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Ministry of Physical Infrastructure and Transport

Department of Transport Management

NEPAL INDIA REGIONAL TRADE AND TRANSPORT PROJECT (NIRTTP)

SUB-PROJECT OFFICE

Road Transport Safety and Axle Load Control Study in Nepal

Part A: Road Transport Safety

TASK-A4

ROUTE APPROVAL AND PERMIT PROCEDURES

Submitted by:

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ABBREVIATIONS AND ACRONYMS

AADT	:	Annual Average Daily Traffic
AC	:	Air condition
ADB	:	Asian Development Bank
CBD	:	Chief business district
CNG	:	Compressed natural gas
DoLIDAR	:	Department of Local Infrastructure Development and Agricultural Roads
DOR	:	Department of Roads
DOTM	:	Department of Transport Management
FBC	:	Full Bright Consultancy
FNNTE	:	Federation of Nepalese National Transport Entrepreneurs
FTTE	:	Federation of Truck Tanker Transport Enterpreneurs (Nepal)
GoN	:	Government of Nepal
IDA	:	International Development Association
IPT	:	Intermediate public transport (informal public transport)
IRI	:	International Roughness Index
JICA	:	Japan International Cooperation Agency
KCR	:	Karachi Circular Railway (Pakistan)
KEI	:	Katahira & Engineers International
kph	:	Kilometers per seconds
km	:	kilometer
LRN	:	Local Road Network
m	:	meters
mm	:	millimeter
MLIT	:	Ministry of Land, Infrastructure, Transportation and Tourism (Japan)
MLIT	:	Ministry of Land Infrastructure, Transportation and Toursim (Japan)
MoPIT	:	Ministry of Physical Infrastructure and Transport (Nepal)
MVTMA	:	Motor Vehicle and Transport Management Act
MVTMR	:	Motor Vehicle and Transport Management Rule
NIRTTP	:	Nepal India Regional Trade and Transport Project
NRS	:	Nepalese Rupees
NTRC	:	National Transport Research Centre (Pakistan)
ODA	:	Official Development Assistance
PPIAF	:	Public Private Infrastructure Advisory Facility (a multi-lateral collaboration group)
PTV	:	Public Transport Victoria (Australia)
SMEDA	:	Small and Medium Enterprise Development Authority (Pakistan)
SRN	:	Strategic Road Network
STLB	:	Sri Lanka Transport Board
ToR	:	Terms of Reference
TSM 1997	:	Traffic Sign Manual 1997, DoR
UK	:	United Kingdom
UN	:	United Nations
US	:	United States
VOC	:	Vehicle Operating Cost
VKT	:	Vehicle Kilometer Travelled
WB	:	World Bank
WHO	:	World Health Organization

EXECUTIVE SUMMARY

Route assessment involve a systematic process to evaluate a new or existing route before it is opened for public transport service and require systematic and scientific assessment (desk study and site inspection). Route permit follows the administration of public transport services after a route is selected and opened for public transport service. If the permit procedure is unsystematic, the transport service can be inefficient and therefore scientific procedure is necessary.

The purpose of this study is to review the existing provisions that prevails in route selection and permit procedures for public passenger transport vehicles in the country and to recommend scientific procedure in the whole permit administration with reference to (i) road geometry and pavement conditions; (ii) vehicle dimensions and turning radius; (iii) arrangement of routes in urban areas based on the time of day, different locations and combination of different vehicles and (iv) develop a threshold criteria to control public transport route.

The methodology that was adopted for this study involved review of the existing legal provision stipulated in the Motor Vehicle Transport Management Act 1992 (2049) and the Motor Vehicle Transport Management Regulation 1997 (2054); desk research on available literature, state-of-the-arts practice, report and research that has relevance to route permit administration drawn from both neighbouring as well as developed countries; research on studies and application of academic theories of various aspects that can impact management of public passenger transport vehicles and finally consultant's best knowledge into the subject matter.

In addition, interaction with stakeholders (Department of Transport Management, Federation of Nepalese National Transport Entrepreneurs, Transport Labour Association, Traffic Police, etc.) took place during the tenure of this study to gauge their views, requirements and accordingly fine tune the recommendations outlined in thus study.

Chapter 2 presents a literature review of the existing procedure in other countries that revealed that transport services are regulated in a roughly similar manner with Nepal. Public transport vehicles are however de-regulated in Japan and UK.

Chapter 3 reviews route assessment that is involved when selecting a new route before establishing the route for public transport services. It reviews the existing practice for route assessment in Nepal and then outline a recommended procedure to improve the process. This chapter formalise the formation of a DoTM Route Selection Committee; outlines the road and vehicle design elements that should be reviewed through desk study followed by actual test run before making an informed decision whether or not to certify and open the new route for the public.

Chapter 4 discuss on route permit procedure that follows after route assessment for new routes. It reviews the current practice in Nepal as per Motor Vehicle and Transport Management Act 1992 and Motor Vehicle and Transport Management Regulation 1997 and the regulatory mechanism that Department of Transport Management employs. This review clearly indicated that the Department lacks the enabling policy provisions and scientific tools to monitor permit regulation compliance and the need for re-structuring of the routes.

Other aspects that also influence public passenger routes are also discussed. Finally, a procedure to assess route permits including the formation of a Route Permit Committee, its membership structure and modification in the permit certificate to better align public transport operators with the prescribed schedule are recommended.

Chapter 5 discusses the issues pertaining to passenger transport routes in Nepalese cities that are of concern to DoTM. Amongst these issues, impact of policy options such as re-assignment of the urban routes according to the vehicle size, institutionally re-structuring passenger transport services and feasibility of different options to improve permits is analysed. Amongst these options, re-assignment of routes to tally with the type of vehicle size was assessed to be logical and necessary for application in Nepalese cities. Lastly a logical procedure to establish a threshold criteria against which the Department of Transport Management could control route permit is recommended.

Both the issues pertaining to route selection and route permit is presented and measures to assist the Department of Transport Management is presented.

It is recommended that new route assessment is also given due importance with mandatory desk study as well as site inspection before the route is opened for public transport.

Following route assessment, route permit should be issued after due process as per the regulations. Re-structuring of the routes, institutional development within and adoption of some simple tools to improve monitoring of permit is recommended.

मुख्य-संक्षेप

सरकारी पक्षद्वारा नयाँ वा प्रयोगमा रहेका सडकमा सवारी यातायात संचालन गर्न दिने स्वीकृत जारी गर्न पूर्व उक्त बाटोको बैज्ञाानिक तवरबाट बाटो मूल्याङ्कन गर्न आवश्क रहन्छ । बाटो इजाजत प्रप्त गरिसकेपछि मात्र उक्त सडकमा सार्वजनिक सवारीहरु संचालन गर्न पाइन्छ । बाटो ईजाजत दिने कार्य व्यवस्थित नभएमा यातायात व्यवस्थमा असर पर्ने हुँदा व्यवस्थित र बैज्ञनिक विधिको आजश्यकता रहन्छ ।

यस अध्ययनको उद्देश्य भनेको बाटो निर्धारण गर्दा र बाटो ईजाजत प्रदान गर्दा अपनाइने विधिहरुको पुर्नवालोकन गर्ने, बाटो ईजाजतको व्यवस्थापन वैज्ञानिक किसिमले नियन्त्रण गर्न कुनै अधिकतम परिमाणलाइ्र आधार मानी गर्न मापदण्ड सिफारिश गर्नु रहेको छ । साथै निम्नानुसार पक्षहरुलाई बिचार गरी बाटो ईजाजत को सम्पूर्ण प्रशासनिका कार्यलाई बैज्ञानिक तवरले गर्न गराउन पनि अध्ययन गरी सिफारिश गर्नु पनि यस अध्ययनको उदेश्य रहेको छ ।

१. सडकको ज्यामितीय आकार र सतहको अवस्था

२. सवारीसाधनको साइज र सडकमा रहने घुम्तीको आधारमा

३. शहरी क्षेत्रहरुमा बाटो ईजाजत प्रदान वैज्ञानिक तवरले गर्ने सम्बन्धमा तहाँ विभिन्न प्रकार एवं आकारका सार्वजनिक सवारीहरुको समिश्रणको आधारमा अथवा प्रत्येक प्रकार सार्वजनिक सवारीहरुलाई दिनको अलगअलग समयमा संचालन गर्नै उपायहरु उपर सभाव्यता अध्ययन गर्ने ।

यस अध्ययनका लागी हालमा बिध्यमान रहेको सवारी तथा यातायात व्यवस्था ऐन, २०४९, सवारी तथा यातायात व्यवस्था नियमावली २०५४ मा उल्लेखित कानूनी प्रावधानहरुको व्यवस्थाहरुको अध्ययन;, विभिन्न साधारण, अनुसन्धान एवं उच्च तहका प्रचलनविधीहरु; छिमकी एवं विकसित मूलुकहरुमा सार्बजनिक यातायातहरुको बाटो ईजाजत वा व्यवस्थान गर्ने सवालमा हाल अपनाइएका प्रचलनहरुको पुर्नवालोकन; सम्बन्धित विषयहरुमा प्राज्ञिक आधारहरु एवं विशेषज्ञको अनुभव एबं मान्यता, आदी, को आधारमा तर्जुमा गरिएको थियो । साथै अध्ययनको सिलसिलामा विभिन्न सरोकारवालाहरु (यातायात व्यवस्था विभाग, ट्राफिक प्रहरी, नेपाल राष्ट्रिय यातायात व्यवसायी महासंघ, यातायत मजदुर संघ, आदी) संग पनि आवश्यक छलफल गरी, निजहरुको सल्लाहसुझावहरुको आधारमा पनि सिफारिशहरुलाई संशोधन गरिएको छ ।

अध्याय २ मा सार्वजनिक सवारी व्यवस्थापनको बारेमा अन्य देशमा गरिने प्रचलित विधिहरु पुर्नवालोकन गरिएको छ जसबाट। छिमेकी देशहरुमा केही भिन्नता बाहेक लगभग नेपालमा विद्यमान व्यवस्था अनुरुप नै नियन्त्रण गरिने देखियो । जापान र संयुक्त अधिराज्य मा भने सार्वजनिक यातायात सेवाहरुलाई पूर्ण स्वतन्त्र रुपले न्यूनतम नियन्त्रण गरिदै आएको देखियो ।

अध्याय ३ मा हालै निर्माण सम्पन्न भएका सडकमा सर्वसाधारणहरुका लागी सार्वजनिक यातायात संचालन गर्न बाटो खोलाउनु अगाबै गरिन पर्ने बाटो मुल्याङ्कनको एवं निर्धारण गरिन हाल अपनाइने विधिलाई पुर्नवालोकन गरिएको छ । यस पुनर्वालोकनको आधारमा बाटो मूल्याङ्कन लाई अझ व्यवस्थित एवं वैज्ञानिक तवरले गर्ने प्रकृया सिफारिश गरिएको छ । यस सम्बन्धमा यातायात व्यवस्था विभागले अनौपचारिक रुपमा अपनाइदै आएको बाटो निर्धारण समितिको व्यवस्थालाई औपचारिक बनाइएको, बाटो मूल्याङ्कन गर्दा सडकको डिजाइनका पक्षको पुर्नवालोकन एवं सडकको स्थलगत निरिक्षण दुबै गरी तिनबाट प्राप्त आधारमा मात्र सार्वजनिक यातायात सेवा त्यस सडकमा संचालन गर्न उपयुक्त हुनेनहुने आकलन गरी अपनाइने एउटा उपयुक्त बाटो निर्धारण पद्दती समावेश गरिएको छ ।

अध्याय ४ मा नयाँ सडकहरुमा बाटो परीक्षण पश्चात खुला हुने बाटो इजाजत सम्बन्धी विधिको बारेमा उल्लेख गरिएको छ । यस अर्न्तगत सवारी तथा यातायात व्यवस्था ऐन २०४९ र सवारी तथा यातायात व्यवस्था नियमावली २०५४ मा उल्लेख गरिएको विधिहरु एवं यातायात व्यवस्था विभागले बाटो ईजाजत प्रदान गर्दा हाल अपनाउर्दै आएको विधी

समेतलाई पुनृवालोकन गरिएको छ । यो पुनवालोकनको आधारमा विभाग संग बाटो इजाजत को प्रकृयालाई प्रभावकारी निति एवं बैज्ञानिक विधीहरु कमि रहेको महशुस गरिएको र बाटो (रुट) हरुको पर्नस्थापन गर्न पर्ने प्रष्ट देखिएको छ । अतः बाटो इजाजत प्रदान गर्दा अपनाउन पर्ने व्यवस्थित विधि, त्यसका लागी आवश्यक कार्वाही बढाउन गठन गरिन पर्नै बाटो ईजाजत समिती, तीनको सदस्यताको स्वरुप कस्तो हून पर्ने र यातायात व्यवसायीहरुलाई आफ्नो सेवा ईजाजतमा निर्देशित समयतालिका (समय शारणी) संग आबद्द गर्नगराउन सुधारित प्रकृया सिफारिश गरिएको छ ।

अध्याय ५ मा यात्रुबाहक सार्वजनिक सवारीको व्यवस्थापन सम्बन्धमा विभागले औलाएको नीतिगन पक्षहरु जस्तै सार्वजनिक यात्रुवाहक सवारी बाटो (रुट) हरुको पुर्नसंरचना, विभिन्न रुटहरुलाई उपयुक्त सार्वजनिक सवारीको आकार अनुरुप पुर्नस्थापना गर्ने उपाय बारे वर्णन गरिएको छ । साथै बाटो इजाजत पद्दतीलाई सुधार गर्न विभिन्न उपायहरुको पनि संभाव्यता अध्ययन यस अध्यायमा गरिएको छ । यी उपायहरु मध्ये सार्वजनिक यात्रुवाहक सावारीहरुलाई शहरी रुटहरुमा सवारीको आकार अनुरुप वितरण गर्ने अवधारणा नेपालको् शहरहरुमा लागु गर्न सबैभन्दा उपयुक्त देखिन्छ । अन्तमा बाटो इजाजतलाई व्यवस्थित तवरले अनुगमन गर्न ईजाजतलाई कुनै एक अधिकतम मापदण्डसंग दाजी गर्न सिफारिस गरिएको छ ।

यस अध्ययन प्रतिवेदनमा यातायात व्यवस्था विभागलाई बाटो निर्धारण र बाटो इजाजत सम्बन्धी पक्षहरुमा अवलम्बन गर्न पर्न बारे बर्णन गरिएको छ । नयाँ सडकमा सार्वजनिक यातायात संचालन गर्नु पूर्व त्यो सडकहरुमा बाटो मूल्याङ्कनका लागी त्यसको डिजाइनको विस्तृत अध्ययन एवं सो पश्चात सडकको स्थलगत निरिक्षण गरे पश्चात मात्र बाटौ निर्धारण गर्न पर्ने देखिन्छ । बाटो निर्धारण भए पश्चात मात्र बाटौ इजाजत दिनुपर्नै सिफारिश गरिएको छ । रुटहरुको पुर्नसंरचना, विभागको संस्थागत विकास र बाटो ईजाजतको अनुगमनको सुधार गर्न केही समान्य पद्दत्तीहरु पनि यस प्रतिवेदनमा सिफारिश गरिएको छ ।

CHAPTER 1 RATIONALE FOR ROUTE SELECTION AND PERMIT PROCEDURE

1.1 RATIONALE

A route selection opens a network of road or path for operation of public transport services. A route permit in turn regulates the public transport services along the route concerned taking into consideration the demand-supply conditions and other consideration.

If the process of route selection involve careful network planning, assessment of road environment, it scientifically establishes that the route in question is accessible for motorized vehicles and identifies the types of vehicles that can access it in an efficient and safe manner. Ideally, a new route is first assessed in terms of the following factors before it is opened for the public use:

i. Whether the route is accessible for motorized vehicles
ii. The degree of accessibility possible in the route in question
    a. Over the year (dry weather, all season)
    b. Whether the route is accessible for all vehicles or specific vehicles only owing to geometric condition, terrain, seasonal changes or land-use (urban, rural, school/ pedestrianized zones, market centres, CBD, etc.)

Based on the route assessment above, the route is opened to the public and permits are issued for public transport services. If the route permit is also scientifically issued, it will efficiently regulate public transport services along the route in question to run safely and efficiently including compliance with the following requirements.

i. Ensures the required demand-supply balance of transport services.
ii. Monitors to ensure the quality of service desired

Ensure that the appropriate types of public transport vehicles access the route

Adherence to the operating restrictions that apply (e.g. operations during day time only; prohibition during weekend or weekly roadside markets, etc.);

Driving behaviour and operational codes to adhere to.

If the route permit procedure is unsystematic, the transport services in turn can be inefficient, unsafe and poor and therefore, a scientific route selection and permit procedure is necessary

1.2 PAST PROCEDURE FOR ISSUING ROUTE PERMITS IN NEPAL

As per the Vehicle Transport and Management Act 2049 (1993) or VTMA, the Department of Transport Management (DoTM) has been identifying and publishing routes for public transport all over Nepal for public information. DoTM issued route permits, valid for four months at a time, to applicants who wanted to operate transport service in any of these published routes when the following provisions is satisfied.

i. Insurance for driver, vehicle crew
ii. Insurance for passengers' luggage
iii. Third party insurance
iv. Renewed vehicle fitness certification
v. Renewed vehicle registration certification

Compliance with the stipulated vehicle standard for medium to long distance services, where applicable.

Confirmation that there will be no adverse impact to the demand- supply balance of the transport services as well as pollution from vehicle emission.

If during the course of application review, adverse impact to the demand-supply situation and emission pollution is perceived if the permit was granted, it can reject the application after due consultation with the Transport Management Committee (TMC)[1]. The permits were renewed for another four month interval upon receipt of such application within one month after the expiry of the existing permit if all the requirements stipulated above were still maintained and met. A transport operator could also apply for another route permit to replace its existing permit if the operator want to operate its services along a different route. In addition, a transport operator could acquire multiple route permit if DoTM determined that such action would not adversely impact the transport services along the existing routes

MVTM-A 1993 also allowed short term route permits (not exceeding seven days) to public transport operators that wanted to temporarily use a route different from its approved route.

A record of all the permits issued was maintained at the concerned ZTMO as provisioned in VTMA 2049 and its regulation, VTMR 2054 (1997)[2].

1.3 RECENT IMPROVEMENTS IN ISSUING ROUTE PERMITS IN NEPAL

The current practice in route permit for public transport vehicles including database management still follow the same procedure as outlined in the previous section. However, DoTM has recently taken a few policy decision as follows to improve route permits regulation in the country.

i. It has stopped issuing route permits for new transport operator within Kathmandu Valley in light of the increasing traffic congestion.
ii. It has cancelled route permits of public vehicles involved in crashes

[1] The TMC is a body formed in each of the district where the Zonal Transport Management Office (ZTMO) is located. It comprises of the Chief District Officer (as the chairman); ZTMO Chief (as the member secretary); District Police Chief and representative from the transport entrepreneurs and transport labourers as members.

[2] VTMR 2054 = Vehicle Transport and Management Regulation, GoN.

CHAPTER 2 REVIEW OF INTERNATIONAL PRACTICE FOR ROUTE PERMIT

2.1 ROUTE PERMIT PROCEDURE IN NEIGHBOURING COUNTRIES

2.1.1 India

In India, public transport services are regulated by segregating the various services into contract carriage, stage carriage and goods carriage as stipulated in India's Central Motor Vehicle Act 1988 including its 2001 amendment and applying different conditions for operating each of these category of services. These three carriages are defined as follows.

i. "Contract carriage" comprise public vehicles carrying up to 12 passengers between two points without any fixed schedule or stops permitted in between the two points.
ii. "Stage carriage" are public vehicles carrying more than six passengers excluding the driver with stops between the routes permitted.
iii. "Good carriage" are public vehicles that transport goods through any routes.

There is no further distinction employed to differentiate the different types of public passenger transport vehicles whose size and seating capacities can be diverse (e.g. bus, minibus or microbus) beyond these three categories and particular regulation specific to each category is applied for the public vehicles according to the service they provide (e.g. taxis fall under contract carriage, intra/inter -regional bus service will fall into stage carriage). There is full freedom to operate any passenger vehicle (e.g. bus, minibus, microbus, etc.) in any local, medium or long distance route as long as the vehicle in question meets the minimum seat capacity prescribed and any stage permit can also be converted into a contract carriage permit.

There is no entry or exit barriers for public transport vehicles to operate in India but the Central Government can direct a State/Regional Transport Authority to limit the number of stage or contract carriage permits for an area with a population 500,000 or more within a certain limit if the Central Government has concerns on the traffic levels, road conditions or other matters.

Regardless of the Central Government directive, the Regional Transport Authority is also free to specify the minimum and maximum number of daily trips that a stage carriage has to provide. Similarly, it can fix the maximum number of passengers and luggage weight that a contract carriage vehicle can carry generally, at specific occasions, specific times or seasons. During application for a stage permit, the applicant (transport operator) must specify the minimum, maximum number of daily trips; schedule of normal trips proposed and vehicle type and seating capacity to use in addition to the route or routes sought. There are numerous check and balance to ensure that a stage carriage vehicle is operating optimally with other requirement it must abide to such as (i) maintaining time schedule with occasional deviation lying within the prescribed range; (ii) maintaining the prescribed number of stops and (iii) not picking-up and dropping off passengers at undesignated stops.

While State Government formulates routes for stage carriage, Regional Transport Authorities can limit contract or stage permits within a certain threshold or mandate a stage carriage operator to be bound within a minimum and maximum number of trips daily, there is no details available about how these limits are set nor of the procedure guiding route rationalization in India. The frequency of services by each stage carriage vehicle will automatically be according to the daily trips that is prescribed if operators strictly comply with it. Operators can increase their service frequency without increasing their fleet size provided the distance covered by variation or extension does not exceed 24 km but the rationale behind this limit is not clear. Therefore, public passenger transport services in India is regulated through a set of rules that the operator must comply but beyond these conditions, permits are still issued arbitrarily to a large extent in India. . Within these bounds, there are other provisions as follows that positively regulates public transport in India if they are enforced.

i. The Regional Transport Authority can also stipulate the (a) vehicle type, body specification to comply; (b) issue of tickets with the fares clearly indicated and their record; (c) reserve the right to change the conditions of the permit and (d) require the permit holder to provide all statistics, other data in relation to their services.
ii. Good carriage permit can use their tractor truck to rent and draw any trailer, semi-trailer subject to the operating conditions that may be prescribed.
iii. Comply with the speed limit applicable, fares (passengers, freights), gross vehicle weight-limit and driving hours prescribed.
iv. Compliance with liability in case of crash, third party insurance and claim tribunals.
v. Compliance with the requirement to paint or affix the name, address of the operator outside of the vehicle.

There is still the perception that there is more emphasis on revenue collection from public transportation services than in upgrading the services.

2.1.2 Sri Lanka

Sri Lanka followed the mixed competition model for regulating public passenger transport since 1979 with both the Sri Lanka Transport Board (STLB) and private operators competing for service. During 1979 -1983, it fully deregulated public transport to allow full entry to the private sector. However, this measure resulted in numerous private bus operators holding single or few fleet (few operators are in the form of a company running fixed routes) resulting in deteriorating quality of service.

Sri Lanka instituted a dedicated National Transport Commission to regulate the private bus transport as per its National Transport Commission Act, 1991. While this act has effective regulatory provisions for permits, the Commission is mostly confined to administer the permits but has been unable to fulfill its other wide-ranging responsibilities as a regulator and lack mechanism, data to assess passenger demand, fare levels, routing, scheduling, etc.

In Sri Lanka, private bus operators need route permits with relatively few government regulation except for stringent requirement on safety, insurance and vehicle inspection. The private operators are free to fix their own schedule and fare (subject to a maximum limit stipulated by the government). Despite this opportunity, private operators have very limited knowledge of their actual daily operations, cost/revenue and their services are not integrated with other modes (e.g. railways, other services).

