

Government of the Peoples' Republic of Bangladesh



**Ministry of Local Government, Rural Development & Cooperatives
Local Government Division**

Operational Handbook on Paurashava Street Development

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Operational Handbook on Paurashava Street Development

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Table of Contents

Chapter One: Introduction	1
1.1 Background.....	1
1.2 Street Development in Context of Paurashava.....	1
1.3 Objective and scope to prepare Paurashava Street Development Handbook.....	2
1.4 Basic Structure of the Handbook.....	2
1.5 Target Group of the Handbook.....	2
Chapter Two: Legal Context Related to Street Development and Street Lighting for Paurashava.....	3
Local Government (Paurashava) Act, 2009.....	3
2.1 3	
2.2 In Private Residential Land Development Rule, 2004 (Amended in 2012 and 2015).....	4
2.3 Relevant other laws, policies and rules	4
2.4 Other relevant Document/Papers	4
Chapter Three: Aspects to be considered for Paurashava Street Development	5
3.1 Public Streets	5
3.1.1 Preparation of Existing Road Inventory and Mapping of Street Network	5
3.1.2 Formation of Street Network through determining future Demands	7
3.1.3 Aspects Related with Setting up Design Standard.....	9
3.2 Operation and Maintenance of Streets	19
3.2.1 Operation of Street.....	19
3.2.2 Supervision and Quality Control of Street Construction Works	21
3.2.3 Street Maintenance Activities	24
3.2.4 Method of Maintenance Works according to Street Type/ Street Type wise Method of Maintenance Works	25
3.3 Street Lightning	28
3.4 Control and Coordination of the Construction of Private or GoB/Non-Government organization owned streets in the Paurashava area.....	31
Chapter Four: Procedure to follow for the development of Street and street lighting in Paurashava area	33
4.1 (Step-1): Determination of the Existing Situation of Street Networks, Preparation of the Street Network Map and Inventory of Physical Features of Street.....	34
4.2 (Step-2): Identify Missing Links and Set-out Future Street Development Demand by analyzing existing condition of street, Street Map and Physical Features of Street and as per Existing and Future Demands	37
4.2.1 Analysis of Street Development Activities.....	41
4.2.2 Street Alignment and Land Acquisition Survey	44
4.3 (Step-3): Set out Detail Activities for Planned Street Network Development	44
4.3.1 Vision of Street Development.....	44
4.3.2 Prioritization of Street Development Works.....	45
4.4 Step-4: Analysis of Existing Condition of Street Lighting, Operation of Maintenance Activities and Identification of Future Demands	48
4.5 (Step-5): Set out Action based Regular Activities for Maintenance of Streets, Street Lights and Foot paths etc.	50
4.6 (Step-6): Adopt integrated program for Street and Street Light Development	50
4.7 (Step-7): Supervise and Control Private Streets, and Observe and Monitor the Streets of other Public Department/Organizations.....	52
Chapter-Five: Monitoring and Evaluation Activities for Paurashava Street Development .	53
5.1 Introduction	53
5.2 Objectives of Street Development Monitoring and Evaluation	53
5.3 Monitoring Tools	53
5.4 Evaluation.....	54

Table

Table 3-1: Steps to select alignment of Connecting Street	7
Table 3-2: Table Documenting Synopsis of Streets having Missing Links	9
Table 3-3: The Proximity of Bus-bay from the Intersection	11
Table 3-4: Examples of Hierarchy based Street Cross Section	13
Table 3-5: Required Stopping Sight Distance and Associated Matters	16
Table 3-6: Width and Depth of Gutter According to Street's Width	16
Table 4-1: A Sample Standard Table to Prepare Inventory of Physical Feature of Street	36
Table 4-2: A Sample Table of Existing Condition of Streets containing data and Information from Survey	37
Table 4-3: Sample Format of Traffic Count Survey	38
Table 4-4: Traffic Volume and Percentage of Traffic Modes at Different Time of Major Street	39
Table 4-5: Proposed New Streets (missing links) to complete the Transportation Networks	41
Table 4-6: Street Development Activities for Both Existing and Proposed New Streets	43
Table 4-7: Sample Land Acquisition Survey Results	44
Table 4-8: Inventory of the Existing Condition of Street Lights (Sample)	48
Table 4-9: Selection of Priority based Street for Street Light Extension (Sample)	49
Table 4-10: Selection of Priority based New Street for Street Lighting (Sample)	49
Table 4-11: Inventory for Maintenance Work of Street (Sample)	50
Table 4-12: Measures to be followed to achieve the Standard Street Network for Paurashava ..	51

