GUIDELINES FOR PLANNING AND DESIGN FOR ROADS & HIGHWAY PROJECTS FUNDED BY KIIFB

Version 1.0

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1. TYPES OF ROADS FUNDED BY KIIFB

KIIFB shall undertake the funding of two main types of road/highway projects viz., new formation and upgradation of road/highway projects which include improvement/strengthening and/or widening works.

Among the afore mentioned types of road/highway projects, the funding shall be restricted to the following categories of road/highway projects

- State Highways
- Bypass (to NH / SH / MDRs) / Ring road Projects
- Hill Highway
- Coastal Highway
- Other KIIFB Roads
- City Roads (Arterial Roads)

2. STAGES IN PROJECT PREPARATION

The stages involved in the preparation and sanction of road projects are:

a) Pre-feasibility study

The pre-feasibility study is necessary to enable the funding agency to appreciate the features of the project. This is to be done based on reconnaissance survey by collecting information based on the present status of the road and the anticipated traffic after development/improvement

b) Feasibility study /Preliminary project report preparation

The feasibility study is intended to establish whether the proposal is acceptable in terms of soundness of engineering design and expected economic benefits from the project for the investment involved.

c) Detailed engineering and plan of construction

Detailed engineering covers detailed alignment surveys, soil and materials surveys, pavement design studies, drainage studies, environmental management plan based on environmental impact assessment studies (if required), detailed drawings, estimates and implementation schedules and documents.

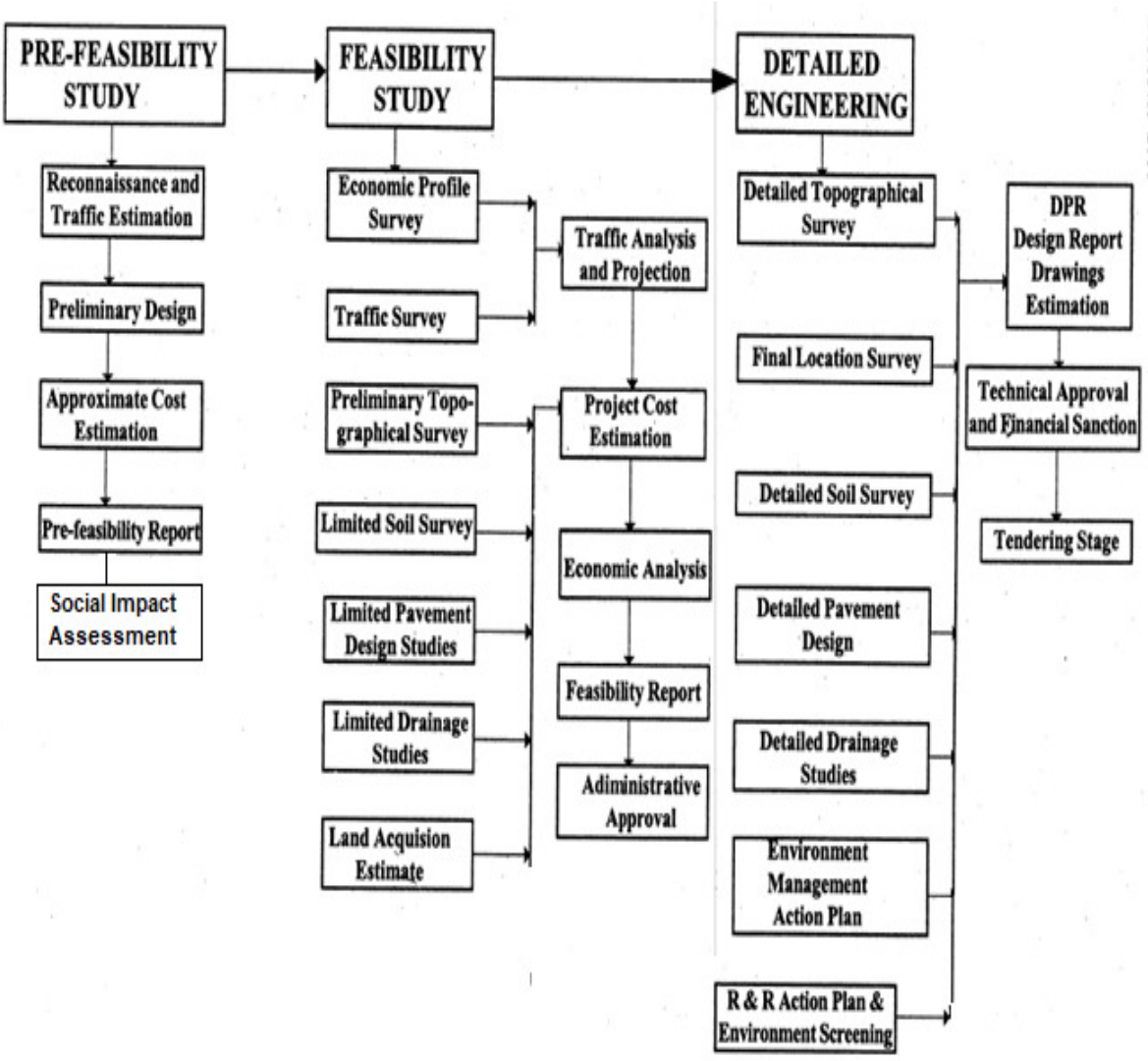


Figure: 1. Steps involved in Road project preparation

3. REQUIREMENTS FOR DEMAND ANALYSIS STUDY

The codes, standards and technical specifications applicable for the design of project components are

- Indian Roads Congress (IRC) standards and specifications(Latest).
- Specifications for Road and Bridge Works, Ministry of Road Transport & Highways herein after referred to as MoRTH Specifications Fifth Revision, 2013
- Any other standards referred to in the manual and any supplement issued with the bid document.
- The latest version of the codes, standards, specifications, etc. notified/published at least 60 days before the last date of bid submission shall be considered applicable.

- In the absence of any specific provision on any issue in the aforesaid codes or specifications read in conjunction with the specifications and standards contained in this Guidelines, the following standards shall apply in the order of priority:

  (i) Bureau of Indian Standards (BIS).

  (ii) British Standards, Australian Standard, American Association of State Highway and Transportation Officials (AASHTO) Standards and American Society for Testing and Materials (ASTM) Standards.

  (iii) Any other specifications/standards proposed by the concessionaire/contractor and concurred by the Technical Sanction Authority and KIIFB.

  (vi) The DPR should be prepared strictly as per IRC: SP:19-2001

Table: 1. List of study reports that are required to be submitted along with DPRs

Type of reports	New formation	Improvement works
Classified traffic volume Count	-	Yes
Traffic survey for Junction designing	-	Yes
Traffic survey for RoBs/Subways	-	Yes
Origin Destination Survey	Yes	Desirable
Speed and Delay studies	Desirable	Yes
Axle load survey	Desirable	Desirable
Accident Records	-	Desirable
Hydrological studies	Desirable	Desirable
Pavement condition survey	-	Yes
Pavement evaluation	-	Yes
Soil Investigation	Yes	Yes
Pavement design	Yes	Desirable
Strengthening/Rehabilitation Design	-	Yes

a) Traffic volume count to be conducted for a minimum of three consecutive days that may include working day and market day. Classified traffic volume count is carried out as per IRC: SP:19-2001 and the design traffic estimated as per Clause 4.6 of IRC:37-2012 or as per IRC: SP:72-2015, depending on the volume of traffic.

b) O-D survey, speed & delay studies shall be conducted in improvement works where extensive improvements are being undertaken (for example: bypass/ring road, etc). The survey shall conform to IRC: 102.

c) Traffic survey for the design of road junction/at-grade intersections shall conform to IRC: SP-41.

d) One-day axle load survey should be conducted, for road improvement projects, as per IRC:37-2012 / IRC: SP:19. For all roads that are expected to carry design traffic more than 5 msa, axle load survey shall mandatorily be conducted. For low volume roads, indicative VDF values as per IRC:37-2012 may be considered.

e) Traffic growth rate for the traffic projection to be followed as per IRC: 108.

f) In case of low volume roads, the relevant IRC viz., IRC: SP:72-2015 may be referred for the design of the pavement thickness.

4. REQUIREMENTS FOR SURVEY AND INVESTIGATIONS

4.1Reconnaissance survey

Reconnaissance survey is done to be examine the general characteristics of the area for determining the most feasible route or routes for furthermore detailed investigations. Reconnaissance survey of the roads are to be conducted for the general assessment of the existing situation and level of improvement needed.

Table:2. Types of survey and investigation

Types of survey and investigation	New formation	Improvement/Strengthening works
Road inventory	-	Mandatory
Pavement Condition Survey	-	Mandatory
Pavement Evaluation Survey	-	Mandatory
Soil investigation	Mandatory	Mandatory
	Detailed investigation of landslides may be done compulsorily in Hill highways. Reference may be made to IRC SP:15	
Soil tests including Atterberg limits, wet sieve analysis, max dry density and OMC tests, California Bearing Ratio (CBR) test (soaked/ un-soaked or both) of the existing soil subgrade	Mandatory	Mandatory when widening or full depth reinstatement is proposed

a) Topographic surveys are conducted preferably using LIDAR and the data used to plot the LS and CS. The finished road level and the subgrade level should be fixed as per IRC:34-2011.

b) The structural and functional condition of the pavement along with the details of the distresses should be presented in a tabular form with chainages. Photos should be provided.

c) Pavement Condition Surveys refer to activities performed to give an indication of the serviceability and physical conditions of the pavements.

d) Pavement evaluation survey conducted for Structural and Functional Evaluation of existing road.

e) The properties of soil at subgrade level are required for road construction works. The common soil test for road construction includes classification of soil, particle size distribution, moisture content determination, specific gravity, liquid limit and plastic limit tests.

f) The Subgrade soil is to be tested for its properties @ 1 trial pit/km and as per IRC:37-2012, if the length of the road is more than 10km. For shorter roads, a minimum of 2 trial pit/km shall be staggered and taken. All basic tests viz., Atterberg's limits, Proctor density (IS:2720-Part-8), OMC, Soaked CBR at max dry density and OMC, free Swell Index along with Wet sieve analysis results shall be conducted and form part of the DPR. Where ever required, effective CBR should be determined as per IRC:37-2012 Clause 5.2.

5.ROAD INVENTORY

Road inventory is conducted for collecting data by directly measuring the conditions of road.

Steps shall be followed for road inventory.

a) Categorise the road based on traffic.

b) Photographs of the road shall be taken for showing existing road conditions as well as specific landmarks; during site investigations using visual inspection or Drone- based/LIDAR based surveys

c) Existing Carriageway (ECW) and Right of way (RoW) of project corridors.

d) Visual pavement condition survey Recommendations as per IRC:81

Table: 3. Criteria for Classification of Pavement Sections

Classification of road	Pavement condition
Good	No cracking, rutting less than 10mm
Fair	No cracking or cracking confined to single crack in the wheel track with rutting between 10mm and 20mm
Poor	Extensive cracking and/or rutting greater than 20 mm. Sections with cracking exceeding

e) Terrain classification as per IRC:73 shall be followed:

Table: 4. Terrain Classification

Terrain classification	**Cross slope (%)**
Plain	0-10
Rolling	10-25
Mountainous	25-60
Steep	Greater than 60

f) Major/minor junctions passing through and byroads with all physical details.

g) Existing Cross drain and drainage details, checking of land availability at curves for extra widening.

h) Existing retaining structure details.

i) Suggestions, location identification for bus bay improvement/shifting

j) Identification of locations for overtaking zone.

k) Off-street parking spaces for trucks, taxis and auto rickshaws.

l) Bridge inventory carried out with the recommendation of IRC: SP-52

m) Drainage and cross drainage inventory shall be conducted to collect present conditions of the structure with reference of Tables 5 & 6.

Table:5. Culvert Inventory Details

CULVERT						
Sl. No	**Chainage**	**Type**	**Dimension**	**Direction of flow**	**Discharge conditions**	**Remarks**

Table6. Drainage inventory details

DRAINAGE						
Rt/Lt	**Chainage**	**Type**	**Dimension**	**Condition**	**Discharge point**	**Remarks**

6. GEOMETRIC DESIGN AND ALIGNMENT PLANNING

6.1 Right of Way guidelines

The following guidelines for Right of Way (RoW) proposed shall be adopted as a minimum considering the nature of the roads funded by KIIFB, climatic conditions, the limited land availability and nature of traffic in Kerala.

Table: 7. Right of Way Guideline

Road Classification	Parameters							
	Carriage-way (m)	Shoulder (Both sides) – Paved / Interlocks (m)	Drain cum Footpath / Utility (m)	Cycle track (m)	Avenue Plantation (m)	Median (m)	Right of Way (m)	Annexure No.
State Highway	7	3(2x1.5)	3.6(2x1.8)	0	0	0	13.6	3
Hill Highway	7	3 (2x1.5)	3.6(2x1.8)	0	0	0	13.6	3
Coastal Highway	7	3(2x1.5)	3.6(2x1.8)	2@	2$	0	15.6/17.6	4, 6
Junction / Bus Bays	10	3(2x1.5)	3.6(2x1.8)	0	0	0	16.6	5
Bypass/ Ring road (Two Lane)	7	3(2x1.5)	3.6(2x1.8)	0	(2x2)$	0	13.6/17.6	3, 6
Bypass/ Ring road (Four Lane)	2 x 7	3 (2x1.5) +0.5 (2x0.25)	4(2x2)	0	(2x2)$	1.5	23 / 27	7
City Roads (12m Arterial)	5.5	0.5 (2x0.25)	3.6(2x1.8)	0	2x1.75$	0	9.6/13.1	
City Roads (20m Arterial)	2 x 5.5	0.5 (2x0.25)	2 x 2.5	0	2x1.75$	0.5	17/20.5	
City Roads (24m Arterial)	2 x 5.5	0.5 (2x0.25)	2 x 2.5	2 x 2	2x1.75$	0.5	22/24.5	8
Other KIIFB Road (<5000) PCU	5.5	1.5 (0.75+0.75)	3(2x1.5)	0	0	0	10	1
Other KIIFB Road (5000-18000) PCU	7	3(2x1.5)	3.6(2x1.8)	2	(2x1)$	0	13.6/17.6	3, 6

Other KIIFB Road (>18000) PCU	2 x 7	3(2x1.5) +0.5(2x0. 25)	4(2x2)	0	0	1.5	23	7

a) At land restricted or low volume roads, shoulder width may be restricted to 2 m (1m +1m) on either side.

b) At land constraints prevail, a limiting value of 1.5 m wide walkway can be adopted

c) * Footpaths are mandatory at thickly populated locations and towns, limits where educational institutions, hospitals, Government offices and other public amenities are located.

d) Concrete / Paver block shoulders can be provided in such cases where the required camber and drain condition are available.

e) $ Avenue plantation to be provided based on land availability

f) @ Cycle track of minimum 2m width (2.5m preferred) may be provided at select stretches

g) Typical cross section for different types of roads included in Annexure

h) Guidelines are given for minimum requirement of Right of Way and features to be provided. The required RoW may be adopted based on the terrain of land wherever side slopes, retaining wall etc need to be provided. The cross-sectional parameters shall be retained as per the minimum specifications provided in the table above.

i) Based on the importance or roads and specific nature of any particular roads, case by case variations may be adopted and shall be pre-approved by KIIFB during concept design stage.