The Government provides grants to SLTB for new bus purchases, cover salary shortfalls and subsidy to uneconomic rural routes. Since the NTC has not institutionally developed, the provincial regulators have also not developed resulting in bus services that are either over/under priced or supplied.

With the World Bank's assistance, NTC has launched an ITS[3] pilot project on inter-provincial bus services, involving about 70 buses. The core application is automatic provision of location data to the NTC Control Centre using GPS and GPRS units. Subject to the successful implementation of this pilot project, NTC intends to make ITS installation mandatory as part of the permit conditions and to use these devices to monitor route and service quality compliance.

2.1.3 Pakistan

Pakistan [4] also segregates different types of public vehicles according to the service they provide i.e. (i) contract carriage, (ii) stage carriage and (iii) public carrier instead of applying particular regulation to cater to diverse size of public vehicles of various types. Contract carriage rules applies to public vehicles carrying up to ten passengers excluding the driver that are hired for any door-to-door transport with restriction to pick/drop passengers enroute (e.g. taxis). Stage carriage regulation includes any public vehicles with carrying capacities more than six passengers excluding the driver and can pick or drop passengers along the route. A public carrier permit applies to freight transport and any stage carriage permit can also operate as a contract carriage subject to additional requirements.

The private sector predominantly operate public bus services in Pakistan but the government owned Road Transport Corporation also exists. The Department of Transport is responsible for coordinating, planning and monitoring the sector and the Regional or Provincial Transport Authority is authorized to reform the permit administration as necessary. However, the Department of Transport is institutionally weak in effectively guiding, coordinating nationally, managing, planning, securing investment and providing technical input to the public transport sector in Pakistan. Close and effective coordination horizontally and collaboration with the other agency that is responsible for road development and land-use do not exist.

[3] ITS = intelligent transport system

[4] With reference to the Provincial Motor Vehicles Ordinance, 1978 (amended)

The private sector led transport operators are free to fix their own schedules and decide their operation but over the years the private operators have become disorganized with too many single operators (none in the form of a company). Even though franchised bus routes[5] operated in the past, they could not sustain for long as (i) the services could not keep pace with the city size; (ii) the quality of service did not improve despite the increase in the frequency of service; (iii) there was no investment from the private sector and (iv) government's weak institutional capacity to resolve conflicts that emerged from this initiative and (iv) low priority from the government in terms of investment towards public transport sector compared to that was accorded to road infrastructure.

Though the Regional or Provincial Transport Authority can decide whether to grant or deny a permit application based on the number of permits the applicant already holds, the limit on the number of permits permissible for the area or revise the maximum limit to the number of permits for an area, there are no mechanisms to guide the means to do these analysis.

Despite the past shortcoming, Regional or Provincial Transport Authority can adopt the following intervention in order to reform the permit administration within their jurisdiction area.

i. It can prohibit or restrict permits throughout a province or any area in order to mitigate further road deterioration along the route or prevent uneconomic competition amongst operators.
ii. It can fix the minimum or maximum passenger fares or freight charges to apply.
iii. It can also cancel permits generally or in specific area in order to enable the government's Road Transport Corporation to operate transport services and also has unlimited powers to cancel permits.
iv. Public transport vehicles registered in one province can ply in another province through general or special resolution/order thus facilitating administrative task and allowing reassignment of such vehicles to another area where transport service is deficient provided that these activities are effectively monitored and recorded. If these reassignments are not properly documented, this practice can instead lead to over-supply over a route.
v. Mandate operators (stage, contract carriage) to maintain and submit data on financial, statistical returns and produce the same on demand to the inspecting officer deputed from the authority;
vi. Contract carriage application for non-urban routes require to submit a bank guarantee and the financial security fee to cover for any compensation towards passenger fatality or injury in a road crash.
vii. Can (a) specify conditions when freights are allowed and (b) inspect permit documents on site for monitoring purposes and (c) revise taxi-meter standards, their inspection, testing and sealing for contract carriages.
viii. Can (a) prescribe a cut-off time to start transport service from the date of permit issue and (b) mandate issue of tickets to passengers for stage carriages.

[5] Franchised route or routes involve contracting of the bus services to private operator subject to a pre-defined quality of service and maximum fare that can be applied.

2.2 ROUTE PERMIT PROCEDURE IN OTHER AND ADVANCED COUNTRIES

2.2.1 Japan

Roads including expressway, highway and municipal roads in Japan are basically used fairly and equally by the public. Normal vehicles can generally drive on any roads with exception of large vehicles prohibited due to the steep curve or narrowness of the road as prescribed in the national traffic law. One of the reasons for this is that road condition is always kept good and safe with daily maintenance by each road operator to the level where road assessment is no longer required. Therefore, route assessment procedures are usually not applied except for special cases that are mentioned hereafter.

In Japan, the Enforcement Regulations for Road Vehicles Act stipulate business of passenger vehicles and trucks. In this regulation, route permit is described for application for the special purpose vehicles only. Bus services along long routes that use the expressways will also be considered a special purpose vehicle for which the permit procedure discussed below applies. MLIT (Ministry of Land, Infrastructure, Transportation and Tourism) receives application from the owners of the special purpose vehicles (regardless whether individual owner or operator with fleet of different vehicles) and give permission if the conditions stipulated below are satisfied after judgment. Items necessary for route permit for special purpose vehicle is as follows.

(1) Passenger vehicle (including bus)

i. Business plan: origin and end point of the route, distance, elapsed district, garage site and capacity, specification of vehicle such as length, height, width and weight, total number of vehicles, names and sites of stops and business office.
ii. Service plan: operating system (time schedule, frequency, etc.)
iii. Business area: areas covered by service among the designated zones Ministry defined
iv. Fee: basis of the fee, cost accounting

(2) Truck (Freight vehicle)

Business plan: number of vehicles by types, garage site and capacity, specification of vehicle such as length, height, width and weight, names and sites of business office, contents of cargoes, facilities and their capacity for drivers' rest and sleep, storage sites and their capacity for cargoes

i. Service plan: operating system (service routes, time schedule, frequency; maximum and minimum in a day)
ii. Business area: areas covered by service among the designated zones Ministry defined
iii. Inspection of transportation safety: inspection plan with permission by concerned bodies regarding transportation safety (vehicles and facilities for transportation)

Figure 2.1 illustrates the route permit procedure involved for city bus services on local or short distance routes in Japan. In Japan, the number of buses required is decided by the bus operators themselves but at least six buses are necessary for new permit to start operation. Bus operators make business plan (operating system, fares, number of service, etc.) based on the passenger demand forecast for each route and then determine required number of buses.

When new routes are opened, the local transportation director of MLIT passes around the submitted applications to the road administrator and transportation administrator (prefectural police) and seek their opinion. The road administrator provides his/her opinions from viewpoint of distance, width and structure of the road (especially considering weight of bus).

Because the route application form is submitted after the bus operators has consulted with the pre-road administrator, road administrator is unable to answer the problem smoothly.
In the case of Japan, transportation administrators gives an opinion on the main installation of the bus stop rather than the road administrator. Examples of opinion that can emerge are dangerous degree of a bus stop, of position, causes of congestion and possibility of bus passage due to road regulation, etc.

The presence or absence of the residents and number of residence if any and the presence or absence of public institutions along the route will be important reference material for management decisions of bus operation to open routes. In case there are no bus services in a populated area nor any bus services run by public institutions, the local government sometimes requests the main government for a new bus route.

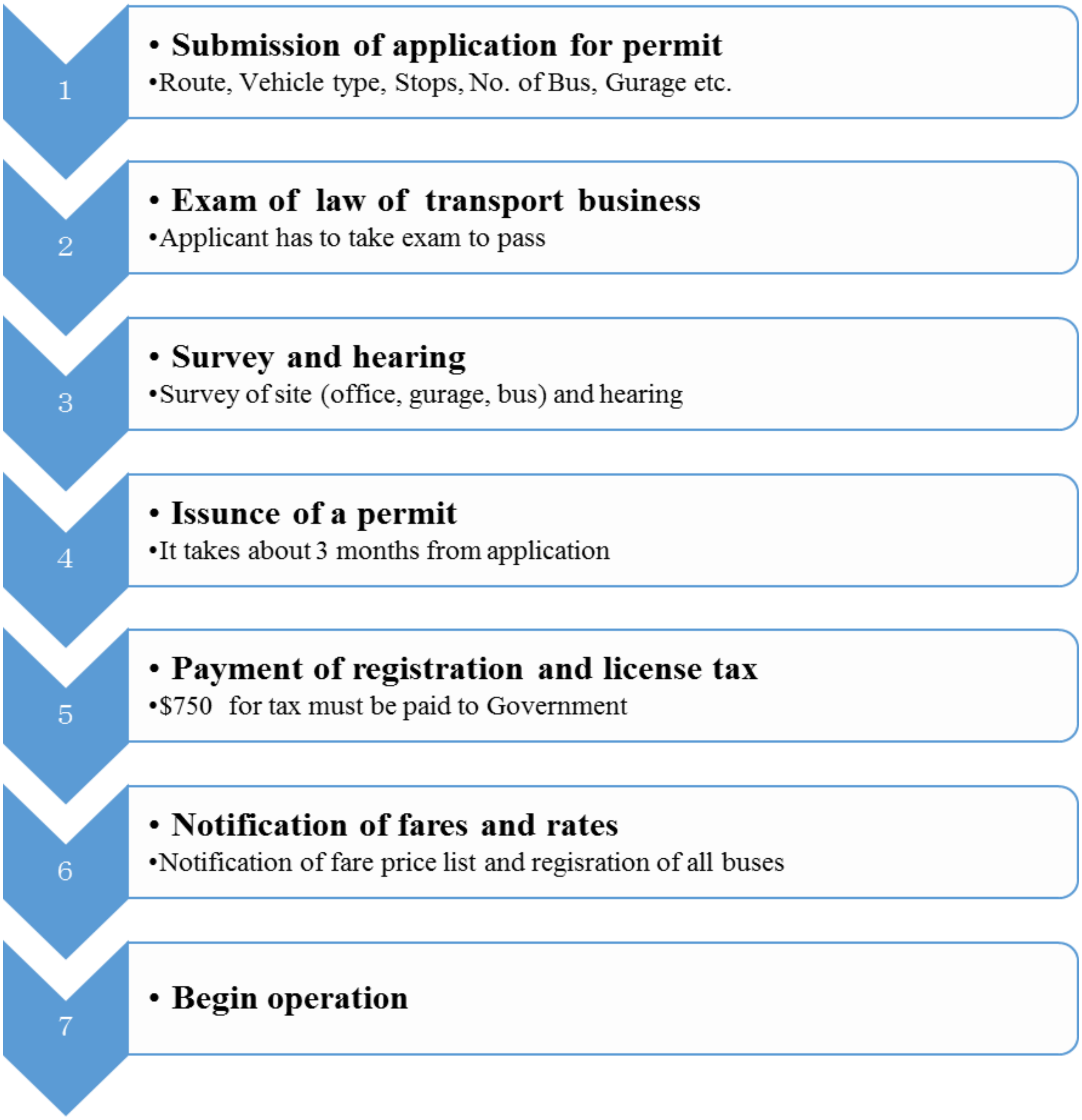


Figure 2.1 Flowchart Showing Permit Procedure for City/ Local/Short Distance Bus Services

2.2.2 United Kingdom

With the passage of the British Transport Act, 1985 all the public bus services were fully deregulated and privatized throughout the United Kingdom except in the Greater London Metropolitan Area (GLMA). Most of the bus operators in the UK are private but some are community-based not-for-profit organisations or an entity of the local government. Currently there is minimal entry barrier for public bus service in the UK. Transport for London (TfL), a local government body, regulates bus services in GLMA. In this area, the model of competition was adopted (modified version of route franchising model[6]). This model worked well in the GLMA as there was a strong regulator, public

[6] *Route franchising model adopts contracts public transport services to private operators through competitive bids with the quality of service and maximum fare applicable stipulated*

subsidy available and a strong political commitment to back the scheme, etc., that were pre-requisites to ensure the success of this model in public transportation services.

Bus services outside London must abide to the requirement of the local Traffic Commissioner. All operators outside London are free to develop their own routes, schedules and do not need acquire route permits. They however need to register the new routes and the only ground on which any new routes could be denied is based on concern regarding the prevailing traffic. The government regulator role is to coordinate, monitor the public bus services and ensure that socially necessary but uneconomical routes are also maintained. After deregulation, heavy competition have taken place for local and sub-urban bus services but most of the operators have cited to be resorting to add more buses than to reduce the fares. Therefore, routes, operation schedules for public bus services are entirely managed by the transport operator.

Since deregulation, competition in the long-distance bus routes have taken place primarily in the economically attractive routes with fare competition between operators. Numerous features such as innovative fare structure, introduction of rapid and express services, increase in service frequency and utilization of opportunities through the new motorway system have taken place.

The British Transport Act 1985 made positive impact to the public transportation sector such as (a) separation of publicly owned bus companies from for-profit bus companies and (b) local government cross-subsidy for unprofitable routes with the profitable ones but requirement for cross subsidy to be secured through competitive bidding. The British Transport Act 2000 introduced certain provision for collaboration between the local authorities and bus operators to improve services and operation of variable route services (demand responsive transport[7]).

[7] Demand responsive transport is an advanced, user-oriented form of public transport employing small to medium vehicles where the routing, scheduling is flexible between pick-up and drop-off locations dictated by passengers. It is used in rural areas of areas where passenger demand is low for regular bus service or for specialized groups (e.g. persons with disability) and therefore qualify as socially necessary transport that are fully or partially funded by the local transit authority.

CHAPTER 3 RECOMMENDED ROUTE ASSESSMENT, SELECTION

3.1 ROUTE ASSESSMENTAND SELECTION

An assessment of the route is necessary to determine if it can be opened for public transport services in an efficient and safe manner. This route assessment and selection should always take place prior to issuing route permits.

3.1.1 Existing Practice of Route Assessment and Selection in Nepal

As per MVTMA 1993, DoTM need to open new routes for transport service and notifies them in the official gazette for public information. In reality, in the case of new routes, the process of establishing the route and issuing permit generally takes place at the same time following demand from interested transport operators who desire to run their service in the route in question. Under the current rules and regulation, there is more emphasis in administrating route permits with scant details about route assessment and its selection even though both would involve common desk-study items. The following steps are adopted for route assessment and selection for public transport services in Nepal in parallel to issuing route permit.

i. Step 1- A transport operator who wants to operate its service in a new route applies for route establishment and permit to the Transport Management Committee (TMC)8

ii. Step 2- The TMC assess the application and forwards it to DoTM at the Centre for endorsement.

   a. Alternatively, the TMC can formally request DoTM to open a new route in parallel to issuing a temporary route permit if it is deemed necessary to allow operation of public transport for some time.

   ZTMO can also issue intermittent route permit for freight valid for up to seven days within their jurisdictional area if an operator needs a permit to adopt a route different from his/her designated route.

i. Step 3- DoTM sets up a committee to review the application.

ii. Step 4 - The DoTM committee above reviews the route including the recommendation from the TMC

iii. Step 5 - The DoTM completes its desk study and test ride through the route.

iv. Step 6 - The committee finalise its assessment, fix the fare to apply and then send its approval to open the route.

[8] As per MVTMA 1993, a Transport Management Committee is established in each zone to monitor if public transport services are operating systematically within its jurisdictional area. It is chaired by the Chief District Officer with the Chief/ZTMO acting as the member secretary and one representative each from the transport entrepreneurs, transport labourers, police.

All the steps above are neither explicitly outlined nor the list of items to review, test runs for route assessment and permit are formalized in MVTMR 1997. Only administrative documentation requirements such as insurance coverage for the vehicle crew, valid vehicle inspection certificate and valid vehicle registration are stipulated in MVTA 1993. The act however has reserved the authority for the ZTMO to deny a route permit application if the latter determines that there would be an over-supply in transport services, adverse environmental impact or other impact that would be detrimental to the public interest. In denying a permit application, the concerned ZTMO has to consult with the concerned TMC. A clear guideline on the aspects to review (e.g. road geometric design, terrain, road condition, assessment of vehicles that can safely and efficiently ply along the route, formalization for establishing the DoTM committee and its composition, etc., is lacking.

3.1.2 Recommended Procedure for Route Assessment and Selection

As discussed previously, route assessment and selection currently takes place when there is an application for route permits on new routes. DoTM should also pro-actively conduct route assessment through its own initiative rather than being prompted only when a permit is sought for new routes. It is thus recommended that a clear guideline on the aspects to review (e.g. road geometric design, terrain, road condition, assessment of vehicles that can safely and efficiently ply along the route), formalization for establishing the DoTM committee and its composition, etc., along with test runs through the route should be introduced in Nepal. This would make the process of route assessment and selection more systematic and consistent throughout Nepal.

The DoTM Route Selection Committee is the most important body whose expertise will significantly influence the quality of route assessment. This committee should have the necessary experience, skills as follows.

b. Knowledge about road geometry, condition and their relevance to the type of access to be accorded to vehicles
c. Knowledge about operation and configuration of all types of vehicles with special reference to negotiation limits around curve and along grade and brake limitation
d. Knowledge of the maximum dimension and axle-load limits that apply
e. Knowledge of heavy vehicle issues, legal requirement and permit systems
f. Knowledge of road safety concepts and principles

The route assessment and selection should therefore adopt the following procedure in order to be scientific and systematic.

STEP 1: Concerned agencies such as DoR, DoLIDAR, DDC, VDC, etc., should mandatorily notify DoTM about completion of any new road under their jurisdiction. Alternatively, the concerned TMC may also recommend DoTM for route selection and permit following receipt of an application for permit over a new route from a transport operator. The concerned road agencies should avail all the road design details of the route concerned to the DoTM.

i. STEP 2: DoTM should establish a Route Selection Committee with the following composition to assess and select the new route.

Director, DoTM	Chairman
Senior Divisional Engineer (civil[9]), DoTM	Member
Mechanical Engineer, DoTM	Member secretary
Officer, DoTM	Member
Representative, Traffic Directorate, Police HQ	Member
Highway engineer- , DoR/ DoLIDAR[10]	Member

ii. STEP 3: The Route Selection Committee should start compiling the necessary documents and review the following aspects prior to the test ride and route selection.

- Review the road design including geometry, pavement condition and surface, to assess the accessibility and safety that motorized vehicles can get in general.
- Assess the specific vehicles that can access the routes safely based on geometric features and distance involved through correlation with the capability of different types of vehicles.
- Assess the Level of Service that can be expected along the route in terms of time of travel, distance, comfort and safety.

iii. STEP 4: The Route Selection Committee should make test runs along the route in various vehicles to refine its desk-study and to also to confirm the following aspects.

- Determine the restrictions that may apply to all or specific types of vehicles during monsoons
- Determine if vehicular should be restricted during any specific time in certain season when visibility is obscured (e.g. misty fog during certain times at high precipitation areas in hill roads, winter fog during morning and evenings, etc.).
- Variable speed limit that may apply depending on the time of the day, season, etc.

iv. STEP 5: Based on its desk study and test runs in above steps, the Committee should decide whether to open the route, open the route with certain restriction or recommend some improvement to the route prior to opening to run public transport.

v. STEP 6: DoTM should notify the public about the route selection.

Figure 3-1 illustrates the various steps involved for route assessment and selection.

[9] Will be available in DoTM under the new organization proposed where the Senior Divisional Engineer (Gazette 2nd Class rank) will head the proposed Road Safety and Transport Improvement Section.

[10] To include either highway engineer either from DoR or DoLIDAR depending on the type of road involved in the route.

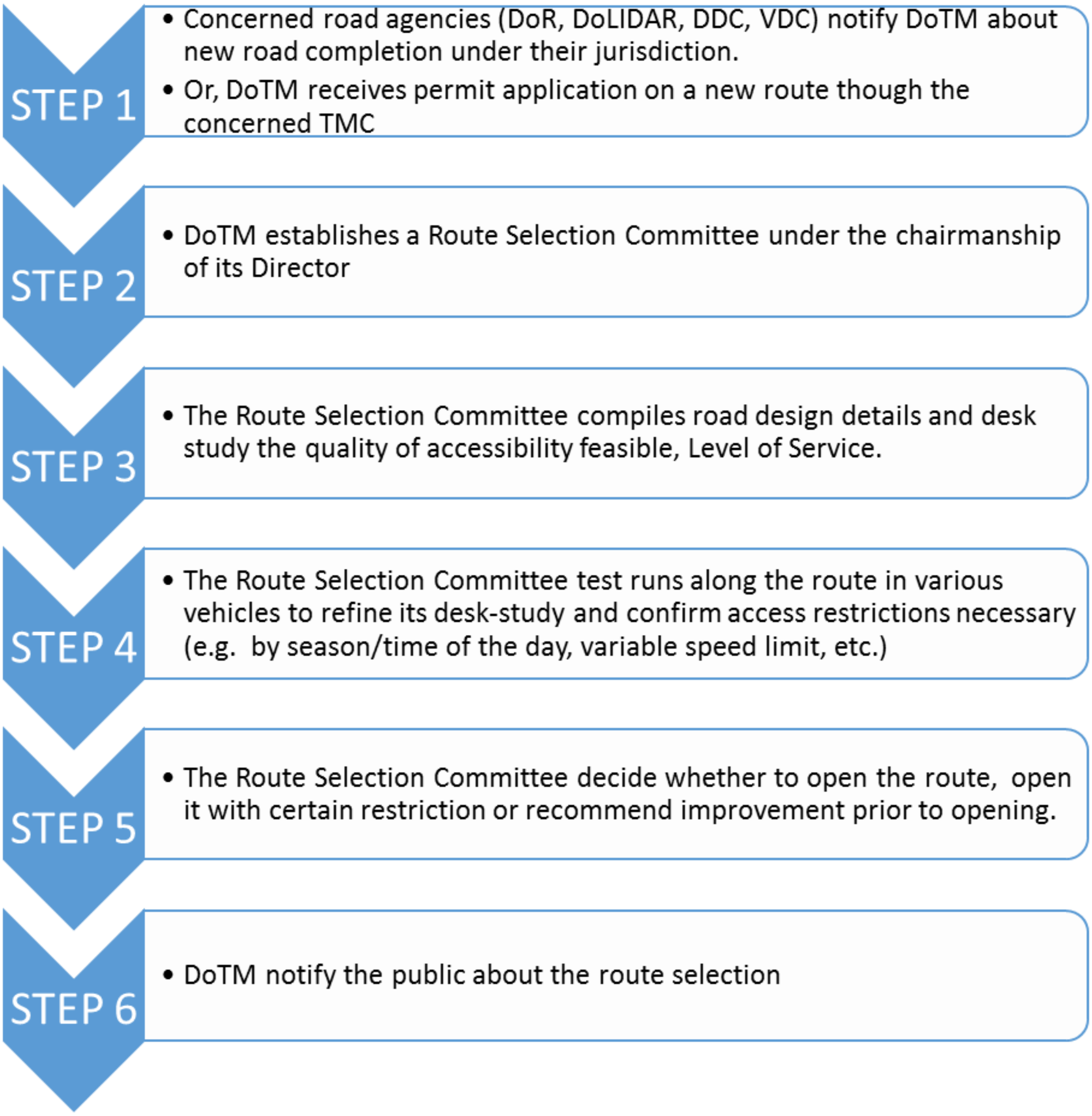


Figure 3.1 Steps for Route Assessment

The detailed assessment of the road design, vehicular capability to traverse the route as part of the desk study is the most important aspect of the route assessment process. Though a lot of agencies continuously develop new roads, their database management is often poor and therefore details of the road designs along the route concerned may not be completely available. In such event, it would be first necessary to confirm the standard design that applies to the roads along a new route. The following discussion will thus provide a useful guide in each of these aspects.