Figure

Figure 3-1: Finding out the Missing Links	9
Figure 3-2: Pedestrian-friendly Concept in Design and Practice	10
Figure 3-3: Seating arrangement in the pedestrian way	10
Figure 3-4: Sample picture of Bus-bay	11
Figure 3-5: Sample Cross Section of Paurashava Streets based on Hierarchy	14
Figure 3-6: Crest and sag curve	15
Figure 3-7: Camber and Crown	16
Figure 3-8: Sample picture of a usual Gutter	16
Figure 3-9: Super Elevation	17
Figure 4-1: Flow Diagram of the procedure of Paurashava Street and Street Light Development, Maintenance, Observation and Coordination	33
Figure 4-2: Steps for Identification of future path of Street Network	40

Annexure

Annexure 1- Application for Approval of New Street Construction by Private/Non-government Agency	56
Annexure 2- Paurashava Field Verification Report on Approving the New/private Street Construction	58
Annexure 3- Sample of Authorization Format to approve New/private Street Construction	59
Annexure 4- Evaluation Report on the Newly constructed street	60
Annexure 5- Steps to be followed in Approval Process	61
Annexure 6- Good Practice on Infrastructure (Street and Drainage System) Development	62

Chapter One: Introduction

1.1 Background

Paurashava Street is the main way of transport in the Paurashava area. Economic condition and living standards of any Paurashava are vastly depend on the quality of Paurashava Street. Important urban demands are fulfilled through sustainable development and proper maintenance of these streets. Construction, re-construction, repair and maintenance of Paurashava streets and control of private street construction are vital part of Paurashava functions.

Providing expected urban services in most Paurashava is not satisfactory due to the limitation of economic resources. The necessity of taking effective initiatives by Paurashava for planned urbanization through sustainable development of street system is immense. On the other hand, it is necessary to prepare planned street network, establish control over all kind of development and coordination, establish essential services based on the transport demand through taking proper decision, etc. for the development of street system.

This Handbook will be used as guiding principle/guideline to operate Paurashava street system's planned development activities, provide directions regarding control, monitoring and coordination of new road construction under both government and private sector management and for the development of Paurashava street system through regular monitoring and supervision.

1.2 Street Development in Context of Paurashava

According to the rules of Local Government (Paurashava) Act, 2009, 'construction maintenance and lighting of Public Street' and 'control of the construction of new Private Street' are included in Paurashava functions. At Paurashava level, Public Streets are defined as the streets, which have been owned, planned, constructed and maintained by the Paurashava. Private Streets are defined as the streets owned by private individuals/organizations, which need authorization form Paurashava for construction, and to follow Paurashava's instructions for the implementation of proper drainage system, street lighting and other associated works.

In the Paurashava area, other organizations like: Roads and Highway Department (RHD), Local Government Engineering Department (LGED), Zila Parishad, Upazila Parishad, etc. construct and develop streets along with Paurashava. All roads owned by RHD are constructed and maintained by RHD. While the ownership of roads belongs to LGED, Zila Parishad and Upazila Parishad within Paurashava area, are normally transferred to Paurashava after their construction. In addition, National Housing Authority of the Government of Bangladesh develops Satellite Township within Paurashava area together with internal street system. These streets are also handed over to Paurashava, at certain stage, for their maintenance. Besides, entrepreneurs usually develop streets within their jurisdiction for the development of private lands after obtaining authorization from the Paurashava under specified terms and conditions.

