ROYAL GOVERNMENT OF CAMBODIA

MINISTRY OF RURAL DEVELOPMENT

INTERIM RURAL ROAD STANDARDS

Final Draft - January 2006

FOREWORD TO THE 2006 INTERIM RURAL ROAD STANDARDS

The Ministry of Rural Development (MRD) has formulated a policy document for rural roads which provides a framework for the sector activities (1999 and revised 2002).

These Interim Rural Road Standards (IRRS) interpret the MRD policy into practical and appropriate standards for the development and maintenance of the rural road network.

The IRRS have been developed by a Special Committee of MRD senior personnel with support from international and local advisers under the DFID funded SEACAP 2 project – Cambodia Transport Mainstreaming Partnership, under the Chairmanship of H.E. Suos Kong, Secretary of State.

The Committee also included the following members:

- H.E. Try Meng, Under Secretary of State.
- H.E. Kim Sour, Under Secretary of State.
- H.E. Cheam Nimol, Director General of Technical Affairs.
- Mour Kimsan, Deputy Director General of Technical Affairs.
- Yoeun Sophal, Director of Rural Road Department.
- Nguon Dara, Deputy Director of Rural Road Department.
- Noun Sokha, Deputy Director of Rural Road Department.
- Chhour Longsrun, Deputy Director of Rural Road Department.
- El Say, Director of PDRD Battambang Province.
- Moa So, Deputy Director of PDRD – Banteay Meanchay Province.
- Im Phoansophal, Deputy Director of PDRD – Siem Reap Province.
- Heng Kackada, Executive Secretary of CNCTP.
- David Salter, SEACAP Manager.
- Robert Petts, Regional Manager Intech-TRL & Director of SEACAP-2 project.

The document is divided into two parts. The first part contains the Interim Standards, whereas the second part contains background explanations or reasons for the choice of each standard. This will enable the standards to be more easily understood, and reviewed with full background knowledge at a later date, as circumstances on the rural road network or in Cambodian economy change.

POLICY OBJECTIVE

"The Ministry of Rural Development is responsible for facilitating improvement of rural social and economic conditions.

Mission Statement

"The MRD Department of Rural Roads will contribute to this goal by increasing rural access through cost-effective investment in the maintenance and development of rural roads, routes and transport infrastructure."

Source: Policy for Rural Roads

1 INTRODUCTION

1.1 Setting & Updating Policy

Ministry of Rural Development will be responsible for the development and implementation of policies for the rural roads and routes of Cambodia. It will also develop and monitor implementation strategies to achieve the policy objectives, review their impact and effectiveness and update the policies and strategies as necessary. Ministry of Rural Development will liaise with Ministry of Public Works & Transport (MPWT) and other partner organisations on all issues of common interest to ensure harmonisation with the National Transport Plans and other policies affecting the Transport sector.

1.2 Road Categorisation

Public Roads in Cambodia are categorised as follows (source: MRD Policy 2002).

1.2.1 Non Urban Roads are currently categorised as:-

National (Ministry of Public Works & Transport)
Provincial (Ministry of Public Works & Transport)
&
OTHER RURAL - which are the responsibility of Ministry of Rural Development.

1.2.2 The functional categorisation of the OTHER RURAL roads is necessary to enable ownership, responsibilities, resources and management to be assigned. The following criteria have been adopted for the general categorisation:-

TERTIARY -	District to District
SUB-TERTIARY 1 -	District to Commune
SUB-TERTIARY 2 -	Commune to Commune
SUB-TERTIARY 3 -	Commune to Village and Village to Village

1.3 Application of these Interim Rural Road Standards

The Interim Rural Road Standards should apply to any rural road that:-

i) MRD or a Provincial Department of Rural Development (PDRD) is the management or advisory agency for the construction or rehabilitation works,

ii) MRD or a PDRD is the management or advisory agency for the maintenance or spot improvement works.

Traffic volumes will vary considerably on rural roads depending on location, weather, seasonal factors, etc. Traffic composition will also vary substantially from road to road. There are currently no agreed arrangements or circumstances regarding when

roads should change from MRD to MPWT responsibility with growing traffic.

