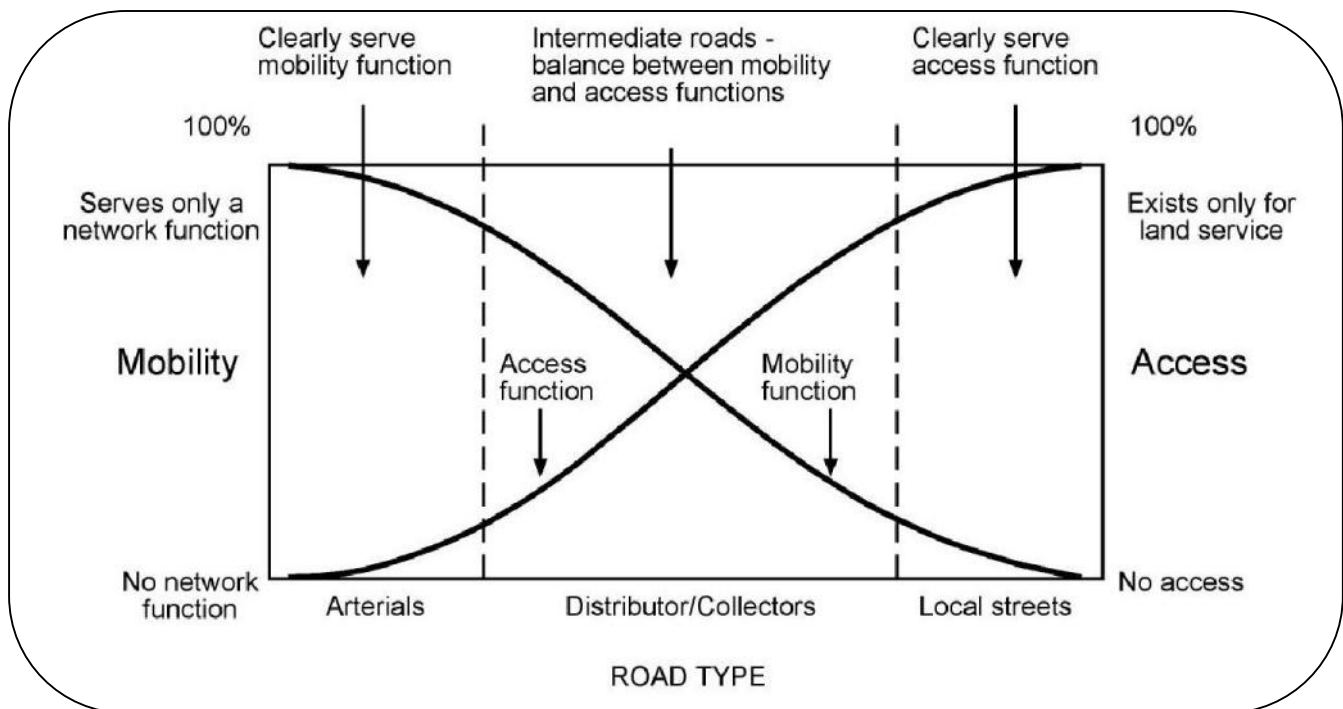


Submission on Draft Nepal Urban Roads Standards to Kathmandu Valley Development Authority



Dr Partha Parajuli

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February 2015

The Chief Development Commissioner

Kathmandu Valley Development Authority (KVDA)

Kathmandu, Nepal

Thank you for the opportunity to attend FOURTH KATHMANDU SUSTAINABLE URBAN MOBILITY FORUM which was held on 2nd February 2015 from 08:30 AM TO 02:00PM at Hotel Shanker, Lazimpat and to contribute to the development of Nepal Urban Roads Standards (NURS). Thanks also to Kathmandu Sustainable Urban Transport Project (KSUTP) to authorize the participation in the forum.

Although I attended the Forum on behalf of KSUTP, this submission is prepared on individual capacity. The contents of the submission may not necessarily represent the formal position or views of the KSUTP.

The submission is based on the presentations made in the Forum and subsequently supplied Draft Concept Paper. The invitation email and other documentations from KVDA together with the request email inviting comments as well as the Draft Concept Paper are attached at the end of this text (See Appendix A) for future reference and record.

While a list of legal and policy framework is included in page 2 of the first part (Development Concept) of the concept paper, it does not attempt to relate all relevant Acts with NURS sufficiently to enable empower the agencies to implement the standards. It is recognized that Section 2 of the second part (Proposed Standards) does mention the legal background of the NURS. It is suggested that the NURS clearly states the consequence of not adhering to the standards. It is also required to mention when the standards would become effective, who has the power to amend it, what would happen when standards are not complied with, what if a member of the public opts to challenge the implementation of the standards, what is the responsibility and obligation of the professional engineers in the design and operation of urban roads. It is appreciated that these issues are not the content of the NURS itself but the concept paper should have clarity on these matters. Further, it is highly desirable, and in fact essential, that for which roads these standards are applicable. For example, are these standards to be applied for new construction, or to existing or during upgrade or what? Are these standards to be followed by Department of Local Infrastructure Development and Agricultural Roads (DoLIDAR), District Development Committees (DDCs) and Municipal Development Committees (MDCs) who also develop, own, manage and operate road asset. Part of rural roads may pass through urban fringe and rural township. Will these standards are to be applied by these agencies? Also what is the role of KVDA in NURS is not clear. Department of Urban Development and Building Construction (DUDBC?) is another agency which is also concerned with urban road development, Is there any role for it in urban roads planning and management? The document states that the legal power for the implementation of NURS comes from KVDA Act 2045. I think there is a need of clarity here. I would suggest that a separate Document Application Section be included in NURS where one would like to explain all these details including the time line for NURS implementation and proposed institutional framework for implementing and monitoring NURS (See Appendix B). If my understanding on the division of

responsibilities for road transport sector management is correct, we should acknowledge that the responsibilities are fragmented among multiple agencies. One would argue rural roads are not covered by this standards and why we need to worry about it? However, as discussed above, sections of rural roads could pass through the township or urban fringe and it is not clear whether NURS should be applied on those roads when such roads pass through the towns. If it is confusing to me, it should be confusing to other users as well. I think NURS is not a document for Kathmandu City only, although its implementation trial can well be limited to Kathmandu. I suggest that readers and users be given clarity in the scope, application and ownership of the document.

It is believed that NURS is applicable only for public roads. If it is so, a definition of a public road needs to be included at the beginning of the document.

The remainder of the submission below contains comments/ clarifications /suggestions on NURS by its sections.

Section 1: I would suggest that "minimize commuting time" be replaced by "reduce travel time". In transport profession, commuting time implies specific type of travel (regular) such as trip time to work or schools. We can aim to reduce travel time from what it is now but minimize it is probably a big challenge.

Section 2: Is KVDA Act -2045 the only Act that is related to this document. What aspects of roads are addressed by Public Roads Act? What aspects of roads are addressed by Vehicle and Transport Management Act (VTMA). Which Act is applicable when urban roads are not used by road users appropriately or misused or encroached? Who administers access control and who issues permits to access urban roads? These are very critical issues from urban roads operation (safety and capacity) perspective and NURS should address these. In fact, the proposed NURS does not address the issue of number of private accesses (driveways) that can or should be permitted (not permitted) adequately (Also see other sections of this submission).

Section 3: Definition of urban roads is another critical issue. This definition should be broader and inclusive. While it is a good idea to start with simple definition, it should not be too loose to allow loop holes for misinterpretation. Also, as said above, the definition should be broader to reflect various level of urbanization. For example, a road standard appropriate to use for fully built commercial and residential environment cannot be applied to urban fringe or rural township environment. If one would try to apply the same standard for these two different urban environments, the NURS is bound to fail. It will simply be not accepted by the community. We should introduce different classification system of urban roads in these different environments and apply standards for roads under these urban environment options with possible gradual change over from one environment to another environment. It is therefore suggested that urban road classification be linked with land use/ degrees of development. We cannot apply, for example, the same standard for Kanti Path at the heart of the city centre and to Tokha Road, although both roads as per Section 3 of the proposed NURS are classified as urban roads. This is an impractical definition of urban roads from functional or technical, although administratively, this definition is quite correct. Please see comment on Section 5.

Section 4: It will be unfair to miss out safety in the list of guiding principles for NURS. It is suggested that safety of all road users be included as one of the guiding principles in defining urban road standards. It may be argued that the first two dot points implicitly consider safety and general design principles and is included in Section 6. However, safety outcome needs to be highlighted not only in the design but also in planning and functional classification stage. Also we need a definition of Level of Service (LOS). NURS concept paper uses this term without its definition. Not every designer would probably know the term LOS (Concept of LOS A to D which was common to traffic engineers was not known to me even by the time I already produced the design of hundreds of kilometer of roads!). Other terms also need to be defined.

Section 5: The proposed road classification derived from KVMP does not differentiate between the traffic carrying function and local access function, whereas the engineering basis for setting design standards is to be based on this functional classification of roads. This is the heart of any design standards. Also dedicated Padyatru Kshetra and cycle ways are not roads by definition. Any local streets can be converted into shared zone or pedestrianised zone (Padyatru Kshetra). It is believed that declaration of a street to shared zone is an operational issue and not the design standard issue. It is therefore suggested that item E and F be taken out from the classification of section 5. Please note that a cycle lane is a design element of a road and an off-road cycle way does not fall under the category of roads.

Taking into consideration the KVMP classification proposed in the draft NURS and need to relate this classification in engineering system, it is suggested that the functional classification of roads as shown in Appendix C be adopted in developing NURS.

In the suggested option of urban road classification (Appendix C), it is acknowledged the gradual development of roads occurs from predominantly rural to predominantly rural residential (urban fringe) to roads in fully built up commercial or residential or mixed (commercial/residential) land use environment. Equivalent nomenclature is also given in Table C1, which can be extended to other land use environment. It is more sensible classification system for a developing city like Kathmandu as it allows gradual change over.

Number of lanes in any roads is a function of traffic volume. It is not mandatory that an arterial road should "essentially" have four lanes, although there is some linkage. There are many arterial roads elsewhere in the world with two lanes. It is considered that the road classification is to be based on its functional hierarchy in the urban road network. While the right of way for urban arterial roads should allow the expansion of lanes to cater for future traffic growth, four laning is not to be the essential feature of urban arterial roads (Path). Similarly, provision of kerb cycle lane or dedicated cycle lane should be addressed by urban transport policy.

While a median strip of width equal to or more than the width of a traffic lane is a great idea, it is not feasible to have these in existing arterial roads. Hence this requirement should be specified only for new construction or where the provision is practical during the time of road widening or upgrade. In fact, the requirement of median strip is largely for safety and for introducing right turn pocket lane. In low speed urban arterial roads, there is no need to have median strip. Only if the posted speed limit is higher than 70km/hr median barrier is recommended to reduce severity of head on crashes. I would not recommend median strip is to be an essential element

of urban arterial roads but to include as a desirable feature. Also note that the second statement in Section 5.1 contradicts with the statement in the subsequent sentences. It is suggested that the last paragraph be removed as decision to allow or not to allow parking is an operational issue and not the design issue. Whether a separate parking lane is to be provided or not in the design in addition to traffic carrying lane is an issue to be based on capacity analysis and parking requirement as well as parking policy.

It is strongly recommended that the provision of expressway be totally removed from NURS. Any roads inside the outer ring road (proposed) and middle ring road (existing) should not have posted speed limit higher than 60km/hr. I would recommend it even lower for Kathmandu context. A posted speed limit is usually 10km/hr less than the design speed. The design speed for urban roads in Kathmandu therefore does not have to be higher than 70km/hr. I would suggest that the reference to expressway in Figure 3 be replaced by arterial road (Path) with limited access. Also, please forget dreaming about providing underpass or overpass in any urban roads in Kathmandu. This is my humble request to the engineering community in Nepal. There is no need to construct these expensive structures. A properly functioning network of traffic lights will serve pedestrians very well in most cases if not all. It is therefore suggested to remove reference to subway in Figure 3 and instead specify desirable frequency of mid-block pedestrian crossings (pelican) if the distance between the two intersections with (or without) traffic light is greater than 1 Km.

It is suggested that the Path be functionally defined as an urban arterial road (Examples: Kathmandu - Bhaktapur Road, Kathmandu - Lalitpur Road, Kathmandu - Kirtipur Road, Section of roads within ring road carrying Valley outbound traffic) and not as primary distributor, Sadak as sub-arterial (example Putali Sadak), Marg as trunk collector and collector road and Galli as local street. Someone should sit with the road network map, revisit the functional hierarchy and re-designate existing roads into arterial, sub-arterial, trunk collector, collector and local types. This is a very important piece of exercise for Kathmandu that should be done sooner than later (if not done yet), especially after the road widening program implemented in recent years.

Section 6: I suggest one more dot point "Provide for transit / bus lanes (where feasible or as designated by policy) be added. For sustainability of urban transport system, someone at some stage must make a hard decision to designate one kerb lane in each direction along at least one north-south and one east-west radial arterial road corridor for transit vehicles or buses (transit lane or bus lane).

Section 6.1.1: Can I suggest we replace cruising speed by posted speed limit? Posted speed limit is the maximum speed at which a motorist is permitted to drive. It is an offence to drive vehicles at speed higher than the posted speed limit.

Remove second paragraph altogether. Having suggested to remove expressway from urban road system in Kathmandu within outer ring road, there is no need of this paragraph.

In Table 4, there is no need to provide figures for likely 85th percentile speed. This is not a design parameter and including figures for 85th percentile speed in NURS just confuses practitioners.

Reduce design speed to 70 km/hr, 60km/hr for Path and Sadak. Most existing urban arterial roads are without median strip. From Safe System Approach (which is adopted by Nepal Road Safety Action Plan) perspective, we should encourage to use harm minimization speed (For definition of harm minimization speed please refer relevant literature) for posted speed limit. As mentioned earlier, in absence of operating speed model, posted speed limit (maximum allowable speed) is 10 to 5 km/hr less (higher figure for Path and Sadak) than the design speed. Also replace the term "Allowable maximum speed limit" by "posted speed limit". If there is no posted speed limit signed, then the speed limit defaults to 60 m/hr for arterial roads, 50km/hr for sub-arterial roads, 40 or 30 km/hr for Marg and 10 km/hr for Galli)

In most countries, speeds of heavy (commercial vehicles - buses and trucks) vehicles are required to be less than for passenger cars and motorcycles. I am not sure what is the rationale for recommending higher speed limit for buses and trucks than for passenger cars. For safety reason, lower speeds for larger vehicles are to be considered. It takes more time to stop heavy vehicles (momentum is high for the same speed). I strongly suggest to adopt 50, 40 and 30 km/hr posted speed limit for Path, Sadak and Marg respectively for passenger cars and 40, 30 and 20km/hr for heavy vehicles and tempo (tempo has low stability feature) for Path, Sadak and Marg respectively.

Remove the provision for bicycle speed limit. Most bicycles are not fitted with odometer and it is impractical to specify maximum allowable speed (we cannot monitor speed and therefore we cannot enforce speed limit and penalties attached for speeding). Also reference to bicycles and expressway is redundant if my suggestion is considered. Also remove Padyatru Path (previously it was called Padyatru Kshetra) and cycle lane because reference to speed for these vehicles

An example of speed limits for various functionally classified roads and road spaces is included in Appendix D. It is not my intent to include as attached in NURS but to demonstrate that setting an appropriate speed limit is a complex process and there are overlaps between various classes of roads. It is because the posted speed limit is not just a function of road class but also its design/ geometric features and built environment.

Section 6.1.2: I am not sure if giving desirable acceleration and deceleration figures encourages practitioners to design the length of turning lane using formulas which are not included in the standard. There are standard tables available to consider these parameters in the design of right turning or left turning slots. As these are based on the theory of mechanics those standards are usually replicable everywhere. Examples of such tables are included in Appendix E. These are universal standards and can be considered for NURS as well. The minimum length is provided from acceleration and deceleration requirements but the actual length of turning slots is determined by operational analysis (using software similar to SIDRA or manually applying queuing theory for the given right turning volumes and through volumes such that vehicles would not block either of through and right turn lanes). You may only wish to specify the minimum length of taper section instead of acceleration and deceleration figures, if you so wish, at this stage. Alternatively, If decided to include tables in the NURS, I can be contacted.

Section 6.2.1: Suggestions not offered - should be discussed first in person with the author. I am not sure if it is practical to implement different vehicle size for different roads. Once import of certain vehicles is allowed, motorist should be able to drive on all roads. Obviously we can limit restriction to commercial (heavy) vehicles or a vehicle of height greater than the specified in a tunnel or low overhead clearance etc. but I am not sure how we enforce restriction of the movement of passenger cars and specify different length, width and height for Path, Sadak, Marg. There would probably be one single design vehicle for establishing swept path and therefore inside turning radius though.

Section 6.2.2: Is not it the other way round? There is no obstruction to pass by opposing flow in divided roads. Hence capacity of divided roads is not dependent on the proportion or distribution by direction. The opposite is true for undivided roads specially when there is one lane in each direction due to limited overtaking opportunity. I hope the reference capacity figures given are taken from some other standards. I suggest that reference be given to have confidence on these figures. We should not just pick up the figures without quoting them! I do not think research was conducted in Nepal urban roads that established these figures. Do the same PCU equivalent figures as for rural roads apply for urban roads? Probably they do not. Are these parameters to be taken from NRS (Now probably to be renamed to NRRS)?

Section 6.2.3: Suggestion not offered. I am not clear if these figures are for on-road kerb side cycle lane or off-road bike lane. A separate standard are produced in other countries for pedestrian and cycle ways. I would be probably inclined to limit to on-road cycle lane only in NURS.

Section 6.3.1: It is not enough just to state here that no reduction of carriage way on bridges and culverts shall be allowed. It is important to change the bridge design standards too. Without this change no bridge designers will likely follow NURS in practice. Also why this requirement is specifically for carriageway? I have seen sub-standard footpath on almost all bridges in Kathmandu!