1.3 Objective and scope to prepare Paurashava Street Development Handbook

Main objective of preparing this Handbook is to orient elected representatives and related officials of Paurashava about urban street development for achieving proper quality urban street system. Moreover, considering the establishment of planned and sustainable transport system, this Handbook also includes road related land use control, control of the construction of private road construction, etc. To orient about regular operation and maintenance works of all Paurashava roads is another prime objective of this Handbook.

Specific objectives of this Handbook are presented below:

- ⇒ To orient about reconstruction, operation and maintenance of existing roads and operational procedure to prepare plan for the construction of new roads for achieving urban road system with proper standard.
- ⇒ To orient about establishment of Paurashava street light, footpath and development of street related other issues;
- ⇒ To orient about operational procedure for authorization/coordination of new street construction and maintenance of existing streets by private and other government agencies ensuring footpath, street light, proper drainage system and other associated works;
- ⇒ To orient about the operational process establishing/forming monitoring and evaluation framework to ensure implementation of development activities confirming with street system's proper standard as per plan.

1.4 Basic Structure of the Handbook

Considering implementation issues of the specific purposes mentioned above, this Handbook has been arranged with following five chapters:

Chapter One: Basic concept about Paurashava street development and the goal and objectives of the Handbook.

Chapter Two: Legal context to be followed for the development of Paurashava streets, their maintenance and installation of street light.

Chapter Three: Technical and other considerable aspects related to construction/establish of streets/street light; construction, control and coordination of new streets (government, non-government or private ownership).

Chapter Four: Process/strategies/steps need to be followed for the development and maintenance of streets, street light and new street.

Chapter Five: Monitoring and evaluation of street development works.

1.5 Target Group of the Handbook

This Handbook has been prepared mainly for Paurashava's elected representatives and the officials of Engineering Department. Mayor, Councilors and officials of the Engineering Division of Paurashavas are expected to be able to achieve urban street system within Paurashava area with proper standard through enhancing their capacity.

Chapter Two: Legal Context Related to Street Development and Street Lighting for Paurashava

2.1 Local Government (Paurashava) Act, 2009

Legal basis of the development of Paurashava street system is as follows:

Section 50 (2)(e) and 50 (2)(g) of the Local Government (Paurashava) Act, 2009 has stated following about development and management of transport system:

(e) Construction of road/street, footpath and terminals to develop communication system for the benefit of people's movement, passengers and goods.

(g) Traffic management planning for better transport management and arrange passenger shade for pedestrians, road/street light, parking place, bus stand and bus stop.

Public Street according to serial 38(1) and 38(2) of Schedule-2

(1) Paurashava (A municipality) shall provide and maintain such public streets and other means of public communications may be necessary for the comfort and convenience of the inhabitants of the Paurashava and of the visitors thereto.

(2) Paurashava shall prepare and execute street maintenance and street development program in a prescribed manner and all cost shall be born subject to provision made in the annual budget; but the prescribed authority may change or revise this plan, if found necessary.

New Street according to serial 39(1) of Schedule-2

No new streets shall be laid out except with the previous approval of the Paurashava and inconformity with the terms and conditions of such approval.

Arrangement of Street Lighting according to serial 41(1) and 41(2)

(1) A Paurashava shall take such measures as may be necessary for the proper lighting of the public streets and other public places vesting in the Paurashava by oil, gas, electricity or such other illuminant as the Paurashava may determine.

(2) A Paurashava can formulate and implement Street Lighting Scheme/project in a prescribed manner.

Watering of Streets according to serial 42

A Paurashava shall take such measures as may be necessary for the watering of public streets for the comfort and convenience of the public, and for this purpose, maintain such vehicles, staff and apparatus as may be necessary.

Traffic Control according to serial 43

A Paurashava shall, by By-laws, make such arrangement for the control and regulation of traffic as may be necessary to prevent danger, and to ensure the safety, convenience and comfort of the public.