The Standards for Tertiary and Sub-Tertiary roads detailed by this document will accommodate motor traffic flows from Zero to more than 2,000 vehicles per day.

The Interim Rural Road Standards will apply to roads irrespective of their surface, be it earth, gravel/laterite or a more durable surface, however different requirements will apply to the various surface types.

1.4 Road Features

The various features of a typical rural road are shown in Figure 1.

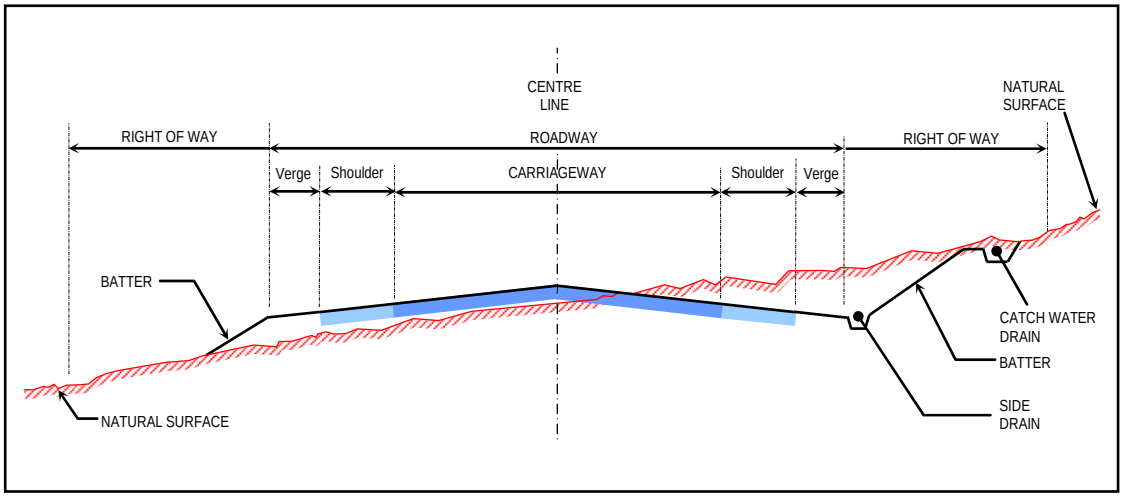

Figure 1 – ELEMENTS OF ROAD CROSS SECTION (Not To Scale)

Some of these features will not be required or be apparent, depending on location, circumstances and road category.

1.5 Determination of Future Traffic Flows

For the purposes of rural road design, the prediction of future traffic flows will be based on surveys of current traffic, and assessment of adjustments expected due to generated traffic, diverted traffic and future growth.

The standard for Traffic Flow measurement is Average Daily Traffic (ADT), based on the Passenger Car Unit (PCU).

The following table provides conversion factors for the various vehicle types.

Type of Vehicle	Equivalent Value in PCU's for Rural Traffic Flow Calculations
Passenger Car	1.0
Motorcycle	0.4
Motorcycle-trailer	0.6
Bicycle	0.3
Animal Cart	0.4
Light Vehicle / Van	1.0
Koyun	1.5
Medium Truck (6 tyres)	2.0
Heavy Truck (> 6 tyres)	2.5
Bus (> 4 tyres)	2.25
Mini-bus (4 tyres)	1.1

Figure 2 – Recommended PCU Conversion Factors for determination of road Type.

1.6 Topography

For interpretation of the standards and design purposes, topography is classified into **flat, rolling or mountainous** using the following definitions (Source: MPWT Road Design Standards):

Flat Terrain:

The topographical condition where road sight distances, as governed by both horizontal and vertical restrictions are generally long or could be made to be so without construction difficulty or expense. The natural ground, cross slopes (ie. perpendicular to natural ground contours) in a flat terrain are generally below 3 %

Rolling Terrain:

The topographical condition where the natural slopes consistently rise above and fall below the road or street grade and where occasional steep slopes offer some restrictions to normal horizontal and vertical roadway alignment. The natural ground cross slopes in rolling terrain is generally between 3 – 25 %.

