NEPAL ROAD STANDARDS (2027)

(FIRST REVISION-2045)

His Majesty's Government
Ministry of Works and Transport
Department of Roads

2045

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PREFACE

Consistency in road design and construction necessitates a need for certain road standards. With this objective, Nepal Road Standards (2027) was introduced in B. S. 2027. The subject matters of Highway and Traffic Engineering are well established in developed countries. The research findings of those countries may not be applicable to Nepal due to specific geographical feature and traffic composition differing from those countries. In applying research findings of developed nations to our country great care should be exercised to make it suitable to the conditions of Nepal. Chapter 3 of Nepal Road Standards (2027) under-estimates the capacity of the roads. Alterations to this chapter is therefore based on studies conducted with almost identical geographical features and traffic compositions. Certain additions, alterations and ommissions to the current standards are indicated in this revision. Nepal Road Standards (2027) (First Revision – 2045) as with any other standards shall require periodical review and updating incorporating the latest research findings.

Trunk Roads and National Highways shall be used synonymously and Panchayat Roads shall be conjunctional to District Roads.

In the absence of any other standard not covered by this standard on highways and traffic the standards set by ESCAP shall be followed.

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1. Introduction:

1. Nepal Road Standards (2027), in short called 'NRS' shall apply to all roads being constructed within the Kingdom of Nepal. In case of urban roads, individual requirements will also be considered.

1.1 These standards may be relaxed by His Majesty's Government to meet special circumstances.

1.2 The initial traffic on some roads shall normally be comparatively light but their development function shall result in a steep rise in traffic volume over the first 10-15 years. The roads provided initially must, therefore be capable of progressive improvement to the higher standards which the higher traffic volumes will demand.

1.3 These considerations lead to the conclusion that the roads should be designed for stage construction and that the standards should be framed on the same principle, i. e. flexible standards, suitable for modification to higher standards but incorporating the lower standards.

1.4 At any stage in the life of the road it must be capable of providing passage to the traffic wishing to use it at the lowest overall cost per kilometre. The overall annual cost shall comprise of:-

(a) The amortised cost of the original investment

in the road and its improvement to the stage under consideration per vehicle-kilometre:

(b) The annual cost of maintaining the road per vehicle-kilometre;

(c) *The cost of providing the operating vehicles on the road per vehicle-kilometre.

2. Traffic :

2.1 It is not feasible to improve the standard of a road by very small increments and it is normal practice to design and construct new roads and improvement works to withstand the estimated traffic at some future date. In Nepal this forward period shall be 10 years, i. e. roads shall be designed with a capacity sufficient to cater for the estimated traffic volume 10 years after the date of completion of the works. (This agrees with ECAFE recommendations for the Asian Highway).

2.2 Different types of traffic take up differing amounts of road space and impose differing loads on the road structure. It is necessary, therefore, to adopt a standard traffic unit to which other types of traffic may be related. This standard is the 'Transport Unit (T. U.)' which is that of a normal car, (passenger car), light van or pick-up. This unit is also sometimes called "Passenger Car Unit". Other types of traffic are related to this unit on the basis of the amount of road space they occupy, and the loads they impose on the road structure relative to those of a normal car travelling at the running speed of the road.

2.3 The traffic co-efficients to be adopted are as follows :-

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*The effect of raising standard is to raise (a) but lower (b). If standards are not raised (a) shall decrease but there shall be a heavy resultant increase in (c).

	Transport Units 'T. U.'
Cars, light vans and pick-ups	1.0
Light trucks upto 2½ tons gross	1.5
Trucks 10 "	3.0
Trucks 15 "	4.0
Trucks 25 "	5.0
Trucks 40 "	6.0
Buses 40 passengers	3.0
Buses over 40 "	4.0
Bi-cycles	0.5
Rickshaws and goods tri-cycles	1.0
Hand-carts	2.0
Bullock-carts	8.0
Mule-carts or horse-drawn-carts	6.0
Pack animals	2.0
Pedestrains where no separate footpath is provided	0.25
Porters where no separate footpath is provided	0.50

3. Design Capacity :

Design capacity (Design service volume) governs the number of lanes required for the design volume of traffic. Table 3.1 gives the design capacity for the level of service 'B' (which is about 45 percent of capacity) under mixed traffic condition.

