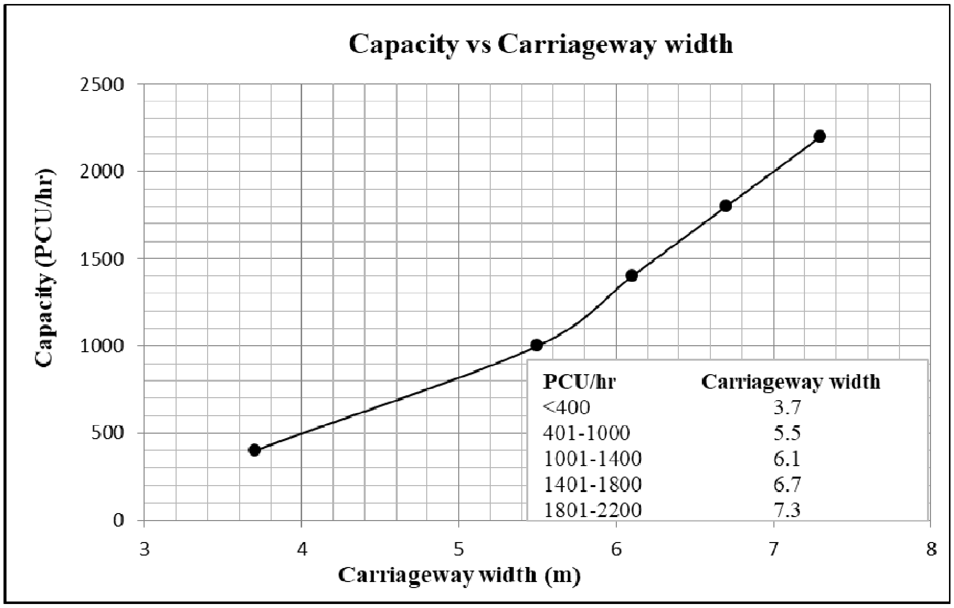


Figure 2: Relationship between Roadway Capacity and Carriageway Width

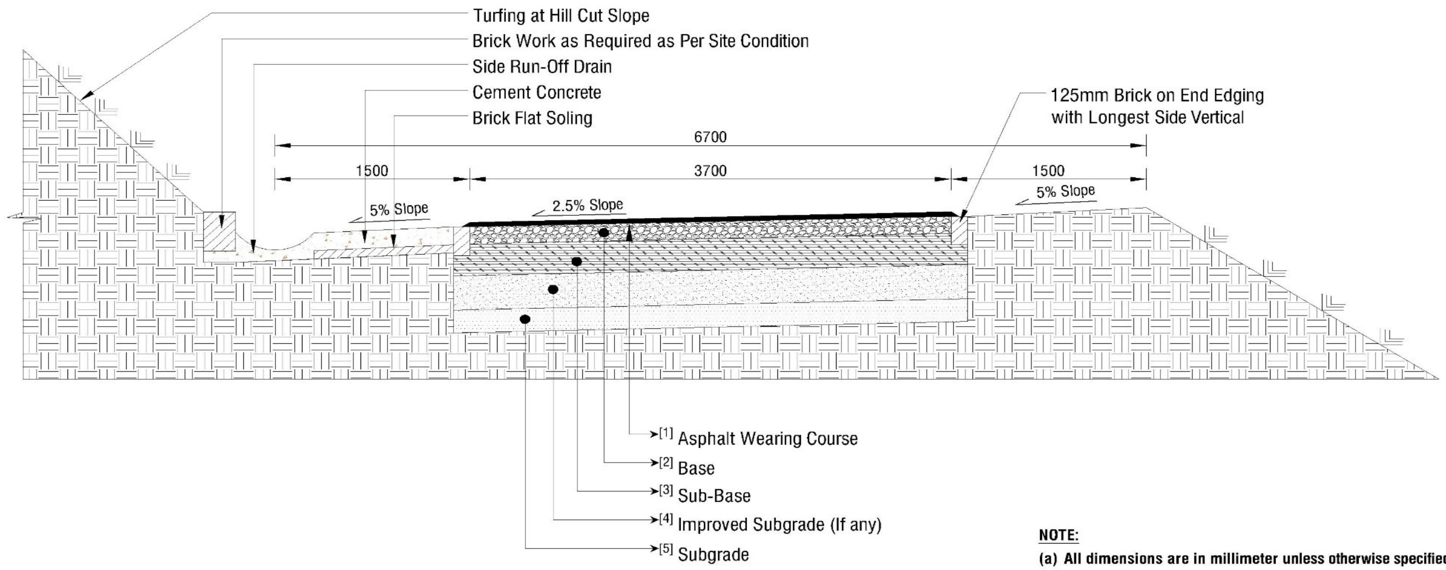
Vehicle Type	PCU
Truck (All Trucks)	3.6
Bus	3.0
Utility Vehicles (Delivery Van/ Covered Van/ Land Rover/Jeep)	1.3
Car	1.0
Tempo/CNG/Baby Taxi	1.0
Auto Rickshaw	0.6
Pedal/Van Rickshaw	1.0
Motorcycle	0.4
Bicycle	0.5
Animal (Bullock/Horse/All animal) Cart & Human Drawn/Pushcart	4.0

Table 5: Passenger Car Unit (PCU)

Appendix – G

PAVEMENT DESIGN TEMPLATE THROUGH HILLS (CVD 0-300)

HAVING HILL-CUT ON ONE SIDE AT INWARD CURVATURE TO HILL

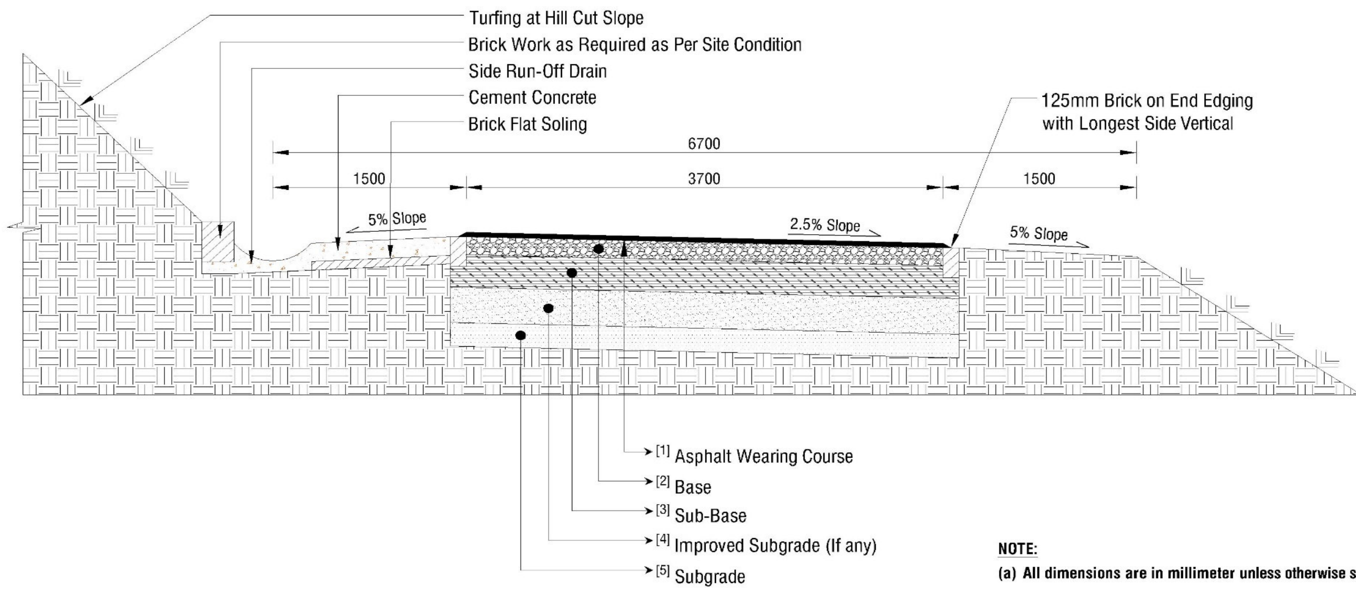


NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

CVD	Pavement Thickness (mm)											
	For Subgrade Soaked CBR 2% - 3%				For Subgrade Soaked CBR 4% - 6%				For Subgrade Soaked CBR ≥7%			
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade
0-100	40	150	250	300	40	150	200	250	40	150	150	-
101-200	40	150	275	300	40	150	225	250	40	150	175	-
201-300	40	175	300	300	40	150	250	250	40	150	200	-

PAVEMENT DESIGN TEMPLATE THROUGH HILLS (CVD 0-300)
HAVING HILL-CUT ON ONE SIDE AT OUTWARD CURVATURE TO HILL

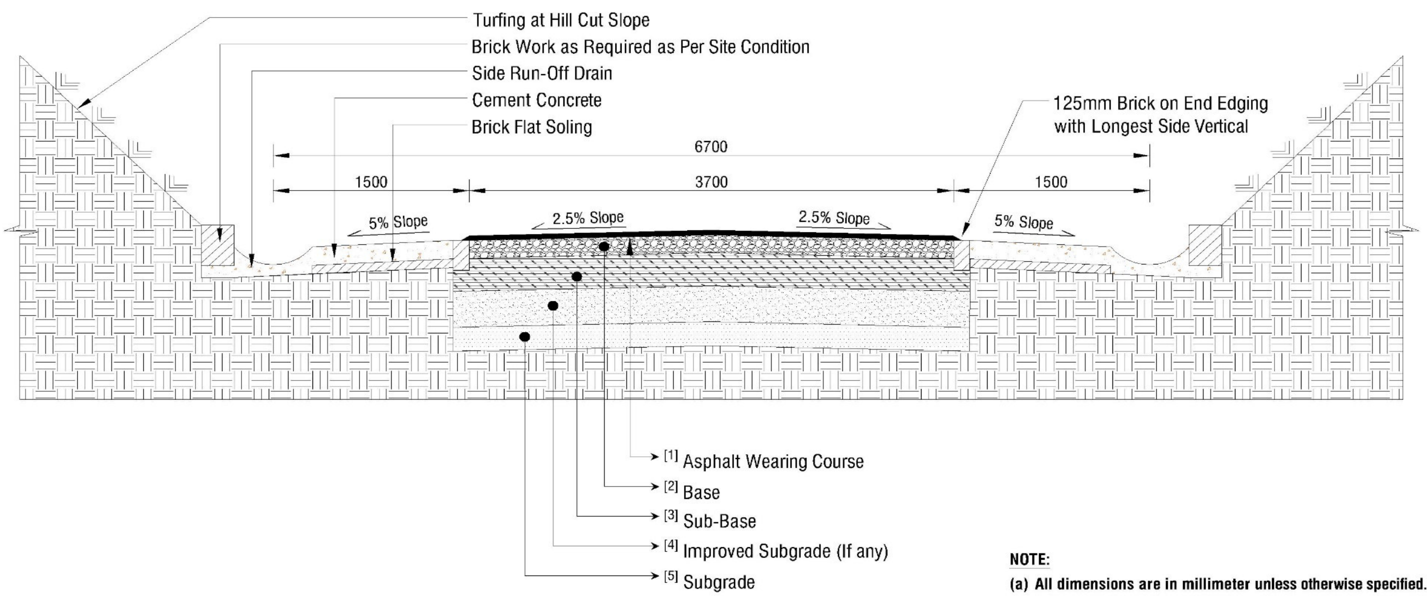


NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

CVD	Pavement Thickness (mm)											
	For Subgrade Soaked CBR 2% - 3%				For Subgrade Soaked CBR 4% - 6%				For Subgrade Soaked CBR ≥7%			
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade
0-100	40	150	250	300	40	150	200	250	40	150	150	-
101-200	40	150	275	300	40	150	225	250	40	150	175	-
201-300	40	175	300	300	40	150	250	250	40	150	200	-

PAVEMENT DESIGN TEMPLATE THROUGH HILLS (CVD 0-300)
HAVING HILL-CUT ON BOTH SIDES

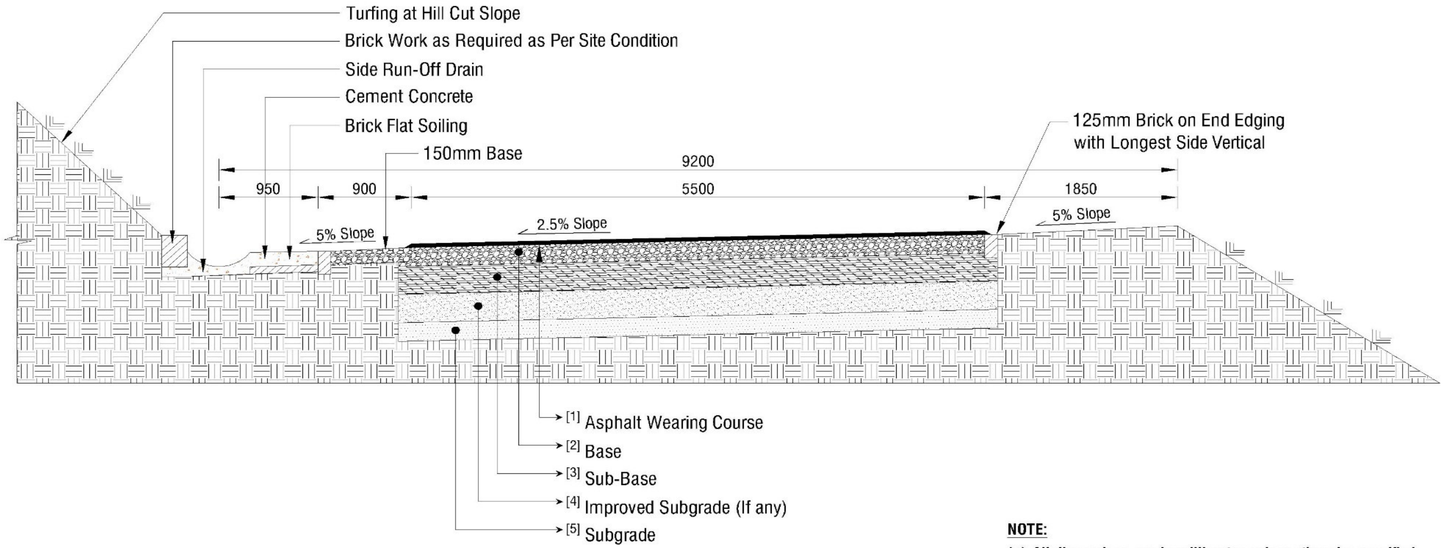


NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

CVD	Pavement Thickness (mm)											
	For Subgrade Soaked CBR 2% - 3%				For Subgrade Soaked CBR 4% - 6%				For Subgrade Soaked CBR ≥7%			
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade
0-100	40	150	250	300	40	150	200	250	40	150	150	-
101-200	40	150	275	300	40	150	225	250	40	150	175	-
201-300	40	175	300	300	40	150	250	250	40	150	200	-