6.2 Design Speed guideline

Table: 8. Minimum Design Speed requirements for different classification of roads.

Sl No	**Nature / Classification**	**Design Speed (km/h)**								
		Plain		**Rolling**		**Mountainous**		**Steep**		**Corresponding category in IRC**
		Ruling	Min.	Ruling	Min.	Ruling	Min.	Ruling	Min.	
1	Coastal Highway	65	50	50	40	30	25	25	20	ODR in Non-Urban Highways
2	Hill Highway	80	65	65	50	40	30	30	20	MDR / MDR in Hill Roads
3	State Highways / By Pass / Ring roads (NH & SH)	100	80	80	65	50	40	40	30	State Highway
4	Other KIIFB Roads (ODR)	65	50	50	40	30	25	25	20	ODR in Non-Urban Highways
5	Other KIIFB Roads (MDR)	80	65	65	50	40	30	30	20	MDR in Non-Urban Highways

a) In general, the ruling design speed shall be adopted for the various geometric design features of the road.
b) The minimum design speed shall be adopted only where site conditions are restrictive and adequate land width is not available.
c) Mandatory signs for speed breakers shall be provided wherever minimum design speed is adopted.

6.3 Horizontal Alignment

While designing the horizontal alignment, the following general principles shall be kept in view:

a) Alignment shall aesthetically merge and blend with the surrounding topography.
b) For new roads, the curves shall be designed to have a largest practically possible radius, but in no case less than the ruling minimum radius corresponding to ruling design speed.
c) The curves shall be sufficiently long, and they should have suitable transitions to provide riding safety and pleasing appearance.
d) Long tangent sections exceeding 3km in length shall be avoided as far as possible.
e) Reverse curves shall be avoided as far as possible. Where unavoidable, sufficient length between the two curves shall be provided for introduction of requisite transition curves.
f) Curves in the same direction, separated by short tangents known as broken back curves, shall be avoided as far as possible.
g) Hairpin bends on hilly terrain shall be avoided as far as possible. They should be designed as per the Hill Roads Manual/relevant IRC

6.3.1 Transition curves

Transition curves are necessary for the vehicle to have a smooth entry from a straight section into a circular curve.

a) To improve the aesthetic appearance of the road beside
b) At the horizontal curves permitting gradual application of the superelevation and extra widening of carriageway
c) Spiral curves are used as transition curves.
d) The geometric design standards for rural roads viz: IRC:73 / KIIFB guidelines should be followed.
e) Geometrical design for curves etc shall be as per MoRTH / IRC applicable for minimum ODR Standards

Length of transition curves selected based on curve radius, design speed and terrain as per

- IRC:86 for Urban Highway
- IRC:73 for Non-Urban Highway

6.3.2 Extra widening

The extra width of pavement at Horizontal curves provided due to Mechanical and Psychological parameters.

Table: 9. Extra width provided corresponding to radius of curve in two lane road as per IRC: 73

Radius of Curve	Extra Width
Below 40	1.5m
40 - 61m	1.2m
61-100 m	0.9 m
101-300 m	0.6 m
Above 300m	nil

a) For multi-lane roads, the pavement widening may be calculated by adding half the widening for two-lane roads to each lane.
b) Should increase the width at an approximately uniform rate along the transition curves.
c) Extra width should be continued over the full length of the circular curve.
d) At curves with no transition provide widening with two-third being attain on the straight section before the start of the curve and one-third on the curve.
e) Widening should be applied equally on both sides of the carriageway, except hill roads.
f) On hilly roads, entire widening is to be done only on the inside of curve.

6.4 Cycle track

A dedicated cycle track of minimum width of 2m (2.5m preferred) should be provided along the carriageway, according to demand. Cycle tracks should be colored in addition with mandatory and cautionary markings. Recommendations from IRC: 11 can be considered for the cycle track design. Cycle tracks shall be provided in select stretches of roads provided land is available or can be obtained at free of cost or can be acquired with reasonable cost.

6.5 Overtaking Zone

For a higher level of service on undivided roads, it is necessary that vehicle moving at design speed should be frequently able to overtake vehicle slower than them. Since overtaking maneuver involves the occupation of road space normally used by opposing traffic, drivers must have sufficient sight distance available to them so that the whole operation can be accomplished. The overtaking sight distance can be adopted corresponding to the design speed as per IRC: 66

Table: 10. Overtaking distance corresponding to design speed as per IRC :66

Speed (kmph)	Safe over taking sight distance
40	165
50	235

60	300
65	340
80	470

Overtaking zones are provided when Overtaking Sight Distance (OSD) is not possible to be provided throughout the length of the highway especially in hilly roads. These are zones dedicated for overtaking operation, marked with wide roads. The desirable length of overtaking zones is 5-time Overtaking Sight Distance and the minimum is 3- times Overtaking Sight Distance.

6.6 Vertical Alignment Design

The vertical alignment should provide for a smooth longitudinal profile consistent with the category of the road and lay of the terrain.

a) Grade changes should not be too frequent as to case kinks and visual discontinuities in profile.
b) Broken back guideline, i.e. two vertical cures in the same direction separated by small tangent should avoid due to poor appearance and preferably replaced by a long curve.
c) Deck of small cross drainage structures (i.e. culverts and minor bridges) should follow the same profile as the flanking road section, without any break in grade line.
d) While designing a road the amount of material from cuts roughly matches the amount of fill needed so as to minimize the amount of material and construction.

6.6.1 Grade

The grade should be carefully selected keeping in view design speed, terrain conditions and nature of traffic expected on road.

Table: 11. Gradients of the road in different terrain as per IRC:73

Terrain	Ruling gradient	Limiting gradient	Exceptional gradient
Plain or rolling	3.3 percentage (1 in 30)	5 percentage (1 in 20)	6.7 percentage (1 in 15)
Mountainous terrain and steep terrain having elevation more than 3000 from mean sea level	5 percentage (1 in 20)	6 percentage (1 in 16.7)	7 percentage (1 in 14.3)
Steep terrain upto 3000m above mean sea level	6 percentage (1 in 16.7)	7 percentage (1 in 14.3)	8 percentage (1 in 12.5)

Provide sufficient grade compensation at curves on hill roads where gradient more than 4 percent, and gradient compensation correction need not be eased beyond 4 percent as per IRC:73

6.6.2 Vertical Curves

Vertical curves are introduced for a smooth transition at grade changes. Convex vertical curves are known as summit curves and concave vertical curves as valley or sag curves. Both of these should be designed as per relevant IRC.

The length of the vertical curves is controlled by sight distance requirements, but curves with greater length are aesthetically better. For the satisfactory and smooth drive, a minimum length of vertical curves should be provided.

Table: 12. Minimum length of vertical curves

	Design Speed, (kmph)	**Minimum length of curve, (m)**	**Maximum Grade change, (%)**
Minimum Length of Vertical Curves (as per IRC:73)	35	15	1.5
	40	20	1.2
	50	30	1.0
	65	40	0.8
	80	50	0.6

6.6.3 Sight Distance Considerations

The safe and efficient operation of vehicles on the road depends on the visibility of the road ahead of the driver. Thus, the geometric design of the road should be done such that any obstruction on the road length could be visible to the driver from some distance ahead.

Table: 13. Length of vertical curves for different speed when the length of curves is greater than sight distance. (as per IRC: SP:23)

	Design Speed, (kmph)	**Length of vertical curves, (m)**	
		Crest	**Sag**
Length of the vertical curve in Crest vertical curve /Sag vertical curve	80	32.6A	25.3A
	65	18.4A	17.4A
	50	8.2A	10A
	40	4.6A	6.6A
	30	2.0A	3.5A
	Where, A is the algebraic difference between grades expressed as a percentage		

6.6.4 Camber/cross fall

The camber on straight sections of roads shall be as indicated in the table for various types of surfaces

Table: 14. Camber/Cross fall slope values for different road surface types.

Sl. No.	Surface Type	Camber/Cross fall
1	Thick type bituminous surfacing (more than 40 mm) or cement concrete surfacing	1.7-2.0 percent (1 in 60 to 1 in 50)
2	Thin bituminous surfacing (Less than 40mm)	2.0-2.5 percent (1 in 50 to 1 in 40)
3	Shoulders along unkerbed pavements	At least 0.5 percent steeper than carriageway pavement

6.7 Superelevation

i. Superelevation shall be provided on curves as per details are given in IRC: 73 corresponding to the design speed adopted.

ii. Superelevation shall be limited to 7 percent if the radius of the curve is less than the desirable minimum.

Radii of Horizontal & Transition curve shall be designed and be in conformance with IRC specifications.

7. PAVEMENT AND ENGINEERING DESIGN

New pavements shall be designed in accordance with the method prescribed in IRC:37-2012 or any alternative pavement composition methods or improvements methods to reduce pavement thickness. Otherwise, pavement composition shall not be less than the minimum requirement specified in IRC:37 2012/ IRC: SP:72-2015 depending on the projected traffic for the design life.

Table: 15. Mandatory data requirements for improvement and new formation of road

Type of data required	New Formation	Improvement/Strengthening
Traffic volume	Mandatory	Mandatory
Pavement evaluation (BBD test results)	-	Mandatory

Pavement Thickness and composition	-	Existing details mandatory
International Roughness index /Bump integrator / Roughometer	-	Mandatory
Soil investigation	Mandatory	Mandatory
Hydrological studies for cross drainage structures	Mandatory	Mandatory
Drainage studies • HFL • Depth of water table • Amount of surface runoff • Seepage of irrigation water (to account for capillary rise) • Discharge condition and points	Mandatory	Mandatory
Functioning of existing drain structure	-	Mandatory

The following aspects should consider while designing pavement to achieve better performance.

a) The select soil forming the subgrade should have a minimum CBR of 8 per cent for roads having traffic of 450 commercial vehicles per day or higher.
b) A minimum of 15 year design life should be considered.
c) Computation of effective CBR of subgrade for pavement design as per IRC:37-2012.
d) Use of rut resistant surface layer in case of high trafficked highways
e) Use of fatigue resistant bottom bituminous layer in case of high trafficked highways
f) Selection of surface layer to prevent top down cracking
g) Use of bitumen emulsion/foamed bitumen treated reclaimed asphalt pavements in base/ binder course.
h) Consideration of stabilized sub-base/ base course with locally available soil and aggregates.
i) Design of subsurface drainage layer
j) Computation of design traffic as per IRC:37-2012/IRC: SP:72-2015
k) Design of perpetual pavements with deep strength bituminous layer.
l) Use of Geosynthetics in pavement layers
m) Ground improvement should be considered wherever necessary
n) Soil nailing / RE walls should be adopted where necessary

7.1 Soil investigation

The design and construction of road subgrade shall meet the requirements, standards and specifications given by IRC and MORTH. Necessary soil surveys, field and laboratory investigations are to be carried out on the subgrade soil for identifying and treating problematic

ground locations, if any, and for establishing improved ground properties and for finalizing structural features and design of the subgrade and pavement thereafter.

For planning and execution of earthwork should follow the guidance of IRC: 36 “Recommended practice for the construction of earth embankments and sub-grade for roadworks”. All the specified laboratory tests need to conduct as per the relevant Indian Standard Codes of Practice.

- Grain size analysis (wet sieve analysis) – IS:2720 (Part 4)
- Atterberg limits – IS: 2720 (Part 5)
- Modified Proctor Test (OMC & MDD) – IS:2720 (Part 8)
- CBR – IS:2720 (Part 16)

7.2 Traffic Volume

a) A classified volume count required as per IRC: 9 /IRC: SP:19
b) Traffic volume count to be conducted for minimum of three consecutive days that may include working day and market day.
c) The count stations should be such that the results represent the traffic flow of a homogenous section of the road.
d) If projected traffic is more than 5 msa CVPD, one - day axle load study shall be conducted as per IRC SP-19 & IRC-37-2012.

7.3 Pavement Thickness and Composition

Indian Roads Congress has specified the design procedures for the design of flexible pavements based on CBR values.

a) The pavement designs are given in IRC: 37- 2012, are applicable to design traffic upto150 million standard axles(msa).
b) Roads having design traffic below 2 msa shall be considered as low volume road and for such roads, the pavement design shall be as per IRC SP: 72-2015.
c) City roads shall be designed for a minimum 5 msa traffic.
d) Subgrade layers shall have a minimum CBR of 8%. Wherever the values are lower, appropriate soil stabilization or ground improvement methods shall be adopted.
e) If the subgrade soil has a very low CBR value appropriate ground improvement methods should be adopted.
f) Complete reconstruction of full depth pavement with the reclamation of materials and strengthen the subgrade to minimize aggregate quantity adopting Full-Depth Reclamation (FDR) technology may be considered where feasible. Mix design for FDR with cement/lime for the desired strength shall be conducted, as per IRC guidelines.
g) Pavement design method considers traffic in terms of the cumulative number of standard axles (8160 kg) to be carried by the pavement during the design life.

h) This requires the following information:
    a. Initial traffic in terms of Commercial Vehicle per Day (CVPD)
    b. Traffic growth rate during the design life as per IRC:108
    c. Design life in a number of years- minimum 15 years/ as per IRC
    d. Vehicle damage factor (VDF)
    e. Distribution of commercial traffic over the carriageway.
i) The pavement layer thickness shall be selected from corresponding CBR plate and traffic and supplemented with results/output from IITPAVE software.
j) The CBR plates and traffic selected for design shall be included with the pavement design.
k) Where required soil stabilization should be considered as per IRC: SP:89-2010.