3.1.3 Assessing route accessibility to motorized vehicles in general

The geometric design of the each road network along the route if available, can provide prior insight on the road geometry to expect along the route prior to the test rides. The Route Selection Committee should proceed as follows.

i. Collect whatever details of the road designs, plans that is available from the concerned agency (DoR, DoLIDAR, DDC, VDC or municipality) concerning the route in question.

ii. Geometric details such as radius of the horizontal curves, gradients, road cross-section (carriageway width, shoulder width/surface, footpath width/type), design speed[11], cross section of the cross-drains (culverts, causeways), side-drains, etc., are particularly important as these influence accessibility to types of vehicle as well as safety along the route.

iii. Compile the details of all the bridges such as cross-section (carriageway, footpath), weight-limit, vertical clearance, approach road geometry, etc.

iv. Alternately, if geometric design of all/any of roads along the route is not available (as is often the case in Nepal), proceed as follows.

v. First identify the road network involved along the route (strategic[12], local[13], urban)

   i. Identify the road class that individual roads along specific network belong to (e.g. national highway, feeder road, district road, village road or urban road).

vi. Refer to the design standard applicable for each of these specific roads to gather geometric details.

For various types of road network, the following design standards apply.

- Nepal Road Standard 2070 (2014) or NRS 2070 -for strategic roads
- Nepal Road Standard 2059 (2003 -Draft) –for strategic roads
- Nepal Road Standard 2045 (1988) or NRS 2045 – for strategic roads
- Design Standard for Feeder Roads -3rd Rev., 2053 (1997) or DSFR 2053 –for strategic roads
- Nepal Rural Roads Standard 2068 (2012) or NRRS 2068
- Nepal Urban Road Standard 2068 (2012) or NURS 2068

The general assumption when referring to these road design standards is that the roads along the route will conform to the applicable standard substantially with some exception. However, this assumption may not always be true as a major section of the roads may be non-compliant with the applicable design standard. The actual observation during the test rides will refine the route assessment in terms

[11] *The design speed is the basic parameter that governs the geometric details of the road, particularly, the minimum radius of the horizontal curves; vertical curves visibility (stopping sight distance); lateral clearance, etc.*

[12] *Strategic roads include all the national highways and feeder roads that fall under DoR's jurisdiction. National highways are the main roads connecting east to west, north to south across the country and are of longer span. Feeder roads are important roads of localized nature linking the district headquarters, major economic centers with the national highways.*

[13] *Local road network include all the roads developed through local government and comprises the district road and village road. The district road links a VDC headquarter or the nearest economic centre to the district headquarter via a neighboring district headquarter or the strategic road network. Village roads are the lower tier local roads, agricultural roads that link other locations in the village.*

of accessibility, comfort and safety of travel along the route. The various geometric details of each of the road design standards above is shown below to assist the Route Selection Committee during its desk study in context to route selection for a new route for public transport.

(1) Road Cross-sections

The width of the carriageway or area of the road available for vehicles to travel normally, is the most basic feature of the road that gives idea of the types of vehicles that can access the road concerned. The standard width of the carriageway in the various design standards that governs different class of roads above all accommodate the largest vehicle (design vehicle) that can be expected in Nepal.

Similarly, the shoulders, which, are the strip of the road way on both sides of the carriageway, allows vehicles to pull over for emergencies, park if permitted or use as footpaths for pedestrians. In the urban roads, these shoulders are mostly replaced by footpaths provided raised above and segregated with kerbs from the carriageway and to restrict the use the side area exclusively for pedestrians. As traffic increases, vehicles need more overtaking opportunity in the same direction or passing opportunities for opposing traffic. The width of the roadway, which comprise the width of the carriageway and the shoulders can also give useful guide the route assessment team whether such opportunities is feasible between two design vehicle or between a combination of a design vehicle and a narrow vehicle (car, motorcycle, cycle, microbus, minibus, etc.).The geometric details of different road class in different road network (strategic, local, urban) is given in Table 3-1 Carriageway, Shoulder and Roadway of Different Roads to Table 3-4.

Table 3-1 Carriageway, Shoulder and Roadway of Different Roads

Road Network	Road Type, Cross-section		Carriageway Width(m)	Shoulder width each side(m)	Roadway width(m)
Strategic roads (NRS 2045/2070	Single lane - difficult terrain or low traffic (<100 vpd)		3	0.75	4.5
	Single lane		3.75	1.5	6.75
	Intermediate lane		5.5	2	9.5
	Double lane without kerbs		7	2.5	12
	Double lane with kerbs		7.5^	2.5	12.5
	Four lane without median		14	3.75	21.5
	Four lane with median≥ 3 m wide		14	3.75	24.5
	Multi-lane (N lanes total) without median		$3.5 \times N$	2.5~ 3.75	$3.5 \times N + 5$ ~ $3.5 \times N + 7.5$
Local roads (NRRS 2068)	District Roads				
	Hill	Single lane - difficult terrain/low traffic (<100 vpd)	3	0.75	4.5
		Single lane	3.75	0.75	5.25
		Intermediate lane	5.5	0.75	7
	Terai	Single lane -low traffic (<100 vpd)	3	1.5	6
		Single lane	3.75	1.5	6.75
		Intermediate lane	5.5	1	7.5
	Village Roads				
	Hill	Single lane	3	0.5	4

Road Network	Road Type, Cross-section		Carriageway Width(m)		Shoulder width each side(m)		Roadway width(m)
	Terai	Single lane		3		0.75	4.5
			Carriageway Width(m)	**Pedestrian Traffic (pph*) One dir.**	**Pedestrian Traffic (pph*) Both dir**	**Footpath width (m) F**	**Roadway width(m)**
	Single lane -local access road		3	2400	800	2	$3 + 2 \times F$
	Single lane – collector street		3.5	3600	2400	2.5	$3.5 + 2 \times F$
	Intermediate lane –collector street		5.5^{+}	4800	3200	3	$5.5 + 2 \times F$
	Double lane without kerbs		7	6000	4000	4	$7 + 2 \times F$
	Double lane with kerbs		7.5				$7.5 + 2 \times F$
	Three lanes without kerbs		10.5				$10.5 + 2 \times F$
	Three lanes with kerbs		11				$11 + 2 \times F$
	Four lane without median		14				$14 + 2 \times F$
	Four lane with median≥ 3 m wide		14				$14 + 2 \times F$
	Multi-lane (N lanes total) without median		$3.5 \times N$				$3.5 \times N + 2 \times F$

Note: Strategic roads are functionally classified from Class I to IV.

Class I are high standard, divided carriageway, access controlled road with ADT≥ 20,000 PCUs over 20 years period.

Class II roads are those with ADT 5000-20000 PCUs over a 20 years perspective period.

Class III roads are those with ADT 2000 to 5000 PCUs over a 20 years perspective period.

Class IV roads are those with ADT less than 2000 PCUs over a 20 years perspective period

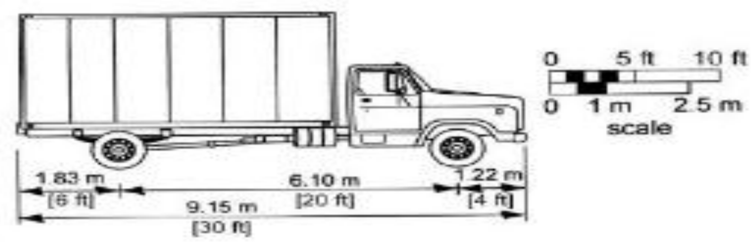
^Not specified in NRS 2070, figures are those taken from NRS 2045.

**pph = number of pedestrians per hour*

+ Not specified in NURS 2068, figures are assumed from NRS 2070/2045.

(2) Horizontal Curves

Heavy vehicles may not be able to access the route if there are a number of narrow horizontal curves along the route whose radius is less than the minimum turning radius that is required for heavy vehicles. The minimum radius of the horizontal curves for all the roads that are part of the strategic and local road network consider design vehicle that accommodates the largest heavy vehicles that can be expected in Nepal. Also, the carriageway along horizontal curves should be wider than the straight section of the road as vehicles require more space while turning owing to difference between the track paths of the front and rear wheels of the vehicles and this is particularly significant for heavy vehicles owing to the longer wheelbase[14] and width as illustrated in **Error! Reference source not found.**.



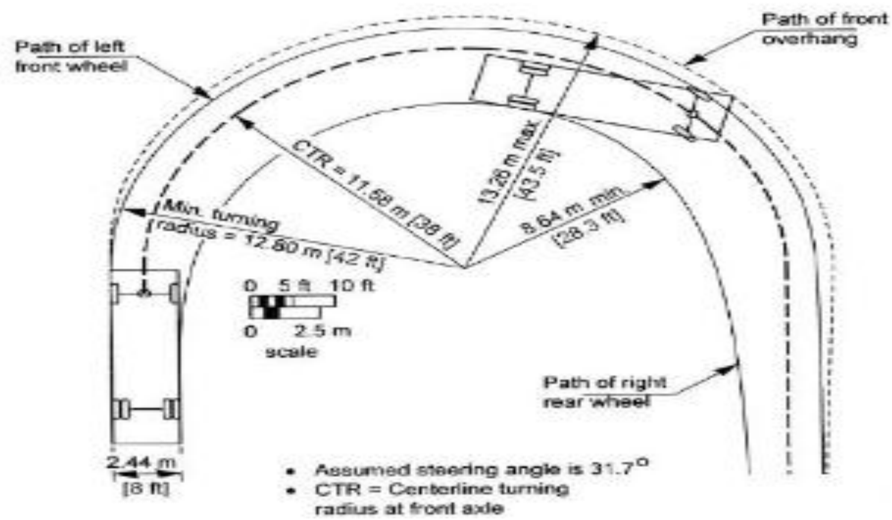


Figure 3.2 Minimum Turning Path for Trucks

Source: Geometric Design of Highways and Streets2001; American Association of State Highways & Transportation Officials, USA

[14] *Wheelbase is the shaft length between the front and rear axle of a vehicle.*

Table 3-2 Minimum Radius, Carriageway Width of Horizontal Curves for Strategic Roads

Road Network	Road Class				Design Speed (kph)	Minimum Radius (m)			Carriageway Required At Curve Apex* (m)		
						No e^	Max. e (10%)	e as per comfort criteria	Single Lane	Double Lane	Multi-Lane (n)
Strategic Roads (NRS 2070/ NRS 2045)					120	1730	600	760		7	3.5n
	I				100	870	370	530		7	3.5n
		II			80	440	210	340		7	3.5n
			III		60	200	110	190		7.6	(3.5+0.3)n
				IV	40	70	40	90	3.75	7.9	(3.5+0.45)n
					30	30	20	50	4.35	8.2	(3.5+0.6)n
					20	20	10	30	4.65	8.5	(3.5+0.75)n
Feeder Roads in hills (DSFR 2053)	Road standard				Traffic (vpd)	Minimum Radius (m)			Carriageway Required At Curve Apex (m)		
						Hilly	Terai		Hilly		Terai
									3 m Single Lane	Single Lane	Single Lane
	FW tractor				< 50	12.5	NA		4.5		
	FW earthen/ gravel				> 50	12.5	12.5			5	4.4
	AW gravel/ bitumen				>50	12.5	12.5			5	4.4

*Note: FW= fair weather (dry seasons); AW= all weather *To accommodate extra-widening due to path difference*

^e= superelevation

Table 3-3 Minimum Radius, Carriageway Width of Horizontal Curves for Rural Roads

	Road Class		Design Speed (kph)	Minimum Radius (m)		Carriageway Required At Curve Apex (m)		
				e=10%	e=7%	3 m Lane (traffic< 100 vpd*)	Single Lane	Intermediate Lane
Local Roads in hills (NRRS 2068)	District Roads	Terai	50		90	3	3.75	5.5
		Terai	40		60	3.6	4.35	6.1
		Terai	30		30	3.6	4.35	6.6
		Terai	25		20	4.5	4.65	7.2
		Hilly	25	20		4.5	4.65	7.2
		Hilly	20	12.5		4.5	4.65	7.2
		Hilly	15	10		4.5	4.65	7.2
	Village Roads	Terai	30		30	3.6	4.35	6.6
		Terai	25		20	4.5	4.65	7.2
		Terai	15		10	4.5	4.65	7.2
		Hilly	15	10		4.5	4.65	7.2

Table 3-4 Minimum Radius, Carriageway Width of Horizontal Curves for Urban Roads

	Design Speed (kph)	Minimum Radius (m)		Carriageway Required At Curve Apex (m)			
		e=7 %	e=4%	Local Street (3 m)	Single Lane	Intermediate Lane	Double Lane
Urban Roads (NURS 2068)	80	230	265	3	3.75	5.7	7.6
	60	130	150	3	3.75	5.8	7.6
	50	90	105	3	3.75	5.9	7.9
	30	30	40	3.6	4.35	6.6	8.5

(3) Hairpin Bends in Hilly Roads

Hairpin bends (very sharp bends) are provided in hilly roads to negotiate road alignment that reverse its direction owing to difficulty to avoid sharp bends at locations where the direction of the road reverses. The route assessment team should note the hairpin bends where applicable will follow the geometric details outlined in Table 3-5.

Table 3-5 Hairpin Bends Design Parameters

	Strategic Roads (NRS 2070, NRS 2045)	**Feeder Roads in hills (DSFR 2053)**	**Local Roads (NRRS 2068)**	
			District Road	**Village Road**
Minimum design speed (kph)	20	20*	NA	NA
Minimum curve radius (m)	15	15*	12.5	10
Minimum length of transition curve (m)	15	15	15	15
Max longitudinal gradient	4%	5%	4%	4%
Maximum super elevation	10%	10%	10%	10%
Minimum gap between successive hairpins (m)	60	100	100	100
	Minimum roadway width at the apex of the curve (m)			
Carriageway	**Strategic Roads (NRS 2070, NRS 2045)**	**Feeder Roads in hills (DSFR 2053)**	**Local Roads (NRRS 2068)**	
			District Road	**Village Road**
Single lane -3.75 m carriageway	7.5^	7.5	6.25	5
Single lane- 3.0 m carriageway			5.5	5
Double lane	8.5			
Multi-lane (N lane)	$5.75 \times N$			

*Note: * This parameter is not specified in DSFR 2053 and figure shown is as per NRS 2070.*

Roadway includes the carriageway (where vehicle travels) and shoulders but excludes the side-drains, passing zones and laybys.NA= not available or not specified .^ Figure is as per NRS 2045, not specified in NRS 2070.

(4) Gradients

Various types of vehicles can climb road for up to certain gradients and also the distance that they can traverse without losing speed significantly vary owing to diverse power capability of different vehicles. The speed reduction for heavy vehicles along grades is particularly significant beyond certain span (known as critical length) in road alignment design. Where the road section in grade exceeds the critical length, either the road alignment design is adjusted or climbing lanes as illustrated in found. Are provided to allow lighter vehicles to pass heavy vehicles along the grade section.

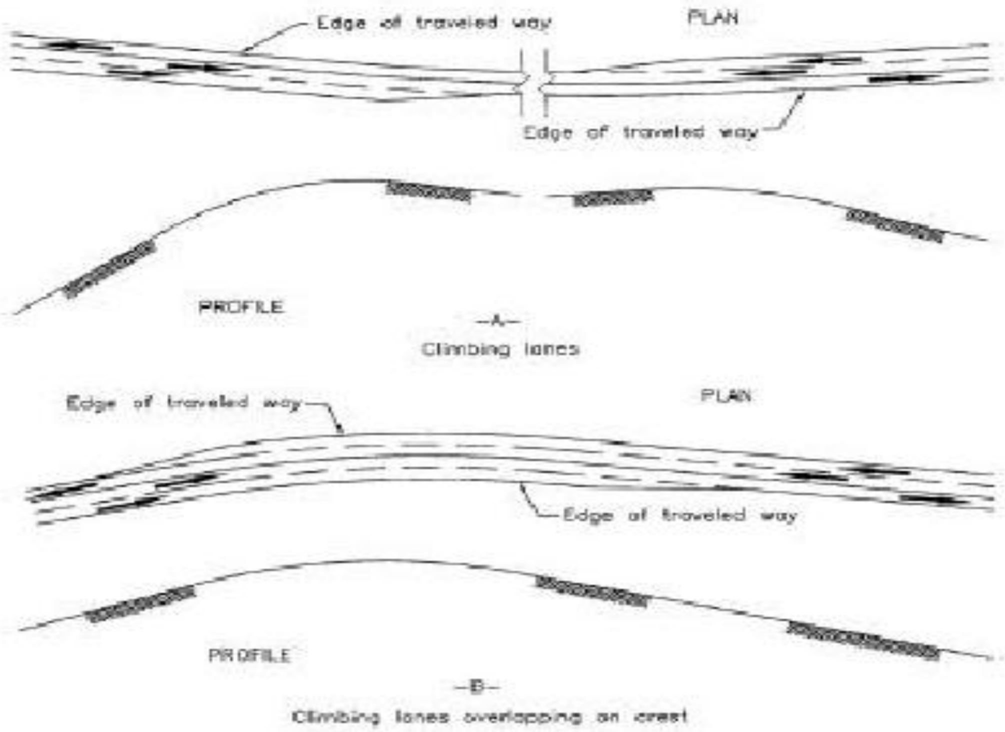


Figure 3.3 Climbing Lanes Provided on a Two-lane Highway

Source: Geometric Design of Highways and Streets2001; American Association of State Highways & Transportation Officials, USA

Road alignments along various network will generally be limited to the maximum gradients shown in Table 3-6 as per their respective design standards.

Table 3-6 Maximum Gradients Applicable in Various Road Networks

Design Speed (kph)	Strategic Roads (NRS 2070, NRS 2045)		Feeder Roads (DSFR 2053)		Local Roads (NRRS 2068)			
					District Road		Village Road	
	Maximum Gradients (%)	Critical Length (m)	Maximum Gradients (%)	Critical Length (m)	Maximum Gradients (%)	Critical Length (m)	Maximum Gradients (%)	Critical Length (m)
15							12%- hills	150
20	12%	150	12	150	12%- hills	150		
25	12%	150	12	150	12% - hills	150		
30	10%	150	10	150			7% -Terai	150
40	9%	200	9	200				
50	8%	250	8%	250	7% - Terai	250		
60	7%	300	7	300				
80	6%	400						
100	5%	450	5	450				

Based on **Error! Reference source not found.**, all types of vehicles that commonly ply in Nepal can traverse through the maximum grades specified in Table 3-6 in general but light vehicles such as cars, vans and motor-cycles cannot traverse over very steep grades for long distance owing to their lower gradeability compared with heavy and four wheel drive vehicles.

High gradient sections (more than 9%) along a route that traverse through earthen or gravel road significantly impact pavement deterioration during monsoon periods. In turn, grades often dictate the choice of pavement surface to provide (e.g. chip seal for short section of grade less than 2% or asphalt concrete if grade is more than 5%).

(5) Pavement Condition

The condition of pavement will influence navigation along a route including road safety during maneuvers. For example, poor pavement significantly impacts pavement damage over bridges, culverts, etc., as well as stability of heavy vehicles. Heavy vehicles tend to take additional space when the pavement condition worsen. In addition, light vehicles with lower ground clearance cannot navigate unpaved roads as such roads are often poorly maintained in Nepal with deep undulation created laterally by the wheels of heavy vehicles and farm tractors that traverse such roads and such undulation can be severe during the monsoon seasons. It is imperative that the Route Selection Committee assess the condition of the pavement to determine the type of vehicles that can access the route or to apply restrictions to ensure safe travel.

Figure 3.4 Deep Undulation Created in Poorly Maintained Road in Nepal

While it is not reasonable to expect the Route Selection Committee to conduct pavement condition surveys, it is important for the committee above to be knowledgeable about the common form of pavement condition surveys that are conducted in Nepal and the method adopted by road agencies to evaluate pavement condition.

The condition of pavement in Nepal is usually assessed through two form of surveys (i) road roughness and (ii) surface distress index (SDI). Roughness surveys quantitatively measures the pavement undulations and correlates it to interpret the pavement condition. It measures the cumulative surface undulations using a vehicle mounted bump integrator attached to the wheel or axle of the survey vehicle traversing the road surveyed. The cumulative vertical movement is converted to the international roughness index (IRI) in mm per km and DoR adopts the following correlation to interpret pavement condition.

Table 3-7 Pavement Evaluation based on IRI

IRI	Pavement evaluation
<3.5 mm/ km	Good condition
3.5 ~ 8.5 mm/km	Fair condition
>8.5 mm/ km	Poor condition

In reality, the correlation of IRI values with the pavement condition varies with different types of pavement surfaces and construction. Nevertheless, IRI indicates the need for pavement rehabilitation and reconstruction. For example, IRI value of 7.9 and more than 13 for a surface dressed pavement will trigger the need for rehabilitation and reconstruction, respectively. SDI surveys in Nepal involve visual inspection of the characteristics of pavement damage shown in Table 3-8 and are conducted by a pair of trained highway engineers walking-over and drive-through the road to be surveyed.

Table 3-8 Characteristics of Pavement Damage Assessed during SDI Surveys

Pavement Damage Characteristics	Unpaved Roads	Paved Roads
Stripping/ bleeding/ raveling	No	Yes
Cracking (longitudinal, transverse, alligator and block)	No	Yes
Edge damage	No	Yes
Shoulder step	No	Yes
Camber loss	Yes	No
Rutting	Yes	Yes
Corrugations	Yes	No
Potholes	Yes	Yes
Gravel loss	Yes	No

All of the pavement characteristics above covering 10% of the survey sample are quantified and then added to generate a numerical index or SDI that range from 0 to 5. Pavement condition is then assessed by correlating the resulting SDI as follows.

Table 3-9 Pavement Evaluation based on SDI

SDI	Pavement evaluation
0 ~ 1.7	Good condition
1.8 ~ 3.0	Fair condition
3.1~ 5.0	Poor condition
Trigger for Pavement Remedial Acton	
% of the sample	Action
If 20% have SDI = 5	Reconstruction
10 – 30 % have SDI =4	Rehabilitation
20 – 30 % have SDI =3	Resealing with local patching
20 – 30 % have SDI =2	

SDI index are also useful indicator for maintenance intervention as shown in Table 3-9. In recent days, SDI surveys have been conducted using video footage of the pavement surface through CCTV cameras fitted beneath the survey vehicle with GPS tracking.

The Route Selection Committee should compile whatever details that is available regarding pavement condition of the roads that form the new route from the concerned agencies. However, it should be noted that pavement condition survey evaluation are mostly only available for strategic roads under DoR jurisdiction.

Therefore, the committee will need to assess the pavement condition mostly following test runs along the route. It can evaluate the pavement condition based on its own judgment adopting some or all of the same defect characteristics as adopted for SDI assessment. In particular, it should note the following points.

i. Assess suitability of the pavement for all vehicles or specific vehicles. For example, heavy vehicles may need to be restricted on earthen or graveled roads that are narrow when the pavement condition worsen[15]. Light vehicles should be restricted along unpaved roads that are poorly maintained due to navigational difficulty.

ii. Poor pavement significantly impacts pavement damage over the bridges and culverts that intercept the route and also impact stability of heavy vehicles.

iii. Variable speed may be necessary along poorly maintained roads for all vehicles during monsoon period.

iv. Improvement to the road or maintenance may be necessary before opening the route for public transportation services.

(6) Bridges, Culverts, Other Structures

Apart from the geometric design of the road, the Route Selection Committee need to check with the load limit, clearance available (vertical, lateral) across bridges, culverts, causeways, etc., that would intercept the new routes to determine if restriction is necessary for heavy vehicles. Therefore, the Route Selection Committee need to proceed as follows in their assessment pertaining to bridge, culvert and other structures.

i. Identify the bridge, culverts, causeways that traverse the route and collect their details from DoR, DoLIDAR, DDC, etc. In this respect, the committee can refer to the DoR Bridge Management System which immediately gives useful information of various crossing that exists along the strategic roads and is available online.