PAVEMENT DESIGN TEMPLATE THROUGH HILLS (CVD > 300)
HAVING HILL-CUT ON ONE SIDE AT INWARD CURVATURE TO HILL



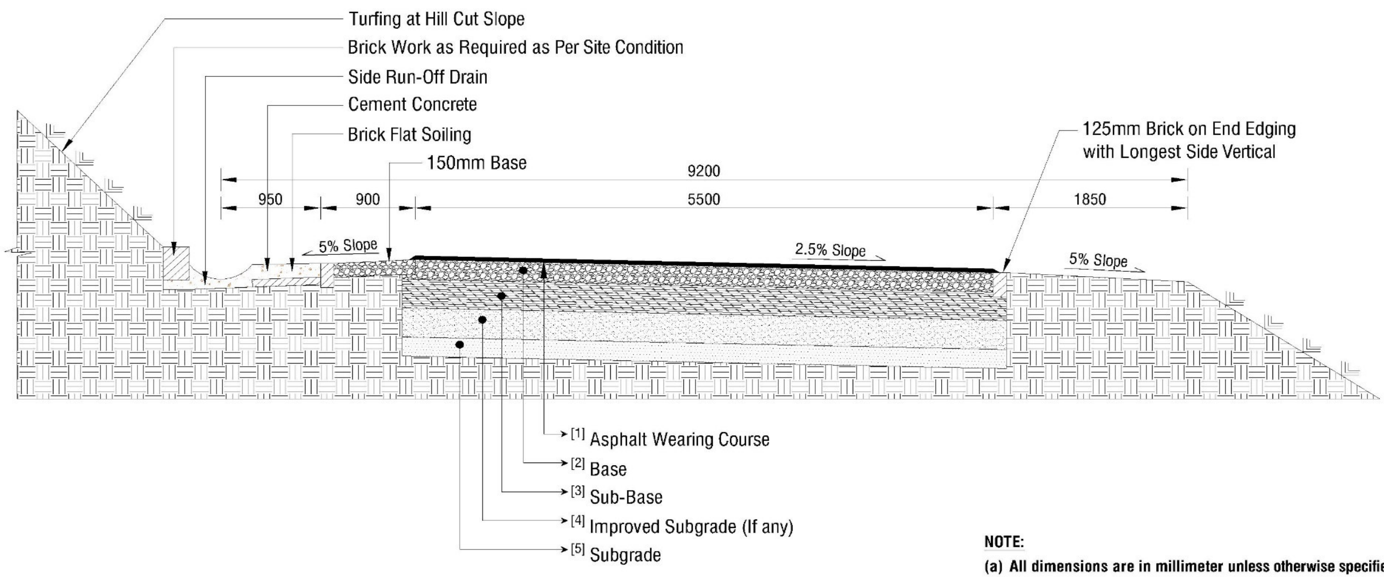
NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

CVD	Pavement Thickness (mm)											
	Layer Thickness for Subgrade CBR 2% - 3%				Layer Thickness for Subgrade CBR 4% - 6%				Layer Thickness for Subgrade CBR ≥7%			
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade
301-400	40	200	300	300	40	175	250	250	40	175	200	-
401-500	40	225	300	300	40	200	250	250	40	200	200	-

Note: Hilly roads with CVD>500 will be designed case by case based on traffic and subgrade condition

PAVEMENT DESIGN TEMPLATE THROUGH HILLS (CVD > 300)
HAVING HILL-CUT ON ONE SIDE AT OUTWARD CURVATURE TO HILL

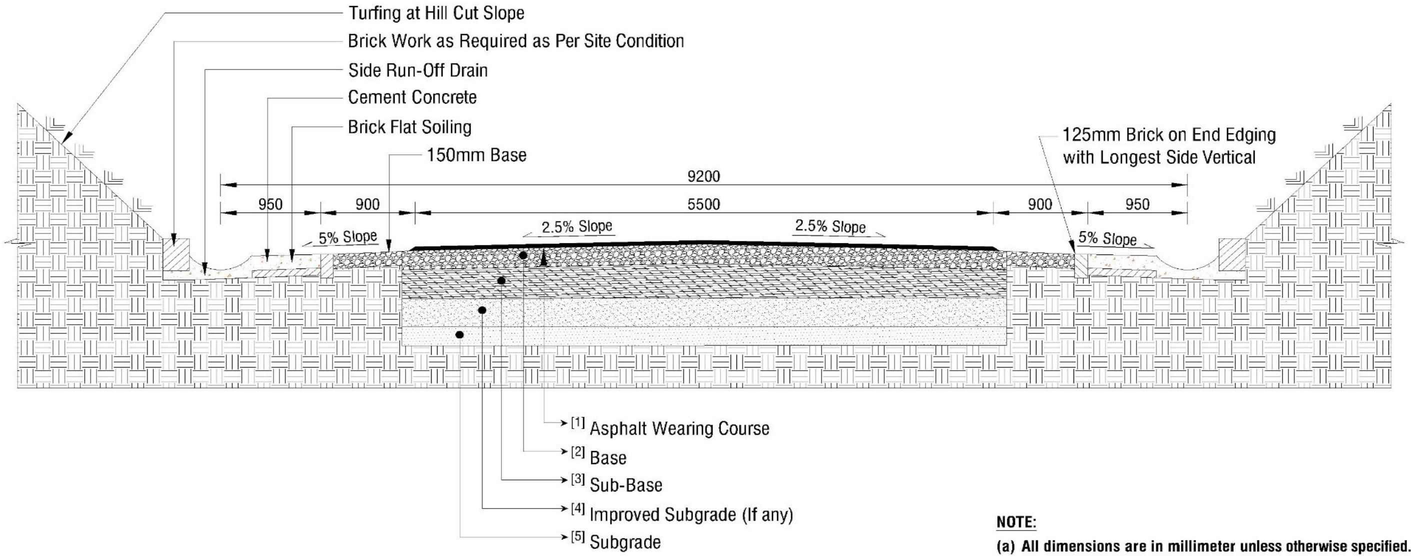


NOTE:
(a) All dimensions are in millimeter unless otherwise specified.

CVD	Pavement Thickness (mm)											
	Layer Thickness for Subgrade CBR 2% - 3%				Layer Thickness for Subgrade CBR 4% - 6%				Layer Thickness for Subgrade CBR ≥7%			
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade
301-400	40	200	300	300	40	175	250	250	40	175	200	-
401-500	40	225	300	300	40	200	250	250	40	200	200	-

Note: Hilly roads with CVD>500 will be designed case by case based on traffic and subgrade condition

PAVEMENT DESIGN TEMPLATE THROUGH HILLS (CVD > 300)
HAVING HILL-CUT ON BOTH SIDES



NOTE:
(a) All dimensions are in millimeter unless otherwise specified.

CVD	Pavement Thickness (mm)											
	Layer Thickness for Subgrade CBR 2% - 3%				Layer Thickness for Subgrade CBR 4% - 6%				Layer Thickness for Subgrade CBR ≥7%			
	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]	[1]	[2]	[3]	[4]
	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade	Asphalt Wearing Course	Base Course	Sub-Base Course	Improved Subgrade
301-400	40	200	300	300	40	175	250	250	40	175	200	-
401-500	40	225	300	300	40	200	250	250	40	200	200	-

Note: Hilly roads with CVD>500 will be designed case by case based on traffic and subgrade condition

Appendix –H

RIGID PAVEMENT DESIGN TEMPLATE FOR SUBMERSIBLE ROAD (CVD ≦ 100)

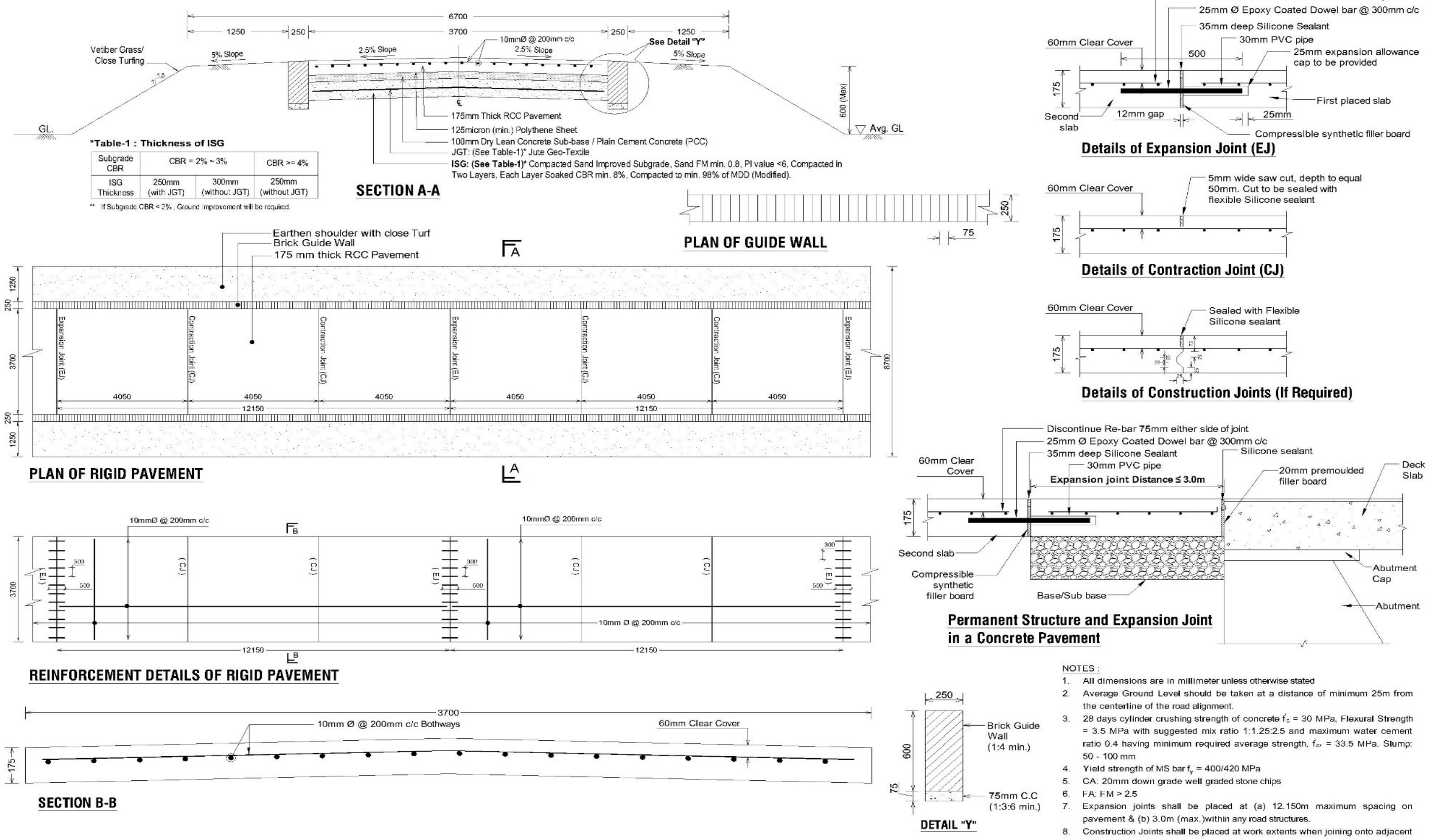


*Table-1 : Thickness of ISG

Subgrade CBR	CBR = 2% ~ 3%		CBR >= 4%
ISG Thickness	250mm (with JGT)	300mm (without JGT)	250mm (without JGT)

** If Subgrade CBR < 2% , Ground improvement will be required.

NOTES :

1. All dimensions are in millimeter unless otherwise stated
2. Average Ground Level should be taken at a distance of minimum 25m from the centerline of the road alignment.
3. 28 days cylinder crushing strength of concrete f'_c = 30 MPa, Flexural Strength = 3.5 MPa with suggested mix ratio 1:1.25:2.5 and maximum water cement ratio 0.4 having minimum required average strength, f_{cr} = 33.5 MPa. Slump: 50 - 100 mm
4. Yield strength of MS bar f_y = 400/420 MPa
5. CA: 20mm down grade well graded stone chips
6. FA: FM > 2.5
7. Expansion joints shall be placed at (a) 12.150m maximum spacing on pavement & (b) 3.0m (max.)within any road structures.
8. Construction Joints shall be placed at work extents when joining onto adjacent rigid pavements.

RIGID PAVEMENT DESIGN TEMPLATE FOR SUBMERSIBLE ROAD (CVD > 100)

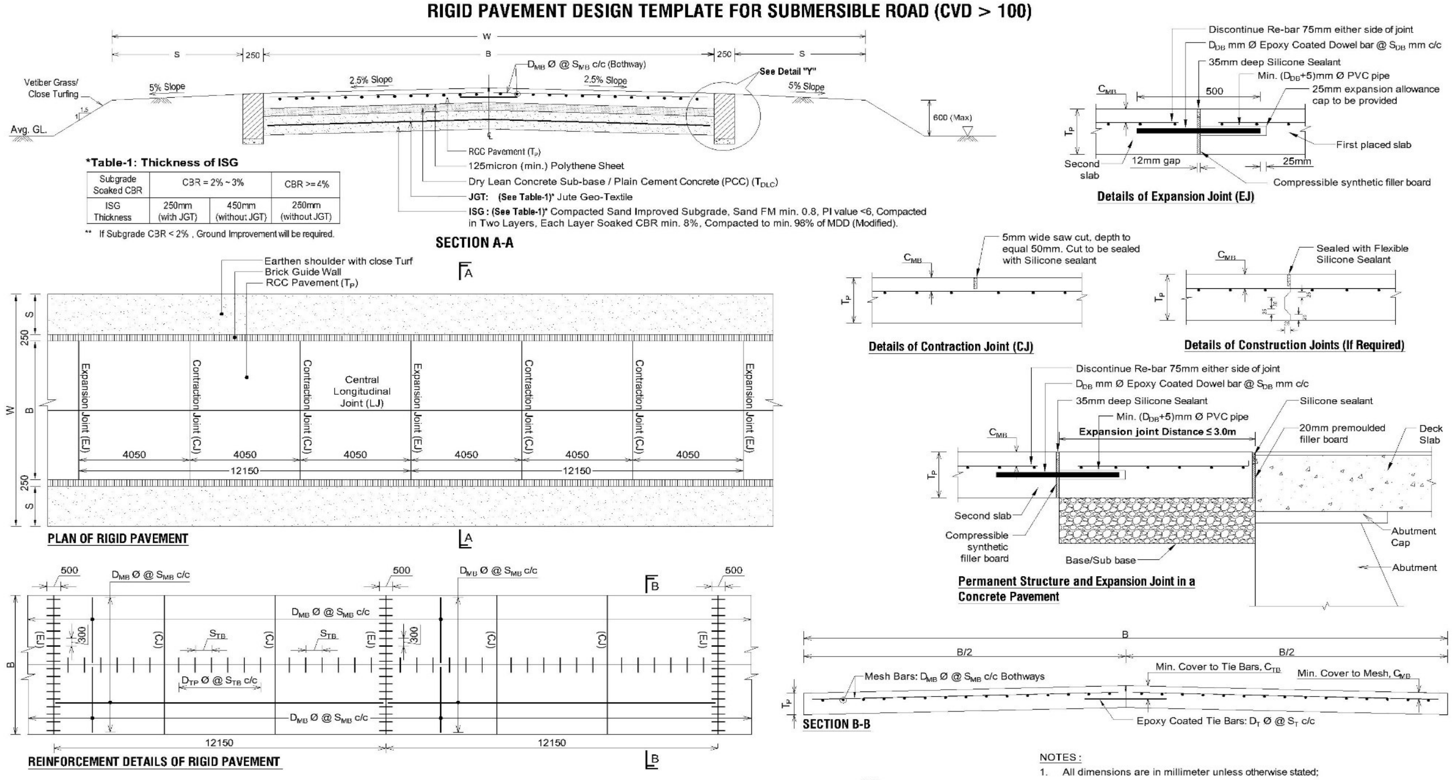


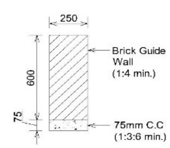
***Table-1: Thickness of ISG**

Subgrade Soaked CBR	CBR = 2% ~ 3%		CBR >= 4%
ISG Thickness	250mm (with JGT)	450mm (without JGT)	250mm (without JGT)

** If Subgrade CBR < 2% , Ground Improvement will be required.

CVD	Width in m			Thickness/Spacing/Diameter in mm									
	Carriageway (B)	Verge/ Earthen Shoulder (S)	Crest (W)	RCC Pavement (T_P)	Dry Lean Concrete (DLC)/ Plain Cement Concrete (PCC) (T_{DLC})	Tie Bar			Dowel Bar		Mesh Bar		
						Diameter D_{TB}	Spacing S_{TB}	Min. Cover C_{TB}	Diameter D_{DB}	Spacing S_{DB}	Diameter D_{MB}	Spacing S_{MB}	Min. Cover C_{MB}
101-200	5.0	1.6	8.7	175	100	10	850	60	25	300	10	200	60
201-300	5.5	1.6	9.2	200	100	10	800	70	28		10	200	80
301-500	6.1	1.6	9.8	200	100	10	750	70	28		10	200	80
501-750	6.7	1.6	10.4	225	125	10	650	80	32		10	180	80
751-1000	7.3	1.6	11.0	250	125	10	600	90	32		10	165	80

Note: Roads with CVD>1000 will be designed case by case based on traffic and subgrade condition



DETAIL "Y"

NOTES :

1. All dimensions are in millimeter unless otherwise stated;
2. Average Ground Level should be taken at a distance of minimum 25m from the centerline of the road alignment;
3. 28 days cylinder crushing strength of concrete f_c = 30 MPa, Flexural Strength = 3.5 MPa with suggested mix ratio 1:1.25:2.5 and maximum water cement ratio 0.4 having minimum required average strength, f_{cr} = 33.5 MPa. Slump: 50 - 100 mm;
4. Yield strength of MS bar f_y = 400/420 MPa;
5. CA: 20mm down grade well graded stone chips, FA: FM > 2.5;
6. Expansion joints shall be placed at (a) 12.150m maximum spacing on pavement & (b) 3.0m (max.) within any road structures;
7. Construction Joints shall be placed at work extents when joining onto adjacent rigid pavements.