2.2 In Private Residential Land Development Rule, 2004 (Amended in 2012 and 2015)

There is provision of developing streets by the non-government/private developers and later on hand over those to the concerned authority. Paurashava is the responsible authority to approve any land development project within its jurisdiction. So, Paurashava should overviewed, inspected, and examined all private residential land development project whether the streets are being constructed following instructions of this rule or not. Other relevant Acts, policies and Rules.

2.3 Relevant other laws, policies and rules

RHD and National Housing Authority usually construct roads and footpaths within Paurashava boundary, by following their own standards, which are guided by concerned rules and procedures. Within the Paurashava boundary, RHD construct and conduct maintenance works of its roads/streets by itself. While National Housing Authority normally transfer its streets to Paurashava for maintenance after a certain period of their construction.

Besides, for national development, National Land Transport Policy, 2004 has been formulated to ensure physical and institutional infrastructure appropriate for road transport. That policy may be considered during formulation of Paurashava street construction plan,

2.4 Other relevant Document/Papers

Paurashava Infrastructure Design Manual, 2015

Recently 'Paurashava Infrastructure Design Manual, 2015' has been formulated by LGED. Design of various type of roads/streets, design types along with road construction are elaborately discussed in this manual. In operation and maintenance part, regular maintenance, periodic maintenance, emergency maintenance and revision maintenance for all kind of infrastructure being implementation in Paurashava area are also discussed.

Master Plan

Paurashavas, for those Master Plans have already formulated, should follow policies and programs proposed in that Master Plan during construction/development of streets in its jurisdiction. Usually, Master Plan is prepared/formulated based on the analysis of various aspects for achieving future development. This Master Plan can provide proper directions and guidelines in case of street construction and development.

Chapter Three: Aspects to be considered for Paurashava Street Development

3.1 Public Streets

Generally, a Paurashava is formed with one or more Union Parishad or part of it. So for due reasons, Paurashava gets the ownership of the road-ghats and other transport infrastructure located in the abolished Union Parishad or part of it and owned by previous Union Parishad, by the way of inheritance. Noted that, these infrastructures were basically built as rural infrastructures. These rural infrastructures are not always capable to take care of the urban traffic system created by the formation of Paurashava. In conventional way, street networks of Paurashavas have been developed or extended considering development potentials and existing demand only rather considering Paurashava Master Plan. As a result, existing streets are extended along with the creation of new streets. The alignment, width and connectivity of these streets, in maximum cases, fail to meet the demand of future planned growth and create traffic and transport problems permanently, if no appropriate measures is taken.

To achieve the comfortable transportation system in designing and planning road network by following road quality/standard following aspects can be considered:

- ⇒ Preparation of existing road inventory and Mapping of street network,
- ⇒ Develop road network based on the assessment of future demand,
- ⇒ Preparation of detailed road design,
- ⇒ Achieving the future demands,
- ⇒ Formulation of ‘road network operation and maintenance plan’,
- ⇒ Taking initiatives regarding road construction supervision and quality control aspects,
- ⇒ Determine road lighting demand and taking necessary measures,
- ⇒ Prepare new road construction (non-government/private owned) regulate/control process,
- ⇒ Supervision and coordination of various government agency/organization’s new roads construction works, and
- ⇒ Formation of the institutional framework for monitoring and coordination of Street construction, maintenance and street lightings works.

3.1.1 Preparation of Existing Road Inventory and Mapping of Street Network

For public street development works, detailed information on the existing network and condition of the streets are essential with map. This can play vital role determining priority-based demand for future road development and considering important recommendations of related stakeholders.

Inventory

Paurashavas prepared inventory should have following information along with existing condition of each street:

- ⇒ Name and Identification Number (ID) of street,
- ⇒ Provision of footpath,

- ⇒ Drain,
- ⇒ Street lightings, and
- ⇒ Street related other infrastructures and attributes.

This inventory should be updated regularly to accommodate any change over time. A table can be used for this purpose which will contain existing information of road/street ID, Name, Length, Class, pavement type, road adjacent Footpath, Shoulder, road divider, Median, Right of Way (RoW)¹, presence of Street Lighting, etc.

