# ANNEX 11: ROAD AND BRIDGE DESIGN AND CONSTRUCTION STANDARDS AND SPECIFICATIONS

**To the Agreement between and among the Governments of the Kingdom of Cambodia, the People's Republic of China, the Lao People's Democratic Republic, the Union of Myanmar, the Kingdom of Thailand, and the Socialist Republic of Viet Nam for the Facilitation of Cross-Border Transport of Goods and People (hereinafter referred to as "the Annex")**

The Governments of the Kingdom of Cambodia, the People's Republic of China, the Lao People's Democratic Republic, the Union of Myanmar, the Kingdom of Thailand, and the Socialist Republic of Viet Nam (hereinafter referred to as "the Contracting Parties"),

**Referring** to the Agreement between and among the Governments of the Lao People's Democratic Republic, the Kingdom of Thailand, and the Socialist Republic of Viet Nam for the Facilitation of Cross-Border Transport of Goods and People, originally signed on 26 November 1999 at Vientiane, amended at Yangon on 29 November 2001, acceded to by the Kingdom of Cambodia at Yangon on 29 November 2001, acceded to by the People's Republic of China on 3 November 2002 at Phnom Penh, and acceded to by the Union of Myanmar on 19 September 2003 at Dali City (hereinafter referred to as "the Agreement"),

**Referring** to Articles 3(b) and (n) of the Agreement to the effect that Annexes and Protocols contain technical details or time- and/or site-specific variable elements and that they form an integral part of the Agreement and are equally binding,

**Referring** to Article 36 of the Agreement, as amended, per which the Agreement may be signed and ratified or accepted and enter into force separately from the Annexes and Protocols,

**Referring** to the Ninth GMS Ministerial Conference held in Manila in January 2000, the Seventh Meeting of the Subregional Transport Forum held in Ho Chi Minh City in August 2002, and the 11th GMS Ministerial Conference held in Phnom Penh in September 2002, where the Governments agreed to a work program to finalize the Agreement and its Annexes and Protocols by 2005, and

**Referring** to Article 25 of the Agreement, calling for this Annex to provide technical details,

**HAVE AGREED AS FOLLOWS:**

## Article 1: Overview of Standards

An overview of the road design and construction standards is provided in Table 1.

**Table 1**
**Highway Standards**

| **Highway classification** | | **Primary (4 or more lanes) (control access)** | | | **Class I (4 or more lanes)** | | |
|---|---|---|---|---|---|---|---|
| **Terrain classification** | | **L** | **R** | **M** | **L** | **R** | **M** |
| Design speed (km/h) | | 100-120 | 80-100 | 60-80 | 80-110 | 60-80 | 50-70 |
| Width (m) | Right of way | (50-70) ((40-60)) | | | (50-70) ((40-60)) | | |
| | Lane | 3.75 | | 3.50-3.75 | 3.50-3.75 | | |
| | Shoulder | 1.50-3.00 | | 2.50 | 1.50-3.00 | | 1.50-2.50 |
| Min. horizontal curve radius (m) | | 390 | 230 | 120 | 220 | 120 | 80 |
| Type of pavement | | Asphalt/cement concrete | | | Asphalt/cement concrete | | |
| Max. superelevation (%) | | (7) ((6-7)) | | | (8) ((6-8)) | | |
| Max. vertical grade (%) | | 4 | 5 | 6 | 5 | 6 | 7 |
| Min. vertical clearance (m) | | 4.50 [5.00] | | | 4.50 [5.00] | | |
| Structure loading (minimum) | | HS20-44 | | | HS20-44 | | |

| **Highway classification** | | **Class II (2 lanes)** | | | **Class III (2 lanes)** | | |
|---|---|---|---|---|---|---|---|
| **Terrain classification** | | **L** | **R** | **M** | **L** | **R** | **M** |
| Design speed (km/h) | | 80-100 | 60-80 | 40-60 | 60-80 | 50-70 | 30-60 |
| Width (m) | Right of way | (40-60) ((30-40)) | | | 30-40 | | |
| | Lane | 3.50-3.75 | | | 3.00[3.25] | | |
| | Shoulder | 1.50-2.50 | | 1.50-2.00 | 1.50[2] | | 1.0-1.5[1.5] |
| Min. horizontal curve radius (m) | | 200 | 110 | 50 | 110 | 75 | 50 |
| Type of pavement | | Asphalt/cement concrete | | | Double bituminous treatment | | |
| Max. superelevation (%) | | (10) ((6)) | | | (10) ((6)) | | |
| Max. vertical grade(%) | | 6 | 7 | 8 | 6 | 7 | 8 |
| Min. vertical clearance (m) | | 4.50 | | | 4.50 | | |
| Structure loading (minimum) | | HS20-44 | | | HS20-44 | | |

**Notes:**

1. Abbreviations:

L = Level Terrain M = Mountainous Terrain R = Rolling Terrain

2. ( ) = Rural (( )) = Urban

3. [ ] = Desirable Values

4. The right-of-way width, lane width, shoulder width and maximum superelevation rate can be varied if necessary to conform with the Contracting Parties' design standards.