RIGID PAVEMENT DESIGN TEMPLATE FOR HAT/BAZAR /GROWTH CENTER/WATER LOGGED AREA (CVD ≦ 100)

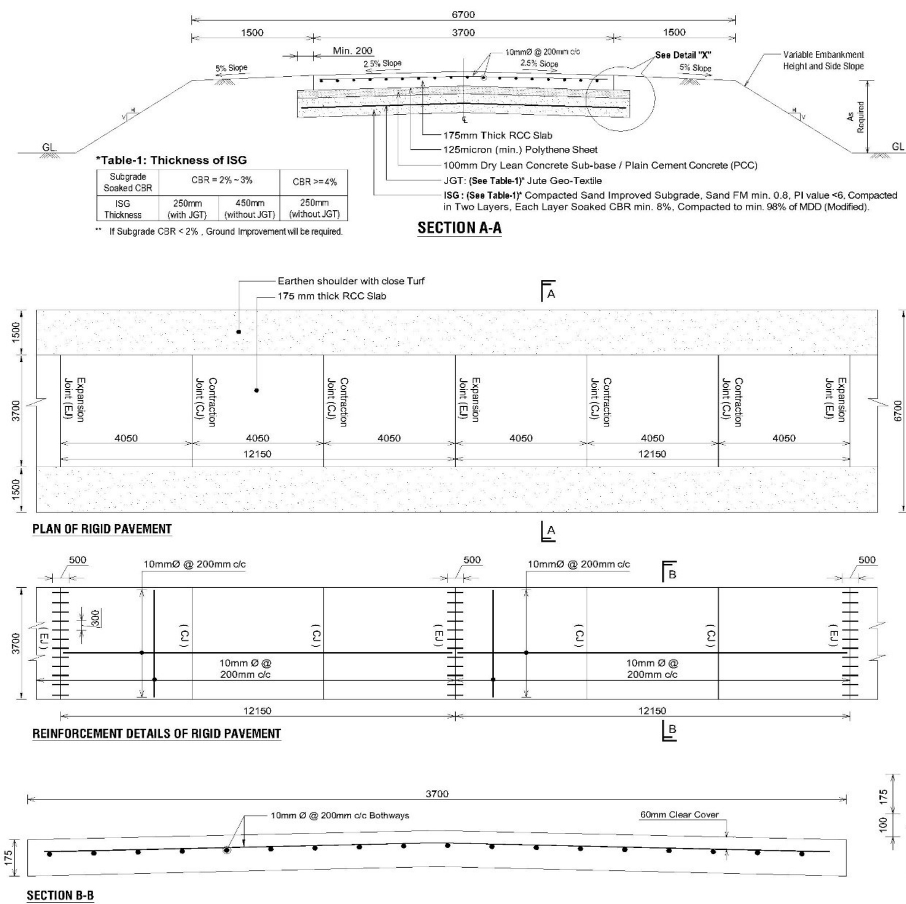
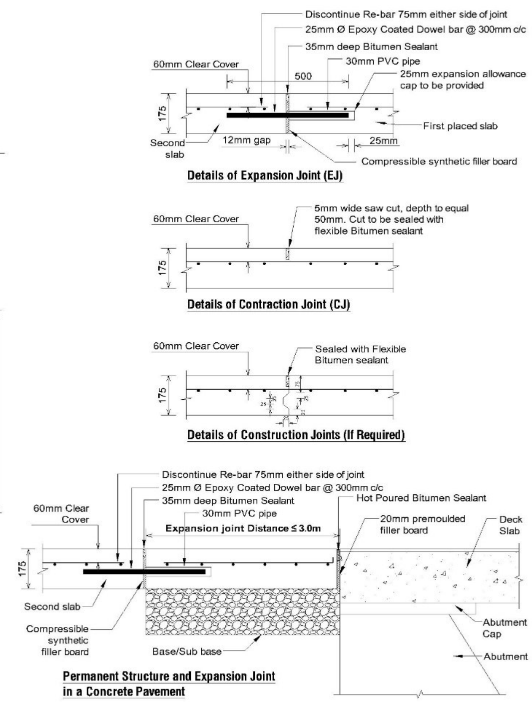
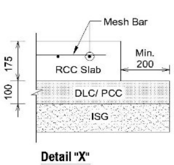


*Table-1: Thickness of ISG

Subgrade Soaked CBR	CBR = 2% ~ 3%		CBR >= 4%
ISG Thickness	250mm (with JGT)	450mm (without JGT)	250mm (without JGT)

** If Subgrade CBR < 2% , Ground Improvement will be required.





NOTES :

1. All dimensions are in millimeter unless otherwise stated;
2. Side Slope Protection method may vary for different conditions;
3. 28 days cylinder crushing strength of concrete f_c = 30 MPa, Flexural Strength = 3.5 MPa with suggested mix ratio 1:1.25:2.5 and maximum water cement ratio 0.4 having minimum required average strength, f'_{cr} = 33.5 MPa. Slump: 50 - 100 mm;
4. Yield strength of MS bar f_y = 400/420 MPa;
5. CA: 20mm down grade well graded stone chips, FA: FM > 2.5;
6. Expansion joints shall be placed at (a) 12.150m maximum spacing on pavement & (b) 3.0m (max.) within any road structures;
7. Construction Joints shall be placed at work extents when joining onto adjacent rigid pavements.

RIGID PAVEMENT DESIGN TEMPLATE FOR HAT/BAZAR/GROWTH CENTER/WATER LOGGED AREA (CVD > 100)

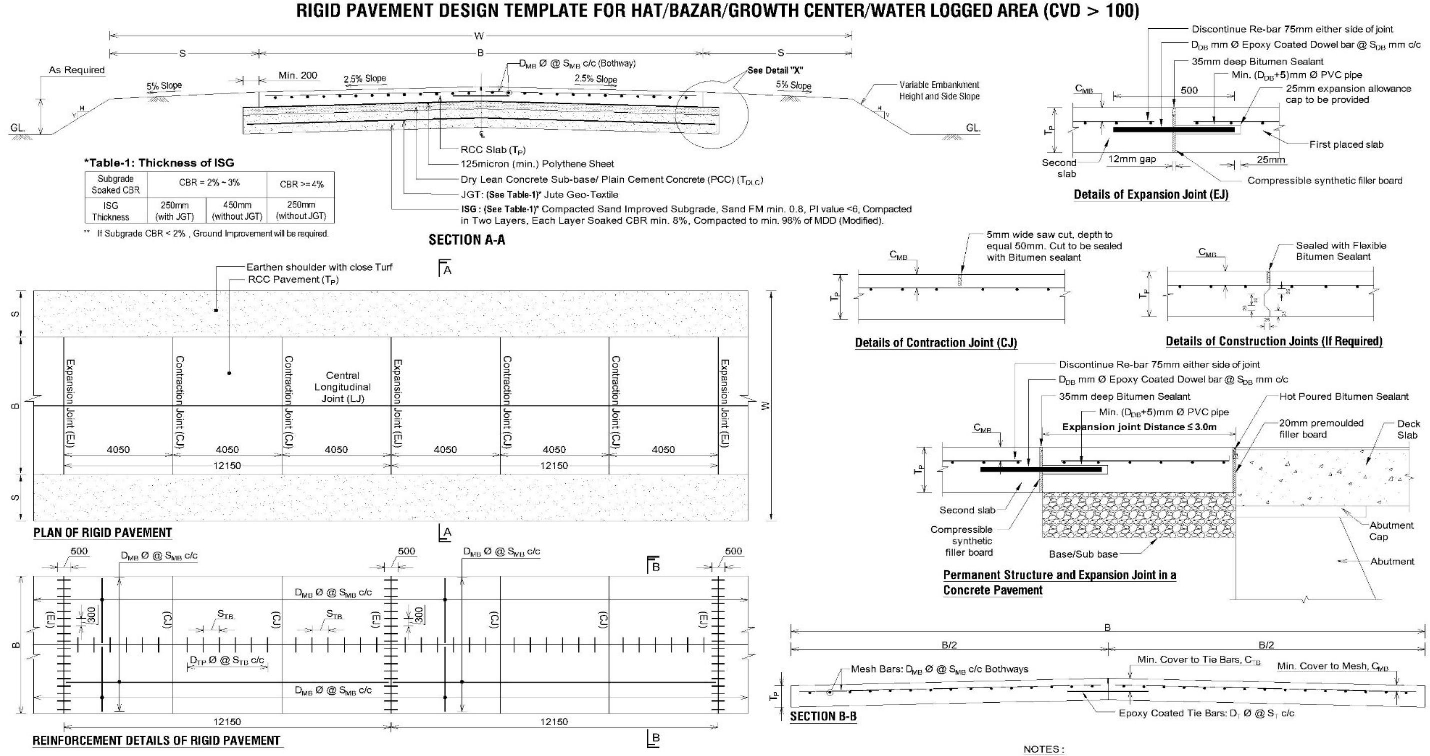


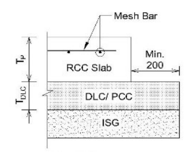
*Table-1: Thickness of ISG

Subgrade Soaked CBR	CBR = 2% ~ 3%		CBR >= 4%
ISG Thickness	250mm (with JGT)	450mm (without JGT)	250mm (without JGT)

** If Subgrade CBR < 2% , Ground Improvement will be required.

CVD	Width in m			Thickness/Spacing/Diameter in mm									
	Carriageway (B)	Verge/ Earthen Shoulder (S)	Crest (W)	RCC Slab (T_P)	Dry Lean Concrete (DLC)/ Plain Cement Concrete (PCC) (T_{DLC})	Tie Bar			Dowel Bar		Mesh Bar		
						Diameter D_{TB}	Spacing S_{TB}	Min. Cover C_{TB}	Diameter D_{DB}	Spacing S_{DB}	Diameter D_{MB}	Spacing S_{MB}	Min. Cover C_{MB}
101-200	5.0	1.85	8.7	175	100	10	850	60	25	300	10	200	60
201-300	5.5	1.85	9.2	200	100	10	800	70	28		10	200	80
301-500	6.1	1.85	9.8	200	100	10	750	70	28		10	200	80
501-750	6.7	1.85	10.4	225	125	10	650	80	32		10	180	80
751-1000	7.3	1.85	11.0	250	125	10	600	90	32		10	165	80

Note: For CVD >1000, Case by case geometry and thickness design will be done based on traffic and subgrade condition



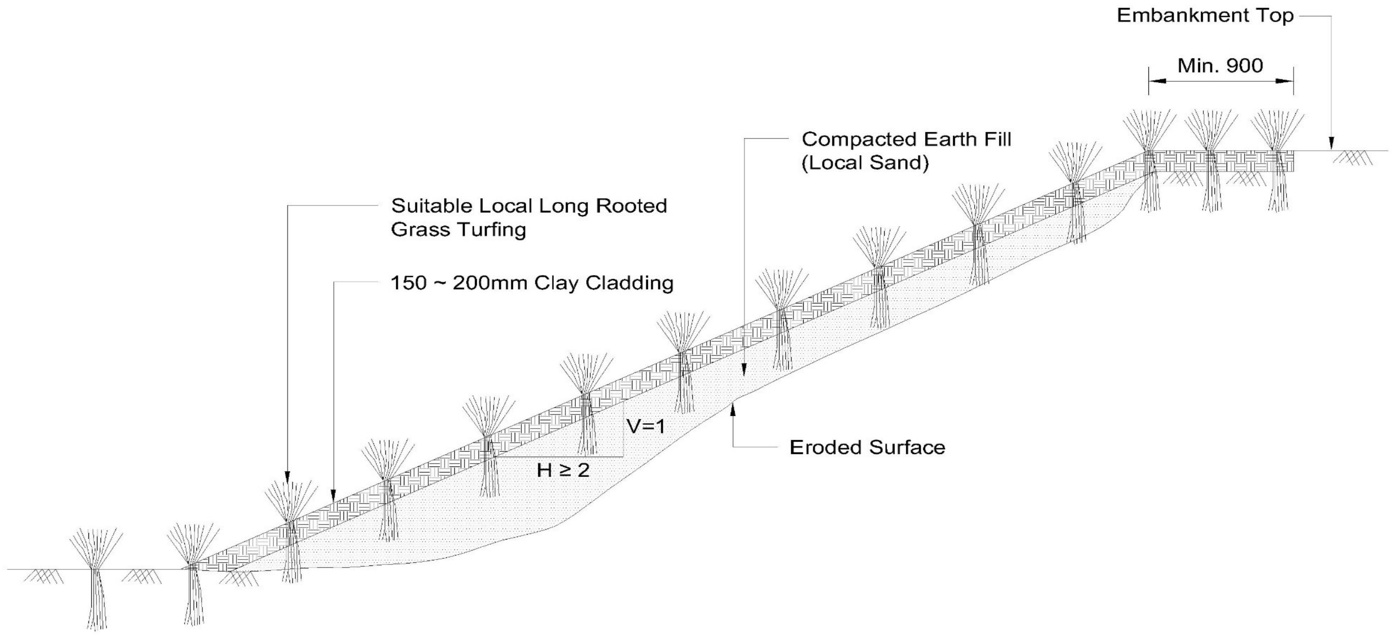
Detail "X"

NOTES :

1. All dimensions are in millimeter unless otherwise stated;
2. Side Slope Protection method may vary for different conditions;
3. 28 days cylinder crushing strength of concrete f'_c = 30 MPa, Flexural Strength = 3.5 MPa with suggested mix ratio 1:1.25:2.5 and maximum water cement ratio 0.4 having minimum required average strength, f'_{cr} = 33.5 MPa. Slump: 50 - 100 mm;
4. Yield strength of MS bar f_y = 400/420 MPa;
5. CA: 20mm down grade well graded stone chips, FA: FM > 2.5;
6. Expansion joints shall be placed at (a) 12.150m maximum spacing on pavement & (b) 3.0m (max.) within any road structures;
7. Construction Joints shall be placed at work extents when joining onto adjacent rigid pavements.