7.4 Pavement Evaluation

Strengthening of existing pavements shall be designed based on the procedure outlined in IRC: 81, using Benkelman beam deflection studies and analysis or by adopting Falling Weight Deflectometer as per IRC:115.

The characteristic deflection of road stretches shall be found out using BBD/FWD survey and analysis with necessary corrections for temperature, subgrade moisture content and seasonal corrections.

Considering the mean deflection (X), and the standard deviation (σ) the characteristic rebound deflection 'D_C' is to be worked out as per the guidelines given in IRC: 81

$Dc = X+2\sigma$---------- (1) for major arterial roads (like SH)

$Dc = X+\sigma$ ---------- (2) for all other roads

From IRC: 81 the design curves relating characteristic deflection and cumulative number of standard axles to be carried over the design life to find the overlay required. The overlay thickness materials can only be Dense Bituminous Macadam (DBM Grade-II), Bituminous Concrete. The binder for the layers can be VG-30/PMB/CRMB.

By conducting core log test on existing pavement, the types layers and thickness should be found and reported. Improvement works shall be carried out by using the possible amount of reclamation of scarified pavement materials.

7.5 Alternate Pavement Design

The following are suggested alternatives for the design of pavements. The proposals submitted shall include detailed evaluation of alternatives and shall arrive at the most optimal design in context of road development in Kerala.

a) Full Depth Reclamation
    a. Helps in reducing the consumption of construction materials in the wake of shortage of the same in Kerala
    b. Serves as an environment-friendly and sustainable construction method.
b) Alternate modes of subgrade improvement
    a. Geotextiles/geogrids can substantially improve the CBR values of Subgrade
    b. Composite layers
c) As per the guidelines in IRC: SP: 59 uses of geotextile in pavements and associated works.
d) Detailed design methodology along with the analysis should be submitted with the design.

7.6 Footpath

As a minimum guideline, the width of the footpath shall be as per table 7 of this manual. However, based on the volume of pedestrian traffic, the footpath width shall be provided as per IRC:103-2012.

a) Footpath should be designed with Interlocking Concrete Paver Blocks as per IRC: SP:63
b) The width of footpath shall be adopted corresponding to pedestrian volume as per IRC: 103.
c) Utility or drain slab shall be used as footpath otherwise paved tiles or interlock tiles shall be provided at the footpath area.
d) Raised footpath with universal design provision for accessibility shall be provided with considering access to the differently abled person.
e) Footpath shall be provided with guard rails at unsafe maneuver crossing areas and heavily built-up areas especially in town areas.
f) The design of Interlocking Concrete Paver Blocks should be as per IRC: SP:63-2004

7.7 Road Side Drainages and Utility Duct

a) A road drainage system designed as per IRC: SP:42- 2014 and must satisfy two main criteria if it is to be effective throughout its design life:
b) It must allow for a minimum of disturbance of the natural drainage pattern.
c) It must drain the surface and subsurface water away from the roadway and dissipate it in a way that prevents the excessive collection of water in unstable areas and subsequent downstream erosion.
d) The depth of drain may be varying according to the storm water drainage characteristics and lead to the nearest discharge point.

e) Provision for adequate drainage is of paramount importance in road design
f) Drainage design is most appropriately included in alignment and gradient planning.
g) Natural drainage characteristics of a hillslope shall not be changed
h) To avoid frequent damage to roads by digging roads for utility flow and crossing propose a conduit for utilities including optical cables as a part of road design.
i) Utility ducts are designed with depth more than drainage for providing cross duct without obstructing the drainage flow.
j) The road drainage should be designed as per IRC: SP:42-2014.

7.8 Hydrology Studies

The function of the drain is to drain surface and subsurface water away from the roadway, before the design of drainage and cross drain structures the amount of runoff from the road surface to be estimated. For better performance and long life, the drainage design shall be followed as per the standards.

(i) Natural drains and conditions shall be considered for the proper drainage as well as economical design.
(ii) If newly constructing drain length more than 75% length of road, a proper hydrology study shall be conducted for validation of drain use.
(iii) Type of hydrology studies includes
- Rainfall analysis
- Runoff analysis
- Condor studies

7.9 Bus Bays and Bus Shelters

The pavement in the lay-by area of bus bay shall be provided with adequate crust thickness with respect to the wheel load expected. Also, the surface shall be strong enough to withstand forces due to frequent braking and acceleration by the bus. The laydown area of bus bay shall have proper drainage facilities to drain of excess water. Design of bus bay with the guidelines of IRC: 80-Type Designs for Pick-up Bus Stops on Rural (i.e., Non-Urban) Highways. The location or shifting of a bus bay/bus shelter shall be decided with the consultation of local administration and the local police to avoid conflicts during the execution. However, safety shall be given priority in conjunction with the convenience. Bus bays with designed bus shelters at all important locations where, a large number of people depend on the public transport system. Bus stops should normally be located 50-100m after the junction. No bus stop should be permitted at the intersection. As far as possible, segregated bus stops should be allowed on new roads.

7.10 Landscaping and avenue plantation

1) Area where foot paths are not essential, buffalo grass turfing may be considered between the edge of ROW line and end of Paved shoulders to facilitate the limited pedestrian movement and smooth natural drainage.
2) Avenue plantation with Kanikkonna and / or Jack fruit trees at a spacing of 10 m c/c at select stretches of roads provided land is available or can be obtained at free of cost or can be acquired with reasonable cost.

8. TRAFFIC FURNITURE

8.1 Mandatory Road Furniture

i. Road signs - All Necessary Road signs shall be in accordance with IRC: 67.
ii. Road Markings - All road markings shall pertain to IRC: 35
iii. Directional boards - Signages, Information panels as per traffic and transportation requirements including junction facilities, landscaped islands and medians wherever technically feasible.
iv. Guideposts
v. Safety Barriers
vi. Light and utility poles - Smart street lighting system with solar power source at all technically feasible road stretches.
vii. Boundary Fences
viii. Raised road markers

8.2 Mandatory Road Safety Barriers

Traffic safety barriers shall pertain to IRC: 119, the mandatory traffic safety barriers are;

i. Road Markings
White color Centre line and yellow color edge line with thermoplastic compound solid road marking should be provided. Continues center line at curves and discontinues line at straight road stretch are required.
ii. Pedestrian crossing
Marking for pedestrian crossing mostly used in the zebra pattern consisting of equally spaced white stripes generally 450mm wide in accordance with IRC:103 should be provided at required areas.
iii. Road Studs
Reflective Road studs (Raised pavement marking) should be fixed in centre line with white reflector, edge line with red and white reflector corresponding to traffic direction and red reflective at stop and zebra lines.

iv. Delineators

Delineators with red, white and yellow colors are using as safety measures in the road.

(a) White - On the right side of two-way roadways i.e. single carriageway.

(b) Yellow - On the right side of one-way roadways i.e. dual carriageway.

(c) Red - On the left side of the roadway.

v. Guard stone

Guard stone should provide road embankments with higher land fill or steep slope more than 1.5m.

vi. W - Beam crash barriers

W-Beam crash barrier like semi-rigid crash barriers should provide at,

- Embankment land fill height or steep slope more than 0.6m
- Near road side obstacles
- Dangerous ditches
- Steep gradient
- Hill roads
- Grade separator structures
- At special locations to ensure the safety Pedestrians

vii. Rigid crash barriers

Rigid crash barriers with reflecting component should provide embankment land filling or steep slope more than 3m height

viii. Hazardous markers

Hazardous road mark should be provided at culvert parapets, post, bridge structure, median opening, other traffic obstacles, etc.

ix. Chevron signs

Chevron signs should be provided at curves to inform the sharpness of curves. Chevron sign spacing provided as per IRC:67 recommendation

9. PARKING AREA AND PUBLIC UTILITIES

a) The parking shall be marked for the physically challenged at the ratio of 2:25 of the total number of parking.

b) Two accessible parking lots with an overall minimum dimension of 3600 mm wide and 5000mm length (including aisle space), shall be provided.

c) There shall be directional signs guiding people to the accessible parking.

d) Dedicated parking slots at select stretches considering the traffic requirements and importance of the road stretch.

e) Mini amenity centres with public toilets and kiosks shall be provided even at every 10km along by considering basic way-side amenities provided at hotels and petrol bunkers

f) Modern amenity centres with toilet, refreshments, Wi-Fi facility etc at distance of not more than 25 km.

g) Based on demand assessment, organised parking space for auto/taxi to be provided.

h) Off-street parking for commercial vehicles should be provided.

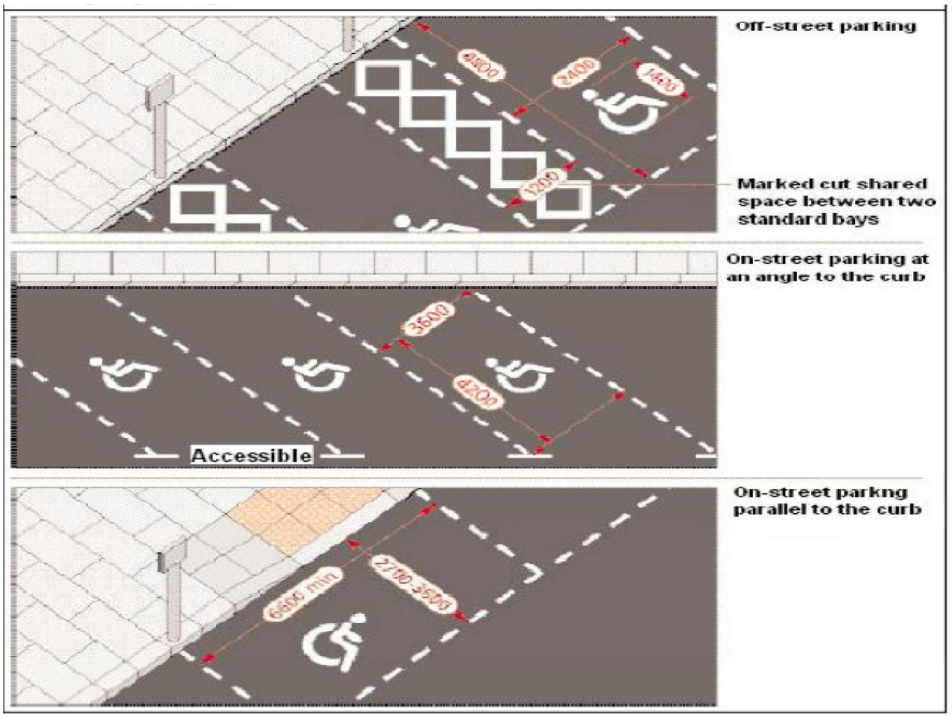


Figure 2 layout for universal parking space

10. ROAD PROJECT AUDITINGS

10.1 Road Safety Auditing

Road safety audit shall mandatorily be conducted by a third party certified road safety auditor, as per IRC: SP- 88, for all roads developed under KIIFB funding, as per standard practices and all provisions shall mandatorily be included in the DPR & estimate. The road safety audit should be conducted during construction and operational stages also.

A road safety audit is a term used internationally to describe an independent review of a future road project to identify anything that may affect the road's safety. The audit team considers the safety of all road users and qualitatively reports on road safety issues and opportunities to improve safety.

Specific aims of Safety Audit;

i. To minimize the risk of accidents likely to occur/occurring on the project facility and to minimize their severity.
ii. To minimize the risk of accidents likely to occur/occurring on adjacent roads i.e., to avoid creating accidents elsewhere on the network.
iii. To recognize the importance of safety in highway design to meet the needs and perceptions of all types of road users; and to achieve a balance between needs of different road user types where they may conflict with one another.
iv. To reduce long-term costs of a project facility, bearing in mind that unsafe designs may be expensive or even impossible to correct at a later stage.
v. To increase awareness about safe design practices among all those involved in the planning, design, construction, and maintenance of roads,

Typical Activities in Road Safety Auditing.

i. Minimize the likelihood of crashes occurring through safety conscious planning and design
ii. Identification of Black spots
iii. Ensure that, if crashes occur, then the likelihood of injury is minimized (Such as provision of anti-skidding surface and safety barriers)
iv. Ensuring that safety-related design criteria (eg. Critical sight distance) have been met.
v. Managing risk, such that the risk of occurring major safety problem is less than the risk of minor safety problems occurring.
vi. Reducing whole life cycle cost of a design (unsatisfactory designs are expensive to correct after built.)
vii. Minimize the risk of crashes occurring in the adjacent road network.

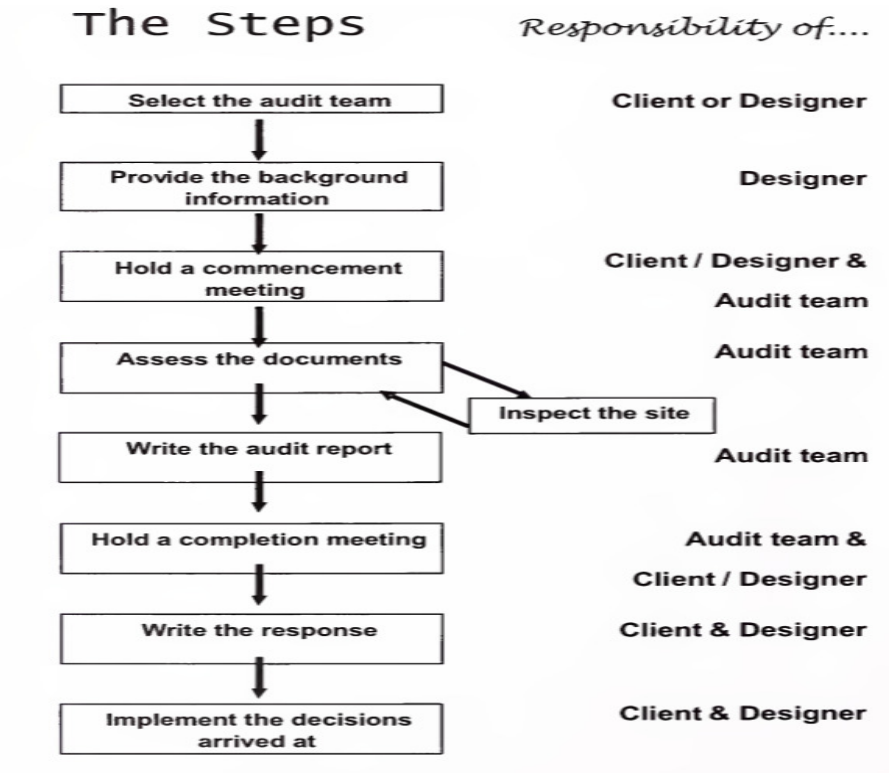


Figure: 3. Steps involved in road safety auditing as per IRC: SP-88

10.2 Social Auditing

Social Audit is a monitoring process through which project information is collected, analyzed and shared publicly in a participatory fashion. Social audits may go beyond the oversight of project finances and procurements to examine all aspects of the project, including the level of access to information, accountability, public involvement, project outputs, and outcomes. Social audits are typically carried out by community volunteers (social audit teams/committees) and findings are presented at a public forum/hearing. Steps involved in the social auditing process

1. Define the scope of the audit
2. Information gathering and analysis
3. Public disclosure and evidence-based dialogue
4. Social audits institutionalized and repeated regularly

A social audit helps to reduce the gaps between vision and reality, between efficiency and viability. It values the voice of stakeholders, including marginalized/poor groups whose voices are rarely heard. Social auditing is taken up for the purpose of enhancing rehabilitation by local governance, particularly for strengthening accountability and transparency in local bodies. Social auditing shall be conducted as per prevailing KPWD / CPWD / MoRTH / IRC rules before commencing of the project to evaluate the demand and requirement of the project.