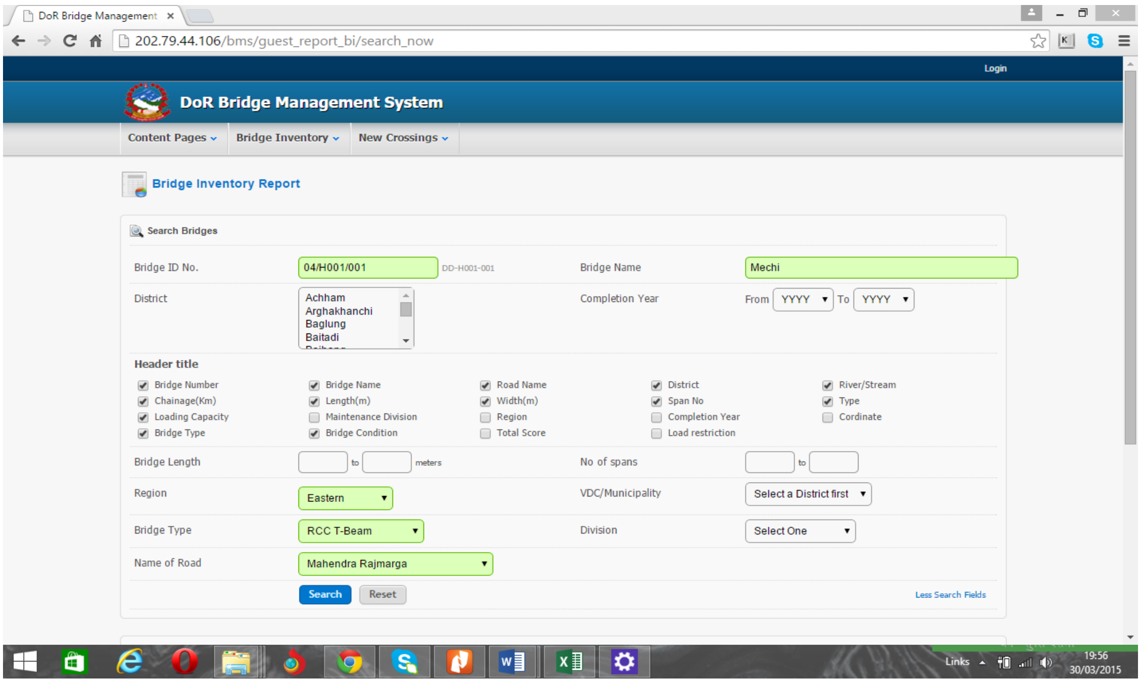


Figure3.5 Bridge Inventory Search, DOR

[15] Heavy vehicles take more space when the road surface is poor.

ii. If the details of the bridge, culverts along the route are incomplete, missing or simply not available, gather whatever details that is available from the concerned agencies themselves to confirm the following details.

iii. Maximum load limit applicable along the individual bridges, culverts, causeways. From a safety point of view, access along these structures should be limited to vehicles whose gross vehicle weight is 90% of the posted load limit. These details should be ascertained from the concerned agencies or through consultation with structural/ bridge engineers.

iv. Cross-section (carriageway, footpath, kerb-barrier, etc.) and clearance (lateral, vertical) available. These details will be useful to assess if heavy vehicles are restricted owing to their larger dimension or whether two way traffic movements is feasible as often single-lane bridge often intercept intermediate or two lane roads in Nepal16.

v. Condition of these structures for which the bridge condition surveys conducted by DoR can be useful resources.

a. Confirm the vertical clearance available at overpass, signs, gantry signs, aerial utility cables, etc., and the lateral clearance to roadside furniture, poles, etc.

b. Check with Nepal Electricity Authority about vertical clearance necessary to high voltage lines and confirm that this comply along the route during the trial runs.

c. Refine the missing information from the trial runs through the route.

To assist in their desk study prior to test runs along the route, Figure 3.6 to Figure 3.8 illustrates some of the standard cross-sections of ridges that can exist along the routes that traverse through strategic roads in Nepal. The route assessment teams should however confirm the actual cross-section from the concerned authorities and site inspection.

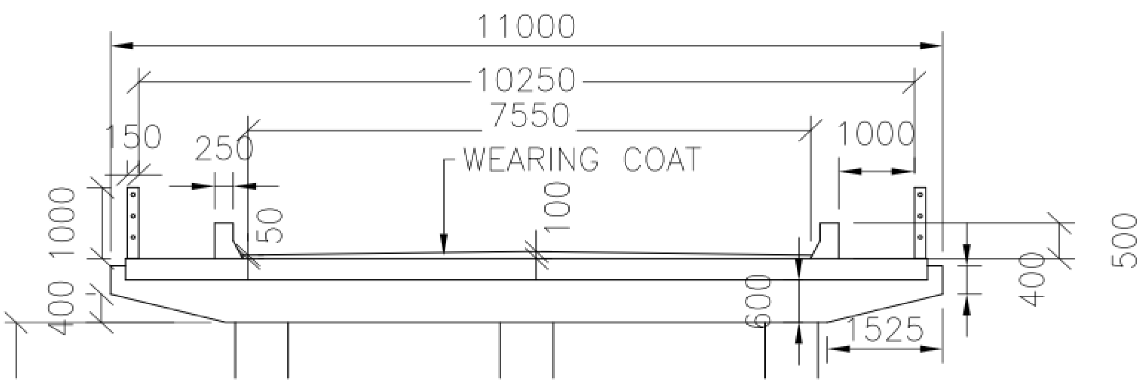


Figure 3.6 Typical Cross-section of a Two-lane RCC Bridge (Arch)

Courtesy: Road Maintenance & Development Project (IDA Cr. 3293), DoR

[16] This was done to reduce cost but recently DoR has adopted the policy of providing only bridges and culverts that are at least of intermediate lane to avoid costly investment in the future when the road is widened.

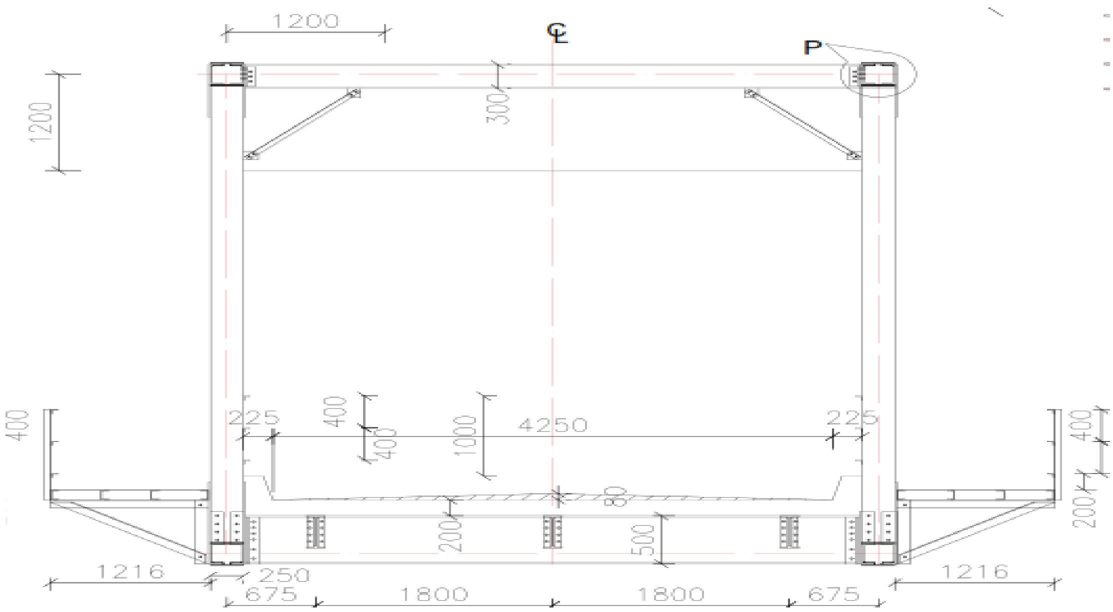


Figure 3.7Typical Cross-section of a Single-lane Truss Bridge with Footpaths (30 m span)

Courtesy: Road Maintenance & Development Project (IDA Cr. 3293), DoR

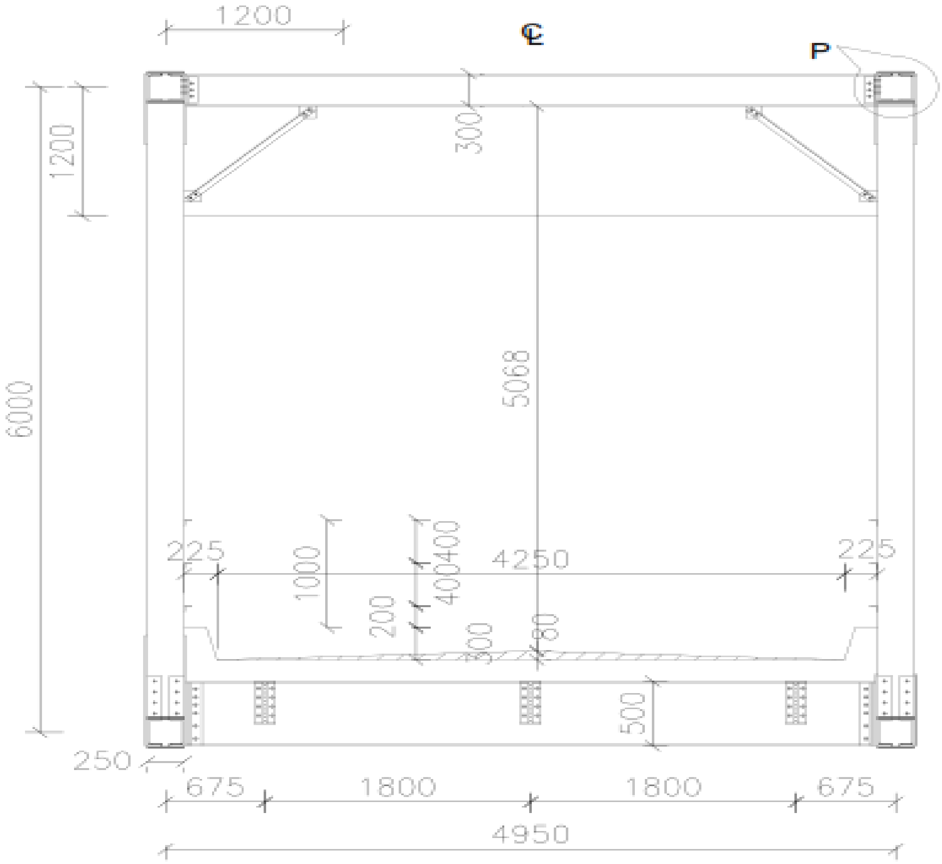


Figure 3.8 Typical Cross-section of a Single-lane Truss Bridge without Footpaths (30 m span)

Courtesy: Road Maintenance & Development Project (IDA Cr. 3293), DoR

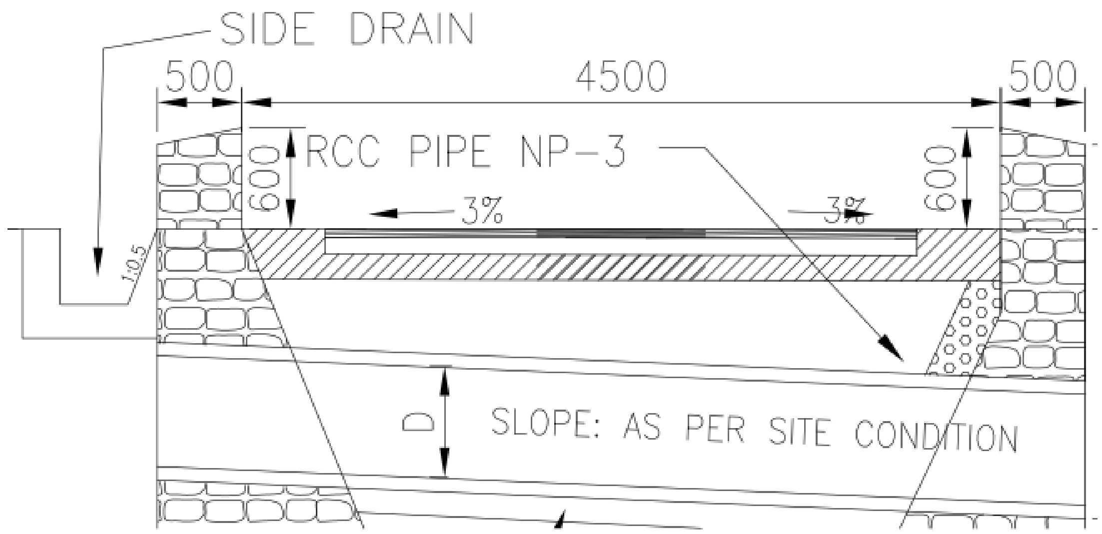


Figure 3.9 Typical Cross-section of a Pipe Culvert on Single-lane Road

Courtesy: Road Connectivity Sector I Project (ADB Grant 0051-NEP), DoR

Typically, the following clearance, design loads is adopted on bridges, culverts and other structures.

Table 3-10 Clearance, Design Loading Required

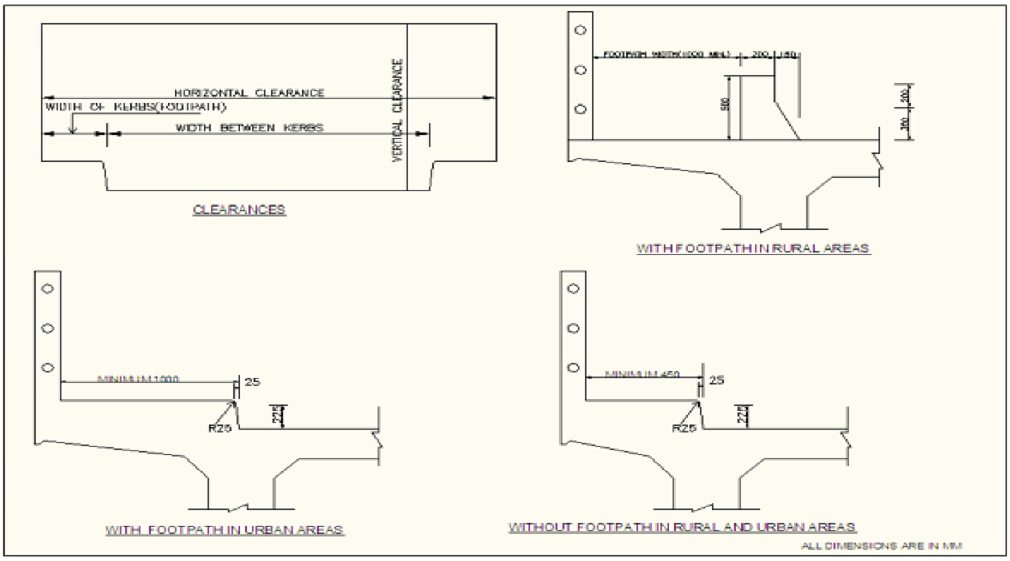
Structure/vehicle	Clearance			Design Loading
	Vertical	Lateral from Kerb		
		without footpath	with footpath*	
RCC bridges in municipalities, industrial areas	4.75 m, 400 mm clear gap	25 mm - urban	25 mm – urban 150 mm – rural	Single lane IRC Class AA[17]/ two lane of IRC Class A[18]
RCC bridges in highways, other areas				Single lane IRC Class AA, two lane of IRC Class A or AASHTO HS 20-44 [19]
Overhead wires	7 m, 500 mm clear gap			
Barrier kerb		150 mm		
Overpass, signs, etc.	400 mm clear gap			
Other non-rigid overhead obstructions (e.g. trees, etc.)	500 mm clear gap			
Semi-trailer multi-axle trucks (ISO 40 foot or longer)	**Gap with other vehicles**	**Lateral from kerb/ outer edge of shoulder**		
	1.2 m	0.6 m		

**Denotes lateral clearance measured from the footpath kerb.*

[17]IRC Class AA load corresponds to the most severe case between a 70 MT track vehicle and a 20 MT seven-axle wheeled vehicle.

[18]IRC Class A corresponds to a train of eight-axle vehicles having a GVW of 55.4 MT travelling with specified gap.

[19]AASHTO HS 20-44 correspond to a uniformly distributed load of 9.3 KN/m and a concentrated load of 80 KN for bending and 115.7 KN shear.



Courtesy: Nepal Bridge Standard -2067; DoR

Figure 3.10 Standard Lateral and Vertical Clearances in Bridges

3.1.4 Assessing Route Accessibility based on Vehicle Dimensions, Operational Capability

As per the previous discussion, roads along the route that are designed as per the standard applicable (strategic, local, urban) can generally accommodate the largest vehicle that can be expected in such roads. However, it is important to bear in mind that various roads will actually have geometry that do not comply with the standard requirements owing to space constraints (in urban built-up areas, rural ribbon developments, etc.). The Route Selection Committee thus needs to take into consideration the dimensional requirement, steering capability into consideration in order to determine the type of vehicles to permit or restrict based on travel safety, preserved road assets (pavement, bridges, culverts, causeways) once it is able to review the road designs if available or following trial runs.

Table 3-11 illustrates the capacity, dimension of various types of vehicles in the models commonly found in Nepal.

Table 3-11 Capacity, Dimension of Various Vehicles Commonly Plying in Nepal

Type of Vehicle/ Configuration	Max engine output (Hp)	Minimum Turning Radius (m)	Max speed (kph)	Maximum GVW (MT)	Vehicle Dimension (mm)				Ground Clearance (mm)
					L	WB	B	H	
Multi-axle trucks (42' semi-trailers)	243 hp @ 2000 rpm	7.0	86	49	8903	3890	2550	3332	272
Multi-axle rigid trucks	189 hp @ 2400 rpm	10	73	25	8163	3880	3235	3235	306
Trucks (two axle)	136 hp @ 2400 rpm	7.2	88	16.2	8163	4540	2434	3645	303
High Capacity	170 hp @ 2000 rpm	9.2	95	12.5	11085	5820	2500	2836	267

Bus (seats> 55)									
Bus (25-55 seats)	132 hp @ 2800 rpm	8.5	96	16.2	12000	6320	3350	2836	263
Minibus (15- 25 seats)	101 hp @ 2800 rpm	6.2	107.5	6.52	6870	3400	2200	2865	276
Micro-bus	108 hp @ 3600 rpm	6.2	98	3	5380	3110	1880	2285	185
Three wheeler (SAFA tempo)=	8.5 hp @ 3800 rpm	7.0	45	1.65	3480	2270	1482	1600	140
Cars	86 hp @ 5400 rpm	4.8	158	1.51	4275	2600	1760	1530	169
4WD	217 hp @ 4600 rpm	7.3	176	3.5	5140	3075	1995	1940	221
Motorcycle	11 hp @ 7500 rpm		113		2095	1340	796	1100	167
Average farm tractor=	66 hp @ 2200 rpm	3.6	26	2.5	4690	4159	2050	2810	445

Note: GVW =gross vehicle weight MT= metric tonnes WB= wheelbase L=length B= breadth H=height

hp= horse power rpm= revolutions per minute

As shown in

Table 3-11, high capacity buses and standard buses comprise the largest size vehicles in the country whereas obviously the semi-trailer trucks and the multi-axle rigid trucks carry the highest gross vehicle weight. Consequently, these multi-axle trucks and standard two-axe trucks have the significant axle-loads that needs to be controlled in order to preserve the road pavement.

As discussed previously, all the vehicles commonly plying in Nepal can negotiate all horizontal curves that are in compliance with the minimum radius prescribed in applicable design standards shown in Table 3-2 to Table 3-4. However it is important to note that there may be many sections of the road along the route that where there are horizontal curves that are tighter than the prescribed minimum. The Route Selection Committee needs to relate the specific narrow curves, intersection turning radius that actually existing along the route with reference to

Table 3-11. On the same note, all types of vehicles commonly plying in Nepalese roads (refer **Error! Reference source not found.**) can generally traverse road upgrades that are within the prescribed maximum gradient applicable in Table 3-6but light-vehicles, especially, three wheelers and motorcycles, find it difficult to sustain through such high grades for considerable length owing to much lower power that these vehicles have comparatively.

Access to different types of vehicles may also be restricted if the carriageway at the apex of intersection corners, horizontal curves or sharp hair-pins (in hilly roads) is insufficient to accommodate the extra-widening that is necessary in these areas as discussed previously. Table

3-12illustrates the width of the carriageway that should be available to accommodate vehicles at turnings. The carriageway width shown for two-way movement in case of semi-trailer truck corresponds to the width required to pass a semi-trailer and a standard two-axle rigid truck as requirement to provision for two semi-trailers is unnecessary and very rare in Nepal.

Table 3-12 Carriageway Width Required to Accommodate Turning

Vehicle Type	Required carriageway width at the apex of the Horizontal Curve, Intersection Turning, Hairpin Bends				Vehicle Dimension (mm)			
	Urban single Lane	Urban Two-way	Strategic/ Local Single Lane	Strategic/ Local Two-way	L	WB	B	H
Average 42' Semi-trailer Trucks	6.8	11.3	6.8	11.3	18,034	3,619	2,519	3,386
Average Multi-axle rigid trucks	3	7	3	7	7,062	4,080	2,408	3,218
Average Two-axle Trucks	3.4	7.1	3.5	7.4	6,835	3,884	2,321	3,070
Average High Capacity Bus	3.9	8.5	4.0	8.8	11,524	5,554	2,547	2,836
Average Bus	3.1	6.7	3.3	6.9	9,113	4,843	2,480	2,836
Average Minibus	3.1	6.7	3.3	6.9	6,870	3,400	2,200	2,865
Average Micro-bus	2.6	5.7	2.8	5.9	5,380	3,110	1,880	2,285
Average Three Wheeler (SAFA tempo)	1.9	4.2	2.0	4.5	3,480	2,270	1,482	1,600
Average Cars	2.9	6.2	3.0	6.4	3,951	2,482	1,708	1,485
Average 4WD	2.8	6.0	2.9	6.3	4,824	2,896	1,869	1,896
Average Motorcycles					2,095	1,340	796	1,100
Average Farm Tractors	4.0	8.4	4.1	8.7	4,100	3,536	1,864	2,768

Taking the carriageway width stipulated inTable 3-12 as the reference, it is also possible to determine whether specific vehicle can access an existing or turning aligned at different angles using template similar to that shown in Figure 3.11 reproduced in a transparent slide on a scale for various types of vehicles. By superimposing these template over the plan of the road turning along the route, one can easily assess access to vehicle of particular interest which would be the heavy vehicles.