Appendix – I

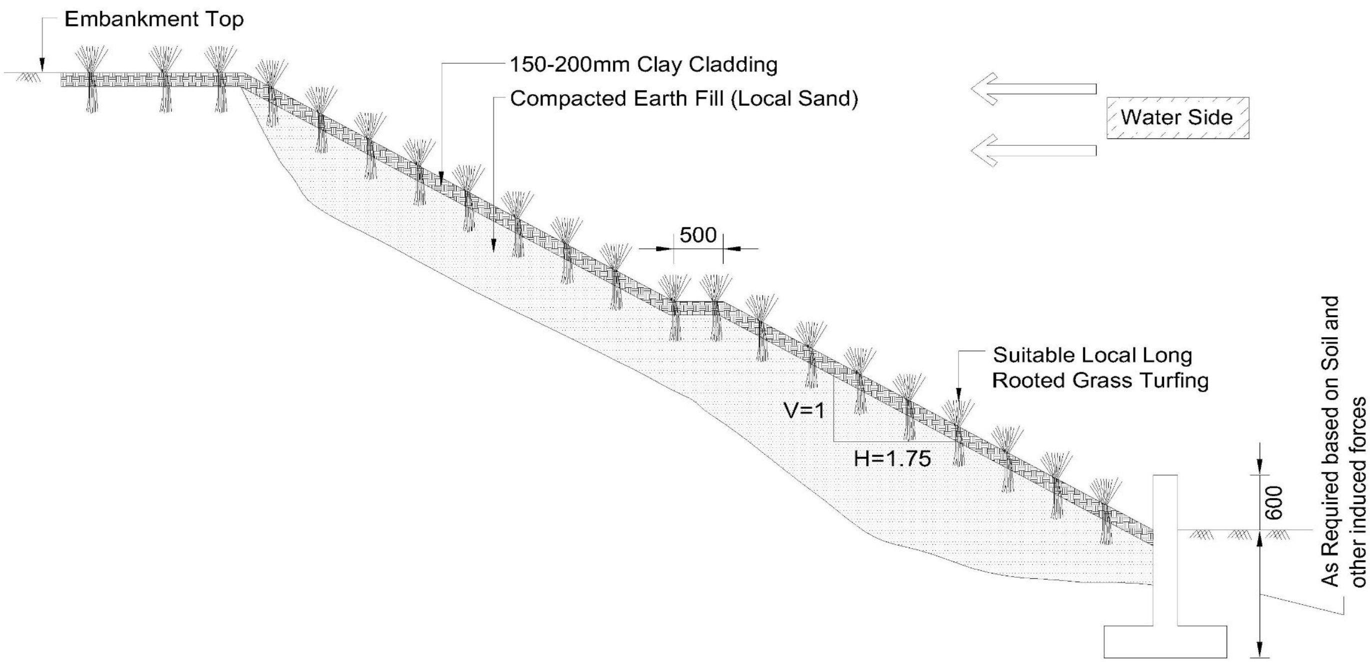
METHOD-01: SLOPE PROTECTION WORK WITH LONG ROOTED GRASS TURFING



NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

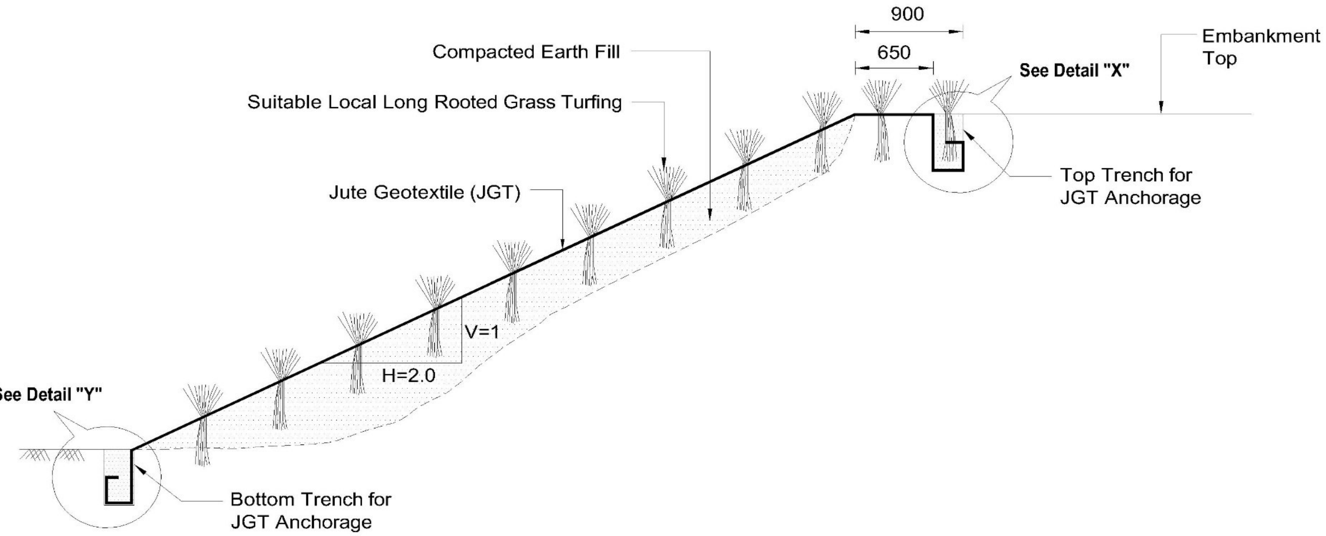
METHOD-02: SLOPE PROTECTION WORK FOR HIGH EMBANKMENT (ABOVE 4.5m) LONG ROOTED GRASS

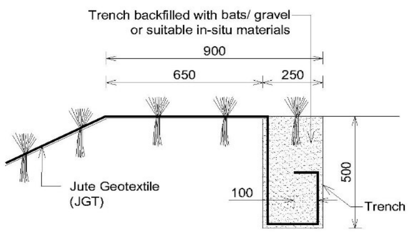


NOTE:

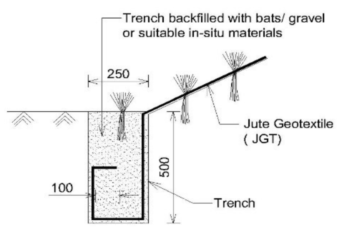
(a) All dimensions are in millimeter unless otherwise specified.

METHOD-03: SLOPE PROTECTION WORK WITH LONG ROOTED GRASS TURFING & JUTE GEOTEXTILE ON SLOPE FOR SANDY SOIL





Detail "X" : Top Trench Cutting for JGT anchorage

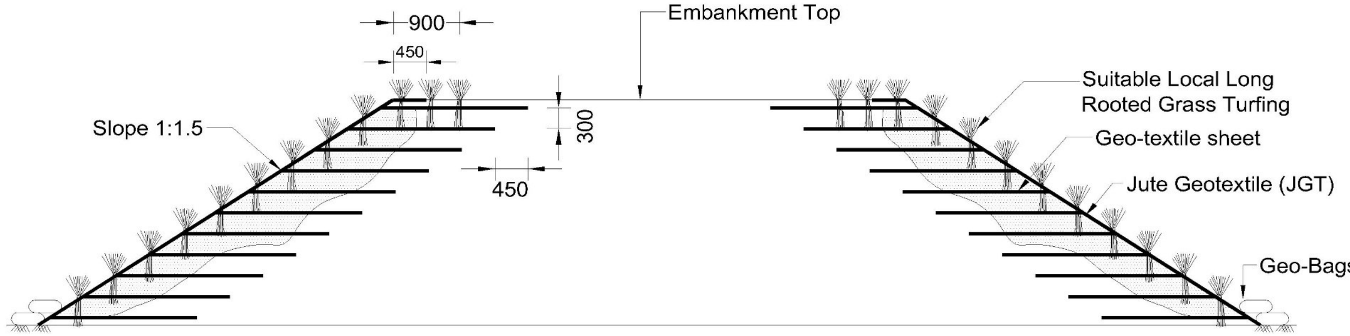


Detail "Y" : Bottom Trench Cutting for JGT anchorage

NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

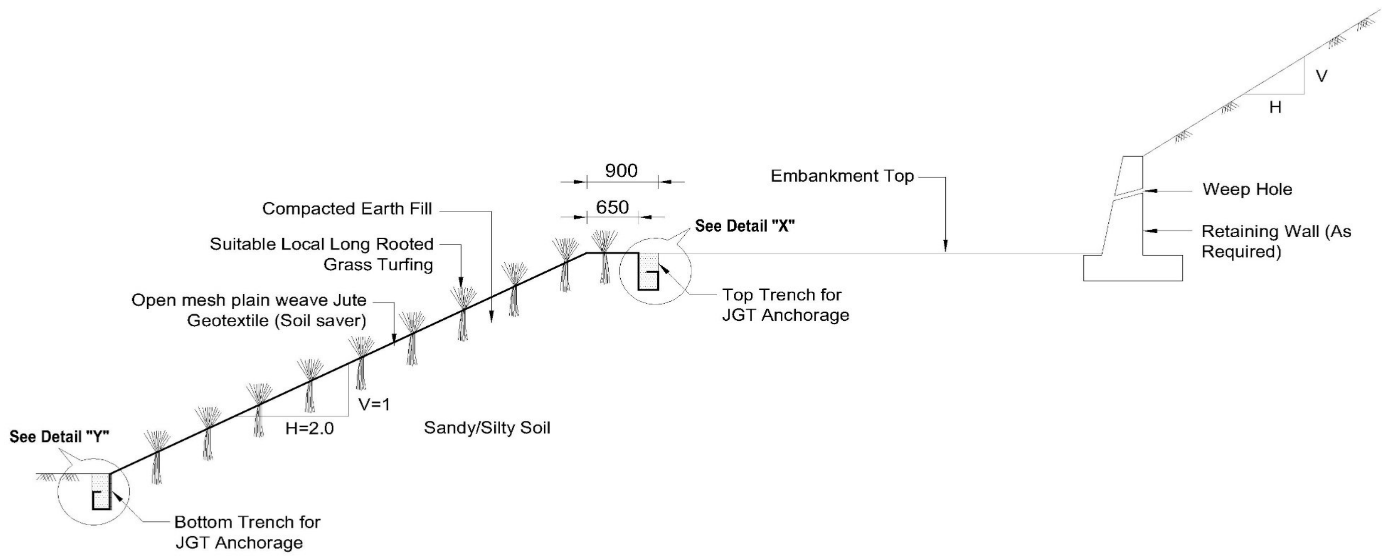
METHOD-04: SLOPE PROTECTION WORK WITH GRASS TURFING, JUTE GEOTEXTILE & GEO-BAGS ON SLOPE FOR CLAYEY SOIL



NOTES:

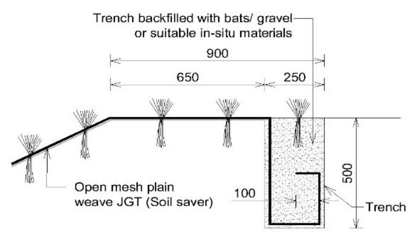
1. All dimensions are in mm (unless otherwise mentioned);
2. Length of Geotextile in each layer depends on the failure plane;
3. Overlapping of Geotextile for succeeding layers should be at least 40%.

METHOD-05: SLOPE PROTECTION WORK WITH LONG ROOTED GRASS TURFING & JUTE GEOTEXTILE ON SLOPE FOR HILLY AREA

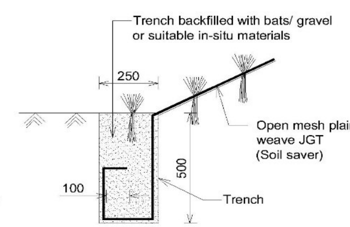


NOTES:

1. All dimensions are in mm (unless otherwise mentioned)
2. Mass per unit area (gsm) of JGT: 500 ± 10%
3. Water holding capacity (% by weight) of JGT ≥ 400
4. JGT should be anchored within a trench at the two ends by filling the trench with bats/ gravel or suitable in-situ materials.
5. JGT should be anchored with staples (6mm Ø U-shaped) into the ground at 600mm c/c.

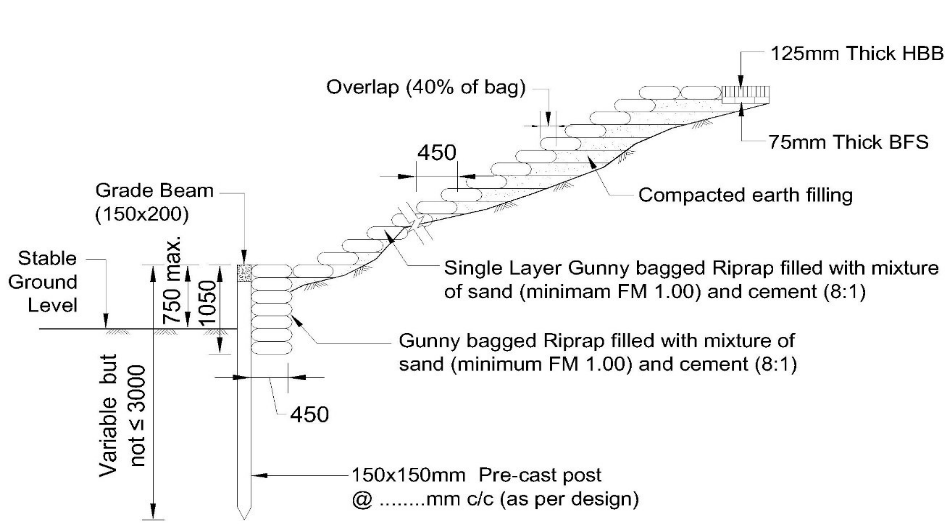


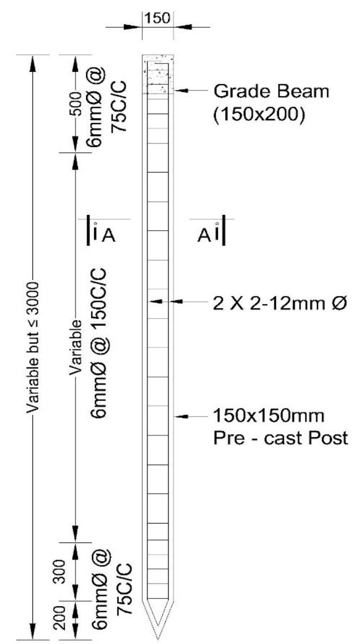
Detail "X" : Top Trench Cutting for JGT anchorage



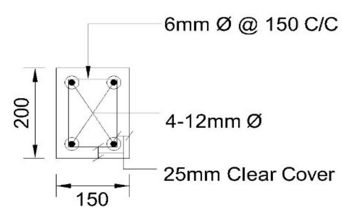
Detail "Y" : Bottom Trench Cutting for JGT anchorage