10.3 Environmental Auditing

Environmental auditing is essentially an environmental management tool for measuring the effects of certain activities on the environment against set criteria or standards. These are used to help improve existing human activities, with the aim of reducing the adverse effects of these activities on the environment. Environmental auditing shall be conducted as per prevailing KPWD / CPWD / MoRTH / IRC rules before commencing of the project to evaluate the demand and requirement of the project. Environmental auditing must be conducted by considering,

1. Air Quality
   – recommended for dust control and mitigative measures
2. Noise control
   – recommended for an adopt noise reduction method of working and equipment's
3. Water Quality
   – recommended for mitigating measures to minimize water control during the construction phase.
4. Resource management (waste management, deforestation, etc.)
   - recommended for avoidance and minimization of waste generation
   - recommended for reuse of materials
   - recommended following relevant environmental protection and pollution laws.

REFERENCES:

IRC :9 - Traffic Census on Non-Urban Roads

IRC: 11 – Design & Layout of cycle Tracks

IRC: 23 - Vertical Curves for Highways;

IRC:34 – Recommendations for road construction in areas affected by water logging, flooding and/or salts infestation (first revision)

IRC: 35 - Code of Practice for Road Markings;

IRC: 36 - Recommended practice for the construction of earth embankments and sub-grade for road works;

IRC: 37- Guidelines for the Design of Flexible Pavements;

IRC: 38 - Guidelines for Design of Horizontal Curves for Highways and Design Tables;

IRC: 64- Guidelines for Capacity of Roads in Rural Areas;

IRC: 66–Recommended Practice for Sight Distance on Rural Highways;

IRC: 67–Code of Practice for Road Signs;

IRC: 72- Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads;

IRC: 73- Geometric Design Standards for Rural (Non-Urban) Highways;

IRC: 79-Recommended practice for Road Delineators;

IRC: 80-Type Designs for Pick-up Bus Stops on Rural (i.e., Non-Urban) Highways;

IRC: 81-Guidelines for the strengthening of flexible road pavements using Benkelman Beam Deflection Technique;

IRC: 86 -Geometric design standards for urban roads in plains.

IRC: 93 - Guidelines on Design and Installation of Road Traffic Signals;

IRC: 103- Guidelines for Pedestrian Facilities;

IRC: 108 - Guidelines for Traffic Prediction on Rural Highways;

IRC: 115 - Guidelines for Structural Evaluation and Strengthening of Flexible Road Pavements Using Falling Weight Deflectometer (FWD) Technique;

IRC: 119 – Guidelines for Traffic safety barriers

IRC: SP-13- Guidelines for the design of small Bridges and Culverts;

IRC: SP-15 – State of the art: Landslide correction techniques.

IRC: SP-19 - Manual for Survey, Investigation and Preparation of Road Projects

IRC: SP-41- Guidelines on Design of At-Grade Intersections in Rural & Urban Areas;

IRC: SP-42 - Guidelines on Road Drainage;

IRC: SP-50 - Guidelines on Urban Drainage;

IRC: SP-59 - Guidelines for use Geotextile in road pavement and associated works;

IRC: SP-63 - Guidelines for the use of interlocking concrete block pavement;

IRC: SP:72- Guidelines for the Design of Flexible Pavements for Low-volume Rural Road

IRC: SP-73 – Manual of specification & standards for two laning of highways with paved shoulder

IRC: SP-88 - Manual on road safety auditing;

IRC: SP:89- Guidelines for soil and granular material, stabilization using cement lime& fly ash

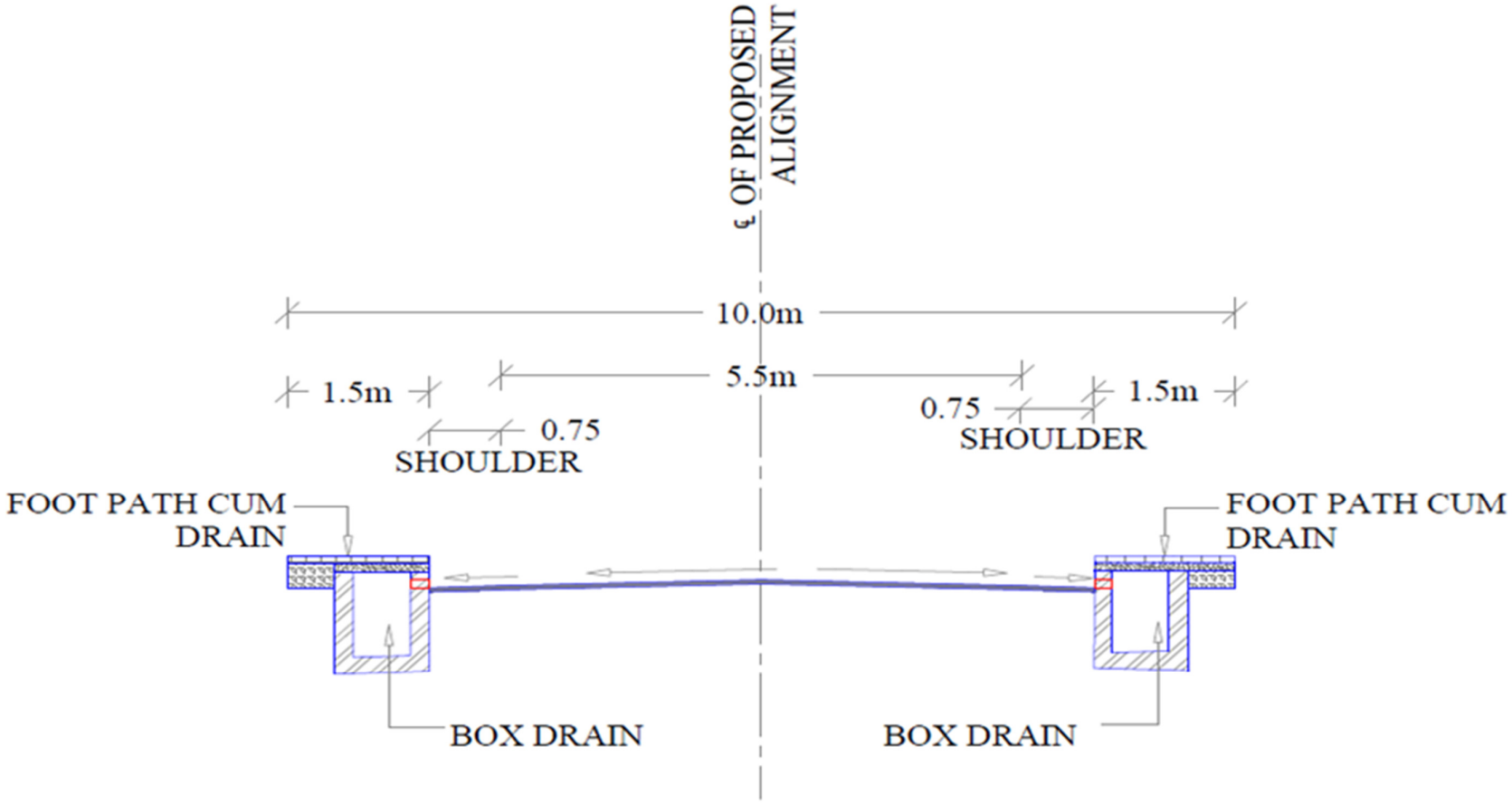
IS: 2720 (Part 4) - Grain size analysis

IS: 2720 (Part 5) - Atterberg limits

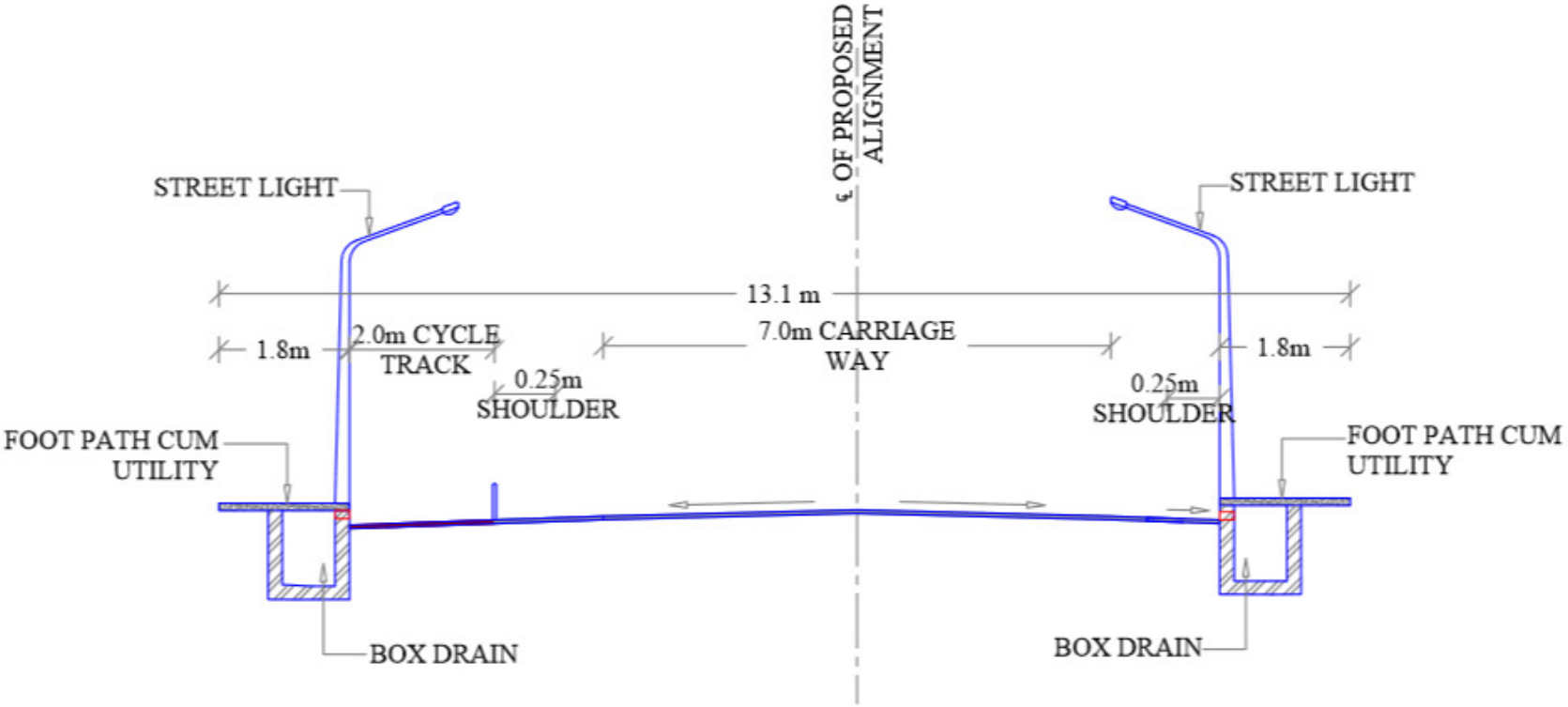
IS: 2720 (Part 8) - Modified Proctor Test (OMC & MDD)