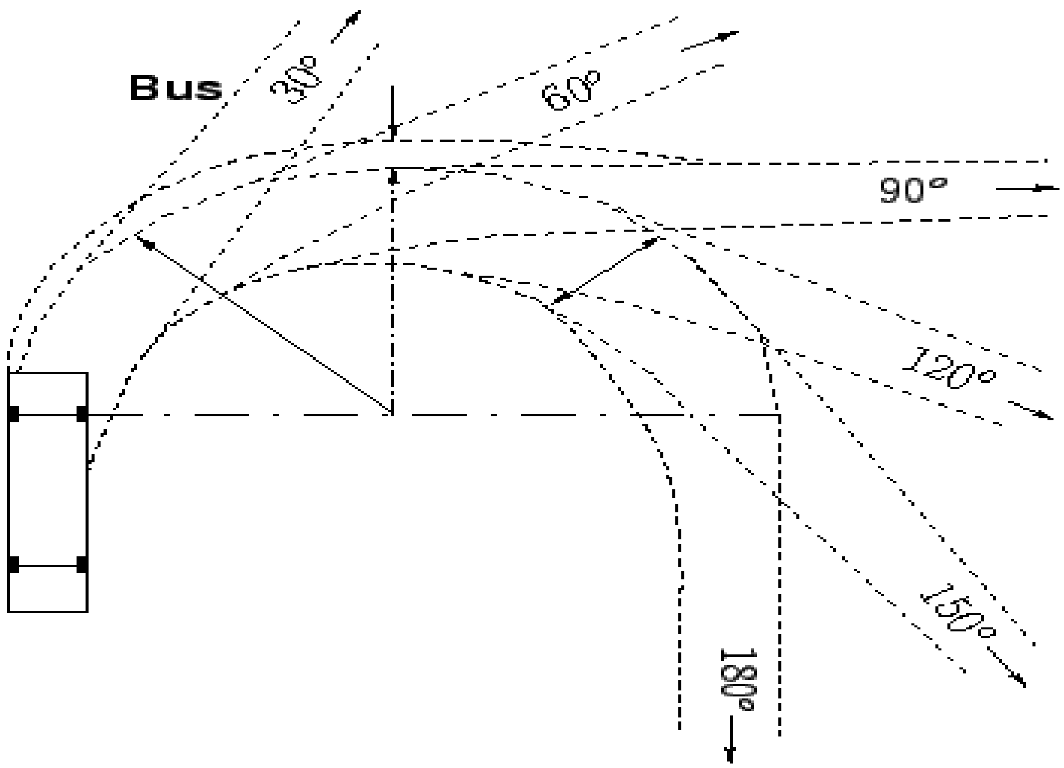


Figure 3.11 Sample Turning Template for Bus

Source: Geometric Design of Highways and Streets2001; American Association of State Highways & Transportation Officials, USA

Therefore, the Route Selection Committee should in addition to the previous steps, proceed as follows during desk study and trial runs to determine whether to allow or restrict specific vehicles based on alignment, turning geometry and vehicle capacity.

i. Confirm CWY available, especially along the bridges, culverts to assess if access for heavy vehicles such as the semi-trailers can be granted.
ii. Check the loading limit applicable along the bridges, culverts as recommended earlier in Section 3.1.4 and determine if certain heavy vehicles should be restricted.
iii. Compare the grade including the span involved along the route with respect to gradeability of various vehicles listed in **Error! Reference source not found.**. If grades existing along the routes exceed that listed in the table above, restrict those type of public vehicles. In the case of private vehicles, while it is not feasible to restrict them, the Committee can advise the public against using inappropriate vehicles to travel along the route in question. Usually, motorcycles, tempos, high capacity buses will automatically be restricted in accessing high upgrades spanning for a long stretch of the road.
iv. Assess accessibility to different vehicles, particularly the heavy vehicles, at the various turning (intersections, curves, hairpins) in the design plan with reference to Table 3-12. Where these turnings intersect are at an angle other than a right angle, determine if these are adequate using the turning path template developed for various types of vehicles.

a. If either the turning radius, width of the carriageway provided at the turning is inadequate, recommend land acquisition to improve the intersection or the bend as applicable, to ensure access to all vehicles.

b. If improvement is not feasible, ascertain the type of vehicle that can have access and issue permit accordingly.

3.1.5 Route Inspection and Test Runs

Following the desk study to identify the suitability of the route in terms of roadworthiness, accessibility that can be accorded to all vehicles or specific one based on geometrical, terrain constraints as outlined in the previous sections, it will be necessary for the Route Selection Committee to physically inspect the route as well as conduct test runs along it to confirm the desk study findings. In this respect, the Committee should proceed as follows.

i. Drive along the route in various types of public vehicles and observe in the checklist the following items.

   a. Pavement type and condition visually including the degree of undulations, pot-holes
   b. Condition and type of shoulder available
   c. Sharp turns, intersection approaches and available carriageway width at the apex of these locations
   d. Roadside landuse (built-up, school areas, industrial corridor, forest areas, etc.)
   e. Condition, geometry, loading limit of bridges and cross-drains
   f. Presence of lateral protection (safety barriers) at the valley side against steep vertical drops more than 3 m deep in hill roads
   g. Presence of blind corners especially in hill roads (e.g. sharp curves, hairpins that are convex towards valleyside, vegetation obstruction, etc.)
   h. Presence of passing bays in the case of single-lane roads including their location to assess if they are positioned to be inter-visible for safety
   i. Steep gradients available and visibility constraints at summits
   j. Period when visibility is restricted along the route due to weather condition and seasonal changes (e.g. misty conditions during monsoons at hill roads that experience heavy rainfalls, winter fog during the early morning and evening, etc.). It may not be feasible to gather this information during all test runs but this information can be collected through interaction with the local community.
   k. Location of ribbon developments, bazaars, roadside amenities, etc., along the route to establish potential bus stops
   l. Observe carriageway, footpaths available at ribbon development, bazars, etc.
   m. Assess accessibility, navigation ease and comfort while travelling along the route in the test vehicle. In this respect, the Committee should note the speed of travel, time taken to complete the route, etc.

n. Return back and refine the desk assessment regarding selecting the route for public transport or opening the route subject to certain restrictions such as
o. Allow only 4WD transport services only for the time being
p. Allow freight transport by farm tractors only for the time being
q. Restrict public transportation during certain period of the day or certain period during specific season
r. Speed limit to adopt or variable speed limit to adopt for certain period of time based safety consideration
s. Trigger road maintenance and/or improvement necessary to facilitate smooth transport services as well as road safety for all type of public transport
t. Enforce load limit along the route to safeguard bridge and cross-drain structures
u. Prohibit vehicles beyond certain dimension owing to width constraints at bridges and cross-drains.
v. Modify the route path or mitigate to minimize traffic conflicts and adverse impact to certain land use such as residential, school or areas with significant number of pedestrians and cyclists.

3.1.6 Certifying the Route

After confirming the test runs and refining the desk assessment, the committee should finalise its assessment and make it decision whether to open the route. If it decides that it is justifiable to select the route or open the route subject to certain restriction, the committee should publish the route for public information.

CHAPTER 4 ROUTE PERMITTING

Route permitting is the broad means of regulating public transport services including its administration, monitoring, coordination, policy directions to ensure safe, reliable and effective public transport services in Nepal and follows after the route assessment and fixing for new routes. The following sub-section discusses about how the existing provisions and possible recommendation for improvement in regulating public transport services in Nepal.

4.1 CURRENT SITUATION

Currently, DoTM administers the route permits for all public transport services in Nepal as per the provisions set in the MVTMA 1993 and MVTMR 1997. In Nepal, transport operators need permits to operate their service along the DoTM designated routes subject to the maximum fare that the department stipulates from time to time. DoTM is institutionally weak in effectively guiding, regulating transport operators as envisaged in the act and regulation despite good provisions. Given this state of affairs, permits are issued ad-hoc in Nepal instead being guided by scientific mechanism.

Even though MVTMR 1997 clearly requires a transport operator to abide by the schedule prescribed by the ZTMO issuing its permit, to date operators such directives is missing and therefore operators fix schedules, arrange fleet to cater to their passenger demand best on their best judgement and experience. There are no service obligations imposed (e.g. minimum, maximum number of daily trips to satisfy) that passenger transport operators need to abide to maintain their permits. While provisions related to route permits were highlighted earlier in Section 1.2, these are once again illustrated in Table 4-1.

Table 4-1 Route Permit Provisions in MVTMA 1993 and MVTMR 1997

MVTMA 1993	MVTMR 1997
1. Passenger transport routes are defined as follows: • Local route (less than 25 km) • Short route (25 – 100 km) • Medium route (100- 250 km) • Long routes (more than 250 km)	1. New permit along different route to replace exisiting permit require concurrence from the concerned ZTMO that issued the existing permit.
2. Various types of vehicles are generally grouped as heavy; medium and light vehicles. Bus can operate during (a) day or/and (b) night time. Permits for passenger vehicles offering the following level of services are issued. • Direct service • Experss service • Normal service	2. Stipulates the vehicle seating capacity, seating size, internal dimesnsion of aisle, ceiling height, doors, etc. and vehicle age-linit for the passenger transport offering the following service. • Direct bus service; • Express bus service • Normal bus service

3. Documents to submit • Prescribed fee • Valid insurance cover (driver, vehicle crew, security , third party) • Valid vehicle inspection certificate • Valid vehicle registration certificate	3. Only bus can operrate in both day and night.
4. Permit are valid four months at a time and renewal.	4. Microbus operating on long routes are restricted within a maximum of 300 km.
5. ZTMO can issue replacement permit to replace an existing permit if the permit holder applies for the same prior to the expiry of the existing permit.	5. Passenger transport operators need to maintain their schedule prescuned by their ZTMO in normal condition. However, this provision in not enforced owing to DoTM inability to provide operators such guide.
6. ZTMO can issue multi route permit to an existing permit holder if such action does not adversely impact the existing transport services in the area concerned.	6. If a permit holder need to use another route before expiry of the existing permit, a new permit can be issued upon applicant for the same.
7. ZTMO can deny permit after due consultation with the area TMC if (a) the existing services deemed adequate for the prevailing demand; (b) adverse environmental impact expected if permit issued or (c) other reasons.	7. Public passenger services plying along medium and long –distance routes should comply with the standard presribed in the government gazette.
8. ZTMO can deny permit for vehicles that are non-compliant with the prescribed standard for the medium and long routes to accord due comfort and security to passengers and vehicle crew.	8. Route permits shall be renewed upon receipt of application for the same
9. ZTMO can issue intermittent permit valid for seven days upon application for the same if a permit holder need to use another route due to special circumstances.	
10. All transport operators need to be listed in DoTM's roster prior to being granted route permits.	
11. ZTMO can suspend an existing permit upon formal request if the vehicle cannot be operated four months following a road crash or other cause after necessary vertification of the facts.	
12. Government can suspend any permit of any vehicle for up to one month if the vehicle is not operated to the public deteriment.	

Based on DoTM data, there was a total of 443 short to long –distance routes and 47 freight routes established all over the country till January 2015.. Within Kathmandu Valley, there are tentatively 102 routes[20] plying from various locations of the valley.

Almost all the public transport services are run by individual private owners in large number but the routes are collectively allocated and managed through individual associations that exists all over the country. However, a few passenger transport services is managed through companies (e.g. Sajha Yatayat in Kathmandu Valley and Manjushree Yatayat, Makalu, Agni, etc., offering medium to long distance bus services across the country).

The numerous individual private passenger transport operators acquire membership in their district or area based associations (referred to as committees in Nepal) even though it is not mandatory to acquire membership to operate transport services in Nepal. Similarly, truck entrepreneurs acquire membership in truck committees within their development region or district. At the national level, both of these type of transport operators are affiliated with their federations i.e. Federation of Nepalese National Transport Entrepreneurs (FNNTE) and Federation of Truck Transport Entrepreneurs Nepal (FFTEN) based in Kathmandu. Through their district based associations and federations, transport entrepreneurs assist DoTM and in many instances can exert considerable influence to serve their interests.

From the existing scenario and the operating regime, it is clear that effective mechanism for DoTM to effect the various provisions and scientific tools to ensure the various permit provisioned in the rules and regulation is lacking. In addition, re-organisation of the routes and introduction of various models of operation that are available in public transportation should be considered for application in Nepal. While a detailed analysis of route re-organisation is outside the scope of this study, some of these aspects is presented in the subsequent section. Most of the emphasis to improve route permit administration in the subsequent concentrate on some of the most pressing areas that can be immediately introduced in Nepal.

4.2 RATIONALISING THE LOCAL, SHORT, MEDIUM AND LONG ROUTES

As pointed out in Section 4.1, MVTMA 1992 classifies routes for public passenger transport as follows.

- Local route (less than 25 km)
- Short route (25 – 100 km)
- Medium route (100- 250 km)
- Long routes (more than 250 km)

[20] Based on survey from Kathmandu Sustainable Urban Transport Project (ADB Loan/Grant 2656/01212-NEP) that are subject to change following verification with DoTM records.

Only buses (seating 26- 56) can operate during day or/and night service according to the time of operation. All public passenger transport services can offer the following quality of service as provisioned in MVTMA 1992.

- Direct service
- Express service
- Normal service

MVTMR 1997 has outlined the seating capacity; internal dimensions (seating, aisle, doors), seating configuration, emergency provisions (fire extinguishers, first aids), etc., and vehicle age that direct, express or local services within any routes must comply for different size of passenger vehicles. Microbus with seating capacity up to 14 are restricted to operate only up to 300 km which implies that these vehicles can operate on long routes that lie within this threshold limit.

The existing demarcation of local, short, medium and long routes therefore appear to ensure that public transport vehicles having the commensurate standards and amenities ply along the Nepalese roads. These demarcation also appear to restricts certain types of vehicle that can qualify to operate in long routes (e.g. MVTMR 1997 prohibits microbus (seating up to 14) to operate beyond 300 km. These policies are consistent with the general practice in public transportation as illustrated below.

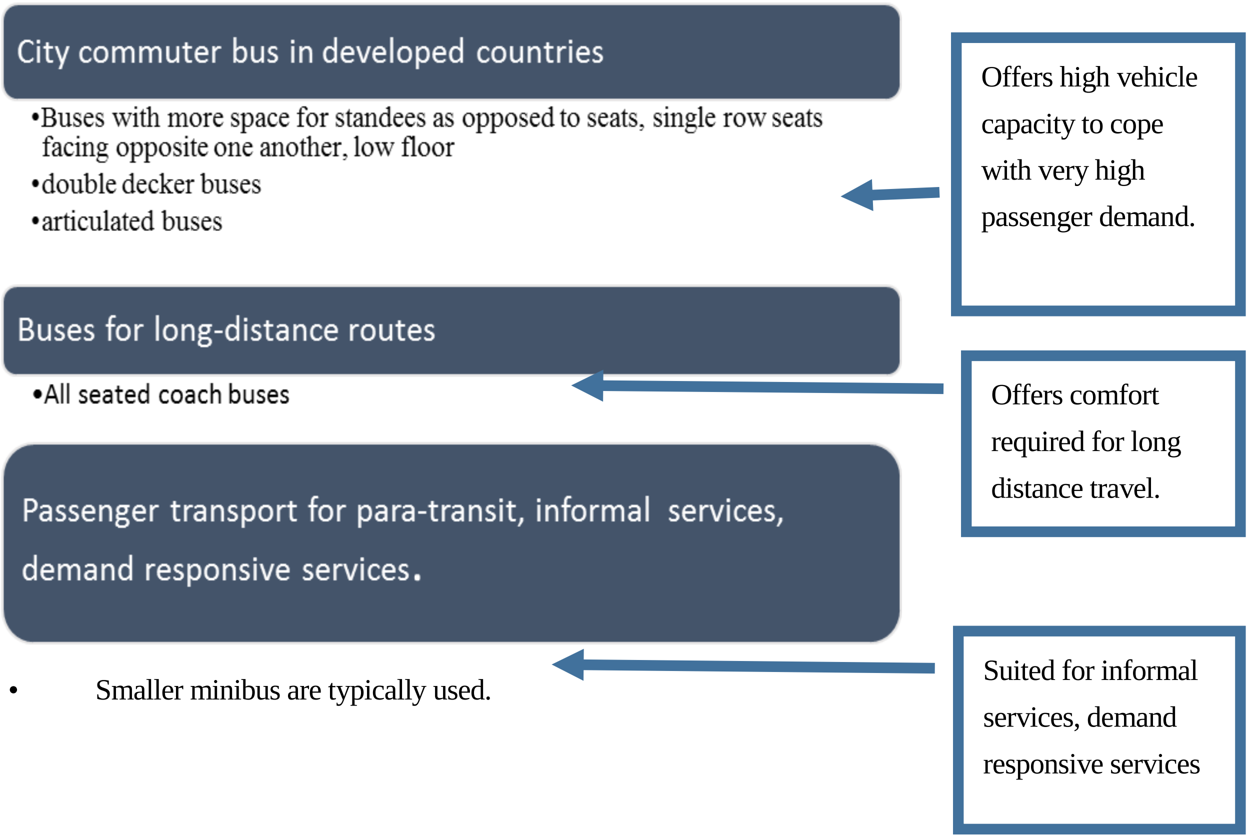


Figure 4.1 Appropriate Vehicle Size for Public Passenger Transport

In addition, the fees for all types and stage of route permits (new, renewals, route change, intermittent and multi) are applied based on the nature of transport (passengers or freight), vehicle size (seating or payload capacity) and distance involved except for buses and minibuses (heavy and medium vehicles[21] as defined in MVTMA 1992) plying in Kathmandu Valley as per MVTMR 1997. Within Kathmandu Valley, a flat permit fee for medium and heavy vehicles that is nearly equal to the maximum fee applicable for medium and heavy vehicles (i.e. long routes that are more than 701 km) is applied for medium and heavy vehicles. Therefore, the permit fee within Kathmandu Valley (which has the maximum traffic levels including public transport vehicles) appear to positively discriminate in favour of smaller public vehicles with seating capacity 5 to 14 that possibly requires revisiting.

Based on the fact above and except for revising the permit fee for light passenger vehicles to apply within Kathmandu Valley, the basic approach to allocating routes of various distances (local, short, medium and long routes) along with stipulation of the particular types of vehicles permitted to operate within these routes and quality of service (local, direct and express) appear to be logical despite the fact that regulators in other countries apply different approach (e.g. stage carriage, contract carriage in India and Pakistan, complete de-regulation in UK, etc.) for regulating public transport services. What appears to be necessary at this stage is to review if the distance range that currently applies for local, short, medium and long –routes in the current development of road network, re-allocate the appropriate type of public passenger vehicle to use the three range of routes. These issues is discussed below for more elaboration.

As part of another task (Task A2: Safe Vehicle Guidelines), the classification of public passenger transport vehicles were reviewed and recommend parallel to this study. The classification for public passenger vehicles that is recommended in the Safe Vehicle Guideline is illustrated again in Figure 4.1 as it is relevant to rationalization of the passenger transport routes.

[21] Heavy vehicles include bus, truck, tractors, construction equipment (dozers, dumper, cranes, rollers, etc.) and medium vehicles include minibus, mini-trucks, SUV (jeeps), pick-up, van, small crane, tankers, smaller roller, etc.

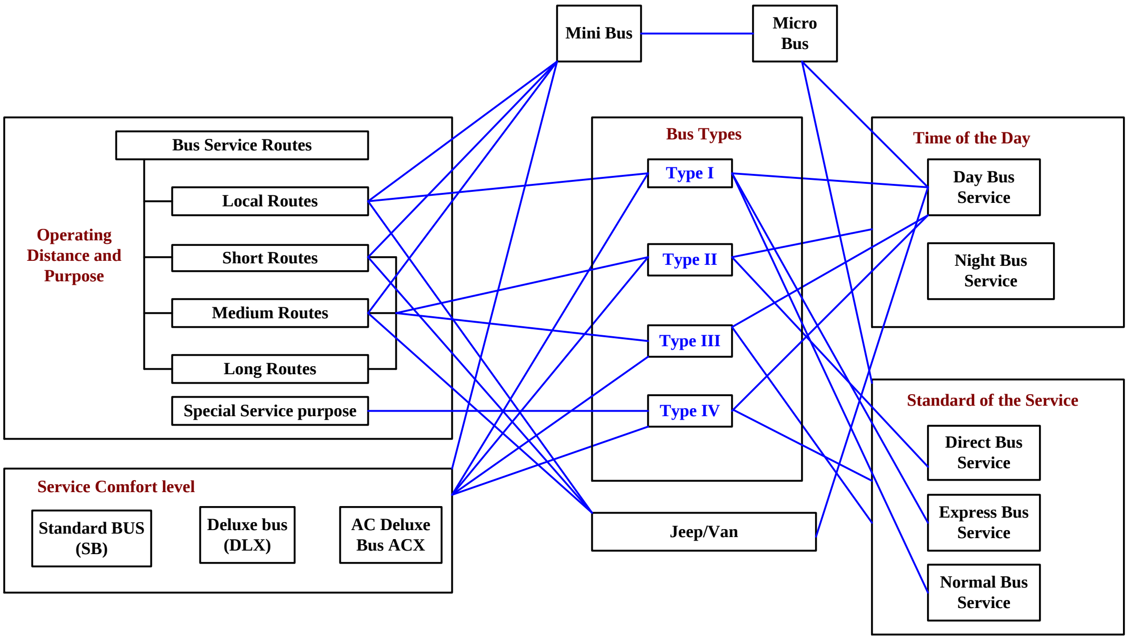


Figure 4.2 Proposed Classification of Public Passenger Transport Vehicles

Source: Task A2: Safe Vehicle Guidelines (draft); RTS & ALC Study; NIRTTP DoTM Component (IDA H863); KEI in association with FBC; June 2015.

As shown in Figure 4.2, keeping in view the varying requirements and uses of public passenger vehicles, all of the bus sub-mode are categorized into Type I, Type II, Type III and Type IV based on their construction as shown in Table 4-2.

Table 4-2 Description of the Type Category Recommended for Bus Sub-mode

Bus Type	Operating purpose
Bus Type I	**Route type:** Local Routes **Time of the day:** Daytime Service **Comfort level:** All Comfort Level **Service standard:** Express, Normal Bus Service
Bus Type II	**Route type:** Short, Medium and Long routes **Time of the day:** Night and Day Service **Comfort level:** All Comfort Level **Service standard:** Direct Bus Service
Bus Type III	**Route type:** Short, Medium and Long routes **Time of the day:** Daytime Service **Comfort level:** All Comfort Level **Service standard:** Direct and Normal Bus Service
Bus Type IV (Buses of special purpose)	**Route type:** Local Routes **Time of the day:** Daytime Service **Comfort level:** All Comfort Level **Service standard:** Direct and Normal Bus Service

Mini Bus and Micro Bus	**Route type:** Local, Short and Medium Route **Time of the day:** Daytime Service **Comfort level:** All Comfort Level **Service standard:** Direct and Normal Bus Service
Jeep/Van	**Route type:** Local, Short and Medium Route **Time of the day:** Daytime Service **Comfort level:** Not Applicable **Service standard:** Not applicable
Tempo (Three wheelers)	**Route type:** Local Route **Time of the day:** Daytime Service **Comfort level:** Not applicable **Service standard:** Not applicable

Source: Task A2: Safe Vehicle Guidelines (draft); RTS & ALC Study; NIRTTP DoTM Component (IDA H863); KEI in association with FBC; June 2015.

As indicated in the Table 4-2, all the sub-modes of bus can offer two quality of service, (i) direct bus and (ii) normal bus service. The existing quality of service corresponding to "express bus service" been dropped as there was ambiguity with "direct bus services" defined in MVTMA 1992.

Similarly, it is recommended to prohibit both minibus and microbus on long routes, confine them to day time (as is currently applicable) but can offer any comfort level.

Beyond these vehicle classification, quality of service, type of construction, level of comfort that align with the various routes, it is necessary to revisit the distance range that is prescribed for the various routes for public passenger transport. Table 4-3 shows the tentative length up to which the street network in a selected number of major cities of Nepal currently extends based on both observation in Google Earth®[22] and map published in 2014 Strategic Road Network Statistics[23]. The distance shown do not necessarily limit within the municipal border but rather on extent of the built-up area that one observe visually.

Table 4-3 Tentative Extent of the Street Networks in Selected Cities of Nepal

City	Tentative Alignment	Tentative Distance (km)
Kathmandu (Thankot – Koteshwor)	East- West	15.7
Kathmandu (Budhanilkhantha)– Ekantakuna (Lalitpur)	North – South	16.2
Kathmandu – Lalitpur Ring Road	Roughly circular	28
Thankot (Kathmandu) – Sallaghari (Bhaktapur)	East –West	21.5
Pokhara (Bijayapur Bridge – Bindebasini)	North – South	8.8
Pokhara (Pardi – Bijayapur Bridge)	East –West	7.8

[22] Google Earth is a registered trademark of the satellite maps available online owned by Google Inc. USA.
[23] GoN DoR annual publication.