Variation of Inventory due to status change

The inventory may have difference due to the difference of having Master Plan or Transport and Traffic Management Plan of a Paurashava or not. If master plan exists, then the inventory can be prepared examining that Master Plan. If there is no Master Plan, then Paurashava needs to complete the inventory data by collecting the information.

Maps for Paurashavas not Having Master Plan

Streets are to be plotted on maps through field survey which shows exact alignment, pavement width, ROW, etc. with respect to the physical features and land use around the streets.

The mapping and the base map for the task can be prepared by joining the Mauza Maps as declared on the Paurashava formation gazette. Paurashava can collect digital format of these kind of map from any appropriate authority (e.g. LGED and DPHE), if it is available to such authority. An easy and relatively accurate way of preparing the street maps is the use of satellite images of Google earth/map from which the streets can be plotted to scale along with the surrounding physical features as reference. The ward boundaries can be super-imposed on the map to have a ward wise street network. Besides, a Paurashava can also prepare the map by outsourcing, deploying survey consultants from non-government/private sector and supervised by the Paurashava itself.

Maps for Paurashavas having Master Plan

Paurashavas, those have Master Plan, should update the street network map of such Master Plan.

Classification of Important Streets of the Existing Transportation Network

Paurashava should identify existing street connectivity and network from the map prepared through field survey or updated map of the Master Plan. For this, all streets can be classified in to following three categories:

- ⇒ **Primary Street:** Roads/Streets those connect Paurashava with other growth centers or nearby higher level national/regional road network.
- ⇒ **Secondary Street:** Roads/streets those connect neighborhoods with primary roads within the Paurashava.
- ⇒ **Tertiary Street:** local streets those connect residential houses with secondary streets.

¹ Right of Way: For Paurashava streets the term '**Right of Way**' means the total width of the street that is granted or reserved over the land for transportation purposes.

From this street classification, missing link/connectivity of the streets according to road connectivity demand can clearly be visible. Paurashava can take decision following due process to fill in the missing link/gaps.

3.1.2 Formation of Street Network through determining future Demands

Paurashava should have a vision aiming to establish planned street network in the Paurashava area. When any new road is constructed or development of any existing road or if any road is expanded then it will play a significant role in changing the morphology of the adjacent areas. Therefore, in front of the vision of street network development, it is necessary to prepare a full street map for the planned street connectivity of the Paurashava within the prescribed time.

In this regard, following aspects can be considered:

Missing link extending connectivity related aspects

Paurashava should find out the missing links among the Paurashava streets and identify areas for their priority development. Moreover, a database should be prepared getting clear idea about existing and future traffic volume of those streets.

If the Paurashava has any Master Plan, which is supposed to be usable, the portion of Traffic and Transport Plan can be used for such purpose. Paurashava authority will modify the plan if necessary. If Paurashava has no Master Plan or such kind of document, then a complete Map of Transport and Traffic Management Plan should be prepared where missing link can be presented clearly.

Selection of road links for Future Connectivity

Paurashava should find out the missing links among existing streets, and prepare street extension proposals for establishing road transport network for future movement in those Paura areas/settlements where having no access or limited access. In this case, preparing street extension proposal for any connection, Paurashava need to identify all possible routes first, and then, they need to select the suitable one from the alternatives considering all necessary aspects. The steps presented in the table 3-1 can be followed selecting alignment of connecting street.