IS: 2720 (Part 16) - California Bearing Ratio

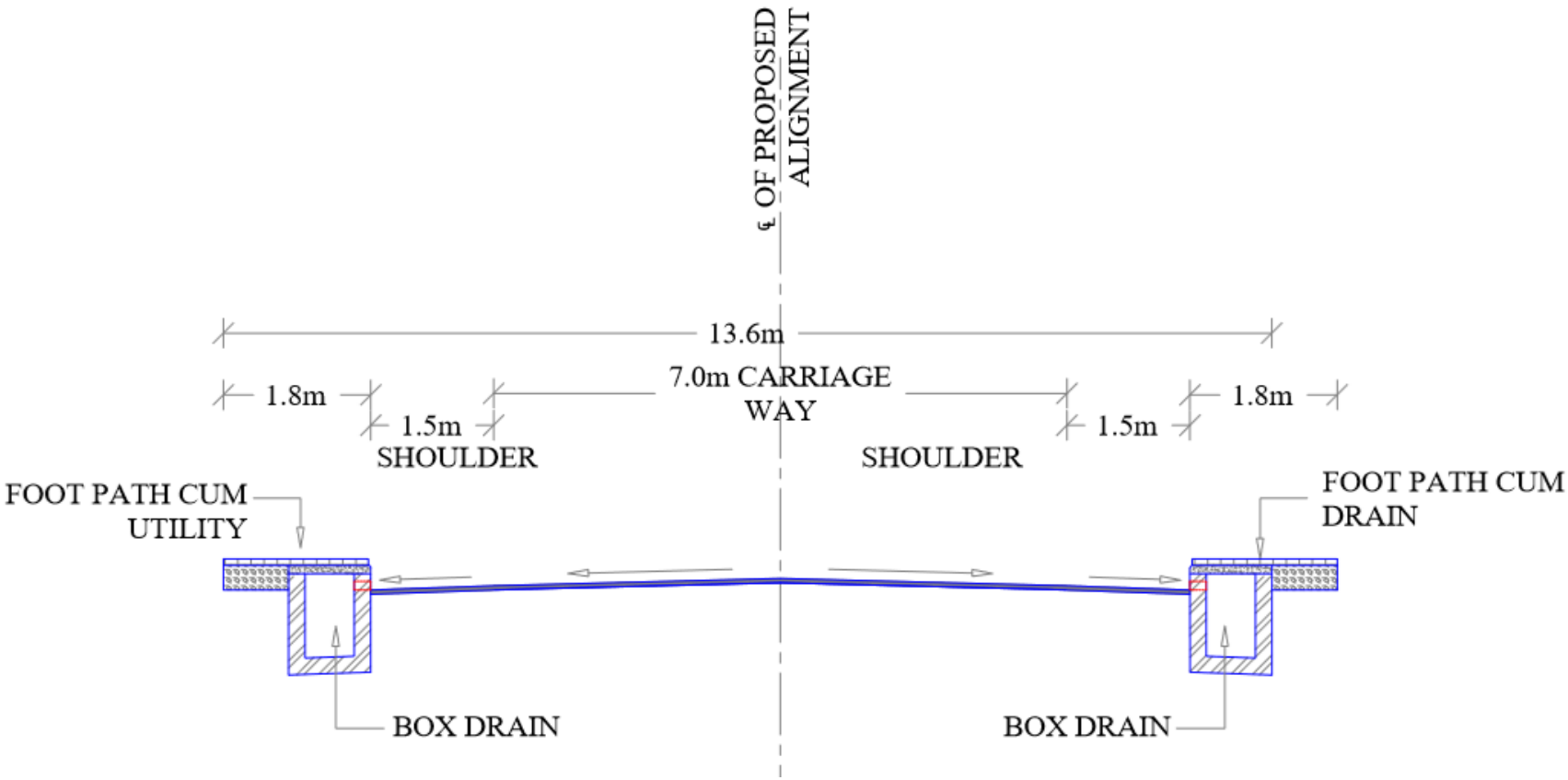
ANNEXURE 1 – Typical Cross Section with 10m RoW



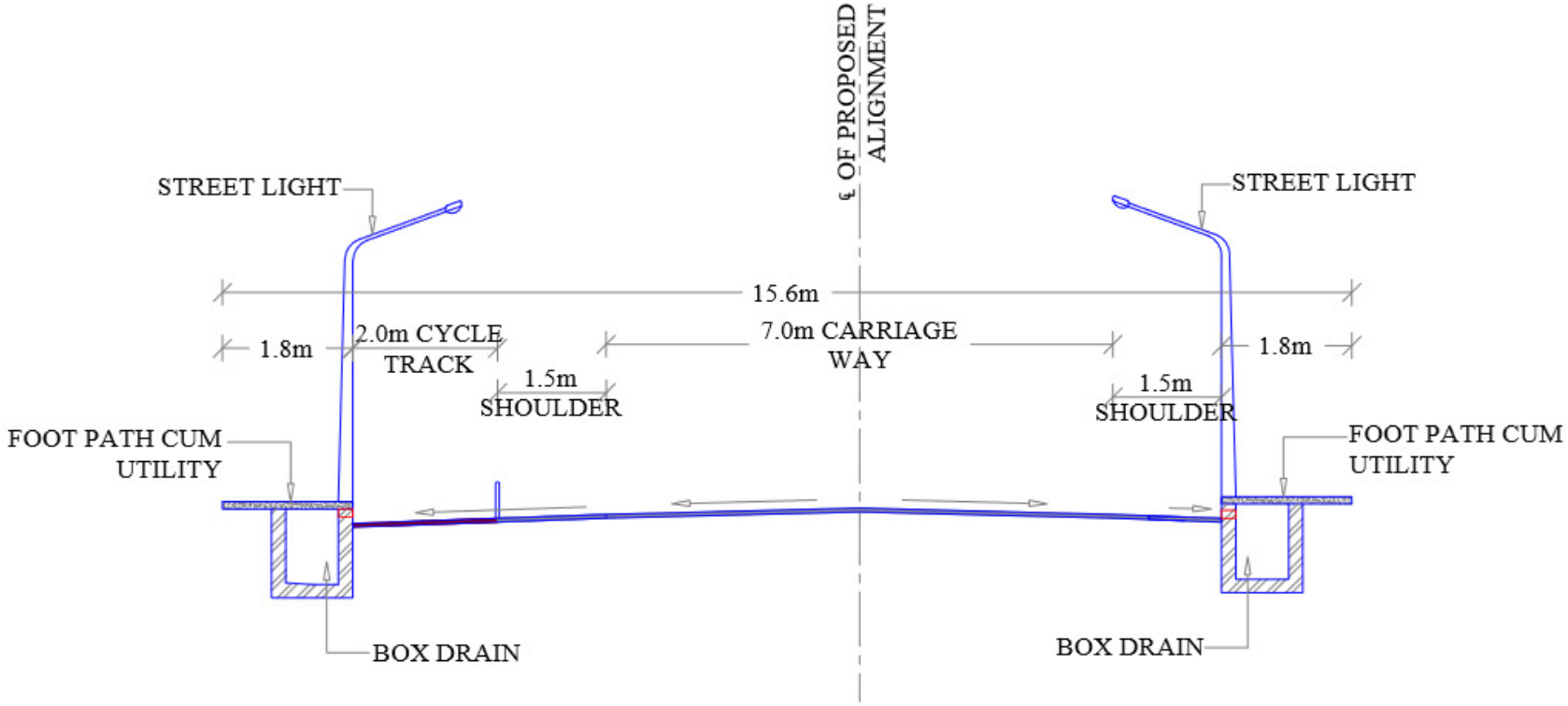
ANNEXURE 2 - Typical Cross Section with 13.1m RoW & cycle track



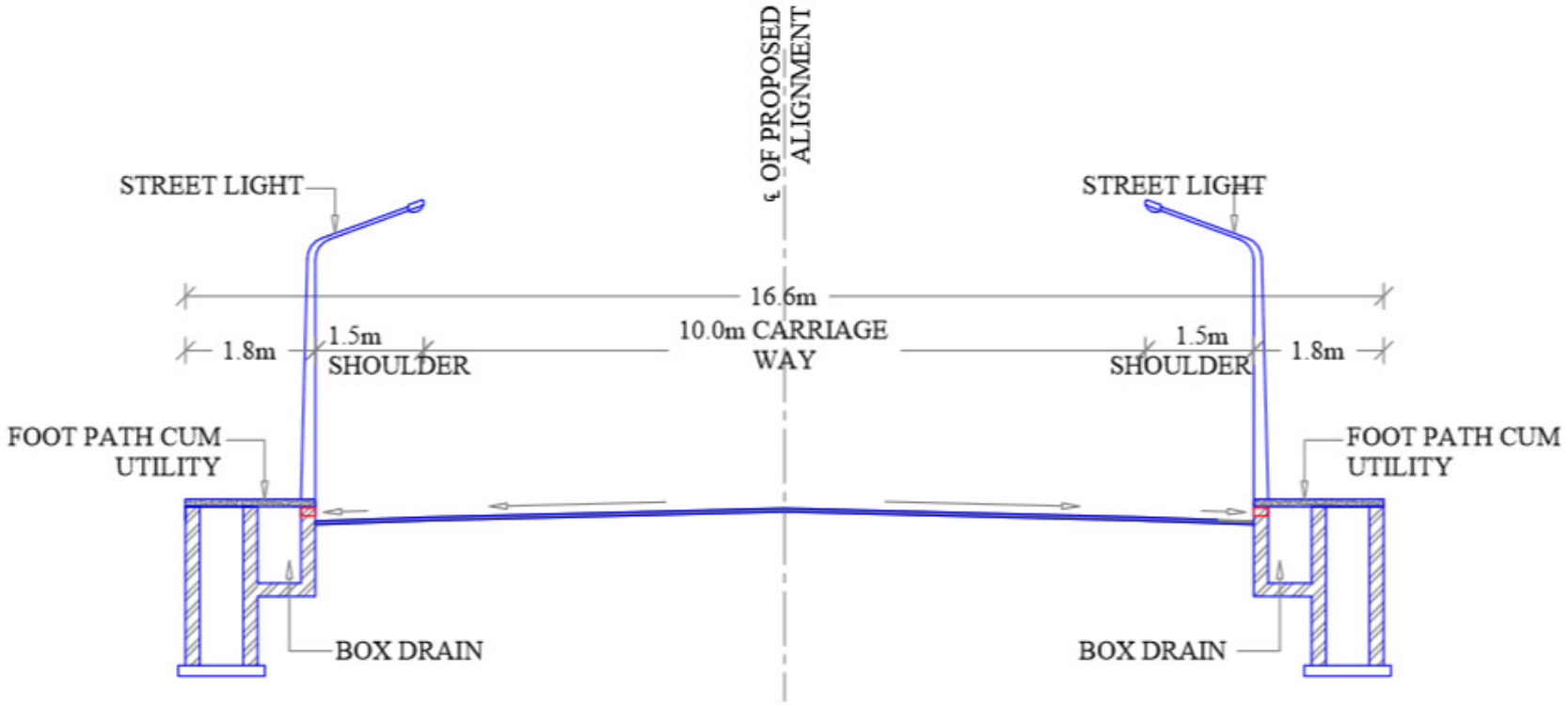
ANNEXURE 3 - Typical Cross Section with 13.6m RoW



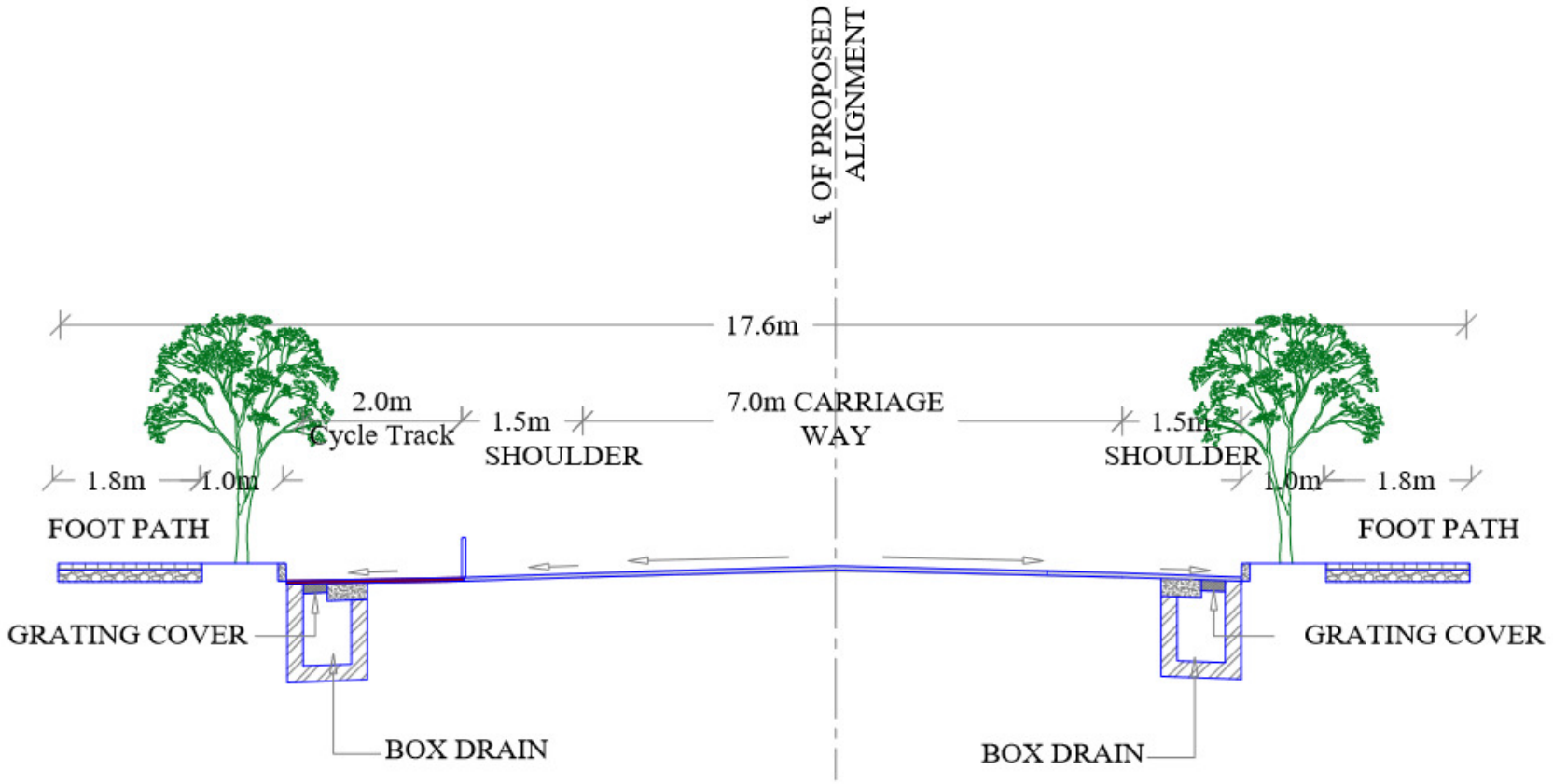
ANNEXURE 4 - Typical Cross Section of Coastal Highway / Road with cycle track