Mountainous Terrain:

The topographical condition where longitudinal and transverse changes in the elevation of the ground with respect to the road or street are abrupt and where benching and side hill excavation are frequently required to obtain acceptable horizontal and vertical alignment. The naturals ground cross slopes in mountainous terrain are generally above 25 %.

PART A

INTERIM RURAL ROAD STANDARDS

Interim Design Standards for Tertiary/Sub-Tertiary Rural Roads

Item	Designation	Type A	Type B	Notes
1	Composition of traffic (ADT)	201 ~ 2,000+	0 ~ 200	Design Period Max flow in PCU
2	Design Period	15 years	10 years	
3	Design speed (Km/hr)	70 / 60 / 50	60 / 50 / 40	Flat / Rolling / Mountainous
4	Assumed ESA of commercial vehicle (6 tyres or more)	1.0	0.4	If axle load surveys are not possible
5	Minimum radius of curvature (metres) Unpaved surface	190 / 125 / 80	125 / 80 / 40	Flat / Rolling / Mountainous
6	Minimum radius of curvature (metres) Paved surface	130 / 85 / 60	85 / 60 / 30	Flat / Rolling / Mountainous
7	Vertical alignment maximum (%) Earth Road	4%	6%	Steeper gradients should be spot improved
8	Vertical alignment maximum (%) Gravel Road	6%	6%	4% if rainfall 1,000–2,000mm/year. Gravel unsuitable > 2,000mm/year
9	Vertical alignment maximum (%) Paved Road	15%	20%	Maximum 10% for thin bitumen seals
10	Horizontal sight distance (metres) Flat / Rolling / Mountainous	85 / 65 / 50	65 / 50 / 35	
11	Maximum super elevation (%)	7%	7%	Normally 3 – 4% is appropriate
12	Extra widening / Increased width at curves (metres)	0.5m	0.5m	If radius of curvature <100m
13	Constructed Carriageway Camber / Cross fall (%): Unpaved / Paved	7% / 3%	7% / 3%	Concrete Slab may be 2%
14	Shoulder plus Verge Width each side of carriageway (minimum)	1.0 metre	1.0 metres	Can be reduced in mountainous areas with provision of passing bays on single lane roads. Minimum Type B roadway = 6.0m
15	Width of earth/gravel/laterite/paved surface carriageway (minimum)	5.0 metres	3.5 metres	These are minima. If resources allow, wider carriageway may be justified
16	Initial constructed thickness of laterite / gravel surface (mm)	200mm compacted	150 ~ 200 mm compacted	Use technical design guidelines, gravel may not be suitable
17	Paved road pavement thickness	depends on requirements	depends on requirements	Use technical design guidelines
18	Elevation of road formation (minimum)	500 mm above the HFWL	500 mm above the HFWL	Sub-grade formation level
19	Embankment construction Maximum layer thickness (compacted)	150mm (each) horizontal layer	150mm (each) horizontal layer	Depends on compaction equipment used. All earthworks must be compacted
20	Embankment side slope	1:2 ~ 1:3	1:2 ~ 1:3	(vertical:horizontal)Turfed finishing
21	Side drainage ditches	See technical guidelines	See technical guidelines	Trapezoidal shape, Turfed. Scour checks or lined if gradient >4%
22	Right of way (from Road Centre line to each Side) (metres)	15	15	Recommended
23	Unobstructed clearance between backs of culvert headwalls at road surface level (Minimum)	7.0 metres	6.0 metres	Headwalls extending above embankment finished level should be clearly marked
24	Unobstructed carriageway width at single lane drifts and structures with width restriction and warning signs (Minimum)	3.5 metres	3.0 metres	Suitable barriers and warning signing to be provided
25	Berm width at embankment toe	2.0 metre	2.0 metre	Recommended minimum

Note: Unpaved = Earth or Gravel/laterite

PART B

THE RATIONALE

B. THE RATIONALE

This **PART B** of the Interim Rural Road Standards sets out the rationale for determining values for the various items of the Interim Standards contained in **PART A** of this document.