City	Tentative Alignment	Tentative Distance (km)
Pokhara (Bijayapur Bridge – Kuvinde, municipal border)	South -West	16.4
Biratnagar	North –South	12.4
Biratnagar	East- West	4
Biratnagar Ring Road (ongoing full development)	Roughly Circular	42
Birgunj	North –South	9
Birgunj	East- West	8
Bhairahawa	North- South	9

Source: Consultant's observation based on inspection in Google Earth®.

Based on inference from Table 4-3, it can be assumed that the current limit of denoting local routes to within 25 km appear reasonable to cover the likely distance that cities currently exists or may expand to in the future with exception to the case for Kathmandu Valley and Biratnagar Ring Road when fully developed. It will not be conducive from regulatory point of view to expand the limit of short route beyond the current 25 km limit despite the fact that cities in Nepal are growing. Owing to jurisdictional constraint that can potentially emerge between neighbouring municipalities and following the administrative boundary effected by the federal structure the country will likely undergo, it is also important to limit the local route to lie within the limit of individual municipalities. The current range of the short to long routes is also recommended to remain as it continuous to fulfill the requirement for public passenger transport as well as be consistent with the prevailing regulation for route permits. The maximum limit of 250 km for medium routes is still reasonable as it tentatively represent a travel time of roughly six and four hours of travel in respectively, the hill and terai (plains) roads of Nepal based on the average travel speed which is appropriate maximum limit that minibus or microbus should be allowed. An exception to this rule is the use of sport utility vehicles or jeeps for passenger transport to the newly constructed earthen, low rural hills road that are too narrow or geometry is poor where jeeps should be permitted to ply along the long routes till the time that the hill road in question is widened or improved to permit buses to ply safely. At that stage, jeeps can be restricted for the long routes. The following is thus recommended for application of the local to long routes in Nepal.

Table 4-4 Recommended Range, Type of Vehicle Applicable for Routes

Routes	Distance Limit	Vehicle Permitted to Ply
Local routes	≤ 25 km, within municipal border or district border, whichever is less	All
Short routes	25 – 100 km	Bus, minibus, microbus, four wheel drive (jeeps)

Routes	Distance Limit	Vehicle Permitted to Ply
Medium routes	100 -250 km	Bus, minibus, microbus, jeeps
Long routes	≥250 km	Bus, jeeps (only at narrow, poor geometry in the hills) Jeeps to be prohibited on long routes once the hill road is improved, widened to permit buses to ply safely.

4.3 THEORETICAL MODELS FOR PERMIT MONITORING, DEMAND ASSESSMENT

One of the problem that DoTM is currently facing while regulating public transport vehicles is lack of mechanism to scientifically monitor the number of permits and assess demand-supply pertaining to public passenger transport. It is important to note that it is the expected number of daily trips in terms of bus, minibus and microbus that should be taken as the controlling threshold by which individual transport operator need to be allocated permits. Once the expected daily trips is about to exhausted, additional route permits should be stopped. This aspect is discussed in subsequent chapter pertaining to public urban transport.

Comprehensive demand analysis for public transport is quite complex; require population census and employs various surveys (origin-destination, vehicle occupancy, traffic and public transport counts, household surveys, etc.). Each of these surveys or combination of them generate trends, statistics, etc., that can help the analyst to determine the ridership of public transport services along a route. In developed countries, data such as average daily trips per capita, trip purpose (home to work, home to shop, home to school) are also for cities or areas that are particular in that country and are adopted to analyse for demand analysis in other cities or areas that are similar in nature. Some theoretical models that be applied in demand analysis is discussed below.

4.3.1 Four Step Travel Forecasting

The four step travel forecasting method is popularly used to forecast travel (or passenger demand if for public transportation analysis). The four step travel forecast sequentially calculates the anticipated trips, distribute it between origins and destinations, assign trips to various vehicle modes and lastly assign along the road routes. The analysis involve the following four aspects of the trip forecast which is why it is called the four step travel forecasting method.

- Trip generation
- Trip distribution
- Modal split
- Route assignment

Trip generation is the first step of travel forecast and involves extrapolation of total trips in an area that can result owing to the virtue of the land development involved. The total trips can either be trip production (trips originating from home or origin of a non-home based trips) or trip attraction (trips that do not start or end from home). Examples of trip productions home to work, home to shop trips, shop to home, office to home trips. Similarly, trip attractions are non-home end trips of a home-based trip or destination of a non-home-based trip. Examples of trip attractions are shopping from home trips, office from home trips, office to shop trips.

Trip distribution follows trip generation and matches the origin and destination of trips and develop a trip matrix that align the trips from a particular origin to a particular destination. The gravity model is the most widely used model to generate the trip matrix over an area and is given below.

$$\boldsymbol{T_{ij} = P_i \times \frac{A_i F_{ij} K_{ij}}{\sum A_i F_{ij} K_{ij}}}$$

Where,

$\mathrm{T_{ij}}$ = number of trips that are produced in zone I and attracted to zone J

$\mathrm{P_i}$ = total number of trips produced in zone I

$\mathrm{A_j}$ = total number of trips attracted in zone J

$\mathrm{F_{ij}}$ = friction factor which is an inverse function of travel time

$\mathrm{K_{ij}}$ = socio economic adjustment factor for interchange ij

Modal split analysis follows trip distribution and this step assigns the trip matrix from one zone to another into the different transport modes based on public choice in the area concerned (e.g. 70% by car and motorcycle, 25% by bus, 5% by walking). The resulting matrix from this analysis is a matrix showing the number of different modes traveling from one zone to another. This analysis may simply involve assumption of the percentage of trips from each zonal pair using best judgement based on factors involved such as in-vehicle time, walking time, waiting time and in-vehicle time (for public passenger transport) that can be simply 'skimmed' through the road and public transport network for each origin- destination pair and ultimately developing a modal trip matrix. In other cases, utility concept is adopted where utility of each mode is calculated based on the attributes involved for this mode. Attributes of a mode can be cost; in vehicle time involved; wait and walk time for public passenger transport; the number of interchanges needed between modes. The utility for mode m is first calculated using the following formula.

$$U(m) = b(m) + b1 * IVT(m) + b2 * \sum f(m) + b3 * WALK(m) + b4 * WAIT(m) + b5 * IC(m)$$

Where,

$U(m) = utility\ of\ travel\ by\ mode\ m$

$b(m) = perception\ of\ mode\ m\ (or\ mode\ constant)$

$b1, b2, b3, b4, b5 = weight\ of\ each\ attribute$

$IVT(m) = accumulated\ time\ spent\ in\ mode\ m$

$f(m) = accumulated\ fare\ by\ mode\ m$

$WALK(m) = accumulated\ time\ spent\ while\ walking\ up\ to\ mode\ m$

$WAIT(m) = accumulated\ time\ spent\ waiting\ for\ mode\ m$

$IC(m) = number\ of\ interchanges\ needed\ to\ make\ the\ trip\ by\ mode\ m$

The modal split is then calculated using the multinomial logit model below.

$$Pm = \frac{e^{Um}}{\sum_{all\ m} e^{Um}}$$

Where,

$Pm = proportion\ of\ trips\ (or\ the\ probability\ of\ )travelling\ on\ mode\ m$

$Um = utility\ of\ travel\ by\ mode\ m$

$e^{Um} = exponential\ raised\ by\ the\ utility\ of\ travel\ by\ mode\ m$

$\sum e^{Um} = sum\ of\ the\ exponential\ of\ all\ utility\ of\ travel\ by\ all\ modes$

The route assignment is the final step in the travel forecasting method after model choice analysis. The trips are ultimately assigned along the routes between the origins and destinations. The capacity restrained assignment is commonly adopted and involve assigning the trips in steps. There are two technique of loading the trips at each of the steps, (i) proportionally and (ii) incrementally. In the proportional method, a portion of the trips is loaded to every origin- destination zone pair that has the shortest travel time at each step. In the incremental method, all the trips are loaded to a subset of the origin- destination zone pairs along at each step. Regardless of which method of trip loading adopted, the travel time is recalculated after each loading of trips using speed-versus-volume curve and trips is assigned to the shortest route at the next step of loading. This process of loading the trips between all zone pair or subset of zone pair is repeated till all the trips is assigned. The multipath probabilistic assignment assigns trips based on probability of choosing each of the several routes based on the relative attraction of each route (measured according to travel time and cost). Figure 4.3 illustrates a version of the four step method that was adopted in Japan for a land development project.

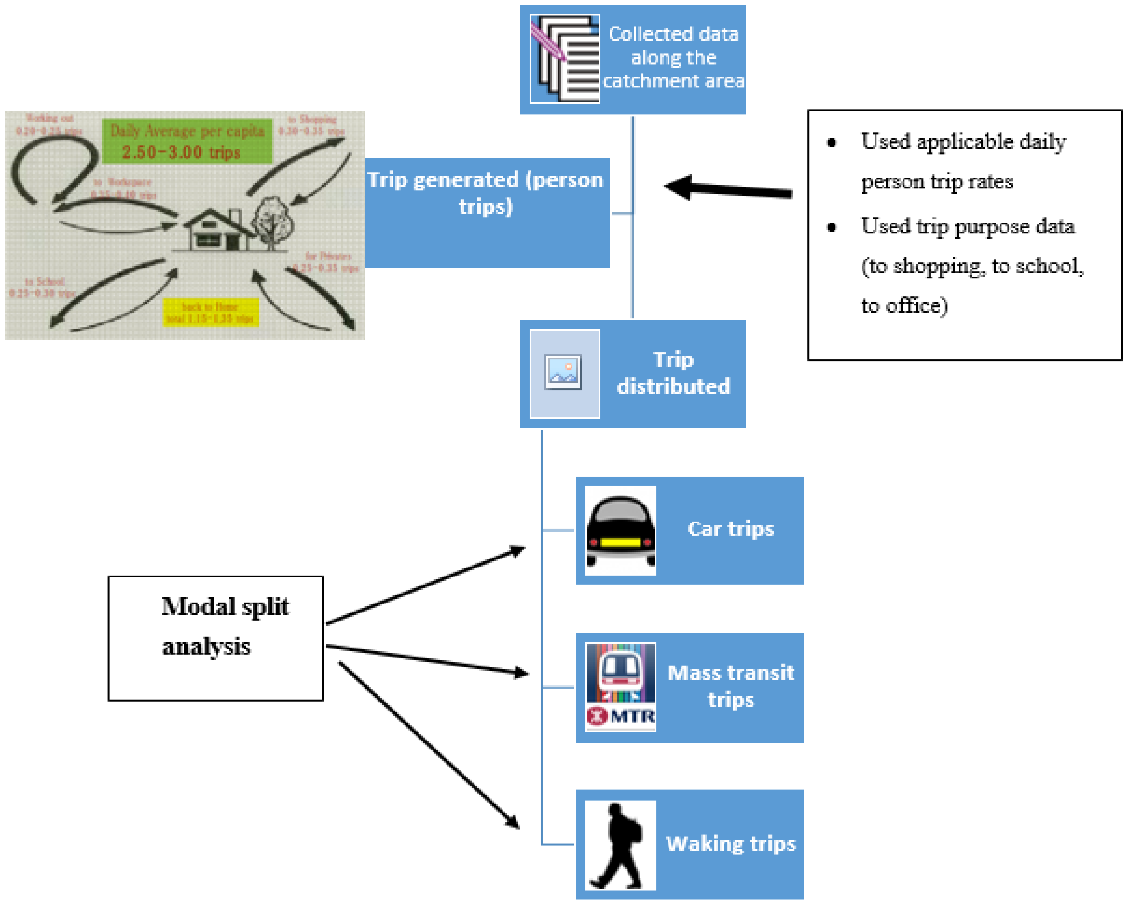


Figure 4.3 Example of the Four Step Travel Forecasting Model Adopted in Japan

(Adopted from: LRT- BRT & Bus Transport Planning; Y. Naruse/JICA Expert; 2014)

From the above description, the four step travel forecasting is quite challenging and requires expertise to use it with confidence. Moreover, it requires data such as demographic census, parameters (e.g. trip generation rates, trip purpose, other parameters pertaining to other analysis models, etc.), which precludes its use for passenger demand analysis in Nepal. However, trip rates newly updated in 2012 are available for Kathmandu Valley under the JICA funded traffic survey for the Kathmandu Valley Master Plan.

4.3.2 Tamin's Trip Distribution Model –cum- Modal Choice from Passenger Counts

This research was conducted in Indonesia using case studies based in Bandung, Indonesia and the main aim was to identify a low-cost demand analysis method which was not too data hungry nor complex. In this research, the gravity model was combined with the multi-nominal logit model and was calibrated from passenger counts and other simple zonal planning data. The model was tested using the 1988 Public Transport Survey conducted in Bandung. However this model use complex mathematical formulation that require familiarity with statistics and therefore is not suitable for DoTM to use.

4.3.3 Simple Steps to Calculate the Number of Buses Required, Route Allocation

Embarq: Bus Karo which is a guideline on bus planning and operations have recommended on the following steps to assist cities to calculate the total number of buses required and to allocate them to the routes.

- First identify the strategic public transport corridors in the city.
- Next, collect mobility data
- Finally, analyse the above data to pick routes and develop a service plan

Amongst the above three points, the most important aspect is step 1 which will rely on best professional judgement in most cases. However, for a thorough picture, it is recommended to follow the procedure described below.

(1) Step 1: Identifying Public Transport Corridors

If the City already has an existing public transport service

If the City already has an existing public transportation, identifying potential public transport corridor is relatively easy. The goal in this case is to provide a more reliable, comfortable and safer bus service. The following procedure should be followed:

- Collect existing data: Collect existing data on population, major arterials, roads, location of the central business district, key commercial areas, education centers, industrial areas, shopping areas, recreational areas, etc.
- Pick existing or historic bus routes in eh city for analysis. In most cases, existing bus routes are the one with the highest demand. Collect other data such as frequency, occupancy and transfer location for these routes.
- Study the city's road network

If the City does not have public transport service

In this case the best way to determine passenger demand is to calculate the total informal transport users (para-transit, tempos, SAFA, shared taxis, etc.). In this case it is harder to find out the origin and destination patterns. Select a list of strategic locations in the city to conducts surveys which can be areas with high densities of informal transport supply, high demand like railway stations, bus stations, commercial centres, industrial areas, etc. These surveys should take place with the minimum resources and time.

(2) Step 2: Collecting the Mobility Data

If the City has an existing public transport service

Collect the following information from surveys.

i) Bus occupancy; hourly counts at boarding and alighting
ii) Through passengers while riding the bus for at least one entire trip of the route.
iii) The travel time of the route from start to finish.
iv) From the above details, determine the peak load point along the route.
v) Review the on-board volume over a 12 to 16 hour period at the peak locations and loads at informal public transport to identify where the highest passenger demand occurs.

vi) Finally, extrapolate the time of the day having the highest traffic (vehicle traffic+ NMT traffic+ IPT based on the 12- 16 hour count.

<u>If the City does not have an existing public transport service</u>

The data collection effort for these cases is similar to that for cities that has an existing public transport services. In this case, proceed as follows.

i) Survey the strategic locations to count the number of informal transport vehicles and occupancy per hour. Count the occupancy in broad terms such as empty, one quarter, half, three quarters and full.

ii) Count also the pedestrians and cyclists during the counts above as these groups are the first one to shift to bus if the service is reliable and good.

iii) Count also the pedestrians, cyclists and informal passenger transport to allow for fleet size and bus.

iv) Inquire with the driver of the informal transport about the most frequently travelled routes.

v) From the review of the roadside conditions at each location over the 12 -16 hour period, determine the location where the peak passenger volume on the informal passenger transport occurs.

(3) Step 3: Analysis

1) Hourly Bus Frequency

To calculate the hourly bus frequency, use the formula below.

$$Hourly\ bus\ frequency = \frac{Passengers\ per\ hour\ peak\ direction}{Bus\ capacity}$$

Peak or off-peak ridership measurements can be calculated through an analysis of the load profiles. Bus occupancy will vary based on the maximum passenger capacity of the buses plying the route.

2) Load Profile of a Route

The survey data should be tabulated to allow for easy comparison between segments of a transit route. For example, Table 4-5 shows the following facts.

- Travel time was 70 minutes for the entire route or 73 minutes from the time of arrival at the first station.
- A total of 129 passengers were transported
- The first and last stations had the highest number of boarding and alighting but the middle stops had the highest through passengers.

Table 4-5 Sample of Bus Ridership Observed in an In-vehicle Public Transport Survey

Date: 2009/09/11		Mon	Tue Wed	Thu	Fri Sat	Sun
Bus No. GT-1652		42	Officer's Name :			
Arrival Time		Route	Kadawatha-Colombo		Departure	
		138	Service:	Normal	a.m.	p.m.
	Stop	Arrival Time	Board	Alight	Through	Departure Time
1	Kadawatha	7.10	44	0	44	7.13
2	Mahara Junction	7.33	1	1	44	7.33
3	Mahara	7.35	1	2	43	7.35
4	Kiribathgoda (YMBA)	7.38	4	10	37	7.39
5	Kiribathgoda (Makola Road)	7.41	12	9	40	7.42
6	Dalugama	7.43	14	2	52	7.44
7	Kelaniya Campus	7.46	14	8	58	7.47
8	Tyre Junction	7.48	0	4	54	7.48
9	Torama Junction	7.54	4	3	55	7.54
10	Pattiya Junction	7.57	9	3	61	7.57
11	4th mile post	7.59	1	3	59	7.59
12	Peliyagoda	8.00	1	3	57	8.00
13	Orugodawatta	8.05	3	3	57	8.06
14	Armour Street	8.10	11	7	61	8.11
15	Panchikawatta	8.13	8	11	58	8.13
16	Maradana (Technical)	8.20	0	6	52	8.20
17	Pettah (BM)	8.21	2	25	29	8.21
18	Fort (Railway Station)	8.23	0	29	0	8.23
	Total Passengers	73 mins	129	129		70 mins

Source: EMBARQ: Bus Karo -A Guideline on Bus Planning & Operations

If the load profile is plotted on a chart and compared with the bus seating capacity, deficiency in the existing bus service offered can be easily observed as shown in .

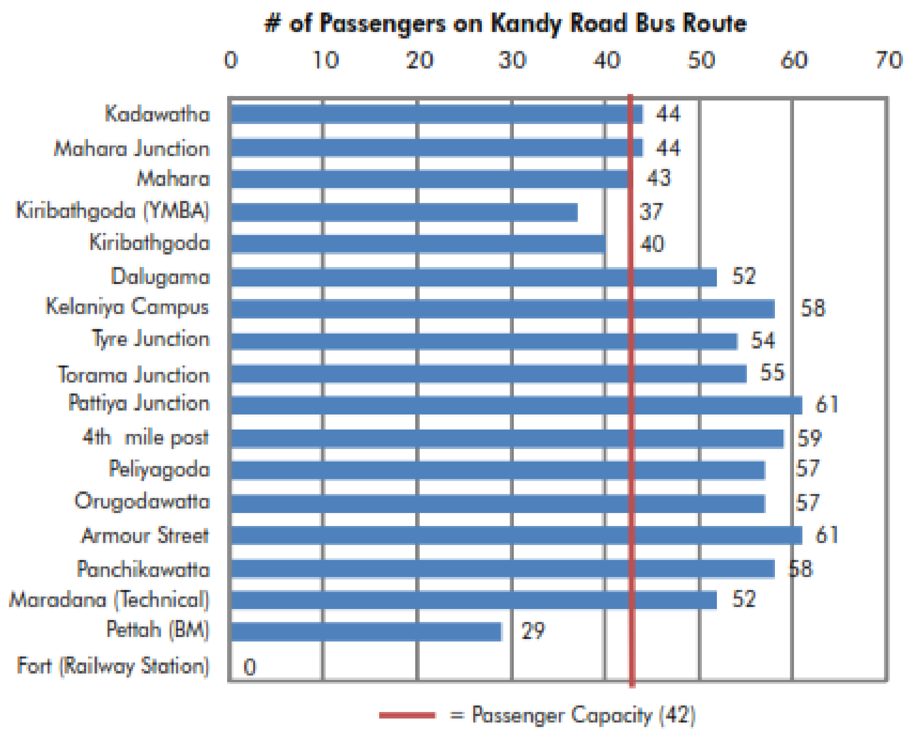


Figure 4.4 Example of Load Profile of a Colombo Bus Route, Sri Lanka

Source: EMBARQ: Bus Karo -A Guideline on Bus Planning & Operations

3) Total Bus Travel Time

The total bus travel time can be calculated by using the following formula.

$$Cycle\ time = Bus\ Run\ Time\ \times 2 + Terminal\ Time$$

The above cycle time includes the bus travel time, dwell time at bus stops and a turn-around terminal time at the bus depot.

The bus run time reflects the time that elapses between the first station departing and arriving at the last station. It takes into account the traffic delays and variability in the corridor.

The terminal time varies depending on the length of the bus route. If the routes are shorter than an hour in total duration, the terminal time may require 10 minutes of terminal time. In contrast, if the route length is more than 20 minutes. These values are however simply estimates but the actual times will depend on the efficiency of the system.

4) Fleet Size Calculation

The following formula calculates the total fleet size that is necessary to play along a bus route or transit route. The fleet size is based on the number of buses that is required to run services at a set frequency.

$$Fleet\ size = \frac{Total\ cycle\ time}{Bus\ headway}$$

Transport operators should conduct load profiles throughout the entire day of their operations to determine the peak hour and off-peak hour ridership along their route. Table 4-6 illustrates the trip details that was observed during different time period for a bus route. This example shows that there was 300 passengers during the peak hour period while there were a minimum of 180 passengers during the off-peak period.

Table 4-6 Sample of Bus Trips Observed

No of Hours	Hour of Operation	Passengers	Bus Trips*
1	6 am	180	3
2	7 am	300	5
3	8 am	300	5
4	9 am	300	5
5	10 am	300	5
6	11 am	180	3
7	12 pm	180	3
8	1 pm	180	3
9	2 pm	180	3
10	3 pm	180	3
11	4 pm	300	5
12	5 pm	300	5
13	6 pm	300	5
14	7 pm	300	5
15	8 pm	180	3
Total	15 hrs	3660 passengers	61 bus trips

Source: EMBARQ: Bus Karo -A Guideline on Bus Planning & Operations

The simple procedure discussed above can be adopted by DoTM for demand assessment provided that the department conducts the surveys required. In the case of Kathmandu Valley, the resource required for the surveys may be prohibitive. DoTM can start by concentrating on the most critical routes and gradually cover for other routes in the Valley.

5) Minimum Service Warranty

The minimum service warranty attaches minimum requirements that public passenger transport must strictly adhere to in terms of schedules, deviation allowed in these stated schedules and how often such deviation in the stated schedule is permitted. This model works when there is a regulated environment and the regulator is institutionally capable. The transport operator is provided a contract performance that requires it to adhere to minimum service warranty to maintain its services. This model is adopted by the Public Transport Victoria (PTV) to contract the metropolitan and regional bus services in in Melbourne, Australia and include the following requirements.

- No timetable service can operate early at any point on their routes
- Not more than 5% of the services on any day or 10% on any route can operate more than 5 minutes late
- 99% of the scheduled services on any day should be operating and completed

Transport operators and regulators can adopt the following means to monitor adherence to these service requirements.