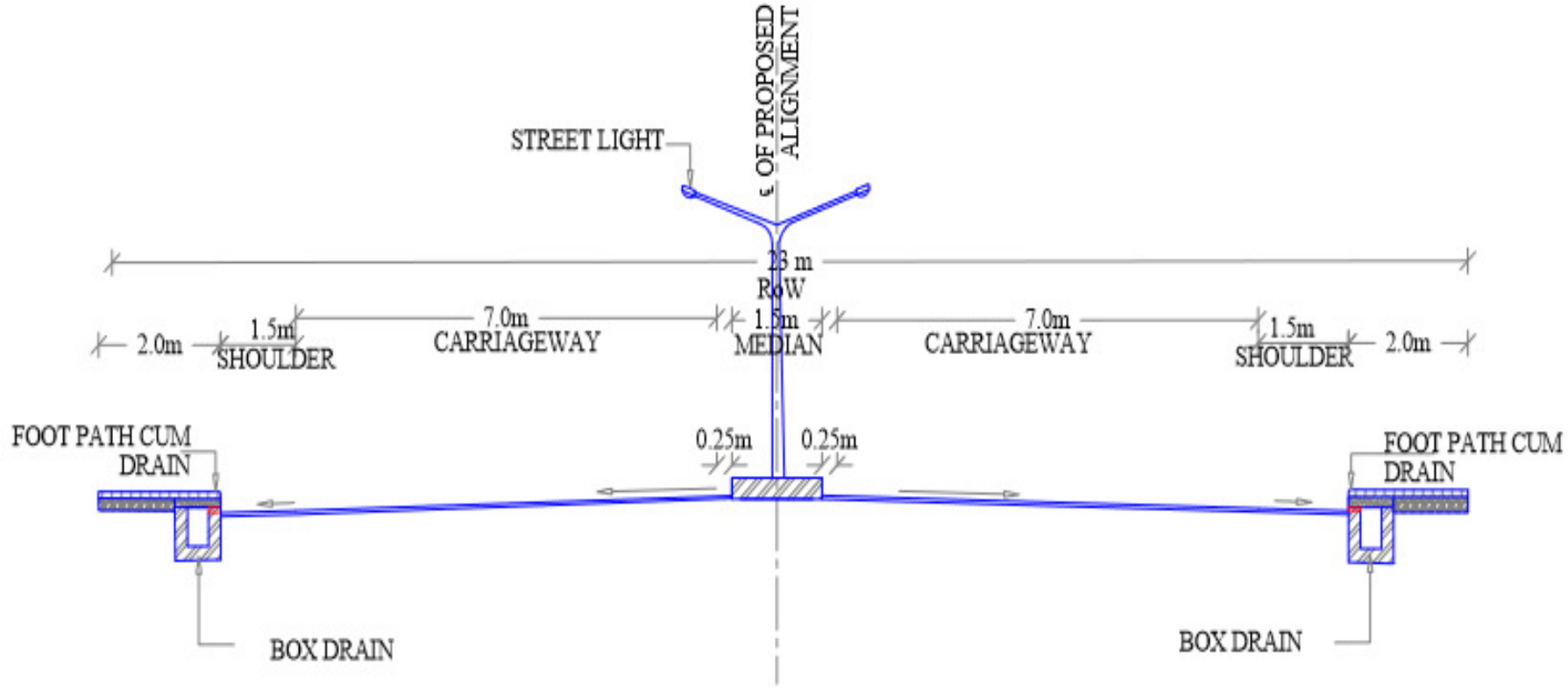
ANNEXURE 5 - Typical Cross section with 16.6 m RoW at undivided junctions



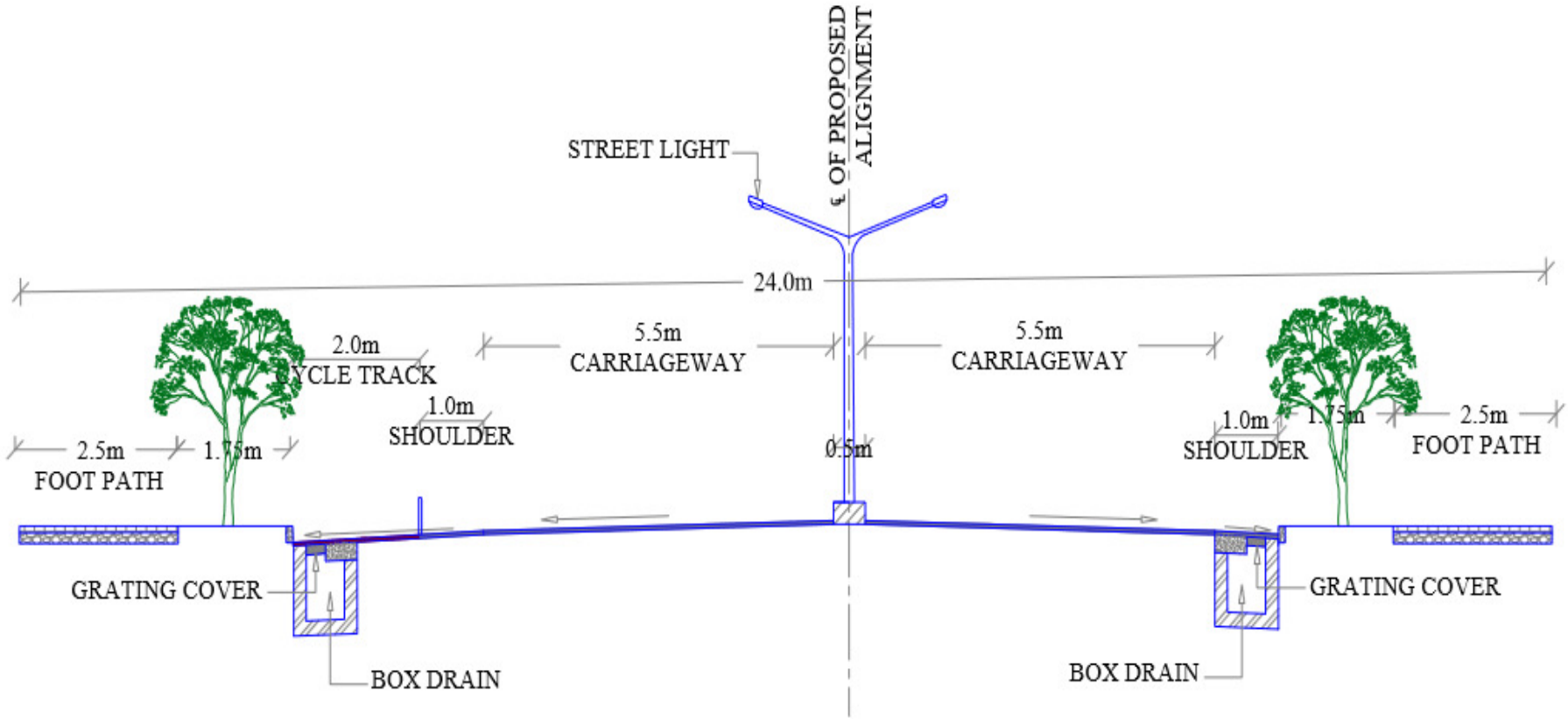
ANNEXURE 6 - Typical Cross section with 17.6m RoW Road & avenue plantation



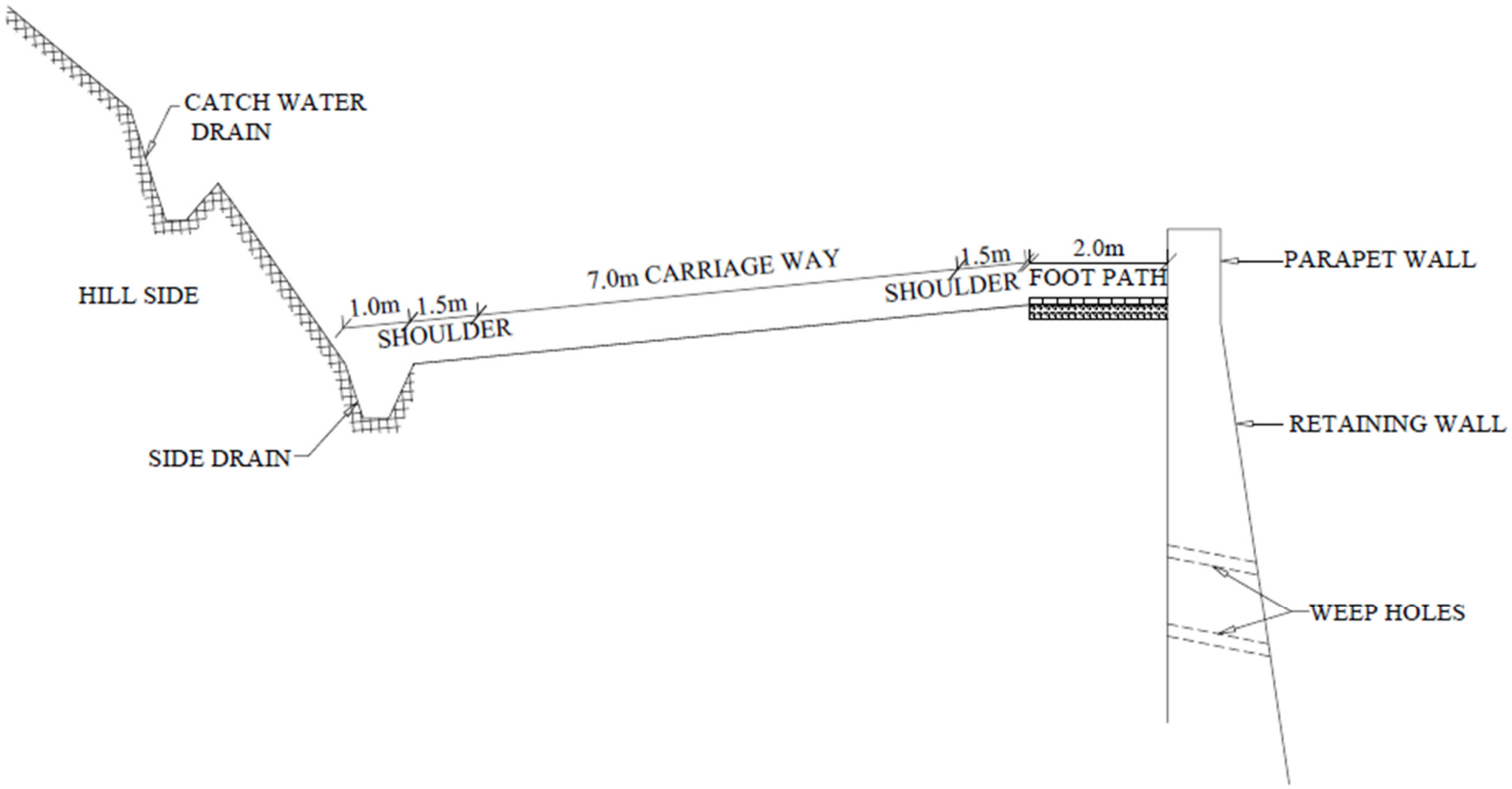
ANNEXURE 7 - Typical Cross Section of four lane road with median (23m)



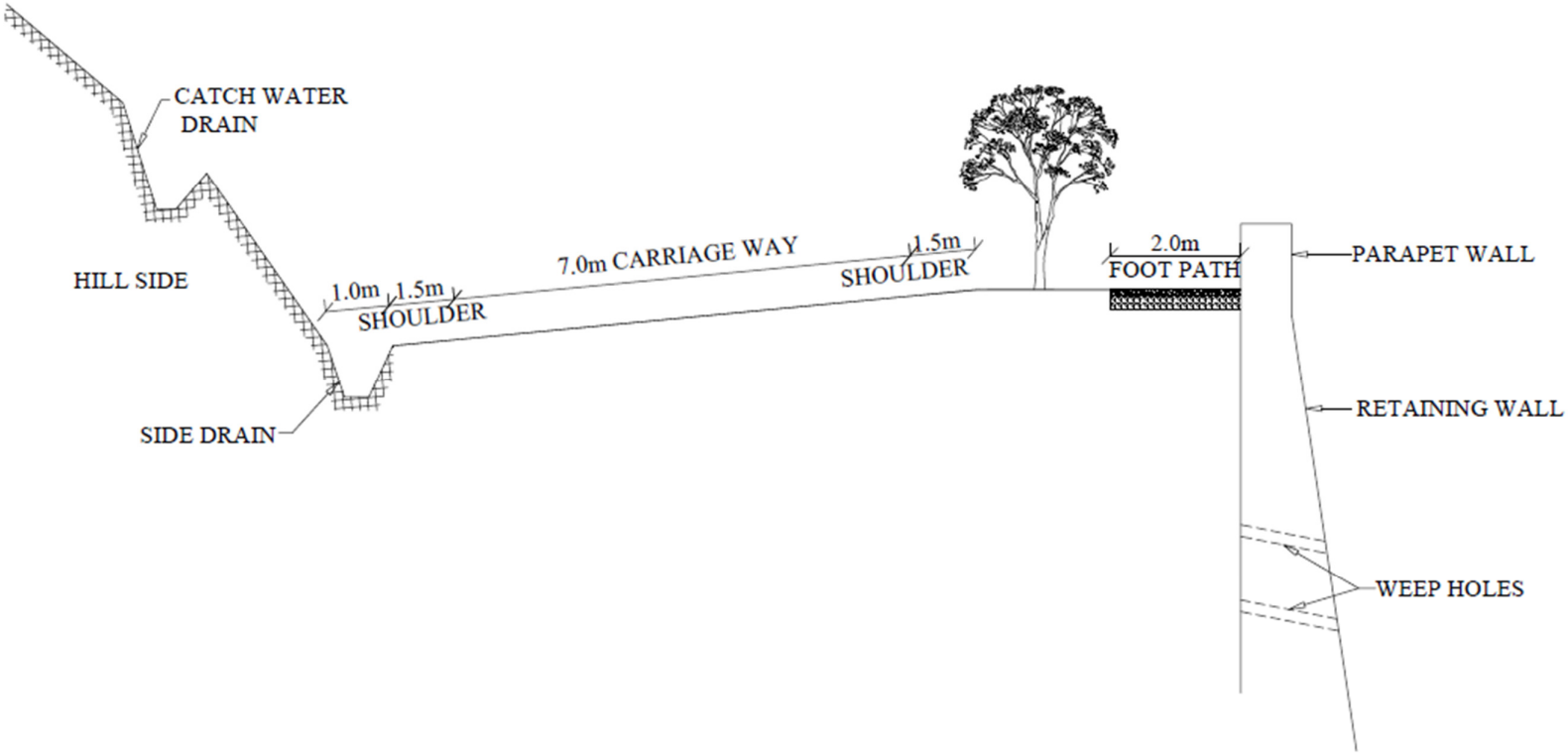
ANNEXURE 8 - Typical Cross Section of City Road with 24m RoW



ANNEXURE 9 - Typical Cross section of two lane road at Hilly Terrain with 13m RoW



ANNEXURE 11 - Typical Cross section of two lane road at Hilly Terrain with >13m RoW



Template for Preparation of Detailed Project Report (DPR) in r/o Roads for KIIFB Assistance

Guidelines for preparing Detailed Project Report

A detailed Project Report is an essential component of the project. It should be prepared carefully. Before finalising the DPR, importance should be given to carry out the needed surveys investigations and designs as per the standard guidelines and best practices. Adequate details should be included in the DPRs to ensure timely appraisal, approval and implementation. Considering the importance of DPR preparation, a document intended for reference is detailed along with. The guidelines provided in this document shall be adhered to strictly. In addition, SPV can incorporate specific additional relevant details to supplement the base data.