Table 3-1: Steps to select alignment of Connecting Street Step	Considerable Aspects
Step-1: Identification of missing links among the existing streets.	Find out streets' missing links through reviewing street map and determine possible alignment of connecting street through conducting field visit and survey of those missing links.
Step-2: Identification of communities/places with no access or no traffic movement	Prepare internal street map of such settlements/places and make arrangement to provide connection of those streets with nearby accessible street.
Step-3: Identification of suitable route of the connecting street	There may be alternatives for connecting the place/ locality which should be taken into consideration and according to that identify alternative routes and ensure that through filed survey.
Step-3: Identification of suitable route	Following aspects need to be considered to determine possible route:

	<ul style="list-style-type: none"> • Considering major demands of the residents • Shortage pathways and saving the valuable properties, • Saving any agriculture lands of the Paurashava • Making connection to each community, wards, markets, important institutions, major functional roads, etc. • Controlling future growth direction • Saving open space, Low lands, etc. • Integration with other transport like waterways, railways, air ways, etc.
--	--

If the street route is selected following the above-mentioned criteria, then:

- Agricultural lands, open space and low lands can be protected in constructing new street,
- It will affect minimum structures
- It is one of the smallest distance
- Future growth direction will be appropriate,
- It will not have any adverse impact on the surrounding landscape and nature, and
- It will bring positive change for many people.

Documentation of the information of streets having missing links in favor of future construction/extension

Paurashava will need to use existing street map to find out the missing links to connect and make easy access to every corner of the Paurashava. The following table can be used for tabulating the required streets or tabulating missing links.

Table 3-2: Table Documenting Synopsis of Streets having Missing Links

Identification Number (ID)	From (Starting Point)	To (Connecting Point)	Distance	Distance (Alternative Alignment)	Type of New Street
Local Street (Ward 01-02)-21	Paura Market (Chainase)	Badiakhali Bazar (Ch..)	351m	---	Tertiary/Access/ local street
Local Street (Ward 06)-25	Bazar Road (Near Saidul's Home) (Ch..)	Paurashava Road (Near The Bat Tree) (Ch..)	255m	312m	Tertiary/ Access/ local street
---	---	---	---	---	---
---	---	---	---	---	---

A sample map which would be prepared after preparing the inventory and conducting survey are given here for example.

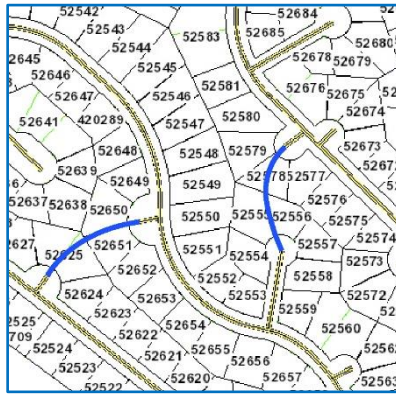


Figure 3-1: Finding out the Missing Links

3.1.3 Aspects Related with Setting up Design Standard

Following aspects should be considered to prepare streets' demand based standard design:

A. Street users' needs

Street design should be inclusive as all classes of people irrespective of age, sex, class, occupation, disable or capability can avail the facilities. While designing, the need for different types of users is to be addressed. Thus, street must be useful for all if its design would be prepared considering demands from all type of users.

Pedestrian

It is desirable to put special emphasis on safe pedestrian movement. Where necessary, appropriate Street/surface level crossings should be provided along with footpath. Increased height and distance become inconvenient for the pedestrians and use of these are difficult for disabled people. So, foot over bridges and underpasses should be avoided unless local topography or other conditions make them necessary. Underpasses, in particular, can also raise concerns over personal security. So, if underpass construction is unavoidable, it should be short as possible, wide and well lit. Moreover, there should have some arrangement to control vehicle speeds to below **15 kmph in residential areas** so that pedestrian's activity is not displaced.

As there is no maximum width for footways, and very minimum amount of land of Main Street are used for this purpose, so width of footpath should be determined in considering adjacent land use type and safe movement of the pedestrians. But the width of footpath should not be less than 1.5 meter. Additional width should be considered between the footway and a heavily used carriageway, or adjacent to gathering places, such as schools and shops.

Surfaces used by pedestrians need to be smooth and free from trouble. Irregular and uneven surfaces/footpath are uncomfortable for pedestrians. Barriers for vehicular use are suggested at the footpath as shown the pictures below.