1. Employ site bus inspectors to monitor adherence in real time. For this purpose, transport operators can utility their control room or utilize their route controllers in the case of large operations. These individuals can monitor the level of service on routes and can take remedial action if problems occur. To assist in these task, the inspectors can easily monitor in real-time using modern technologies such as two way radio contact with the drivers and vehicle tracking systems (GPS device being the most popular).
2. Mandate the transport operator to maintain record punctuality and reliability of at least 5 % of their timetable services and to forward them to the regulator each month (e.g. PTV use this policy).
3. Regulators can make random audits of the services (e.g. PTV adopt this mechanism, MVTMA 1992 has the provision and this authority vested to transport inspectors).
4. Regulators can also collect customer satisfaction surveys making sure that the survey captures both the users and non-users of public transportation services.

Operator's performance regime provides monetary incentives for reducing disruption below agreed target level or penalty if exceeded.

The minimum service warranty is a tools to monitor and ensure that public transport services operate as mandated rather than a tool to assess the passenger demand. However, by ensuring that the transport service operate at the prescribed schedule, the daily number of trips of an operator is closely maintained or checked. If the daily trips is attached to a transport operator, it in effect makes it easy to keep tap of the threshold limit that particular routes can handled provided that there is an estimate of the daily trips that can be permitted or accommodated for the route in question. While even the current act and regulation in Nepal authorizes DoTM to enforce these provisions, it is necessary for the department to estimate the passenger demand for all the routes, use the corresponding demand as the maximum threshold against which permit will be allocated and appoint transport inspectors to monitor the adherence of the prescribed minimum service warranty.

4.3.4 Practical Aspects Affecting Route Allocation

The result of inappropriate or ad-hoc route allocation to passenger transport services or permitting can often result in the following consequences.

- Routes often duplicates with one another while there is poor or absence of any services in some of the routes.
- There is weak interchange between bus and para-transit (informal transport services).
- The transport services become inefficient owing to route duplication with over-supply at the various stops. Management of the transport interchange also becomes chaotic.
- The spatial distribution and location of bus stops that are provided may not be optimal and affects the number of boarding passengers that can be carried along the route. This is because the spatial aspect of passenger demand, person capacity must be stated for a location (typically the stop with the maximum loading point), not for a route or a street as a whole.

While the adoption of the appropriate size and type of public passenger vehicle along the local, short, medium and long routes as defined in the law and some modification has been recommend as discussed in Sub-section 4.2, it is recognized that the newly constructed rural roads in the hilly areas that are unpaved and managed through the DoLIDAR do not accord safe access to buses, four wheel drive or jeeps will continue to be the viable option till the time when these roads are improved to the paved standard as well as in terms of geometry.

The following are practical aspects that affects route allocation for public passenger transport in general.

1. There is no sound mechanism or yardstick (e.g. threshold number of daily trips along a route) that DoTM currently employs to effectively regulate route permits in Nepal. The department however is cognizant of this fact and this study is envisaged to equip or shed knowledge about the means to introduce a scientific tool to control permits along various routes.
2. Passenger transport routes in Nepalese cities are established ad-hoc without consideration to the road network and its hierarchy involved. The result from this practice is that feeder and trunk routes are not optimally planned to operate at maximum efficiency. As result of poor organization of passenger transport routes, bus stops are also inappropriately established and appear to be dictated from simple yardstick of according a stop at a pre-defined interval.
3. Public passenger vehicles are often inappropriately assigned to various routes without consideration to the geometry and road conditions. This problem is particularly evident in Nepalese cities and result in traffic congestion. Smaller public vehicles such as minibuses and

microbuses are inappropriate to ply along long routes. Similarly, microbuses and SAFA tempos are permitted to ply along the major roads and arterials in Kathmandu Valley that are otherwise suited for service using buses. The service thus suffers from inefficiency owing to low vehicle capacity or route capacity from smaller size vehicles along these thoroughfares. Both minibuses and microbuses are recommended to be limited only up to the medium routes as discussed in Sub-section 4.2.

4. The routes for the passenger transport vehicles are often poorly planned with duplication between vehicle modes that operate on fixed route (e.g. bus) and informally (e.g. paratransit such as microbus, SAFA tempos). There is weak interchange between these two form of service that have diverse operation and vehicle capacity.
5. Transport operators manage their own schedule and fleet based on their best knowledge while DoTM does not or is institutionally weak in monitoring the various services. However, it is important to adopt sound principal of monitoring schedules, fleet management, system efficiency and loading pattern as discussed previously in Sub-section 4.3.3. The department should also pro-actively appoint transport inspectors that is provisioned in MVTMA 1992 and start random site audits of the transport services within their jurisdictional area.

4.3.5 Bus Stop Planning, Integration with Cycle and Pedestrian Routes

The judicial location of bus stops affects the patronage if they are not easily accessible by walking or within the tolerable distance that public in the area find it acceptable to access public transport service in lieu of private transport or taxies. While there is no planning to construct cycle lanes in Nepalese cities, it is envisaged that cities particularly in Kathmandu, Pokhara will develop such dedicated lanes in the nook and corner of these cities in the future. Already, there is government directive on according universal accessibility to all public transport services and facilities, public offices, libraries, road facilities, etc., that all state agencies in Nepal must gradually abide to make these accessible to persons with disabilities. Therefore, the concept of integrating the bus stops to potential cycle tracks and routes in Nepalese cities and provision of attachment to fix cycles into the transport vehicles will promote multimodal transport.

In the more advanced version, there could be vacant space allocated towards the back of a low-floor high capacity shuttle bus in Kathmandu Valley where cyclist could keep their cycle and alight at their onward journey. These will also lend well to promote sustainable urban transport in lieu of private vehicle transport. The following provisions are rational basis to spatially plan bus stops and also integrate cycle and pedestrian routes or facilities.

1. As far as possible the bus stops should be located at the far side of the intersection while care should be taken not to locate along a curve but on the straight and wise section of the road for maximum visibility.

2. Stops for different type of vehicles (e.g. bus, minibus, microbus, SAFA tempos) should be located at different location except at the interchange between feeder and trunk service in the urban areas.
3. Stops should generally be located at the following interval but care should be taken that the visibility as well as easy convenience to major land development, cycle and pedestrian tracks, lane, etc., and point of interest is maintained.

   Tempo, SAFA - 200 m interval

   Bus - 1 km interval

   Mini-bus, Microbus, Bus - 400 – 600 km interval in CBD areas
4. Stops must be linked or conveniently located to pedestrian lanes and must be preferably designed as indented laybys.
5. Development of innovative bus stop layout such as queue jump layby24 (see Figure 4.5) to promote public transport should be piloted for potential expansion in other areas of Nepalese cities. These lanes can also be permitted for cyclist to promote cycling as well.

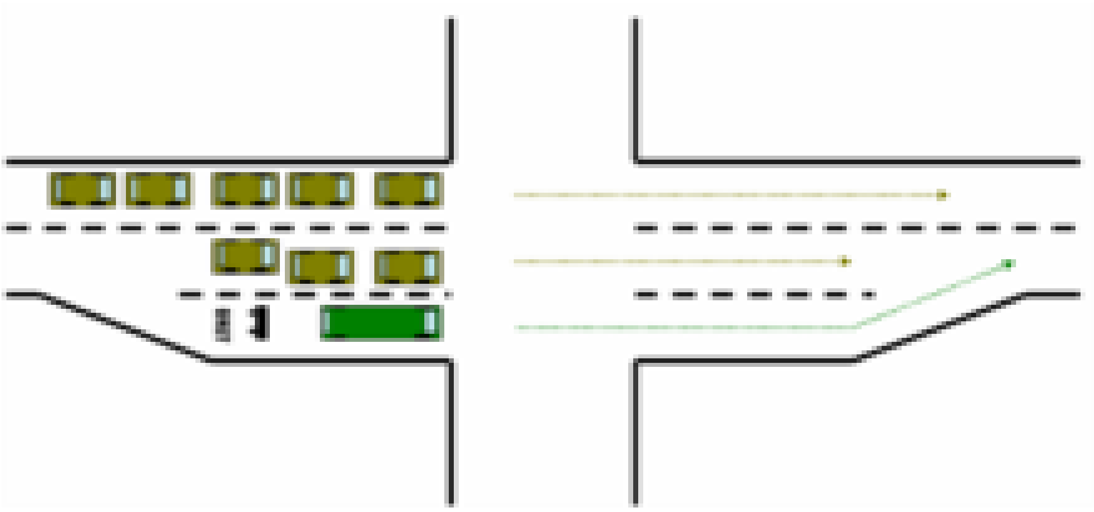


Figure 4.5 Queue Jump Indented Bus Layby

Courtesy: "Queue Jump - Continued Lane" by Andrew Bossi - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Queue_Jump_-_Continued_Lane.png#/media/File:Queue_Jump_-_Continued_Lane.png

6. The local community must be consulting before deciding where to locate the bus stops beyond the requirement given above.

[24] *A queue jump bus layby involve an indented layby starting at the near side of an intersection and ending at the far side as shown in Figure 4.5.*

4.3.6 Promoting Public Passenger Transport Routes

Promotion of public passenger transport routes in lieu of private vehicle is increasingly adopted to enhance sustainable urban transport globally. There are various policies that can assist in promoting these transport services and these are given below.

1. Develop a public passenger transport route that is re-structured to reflect the road network hierarchy with appropriate size of public vehicles assigned along the routes.
2. Conveniently locate bus stops at major land development, offices, business district, retails, recreational centres, etc., apart from abiding to the prescribed interval criteria for stop placement.
3. Construct or provide bus lane or counter-flow lanes along wide one-way streets and confine entry to these counter-flow lanes to buses only along the major thoroughfares of the cities. These dedicated facilities provide preferential access to bus to increase their mobility as against private vehicles.
4. Apply congestion charging during entry to the CBD or city core for private vehicles.
5. Increase tax and duties for import of private vehicles but provide tax break to promote public passenger transport.
6. Explore introducing premium bus services and low floor high capacity buses in the cities with high passenger demand. The premium bus service can potentially provide more amenities such as free WIFI connection, kiosk/TV display, space provision for wheel-chair users, use of automatic ticketing including transfers, etc.

4.4 APPLYING AND ASSESSING FOR ROUTE PERMITS

Transport entrepreneurs who want to operate public transport services on a new route will apply for a permit to the ZTMO having jurisdiction as per the existing rules and regulation.

Operators who directly apply for a permit and route selection at the same time will need to apply at DoTM and attach the recommendation from the TMC concerned. In the latter case, the entire process of route assessment, its selection and permitting will take place at the same time including formation of a Route Permit Committee discussed before. The Route Selection Committee will comprise of the following individuals at DoTM.

Director	- Chairman
Mechanical engineer	- Member Secretary
Section Officer	- Member
Traffic Police	- Member
Highway engineer (DoLIDAR, DoR)	- Member

The Committee will thus select the route and notify the public. Following notification about the new route, the ZTMO concerned will commence the route permit administration process but it is important that the route selection is conducted on a fast-track so that the permit process does not get delayed unnecessarily, inconveniencing the applicant. The permit administration will follow the following process as illustrated in Figure 4.6.

The permit certificate that is issued to public passenger transport should be modified to include the following information in order to improve route permitting, assist DoTM to monitor the operations of individual operators while closely keeping tab on the maximum number of trips (threshold limit) that is established for individual routes. The maximum threshold should be established for a particular route adopting any of the passenger demand analysis models described in the previous chapter or another simplified method discussed in the next chapter.

- Name of the route, routes:
- Type and capacity of the seating
- Number of stops, terminal points
- Maximum and minimum trips to provide

As discussed in the previous section, DoTM should introduce more effective monitoring tools to assist in regulating the public passenger transport. The following measures should be introduced in DoTM to effect these changes.

1. Appoint and depute transport inspectors all over the country. These individuals should closely monitor public transport operations through random audits, surveillance by utilizing the CCTV cameras installed in various cities (e.g. Kathmandu Valley). For this purpose it may be necessary for DoTM to liaise with the Metropolitan Traffic Police Office in Kathmandu to access these cameras or lease a communication connection with the office.
2. Explore the feasibility of using GPS tracking to monitor the operation of public transport vehicles. In this respect, it is worthwhile to note that DoTM is currently planning to enforce GPS devices in all public transport vehicles as condition for issuing a permit.

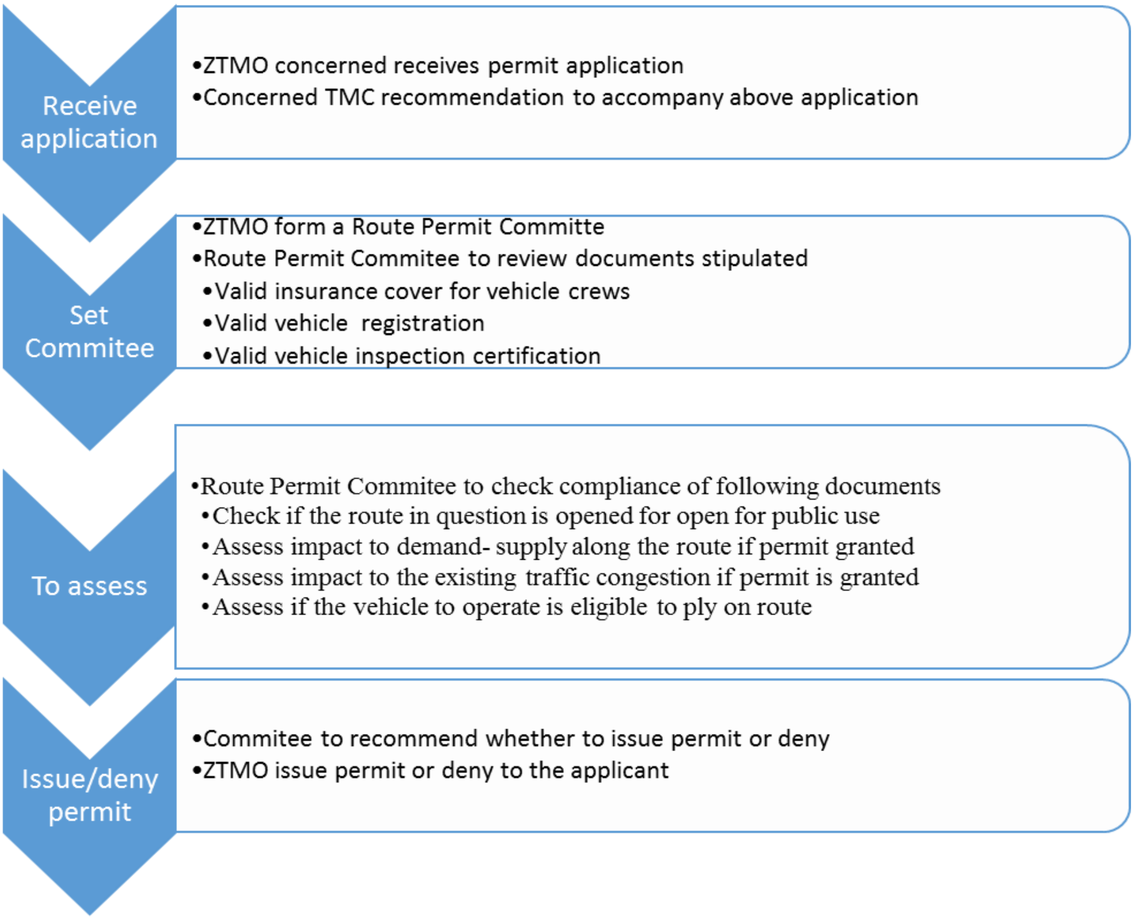


Figure 4.6 Steps to Permit

Regardless of what is shown in the steps above, it is recommended to maintain the mandatory requirement of acquiring DoTM's approval at the centre before issuing the permit for night buses through the ZTMO.

CHAPTER 5 ARRANGEMENTS OF ROUTES IN THE URBAN AREAS

Routes in the urban areas offers more complexities with more public passenger transport services plying around various locations. Currently, routes are established randomly within the urban areas (Kathmandu Valley being the most chronic area) with demand- supply unmatched and weak regulation on the use of appropriate transport vehicles for catering to the passenger demand. The following discussed on measures necessary to reform the routes and the public passenger transport services in the urban areas.

5.1 RE-ASSIGN PERMITS TO TALLY VEHICLE SIZE ACCORDING TO THE ROUTE

The size of the public passenger transport vehicle on a route should reflect the importance of the route in terms of ridership, hierarchy of the road concerned carriageway available and the traffic congestion that prevails. However, all forms of transport services, size, etc., currently operate throughout a particular city of the country without any regards, planning about efficiency and equitable service that these transport can offer to the public concerned. Therefore, it is thus important first to re-assign the public transport vehicles according to the size of the road available and its importance. Thus larger and higher capacity buses should be reassigned to the most important, major roads and highways having higher passenger demand while progressively smaller vehicles such as mini-buses are assigned to run along the collector roads or next hierarch of roads within the urban areas. Ultimately, the smallest public vehicles such as the micro-buses and tempos (e.g. SAFAs in Kathmandu Valley, Basantis in the eastern Terai, etc.) should be re-assigned to the inner streets and local access.

Figure 5.1 Safa Tempo

Figure 5.2 Basanti

There is a rationale behind this approach as passenger demand in heavy throughout the day in the busy locations of an urban area in Nepal and smaller size vehicles cannot adequately fulfil the passenger demand without increasing their fleet, thereby worsening the traffic congestion.

For example, assume that there is demand for 100 passengers along a major route. For this demand, it would require at least 10 SAFA tempos running full capacity (occupancy 10) whereas the same passenger demand can easily be transported using two standard bus with a 55 seat capacity assuming at full occupancy.

Re-assignment of high as well as standard capacity buses along the major roads is also conducive to operate through routes where there are few stops and terminals are located at the fringe of the urban area rather than in the city core or inside the urban area. Traffic congestion along the major routes is also reduced owing to reduced traffic as well as less lane occupation, bus holding in the CBD or city core.

On the other hand, smaller transport vehicles are more efficient, appropriate in the lower category of roads that are narrow mitigating potential road-blocks on these streets and are more compatible with the street environment owing to lower speeds, tighter navigation capability, etc.

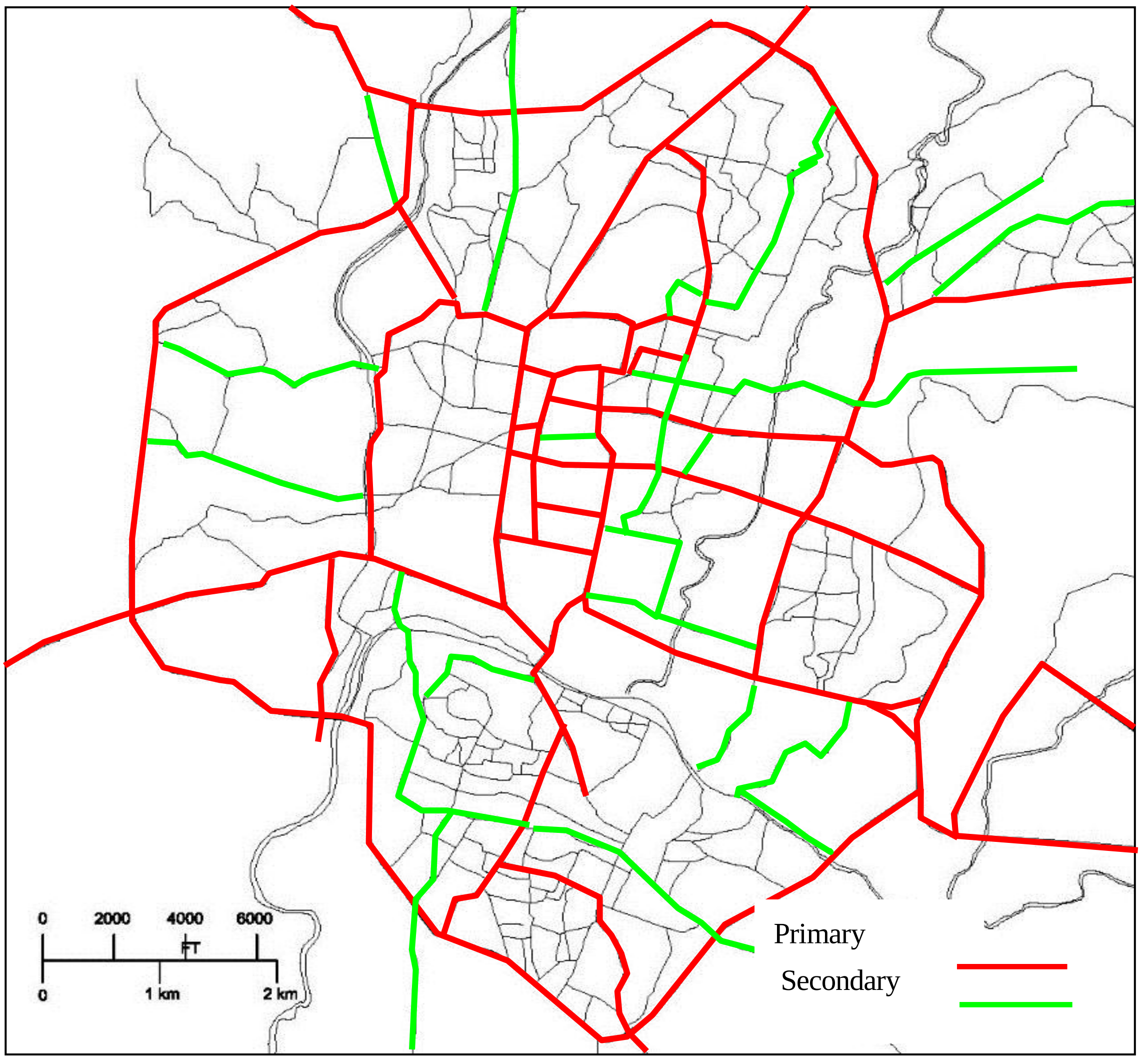


Figure 5.3 An Example of Primary and Secondary Routes

Source: Draft Final Report- Kathmandu Sustainable Urban Transport Project (ADB TA 7243-REG); 2010

The approach discussed here is adopted for the urban public transport restructuring proposed under Kathmandu Sustainable Urban Transport Project (ADB Loan/Grant 2656/0212-NEP SF). This project plans to restructure the urban transport routes into a three tier hierarchy- (i) primary; (ii) secondary and (iii) tertiary and operate bus of capacity commensurate with the hierarchy of the routes i.e. high capacity in the primary routes and progressively lower capacity buses into the two other tier routes. While urban structure in other urban areas of Nepal will not be as complex as in Kathmandu Valley, the principle discussed here in applicable everywhere and is recommended for route re-structuring.

Therefore, the following procedure is recommended for re-assigning the transport vehicles to the routes.

1. Re-assign highest capacity buses appropriate for the city size (standard and high capacity buses or just standard bus or standard and mini-bus) along the major roads that have high passenger demand and are appropriate to be act as through-routes. (Refer to Sub-section 5.2 below regarding re-defining the routes). These routes will correspond to the modified version of Type I to II category of passenger transport (inter-urban transport services) offering deluxe and AC deluxe comfort as proposed in the previous discussion.
2. Assign mini-buses (or mini-buses and micro-buses or microbus only depending on the size of the city) to run along the next tier of roads (e.g. collector, distributors). These routes should(i) directly link the urban outskirts with the city Centre having a relatively lower passenger demand; (ii) provide feeder services between outlying locations and primary route interchange or (iii) provide inter-urban links between points not adequately served by the primary route. Based on vehicle classification proposed, these services will be of Type III category in terms of vehicle classification.
3. Assign microbus and tempos (or tempos only depending on the size of the city) to operate in the inner streets and local accesses linking with interchange to the secondary routes above and internally as well. These tertiary routes correspond to the Type III category.

The only challenge behind this approach is how to encourage existing transport operators that are running smaller vehicles to reassign to the minor streets, inner streets, internal roads, local access, etc. This could be in the form of cross-subsidy to the operator to encourage them to provide service along these routes.