The carriage way width or lane width specification is too generous. These standards apply for high speed rural roads. For multi-lane roads we can go as low as 3.0m for through lanes. For exceptional circumstances right or left turning slots could be as narrow as 2.75. Although not desirable, this provision should be made to allow retrofit right turn slots at intersections. Width of carriage way should be related to parking policy. If parking is allowed in some streets, these should be mentioned. I suggest carriage way width be specified for two different scenarios: kerb side parking permitted and kerb side parking not permitted.

NURS should encourage adopt a simple rule of "1-3-5" in terms of the provision on the number of lanes. In the new design, NURS should recommend that new local streets (Galli) be provided with one lane (preferably intermediate width), collectors and trunk collectors (Marg) with 3 lanes and sub-arterial roads with 5 lanes (with or without frontage roads depending on the access control and rationalization policy). The existing roads with 2 and 4 lane (Sadak and Path) should be widened and flared at intersections to allow for additional lanes for right turning slots and left turning slots (depending on the volume of turning movements. It is not necessary to widen existing roads at mid-blocks. Most roads in Kathmandu have no problem with mid-block

capacity, it is the intersections, where we do have capacity problem. This important aspect of urban road design requirement is missed out in the proposed draft and this needs to be addressed in this very first version of the NURS (See later for further discussion).

Section 6.3.4: For new road design 4m (and even more) is desirable but we should permit reduced with up to 3m (even 2.75m rare) for retrofit condition.

Section 6.3.7: I assume each rectangle bus stop box will be sign posted with route number and not marked. Pavement marking in the box with assignment for each route may not be the efficient use of urban space as the same box can be shared by buses for multiple routes depending on the arrival and departure rate of buses.

Section 6.3.8: As above. Also marking in the pavement for taxi ranks is not going to last long. Road marking is fine but it should only be complimentary to sign post.

Section 6.5.4: Transition curves should be made as desirable feature. They are not the mandatory requirement for low speed urban environment. It is not practical (neither required) to provide transition curves on urban roads. We generally do not have this "luxury". Speed reductions at sharp bends, blind corners, vertical humps are regular operational measures to cater for sub-standard design even in urban arterial roads in western world. Super elevation and extra widening can be fully introduced within the circular curve as well if needed.

Section 6.6.1: The last statement is a bit harsh. How practical it is given the hilly terrain of the city and many existing intersections and mid-block sections with steep bend? Rethink and if appropriate relax this requirement, although I appreciate novice drivers may likely reverse back and hit the vehicle behind during stop-start operation.

Section 6.6.5: Replace "are recommended" by "shall be used"

Section 6.6.6: This section is perfectly alright because it uses "should" every where.

Section 6.7.1: Add at the end of second paragraph ", where warranted", else we would be required to install signals everywhere.

Add third paragraph as follows: "Need of installing mid-block pedestrian crossings (with or without signals) shall be determined based on the available best practice warrant analysis amended suitably to meet local context."

Section 6.7.2: Absolutely "No" to overpass. Please respect the requirement of physically impaired people, moms and dads carrying children on the back or on the prams, people with heavy back loads and elderly and young people. In a constrained environment of Kathmandu, it is not feasible to provide suitably graded ramp to cater for these people at reasonable cost. Further, value of travel time of motorists by saving a few minutes in stopping at signals would not justify the cost of these structures. If designed improperly, these structures turn into eye shore and ugly feature in urban environment (Look at existing overpasses in the heart of city, are they looking good? A few overhead bridges in the city have already spoiled the cityscape.

These are to be brought down and not added. There are better ways to cater the needs of both motorists and pedestrians at cheaper cost with equity put high on the agenda.

If we would like to include it to please motorists and policy makers who want non-stop travel in the government supplied vehicles, let us include the following warrants for overpass (such that these warrants would rarely be met) first and continue with the revised text to reflect the stated intent as below.

" At locations where (i) pedestrian fatality and serious injury (FSI) crashes are more than six in the recent last three recorded years and (ii) if other low cost options have proved to be ineffective or have failed to prevent these crashes"

Add at the beginning "Where warranted," along.....

Add at the end of the first bullet point "and synchronization of traffic lights fails to cut off queues"

In the second bullet, change cruising speed to operating speed and add at the end "(at locations beyond outer ring road)". I would not worry much about reduced speed within the city: How much time we will save? What is the average value of travel time? Where the saving in travel time would be used by average people- for any productive purpose? For a city of hardly 15 Km diameter, how much travel time you would save by achieving to drive in posted speed limit without stopping (density of traffic and pedestrian intrusion will not let drive in the posted speed limit any way - so what is the rationale for overpass?)

Section 6.7.3: As above

Section 6.8.4: Do we need to proportionately narrow down the kerb lane or we wish to retain as shown because slow kerb lane is usually for wider heavy vehicles and the fast inner lane for passenger cars?

Section 6.10: The document as it is presented here gives the feeling that these are the only traffic management measures that are available and that shall be used in urban roads in Kathmandu. I suggest we include introductory paragraph here to deliver the message that these measures mentioned in NURS are not exclusive and that asset managers shall exercise their discretionary power to choose other forms of traffic management measures (such as slow points, mini roundabouts, raised intersections, wombat crossings, gateway treatments, perimeter/ threshold treatment -red painting at the interface of local street with LATM measures and higher order roads) and recommend to use other available best practices that are suitable for local conditions. There are many horizontal displacement and vertical displacement traffic management treatments, line marking , road painting and signage treatments available, which are equally applicable for urban roads in Kathmandu (Refer Appendix F for example).

Section 6.10.1: We have included a typical design of pedestrian refuge in Section 6.8.4. Why not to provide typical design of a hump as well. Note these humps shall have reflectorized" marking/ teething. This feature is highly important given the poor practice of using sub-standard humps (I call them "killer humps!") can be found everywhere in the city. Please see other changes made in the hard copy. Motorcyclists are particularly vulnerable due to loss of control

resulting from shock and air borne effect. This is a major safety issue. I wonder if there are any records of such crashes.

Please add "Humps shall be installed only with the approval of relevant road authorities" (Municipalities or DoR or DoLIDAR) who owns the asset.

Section 6.10.2: How safe are the rumble strips along the direction of travel? What is the effect on safety of motorcyclists especially where overtaking from left is a common occurrence? What about suggesting Audio Tactile (White or Yellow depending on the permissive or prohibitive parking) Line Marking (ATLM)?

Section 6.10.3: I would have thought the priority should be Regulatory> Warning> Informatory - just for query and reconfirmation. Regulatory signs must be provided s as required by law, disobeying of which is a traffic offence. They are not to be included in priority meaning we may not install these mandatory signs. This message needs to be delivered.

Section 6.10.4: Add in the third bullet "and to delineate no stopping at any time zone. Also is "Parallel continuous white lines to indicate no passing from both sides" included in TSM? If not add this as the last bullet

Section 6.11: Don't we have Indian standards for street lighting? Can we use standard referencing style such as below the Table along the Table title (Adopted from Los Angeles Department of Public Works, Year published) All "shall" in this Section could probably be changed to "should" as most statements are recommendation and not for compliance purpose.

Other General Comments to be attended while finalizing the document:

(a) A cautious approach should be taken in using the term "shall". Use of shall in legal documents implies the designers or agencies responsible for delivering and managing urban roads must comply with this requirement. If the requirement is desirable or is just a recommendation we should rather use the term "should" or "may".

(b) The use of "and" and "or": If one of the items of the list shall be complied to meet the requirements specified in the standard use "or". If the intention is to meet two or more of the requirements together, then use "and". I think this practice is the same as in computer programming; right?

(c) If it is called standards we should not use some thing as statement. For example "Transition curves are provided to gradual introduction of super elevation and extra widening of carriageway are needed at the horizontal curves". This is a text book format. In standards either we should use shall or should depending on whether it is a mandatory requirement or whether it the requirement is desirable. This comment/ suggestion needs to be seriously considered and final version of NURS should be rewritten following the above basic rules. I also suggest that service of an appropriate editor / specialist lawyer be used, as design standards have legal ramifications. It is not a guideline or manual. I also suggest that we start this document as a guide or manual, use it extensively for five years and then convert it to standards status.

(d) In a city like Kathmandu do we need speed higher than 60km/hr? I am not convinced for using speeds higher than 60 km/hr especially with such a level of motorists' and pedestrians' discipline.

(e) Intersections: The proposed NURS does not address standards for intersections adequately. In fact, it can be reasonably said the draft NURS does not address this aspect at all. Intersections are probably the single most important feature of urban roads that need to be designed and standardized. This view is reinforced by my experience in designing over 50 intersections in Kathmandu for KSUTP. It is strongly recommended that a new section be introduced in the document to specify where a particular type of intersections needs to be provided. For example, where a basic right turn facility (BAR) would be adequate, where a channelized right turn (CHR) is required, where an intersection with traffic lights would solve the purpose and where a fly over / interchange should be considered. In my discussion with engineers, planners, asset managers, policy makers and even some officials of the funding agencies, I find that every one seem to think fly over is required at all major bottleneck intersections to solve traffic congestion problem in Kathmandu whereas it is not. People and professionals do not want to consider simple low cost solutions such as relocation of statues from the middle of the intersections or roads that are disturbing proper reconfiguration and increase in capacity/ flow. They do not consider options and make decisions to relocate boundary walls, acquire a few metres of adjacent properties around intersections for flaring and provide space for right turning lanes and left turning lanes at signalized intersections which would otherwise solve congestion and improve road safety but talk about the need of expensive fly overs. The change in mind set requires significant efforts in raising awareness, educating, training these peoples through the development of appropriate standards and design guidelines. If this is outside the scope of this Standard Development Work, it is recommended that the warrants for these different types of intersections/ interchanges (in order of development staging) be at least included in this document and referred to Standards (Guide/ Manual) for the Design of Intersections as its Compendium or stand alone document suggested to be developed as soon as possible.

(f) Standards should be designed as a concise and precise document as agencies are legally bound to follow them (unless you can prove significant community benefits by doing otherwise). These standards alone would not be adequate to guide engineers for doing the right thing. It is recommended that works be planned to develop design guidelines and manual for urban roads and intersections.

(g) Finally, a general statement: Design standards adopted with stringent / inflexible requirements are difficult to implement. We need to have a balance between what we can afford and what is acceptable from safety consideration. Obviously, a design standard that can be applied for greenfield sites may not be applied for brownfield sites. We may develop standards for the greenfield sites, however adequate provisions should be made for relaxation of these standards for the brownfield sites. The extent to which this relaxation should be made is a function of a range of factors including technical feasibility, governments' ability for funding and community acceptability and there are no readymade solutions for each of these specific site conditions. But one thing is sure. Any design delivered by the engineering community should not

kill people. A statement should be included in the NURS somewhere in suitable section clarifying that any substandard design (i.e., the design that does not follow the provision of NURS) should undergo through risk assessment process with suggestions for likely risk mitigating measures and potential costs associated with implementing such measures. Based on this information, the authority responsible for the approval of design would have to make a judicious choice cost vs acceptance of risk. No doubt, it would have give top priority to safety outcomes. Higher design standard cannot be applied every where every times. NURS should provide for permitting lower standards with appropriate risk assessment process and risk mitigation measures. Basic rule is that safety should not be compromised by adopting lower standards without mitigating measures or accepting the risk level. A lower standard is possible with the implementation of safety treatments. If money is not enough to adopt higher standards, we can consider adopt lower standards with safety treatments (such as reduced speed in tight bend, blind corners). That is the reason why even in developed world, there are provisions for Extended Design Domain (EDD) and Design by Exception (DE) process in addition to the usually applied Normal Design Domain (NDD) process. I suggest that a final section with the intent of permitting flexibility in the design with the approval for higher authority by willing to accept identified risk should be included somewhere towards the end section of the NURS in absence of detailed treatment on EDD and DE.

I congratulate KVDA, UN Habitat and other agencies and individual professionals involved in the preparation of this long overdue document. Effort made by Mr Sunil Paudyal to develop the document is particularly great. I appreciate incorporating all comments and suggestions included in this submission in the first edition of the NURS may not be possible due to various constraints and considerations at this stage. The submission is also intended to serve which direction we should take in the development of NURS. I will be pleased to clarify any aspects of this submission and to provide further input further if needed.

Appendix A: Invitation to Forum and Forum Documents

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pmparajuli@iinet.n...

TAEC

Fwd: Invitation for the 4th Kathmandu Sustainable Urban Mobility Forum

Inbox x

People (2)

ykp KVDA

to me, yogeshwar

Feb 1 (7 days ago)

☆

Add to circ

Dear Madam Sir,

We would cordially like to invite you all for the "4TH KATHMANDU SUSTAINABLE URBAN MOBILITY FORUM", which is going to be held on **2nd February 2015 from 08:30 AM TO 02:00PM** at Hotel Shanker, Lazimpat. Please find the attached documents for further details regarding the program

i) Formal Letter of Invitation

ii) Concept Note of the Program

iii) Program Agenda

Thank you.

Regards

Ritu Shrestha

Executive Secretary

Katmandu Valley Development Authority

Kathmandu Valley Development Authority

Anamnagar, Kathmandu

01-4770661

01-4771138

Date: 27th January 2015

Dispatch No: 521



To,

.....

.....

Subject: Invitation to participate in 4th Kathmandu Sustainable Urban Mobility Forum

Dear Sir,

Kathmandu Valley Development Authority in collaboration with, Ministry of Physical Infrastructure and Transport, UN-Habitat and Clean Energy Nepal (CEN) and Clean Air Network Nepal (CANN) Clean Air Asia are organizing **4th Kathmandu Sustainable Urban Mobility Forum** on **2nd February 2015** in Kathmandu. This is a follow up to the "Kathmandu Sustainable Urban Mobility Forum" organized in December 2011, December 2012 and January 2014 in collaboration with the Ministry.

The forum aims to bring the stakeholders together to initiate policy dialogues, enhance partnership and collaboration among stakeholders, and share initiatives and best practices on sustainable urban mobility and better air quality in the valley. This year the forum will be focused on **the needs of urban road standards or design guidelines for Kathmandu Valley**. The meeting will be chaired by Development Commissioner of KVDA, Mr. Yogeshwar K. Parajuli.

Various participants from governmental agencies, non-governmental agencies, developmental agencies, transport experts, urban planners, academia, private sectors and media personnel are expected to participate.

We kindly invite you to participate in the program. Please find the attached concept note and program agenda.

Proposed Program Detail:

Date: 2nd February 2015

Venue: Hotel Shanker, Kathmandu

Time: 08:30 am-02:00pm

Best Regards,

Karuna Ratna Shakya

.....
Karuna Ratna Shakya

Senior Divisional Engineer

4th Kathmandu Sustainable Urban Transport Forum

Background

The sorry state of urban transportation in Kathmandu Valley has serious implications on sustainable functioning of the city. The increase in air pollution, carbon emission, traffic congestion and road fatalities are the direct consequences of inefficient transport management in the valley. Although the roads are being widened throughout the city supposedly to reduce the traffic congestion, no proper standard or design guidelines are followed while expanding the roads. Many of these roads are expanded at the expense of sidewalks and the existing design impedes the mobility of pedestrians.

Although the Government of Nepal has formulated revised National Road Standard (NRS) in 2013, it says it applies mostly for non-urban roads. As we don't have any comprehensive standard or design guidelines for urban road, the main purpose of this year forum is to discuss the needs and importance of urban road standard or design guidelines for Nepal.

Objectives

The main objective of the Kathmandu Sustainable Urban Mobility Forum is to initiate policy dialogues, partnership stakeholder collaboration for better air quality and sustainable urban mobility.

- Discuss existing road standard and comprehensive standards for urban roads.
- Sensitize stakeholders on necessity of urban road standard or design guidelines for ensuring safer, efficient and sustainable urban mobility.
- Bring together and share initiatives and best practices

Target Participants

Around 30 participants from governmental agencies, non- governmental agencies, academia, transport entrepreneurs, media and from other concerned stakeholders: urban/transport planners, road engineers etc. will attend the program.

CEN/CANN's Initiative on Sustainable Urban Mobility

CEN/CANN has been continuously advocating environmentally sustainable transport system through research, policy advocacy, awareness campaigns and online discussions. Along with various other campaigns, CANN/CEN has also organized "Kathmandu Sustainable Urban Transport Forum" to raise the issues of urban transportation system and give a new sustainable direction to the system in the future. KSUMF IV is a succession of KSUMF III organized on February 2014. CEN/CANN in partnership with MoPIT, UN-Habitat, ADB and GIZ-SUTP and other stakeholders have various trainings program such as sustainable urban transportation training, parking management etc. as a part of CEN/CANN initiative for people-centric transport system.

This year, the forum was organized together with Ministry of Physical Infrastructure and Transport, Kathmandu Valley Development Authority, UN-Habitat and Clean Air Asia.