METHOD-06: SLOPE PROTECTION WORK WITH GUNNY BAGGED RIP-RAP

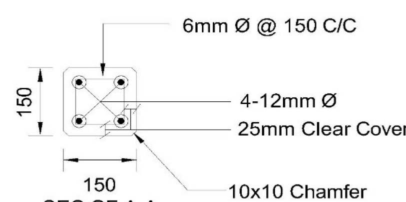




Re-bar Details of RCC Post



SEC OF GRADE BEAM

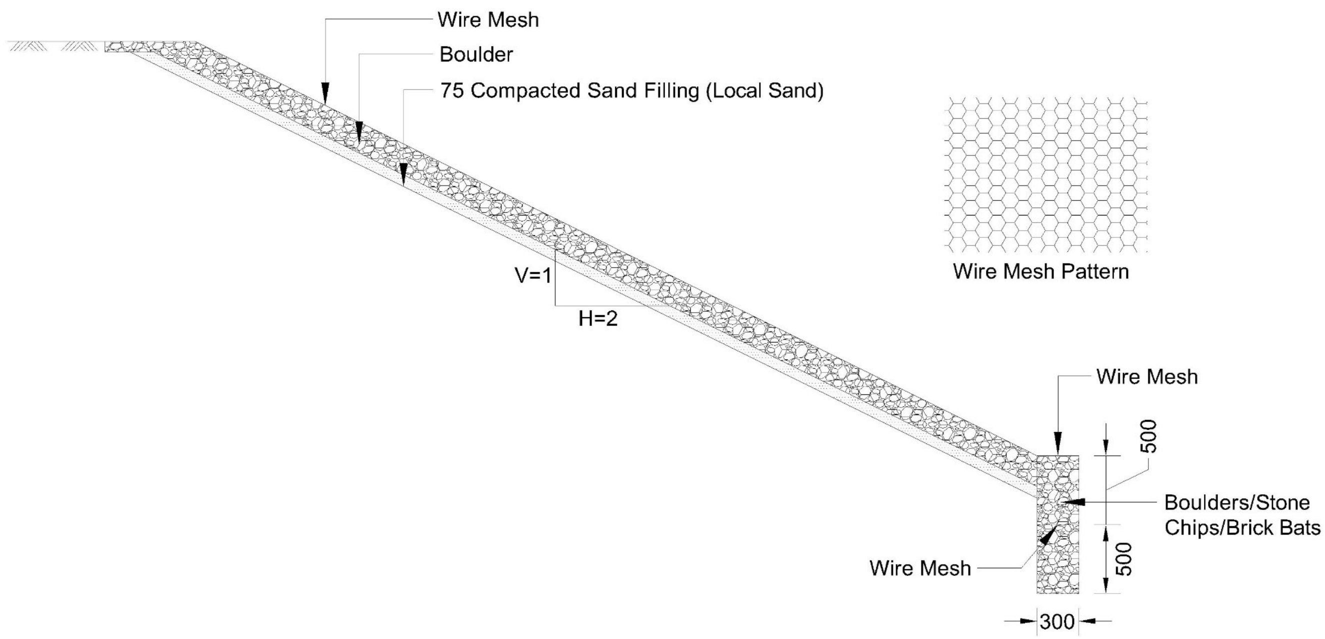


SEC OF A-A

NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

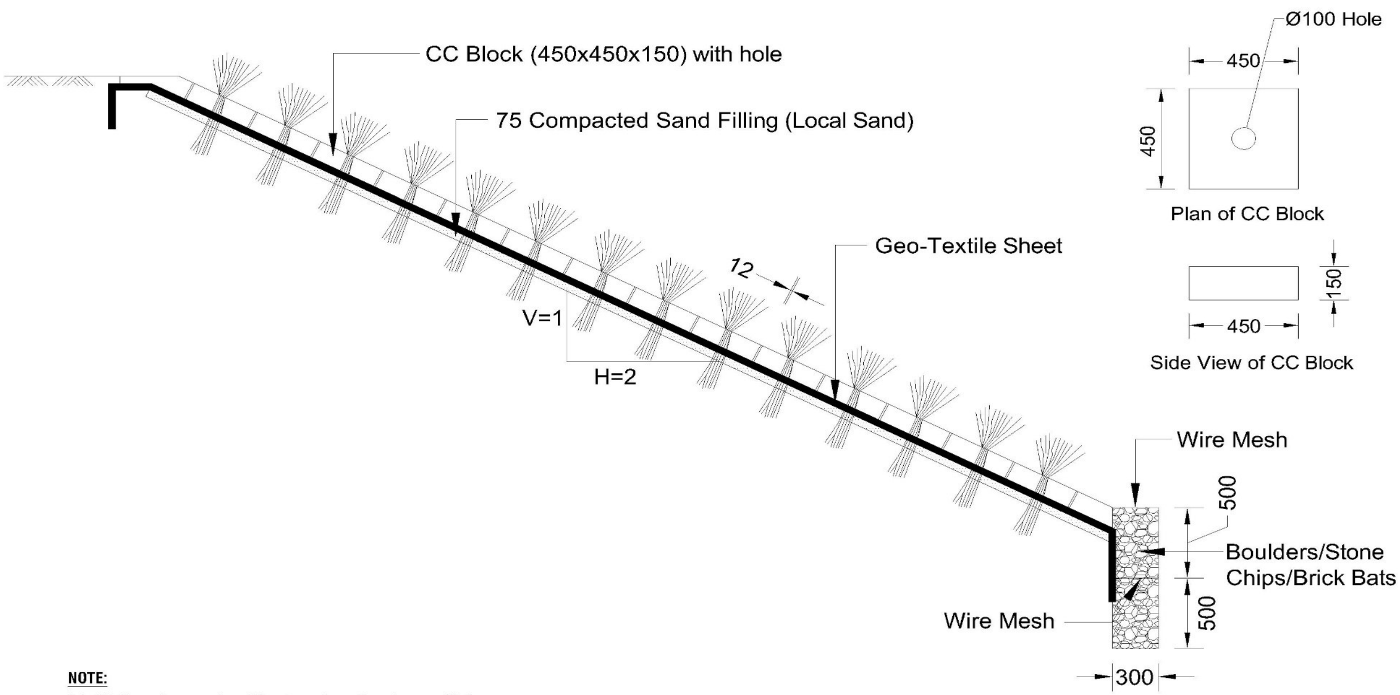
METHOD-07: SLOPE PROTECTION WORK WITH GABIONS



NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

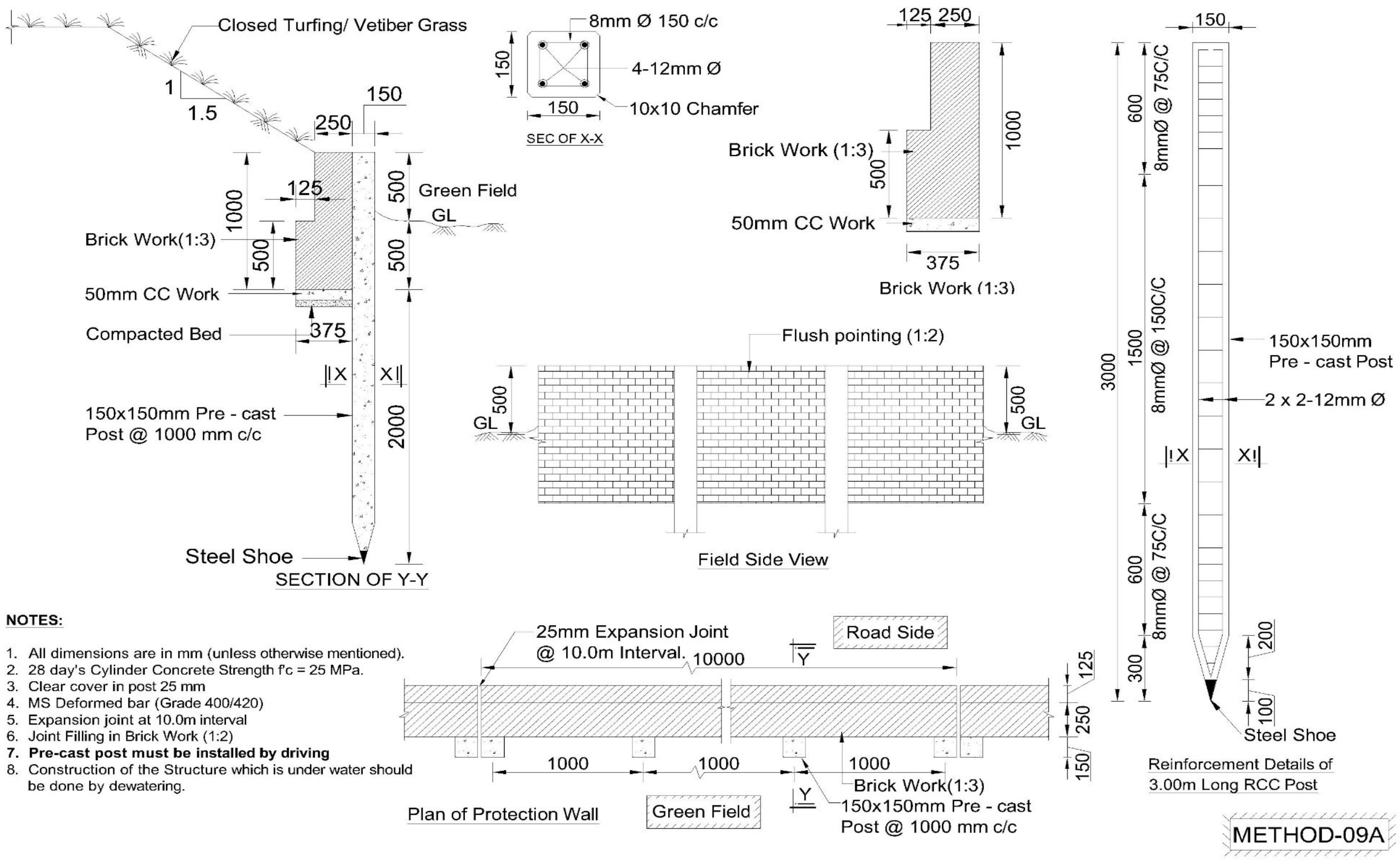
METHOD-08: SLOPE PROTECTION WORK WITH LONG ROOTED GRASS, VEGETATION, BLOCK AND GABIONS



NOTE:

(a) All dimensions are in millimeter unless otherwise specified.

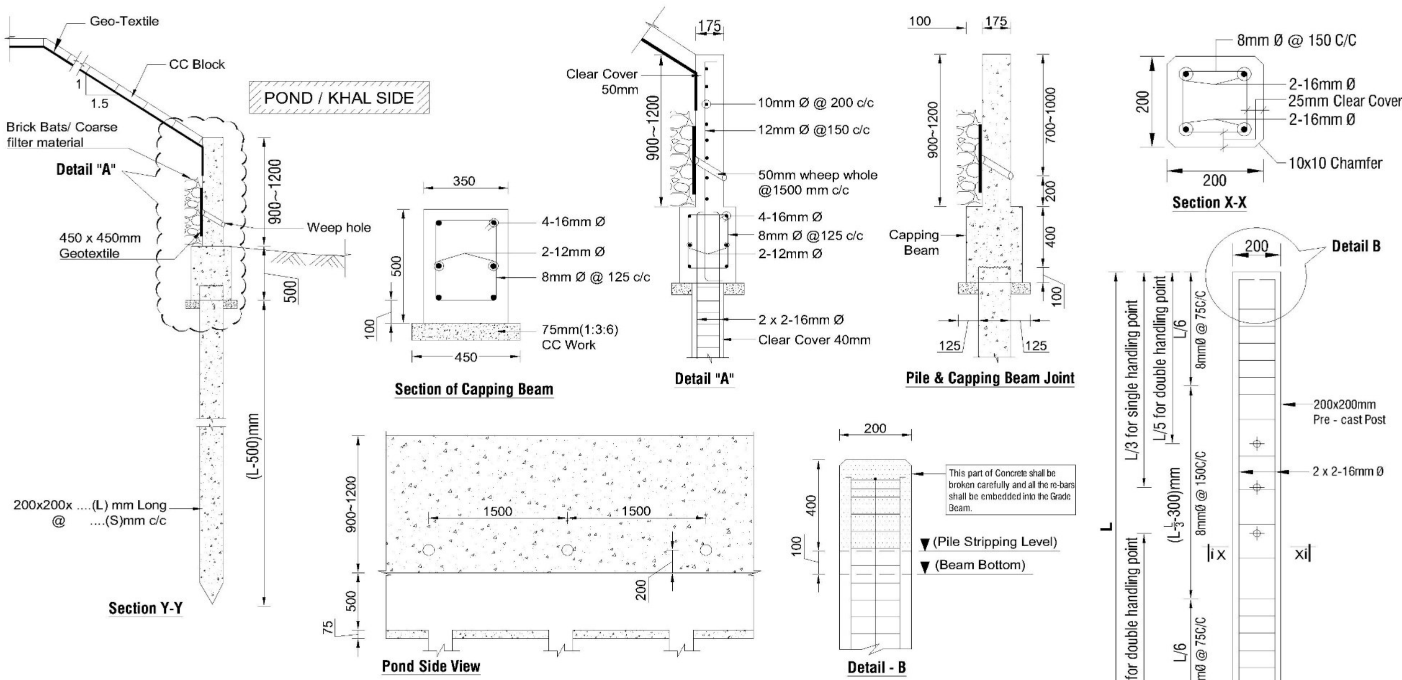
METHOD-09: SLOPE PROTECTION WORK WITH MASONRY BRICK AND PRE-CAST RCC POST



NOTES:

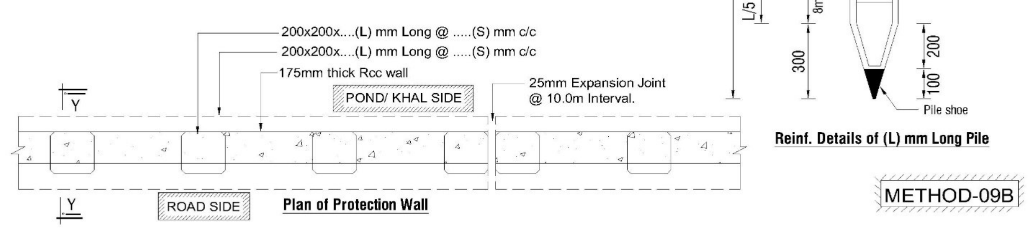
1. All dimensions are in mm (unless otherwise mentioned).
2. 28 day's Cylinder Concrete Strength f'c = 25 MPa.
3. Clear cover in post 25 mm
4. MS Deformed bar (Grade 400/420)
5. Expansion joint at 10.0m interval
6. Joint Filling in Brick Work (1:2)
7. **Pre-cast post must be installed by driving**
8. Construction of the Structure which is under water should be done by dewatering.

METHOD-09: SLOPE PROTECTION WORK WITH MASONRY BRICK AND PRE-CAST RCC POST



NOTES:

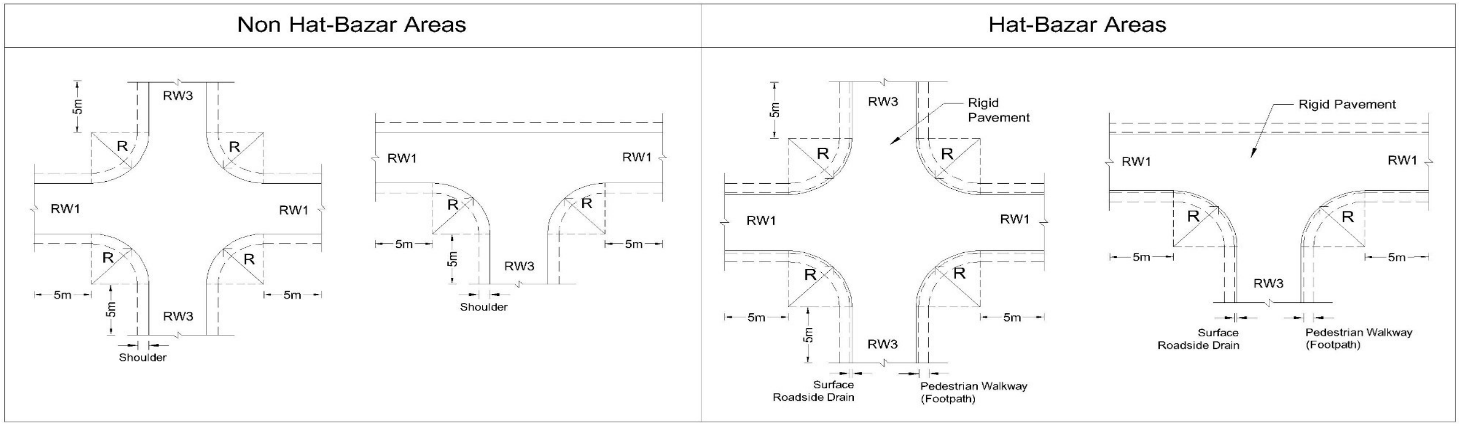
1. All dimensions are in mm (unless otherwise mentioned)
2. **Pile length (L) & spacing (S) shall be adjusted based on soil test report.**
3. 28 day's Cylinder Concrete Strength f'c = 25 MPa.
4. Clear cover in post 40 mm
5. MS Deformed bar (fy = 400/420 MPa)
6. Expansion joint at maximum 10.0m interval
7. **Pre-cast post must be installed by driving**
8. Construction of the Structure which is under water may be done by dewatering.