This could be in the form of cross-subsidy to the operator to encourage them to provide service along these routes if the new routes are loss making ones. DoTM can compensate the operators on the loss from their new assigned route (calculated as the difference between the collection made per km and the actual cost of operation incurred per km. Alternatively, a set of routes comprising both the profitable as well as the loss making routes could be granted to the smaller vehicle operators as a way of offsetting any loss. However, the success behind these concepts in Nepal is still unclear and will need to be piloted.

5.2 UPDATE THE URBAN ROUTES

Prior to re-assigning appropriate public transport vehicles to the urban routes discussed in the previous sub-section, it is important to review and define the routes systematically to be compatible with the passenger demand they can cater with the carriageway geometry that is conducive for such demand. Figure 5.4 illustrates the steps involved in defining the urban routes for public passenger transport.

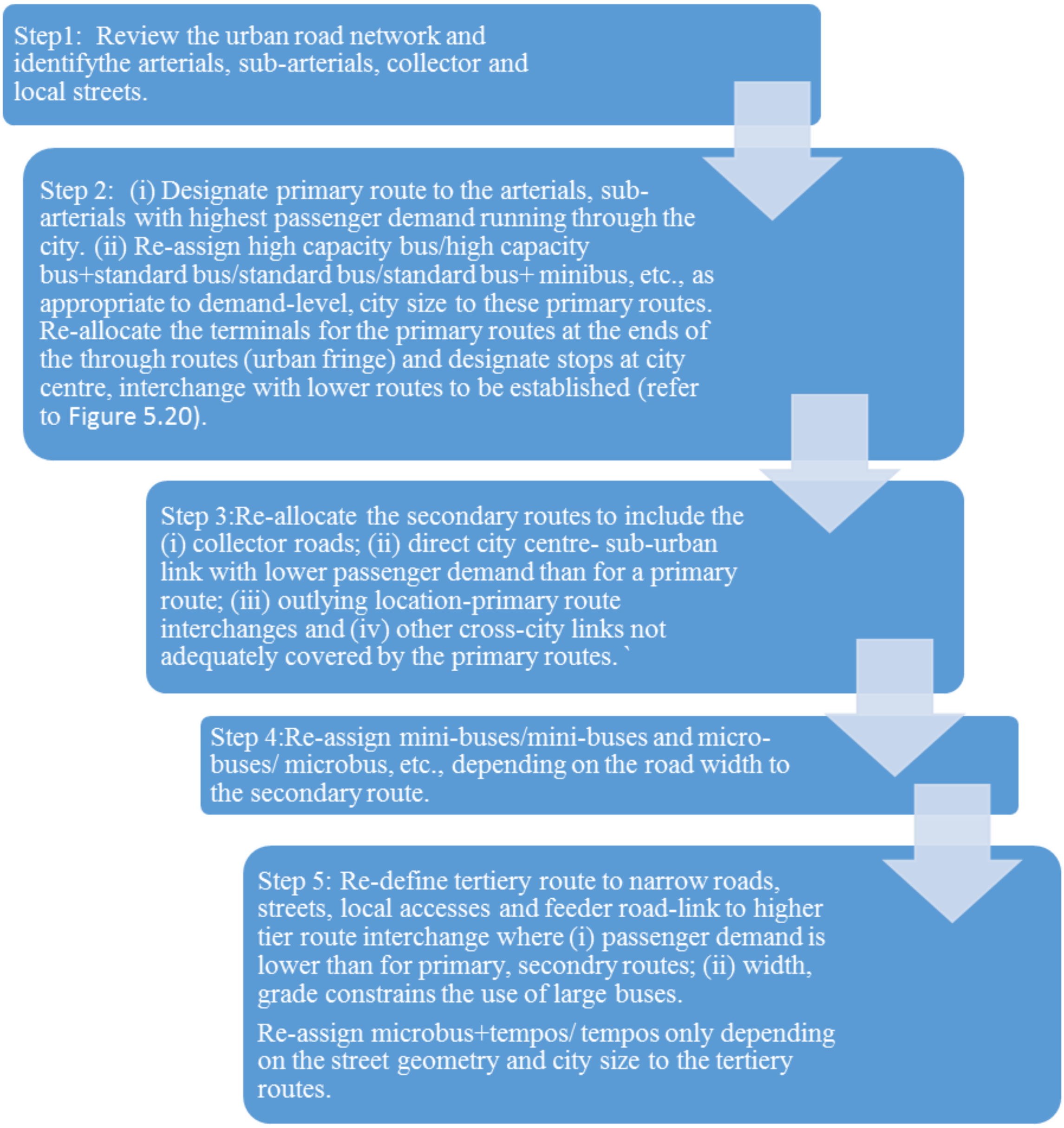


Figure 5.4 Establishing, Re-assigning Urban Routes

Except for Kathmandu Valley, the urban road network in most cities in Nepal have expanded around highways that are oriented roughly east-west or north- south (e.g. Birgunj, Biratnagar, Pokhara, etc.). Therefore, for small Nepalese cities, the primary route may comprise only the highway or main road running through them with the other tier of routes intercepting them.

While restructuring the urban routes, the following should be considered as well to optimize use of the public passenger services.

i. Have the routes (of same hierarchy or other) intersect one another to make it more convenient for passengers to embark/disembark, achieve better occupancy and better integration with all sub-modes of public transportation.
ii. Avoid different routes running parallel to one another to avoid unhealthy competition and oversupply.
iii. Minimise the right turns to minimize congestion.
iv. Plan for different stops for different routes hierarchy.
v. Provide stops at the far side of intersections on the straight section where there is adequate visibility

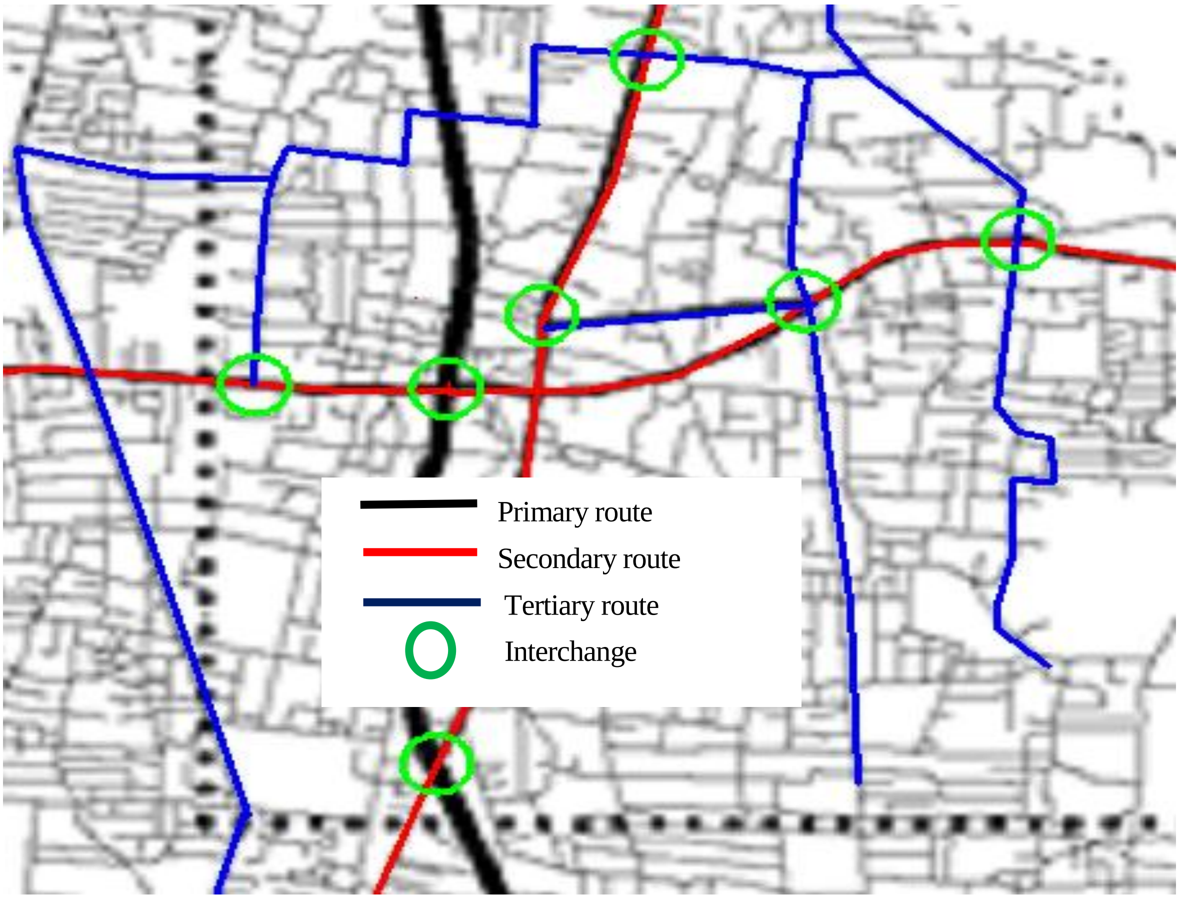


Figure 5.5 Example of Different Route Hierarchies and Interchange between them

The urban routes need to be regularly updated as new land develops, roads improve and new trip generators, attractors develop over time. For example, it would be necessary to review the routes after specific portion of the roads widen or upgrade to higher class to be conducive for inclusion in primary route. Likewise, there may be modal shift from private vehicles to public transport services following road improvement and enhancedquality of service or as result of policy promoting urban public transportation (e.g. higher taxes and duties for private vehicles, imposition of high congestion charge in the major urban network or city core, etc.). The existing hierarchy of routes should then be reviewed and the new trip generator and attraction centres suitably linked.

5.3 DEVELOP INSTITUTIONAL STRUCTURE OF OPERATION

Operation of urban public passenger transport services requires management through a company structure owing to the complexity involved, particularly in major cities. This would require the huge number of individual operators running few fleet to merge together or collaborate so that they could manage the public transport services efficiently, offer new fleet and service facilities (e.g. premium service) with their enhanced financial strength. In the end, these company managed transport operator can run in a more business-like approach while providing higher quality of service for passengers.

5.4 SCIENTIFIC MEANS TO CONTROL PERMITS

In order to operate urban public transport efficiently, DoTM is constantly exploring means to scientifically control the issue of permits for public transport services. The re-assignment of routes and institutional re-organization of the transport operators also comprise scientific means to better regulate permits. In addition to these measures, a discussion on the following interventions is given below.

5.4.1 Stagger Transport Services to Different Time

Under this approach, some of the transport operators are assigned permit to operate on specific period of time (e.g. off-peak period, Saturdays, public holidays) to avoid over-supply situation, if it exists. However, this approach works well only if the transport operator is running in the form of a company rather than individual operators or if some of incentive is provided (e.g. cross-subsidy from the government) to the operator involved. Alternatively, ZTMO can issue new permits under fresh operator to operate in different time slot with no provision for cross-subsidy. However, the benefit from this exercise is not always ensured.

5.4.2 Restraining against Capacity

Under MVTA 1993, ZTMO can deny new permits or permit renewals if the authorities have reason to believe that severe traffic congestion, result in over-supply of transport services. Under this approach, it would be prudent and scientific to assess when to stop issuing permits using the capacity of the road along the route as the threshold point.

Table 5-1 Design Capacities (in PCUs/day) of Different Types of Strategic Roads

S. N.	Category	Plain		Rolling		Mountainous and Steep	
		Low curvature (0-50 deg/km)	High curvature (>50 deg/km)	Low curvature (0-100 deg/km)	High curvature (>100 deg/km)	Low curvature (0-200 deg/km)	High curvature (>200 deg/km)
1	Single Lane Road (3.75 m) with good quality shoulders (≥ 1 m wide)	2000	1900	1800	1700	1600	1400
2	Intermediate Lane Road (5.5m) with good quality shoulders (≥ 1 m wide)	6000	5800	5700	5600	5200	4500
3	Double Lane Road (7 m) with good quality shoulders (≥1 m)	15000	12500	11000	10000	7000	5000
4	Four Lane Road with a median 3 m minimum	40000	35000	32500	30000	25000	20000

PCU = passenger car unit Source: Nepal Road Standard -2070; DoR.

Table 5-2 Design Capacities (both directions) of Different Road Types

vpd (PCUs/d)

District Road(Core network)		Village Road	
Hill	**Terai**	**Hill**	**Terai**
200 (400)	400 (800)	100 (200)	200 (400)

Source: Nepal Rural Road Standard, 2055; DoLIDAR

Table 5-3 Design Capacities of Different Types of Urban Roads

No. of Lanes (width)	Traffic Flow Direction	Capacities in PCUs per hour for various traffic conditions		
		Roads without frontage access, no standing vehicles and nominal cross traffic	Roads without frontage access, no standing vehicle and high capacity intersections	Roads with free frontage access, parked vehicles and heavy cross traffic
2 – lane (7– 7.5m)	One way	2400	1500	1200
	Two way	1500	1200	750
3-lane (10.5m)	One way	3600	2500	2000
4-lane (14.0m)	One way	4800	3000	2400
	Two way	4000	2500	2000
6-lane (21.0m)	One way*	3600	2500	2200
	Two way	6000	4200	3600

Source: Nepal Urban Road Standard, 2068; DUDBC

The corresponding peak hourly traffic for different roads can be approximately assumed to be 10% of the values shown in the above tables. It will be necessary to determine the existing traffic through particular route through traffic count survey. Alternatively, permits may be staggered to other time slot (off-peak) if the only the existing traffic exceeds or is nearing hourly capacity at particular period (e.g. peak AM and PM periods).

5.4.3 At Different Locations

The option of relocating route permit at different locations when there is saturation in the supply of service other than re-assignment as discussed previously is not recommended owing to difficulty in administrating these type of such operations in Nepalese context.

5.4.4 Combinations of Different Vehicles

Adoption of a mix of different mix of vehicles along routes is not recommended as it runs contradictory to the principle of re-assignment of routes according to the type of road, passenger demand commensurate with the throughput capacity of the transport vehicles discussed in Sub-section 5.1 previously.

5.5 THRESHOLD CRITERIA RECOMMENDED FOR PUBLIC PASSENGER TRANSPORT ROUTE

DoTM is constantly facing the pressing need to fix the maximum number of permits for each route in order to regulate the routes and avoid over supply of public passenger transport services. As discussed previously, the department has identified the need for developing a scientific basis in arriving at a threshold limit to the number of permits to allow on particular route. In essence, assessing the maximum number of permits for particular routes for public passenger transport requires application of public transport demand analysis. But public transport demand analysis, particularly for planning purpose is expensive and time consuming for developing countries and particularly DoTM to adopt and therefore a low-cost, simple method for assessment is necessary.

To estimate the maximum number of permits that can be issued to a particular public passenger transport route, it is necessary to first forecast or collect information on the passenger demand. Literature regarding the procedure that the concerned transport authorities in neighbouring countries adopt is not available. Therefore the following simplified criteria is proposed for DoTM to adopt as illustrated in Figure 5.6. The activities involved in each of these steps is discussed in the subsequent sections.

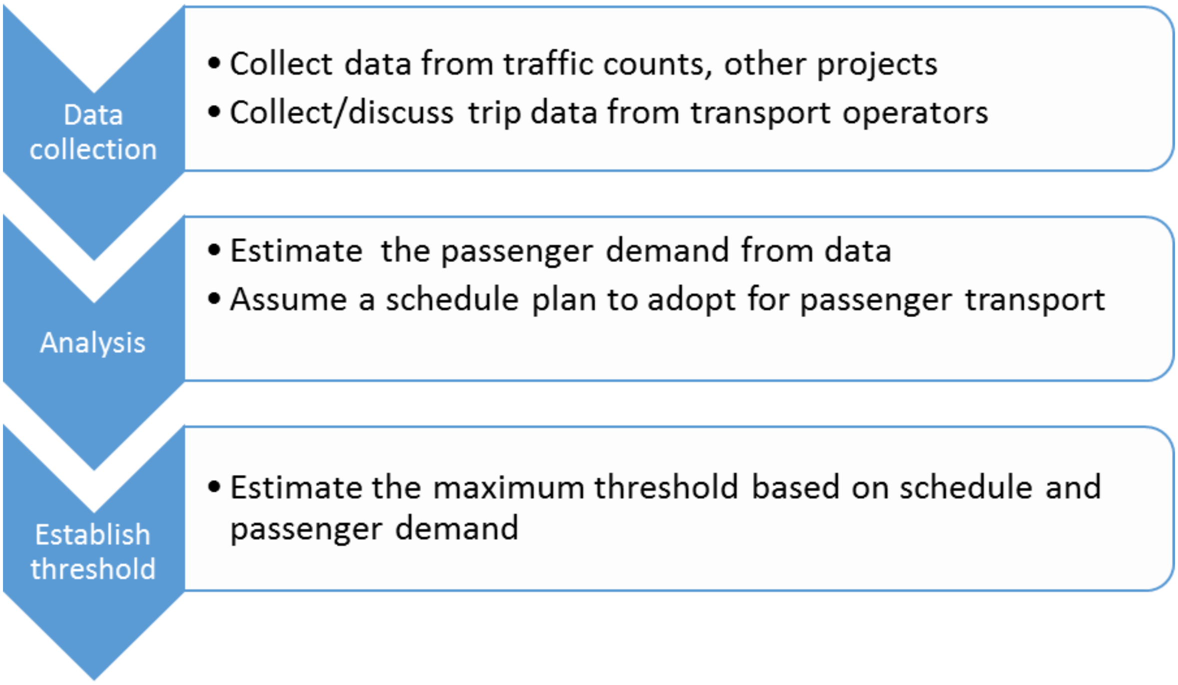


Figure 5.6 Sequence of Activities to Adopt for Establishing Threshold for Passenger Transport

5.5.1 Data Collection

First collect data on traffic counts along the routes from which it is possible to extract indirectly the passenger movements. In this respect, DoTM can collect the annual traffic count data that is available from DoR within strategic roads. Similarly, DoTM can gather whatever count data that is available from other agencies such as DoLIDAR and municipalities. DoTM should also collect passenger trip data from few projects (e.g. JICA surveys for Kathmandu Master Plan Study, Sindhuli – Bardibas Road Project, etc.) in this respect.

It is most probable that count data along all the routes will not be available and therefore DoTM should also gather as much information on the following through FNNTE25 and other operators.

- Total number of trips daily
- Type of vehicle operated
- Schedule followed in daily operation such as frequency of trips, fleet size, time taken per trip

[25] *FNNTE= Federation of Nepalese National Transport Entrepreneurs*

5.5.2 Demand Analysis

Discussion on some travel forecasting models were discussed in Sub-section 4.3. Amongst these the simple approach discussed in Sub-section 4.3.3 prescribed by EMBARQ can be adopted to monitor passenger demand. Another simplified version is given below.

From the data collected, estimate the current passenger demand as follows.

i. From the traffic count, extract the daily passenger movement by mode assuming their average occupancy. Assume an average vehicle occupancy based on observation and discussion with the transport operators. There are a few project led data that have compiled these data within Kathmandu Valley (e.g. Kathmandu Sustainable Urban Transport Project, JICA surveys for Kathmandu Valley Master Plan Study, etc.) to refine this parameter. For example, the average occupancy of public transport vehicles during the peak hour in 2009 based on the occupancy survey conducted at few locations in Kathmandu under the ADB PPTA[26] Study of Kathmandu Sustainable Urban Transport Project were as follows.

- Taxis - 1.5 passengers
- Three-wheelers (tempos, SAFA) - 9.2 passengers
- Microbus - 14 passengers
- Minibus - 26.4 passengers
- Bus - 33.1 passengers

a. The vehicle occupancy during the peak hour will be higher than the corresponding figure during the other period. This can be assessed from inference with the transport entrepreneurs or DoTM may be in the position to assume this from its experience and observation.

$$\text{Daily passenger on route by particular vehicle type} = \text{daily traffic by public transport vehicle} \times \text{average vehicle occupancy}$$

b. If the data is available from the transport operator, then the current passenger demand in terms of daily trips by each mode of transport is readily available.

c. For new routes, the daily passenger movement can be assumed from the design capacity of the road involved along the route since the capacity will curtail the number of buses that can practically ply at one time along the route. Calculate the daily passenger movement on the route from the following formula.

$$\text{Daily passenger movement on the route by particular transport vehicle} = \text{road design capacity (vph)} \times \text{mix composition (\%)} \times \text{average occupancy}$$

d. Where, vph = vehicle per hour

[26] *PPTA = project preparatory technical assistance*

e. The mix composition in the above formula is the percentage of the total traffic that comprise of the public transport vehicle in question.

f. All the daily passenger from different public transport are added together to arrive at the total passenger movements daily.

g. The next step is to assume a schedule for operation of public passenger transport. While this can be quite extensive, it is recommended to adopt a simplified approach. Therefore, estimate the travel time for each trip, its turnaround time27, the frequency of service to adopt, period of operations, etc. These data can be collected from discussion with FNNTE and the transport operators.

- $\text{Vehicle } running\ time\ per\ trip\ \ in\ hours = \frac{distance\ of\ the\ route (km)}{vehicle\ running\ speed\ (kph)}$

ii. Add additional time to the vehicle running time to include the time of stoppage (at intersections, delays, lunch, snack stops, etc.) to arrive at the travel time taken per trip.

iii. Estimate the number of trips feasible using the following formula.

- $\text{Nos. } of\ trips\ daily = \frac{Daily\ hours\ of\ operations}{vehicle\ running\ time\ per\ trip\ in\ hours}$

5.5.3 Estimating the Maximum Threshold for Permits

The maximum number of trips daily that is feasible will be controlling mechanism for establishing the maximum threshold for route permits. In other words, the number of permits to issue will be based on close monitoring of the trips provided by the existing permits and deciding when to stop issuing new permits when the number of trips is about to exceed the threshold number of trips. In this respect, DoTM's new registration and permit requirement for all public transport vehicles to be fitted with GIS[28] devices can help to monitor the actual movements of these vehicles along the route which is very encouraging.

As DoTM gains more experience with the intricacies involved in scheduling and public transport demand analysis, it can employ more advanced method to determine the maximum threshold for permits. Apart from establishing the maximum threshold for permits, the department needs to establish performance threshold to evaluate public transport services in order to regulate them so that they are running efficiently, sustainably and to curtail permits for operators who are not compliant with the performance thresholds. Therefore, DoTM needs to monitor -monitor the performance of operators through comparison of the operator's performance thresholds that includes (i) assessment of punctuality of services evaluated by % change in time arrival at monitored points along the route; (ii)

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[27] *The turnaround time is the taken by a public passenger transport to stop at its destination and start its next trip and includes the time taken for vehicle maintenance, check, refueling, inspection, passenger disembarking and embarking at the terminal, etc., prior to the journey.*

[28] *GIS= geographical information system*

assessment of reliability of services evaluated by proportion of the scheduled timetable that were actually delivered.

An example performance threshold that can be established can be as follows.

i. No timetable service operate early at any point on their routes
ii. No more than 5% of the services on any day or 10% on any route operates more than 5 minutes late
iii. 99% of the scheduled services on any day operate and are completed

As a practical means to compile these data, the department can mandate (a) operators to record and maintain punctuality, reliability of their services for at least 5 % of their scheduled services and forwarding them to the department each month; (b) department can also make random audits of services and conduct customer satisfaction surveys (user and non-users of public transport services).

A system of providing monetary incentives to operators performing for reducing the target level of service disruption or penalty if exceeded should be considered by the department in the future as a powerful tool to regulate permits.

If a particular transport operator is operating in contravention with the permit rules and compliance, the existing permit can be curtailed after reimbursing a certain amount to the operator as adopted in India's Central Motor Vehicle Act 1988 as given below.

Amount reimbursed if route permit curtailed is $\frac{Y \times A}{R}$

Where, Y=length/area curtailed in the existing permit;
A= compensation applicable for each vehicle curtailed subject to a minimum compensation;
R= total length/area of the permit