Table 3.1 Design Capacity of Roads

S. No.	Category	Design Capacity in veh/hr in both directions	Design Capacity in both directions veh/day	TU/day
1.	Single-lane black-topped :			
	a) Plain terrain	100	1000	2000
	b) Rolling terrain	90	900	1800

	c) Mountainous terrain	90	900	1800
	d) Steep terrain	70	700	1400
2.	Single-lane water-bound macadam road :			
	a) Plain terrain	90	900	1800
	b) Rolling terrain	80	800	1600
	c) Mountainous terrain	75	750	1500
	d) Steep terrain	40	400	800
3.	Intermediate lane black-topped road* :			
	a) Plain terrain	300	3000	6000
	b) Rolling terrain	285	2850	5700
	c) Mountainous terrain	260	2600	5200
	d) Steep terrain	225	2250	4500
4.	Two-lane black-topped road :			
	a) Plain terrain	750	7500	15000
	b) Rolling terrain	500	5000	10000
	c) Mountainous terrain	350	3500	7000
	d) Steep terrain	250	2500	5000
5.	Four-lane divided carri-ageway road :			
	a) Plain terrain	5000	50000	100,000
	b) Rolling terrain	4000	40000	80,000

3.1 Road Classification :

Roads in Nepal shall be classified into four categories :

1. National Highways (abbreviated as NH)
2. Feeder Roads (" as FR)
3. District Roads/ Panchayat Roads (" as DR/PR)
4. City Roads/Streets (" as CR)

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* The carriageway width for intermediate lane shall vary from 5.0 to 6.0 m.

3.1.1 National Highways :

National Highways are main highways connecting East to West and North to South of the Nation. The Roads connecting National Highways to Regional Head-quarters shall also be classified as National Highways. These serve directly the greater portion of the longer distance travel, provide consistently higher level of service in terms of travel speeds, and bear the inter-community mobility (regional interest). These roads shall be the main arterial routes passing through the length and breadth of the country as a whole.

3.1.2 Feeder Roads :

Feeder roads are important roads of localised nature. These serve the community's wide interest and connect District Head-quarters and/or Zonal Head-quarters to National Highways.

3.1.3 District Roads/Panchayat Roads :

This class of roads consisting of all roads not defined as National Highways or Feeder and City Roads, serves primarily by providing access to abutting land carrying little or no through movement. These roads should give access to one or more villages to the nearest market or to higher types of roads. Moderate travel speeds are typical on such roads.

3.1.4 City Roads and Streets :

These include roads within the urban limits except for the above classes, passing through the city. These provide access to abutting residential, business or industrial properties.

3.2 Carriageway width :

The standard carriageway width shall be as per Table 3.2. The lanes required, however, shall be governed by capacity of particular location.

Table 3.2 Carriageway width

Width of carriageway (metres)				
Single Lane	Intermediate Lane*	Two lanes without raised kerb	Two lanes with raised kerb	Multilane carriageways, width per lane
3.75	5.5	7.0	7.5	3.5

Notes :

1. On District/Panchayat Roads, the carriageway width of single lane may be restricted to 3.0 m normally. Width greater than 3.0 m may, however, be adopted judiciously depending on the type and intensity of traffic, cost and related factors.

2. Except on important NH, an intermediate carriageway width of 5.5 metres may also be adopted instead of regular two lanes if the same is considered advantageous.

3.3 Terrain Classification :

Terrain shall be classified according to the per cent cross-slope of the country and shall be based on terrain classification Table 3.3.

Table 3.3 Terrain Classification

Class	Terrain type	Percent cross-slope
1	Plain	0 to 10
2	Rolling	>10 to 25
3	Hilly/Mountainous	>25 to 60
4	Steep	>60

* The carriageway width for intermediate lane shall vary from 5.0 to 6.0 metres.