The detailed project report shall strictly be prepared in line with the "GUIDELINES FOR PLANNING AND DESIGN FOR ROADS & HIGHWAY PROJECTS FOR CONSIDERATION FOR FUNDING BY KIIFB" as per the latest version of the guideline and its associated circulars issued if any from time to time.

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SALIENT FEATURES			
1	Title of the project		
2	Department		
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	ii.	Taluk	
	iii.	Corporation/Municipality/Panchayath	
	iv.	Assembly Constituency	
4	Implementing agency/SPV		
5	DPR prepared by		
6	Project outlay		
7	Budget provision		
8	Budget speech reference		
9	Administrative sanction		
	Nature of the project		
10	(New formation/ widening / strengthening / widening and strengthening/ new formation, widening and strengthening)		
11	Present status of roads, if any		
12	Need for the project		
13	Details of proposed roads		
	i.	Length of road	
	ii.	Carriage way width	
	iii.	Thickness and details of pavement layers	
	iv.	Details of cross drainage works	
	v.	Other details	
14	Details of investigations/surveys conducted		
	i.	Geotechnical	
	ii.	Traffic	
	iii.	Existing drainage and protection work details	
15	Whether Land Acquisition involved?		
	If yes, furnish details		
16	Total estimated cost and item wise cost break up and details of Schedule of Rates		
	Whether detailed estimate attached?		
	Indicative cost / km of the project		
	Indicative cost / km of the carriageway		
17	Details of revenue streams		

18	Details of Cost Benefit Analysis (CBR value)	
19	Details of project risks	
20	Details of project management organisation strategy	
21	Details of contract management strategy	
22	Details of Project Implementation Schedule, (PIS) & Work Breakdown Schedule (WBS)	
	- Proposed duration to complete the project	
23	Details of statutory clearances	
24	Quality control infrastructure and mechanism	
25	Operations & Maintenance (O&M) arrangements of the project after completion	
26	Details of attached drawings	
27	Other attachments	

EXECUTIVE SUMMARY:

- This section shall contain brief details of all relevant details discussed in the following chapters.

1. INTRODUCTION

- This section should provide a general introduction of the project being submitted General introduction shall include write up on: type of the road project, location of the project area, general description of topography, physiography and geology of the project area, historical background of the project, need for the project, etc.
- Aims and objectives of the project shall also be briefed in the section.
- This section shall clearly mention the existing category of road (NH/ SH/ MDR/ ODR/ VR/ City Road) etc and its current terrain type (plain / rolling / mountainous/ steep)

2. STATUS OF FEASIBILITY STUDIES

- Description of any feasibility study conducted earlier and their outcome shall be discussed in this section.

3. REQUIREMENT/ DEMAND ANALYSIS

- This section should present the specific problem(s) or issue(s) faced by stakeholders like citizens, businesses or governments that would be addressed by means of provision of improved services through the proposed project.
- In this section, describe the project proposed in terms of the rationale behind the project, clearly focusing on the existing condition (how it will help in improving the situation and bring benefits to the stakeholders).
- The rationale could be broad based and supplemented with facts and figures. Information based on objective research, not subjective impressions, should be provided to justify the need or problem. The rationale should be written in a way that would lead to objectives.
- A social audit as per the requirements shall be conducted as per prevailing KPWD / CPWD / MoRTH / IRC rules before commencing of the project to evaluate the demand and requirement of the project.

4. FUNCTIONAL DESIGN

- This section should present an analysis of different options available to achieve the objective and the reasons for selecting the proposed option should be substantiated.
- The functional design of the project is mainly achieved through field study and documentation using existing information and specifications from various standards
- The details of the existing road shall be provided covering the following as a minimum:
    - Average width of ROW, carriageway and shoulder details
    - Existing pavement layers thickness and type of road surface
    - Chainagewise height of embankment type and condition
    - Location of Cross Drainage structures and its present condition
    - Side Drain details and present condition with outlet details
    - Water logging conditions
    - Chainagewise details of retaining walls and present condition
    - Utilities and trees within the boundary
    - Seasonal temperature variation details
    - Environmental profile of the area
    - Bus bay locations and existing road safety features, if any and its condition
    - Existing sub grade condition with position of water table, HFL (High Flood Level) etc if the project demands
- The details of the proposed RoW with all its features shall be clearly mentioned. (Proposed carriageway, shoulders, drain cum utility duct, footpath locations, protection works, cross drainage structures, bus bays etc). The provisions for horizontal & vertical curves as per the guidelines shall be followed and land acquisition requirements shall be clearly demarcated.
- The detailed design for geometric elements shall cover, but not be limited to the following major aspects:
    - Horizontal Alignment
    - Longitudinal Alignment
    - Cross-Sectional Elements
    - Cross Drainage structures and Protection Works
    - Junctions, intersections and interchanges
    - Bus Shelters, Bus Bays, Parking areas, rest areas, weighing stations, etc.
- The details for at-grade junction improvements shall be adopted as alternative to the grade-separated structures. The geometric design of interchanges shall take into account the site conditions, turning movement characteristics, level of service, overall economy and operational safety.

- This section shall also clearly mention about the features of the proposed road, longitudinal and cross sections at critical locations, drawings of cross drainage structures, drains, cross duct, utility ducts, retaining walls, road furniture, road safety provisions included etc.
- The alignment of a new road shall be fixed with a view to serve maximum population and to achieve the maximum utility of the existing road system, if any. The alignment shall preferably be one which demands minimum land acquisition and avoiding problematic soils, too many cross-drainage works, landslide susceptible slopes etc.
- The proposed alignment should achieve the least overall cost on transportation, having regard to the costs of initial construction of the road facility, its maintenance, and road user cost, while at the same time, satisfying the social and environmental requirements.
- Where the project involves improvements to an existing road, every effort should be directed towards the inherent deficiencies with respect to: plan and profile, sight distance/visibility in horizontal as well vertical plan, carriageway, shoulder and roadway width, cross-drainage structures, road side drainage provisions as well as area drainage consideration and safety features.
- The field study shall include traffic surveys and documentation which may be done as per the latest revisions and amendments of the relevant guidelines of MoRTH, publications of Indian Roads Congress (IRC) and Bureau of Indian Standards (BIS).
- Information about traffic is indispensable for any road project since it would form the basis for the design of the pavement, fixing the number of traffic lanes, design of intersections etc.
- Traffic surveys required to be conducted in connection with the preparation of road project are: Classified Traffic Volume Counts, Origin-Destination Surveys, Speed and delay studies, Traffic Surveys for the Design of Road Junction, Axle Load Surveys, and Accident Records etc.
- All results shall be presented in tabular and graphical form. The survey data shall be analysed to bring out the hourly and daily variations. The traffic volume count per day shall be averaged to show a weekly Average Daily Traffic (ADT) by vehicle type. The Annual Average Daily Traffic (AADT) shall be worked out by applying seasonal factors. The number of Commercial Vehicles per Day (CVPD) shall be computed from ADT or AADT.
- Relevant traffic volume data from secondary sources also may be compiled and the salient features of traffic volume characteristics shall be detailed.
- Traffic Demand Estimation shall be conducted with due detailing and shall establish possible traffic growth rates in respect of all categories of vehicles. Overall traffic forecast and projected PCU shall include the analysis for network road development and the data thus made shall form the basis for the design of the cross-sectional elements, and other facilities/ancillary works.

- Turning Movement Surveys for estimation of peak hour traffic shall be carried out at the important intersections. The details regarding composition and directional movement of traffic shall be furnished.
- One-day axle load survey should be conducted, for road improvement projects, as per IRC:37-2012 / IRC: SP:19. For all roads that are expected to carry design traffic more than 5 msa, axle load survey shall mandatorily be conducted. For low volume roads, indicative VDF values as per IRC:37-2012 may be considered.
- The axle load surveys shall normally be done using axle load pads or other sophisticated instruments. The location(s) of count station(s) and the survey methodology including the data formats and the instrument type to be used shall be documented before taking up the axle load surveys.
- The axle load data should be collected axle configuration-wise. The number of equivalent standard axles per truck shall be calculated on the basis of results obtained. The results of the survey should bring out the VDF for each axle configuration. Local enquiries about the exceptional live loads that have occurred in the past may also be analysed and documented.
- Pavement Design shall preferably be validated using IITPAVE software and its documentary design notes submitted.
- Raised footpath with universal design provision for accessibility shall be provided with considering access to the differently abled person.
- Pedestrian Count & Cross Traffic Surveys may be conducted to determine the requirement for footpaths, provisions required for pedestrian crossings, locations for underpasses / overhead crossings etc for pedestrians to improve the traffic safety.
- The details of all important physical features & utilities along the alignment shall be collected and a comprehensive utility relocation plan based on important physical features along the entire project corridor shall be performed. The features which affect the project proposals should normally include buildings and structures, educational institutions, monuments, burial grounds, cremation grounds, places of worship, railway lines, stream/river/canal, water mains, severs, gas/oil pipes, crossings, trees, plantations, utility services such as electric and telephone lines (O/H & U/G) and poles, optical fibre cables (OFC) etc. The survey would cover the entire proposed RoW of the road on the adequate allowance for possible shifting of centrelines at some of the intersection locations.
- Land Acquisition Plan shall include detailed schedules about acquisition of land holdings, and their locations in a strip plan and also the costs as per district authorities and the market rate basis. It should also include plan of compensating afforestation, its land requirement with specific locations and cost involved for undertaking all such activities in this regard. It should also take into consideration leasehold and land to be temporarily acquired for the project. Land acquisition should include space for accommodating utility equipments such as transformer, junction boxes, telephone pillars etc.

- These details regarding the land acquisition plan shall be submitted as a minimum:
    - Details of the Centre line of the proposed road along the proposed right-of-way clearly marking the requirements of land acquisition;
    - Detailed schedules for acquisition of additional land and additional properties in consultation with the revenue authorities; and, this shall be attached with a detailed listing of all built structures within the proposed right of way and the valuation associated. Outcomes of the Social Impact Assessment (SIA) conducted shall be clearly accommodated in the schedules, while preparing the LA plan.
    - The strip plans and land acquisition plan shall be prepared on the basis of data from environmental / social screening, revenue records and detailed topographic surveys.
- The Report accompanying the strip plans should cover the essential aspects as given under:
    - Land Acquisition Plan (LAP) and schedule of ownership thereof and Costs as per Revenue Authorities and also based on realistic rates.
    - Details of properties, such as building and structures falling within the right of way and cost of acquisition/resettlement/relocation based on actual market rates.
    - Corridor wise accounting regard to felling of trees of different type and girth and value estimate of such trees based on realistic rates obtainable from concerned District forest office.
    - The strip plans shall clearly indicate the scheme for widening. The views and suggestions of the concerned authorities and stakeholders shall be duly taken into account while working out the widening scheme (left, right or symmetrical)
    - Kilometre-wise strip plans for each segment shall be prepared separately
- Arboriculture and Landscaping – The appropriate plan for planning of trees (specifying the type of plantation), horticulture, floriculture on the surplus land of the right-of-way with a view to beautify the roads / highway and making the environment along the highway pleasing shall be explored and provisions included. The existing trees/plants shall be retained to the extent possible.
- Details of way side amenities provided and its facilities

5. ENGINEERING SURVEYS AND INVESTIGATIONS

- Topographic surveys to be conducted preferably using LIDAR and the data used to plot the LS and CS. The finished road level and the subgrade level should be fixed as per IRC:34-2011.
- Levelling Survey with GPS stations and coordinates, a brief methodology of levelling survey, accuracy adopted, nearest GTS bench mark etc.
- The width of the survey corridor should take into account the layout of the alignment including the extent of embankment and cut slopes and the general ground profile. While

carrying out the field surveys, it should be borne in mind that the topographical surveys should cover sufficient width beyond the centreline of the proposed carriageway.