Selection of which Standard (Type A or B) to use for a particular road should be based primarily on predicted traffic in the design period being considered (Item No. 1 of the Standards).

1. Composition of Traffic (ADT)

The traffic capacity assessments of Type A and B are based on international and local experience, with particular consideration of the current predominant nature of two wheel vehicles on Rural Roads. Refer to Figure 2 for PCU conversion factors to calculate the Average Daily Traffic (ADT).

2. Design Period

For most road projects in developing countries an economic analysis period of between 10 and 20 years is normally adopted. TRL Overseas Road Note 31 (ORN 31) recommends a pavement design life of 15 years to reduce the problem of forecasting uncertain traffic trends for long periods into the future.

In view of the current economic and social circumstances of Cambodia, with uncertainties of prediction and with national constraints on resource availability, it is appropriate to consider a shorter design period for some routes.

3. Design Speed

These standards are based on recommendations of TRL Overseas Road Note 6 (ORN6) and consideration of local physical and traffic characteristics in Cambodia.

4. Assumed ESA of Commercial Vehicle

It is not always possible to carry out axle load surveys for the design of Rural Roads. Therefore the Equivalent Standard Axle (ESA) values have been suggested for pavement design in these standards. However, if a particular route may be subject to unusual loading, such as haulage of timber or extraction of construction materials, then specific axle load surveys are strongly recommended.

5. Minimum Radius of Curvature, Unpaved Surface

These standards are based on recommendations of TRL Overseas Road Note 6 (ORN6) and consideration of local physical and traffic characteristics in Cambodia.

6. Minimum Radius of Curvature, Paved Surface

These standards are based on recommendations of TRL Overseas Road Note 6 (ORN6) and consideration of local physical and traffic characteristics in Cambodia.

7. Vertical Alignment Maximum, Earth Road

Earth roads are currently the predominant type of rural roads in Cambodia. They are low cost to construct, however often suffer from lack of maintenance and deterioration in the wet season. Particular attention should be given to minimizing the problems of earth roads by not using such a surface in conditions of steep gradient, where wet weather problems are particularly severe. Steep gradients are often limited in extent and consideration should be given to providing low cost, spot improvements to these sections by the provision of more durable surfaces.

8. Vertical Alignment Maximum, Gravel Road

Gravel road surfaces deteriorate more rapidly with increasing gradient and rainfall. Recent research in South East Asia (Intech-TRL - Rural Road Gravel Assessment Programme, Vietnam, 2005) recommends that restrictions should be placed on use of gravel as a road surface as indicated in the Interim Standards.

9. Vertical Alignment Maximum, Paved Road

Although paved surfaces are more durable than earth or gravel, limitations should be placed on longitudinal gradient due to the risk of deterioration of bituminous seals under repeated heavy braking, and the capacity and safety considerations for the types of vehicles in use.

10. Horizontal Sight Distance

These standards are based on recommendations of TRL Overseas Road Note 6 (ORN6) and consideration of local physical and traffic characteristics in Cambodia.

11. Maximum Super elevation

Determined based on factors of safety, speed and comfort in consideration of international standards and local physical and traffic conditions.

12. Extra widening / Increased width at curves

Determined based on factors of safety, speed and comfort in consideration of international standards and local physical and traffic conditions.

13. Constructed Carriageway Camber / Cross fall

Unpaved (Earth and Gravel/laterite) surfaces should be maintained at a cross fall of between 3% and 7% to shed rainwater effectively and provide a safe running surface. Therefore both types of surface should be constructed to an initial compacted straight cross fall of 7% away from the centre line of the road. Super elevation will be applied to curves/bends to vary the cross fall up to this maximum percentage.

14. Shoulder plus Verge Width each side of carriageway

Shoulders and verges are effectively merged on rural roads. Their functions include the need to:-

- Provide structural lateral support to the road surface or pavement,
- Provide for a safe margin between the carriageway and earthworks side slopes,
- Enhance visibility and safety,
- Provide space to stop in an emergency,
- Allow wide vehicles to pass safely on single lane roads.