4. Design Standards:

4.1 Speed

The following design speeds shall be used.

	Terrain	Design Speed (Kmph)
Trunk Roads	Level	120
	Rolling	80
	Mountainous	50
	Steep	40
Feeder Roads	Level	100
	Rolling	60
	Mountainous	40
	Steep	30
District Roads	Level	60
	Rolling	40
	Mountainous	30
	Steep	25

4.2 Gradient:

Acceptable gradients are related to truck operating characteristics and the design speed of the roads themselves. The gradients proposed are calculated as acceptable for trucks of gross weight of 18 tons with a weight-power ratio of 400 lb/hp and a speed reduction of 25 Kmph below average truck running speed. These criteria have been adopted after the following considerations:-

i. The gross weight of the average trucks operating now is of the order of 8 tons. This may be expected to increase as road design improves and enables heavier vehicles to operate. A figure of 18 tons has been selected as the largest vehicle for which it is practical to design roads in rough terrain of Nepal.

ii. The weight-power ratio of existing trucks is generally below 400 lbs/hp but this may be expected to increase as the design criteria of the present truck manufacture improve and approach international levels.

4.3 The gradient standards shall be as follows: The gradients shall be eased by 0.5% for every 500 metres above mean sea level.

	Mountainous/Steep	Rolling	Level
Trunk Roads:			
Maximum average gradient	5%	4%	3%
Maximum gradient	8%	6%	5%
Maximum length of grade in excess of average grade	150 m	210 m	250 m
Minimum length of recovery at grade specified	210 m @3%	300 m @2%	600 m @2%
Feeder Roads:			
Maximum average gradient	7%	6%	5%
Maximum gradient	10%	8%	7%
Maximum length of grade in excess of average grade	120 m	180 m	210 m
Maximum length of recovery at grade specified	150 m @3%	150 m @3%	300 m @2%
District Roads:			
Maximum average gradient	7%	6%	5%
Maximum gradient	12%	10%	7%
Maximum length of grade in excess of average grade	100 m	120 m	100 m
Maximum length of recovery at grade specified	150 m @4%	150 m @3%	150 m @3%

Note:

Minimum gradient on hill roads shall be 1% to facilitate better drainage.

5. Horizontal Curvature:

5.1 The following criteria for curve design shall be adopted:
Side friction factor (f) from 0.17 at 30 Kmph to 0.12 at 120 Kmph (uniformly distributing for other speeds).
Maximum super-elevation rate (e)

(a) Where snow and ice conditions ex ist for a significant portion of the year, e = 0.80.

(b) Where snow and ice conditions are occcasional, e = 0.18.

(c) Where snow and ice conditions are extremely rare or non-existent, e = 0.12

For calculation of e, following formula will be adopted:-

$$e + f = \frac{V^2}{126.5R}$$

where V = Design speed, Kmph,
R = Radius of curvature in metres.

Full super-elevation will be achieved in the length of the transition curve revolving the pavement around the centre line of the pavement. Following formula shall be used to relate the design speed and the minimum radius of curvature :-

$$R = \frac{0.0079\ V_2}{(e + f)} \quad \text{or} \quad V = \sqrt{126.5\ R\ (e + f)}$$

where R = Radius of curve, metres
V = Design speed, Kmph
e = Super-elevation in metres/metre
f = Co-efficient of friction.

Minimum straight between two successive curves should be 100 m with exceptions in mountainous terrain.

Rate of gain of radial acceleration in transition curves is 1 metre/sec/sec maximum.

Spiral transition curves shall be provided on all curves shorter than 200 metres radius.

5.2 Widening on Curves: The criteria on which the additional width have been calculated are for two-way traffic, normal 2 - axle trucks passing with standard clearance and semi-trailer trucks passing with standard clearance and semi-trailer trucks passing with reduced clearance.