- Where existing roads cross the proposed road, the survey shall extend a minimum of 100 m either side of the road center line and the data should be sufficient to allow improvements, including at grade intersections, grade separators, to be designed.
- The topographical surveys for longitudinal and cross-sections shall cover the following as a minimum:
    - Longitudinal section levels along final centre line at every 25m interval, at the locations of curve points, small streams, intersections and at the locations of change in elevation.
    - Cross sections at every 25m interval in full extent of survey. Cross sections shall be taken at closer interval at curves.
    - Longitudinal section for cross roads for length adequate for design and quantity estimation purposes.
- Soil and Materials Survey:

  The Subgrade soil is to be tested for its properties @ 1 trial pit/km and as per IRC:37-2012, if the length of the road is more than 10 km. For shorter roads, a minimum of 2 trial pit/km shall be staggered and taken. A minimum of three samples should be tested corresponding to each homogenous segment. All basic tests viz., Atterberg's limits, Proctor density (IS:2720- Part-8), Optimum Moisture Content (OMC), Soaked CBR at max dry density and OMC, free Swell Index along with Wet sieve analysis results.

    i. Soil investigation report including CBR details
    ii. Borrow area and quarry details ensuring the quality and quantity of materials, construction water sources
    iii. Soil sample collection and Testing
- For problematic soils the testing shall be more rigorous. The characteristics with regard to permeability and consolidation shall also be determined for these soils. The frequency of sampling and testing of these soils shall be finalized in consultation with the client.
- Materials Report with the details concerning the proposed borrow areas and quarries for construction materials and possible sources of water for construction purposes shall be furnished. The report shall include details on locations of borrow areas and quarries shown on maps and charts and also the estimated quantities with mass haul diagram including possible end use with lead involved, the details of sampling and testing carried out and results in the form of important index values.
- Other surveys if any, shall be performed as its detailed report submitted as per the guidelines for planning and design, issued by KIIFB

6. ENGINEERING DESIGN

- This section should elaborate the technology choices, structural aspects, pavement layer options and evaluation of the technology option, as well as the basis for the technology for the proposed project.
- Detailed description of site including topographical and geotechnical investigations adequate to design the road cross sections shall be furnished.
- The design of new pavement sections, and of strengthening measures (overlay) for the existing pavement shall be carried out in accordance with the criteria, standards and specifications given the latest publications of Indian Roads Congress (IRC) and MoRTH.
- Before strengthening treatment is prescribed, a detailed pavement condition survey and evaluation shall be carried out in accordance with IRC: 81 / IRC:115 to determine the extent of distress and nature of deficiency in the existing pavement structure and whether any special treatments e.g. provision for remedying reflection cracking, pavement internal drainage, sub grade improvement/ reconstruction, or rectification of any other deficiencies are warranted.
- The detailed design of pavement shall involve the design of pavement for the carriageway and design of paved shoulders. The design of pavement shall be rigorous and shall make use of the latest Indian and International practices. The design option shall be established on life-cycle costing, alternate pavement designs and techno-economic considerations taking design period of 15 years for flexible pavement.
- While designing the pavement, specific aspects of the terrain and topographic conditions, weather conditions, etc. shall be duly considered and suitably incorporated in design so that pavement is able to perform well for the design traffic and service life.
- The shoulders shall be designed as integral part of the pavement for the main carriageway. The design requirements for the carriageway pavement shall, therefore, be applicable for the design of the shoulder pavement. The design of granular shoulder, if adopted should take into account the drainage considerations besides the structural requirements and shall follow the specifications as stipulated in IRC publications.
- The pavement design task shall also document the maintenance and strengthening requirements and periodicity and timing of such treatments including overlay requirements.
- Traffic safety features and road furniture including traffic signals, signs, markings, overhead sign boards, chevrons, crash barriers, delineators etc shall be analysed. The locations of these features shall be given in the reports and also shown in the drawings.
- Report of the third-party road safety auditor, as per IRC: SP- 88, shall be included as an appendix. The audit team shall consider the safety of all road users and qualitatively reports on road safety issues and opportunities to improve safety. The provisions shall be included in the estimate as required as an outcome of the audit.

- Detailed analysis, including evaluation of alternate options and design for all embankments of height greater that 3m shall be performed. The design of embankments should include the requirements for protection works and traffic safety features.
- The Drawings Volume covering the following aspects shall be prepared and submitted and the volume shall be 'good-for-construction' drawings. All plan and profile drawings shall be prepared in scale 1:100 (V) and 1:1000 (H) scale. The following drawings shall be provided, but not limited:
    - Key map of the project
    - Horizontal Alignment showing existing tar edge, proposed C/W, ROW, existing and proposed culverts, retaining structures, cross ducts and bus bays and Longitudinal Profile including existing and proposed culverts, by-roads
    - Cross Section @25m interval along the alignment within the RoW with details of protection works if provided
    - Typical cross-sections of all features in the entire RoW including pavement layers
    - Detailed Working Drawings for individual culverts and Cross drainage structures.
    - Detailed Working Drawings for individual Bridges and Structures.
    - Detailed Drawings for at-grade and grade-separated Intersections and interchanges.
    - Drawings for Road Sign, Markings
- Schematic Diagrams (Linear chart) indicating but be not limited to the following
    - Alignment, Existing RoW and Proposed ROW. Locations of median openings, intersections, interchanges, underpasses, overpasses, bypasses.
    - Location of traffic signals, traffic signs, road markings, safety features; and
    - Locations of bus bays, bus stops, parking areas, street lighting etc.
- All drawings shall be prepared preferably in A3 size sheets. The drawings shall include details of all Benchmarks and reference pillars, control points, Horizontal & Vertical Intersection Points The coordinates of all points should be referenced to a common datum, preferably, WGS 84 referencing system.
- The drawings shall also include the locations of all traffic safety features including traffic signals, signs, markings, crash barriers, delineator and rest areas, bus bays, parking areas, street lighting requirements etc.
- The typical cross-section drawings should indicate the scheme for future widening of the carriageway. The proposed cross-sections of road segment passing through urban areas should indicate provisions for pedestrian movements and suitable measures surface and sub-surface drainage and lighting, as required.
- The Strip plans shall be prepared on the basis of data from reconnaissance and detailed topographic surveys covering the following details
    - Details of the centre line of the proposed road along with the proposed right-of way limits to appreciate the requirements.

- The details captured in the land acquisition plan should be such that the concerned authorities could readily initiate the proceedings of acquisition
- Strip plans showing the position of existing utilities and services indicating clearly the position of their relocation
- Separate strip plan showing shifting / relocation of each utility services in consultation with the concerned local authorities
- Strip plan shall indicate the proposed retaining walls & slope protection adopted
- The utility relocation plans should clearly 'show proposed right-of-way and pertinent topographic details including buildings, major trees, fences and other installations such as water-mains, telephone and electricity poles, and suggest relocation of the services along with their crossings the highway at designated locations as required and prepare necessary details for submission to the Service Departments;

7. FINANCIAL ESTIMATES & COST PROJECTIONS

- This section should focus on the cost estimates, budget for the project, means of financing and phasing of expenditure.
- Cost estimates have to be worked out on the basis of detailed bill of quantities (with detailed measurements of length, breadth, and depth / height for each item), using the current Schedule of Rates of the State Government (PRICE) or relevant SOR as applicable.
- Applicable taxes, contingencies including any O&M cost for a specific period shall be clearly specified.
- Details of land acquisition including the survey details, type of land, fair value etc shall be provided in detail.
- Details of utility shifting shall be provided in detail included the expected nos. of utilities to be shifted, various agencies involved and realistic estimate of cost.

8. REVENUE STREAMS

- Options for cost recovery, if any, should be explored
- Innovative ideas for additional revenue generation, including potential for advertisements, revenue recovery options by creating commercial value oriented investments adjacent to the roads, wayside amenities etc may be indicated.

9. COST BENEFIT ANALYSIS & INVESTMENT CRITERIA

- Cost Benefit Analysis (CBA) is a technique whereby the costs of and benefits from a scheme are quantified over a selected time horizon and evaluated by a common yardstick.
- Cost Benefit Ratio (CBR - benefit to cost ratio), EIRR (Economic Internal Rate of Return) etc. shall be worked out in detail with all supporting primary and secondary data conforming to the guidelines of IRC: SP 30 - 2009.

- The project cash flow projections for the life cycle along with underlying assumptions have to be presented.

10. ENVIRONMENTAL & SUSTAINABILITY ASPECTS

- An Environmental Management Plan (EMP) is to be developed explaining the possible environmental issues which may arise during the construction and operation of the infrastructure and associated facilities depending upon the size of the project.
- An environmental auditing for measuring the effects of certain activities on the environment against set criteria or standards. For considering Air quality, noise quality, water quality and resource management.
- Environmental impact assessment study if mandatory and measures identified to mitigate the adverse impact, if any shall be conducted and documented in detail.
- Issues relating to land acquisition, diversion of forest land, wildlife clearances, rehabilitation and resettlement should be addressed in this section.
- The study shall also evaluate the environmental impact, if any, due to developments of the roads with special reference to whether it would affect any hills, water bodies the free flow of any natural streams/canals etc due to development of roads.
- The study shall also cover the socio-economic impact that can be achieved by the development of the roads selected. It may include the details of commercial activities, agriculture, industries, pilgrim centres, tourist spots, S.C./S.T. colonies etc. along the sides of the roads and evaluate the developments that will accrue to these categories on a long term basis by the upgradation of those roads.
- Inclusion of international best practices in sustainable infrastructure management including potential low carbon emission, low energy, zero pollution etc. is desirable.

11. RISK ASSESSMENT AND MITIGATION MEASURES

- For those projects which involve large capital outlay and various issues relating to land acquisition, environmental aspects, a detailed and systematic risk analysis may be resorted.
- Identification and assessment of implementations risks which can lead to time overrun, cost escalation, scope reduction etc. is the primary stage in risk assessment.
- Risk analysis could include legal/contractual risks, environmental risks, revenue risks, project management risks, regulatory risks etc.
- The mitigation plans including risk avoidance, risk transfer, and risk elimination are to be well analysed and documented.
- For complex projects with multiple risk profiles, numerical modelling and simulation may be adopted.

12. PROJECT MANAGEMENT ORGANISATION

- Responsibilities of different agencies for project management of the said project should be elaborated. The organization structure at various levels, human resource requirements, as well as monitoring arrangements should be clearly spelt out.
- Management arrangements refer to the institutional structures and mechanisms that would be set up for ensuring effective project management. The involvement of external consultant if any shall be documented

13. CONTRACT MANAGEMENT STRATEGY

- Contracting methodology for the execution of the project should be specified in detail. (item rate, lump sum, design and execute, EPC etc.)
- The system followed in the bidding document and manuals of reference etc. shall be explained (PWD/CPWD/ FIDIC) etc.
- Any variation proposed from the current practices acceptable under Govt. of Kerala (Arbitration, escalation etc.) in the system due to any specific technical aspects associated with the project need to be explained with justification.
- Any contract clause which may likely to lead to additional financial liability shall be identified and reported with suggestions to overcome such issues.
- The detailed plan for the traffic management and safety during the construction period shall be detailed.

14. IMPLEMENTATION SCHEDULE & WBS

- The time bound work schedule is an important part of every project because it helps in better handling of projects in planning, implementation etc.
- This section should indicate the propose zero date of commencement and also provide a Bar chart / Project Schedule, wherever relevant.
- Phasing of project activities, proposed contract packages and schedule of implementation for each phase.
- Identify critical dependencies in the project and expected timelines for completion of key milestones and associated process indicators for the same.
- The DPR should provide a time-bound action plan including tendering, appointment of contractors, construction schedule, quality assurance & quality control and post-construction activities, including project delivery.

15. STATUTORY CLEARANCES

- This section should elaborate the statutory clearances to be obtained from the various authorities.
- Statutory approvals as per bye laws, master plan, fire safety norms, environmental clearance etc. as applicable for the project are to be taken.

16. QUALITY MANAGEMENT PLAN

- The DPR shall include information relating to the institution to be engaged in the quality assurance & quality control of the project execution.
- Methodology to be adopted to ensure the quality of construction should be clearly mentioned in the report.
- Quality management plan including the internal inspection and testing procedure shall be documented.
- Third party quality control mechanism if adopted its structure and plan shall be specified in detail.

17. OPERATIONS & MAINTENANCE PLAN

- The DPR shall incorporate/include information relating to the institution to be engaged in the O&M of the created infrastructure asset/enhanced infrastructure assets.
- Brief description/analysis of the key issues and obstacles in regard to O&M (including billing/collection issues) and proposed countermeasures to overcome them for the project should be contained.
- Requirement of funds for operation and maintenance of assets should also be included in the report.

ANNEXURES

I. KEY MAP OF THE PROJECT LOCATION
II. CHAINAGE WISE PROFORMA AS PER TEMPLATE 2
III. INVENTORY OF EXISTING FEATURES LIKE CULVERTS, BUS BAYS & SHELTERS ETC
IV. DRAWINGS VOLUME INCLUDING PLAN & PROFILE DRAWINGS, STRIP PLAN AND ALL OTHER DRAWINGS AS INDICATED IN SECTION 6 OF THIS TEMPLATE
V. GEO-TECHNICAL INVESTIGATION REPORT (CBR, SOIL TEST RESULTS ETC)
VI. BBD / FWD TEST RESULTS
VII. LAND ACQUISITION PLAN CLEARLY MARKED IN THE ALIGNMENT DRAWING
VIII. PAVEMENT LAYER COMPOSITION
IX. ESTIMATE SUMMARY, GENERAL & SPECIFICATION ABSTRACT, DETAILED ESTIMATE
X. PAVEMENT EVALUATION & DESIGN REPORT
XI. COPIES OF STATUTORY APPROVALS
XII. SAFETY, ENVIRONMENTAL AND SOCIAL AUDIT REPORTS
XIII. ROAD SAFETY AUDIT REPORT
XIV. ROAD SAFETY STRIP PLAN
XV. ROAD MARKINGS & FURNITURES

TEMPLATE 2 - CHAINAGE WISE PROFORMA FOR SITE DETAILS

Name of the Project:

Project Code:

Cost:

Length of Road:

Land Required (Free Surrender /Land Acquisition):

Type of work (Widening / Improvement / New Formation):

Minimum distance of 1km shall be followed while preparing the sheet. If any key change in feature is noted, smaller chainage length shall be adopted

	Chainage	Ch: 0/000 to Ch: 1/000	Ch: 1/000 to Ch: 2/000	Ch: …… to Ch: ……
Project Details	Name of town/Village			
	Location Description			
Design Basis	CBR			
	MSA			
	Deflection			
	Traffic Data (PCU/day)			
	CVPD			
Existing Road Details	Type of existing road			
	Average ROW in m			
	Carriage way in m			
	GSB in mm			
	WMM in mm			
	DBM in mm			
	BC in mm			
	WBM in mm			
	Chipping Carpet in mm			
Proposed Road Details	Type of road			
	ROW in m			
	Carriage way in m			
	Type of shoulder (Earthen/ Bitumen/ Concrete/ Interlocking)			
	Width of shoulder in m			
	Length of shoulder in m			

Functional requirement	2 Lane / 4 lane / 6 Lane			
	Cutting			
	Filling			
	Height of Embankment			
	Slab Culverts (Existing / Proposed)			
	Box Culverts (Existing / Proposed)			
	Drain Type (OD/FC/ID/LD)			
	Drain Length (L/R)			
	Utility Ducts Type			
	DR retaining wall with height (L/R)			
	RCC retaining wall with height (L/R)			
	CC retaining wall with height (L/R)			
Pavement design	GSB in mm			
	WMM in mm			
	DBM in mm			
	BC in mm			
	Pavement thickness in mm			
Road Furniture	Traffic Sign, Road Marking and Other Appurtenances			
	Boundary Stone laying			
	Safety Barriers			
	Bus Bays			
	Bus Shelter			
Repairs and Miscellaneous	Extension of Bridge			
	Repair and Rehabilitation of Bridges			
	Land Acquisition (L/R) m^2			
	Utility Shifting (EP/TP/TF/PUB.TAP)			
Additional Details if any				