METHOD-09B

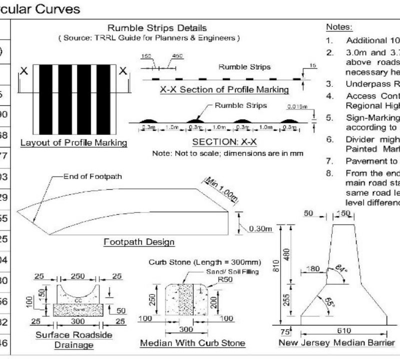
Appendix – J

LGED-LGED ROAD INTERSECTIONS WITH CIRCULAR CURVES



Connectivity with Circular Curves

Connectivity Type	Roadway Data (m)										Rural Areas: Approximate Area (m^2) Needed in Ground Level with Intersection Influence Area (5m on each leg) — Cross intersections									T - intersections								
	RW1	RW3	R	S	SSR	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5
01	3.0	3.0	12	1.25	1:2	1	2	3	4	5	337	476	104	35	678	856	1008	1135	1237	224	340	87	29	515	678	828	965	1090
02	3.0	3.7	15	1.50	1:2	1	2	3	4	5	472	667	168	26	904	1116	1302	1464	1601	302	464	141	22	670	864	1044	1213	1368
03	5.5	3.0	15	1.85	1:2	1	2	3	4	5	550	787	205	32	1020	1227	1410	1567	1699	393	591	172	27	794	984	1161	1325	1477
04	6.1	3.0	15	1.85	1:2	1	2	3	4	5	575	813	205	32	1046	1253	1436	1593	1725	419	617	172	27	820	1009	1187	1351	1503
05	6.7	3.0	15	1.85	1:2	1	2	3	4	5	601	839	204	32	1072	1279	1461	1619	1751	445	643	172	27	845	1035	1212	1377	1529
06	7.3	3.0	15	1.85	1:2	1	2	3	4	5	627	965	205	32	1097	1305	1487	1645	1777	470	669	172	27	871	1061	1238	1403	1555
07	3.7	3.7	15	1.85	1:2	1	2	3	4	5	503	740	205	32	973	1181	1363	1520	1653	332	532	173	27	736	927	1105	1271	1425
08	5.5	3.7	15	1.85	1:2	1	2	3	4	5	581	819	205	32	1052	1259	1442	1599	1731	411	611	173	27	814	1005	1184	1350	1504
09	6.1	3.7	15	1.85	1:2	1	2	3	4	5	608	845	205	32	1078	1286	1468	1625	1757	437	637	173	27	841	1032	1210	1376	1530
10	6.7	3.7	15	1.85	1:2	1	2	3	4	5	634	872	205	32	1104	1312	1494	1651	1784	463	663	173	27	867	1058	1237	1403	1556
11	7.3	3.7	15	1.85	1:2	1	2	3	4	5	660	898	205	32	1130	1338	1520	1678	1810	490	689	173	27	893	1084	1263	1429	1582
12	5.5	5.5	18	1.85	1:2	1	2	3	4	5	814	1087	236	37	1357	1602	1823	2018	2187	549	780	200	31	1019	1244	1457	1658	1846



Notes:

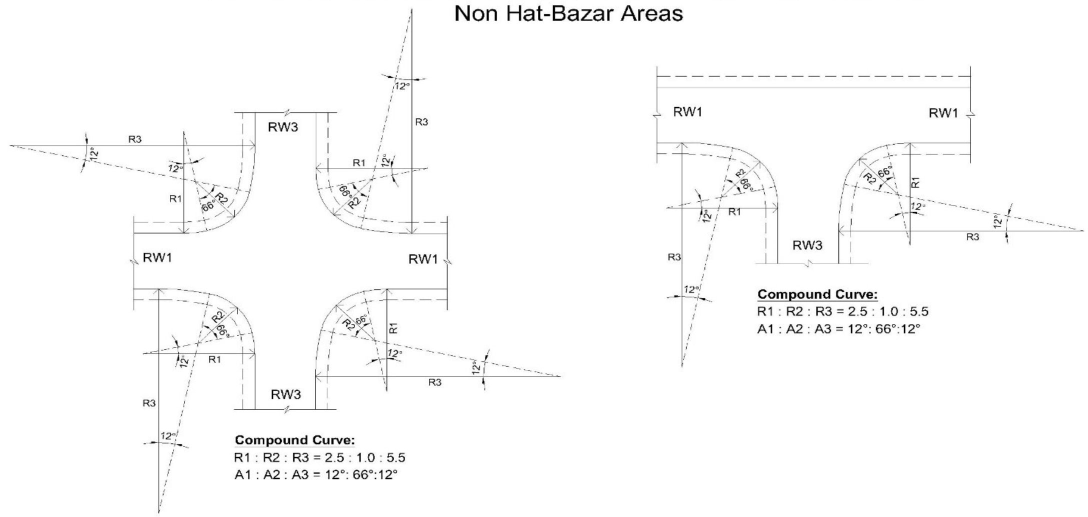
1. Additional 10-15% area might be required considering site specific influential factor.
2. 3.0m and 3.7m width LGED roads should not be connected with 11.0m width or above roads. In this case, lower standard roads should go through underpass with necessary head clearance.
3. Underpass Roadway should be Rigid Pavement with additional clear distance.
4. Access Control: Maximum 3 (three) junction per km with National Highway and Regional Highway.
5. Sign-Marking, Roadway Furniture and Safety Features should be followed according to LGED Safety Manual.
6. Divider might be of Curb Stone, New Jersey Median Barrier, Rumble Strip or Painted Marking.
7. Pavement to be extended to the end of radius.
8. From the end of radius, 15m length of connecting road has to be developed as per main road standard. This portion of the connecting road has to be maintained at the same road level as main road and then 3% gradient has to be maintained to omit level difference.

Notations:

RW1	=	Roadway Width One
RW3	=	Roadway Width Three
R	=	Radius of Curvature
S	=	Shoulder
SSR	=	Side Slope Ratio
H	=	Road Surface Height from Ground Level
Without S	=	without shoulder
With S	=	with Shoulder
PW	=	Pedestrian Walkway
D	=	Surface Drainage

LGED-LGED CROSS-ROAD INTERSECTIONS WITH COMPOUND CURVES

Non Hat-Bazar Areas

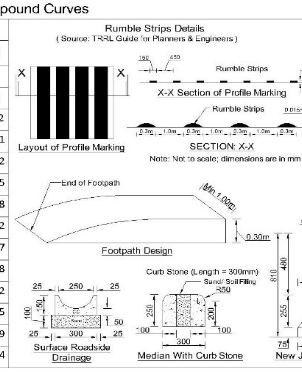


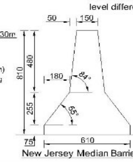
Connectivity with Compound Curves

Connectivity Type	Roadway Data (m)										Rural Areas: Approximate Area (m^2) Needed in Ground Level with Intersection Influence Area (5m on each leg) — Cross intersections										T - intersections									
	RW1	RW3	R	S	SSR	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5
01	3.0	3.0	12	1.00	1:2	1	2	3	4	5	568	816	-	-	1193	1544	1871	2172	2448	374	574	-	-	882	1179	1462	1734	1992
02	3.0	3.7	15	1.85	1:2	1	2	3	4	5	810	1168	-	-	1623	2052	2457	2836	3191	514	802	-	-	1175	1535	1883	2218	2541
03	5.5	3.0	15	1.85	1:2	1	2	3	4	5	940	1379	-	-	1829	2255	2655	3030	3480	668	1021	-	-	1390	1747	2091	2423	2742
04	6.1	3.0	15	1.85	1:2	1	2	3	4	5	983	1422	-	-	1873	2298	2698	3073	3423	711	1064	-	-	1433	1790	2134	2466	2785
05	6.7	3.0	15	1.85	1:2	1	2	3	4	5	1026	1465	-	-	1916	2341	2741	3116	3466	754	1107	-	-	1477	1833	2178	2509	2828
06	7.3	3.0	15	1.85	1:2	1	2	3	4	5	1069	1509	-	-	1959	2384	2784	3160	3509	798	1151	-	-	1520	1877	2221	2552	2872
07	3.7	3.7	15	1.85	1:2	1	2	3	4	5	861	1300	-	-	1751	2176	2576	2951	3301	565	919	-	-	1290	1648	1994	2327	2647
08	5.5	3.7	15	1.85	1:2	1	2	3	4	5	992	1431	-	-	1881	2307	2707	3082	3432	696	1050	-	-	1421	1799	2125	2458	2778
09	6.1	3.7	15	1.85	1:2	1	2	3	4	5	1036	1475	-	-	1925	2350	2751	3126	3476	740	1094	-	-	1465	1823	2168	2501	2822
10	6.7	3.7	15	1.85	1:2	1	2	3	4	5	1079	1518	-	-	1969	2394	2794	3169	3519	783	1137	-	-	1508	1866	2112	2545	2865
11	7.3	3.7	15	1.85	1:2	1	2	3	4	5	1123	1562	-	-	2012	2438	2838	3213	3563	827	1181	-	-	1552	1910	2156	2589	2909
12	5.5	5.5	18	1.85	1:2	1	2	3	4	5	1404	1918	-	-	2450	2957	3438	3894	4325	940	1356	-	-	1795	2221	2634	3035	3424

Rumble Strips Details

(Source: TRRL Guide for Planners & Engineers)





Notes:

1. Additional 10-15% area might be required considering site specific influential factor.
2. 3.0m and 3.7m width LGED roads should not be connected with 11.0m width or above roads. In this case, lower standard roads should go through underpass with necessary head clearance.
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7. Pavement to be extended to the end of radius.
8. From the end of radius, 15m length of connecting road has to be developed as per main road standard. This portion of the connecting road has to be maintained at the same road level as main road and then 3% gradient has to be maintained to omit level difference.

Notations:

RW1	=	Roadway Width One
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R	=	Radius of Curvature
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SSR	=	Side Slope Ratio
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PW	=	Pedestrian Walkway
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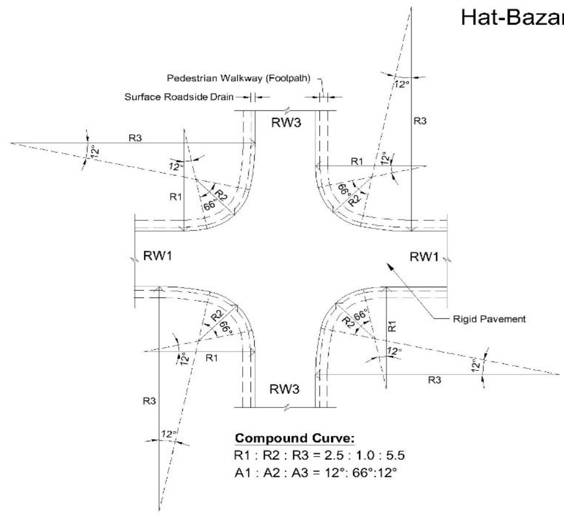
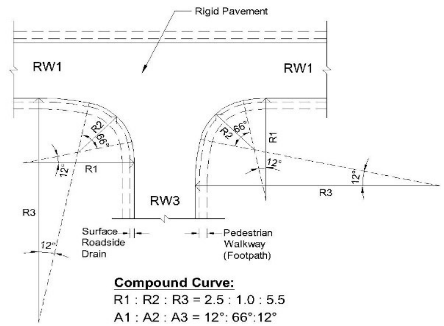
LGED-LGED ROAD INTERSECTIONS WITH COMPOUND CURVES

Hat-Bazar Areas



Compound Curve:
R1 : R2 : R3 = 2.5 : 1.0 : 5.5
A1 : A2 : A3 = 12°: 66°:12°

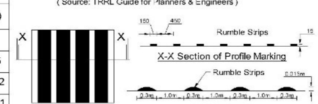


Compound Curve:
R1 : R2 : R3 = 2.5 : 1.0 : 5.5
A1 : A2 : A3 = 12°: 66°:12°

Connectivity with Compound Curves

Connectivity Type	Roadway Data (m)										Hat-Bazar Areas: Approximate Area (m^2) Needed in Ground Level with Intersection Influence Area (5m on each leg) — Cross intersections									T - intersections								
	RW1	RW3	R	S	SSR	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5
01	3.0	3.0	12	1.00	1:2	1	2	3	4	5	568	816	198	50	1193	1544	1871	2172	2448	374	574	203	40	882	1179	1462	1734	1992
02	3.0	3.7	15	1.85	1:2	1	2	3	4	5	810	1168	297	61	1623	2052	2457	2836	3191	514	802	310	48	1175	1535	1883	2218	2541
03	5.5	3.0	15	1.85	1:2	1	2	3	4	5	940	1379	378	61	1829	2255	2655	3030	3480	668	1021	368	48	1390	1747	2091	2423	2742
04	6.1	3.0	15	1.85	1:2	1	2	3	4	5	983	1422	378	61	1873	2298	2698	3073	3423	711	1064	368	48	1433	1790	2134	2466	2785
05	6.7	3.0	15	1.85	1:2	1	2	3	4	5	1026	1465	378	61	1916	2341	2741	3116	3466	754	1107	368	48	1477	1833	2178	2509	2828
06	7.3	3.0	15	1.85	1:2	1	2	3	4	5	1069	1509	378	61	1959	2384	2784	3160	3509	798	1151	368	48	1520	1877	2221	2552	2872
07	3.7	3.7	15	1.85	1:2	1	2	3	4	5	861	1300	378	61	1751	2176	2576	2951	3301	565	919	369	48	1290	1648	1994	2327	2647
08	5.5	3.7	15	1.85	1:2	1	2	3	4	5	992	1431	378	61	1881	2307	2707	3082	3432	696	1050	369	48	1421	1799	2125	2458	2778
09	6.1	3.7	15	1.85	1:2	1	2	3	4	5	1036	1475	378	61	1925	2350	2751	3126	3476	740	1094	369	48	1465	1823	2168	2501	2822
10	6.7	3.7	15	1.85	1:2	1	2	3	4	5	1079	1518	378	61	1969	2394	2794	3169	3519	783	1137	369	48	1508	1866	2112	2545	2865
11	7.3	3.7	15	1.85	1:2	1	2	3	4	5	1123	1562	378	61	2012	2438	2838	3213	3563	827	1181	369	48	1552	1910	2156	2589	2909
12	5.5	5.5	18	1.85	1:2	1	2	3	4	5	1404	1918	443	71	2450	2957	3438	3894	4325	940	1356	462	57	1795	2221	2634	3035	3424

Rumble Strips Details
(Source: TRRL Guide for Planners & Engineers)

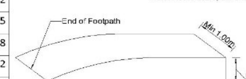


Layout of Profile Marking

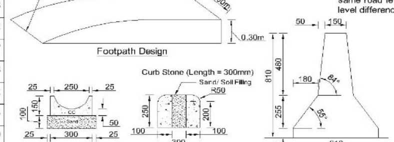
X-X Section of Profile Marking

SECTION: X-X

Note: Not to scale; dimensions are in mm



Footpath Design



Surface Roadside Drainage

Median With Curb Stone

New Jersey Median Barrier

Notes:

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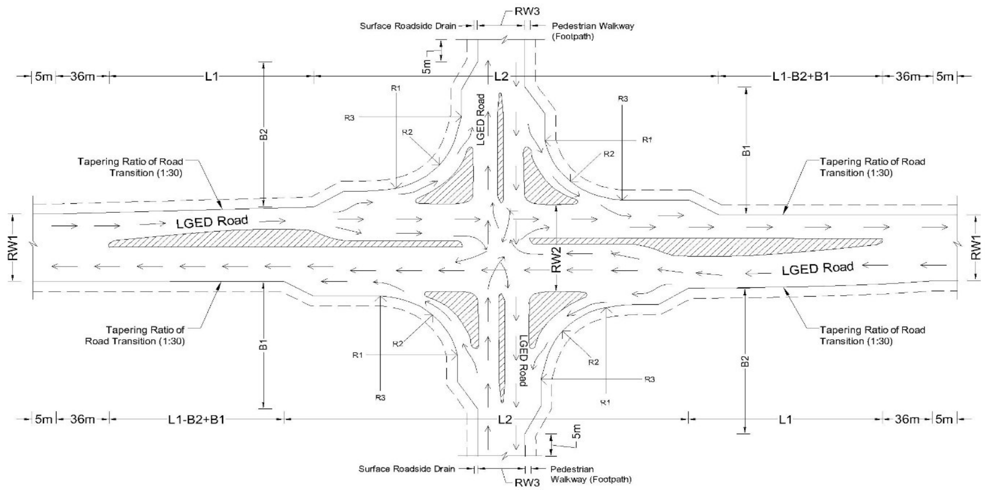
LGED-LGED CROSS-ROAD INTERSECTIONS ON NON HAT-BAZAR AREAS