5. National standards for structure loads may be applied.

**Article 2: Classification**

(a) Routes and corridors designated in Protocol 1 of the Agreement shall be classified as shown in Table 2:

**Table 2**
**Classification**
*(Based on Asian Highway Standards by UNESCAP 1995)*

| Classification | Description | Pavement Type |
|---|---|---|
| Primary | Access-controlled motorway | Asphalt or cement concrete |
| Class I | 4 or more lanes highway | Asphalt or cement concrete |
| Class II | 2 lanes | Asphalt or cement concrete |
| Class III | 2 lanes (narrow) | Double bituminous treatment |

(b) "Primary" class refers to access-controlled motorways. Access-controlled motorways shall be used exclusively by automobiles. Access to motorways shall be at grade-separated interchanges only. Motorcycles, bicycles, and pedestrians shall not be allowed to enter motorways in order to ensure traffic safety and the high running speed of automobiles except when allowed by domestic legislation and regulations. At-grade intersections shall not be designed on motorways, and the carriageway shall be divided by a median strip. This class was included in the classification in view of the recent development of motorways in GMS countries.

(c) Class III can be used only when the funding for the construction and/or land for the road is limited. The type of pavement should be upgraded to asphalt concrete or cement concrete as soon as possible in the future. Since Class III is also regarded as the minimum desirable standard, upgrading of any road sections below Class III to comply with the Class III standard should be encouraged.

(d) Future traffic volume projected for 20 years after completion of road construction/improvement (called projected daily traffic volume hereinafter) should be used to determine the class of road as described below.

(e) It is recognized internationally that the presence of heavy vehicles and slow-moving vehicles greatly influences the design of a highway. Therefore, in this classification system, it is proposed to use the "Passenger Car Unit (pcu)" approach, which is widely used for design purposes in Asian countries.

(f) The traffic volume of light vehicles does not need to be taken into account if exclusive lanes for light vehicles are provided. Flow coefficients for heavy vehicles can be increased if the road is located in a mountainous area.

(g) Class of road is determined as follows using "pcu" as an index representing traffic volume:

(i) Determine "PDT" or "projected daily traffic volume (pcu/day)" using projected traffic volume by vehicle type (vehicles/day) and flow coefficients.

(ii) Determine "K value", which is the ratio of the 30th highest hourly traffic volume over one year (pcu/hour) to annual average daily traffic (pcu/day). Traffic count data on a road section, which has similar characteristics as the planned road, can be used. The K value is usually around 0.10.

(iii) Determine "D value", which is the ratio of heavy directional peak hour (30th highest) traffic volume (pcu/hour) to both directions peak hour (30th highest) traffic volume (pcu/hour). The D value usually ranges from 0.55 to 0.60, although it could reach 0.80.

(iv) Calculate "PPHT" or "planning peak hour traffic volume (pcu/hour)" using the formula PPHT = PDT x K x D. PPHT represents projected heavy directional 30th highest hourly traffic volume (pcu/hour).

(v) Divide PPHT (pcu/hour) by 1,800 (pcu/hour), which is widely recognized as the standard capacity per one lane, and round up the calculated value to determine the number of lanes in one direction. Multiplying by 2 gives the required number of lanes (both directions).

(vi) Determine the class according to the required number of lanes determined in step (v). "Primary" class can be used if the development of an access-controlled motorway is needed.

**Article 3: Terrain Classification**

The terrain classifications shown in Table 3 shall be used.

**Table 3**
**Terrain Classification**

| Terrain classification | Cross Slope |
|---|---|
| Level (L) | 0 to 9.9%. |
| Rolling (R) | 10 to 24.9% |
| Mountainous (M) | 25% or higher |

## Article 4: Design Speed

The relation between design speed, highway classification, and terrain classification is shown in Table 1 in Article 1. A design speed of 120 km/h shall be used only for Primary class (access-controlled motorways) roads that have median strips and grade-separated interchanges. Recommended design speeds for **urban areas** are as follows:

| | | |
|---|---|---|
| *Class Primary* | *80 - 100* | *km/h* |
| *Class I* | *60 - 80* | *km/h* |
| *Class II* | *50 - 60* | *km/h* |
| *Class III* | *30 - 50* | *km/h* |

## Article 5: Cross Section

(a) The dimensions, such as right-of-way width, lane width, and shoulder width, are shown in Table 1 in Article 1 for each highway classification.