Radius of inner edge of carriageway (m)		No. of lanes	Widening on curve in m.	
			Hard verges	Hard verges
From	To		>1.5 m	>1.5 m
15	30	2	3.00	2.50
30	60	2	2.00	1.50
60	120	2	1.5	1.00
120	220	2	1.0	0.70
220	360	2	0.50	—
15	30	1	3.50	3.00
30	60	1	3.00	2.50
60	120	1	2.50	2.00
120	220	1	1.50	1.20
220	360	1	1.00	—

6. Sight Distance:

Minimum stopping sight distances shall be as follows :-

Design speed Kmph	Minimum stopping sight distance metres
120	200
100	145
80	110
60	85
50	65
40	45
30	30
20	20

Based on total perception and brake reaction time of 2.5 seconds and co-efficient of friction from 0.42 at 20 Kmph to 0.28 at 120 Kmph, increase in stopping sight distance on down-grades shall be as follows :

Speed (Kmph)	Increase per 1% grade (m)
120	6.0
100	4.5
80	3.0
60	1.5

No decrease in stopping sight distances shall be permitted on up-grades except on divided carriageway.

7. Vertical Curves:

All vertical curves shall be simple parabolas.

7.1 Summit Curve:

The criterion to be adopted is that the minimum sight distance shall be equal to the stopping sight distance laid down in Para 6. The length of the cur ves necessary will be calcula ted as follows :

L = Length of vertical curve in metres.
S = Sight distance in metres
A = Algebraic difference in approach grades percent,

Height of eye = 1.0 metre
Height of lowest object visible = 0.10 metres

When S is less than L, $L = \frac{AS^2}{200}$

When S is greater than L, $L = 2S - \frac{200}{A}$

It is emphasized that these are minimum lengths and that greater sight distance upto the passing sight distance

should be provided where this is economically and technically feasible (refer to Annexure I).

7.2 Valley Curves :

The criteria to be adopted are that the headlight sight distance shall be equal to the stopping sight distance given on Para 6 and that the centripetal acceleration shall be limited to 0.3 m/sec/sec. The ruling factor is normally the sight distances except for small values of algebraic grade difference and the length of the curves will be calculated as

$$\text{When } S < L, = \frac{AS^2}{500 + 3.5\,S}$$

$$\text{When } S > L, = 2S - \frac{500 + 3.5\,S}{A}$$

Where the centripetal acceleration rules,

V = Speed in Kmph

$$L = \frac{AV_2}{395}$$ (refer to Annexure II)

7.3 Combination of Vertical and Horizontal Alignment:

When vertical and horizontal curves occur in combination or in close proximity to each other, it is recommended that the vertical curves shall be either wholly within or wholly outside the horizontal curve. Care should be taken particularly to avoid sharp horizontal curves near the top of pronounced vertical curves.

8. Shoulder Width:

Following minimum shoulder width shall be provided:

Type of carriageway	Total shoulder width in metres (Both sides included)		
Two and four lanes (Black-topped)	4.00	to	6.00
Single lane (surface-dressed)	4.00	to	5.00
Single lane (gravelled surface)	3.00	to	5.00

Notes:

1. Shoulder width does NOT include widths made up of side cut spoil.
2. Lateral slopes on shoulders shall be 5% for gravel and 8% for turf.

9. Right of Way :

The minimum right of way shall be as follows :

		Between Building Lines
Trunk Roads	50 m (25m on either side of the road centre line)	62 metres
Feeder Roads	30 m (15m " ")	42 metres
District Roads	20 m (10m " ")	32 metres

Notes: In case of special circumstances, greater right of way shall be required on technical reasons. In case of urban and sub-urban roads, the right of way shall be as per the Annexure III (50m for 4-lane roads and 30 metres for 2-lane roads). This may not be strictly applicable in down-town areas where roads have already been constructed.