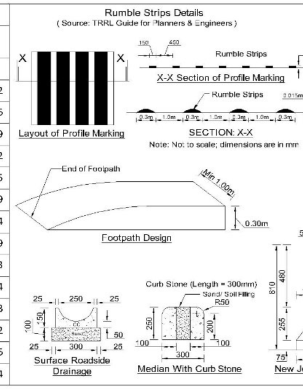


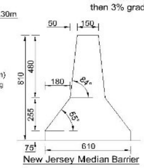
Connectivity with Channelization

Cross Intersection in Rural Areas

Connectivity Type	Roadway Data (m)																Approximate Area (m^2) Needed in Ground Level with Intersection Influence Area (5m on each leg)								
	RW1	RW2	RW3	R2	L1	L2	L3	B1	B2	S	SSR	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5
13	6.1	9.8	5.5	18	75	139	75	51	83	2	1:2	1	2	3	4	5	6238	7998	1521	239	9877	11731	13560	15363	17142
14	6.7	10.4	5.5	18	75	139	75	51	83	2	1:2	1	2	3	4	5	6442	8202	1521	239	10081	11935	13764	15567	17346
15	7.3	11.0	5.5	18	75	139	75	51	83	2	1:2	1	2	3	4	5	6646	8406	1521	239	100285	12139	13967	15771	17549
16	11.0	15.5	5.5	22	75	204	75	57	142	2	1:2	1	2	3	4	5	10456	12680	1923	302	15061	17416	19746	22052	24332
17	6.1	9.8	6.1	18	75	140	75	51	83	2	1:2	1	2	3	4	5	6351	8112	1521	239	9991	11845	13673	15477	17255
18	6.7	10.4	6.1	18	75	140	75	51	83	2	1:2	1	2	3	4	5	6556	8316	1521	239	10195	12049	13877	15681	17459
19	7.3	11.0	6.1	18	75	140	75	51	83	2	1:2	1	2	3	4	5	6760	8520	1521	239	10399	12253	14082	15885	17664
20	11.0	15.5	6.1	22	75	153	75	57	91	2	1:2	1	2	3	4	5	8999	10843	1594	250	12812	14756	16676	18570	20439
21	6.7	10.4	6.7	18	75	141	75	51	83	2	1:2	1	2	3	4	5	6669	8430	1521	239	10309	12162	13991	15795	17573
22	7.3	11.0	6.1	18	75	140	75	51	83	2	1:2	1	2	3	4	5	6760	8520	1521	239	10399	12253	14082	15885	17664
23	11.0	15.5	6.7	22	75	205	75	57	142	2	1:2	1	2	3	4	5	10831	13056	1923	302	15436	17792	20122	22428	24708
24	7.3	11.0	7.3	18	75	141	75	51	83	2	1:2	1	2	3	4	5	6988	8748	1521	239	10627	12481	14310	16113	17892
25	11.0	15.5	7.3	22	75	206	75	57	142	2	1:2	1	2	3	4	5	11019	13244	1923	302	15624	17980	20310	22615	24896
26	11.0	15.5	11.8	25	75	243	75	84	148	2	1:2	1	2	3	4	5	13930	16385	2122	333	19015	21620	24200	26755	29284

Rumble Strips Details
(Source: TRRL Guide for Planners & Engineers)





Notes:

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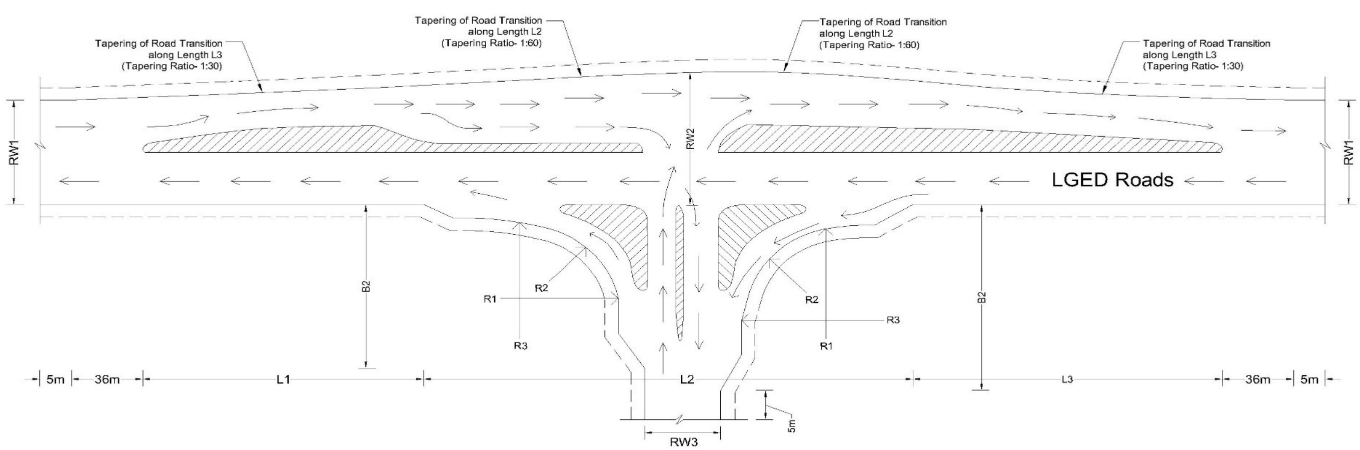
LGED-LGED ROAD T-INTERSECTIONS ON NON HAT-BAZAR AREAS

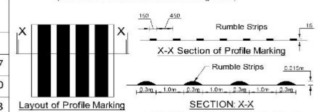


Connectivity with Channelization

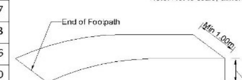
Connectivity Type	T - Intersection in Rural Areas																									
	Roadway Data (m)																Approximate Area (m^2) Needed in Ground Level with Intersection Influence Area (5m on each leg)									
	RW1	RW2	RW3	R2	L1	L2	L3	B1	B2	S	SSR	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5
13	6.1	9.8	5.5	18	75	139	75	51	83	2	1:2	1	2	3	4	5	4927	6546	1399	219	8284	10009	11722	13422	15077
14	6.7	10.4	5.5	18	75	139	75	51	83	2	1:2	1	2	3	4	5	5150	6768	1399	219	8506	10232	11945	13645	15300
15	7.3	11.0	5.5	18	75	139	75	51	83	2	1:2	1	2	3	4	5	5372	6991	1399	219	8729	10455	12167	13868	15523
16	11.8	15.5	5.5	22	75	204	75	57	142	2	1:2	1	2	3	4	5	9094	11165	1790	280	13391	15604	17805	19993	22117
17	6.1	9.8	6.1	18	75	140	75	51	83	2	1:2	1	2	3	4	5	4986	6606	1400	220	8345	10072	11786	13487	15143
18	6.7	10.4	6.1	18	75	140	75	51	83	2	1:2	1	2	3	4	5	5209	6829	1400	220	8568	10295	12009	13710	15366
19	7.3	11.0	6.1	18	75	140	75	51	83	2	1:2	1	2	3	4	5	5432	7052	1400	220	8791	10518	12232	13934	15590
20	11.8	15.5	6.1	22	75	153	75	57	91	2	1:2	1	2	3	4	5	7600	9291	1462	229	11107	12910	14701	16479	18194
21	6.7	10.4	6.7	18	75	141	75	51	83	2	1:2	1	2	3	4	5	5269	6890	1401	220	8630	10358	12073	13776	15433
22	7.3	11.0	6.1	18	75	140	75	51	83	2	1:2	1	2	3	4	5	5432	7052	1400	220	8791	10518	12232	13934	15590
23	11.8	15.5	6.7	22	75	205	75	57	142	2	1:2	1	2	3	4	5	9291	11364	1792	281	13592	15808	18011	20202	22328
24	7.3	11.0	7.3	18	75	141	75	51	83	2	1:2	1	2	3	4	5	5552	7174	1402	220	8916	10645	12361	14065	15724
25	11.8	15.5	7.3	22	75	206	75	57	142	2	1:2	1	2	3	4	5	9390	11463	1793	281	13692	15910	18114	20306	22434
26	11.8	15.5	11.8	25	75	243	75	84	148	2	1:2	1	2	3	4	5	11105	13324	1919	300	15711	18085	20447	22796	25068

Rumble Strips Details

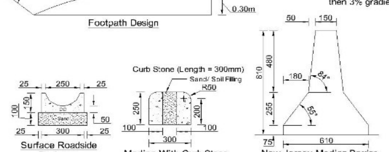
(Source: TRRL Guide for Planners & Engineers)



Note: Not to scale; dimensions are in mm



Footpath Design



Surface Roadside Drainage

Median With Curb Stone

New Jersey Median Barrier

Notes:

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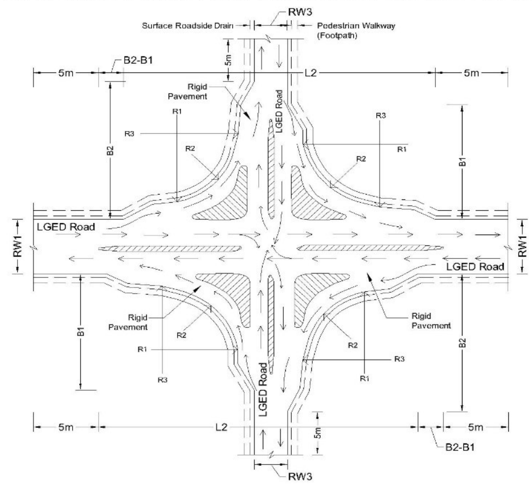
LGED-LGED CROSS-ROAD INTERSECTIONS ON HAT-BAZAR AREAS

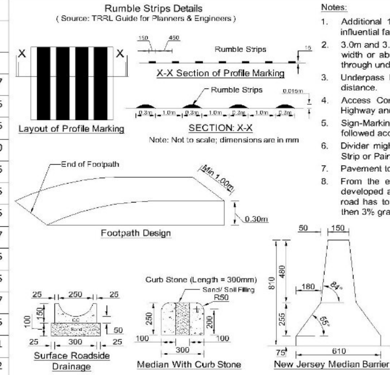


Connectivity with Channelization

Cross Intersection in Hat-Bazar Areas

Connectivity Type	Roadway Data (m)														Approximate Area (m²) Needed in Ground Level with Intersection Influence Area (5m on each leg)								
	RW1	RW2	RW3	R2	L2	B1	B2	S	Ratio	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5
13	6.1	9.8	5.5	18	139	51	83	1.85	1:2	1	2	3	4	5	4212	5371	1002	158	6601	7805	8984	10138	11267
14	6.7	10.4	5.5	18	139	51	83	1.85	1:2	1	2	3	4	5	4301	5461	1002	158	6690	7894	9073	10227	11356
15	7.3	11.0	5.5	18	139	51	83	1.85	1:2	1	2	3	4	5	4391	5551	1002	158	6780	7984	9163	10317	11446
16	11.8	15.5	5.5	22	204	57	142	1.85	1:2	1	2	3	4	5	7681	9701	1746	274	11861	13996	16106	18191	20250
17	6.1	9.8	6.1	18	140	51	83	1.85	1:2	1	2	3	4	5	4321	5480	1002	158	6710	7914	9093	10247	11376
18	6.7	10.4	6.1	18	140	51	83	1.85	1:2	1	2	3	4	5	4411	5570	1002	158	6800	8004	9183	10337	11465
19	7.3	11.0	6.1	18	140	51	83	1.85	1:2	1	2	3	4	5	4501	5660	1002	158	6890	8094	9273	10427	11555
20	11.8	15.5	6.1	22	153	57	91	1.85	1:2	1	2	3	4	5	5870	7130	1088	171	8467	9780	11067	12330	13567
21	6.7	10.4	6.7	18	141	51	83	1.85	1:2	1	2	3	4	5	4520	5680	1002	158	6909	8113	9292	10446	11575
22	7.3	11.0	6.1	18	140	51	83	1.85	1:2	1	2	3	4	5	4501	5660	1002	158	6890	8094	9273	10427	11555
23	11.8	15.5	6.7	22	205	57	142	1.85	1:2	1	2	3	4	5	8048	10068	1746	274	12228	14363	16473	18558	20617
24	7.3	11.0	7.3	18	141	51	83	1.85	1:2	1	2	3	4	5	4720	5880	1002	158	7109	8313	9492	10646	11775
25	11.8	15.5	7.3	22	206	57	142	1.85	1:2	1	2	3	4	5	8231	10252	1746	274	12412	14547	16657	18741	20801
26	11.8	15.5	11.8	25	243	84	148	1.85	1:2	1	2	3	4	5	10831	12927	1811	284	15168	17384	19575	21741	23882

Rumble Strips Details
(Source: TRRL Guide for Planners & Engineers)



Notes:

1. Additional 10-15% area might be required considering site specific influential factor.
2. 3.0m and 3.7m width LGED roads should not be connected with 11.0m width or above roads. In this case, lower standard roads should go through underpass with necessary head clearance.
3. Underpass Roadway should be Rigid Pavement with additional clear distance.
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5. Sign-Marking, Roadway Furniture and Safety Features should be followed according to LGED Safety Manual.
6. Divider might be of Curb Stone, New Jersey Median Barrier, Rumble Strip or Painted Marking.
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8. From the end of radius, 15m length of connecting road has to be developed as per main road standard. This portion of the connecting road has to be maintained at the same road level as main road and then 3% gradient has to be maintained to omit level difference.

Notations:

RW1	=	Roadway Width One
RW3	=	Roadway Width Three
R	=	Radius of Curvature
S	=	Shoulder
SSR	=	Side Slope Ratio
H	=	Road Surface Height from Ground Level
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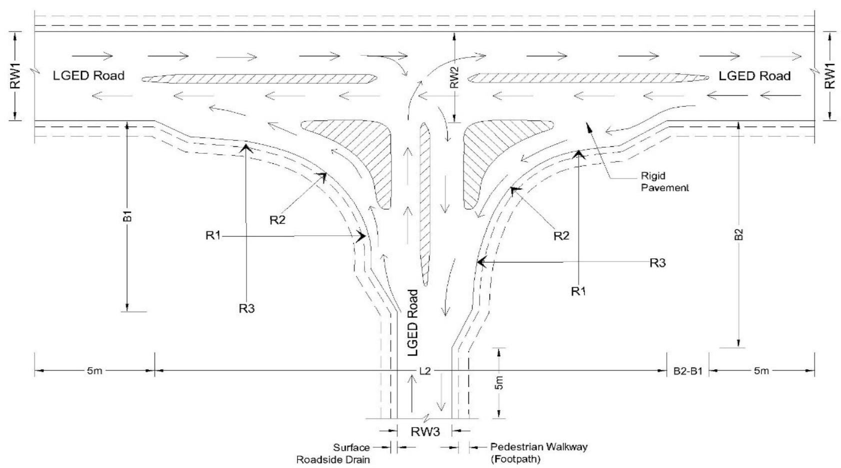
D	=	Surface Drainage

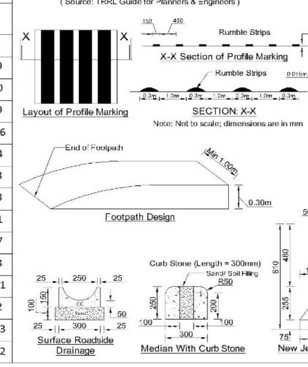
LGED-LGED ROAD T-INTERSECTIONS ON HAT-BAZAR AREAS



Connectivity with Channelization

Connectivity Type	T-Intersection in Hat-Bazar Areas																						
	Roadway Data (m)														Approximate Area (m^2) Needed in Ground Level with Intersection Influence Area (5m on each leg)								
	RW1	RW2	RW3	R2	L2	B1	B2	S	Ratio	H1	H2	H3	H4	H5	without S	with S	PW	D	H1	H2	H3	H4	H5
13	6.1	9.8	5.5	18	139	51	83	1.85	1:2	1	2	3	4	5	3001	3798	689	108	4648	5485	6310	7123	7889
14	6.7	10.4	5.5	18	139	51	83	1.85	1:2	1	2	3	4	5	2651	3448	689	108	4298	5136	5961	6773	7540
15	7.3	11.0	5.5	18	139	51	83	1.85	1:2	1	2	3	4	5	2741	3538	689	108	4388	5225	6050	6863	7629
16	11.8	15.5	5.5	22	204	57	142	1.85	1:2	1	2	3	4	5	5104	6353	1079	169	7691	9016	10329	11629	12866
17	6.1	9.8	6.1	18	140	51	83	1.85	1:2	1	2	3	4	5	2618	3416	690	109	4267	5106	5932	6746	7514
18	6.7	10.4	6.1	18	140	51	83	1.85	1:2	1	2	3	4	5	2708	3506	690	109	4357	5196	6022	6835	7603
19	7.3	11.0	6.1	18	140	51	83	1.85	1:2	1	2	3	4	5	2798	3596	690	109	4447	5286	6112	6925	7693
20	11.8	15.5	6.1	22	153	57	91	1.85	1:2	1	2	3	4	5	3899	4769	751	118	5697	6612	7515	8405	9231
21	6.7	10.4	6.7	18	141	51	83	1.85	1:2	1	2	3	4	5	2764	3564	691	109	4416	5256	6083	6898	7667
22	7.3	11.0	6.1	18	140	51	83	1.85	1:2	1	2	3	4	5	2798	3596	690	109	4447	5286	6112	6925	7693
23	11.8	15.5	6.7	22	205	57	142	1.85	1:2	1	2	3	4	5	5295	6546	1081	170	7886	9214	10529	11832	13071
24	7.3	11.0	7.3	18	141	51	83	1.85	1:2	1	2	3	4	5	2912	3712	692	109	4566	5407	6235	7051	7822
25	11.8	15.5	7.3	22	206	57	142	1.85	1:2	1	2	3	4	5	5390	6642	1082	170	7984	9313	10629	11933	13173
26	11.8	15.5	11.8	25	243	84	148	1.85	1:2	1	2	3	4	5	6910	8308	1208	189	9807	11293	12767	14228	15612

Rumble Strips Details
(Source: TRRL Guide for Planners & Engineers)



Notes:

1. Additional 10-15% area might be required considering site specific influential factor.
2. 3.0m and 3.7m width LGED roads should not be connected with 11.0m width or above roads. In this case, lower standard roads should go through underpass with necessary head clearance.
3. Underpass Roadway should be Rigid Pavement with additional clear distance.
4. Access Control: Maximum 3 (three) junction per km with National Highway and Regional Highway.
5. Sign-Marking, Roadway Furniture and Safety Features should be followed according to LGED Safety Manual.
6. Divider might be of Curb Stone, New Jersey Median Barrier, Rumble Strip or Painted Marking.
7. Pavement to be extended to the end of radius.
8. From the end of radius, 15m length of connecting road has to be developed as per main road standard. This portion of the connecting road has to be maintained at the same road level as main road and then 3% gradient has to be maintained to omit level difference.