(b) It is highly recommended that pedestrians, bicycles, and animal-drawn carts be separated from through traffic by provision, where practical, of frontage roads and/or sidewalks for the sections where smooth traffic is impeded by the existence of this local traffic.

## Article 6: Horizontal Alignment

(a) Horizontal alignment shall be consistent with the topography of the terrain and should provide for safe and continuous operation at a uniform design speed. Horizontal alignment must afford at least the minimum stopping sight distance for this design speed.

(b) In the design of highway curves it is necessary to establish the proper relation between design speed and curvature and also their joint relations with superelevation and side friction. Radius of curvature may be calculated from:

$$R = \frac{v^2}{127.5\,(e + f)}$$

where
- v = Design speed (km/h)
- e = Rate of roadway superelevation m/m
- f = Side friction factor
- R = Radius of curve (m)

The recommended side friction factor is shown in Table 4.

**Table 4**
**Recommended Side Friction Factor**

| **Design speed ( km/h )** | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 |
|---|---|---|---|---|---|---|---|---|---|
| **Side friction factor** | 0.16 | 0.16 | 0.15 | 0.15 | 0.14 | 0.13 | 0.13 | 0.12 | 0.11 |

(c) The minimum curve radius is the limiting value of curvature for a given design speed and is determined from the formula in (c) above using the maximum suggested superelevation rate and the related side friction factor. Minimum curve radius shall be applied only when necessary and shall be used in conjunction with transition curve, which is also recommended for longer curves; larger values by up to 100 percent should be considered as the design normal curve radius.

(d) Widening along the horizontal curves should be provided based on the design speed, the pavement width, the radius of curve, and the dimension of the standard truck.

(e) The recommended minimum horizontal curve radius in **urban areas** is as follows:

| | | |
|---|---|---|
| *Class Primary* | *230* | *m* |
| *Class I* | *120* | *m* |
| *Class II* | *75* | *m* |
| *Class III* | *50* | *m* |

**Article 7: Vertical Alignment**

(a) The vertical alignment of any highway shall be as smooth as is economically possible, that is, there shall be a balance of cutting and filling to eliminate the rolling nature of the land. In the use of the maximum vertical gradient, it shall be kept clear in the mind of the designer that, once constructed to a given vertical grade, the highway cannot be upgraded to a lesser gradient without the loss of the entire initial investment. The maximum vertical grade shown in Table 1 in Article 1 shall be used. The minimum vertical curve length shall be based on the algebraic difference in grades, the design speed, and the minimum stopping sight distance.

(b) The critical length of gradient section for the provision of a climbing lane is recommended to highway classifications Primary and Class 1, as shown in Table 5. It is desirable to provide a climbing lane to the up-gradient highways with heavy truck traffic where the length of gradient exceeds the above values.

**Table 5**
**Critical Length of Gradient Section for the Provision of a Climbing Lane**

| Terrain Classification | Primary | Class I | Remarks |
|---|---|---|---|
| Level (L) | 3% - 800 m | 3% - 900 m | National standards may also be adopted, e.g., based on volume. |
| | 4% - 500 m | 4% - 700 m | |
| Rolling (R) | 4% - 700 m | 4% - 800 m | |
| | 5% - 500 m | 5% - 600 m | |
| Mountainous (M) | 5% - 600 m | 5% - 700 m | |
| | 6% - 400 m | 7% - 400 m | |

**Article 8: Pavement**

(a) Carriageways should be paved with cement or asphalt concrete. Only in cases where the anticipated traffic volume is quite low will bituminous treatment be adopted as surfacing. It is also recommended that the shoulders be paved with cement or asphalt concrete or be surfaced with bituminous materials.

(b) Road pavement is designed taking into account (i) maximum wheel load which should be based on the standard trucks, (ii) traffic volume, (iii) design life, and (iv) qualities of materials to be used.

**Article 9: Bridges and Culverts**

Bridges and culverts should be built as permanent structures. For minor bridges shorter than 50 m, the full roadway width should be carried through including the width of shoulders. The minimum width between curbs for a major bridge longer than 50 m should be one half meter greater than the width of the pavement approaching it. A 1-m wide walkway should be provided but for long spans it can be limited to one side of the bridge only.

**Article 10: Structure Loading**

(a) Increasing heavy traffic, particularly container traffic, requires properly designed load capacity (maximum axle load). In order to prevent serious damage to road structures, and also to reduce maintenance costs, the routes and corridors designated in Protocol 1 of the Agreement, as an international road network, should have high design load capacity.

(b) The minimum design loading of HS20-44, which is the international standard corresponding to full-size trailer loading, shall therefore be used for design of structures. National standards may also be applied.