CANN
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4th Kathmandu Sustainable Urban Mobility Forum, 2015

2nd February 2015 (19th Magh 2071)

Hotel Shankhar, Lazimpat, Kathmandu

Program Agenda

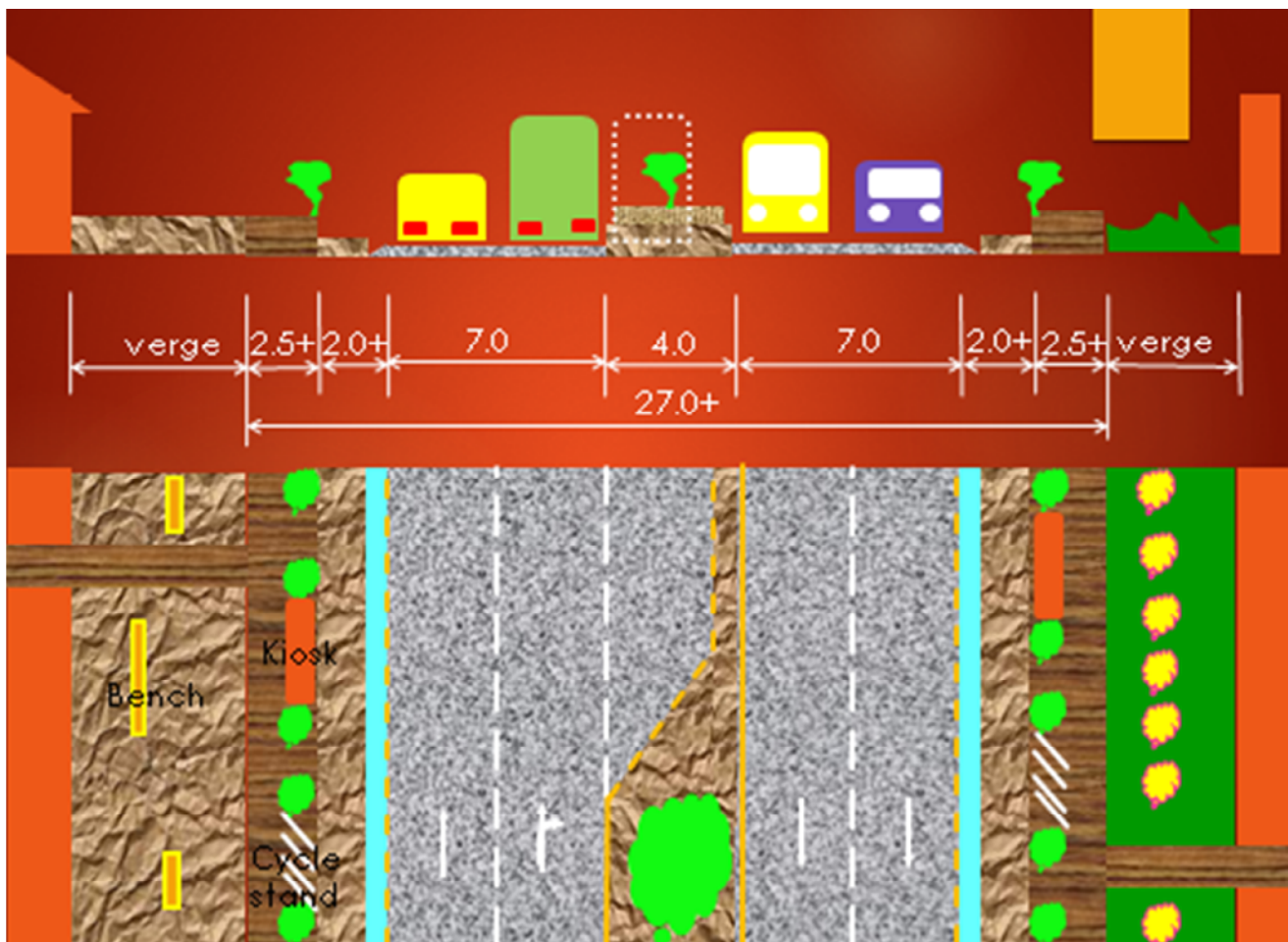
Time	Sessions/Agendas	Presenter/Resource Person
8:30-9:00	Registration and Tea/Coffee	
Session I: Opening Session		
09:00-09:10	Welcome address	Mr. Yogeshwar K. Parajuli, Development Commissioner, Kathmandu Valley Development Authority
09:10-09:20	Introductory Remarks	Mr. Padma Sundar Joshi, Program Manager, UN-Habitat Nepal
09:20-09:50	Key note Speaker-Presentation on Urban Road Standards and Design Guidelines in India	Ms. Paromita (Romy) Roy, UTTIPEC, Delhi Development Authority
09:50-10:05	Remarks	Special Guest- Mr. Arjun Kumar Karki, Secretary, Ministry of Urban Development (5 mins) (TBC) Special Guest- Mr. Tulasi Sitaula, Secretary, Ministry of Physical Infrastructures and Transport (5 mins)
10:05-10:30	Tea Break	
Session II: Technical Session and Group Discussion		
10:30-11:00	Presentation on proposed urban road standards for Kathmandu Valley Q&A with Ms. Paromita Roy and Mr. Sunil Poudyal	Mr. Sunil Poudyal Session chair: Mr. Yogeshwar K. Parajuli
11:00-12:00	Group discussion on the urban road standards for Kathmandu Valley	Facilitated by CEN/UN-Habitat
12:00-12:30	Group Presentation and Recommendation	
12:30-12:45	Crowding and in-vehicular air pollution exposure study of public transportation in Kathmandu Valley	Mr. Narayan Dhital, Research Assistant, CEN/CANN
12:45-12:55	Session IV: Closing Remarks	CEN/CANN
13:00	Lunch	

DRAFT

For comments

NEPAL URBAN ROADS STANDARD 2071

CONCEPT PAPER



Kathmandu, February 2015

Abbreviations

AADT	Average Annual Daily Traffic
AASHTO	Association of American State Highway and Transportation Officials
DUDBC:	Department of Urban Development and Building Construction
DOLIDAR:	Department of Local Infrastructure Development and Agricultural Roads
DOR:	Department of Roads
DRO:	Division Roads Office
E_{av} :	Average illumination
E_{min} :	Minimum illumination
KVDA:	Kathmandu Valley Development Authority
KVMP:	Kathmandu Valley Mapping Programme
h	Hour
IRC	Indian Roads Congress
km	kilometer
kN:	kilo Newton
LED:	Light Emitting Diode
m	Meter
NRS	Nepal Roads Standards 2027 (rev 2070)
NRRS	Nepal Rural Roads Standard 2055 (rev 2069)
NURS:	Nepal Urban Roads Standard 2071
ORN	Overseas Road Notes
PCU	Passenger Car Unit
ROW:	Right-of-Way
s	Second
SRN	Strategic Roads Network (constituted of National Highways and Feeder Roads)
SSD:	Stopping Sight Distance
TSM:	Traffic Sign Manual

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DEVELOPMENT OF CONCEPT

1. OVERVIEW

Urbanization is a global phenomenon. It reflects the desire of the humankind to live progressively in more comfortable surroundings with better access to the livelihood. It is also a measure of the development a country has made. However, this process should be planned and sustainable. The benefits being enjoyed by a section of the community should not be at the cost of the rest.

Nepal is experiencing a phase of rapid urbanization. This has become a major challenge for the urban planners as well as service providers. Planned development of urban roads not only checks the growth of unruly settlements, but also facilitates systematic provision of other services without distorting the city fabric.

Urban road standards is a prerequisite for planned development of urban roads. Although, Nepal Road Standards 2027 (NRS), revised 2070, has some provisions for urban roads, as the Strategic Road Network (SRN) connecting administrative centers and industries to the major trade routes has quite different function, the NRS alone cannot address urban issues. Neither are the issues addressed by Nepal Rural Road Standards 2055, revised 2069, being focused on farm to market and farm to settlement roads.

Both the Department of Urban Development and Building Construction (DUDBC) as well as Department of Local Infrastructure Development and Agricultural Roads (DOLIDAR) have recently started to build urban roads. To address the urban issues, both of them are parallelly formulating a set of standards for urban roads. As the oldest road agency DOR has been constructing and maintaining, including urban roads until recently, through its Division Road Offices (DRO). However, so far it has been paying little attention to follow whatever standard it has for urban roads. Following the promulgation of Local Self Governance Act, the municipalities too have started to build roads following rather ad-hoc standards: depending on the mayor's view and the availability of budget. With a number of agencies mandated to construct and maintain urban roads, for equitable and sustainable development they need to share the same set of standards and adhere to it.

The purpose of SRN is quite different than that of Local Road Network and Urban Roads. Hence Highways and Feeder Roads are globally kept away from settlement area. However due to the terrain and the practice to take urban centers as obligatory points for planning of new roads, high speed roads pass through a densely populated city. Moreover, ribbon settlements along the highways have obtained legitimacy by being declared as municipality. Hence the practical option for these road stretches would be to make them compatible with both NRS or NRRS and NURS as the case maybe. For this the proposed NURS should rather supplement NRS and NRRS by filling in the policy gaps through further details as required in the urban environment.

This concept note is developed with the support of UNHABITAT to chalk-out the requisites of a possible urban roads standards with the cooperation of all concerned agencies.

Implementation of any norms has to face some challenges. The major challenge is to get land for the road and associated development. Existing legal tools of imposing the Right-of-Way limits and public acquisition of land needs to be modified and strengthened to include the state's prerogative of expropriation of private properties and land pooling. There should be a way for the city dwellers to share the financial burden of development.

2 ISSUES IN URBAN ROAD DEVELOPMENT

The major issues in our context regarding urban road development are as follows:

- Allocation of space for all road users and services
- Development plan sellable to funding agencies for construction and upgrading
- Stakeholder coordination and consultation for developing people-centric transport systems
- Road maintenance organization and finance
- Traffic management to improve capacity, quality and safety of urban transport systems
- Demand management for maximization of social values from network use
- Promotion of certain modes for sustainability and safety concerns
- Infrastructure expansion planning and appraisal
- Agreeing to a common plan by the local inhabitants, the business communities and the government.

3. LEGAL AND POLICY FRAMEWORK

The relevant legal and policy provisions are as follows:

- Kathmandu Valley Development Authority Act 2045
- The Thirteenth Plan (2070/71-2072/73) 2014
- Nepal Road Safety Action Plan (2013 – 2020), 2013
- Guidelines for Works in Kathmandu Valley, 2007
- National Transport Policy, 2002
- The Long Term Development Concept of Kathmandu Valley (2020), 2002
- Road Boards Act, 2001
- Local Self Governance Act, 1998
- Vehicles and Transport Management Regulations, 1996
- The Study on Kathmandu Valley Urban Road Development, 1993
- Public Roads Act, 1993
- Vehicles and Transport Management Act, 1990
- Town Development Act, 1987
- Ancient Monuments Preservation Act, 1956

Consequently, a number of government agencies and local bodies are legally empowered to address the urban issues. The involvement of a large number of agencies should be taken as an opportunity rather than a hindrance for urban road development.

4. HIERARCHICAL REQUISITES

Different roads have different functions. Although all of them are important, they should have different capacity and dimensions for a good circulatory function. For this, the roads are categorized under different hierarchy elsewhere as follows. Nepal needs modify it to suit its purpose.

Classification	Principal function	Design speed	Parking
Pedestrian Paths	safe pedestrian circulation	<15	prohibited
BiCycle Lanes	safe bicycle circulation	<30	prohibited
Local Streets	land and property access	30-40	limited
Collector Streets	links Local and Arterial streets	40-50	limited
Arterial Streets	Intercommunity and intra-city movement	50-75	limited
Freeways	Extra-city and inter-metropolitan movement	>75	prohibited

Table 1: Urban road hierarchy

5. PAST ATTEMPTS

NRS standardized cross-section for 4-lane and 2-lane urban roads, as given in Figure 1, more than 40 years back. It was a radical but progressive concept at the time but was never followed.

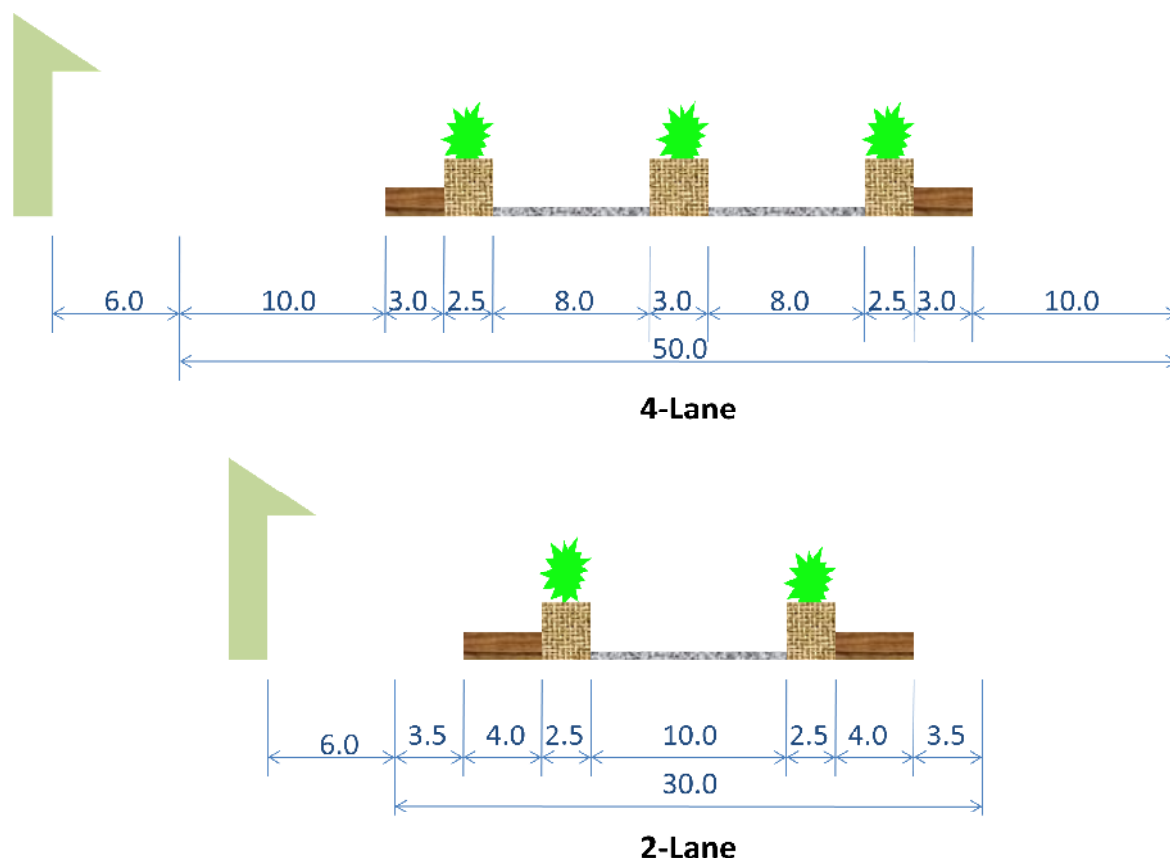


Figure 1: Provisions made for urban roads in Nepal Road Standards 2027

A number of urban development and restoration attempts have been made in the past. The Bhaktapur Development Project is an example where the improvement of all the roads of different category within a bustling settlement has been done. In sparsely populated area, there has been many urban development projects mainly through land-pooling. Similarly, there also has been attempts for landuse zoning and setting

road hierarchy. However, after some initial activity the efforts just fizzled out as the enforcement efforts were not enough and the classification could not address the local issues in a significant way.

In order to improve the urban road network within its jurisdiction, Kathmandu Valley Mapping Programme (KVMP) under Kathmandu Municipality classified urban roads in 4 categories as in Table 2. The classification is still in use as a part of the metric house numbering system.

Carriageway (m)	Walkway x2 (m)	UPBB Classification	British Classification	KVMP Classification
3.0		Awagaman Marg	Pedestrian Street	Galli
4.5		Awagaman Marg -Ka	Access Road	Marg
6.0		Awagaman Marg -Kha	Access Road	Marg
6.0	1.0	Awagaman Marg -Ga	Local Distributor	Sadak
10.0	2.0	Sankalak Sadak	Local Distributor	Sadak
11.0	1.5	Chakra Path	District Distributor	Path
16.0	3.0	Arterial Sadak	District Distributor	Path
variable	1.0	Rajmarg	Primary Distributor	Path

Table 2: KVMP Classification of urban roads

KVMP also developed a provisional standard for urban roads summarized in Table 3. Following the dissolution of the local bodies, the standard was never formally approved. These standards need to be expanded and updated so that other issues, for example access roads and pedestrian amenities, could also be dealt with.

Parameter	Path	Sadak	Marg	Galli
ROW for SRN roads	as per NRS	as per NRS		
ROW for SUN roads	11.0 m	7.0 m	5.5 m	3.0 m
Normal lane width	3.5 m	3.5 m	3.5 m	<3.0 m
Lane width at signals	3.0 m	3.0 m	3.0 m	3.0 m
Camber	2.5 %	2.5 %	3.0 %	4.0 %
Design speed	60 kmph	40 kmph	30 kmph	20 kmph
Min. horizontal radius	100.0 m	50.0 m	12.5 m	6.0 m
Vertical clearance: normal	4.75 m	4.75 m	4.75 m	4.75 m
Vertical clearance: wires	7.0 m	7.0 m	7.0 m	4.75 m
Min. sidewalk width	2.5 m	2.5 m	2.5 m, level	
Stopping sight distance	85 m	45 m	20 m	20 m
Intersection with Path	signal	roundabout	priority	priority
Intersection with Sadak	roundabout	signal	priority	priority
Intersection with Marg	priority	priority	priority	priority
Intersection with Galli	priority	priority	priority	
Storm drainage: surface	Tick/ covered U	Tick/ covered U	Tick	Tick
Storm drainage: collector	O-type, class II	O-type, class II	O-type, class III	

Table 3: KVMP provisional standard for urban roads

PROPOSED STANDARDS

1. OBJECTIVES

The purpose of developing a standard for urban roads is as follows:

- Provide safe, easy and comfortable roads to all users;
- Minimize commuting time;
- Develop a road network which is economic to build and maintain;
- Enhance the environment and aesthetics;
- Define location of underground and overhead services;
- Facilitate for economic growth.

Nepal Roads Standards 2027 and Nepal Rural Roads Standards 2013 do not address urban mobility issues. Urban roads have different function and users than other roads. Here safety, riding quality and aesthetics are more intertwined with equitable road space distribution, saving of commuting time and economic growth of the area. Furthermore, with higher cost of land in urban areas, the efficiency of its use is of paramount importance.

2. LEGAL BACKGROUND

The proposed standards for urban roads is founded on the authority provided by Kathmandu Valley Development Authority -2045 act. Consequently, the standard shall have statutory status within the area defined in the act.

Clause 5.1 of the act has empowered Kathmandu Valley Development Authority to formulate regulations for the physical improvement of the valley.

3. DEFINITION

Urban Roads are the roads serving within the urban municipalities.

This implies that all the roads within municipal boundaries, including those covered by NRS and NRRS, will be urban roads and have to conform to the standards for urban roads, in addition to their respective standards.

In the US, area with population over 5,000 are designated as urban areas.

Considering the human and cost implications, it is neither practical to construct bypasses to many of the major traffic carriers nor possible to shift the historic city from its present position.

4. GUIDING PRINCIPLES

The basis of the standards are the following guiding principles:

- Equitable allocation of road space to all road users;
- Segregation of road space for different modes;
- Access to emergency services within 100 m;
- Access to utilities to each household.