10. Structures:

10.1 Classification of structures shall be as follows:

i. Culverts ... Upto 6 metres length

ii. Minor Bridges ... More than 6 metres and upto 20 metres length

iii. Medium Bridges ... Above 20 metres length, span lengths less than 20 metres.

iv. Major Bridges ... Bridges with span lengths greater than 20 metres.

10.2 Vertical Clearance :

Minimum vertical clearance for through structures shall be 4.75 metres. Overhead wires, poles etc. shall be at least 7.0 metres above the road surface.

10.3 Lateral Clearance:

For culverts, the full roadway width shall be carried through including the width of the shoulders.

For minor and medium bridges, minimum width between kerbs shall be one metre greater than the approaching pavement width. For major bridges, minimum width between kerbs shall be one half metre greater than the approaching pavement width. The width between railings or trusses shall be increased beyond the kerbs by the least one half metre on each side. On all trunk roads and other roads requiring a two-lane carriageway, the bridge shall be designed for a two-lane carriageway with necessary widenings as above.

10.4 Sidewalks:

Sidewalks should be provided, wherever found necessary, for at least one metre width on both sides on minor and medium bridges, but for major bridge can be limited to one side of the structure only. Sidewalks must be provided on all major bridges, if no other way is available for pedestrains to cross the river in the vicinity.

In urban areas, the sidewalk should be provided as per the number of pedestrians estimated for future. Usually a clear 60 cm width should be provided for a pedestrain density of 30 pedestrains/minute, subject to a minimum sidewalk width of 2.5 metres on each side of the carriageway.

10.5 The following standards of loading shall be adopted provisionally for design of structures:-

Major Bridges	... HS 20-44 or IRC Class AA or any other equivalent loading.
Medium & Minor Bridges and Culverts	... HS 15-44 or IRC Class A or any other equivalent loading.
Temporary Structures	... HS 15-44 or IRC Class B or any other equivalent loading.

11. Signs:

11.1 Distance signs: The standard designs for kilometre and 5 kilometre posts issued separately by the Department of Roads shall be followed on all roads.

11.2 Traffic signs: The standard designs for traffic signs issued separately by the Department of Roads shall be followed on all roads.

12. General:

12.1 Drainage: Provisions for road-side drains and cross-drains should be made as necessary.

12.2 Parapets and guard rails: In hilly and mountainous roads, parapets and guard rails should be provided as per standards to be issued by the Department of Roads.

12.3 Tree-plantation: In rural areas, trees shall be planted on either side of the roads. In case of urban roads, trees or hedges shall be planted as and where possible.

13. Camber:

The choice or type of the road surface shall govern the camber/cross-slope on the carriageway. The carriageway cross-slope shall be as given in Table 13.1

Table 13.1 Carriageway Camber/Cross-slope

Type of surface	Cross-slope (percent)
Earthen	5.0
Gravel	4.0
Bitumen (Rural area)	3.0
Bitumen (Urban area)	2.5

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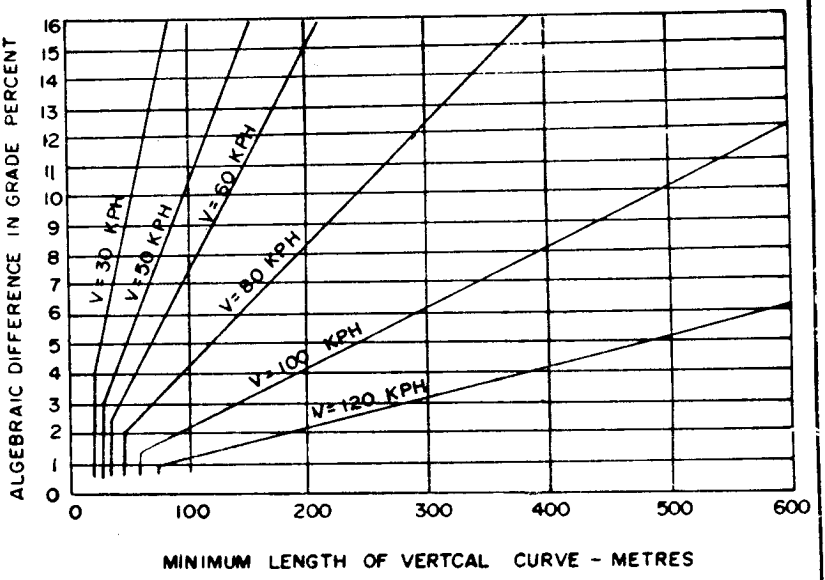
HIS MAJESTY'S GOVERNMENT
NEPAL