**Article 11: Vertical Clearance**

Minimum vertical clearance shall be 4.50 m, which is the requirement for safe passage of standard ISO containers. However, in cases where sufficient clearance cannot be secured because of the high cost of rebuilding existing structures such as bridges, goose-neck trailers with low vehicle bed clearance could be used. Generally the desirable vertical clearance should be 5.00 m, especially on Primary roads along routes and corridors designated in Protocol 1 of the Agreement, which will be constructed or improved.

**Article 12: Recommended Roadside Equipment**

The Contracting Parties will consider installing the following recommended roadside equipment, as required for safety and in accordance with the highway classification:

(a) **Illumination**

(i) In special areas, such as frontier posts, long tunnels and bridges, adjoining areas, and interchanges with other roads.

(ii) Also certain other sections of the road may require homogeneous lighting.

(b) **Anti-Glare Devices**

Outside illuminated sections with narrow medians, an artificial screen or hedge on the central (median) strip or shoulder strip in order to shield it respectively from the opposite carriageway or from a parallel road.

(c) **Acceleration and Deceleration Lanes**

Acceleration and deceleration lanes for access to or exit from the motor or expressway.

(d) **Emergency Stopping Strip (Stabilized Shoulder)**

On Primary and Class I highways a continuous stabilized and paved emergency stopping strip on the shoulder.

(e) **Arrester Beds**

In order to assure the safety of trucks on long steep gradients, where no other measure is possible, arrester beds built alongside the downhill lane.

(f) **Safety Fences and Barriers**

Guard rails, crash barriers, safety barriers, and fences, designed to prevent vehicles from accidentally leaving the carriageway or in order to absorb the shock.

(g) **Railway Intersections**

At different levels (bridge or tunnel) for motorways, expressways, and highways with high volume of traffic and trains.

(h) **Protection from Animal Crossing**

(i) Fences installed wherever there is a risk of animals crossing the road.

(ii) Also suitable over- or under-passes for animals.

(i) **Emergency Communication Systems**

Emergency call-points installed along the road and linked to a call-center operating around the clock, especially on Primary class highways.

(j) **Service Facilities and Rest Areas**

Rest areas combined with service facilities (parking lot, fuel and vehicle maintenance station, communication center, sanitary equipment (toilets), hotel, restaurant) integrated in the road construction.

**Article 13: Amendment**

Any Contracting Party may propose amendments to the Annex via the Joint Committee. Such amendments shall be subject to the unanimous consent of the Contracting Parties.

**Article 14: Ratification or Acceptance**

The Annex is subject to ratification or acceptance of the Governments of the Contracting Parties. The same applies to an amendment to the Annex, if any.

**Article 15: Entry into Force**

The Annex will enter into force on the day that at least two Contracting Parties have ratified or accepted it, and will become effective only among the Contracting Parties that have ratified or accepted it. The same applies to an amendment to the Annex, if any.

**Article 16: Conforming National Law**

Where necessary, the Contracting Parties undertake to conform their relevant national legislation with the contents of the Annex.

**Article 17: Reservations**

No reservation to the Annex shall be permitted.

**Article 18: Suspension of the Annex**

Each Contracting Party may temporarily suspend wholly or partly the application of the Annex with immediate effect in the case of emergencies affecting its national safety. The Contracting Party will inform the other Contracting Parties as soon as possible of such suspension, which will end as soon as the situation returns to normal.

**Article 19: Relationship with the Agreement**

As a measure to implement the principles laid down in the Agreement, the Annex cannot depart from or be contrary to these principles. In case of incompatibility between the Annex and the Agreement, the latter shall prevail. In case of incompatibility between the Annex and another annex or protocol, such incompatibility shall be interpreted in light of the Agreement.

**Article 20: Dispute Settlement**

Any dispute between or among two or more Contracting Parties on the interpretation or application of the Annex shall be settled directly or by amicable negotiation in the Joint Committee.

**Article 21: Denunciation**

Once entered into force, the Annex cannot be denounced separately from the Agreement.

In witness whereof, the undersigned, being duly authorized, have signed this Annex.

Done at Phnom Penh on 30 April 2004 in six originals in the English language.

Signed:

For the Royal Government of Cambodia

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**His Excellency Tram Iv Tek**
Secretary of State, Ministry of Public Works and Transport

For the Government of the People's Republic of China

.....

**His Excellency Hu Xijie**
Vice Minister of Communications

For the Government of the Lao People's Democratic Republic

.....

**His Excellency Sommad Pholsena**
Vice Minister of Communication, Transport, Post and Construction

For the Government of the Union of Myanmar

.....

**His Excellency Thura Thaung Lwin**
Deputy Minister of Rail Transportation

For the Government of the Kingdom of Thailand

.....

**His Excellency Nikorn Chamnong**
Deputy Minister of Transport

For the Government of the Socialist Republic of Viet Nam

.....

**His Excellency Pham The Minh**
Vice Minister of Transport