The guiding principles define the scope and the limitations of the guidelines. These principles complement the objectives.

The aimed Level of Service is C.

- Constant monitoring of the road use by different modes;
- Achieve stable flow condition during peak hours;
- Relaxation to these guidelines could be authorized only by the relevant ministry.

5. ROAD CLASSIFICATION

Urban Roads are categorized into the following broad classifications:

- Path
- Sadak
- Marg
- Galli
- Padyatru Kshetra
- Cycle Lane

Several different classifications are in use elsewhere, for example: Boulevard, Avenue, Drive, Street, Road, Alley, Lane, Passage and Path in the USA and Canada; Arterial, Sub-arterial, Collector Street and Local Street in India. As the characteristics of the traffic, road geometry and road user vary from country to country, adopting a new set of nomenclature is better than redefining them.

5.1. Path

Functionally Path is a Primary Distributor and a part of SRN. These roads shall essentially have 4 or more separate lanes for mass-transit buses, other motorized vehicles, bicycles and pedestrian. The number and width of the lanes for each mode shall depend upon traffic volume. Any additional space shall be reserved as verge between the walkway and the building line.

The lanes for pedestrian and non-motorized traffic shall be at a different level than that for the motorized traffic: both for along the road and across the road at crossing points.

For directional segregation and future development, central median is desirable. There could be additional dividers to segregate the local traffic from through traffic in case of roads with more than 2 lanes for high-speed traffic.

Parking is allowed only when the traffic is less than 25% of the road capacity and that too only on lanes for motorized local traffic.

Typically, Maitighar-Surya Vinayak section of Arniko Highway has characteristics of Path. On the other hand, Kantipath could be a Path only when bicycle tracks are laid along the road.

Any additional space could be used to extend the walkways so that kiosks or greenery could be added between walkways and bicycle track in such a way that the space taken by the road furniture on the walkway is compensated from the verge. As road furniture enhances the comfort and aesthetics, efforts will have to be made to push out the building lines.

In case of grade separation to accommodate topographical constraints, additional space will also be required for retaining structures and catch drains.

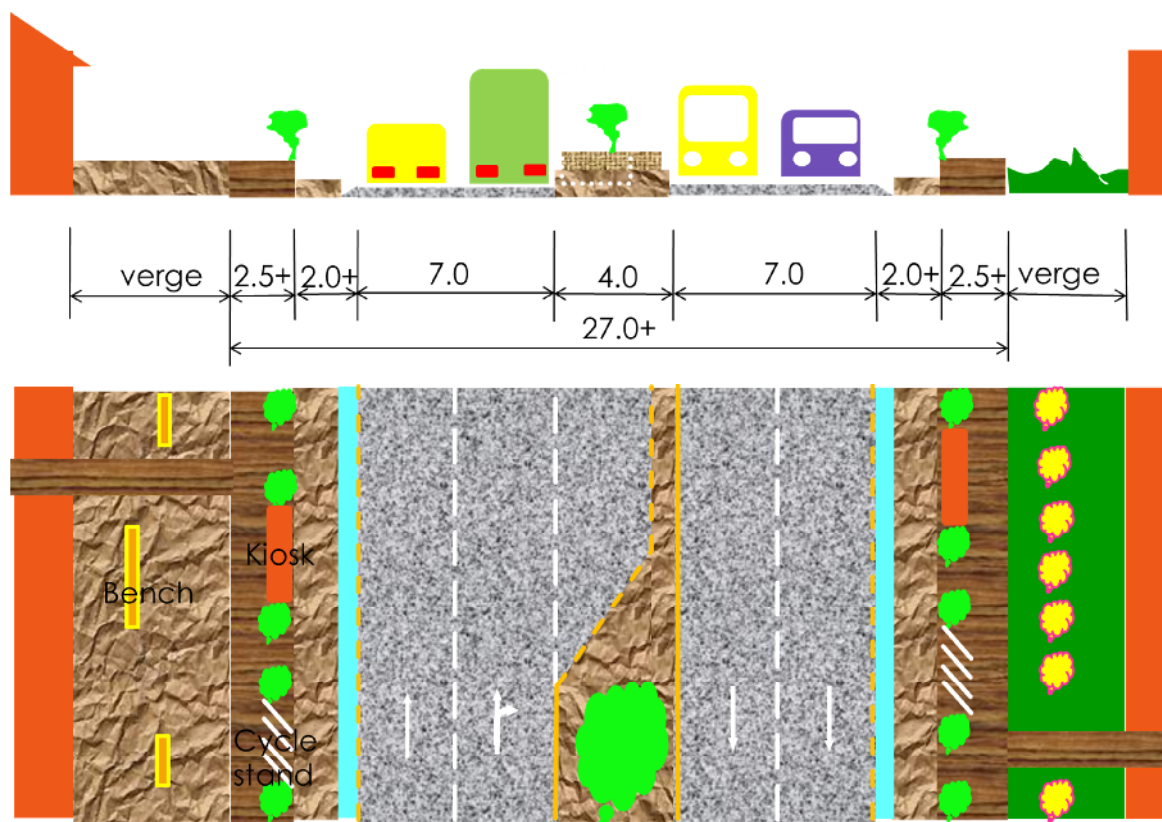


Figure 2: Typical Path with median strip (to be trimmed to provide deceleration lane) and additional space

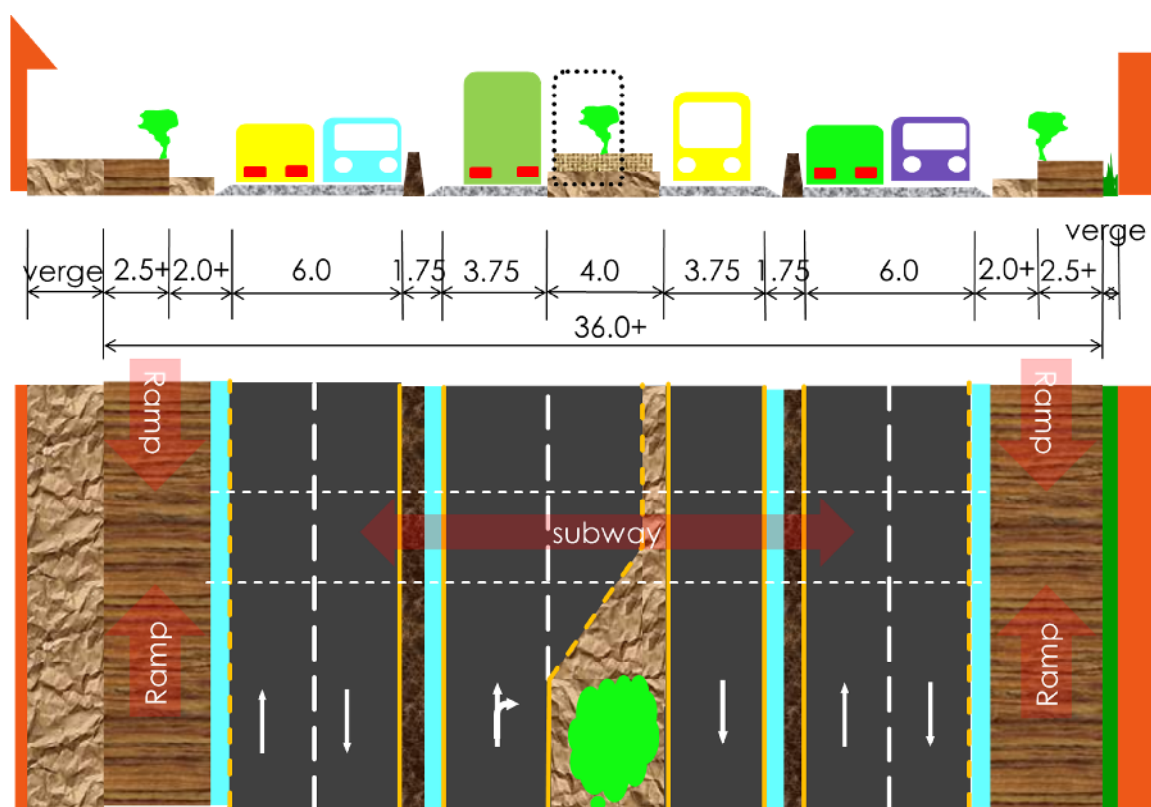


Figure 3: Path with expressway in the middle and service roads on either side

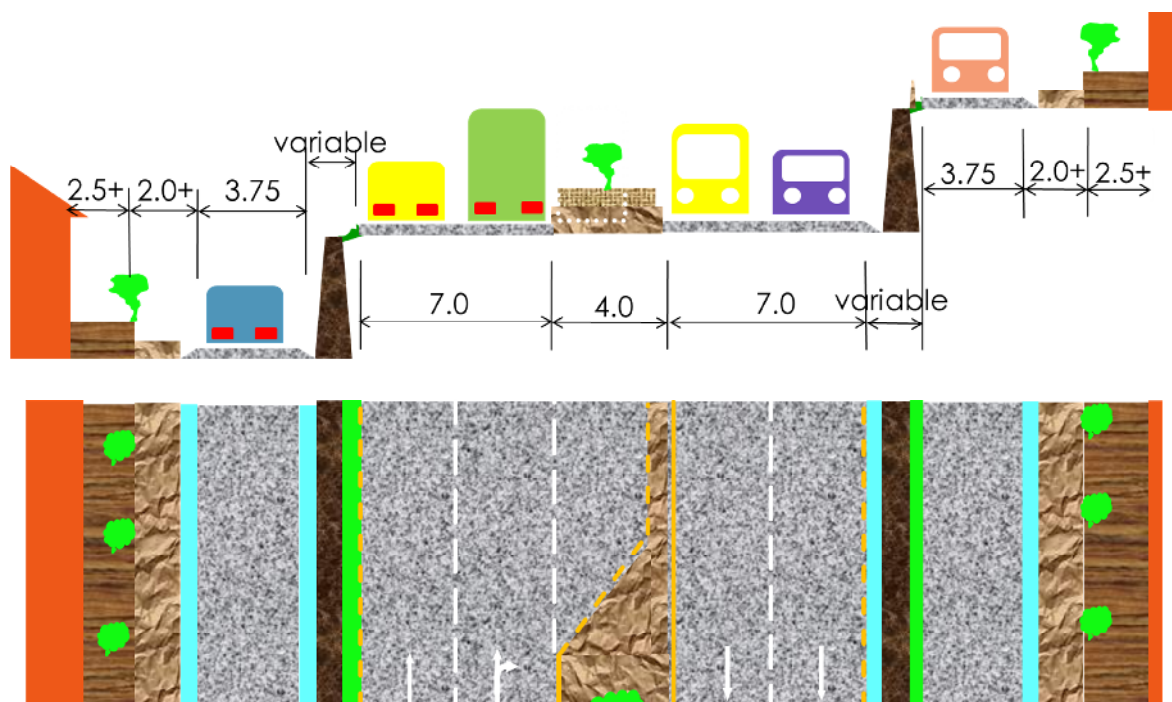


Figure 4: Path with lanes at different grades

5.2 Sadak

Functionally Sadak is a Local Distributor and often a part of SRN. The pavement shall normally be 2 lane wide with an additional exclusive lane if a mass-transit system is to be accommodated. In case of 2-lane pavement, the buses have to share the space with other motorized transport. In some cases, even bicycles may have to share the same lanes on short stretches. However, in normal cases bicycles and pedestrian shall have separate lanes in both the directions. Pedestrian and bicycle traffic shall have exclusive priorities in their respective lanes and get higher priority than the motorized traffic at crossing points.

Equitable allocation of road space among road users requires cycle track on existing roads as well. Thus, Thirbun Sadak will not fall on Sadak category until cycle tracks, at same or at different level than the road pavement, is provided.

With increasing number of municipalities in Kathmandu Valley, the aim should be to upgrade all roads in lower category to Sadak. Although a minimum of 16 m wide roadway is required for Sadak, considering high pedestrian volume in rural area, and that too carrying goods, a wider walkways are would be required. Hence the proposed width of roadway for new municipalities and villages in the valley is 20 m.

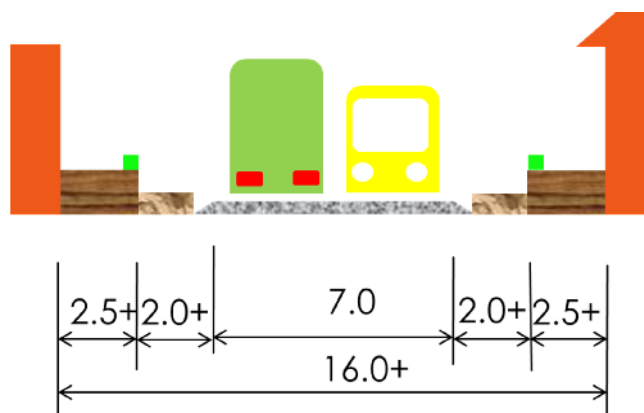


Figure 5: Typical Sadak cross-section

The Sadak could have a median barrier for directional segregation. Parking is allowed only when the traffic is less than 25% of the road capacity and that too only on lanes for motorized traffic except for the lanes used by mass-transit.

On the existing roads with walkways, the following variety of Sadak is possible depending upon the pavement width and bicycle traffic.

Exclusivity of cycle tracks at the same level as the pavement

When the pavement width is:

- $<12 > 7$ m: bicycle exclusive tracks
- $>12 > 7$ m: bicycle tracks shared by vehicular traffic

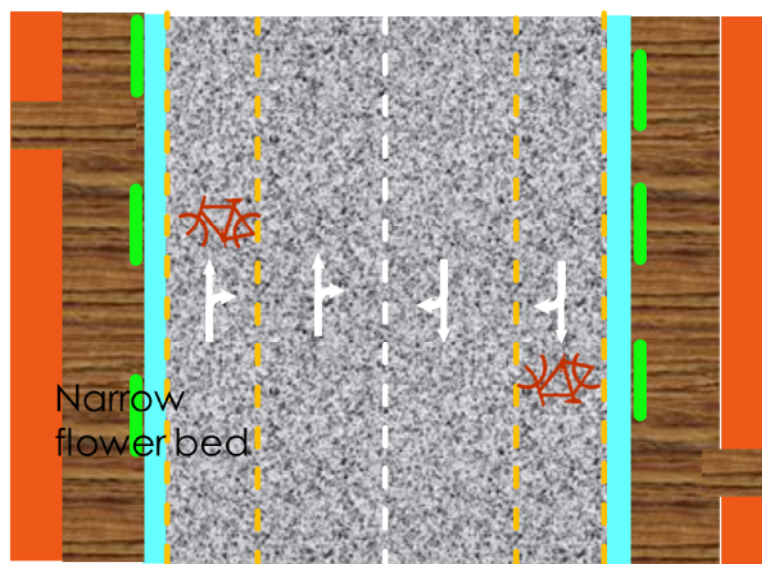
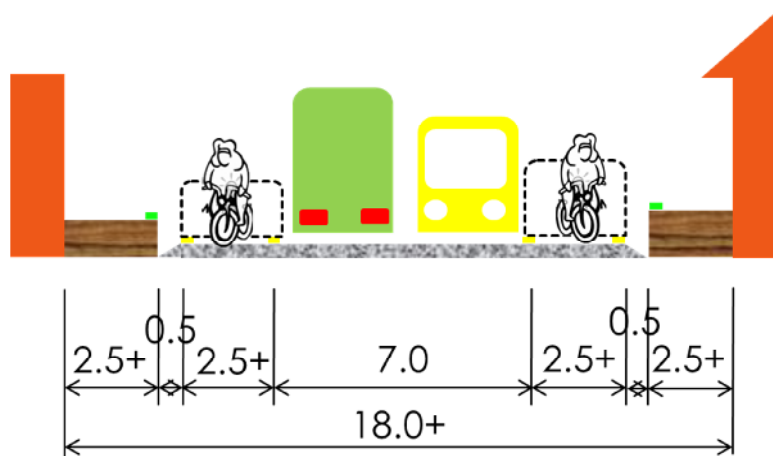


Figure 6: Use of existing pavement

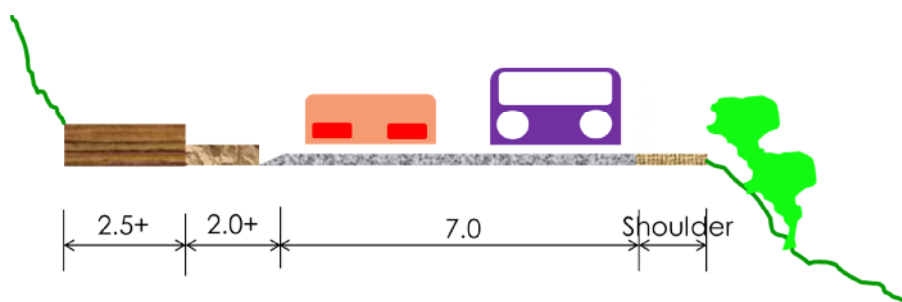


Figure 7: Sadak with single-side frontage

5.3. Marg

A Marg is an Access Road by function. Pedestrian and non-motorized traffic shall have priority along these roads. Motorized traffic of only the local inhabitants shall be allowed with restriction to speed, sound, high beam and emission. In order to facilitate movement of emergency vehicles, on-street parking shall be disallowed.

The width of pavement of Marg category of roads shall be between 6.0 m to 5.5 m without walkways, and up to 4.0 m if raised walkway of minimum width (1.5 m on one or both sides) exists.