Notations:

RW1	=	Roadway Width One
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R	=	Radius of Curvature
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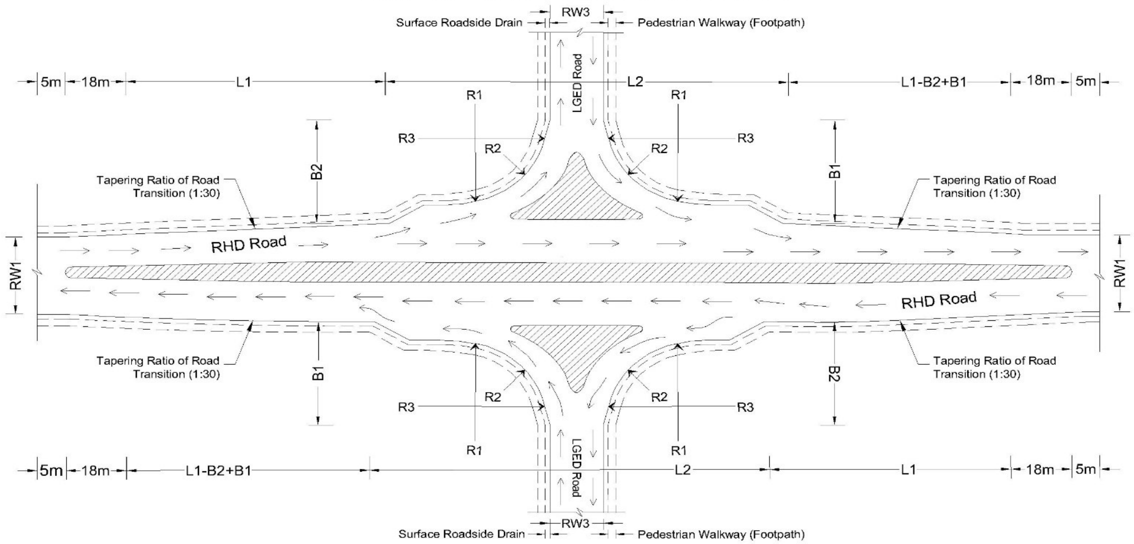
LGED-RHD CROSS-ROAD INTERSECTIONS

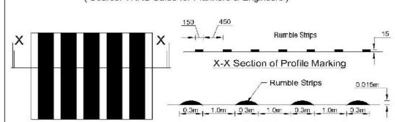


Notes:

1. Necessary dimensions will be determined through case by case geometric design
2. Vehicles from LGED roads will travel a distance along the RHD service roads, where available, before getting on the highways
3. LGED will follow all instructions / orders issued time to time regarding road safety including intersection from different ministries.

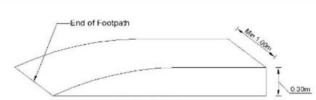
Connectivity with Channelization

Rumble Strips Details
(Source: TRRL Guide for Planners & Engineers)

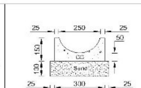


Layout of Profile Marking

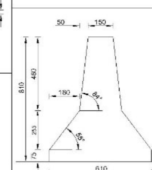
SECTION: X-X
Note: Not to scale; dimensions are in mm



Footpath Design

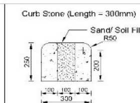


Surface Roadside Drainage



New Jersey Median Barrier

Curb Stone (Length = 300mm)



Median With Curb Stone

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PW	=	Pedestrian Walkway
D	=	Surface Drainage

Notes:

1. Additional 10-15% area might be required considering site specific influential factor.
2. LGED-RHD Connectivity: Need Co-ordination between LGED and RHD.
3. 3.0m and 3.7m width LGED roads should not be connected with 11.0m width or above roads. In this case, lower standard roads should go through underpass with necessary head clearance.
4. Underpass Roadway should be Rigid Pavement with additional clear distance.
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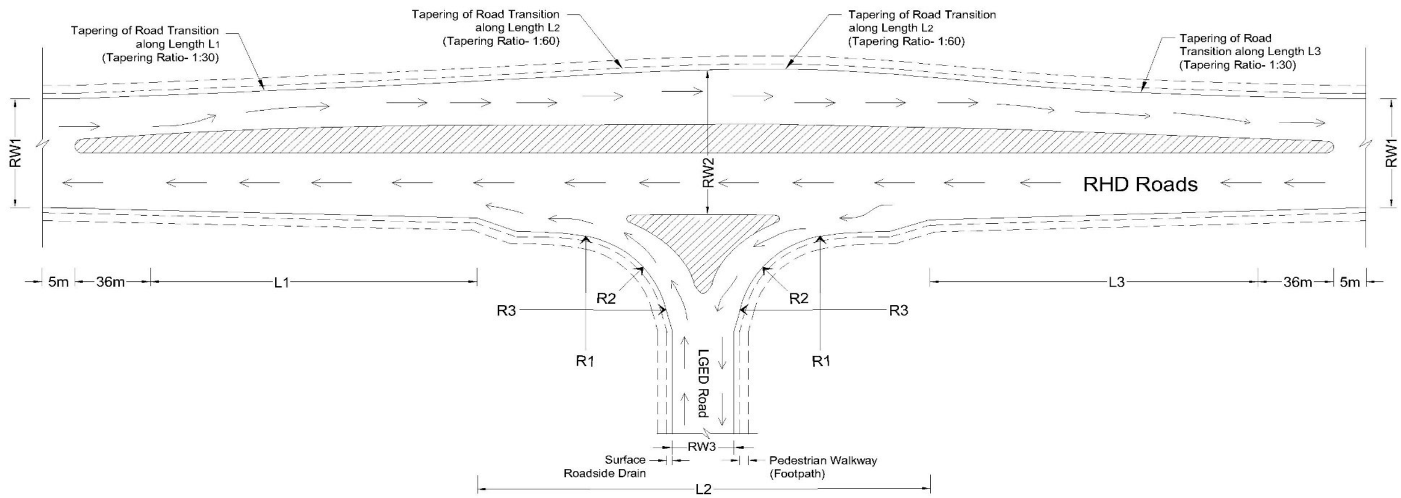
LGED-RHD T-INTERSECTIONS



Notes:

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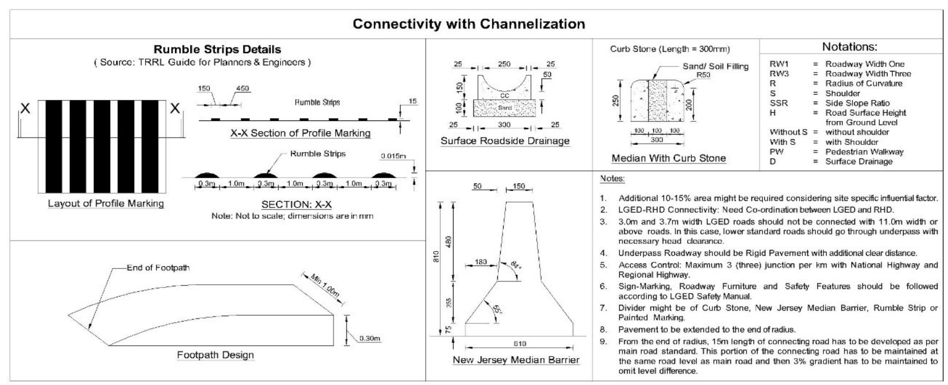
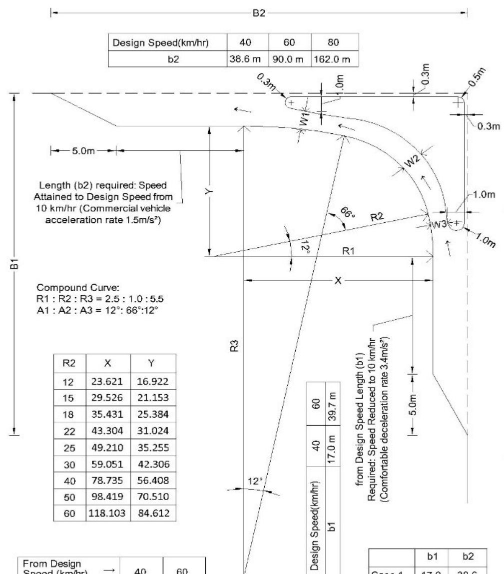
3. LGED will follow all instructions / orders issued time to time regarding road safety including intersection from different ministries.



INTERSECTION DETAIL DESIGN



Design Speed(km/hr)	40	60	80
b2	38.6 m	90.0 m	162.0 m

R2	X	Y
12	23.621	16.922
15	29.526	21.153
18	35.431	25.384
22	43.304	31.024
25	49.210	35.255
30	59.051	42.306
40	78.735	56.408
50	98.419	70.510
60	118.103	84.612

Design Speed(km/hr)	40	60
b1	17.0 m	39.7 m

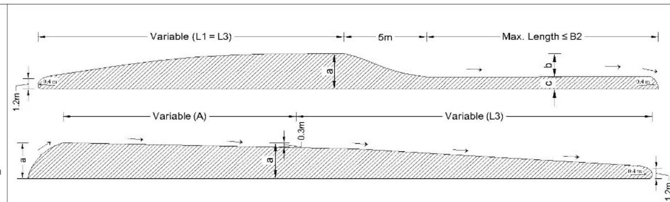
From Design Speed (km/hr) → / To Design Speed(km/hr) ↓	40	60
40	Case 1	Case 2
60	Case 3	Case 4
80	Case 5	Case 6

	b1	b2
Case 1	17.0	38.6
Case 2	39.7	38.6
Case 3	17.0	90.0
Case 4	39.7	90.0
Case 5	17.0	162.0
Case 6	39.7	162.0

R2 (m)	18			22			25			30			40		
W (m)	w1	w2	w3	w1	w2	w3	w1	w2	w3	w1	w2	w3	w1	w2	w3
	4.88	6.71	4.88	4.88	6.41	4.88	4.88	6.10	4.88	4.88	5.79	4.88	4.88	5.50	4.88

* w2 is on the mid of circular curve

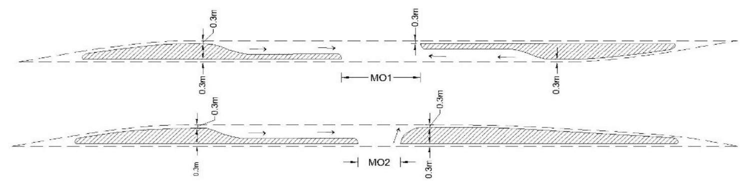
Design detail for left-turn roadways



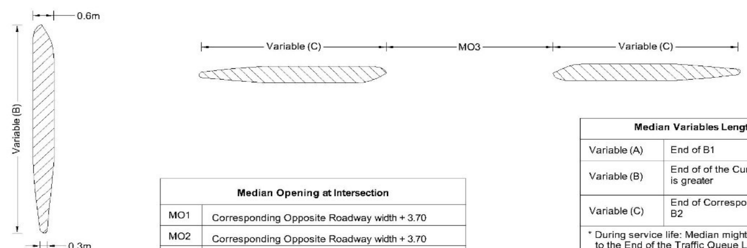
		L1 or L3 values (m)		c	a = b +c
Ratio →		1:20	1:30		
b	3.0m	50m	75m	0.7m	3.7m

- L1 and L3 values are preferably used of 1:30 ratios
- L2 = B1 + B2 + Corresponding Roadway Width
- Recommended Values : b = 3.0m; L1 = L2 = 54m; c = 0.7m; a = 3.7m

Design detail for right-turn roadways



Design detail for Median Opening (MO) on Intersections

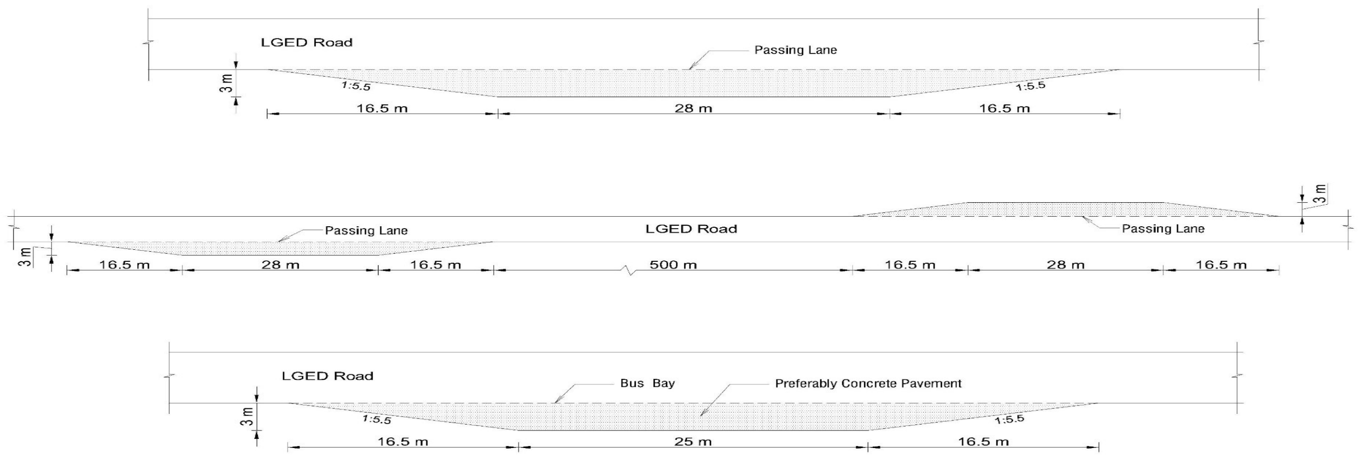


Median Opening at Intersection	
MO1	Corresponding Opposite Roadway width + 3.70
MO2	Corresponding Opposite Roadway width + 3.70
MO3	Corresponding Opposite Roadway width + 1.83

Median Variables Lengths	
Variable (A)	End of B1
Variable (B)	End of of the Curve which ever is greater
Variable (C)	End of Corresponding B1 and B2
* During service life: Median might be extended to the End of the Traffic Queue Length in the Double carriageway or higher standard roads.	

Design detail for Nose Splitter and Median Opening on Intersections

LGED ROAD PASSING LANE AND BUS BAY (SCHEMATIC DIAGRAM)



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