The road shoulders should be completely free of any obstructions or obstacles such as culvert headwalls, sign post poles etc. and should be a continuous roadside refuge for any vehicle to pull up in an emergency.

In mountainous areas it is sensible to reduce or eliminate shoulders and verges in appropriate circumstances, so long as adequate drainage provisions are made and vehicle passing places are provided at regular intervals.

Minimum width of roadway is set so that two trucks may pass each other safely, even if they have to use the shoulders/verge to do so.

These standards are based on a review of international practice, practicalities of construction, and consideration of local experiences, physical and traffic characteristics in Cambodia.

15. Width of Carriageway

Standard has been determined based on factors of safety, economic, financial, speed and comfort in consideration of ORN6, international standards and local physical and traffic conditions. This includes consideration of the Puok surfacing trials and experiences with other rural road projects.

16. Initial constructed thickness of Gravel/Laterite Surface

Local Experience on gravel loss rates and the SEACAP 4 Rural Road Gravel Assessment Programme (2005), have demonstrated the very high rates of gravel loss experienced in Cambodia and South East Asia. Gravel must be properly compacted and meet the required technical specifications. Even then, surface loss rates of 2-5 cm per year will be common.

A “residual thickness” of gravel is required for the surface to continue to protect the underlying weaker subgrade from failure. This requirement is typically between 5 – 10 cm. Therefore initial constructed layer thicknesses should take account of the expected rates of loss and the maintenance arrangements for re-gravelling.

Gravel/laterite is not suitable for use in many locations and the Technical Guidelines should be used to evaluate suitability.

17. Paved Road Pavement Thickness

The choice of pavement type and layer thicknesses will depend on factors such as local conditions, available materials, traffic loading etc. The Technical Guidelines

should be used for pavement design.

18. Elevation of road formation

Excess moisture in the road pavement and subgrade will seriously reduce the bearing capacity of the pavement. Flooding of these layers with prolonged soaking should be avoided. The cost of increasing earthworks to raise the subgrade and pavement sufficiently above flood level invariably provides greater benefits of longer pavement life and reduced maintenance.

19. Embankment Construction Maximum Layer Thickness

Earthworks layer thickness should depend on the materials and compaction equipment and methods used. The contract specifications will provide requirements and guidance on compaction techniques and layer thicknesses.

20. Embankment Side Slope

These standards have been developed from experience of local materials and conditions. Due to the intense rainfall experienced, turfing is the preferred approach to counter erosion on newly constructed earthworks.

21. Side Drainage Ditches

Side drains should be constructed to a form that can be easily maintained. Protection against erosion is required in most locations through turfing to rapidly consolidate the drain surfaces. Where fast flows are expected on gradients, other forms of lining may be required.

22. Right of Way

These are recommended standards to prevent undesireable development at the roadside and allow for future widening.

23. Unobstructed Clearance between backs of Culvert Headwalls at Road Surface Level

The carriageway and shoulders of the roadway should be un-obstructed by any item or component of road furniture or structures. This is particularly important for night driving, when drivers can have their vision impaired by the lights of vehicles traveling in the opposite direction.

Culverts must be constructed so that any part of the headwall rising above the level of the road embankment or surface is outside of the shoulder margins.

24. Unobstructed Carriageway Width at Single Lane Drifts and Structures with Width Restriction and Warning Signs

Because of the high cost of structures and drifts, it is sometimes not possible to justify two lane width construction on low traffic volume roads. In these circumstances a single lane structure may be justified. Adequate warning signs and safety features must be provided to provide advance information to drivers and safe

passage without risk of vehicle damage or injury to travellers. Adequate provision should be made for refuge and safety of pedestrians and other vehicle users where necessary.

25. Berm Width at Embankment Toe

This is the horizontal dimension between the toe of the embankment and the side drain. The standard dimension is recommended, however, this may have to be adjusted in consideration of local conditions, including land availability, whether there is significant animal cart traffic and whether the drain is lined.