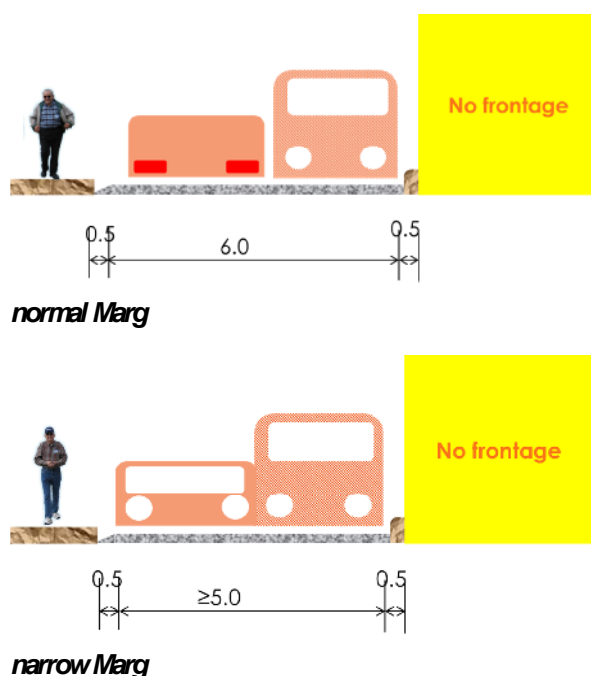


Figure 8: Width of typical Marg category of roads

5.4. Galli

Historic Galli

A Galli is a pedestrian priority Access Road of width less than 4.0 m. Only the bicycles and motorcycles of the local inhabitants shall be allowed to share the road pavement with the pedestrian with restriction on speed, sound and high beam. No on-street parking is allowed to facilitate any emergency movement.

In case of gradient higher than 20%, Galli shall be provided with steps. Narrow inclined plane shall be added over the steps to facilitate towing of bicycles.

Most of the present roads in Marg category are a result of gradual widening of roads in Galli category and opening of motorable access along land parcel borders by property dealers to appreciate monetary value of adjoining parcels. Some of the Marg roads have been constructed following NRRS in the former villages surrounding municipalities.

The existing Marg roads are full of sharp bends and bottlenecks, most often without functional drainage system and pedestrian facilities. Thus, except for those ending in a cul-de-sac, Marg should not be taken as fully developed roads but roads in transition to acquire standard characteristics. Hence before an area becomes heavily built up, Marg category of roads meant for thoroughfare shall be widened to Sadak category, or at least appropriately wide space should be reserved for Sadak.

Narrow accesses hinder rescue operations in case of a disaster. Hence the aim shall be to widen existing Galli to allow free movement of four persons carrying a sick person on a stretcher. This translates into a minimum width of 2 m and a minimum inner curvature of 4R.

Galli too should be considered as roads in transition to development. Thus new Galli shall be built only as a second access for pedestrian and bicycle traffic.

Dedicated Access

All dedicated accesses leading to a single building, whether private or public, fall under this category. The width of the accesses should be minimum 3 m.

Except for mountable kerb at the start of dedicated accesses no modification to the adjoining road or walkway (e.g.: reduction in width, increase in cross-slope) shall be allowed.

With the provision of underground parking lot a pre-requisite for new buildings in commercial area, property owners are found to build parking lot with steep driveway, often encroaching the pedestrian walkway. As a result, the walkways are not wheel-chair friendly and the driveway is too steep for small cars and motorcycles requiring additional tractive force.

5.5. Padyatru Kshetra

By Padyatru Kshetra, designated pedestrian zone shall be understood. This area is for commuting and non-commuting people on feet, slow moving designated urban transport buses as well as carts, prams and towed bicycles in limited numbers. Only emergency vehicles shall be allowed in this area. Other modes shall be allowed only during night time.

As the name implies, pedestrian zone should be exclusively for pedestrian. Unless in case of emergency, no police and other government vehicles shall be allowed in such area during daylight hours.

5.6. Cycle Lane

Cycle Lane shall be exclusive for bicycles. Only emergency vehicles shall be allowed in this area. Other modes including carts shall be allowed only during night time.

On the existing roads, bicyclists could be required to share road space with other modes. However on new roads, bicyclists shall enjoy exclusive lanes.

6. GENERAL DESIGN PRINCIPLES

Urban roads should be designed to:

- provide safe, short and fast thoroughfare and access to all road users, being motor vehicles, cyclists and pedestrians;
- convey clearly the primary function to road users and encourage appropriate driver behavior;
- deliver traffic volumes at speeds compatible with function;
- provide convenient location for services;
- provide an opportunity for landscaping;
- allow for stopping of buses and taxis, where appropriate;
- have due regard to topography, geology, climate, environment and heritage;

The appropriate design criteria for an urban road largely depend on a set of economic indicators, namely costs of construction and operation on one side, and the financial benefits to the community on another. To avoid contradiction to NRS, only the elements exclusive to urban roads are defined here.

6.1. Speed

6.1.1. Relation among speeds

Cruising speed is a function of safety instead of road geometry and surface condition in urban roads. The different speeds relevant to Urban Roads are as follows.

For higher speeds in case of long distance buses and trucks, express-ways needs to be built with complete access control and grade separated pedestrian crossing as per Figure 3.

The Design Speed is no longer referred after completion of construction. In practical terms, only speed allowable from safety point of view and cruising speed of majority of vehicles govern thereafter.

Type of Road	Design speed (kmph)	Likely 85% speed (kmph)	Allowable maximum speed (kmph)			Remark
			Bus/ Truck	Other motorized vehicles	Bicycle	
Path	80	85	50	40	15	Bicycle only on exclusive lane. Express-way for higher speed of bus/truck
Sadak	65	70	30	30	15	Bicycle only on exclusive lane
Marg	40	50		20	10	Only emergency vehicles and local inhabitant's vehicles
Galli	15	20		5	5	Only emergency vehicles and local inhabitant's vehicles
Padyatru Path				10	5	Only emergency vehicles
Cycle Lane				10	15	Only emergency vehicles

Table 4: Category of roads and speeds

6.1.2. Acceleration and deceleration

When acceleration or deceleration lanes are added to right turning channel by trimming the median strip or by flaring the road width, the values should be taken as 1.5 m/s² and 3.0 m/s² for acceleration and deceleration respectively.

Median strips provide space for acceleration or deceleration. Refer Figure 2, 3 or 4.

6.2. Traffic

6.2.1. Standard Vehicle

The equivalency factors and axle load limit shall be as in NRS. The standard design vehicle for urban roads are of the following dimensions:

The height and width of the standard vehicle is based on the dimensions of fire engines. The lengths are based on the existing dimensions of single wheel-base public buses and future articulated buses for mass transit.

Location	Wheelbase (m)	Overall Length (m)	Width (m)	Height (m)	Min. Inside Turning Radius (m)
Path, Path-Path intersections, Sadak, Path-Sadak intersections	6.5 (single wheelbase), 6.7+5.9 (articulated)	12.0 (single wheelbase), 18.0 (articulated)	2.5	4.5	7.3 (single wheelbase), 6.5 (articulated)
Sadak-Sadak intersections, Marg, Sadak-Marg intersections, Path-Marg intersections	4.9	9.4	2.5	4.5	7.8
Galli, Path-Galli intersections, Sadak-Galli intersections, Marg-Galli intersections	2.8	4.5	1.8	3.0	4.4

6.2.2 Capacity of carriageway

On two-way undivided carriageway, the capacity is relatively independent of distribution by direction, and design is based on two-way total flows. On divided carriageway, capacity is dependent on distribution by direction and design should therefore be based on peak hour flow in the busier direction of travel.

The design should not be based on AADT but on peak hour demands to get Class C Level of service.

5.5 m and 6.0 m wide pavements do not allow stable flow even on one way roads.

Traffic lanes; width	Traffic flow	Capacity (PCU/hr) of road carriageway		
		No frontage access, no standing vehicles, very little cross traffic	With frontage access and high capacity intersections but no standing vehicle	Free frontage access, parked vehicles, and heavy cross traffic
2-lane; 7.0 m	1-way	2,400	1,500	1,200
	2-way	1,500	1,200	750
3-lane; 10.5 m	1-way	3,600	2,500	2,000
4-lane; 14.0 m	1-way	4,800	3,000	2,400
	2-way	4,000	2,500	2,000

Table 5: Reference traffic capacity for different road width

6.2.3 Capacity of Cycle Lane

Traffic lanes; width (m)	Capacity in number of bicycles/hour	
	1-way traffic	2-way traffic
2-lane; 3.0 m	250 to 600	50 to 250
3-lane; 4.0 m	>600	250 to 600
4-lane; 5.0 m		>600

Table 6: Reference capacity of Cycle Lane

There seems to be no solution to hawkers on bicycles for the time being. Although they reduce the capacity of Cycle Lanes considerably, they cannot be allowed on pavement during daylight hours for safety reason.

6.3 Space

6.3.1 Carriageway

There shall be no reduction of carriageway on the bridges and culverts.

Excluding the widening at horizontal curves, shoulders, side drains and median barriers the carriageway widths should be as follows:

Road type	Path (m)	Sadak (m)	Marg (m)	Galli (m)
2-way, multi-lane	3.5	3.5	6.0	
	/lane	/lane		
1-way, 1-lane	3.75	3.75	5.5	4.0
	/lane	/lane		
At approach to traffic signals	3.25	3.25	3.0*	3.0*
	/lane	/lane		

Note: *exclusive of tick-type or covered side drains

Table 7: Carriageway widths

The carriageway width shall be as per NRS for cases other than defined in Table 7.

Even if the storm water-drain is covered or made flat, it cannot be included into carriageway width. However this space could be considered for the space taken by overhang portion of vehicles.

6.3.2 Cycle Lane

Separate Cycle Lanes should be provided when the peak bicycle traffic exceeds 400/hr on routes with motor vehicle traffic within 200 PCU/hr. When the motor vehicle traffic exceeds the threshold, separate Cycle Lanes are justified even if the bicycle traffic is only 100/hr.

The minimum width of Cycle Lane should be 1.2 m clear of all obstructions on each side of the road and 1.0 m away from the pavement edge. Each additional lane where required should be 1.0 m.

Cycle Lanes shall be of the following types:

A. Cycle Exclusive Lane:

- a. Segregated Cycle Exclusive Lane: located on raised pavement along the road but separated from the vehicular traffic by mountable kerb
- b. Non-segregated Cycle Exclusive Lane: located on the same level as the pavement for vehicular traffic but with distinctive pavement surface and delineated by continuous yellow line

B. Cycle Priority Lane:

located on the same level as the pavement for vehicular traffic but with distinctive pavement surface delineated by broken yellow line

C. Cycle Lane:

located inside park or vacant land and away from motorable road

The 1.2 m wide lane for each direction as provisioned in NRS should be taken as absolute minimum value.

Considering the need for overtaking and frequent spillover of pedestrian onto cycle lanes, the minimum width shall be 2.0 m.

The Cycle Lane surface shall be sand sealed for evenness yet adequate roughness for traction. Precast concrete tiles are not suitable.

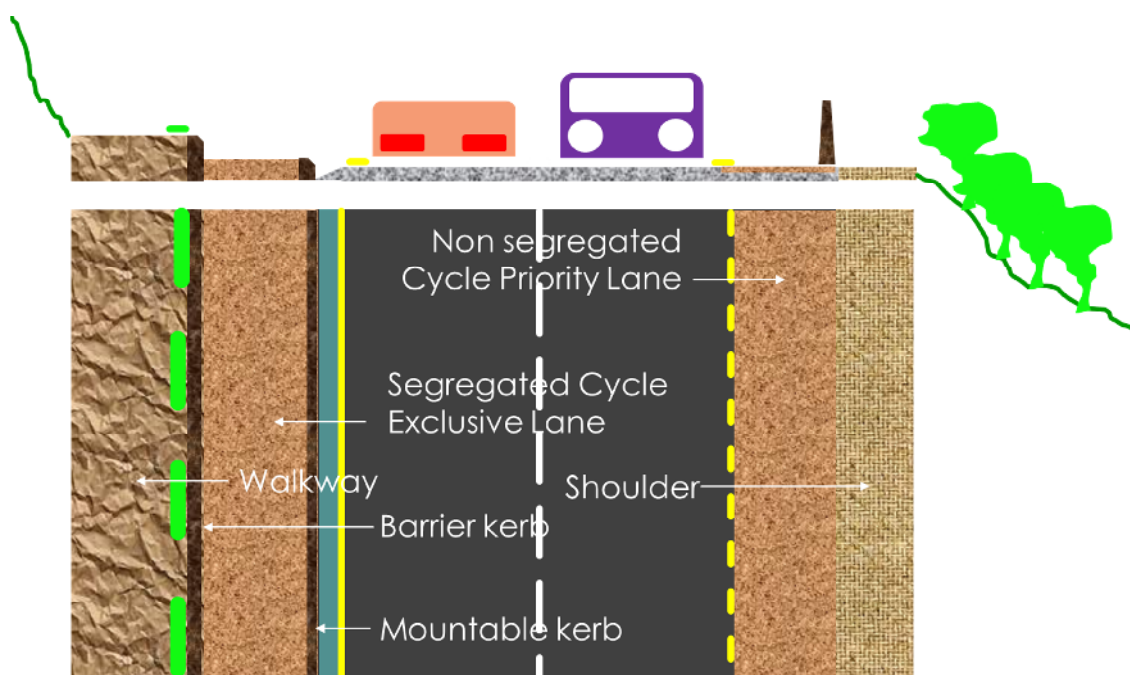


Figure 9: Segregated and non-segregated Cycle Lanes

6.3.3. Sidewalk

For up to 30 pedestrian per minute, 1.5 m wide sidewalk clear of trees, poles and other obstructions shall be provided on each side of the road. Beyond the volume, 0.6 m width shall be added for each additional 30 pedestrian per minute.

If additional space than that required for pedestrian traffic is available, then kiosks, bicycle stands and slow growing trees of large girth may be located aligned to the walkway-Cycle Lane border. Space taken by such uses on the walkway shall then be compensated by equal width from the verge as shown in Figure 2.

6.3.4. Median

Width of median is dictated by a variety of conditions, as follows:

- Median as pedestrian refuge: 1.2 m;
- Median strip for protection of vehicle making right turn, 4.0 m;
- Minimum width of median barrier: 1.2 m;
- Medians should be of uniform width in a particular section. Where deceleration or acceleration lanes are to be provided or when the roadway is to be narrowed, a transition of 1 in 15 to 1 in 20 must be provided.

A 4 m wide median can be trimmed to 1 m to accommodate additional acceleration or deceleration lane for the turning traffic.

A 1.2 m wide space for median barrier allows for 0.8 m wide barrier with 0.2 m on either side for road marking to warn the drivers.

6.3.5. Shoulder

Shoulders are not a part of urban roads. However where there is negligible pedestrian traffic or where from drainage considerations no raised sidewalk could be provided, shoulders are required between carriageway and property line to accommodate electric poles, traffic signs, underground service, appropriate clearance to ensure proper vehicle placement and development of full carriageway capacity.

Shoulders should be sealed with a texture rougher than the carriageway to discourage driving and parking on them. The width could be as prescribed by NRS.

6.3.6. Parking Lanes

Parking lanes width for parallel parking should be 2.5 m to 3.0 m.

6.3.7. Bus Stops

Busbays in recess shall be as specified in NRS.

In case of space constraint for the recessed stop, bus stops could be provided by covering the side drain or making it flatter and using a part of the pavement. A series of rectangles of 2.5 m width and 8.0 m long shall be marked on the pavement next to the kerb stone to indicate bus stops. Each rectangle should bear the assigned route number on which the bus is supposed to ply.

The provision of bus-stop and taxi-stand without recess shall need a yet to be defined lane marking to allow vehicles to overtake the stopped vehicle while disallow the vehicles on the adjacent lane to cross the lane line.

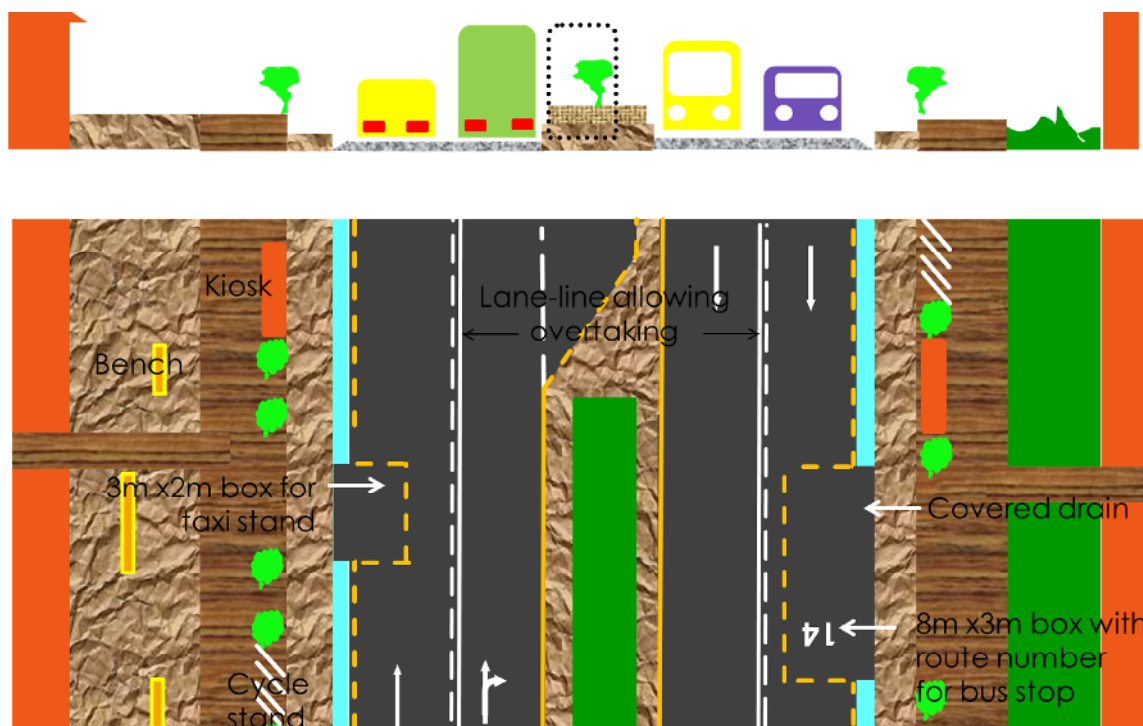


Figure 10: Bus-stop and taxi-stand on pavement

6.3.8. Taxi Stand

Taxi stands should preferably be located 20 m before an intersection in a 2.5 m deep recess. If space is limited, 2.0 m wide and 3.0 m long space per car shall be marked on the pavement and the side drain covered.