ANNEXURE—1

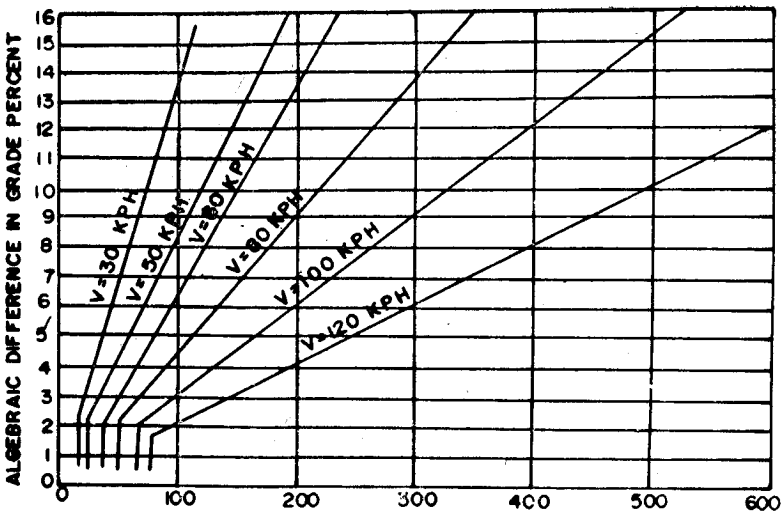
DESIGN CONTROLS FOR CREST VERTICAL CURVES BASED ON STOPPING SIGHT DISTANCE



SOURCE AASHO "A POLICY ON GEOMETRIC DESIGN OF RURAL HIGHWAYS"

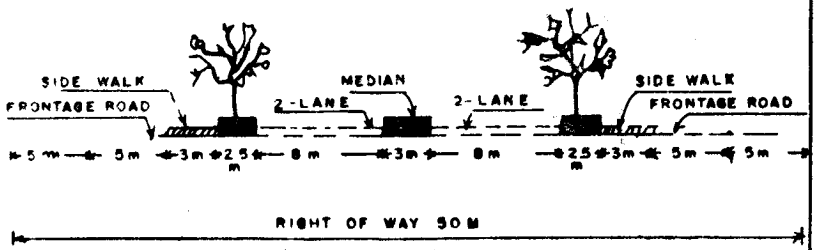
ANNEXURE—II

DESIGN CONTROLS FOR CREST VERTICAL CURVES BASED ON HEADLIGHT SIGHT DISTANCE

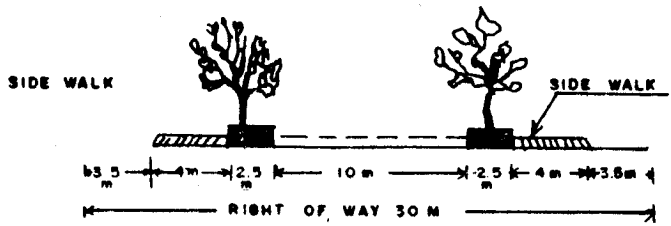


SOURCE: AASHO "A POLICY ON GEOMETRIC DESIGN OF RURAL HIGHWAYS"

ANNEXURE—III



4-LANE CITY ROAD



2-LANE CITY ROAD

Note All Buildings Should be Constructed 6 metres away from either end of the Right of way

Errata

Page	Line	Incorrect	Correct
9	24	V_2	V^2
10	11 (4 th Col.)	>1.5 m	<1.5 m
12	9	as	as follows:-
12	18	V_2	V^2