Taxi stand shall be located where they do not obstruct accesses, turning traffic and visibility.

6.4. Sight Distance

The Stopping Sight Distance, Overtaking Sight Distance and Headlight Sight Distances shall be as provisioned in NRS for corresponding design speed.

6.5. Horizontal Alignment

6.5.1. Camber and Superelevation

The recommended camber and superelevation are as follows:

Type of road	Camber (%)		Super-elevation
	Min	Max	
Path	2.0		as per NRS
Sadak	2.5		as per NRS
Marg	3.0	5.0	
Galli	4.0	6.0	
Padyatru Kshetra	3.0	5.0	
Cycle Lane	2.0	4.0	

Table 8: Camber and superelevation for urban roads

Except for high-speed roads of Path category, camber for hydroplaning purpose supersede superelevation requirements to counteract centrifugal force at curves. Higher camber also means less maintenance. Nevertheless, too high camber prompting drivers to move towards the pavement center and camber in wrong direction than the required superelevation are always to be avoided.

6.5.2 Setback

In order to provide the drivers adequate stopping sight distance, it needs to be ensured that any physical objects on the inside of horizontal curves do not restrict it. The obstruction includes trees and poles as well. The NRS may be referred to calculate the set-back.

6.5.3 Clearance to structure

Any poles or other structures on walkways flanking the road or the central median shall be 1.0 m away from the pavement edge. However, this provision should not encroach into the designated area for other road users. The walkway and Cycle Lane needs to be widened from their minimum value to accommodate electric pole, flag stands and telephone cabinets.

6.5.4 Transition curve

When a vehicle traveling on a straight road shifts to a tangential circular path, it experiences jerk because of the sudden centripetal acceleration starting at the tangent point. The severity of the jerk increases with the speed of vehicle. Transition curves are provided to gradual introduction of the super elevation and extra widening of carriageway needed at the horizontal curves.

The NRS may be referred to determine the minimum length of such curves, rate of change of super elevation and ways to introduce it.

6.5.5 Widening of carriageway on curves

At horizontal curves, it is necessary to widen the carriageway to provide for safe passage of vehicles. In addition to the conventional mechanical widening to compensate tracking of the rear wheels and psychological effect of narrowing road, additional widening is required to prevent hitting due to long rear overhang of the buses and trucks.

The NRS may be referred to determine the minimum width of such extra-widening and ways to introduce it.

For the same reason the pavement at intersections need to be widened. The widened section should be out of way of the adjoining lane. The design speed shall be taken as 30 kmph at intersections.

6.6 Vertical Alignment

Vertical alignment in urban areas is governed by the need to match building line and entrance line levels and levels of intersections and median openings.

6.6.1 Gradient

The gradient should ideally be within 0.5% to 4.0% and never higher than 7%. In the road sections with gradient higher than 4%, compulsory stopping device such as traffic signal or zebra crossings shall not be provided.

The minimum limit is governed by drainage considerations and the maximum limit is governed by ease to attain the allowable maximum speed within 2 seconds after stopping at the signals and same-grade pedestrian crossings.

When the gradient exceeds the maximum value, the road shall either be replaced with steps rendering it unusable even for motorcycles and bicycles or the alignment needs to be changed.

6.6.2 Vertical curves

Summit curves in urban areas should be designed for safe stopping sight distance and they should be coordinated with horizontal curvature. Valley curves on unlit urban roads should be such that for night travel the headlight beam distance is the same as the SSD.

The NRS may be referred for type of vertical curve, way to introduce them and to determine the minimum length of curve in relation to SSD.

6.6.3 Vertical clearance

Except for road under pedestrian bridges and wires, a vertical clearance of 5.5 m as per NRS shall be necessary only for Path and Sadak category of roads. For Marg and Galli roads, 4.0 m clearance is adequate for light commercial vehicles and emergency vehicles.

Without strengthening the underlying layer, an asphalt overlay merely seals the surface to a limited time without adding to its strength and elasticity. Soon the underlying cracks are reflected on the new overlay. The practice also causes drainage problem and steepens the grade of accesses to the adjacent properties.

Preferably, the pavement surface shall either be sand sealed periodically to prevent cracking or dug out and re-laid to the original level during rehabilitation.

6.6.4 Road level

The practice of adding layers upon layers of pavement periodically over the old surface shall be discontinued. The level of pavement, sidewalk and verges once fixed shall remain the same for a minimum of 50 years.

6.6.5 Height of kerbs

NRS shall be referred for the shape and size of the kerb stones. The following types are recommended:

- **Barrier type:** Built-up areas adjacent to footpaths with considerable pedestrian traffic: to get a grade separation of 200 mm than the road pavement; Median and channelizing islands where pedestrian should not have access.
- **Semi-barrier type:** Within the roadway at mountable islands, pedestrian refuse and to separate Cycle Lane or where motorable access to the abutting property is to be given: to get a grade separation of 100 mm than the road pavement;
- **Mountable type:** To ramp down the edge of Cycle Lane or walkways to facilitate wheel chairs and the physically challenged road users: to get a grade separation of 50 mm than the road pavement.

6.6.6 Co-ordination of horizontal and vertical alignments

Horizontal and vertical alignments should be designed considering the effect on one on the other. Following broad principles should be followed in alignment co-ordination:

- The degree of curvature should be in proper balance with the gradients. Straight alignment or flat horizontal curves at the expense of steep or long grades, or excessive curvature in a road with flat grades, should be avoided;
- Vertical curve superimposed upon horizontal curve gives a pleasing effect. The length of horizontal curve should be equal or longer than the vertical curve;
- For safety reason, sharp horizontal curves should be avoided at or near the apex of pronounced vertical curves;
- Sharp horizontal curve after a long stretch should be avoided.

6.7. Road Crossings

6.7.1. At grade crossings

The Traffic Signs Manual 1997 (TSM) has defined two types of at-grade crossings: conventional zebra where pedestrian gets the priority and dashed zebra at signalized intersections where priority is defined by the traffic signal. The locations and conditions for such crossings shall follow the TSM.

To enforce the crossings, especially during peak traffic hours, pedestrian actuated signals shall be installed.

6.7.2. Overpass

Along heavily trafficked Path and Sadak category of urban roads overhead pedestrian crossings shall be provided under the following conditions:

- If stopping of vehicular traffic for more than 15 seconds results in locking of preceding intersections;
- If stopping at at-grade crossings significantly reduce the cruising speed of long distance traffic.

The width of the overhead walkway shall be designed as for normal walkway. The rise of the stair shall not be more than 150 mm and tread shall be about 300 mm wide. There shall be a continuous track along the staircases for towing bicycles up and down the bridge. An overpass at an intersection shall preferably have staircase to all the road legs meeting at the intersection.

6.7.3. Underpass

At the Path-Path and Sadak-Path intersections where the pedestrian and wheelchair-bound traffic volume is higher than 100 per minute for more than an hour pedestrian underpass shall be constructed. The minimum width shall be as follows:

- 5.0 m wide and 2.5 m high for pedestrian exclusive underpass
- 6.5 m wide and 2.5 m high for pedestrian-cum-cycle underpass
- 7.0 m wide and 4.0 high for underpass combined with underground shopping centres

The entry to the underpass shall be wheelchair-friendly with maximum 9% longitudinal gradient. In case of stair, the rise shall not be more than 150 mm and tread shall be about 300 mm wide.

The underpass for motorized vehicles shall be as provisioned in NRS.

6.8. Provision for the Special Users

Special provision shall be made for the following road users:

- Pedestrian with vision impairment
- Pedestrian with hearing impairment
- Wheel-chair bound road users
- Parents with pram
- Small children
- Senior citizens with walking stick

6.8.1. Ramped Sidewalks

The walkways and cycle lanes shall be ramped down to the level of mountable kerb at 7% at level pedestrian crossings.

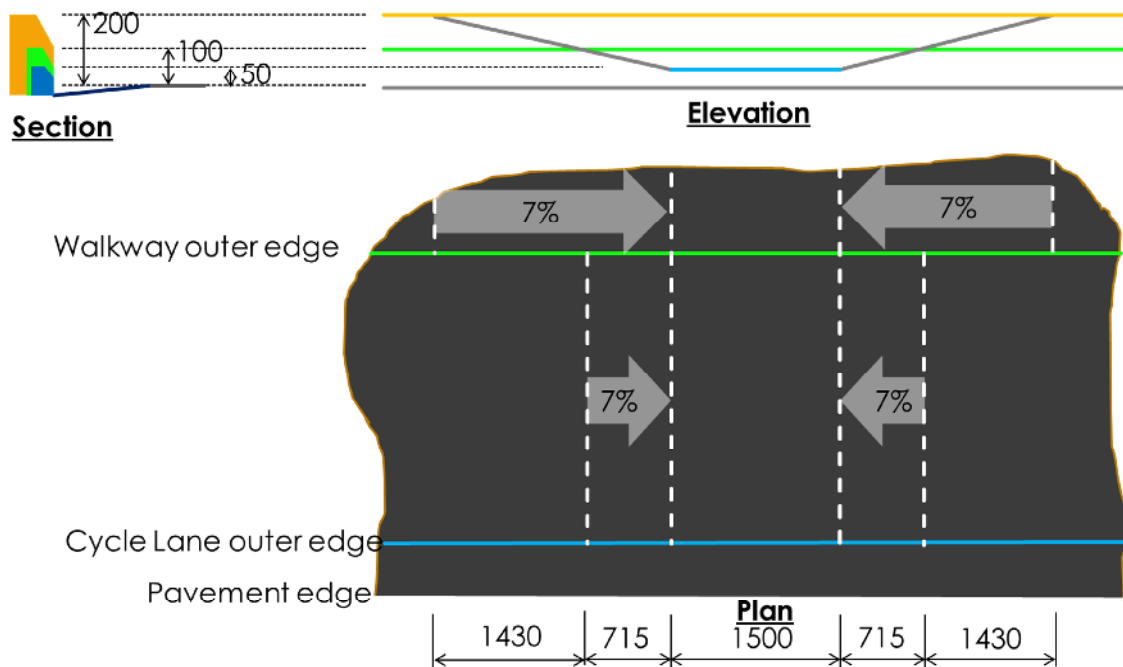


Figure 11: Ramping down of walkway and cycle lane

6.8.2. Tactile paving

Tactile paving is done with two different tiles of size 300 mm x 300 mm with 5 mm thick profile as follows.

- Dotted tile where it is required to stop or change the direction of movement
- Long profile tiles where there is no hindrance to walking
- Tactile tiles are paved 300 mm on the inner side of walkway edge (kerb line)

6.8.3. Signal with buzzer

Traffic signals and pelican signals shall be provided with buzzer so that a beeping signal is emitted when the pedestrian signal is green.

6.8.4. Pedestrian refuge

On all roads with 4 or more lanes, pedestrian refuge islands shall be built along the center line and flanking the level crossing. The height of the island should be 100 mm and shall have a roughened top to deter vehicles against driving on them.

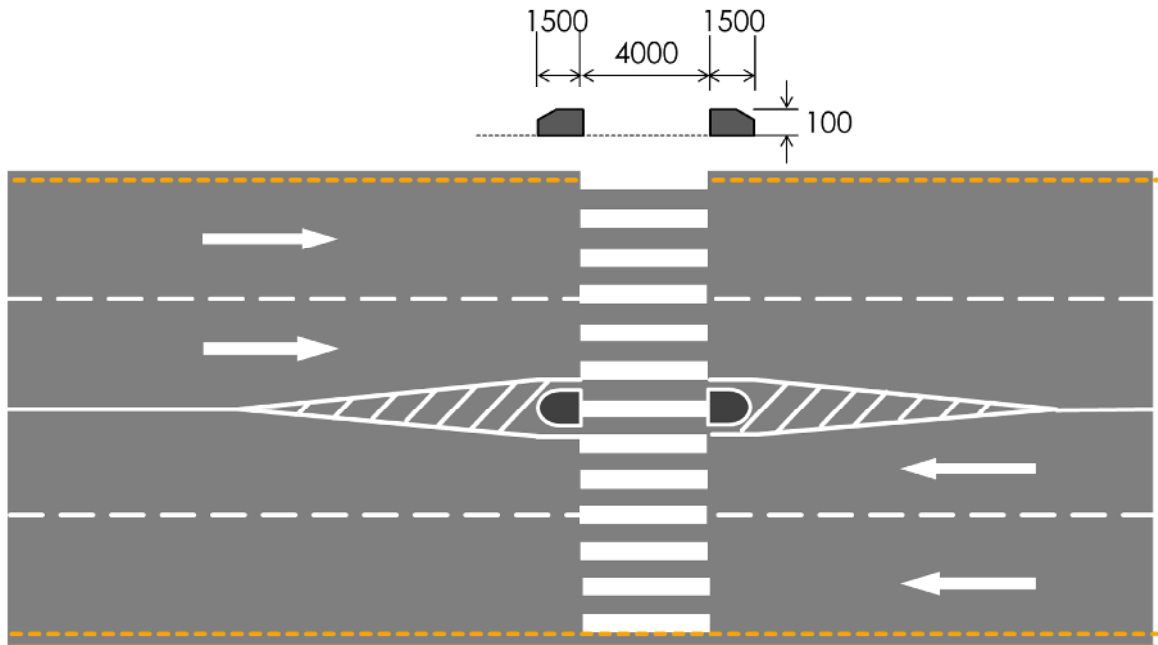


Figure 12: Layout of pedestrian refuge

6.9. Location of Utilities

The utilities should fulfill the following condition:

- At depth from 0.5 m to 2.0 m for its own safety and to avoid heavy relocation costs later on;
- At a minimum height of 5.0 m to allow safe movement of emergency vehicles
- Underground utilities not located under road pavement to avoid traffic detour during servicing and for safety concerns
- Minimization of poles and use of underground duct for aesthetics

6.9.1. Water pipes

The water mains shall be at 1.0 m depth below the walkway or the median strip. The house connection could be at 0.5 m depth.

6.9.2. Electrical lines

The overhead electrical lines shall be at least 5.5 m above the road pavement when along the road and 6.0 m above at road crossings with the poles at the inner edge of the walkways or on the median strip. The underground electric cable should be at least 2.0 m from the building line and at 1.5 m depth under the walkways or the median strip.

6.9.3. Other cable lines

The overhead cables other than that for electricity (telephone, data, TV, etc) shall be at least 5.0 m above the pavement level when along the road and 5.5 m above at road crossings on the same poles as that for electricity. The poles shall be erected at the inner edge of the walkways or on the median strip. The underground cable ducts should be 1.0 m from the building line and at 1.0 m depth under the walkways or the median strip.

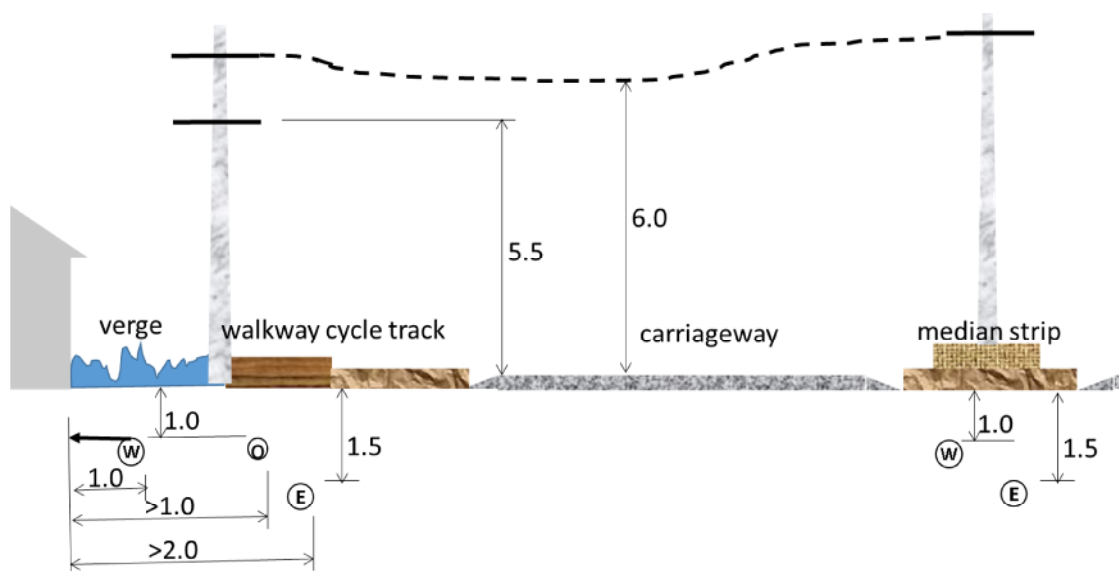


Figure 13: Location of utilities

6.9.4. Provision for future utilities

Class III concrete pipes shall be laid under the roads of Path and Sadak category at Path-Path, Path-Sadak and Path-Marg intersections for future utilities without disturbing the road surface. Separate pipes shall be required for electric cable, other cables and water mains.

6.9.5. Side drain

Side drains along the pavement edge shall be "tick" shaped. The collector drains under the walkways could either be of concrete pipes or covered U channel.

6.10. Traffic Management Elements

6.10.1. Hump for traffic calming

A speed hump is a raised area across the roadway pavement. For a height of 100 mm, the width is about 4.0 m, that is, the gradient is limited to 5%. This can reduce the speed of a cruising vehicle by 20 kmph and help bring it to safe range. Any increase in height and decrease in width can result severe discomfort to the passenger, damage the vehicle and cause loud noise.

Speed humps are recommended only on streets where the speed limit is up to 50 kmph (roads in Sadak, Marg and Galli category) and are not considered appropriate where the 85th percentile speed is more than 70 kmph (i.e, Path category).

6.10.2. Rumble Strips for traffic calming

Strips of height 25 mm to 50 mm and width up to twice the height, cause a tactile vibration and audible rumbling transmitted through the wheels into the vehicle interior. The applications are as follows:

- Along the direction of travel following an edge line or centerline, to alert drivers when they drift from their lane. Gaps needs to be made in the strip to ease surface runoff.
- Across the direction of travel, to warn drivers of a stop or slowdown ahead, or of an approaching danger spot. Seven strips at 50 m, 35 m, 25 m, 16 m, 9 m, 4 m and 1 m towards the direction of the warning needs to be laid.

As the effect of the rumbles is more pronounced with higher speed, the strips are recommended for roads of Path category and straight sections of Sadak category in the urban area.

6.10.3. Signs for traffic management

TSM has defined three categories of traffic signs. Due to cost and space considerations the priority should be in the order: Regulatory > Information > Warning. Except for the following details, TSM shall be followed.

- Except for "on approaches to junction (C24)", and for road works, signs shall be installed with the bottom at a height of 2.0 m from the road edge. The height of the signs plate shall be 450 mm;
- On approaches to junction (C24) sign shall be installed with the bottom of the sign at a height of 5.5 m from the road edge. The size of the sign plate is determined by the text on it.
- The temporary signs for road works shall be erected with the bottom of the sign at a height of 300 mm from the ground level.

6.10.4. Road markings

The following additions to that prescribed in the TSM shall apply for road markings:

- Dotted yellow line to delineate bicycle priority lane
- Dotted yellow line to delineate stopping place for bus and taxi where recess cannot be provided
- Continuous yellow line to delineate bicycle exclusive lane
- Parallel dotted and continuous white lines to indicate lane crossing is allowed only from the dotted side

6.10.5. Road name plate

Road Name Plate shall follow "at the junction (C25)" in the TSM. The names and the corresponding spelling shall be as ascertained by the respective municipality council. The size of the name plate shall be as determined by the text on it. It shall be installed, preferably on buildings, with the bottom of the plate at a height of 2.0 m from the road edge.

6.10.6. House number plate

The house number plate shall be as obtained from the corresponding municipality. It shall be installed with the bottom of the plate at a height of 1.5 m from the road edge.

6.10.7. Restriction on commercial sign boards

For easy reading of the signs and signals, no other signs and advertisement boards, on the existing structure or separately, shall be allowed in the following area:

- From 1.5 m to 3.0 m from the road edge
- From 5.0 m to 7.0 m from the road edge

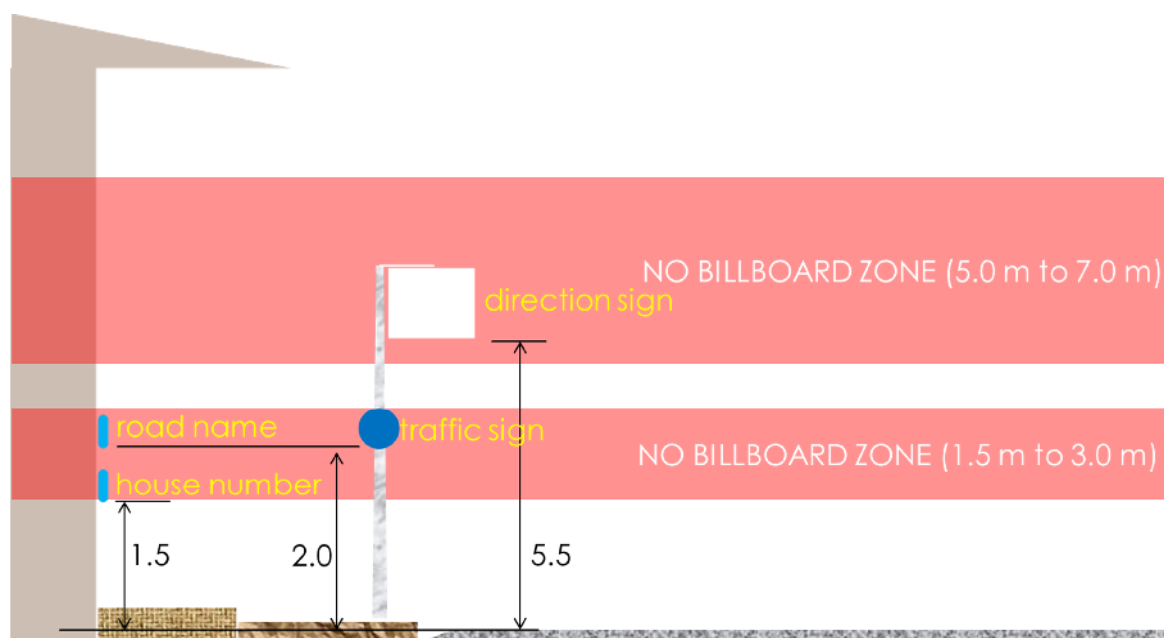


Figure 14: location of signs, plates and restriction for billboards

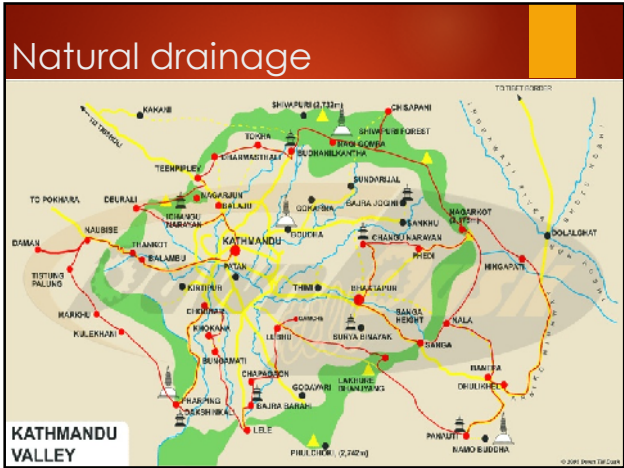
6.11. Street lighting

Referring to the standards set by Los Angeles Department of Public Works, the following illumination standards are recommended. To avoid cluttering, number of additional poles shall be minimized by using existing utility poles and buildings. To keep the costs low, instead of conventional mercury vapor and metal halide lamps, fluorescent tubular and LED lamps shall be chosen.

Location	Average luminous flux on pavement (Lux)	Uniformity Ratio (E_{av}/E_{min})	Mounting height (m)
Path	6	3	>9<10
Sadak	4	4	>7.5<9
Marg	3	6	>7.5<9
Path-Path intersection	18	3	>9<10
Path-Sadak intersection	13	3	>9<10
Sadak-Sadak intersection	12	4	>7.5<9
Sadak-Galli intersection	10	4	>7.5<9
Galli-Galli intersection	8	6	>5<6
Stairways	4	4	
Cycle Lane	10	4	>4<5
Padyatru Path	4	4	>3<4
Bus stop area	25	3	>3<4
Pedestrian underpass	10	4	

Table 9: Illumination requirements











Or no bin



Parking space for bicycles vs cars



Public toilets



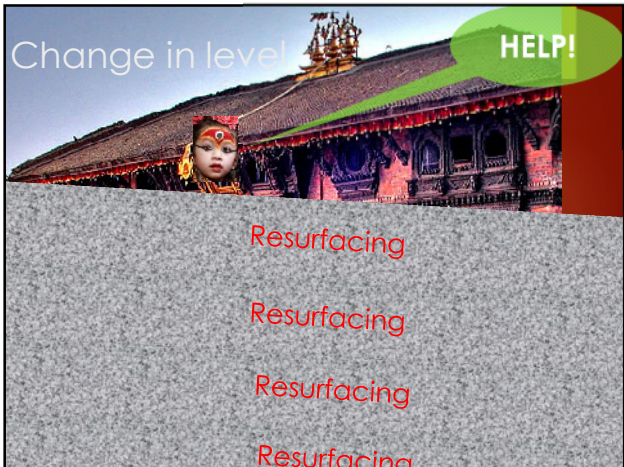
Or a lack of it



वार भाग्या वसुधरा



Are there no pedestrian?



Issues

- Allocation of space for all road users and services
- Sellable development plan for construction and upgrading
- Stakeholder coordination and consultation for developing people-centric transport systems
- Traffic management to improve capacity, quality and safety
- Demand management for maximization of social values
- Promotion of certain modes for sustainability and safety
- Infrastructure expansion planning and appraisal
- Agreeing to a common plan by the local inhabitants, the business communities and the government

Vision

- Facilitation of Economic Growth
- Safe, Easy and Comfortable to the users
- Economic in construction and maintenance
- Enhancement of Environment and Aesthetics
- Minimization of Commuting Time

Objective

- Safe, easy and comfortable
- Minimization of commuting time
- Economic to build and maintain
- Enhancement of environment and aesthetics
- Defined location of services
- Facilitation for economic growth

Definition

Urban Roads are the roads serving within the urban municipalities

Thus all the roads within municipal boundaries, including those covered by NRS-2070 and NRRS-2069, will be Urban Roads and have to conform to the standards for Urban Roads, in addition to their respective standards

Note:
In the US, Urban Area has 5,000 population (Urbanized Area: 50,000; Small Urban Area: 5,000 ~50,000)

Legal standing

Based on the statutory authority provided by:

Kathmandu Valley Development Authority -2045 act

Clause 5.1 of the act has empowered Kathmandu Valley Development Authority to formulate regulations for the physical improvement of the valley

GUIDING PRINCIPLES

- Equitable allocation of road space to all road users;
- Segregation of road space for different modes;
- Access to emergency services within 100 m;
- Access to utilities to each household;
- Constant monitoring of the road use by different modes;
- Achieve stable flow condition during peak hours;
- Relaxation to could be authorized only by the relevant ministry.

Nomenclature

US and Canada

- Boulevard
- Avenue
- Drive
- Street
- Road
- Alley
- Lane
- Passage
- Path

Nepal

- Path
- Sadak
- Marg
- Galli
- Padyatru Kshetra
- Cycle Lane

UK

- Primary A
- Non-primary A
- Primary B
- Primary C
- Alley
- Pedestrian Road

India

- Arterial
- Sub-arterial
- Collector Street
- Local Street

Speed: NRS-2070

Class	ADT (PCU)	Design Speed			
		Plain	Rolling	Mountainous	Steep
I	>20,000	120	100	80	60
II	<20,000 >5,000	100	80	60	40
III	<5,000 >2,000	80	60	40	30
IV	<2,000	60	40	30	20

Speed: NRRS-2069

Hierarchy	Terrain	Ruling (kmph)	Minimum (kmph)
District Road	Hill	25	20
	Terai	50	40
Village Road	Hill	15	
	Terai	30	

Hierarchical Requisites in Europe

Classification	Principal function	Design speed	Parking
Pedestrian Paths	safe pedestrian circulation	<30	prohibited
Bicycle Paths	safe bicycle circulation	<30	prohibited
Local Streets	land and property access	30-40	permitted
Collector Streets	links Local and Arterial streets	40-50	limited
Arterial Streets	Intercommunity and intra-city movement	50-75	limited
Freeways	Extra-city and inter-metropolitan movement	>75	prohibited

Proposed Speeds

Type of Road	Design speed (kmph)	Likely 85% speed (kmph)	Allowable max speed (kmph)			Remark
			Bus/ Truck	Other motorized	Cycle	
Path	80	85	50	40	15	Bicycle only on exclusive lane. Express-way for higher speed of bus/truck
Sadak	65	70	30	30	15	Bicycle only on exclusive lane
Marg	40	50		20	10	Only emergency vehicles and local inhabitant's vehicles
Galli	15	20		5	5	Only emergency vehicles and local inhabitant's vehicles
Padyatru Path				10	5	Only emergency vehicles
Cycle Lane				10	15	Only emergency vehicles

Standard vehicle per road hierarch

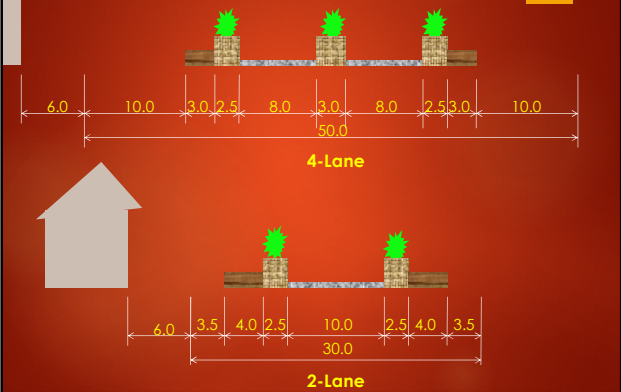
Location	Wheelbase	Overall Length	Width	Height	Min. Inside Turning Radius
Path, Path-Path Intersections, Sadak, Path-Sadak Intersections	S: 6.5 m; A: 6.7+5.9 m	S: 12.0 m; A: 18.0 m	2.5 m	4.5 m	S: 7.3 m; A: 6.5 m
Sadak-Sadak intersections, Marg, Sadak-Marg intersections, Path-Marg intersections	4.9 m	9.4 m	2.5 m	4.5 m	7.8 m
Galli, Path-Galli intersections, Sadak-Galli intersections, Marg-Galli intersections	2.8 m	4.5 m	1.8 m	3.0 m	4.4 m

Max. Axle load = 10 MT

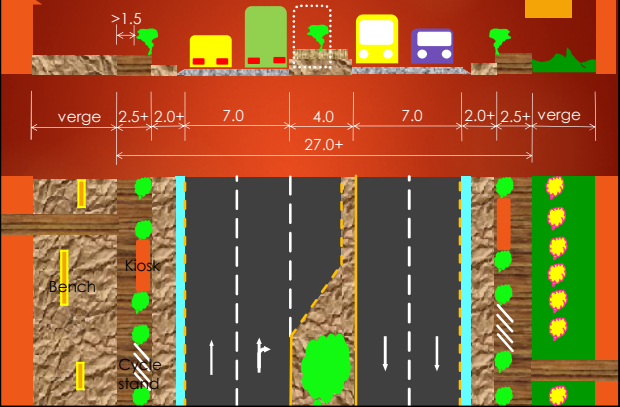
Space

- NRRS 2069: A function of basic accessibility
- NRS 2070: A function of AADT for Class B (Free Flow) Level of Service
- NURS 2071: A function of peak hour demand for Class C (Stable Flow) Level of Service for Path and Sadak category of roads

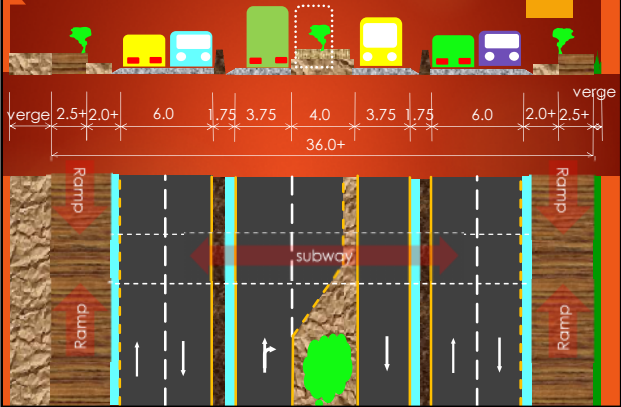
NRS 2027 cross sections



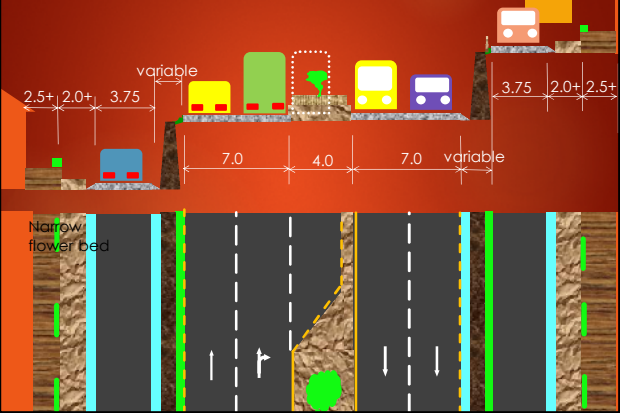
NURS Path



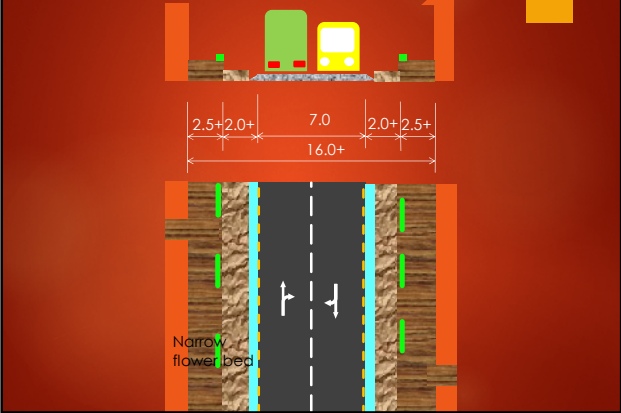
Path accommodating expressway

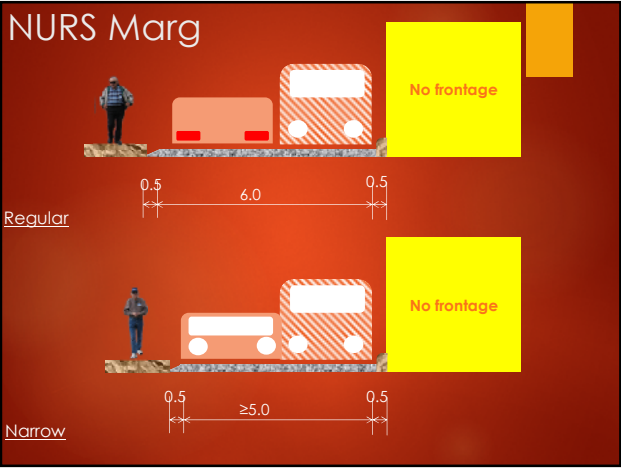
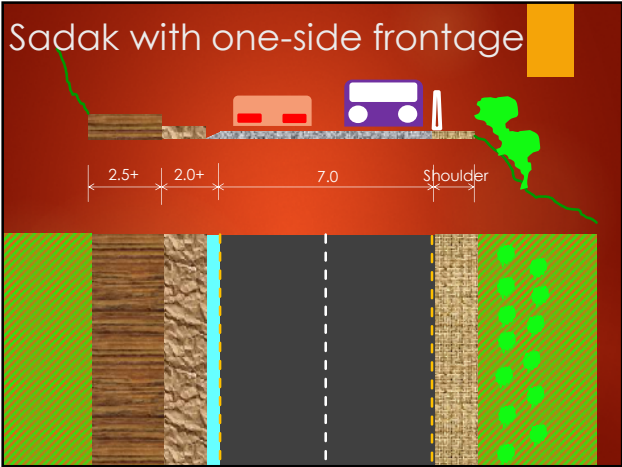
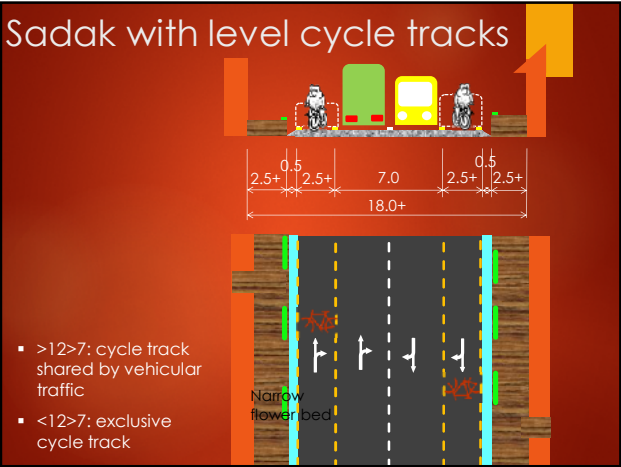


Path with pavement at different levels



NURS Sadak





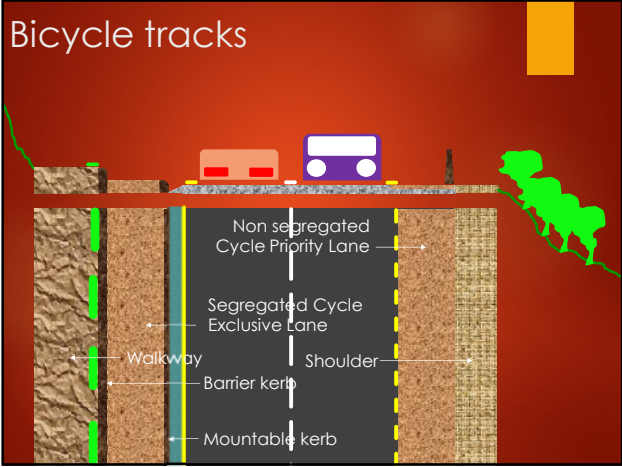
Space: NRRS-2069

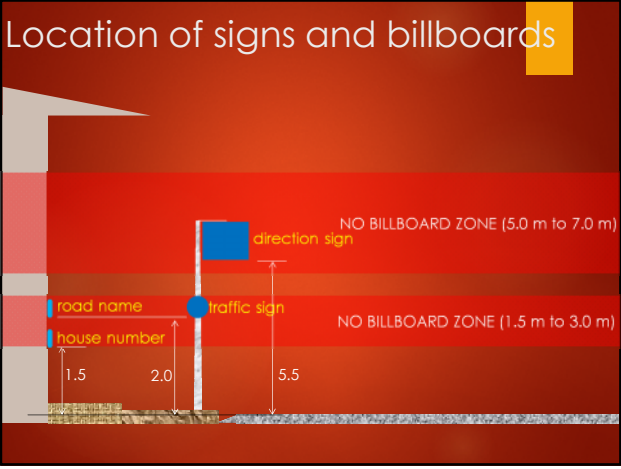
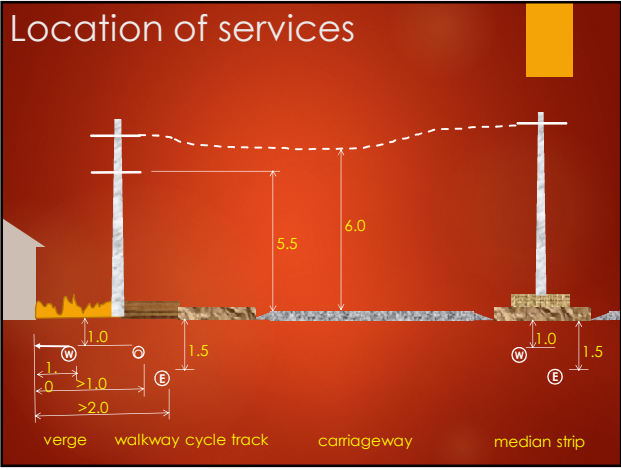
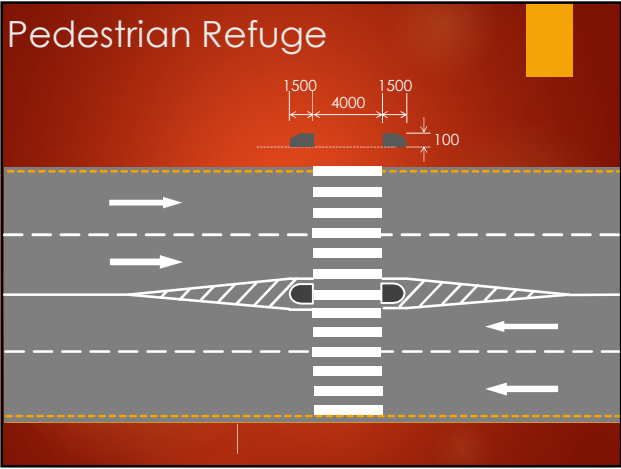
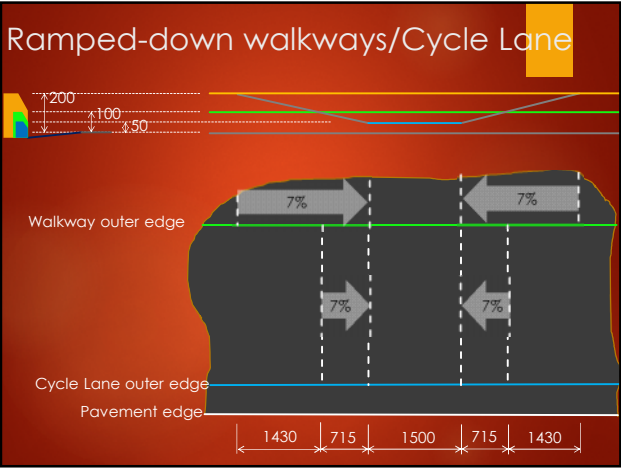
Hierarchy	Terrain	Traffic (V/Day)	Carriage way (m)	Shoulder (m)	ROW (m)	Setback (m)
District Road	Hill	>400	5.50	0.75	20	6
		>100	3.75	0.75		
		<100	3.00	0.75		
	Terai	>400	5.50	1.00		
		>100	3.75	1.50		
Village Road	Hill		3.00	0.50	15	3
	Terai		3.00	0.75		

Lane width

Road type	Path	Sadak	Marg	Galli
2-way, multi-lane	3.5 m /lane	3.5 m /lane	6.0 m	
1-way, 1-lane	3.75 m /lane	3.75 m /lane	5.5 m	4.0 m
At approach to traffic signals	3.25 m /lane	3.25 m /lane	3.0* m /lane	3.0* m /lane

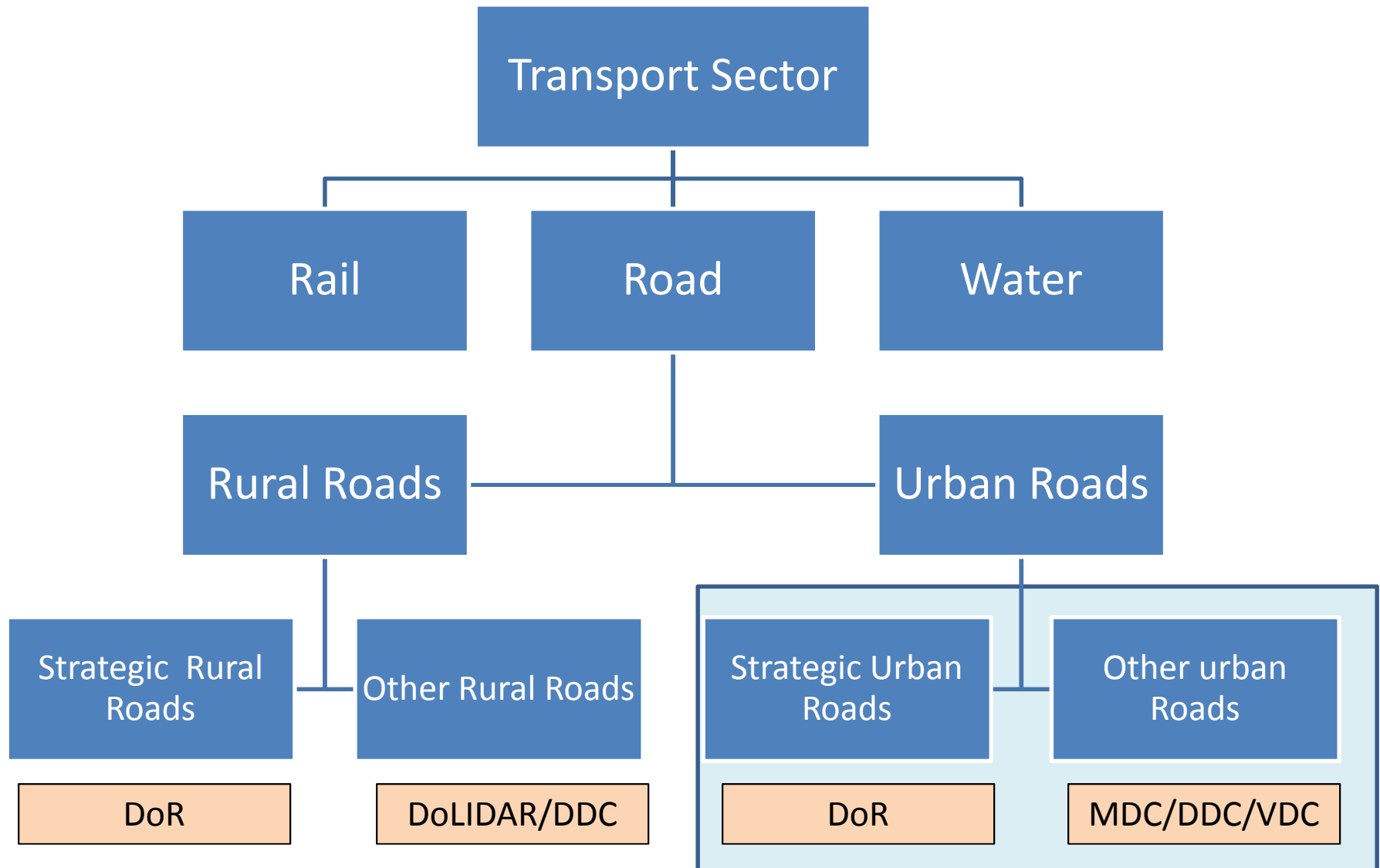
*only if tick-type or covered side drains







Appendix B Understanding of the Institutional Framework for NURS



APPENDIX C

FUNCTIONAL CLASSIFICATION OF ROADS

Urban roads are classified in terms of their function as part of the development of a road hierarchy plan. For the purpose of NURS, the classification shown in Table C has been suggested for urban roads in fully built up environment, Table C2 for rural and rural township environment and Table C3 for rural roads within urban fringe and rural residential areas.

Traffic flows should not be used as the primary determinant for establishing functional classification. Emphasis should be placed on the statement of road purpose e.g. access to property, transport of people and goods across metropolitan areas etc. This is not always easily established. However, the mix of trip origins and destinations provides the best indication of road function. For example, a road which carries traffic which primarily has trip origins and destinations outside a local area is regarded as traffic carrying and is likely to be a higher order road (e.g. trunk collector road, sub-arterial road etc) than access, local or collector streets.

Table C1 FUNCTIONAL CLASSIFICATION OF ROADS IN URBAN ENVIRONMENTS

Classification	Functional Description to be used for specifying design standards	General Purpose Classification for use in naming streets/ roads
Access or local street	Access to property.	<i>Galli</i>
Collector street	Access to property and other streets; local neighborhood access.	<i>Marg</i> (Lower Order)
Trunk collector road	Transport of people and goods within suburbs; district movement.	<i>Marg</i> (Higher Order)
Sub-arterial road	Transport of people and goods across <i>Toles</i> and between arterial roads. Typical intersection spacing: 0.3 km.	<i>Sadak</i>
Arterial road	Transport of people and goods across metropolitan areas. Typical intersection spacing: 0.5 -1 km.	<i>Path</i>
Controlled access arterial road	Transport of people and goods through and around metropolitan centres. Typical intersection spacing: 1 - 2 km.	Not Applicable

Table C2 FUNCTIONAL CLASSIFICATION OF ROADS IN RURAL ENVIRONMENTS

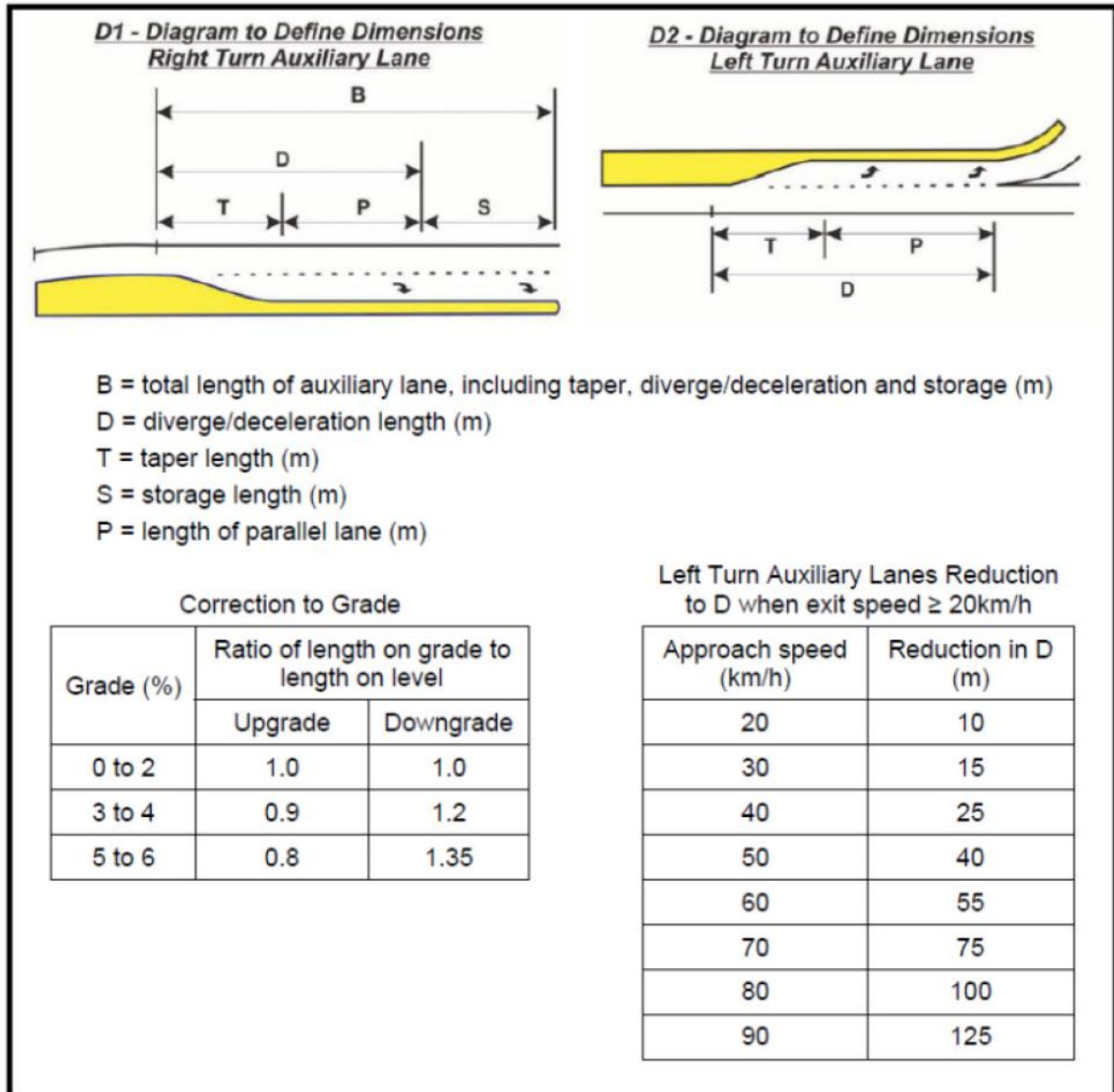
Classification	Functional Description
Local road	These roads provide access to abutting property (including property within a town in a rural area). These are also roads which provide almost exclusively for one activity or function which cannot be assigned to any of the functions for arterial or collector roads.
Trunk collector road/ collector road	Used to travel through an area or as a major connector into an area. Significant use by motorists from outside the rural residential area.
Arterial road	These roads, which form the principal avenues for communications between major regions including direct connections between cities, between a city and adjoining regional centres, between city and key towns and between key towns.

Table C3 FUNCTIONAL CLASSIFICATION OF ROADS IN URBAN FRINGE AND RURAL RESIDENTIAL ENVIRONMENT

Classification	Functional Description
Access road	Used only for direct access to property. Generally used only by owners of properties along these roads.
Collector road	Used for access to property and other roads and for local neighborhood access within the rural residential area. Generally used only by owners of properties along those roads and by other people living within the rural residential area.
Trunk collector road	Used to travel through an area or as a major connector into an area. Significant use by motorists from outside the rural residential area.

Note: Generally an urban fringe environment does not have arterial roads

Appendix E: Example of Preferred Way of specifying Length of Auxiliary Lanes



Design Speed of Approach Road (km/h)	Length of Deceleration (m) – including tapered approach where design speed of exit curve (km/h)										Diverge Length T_d (m) for lane widths	
	0 (Refer Note 2)		20	30	40	50	60	70	80	90	3.5m	3.0m
	Comf. 2.5m/s^2	Max 3.5m/s^2	Comfortable average rate of deceleration 2.5m/s^2									
50	40	30	30	25	15						50	40
60	55	40	50	40	30	15					60	50
70	75	55	70	60	50	40	20				70	60

Appendix F: Demonstrating the Application of LATM Treatments



(Here shared zone is delineated by a combination of signage and threshold treatment)