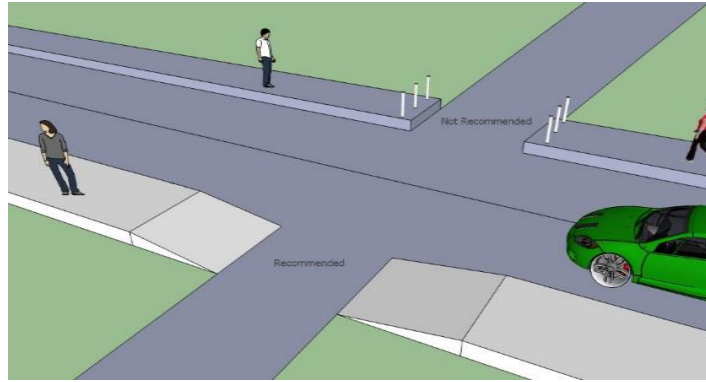


Figure 3-2: Pedestrian-friendly Concept in Design and Practice

Drainage system/arrangement of footpath area should be considered in road designing as the area neither washed by runoff nor subject to standing water.

Seating on key pedestrian routes should be considered every **100 m** to provide rest points and to encourage street activity. Pleasant seating arrangement is recommended.



Figure 3-3: Seating arrangement in the pedestrian way

Non-Motorized Vehicles (cycle, rickshaw and van)

NMVs are till now the major portion of the transport mode in the Paurashavas. Their movement, naturally should be considered with importance. If necessary, road divider can take place in the carriage way for Rickshaws, Cycles means for the NMVs. Generally, in areas with low traffic volumes and speeds, dedicated cycle lane on the street is not required. If rickshaw and cycle lanes are provided, measures should be taken to prevent them from being blocked by parked vehicles. If cycle rickshaw and cycle tracks are provided, they should be physically segregated from footways/footpaths if sufficient width is available.

Public Transport Vehicles

Till now public transport (bus service) is not introduced in Paurashavas for their local necessity. But the primary streets and some secondary streets are used as inter district and inter Upazila bus routes. In these cases, the **design speed of the street should be well maintained**. Keeping arrangement of Bus-bay and Bus-stop in the inter district and inter Upazila bus routes is must.

Close coordination among Paurashava and the owners of public transport is very necessary. Identification of future public transport route should be done along with the public transport owners. Location of Bus-route and Bus-stoppages should consider within walking distance of the important places of Paurashava.

Bus stoppage/Bus-bay

The Bus-stoppage or Bus-bay is a designated place where passengers can land from the buses or waiting passengers can ride to the buses. While preparing the design of the street network of Paurashava, it is essential to consider the necessary bus stoppage for public transport. In order to avoid traffic congestion, there may be multiple bus stoppage or bus-bays as required at the designated location.

Bus bays are usually constructed at proper distances from road intersections. Where this is not practicable, it is preferred that the bus bay would be located earlier than the intersection. Passenger waiting space or landing/riding place should be marked in these bus-bays along with lighting arrangement to illuminate the area and necessary to incorporate other facilities. Desirably, lighting poles should be within 5m to 10m of the pedestrian waiting area.

The distance of Bus Bay from intersection having multiple roads is mentioned below:

Table 3-3: The Proximity of Bus-bay from the Intersection

Preferred (after intersection)		Alternative (prior to intersection)	
Desirable	Minimum	Desirable	Minimum
30m	10m	100m	40m

Width of the walk ways nearby bus-stoppage or bus-bay should be sufficient as pedestrians can move from there along with the waiting passengers. A sample picture of bus-bay is given below:



Figure 3-4: Sample picture of Bus-bay

Private and Commercial Motor Vehicles

Paurashava streets need to be designed in such manner as it could accommodate a range of vehicles from private cars and three wheelers (Auto rickshaws, etc.) to larger vehicles such as delivery vans and Lorries with frequent access requirements. Geometric design of these street should be in such as vehicles used for emergency purposes (ambulance, waste collection truck, fire brigade vehicles, etc.) can move without facing any difficulty.

Emergency Vehicles

The requirements for emergency vehicles are generally dictated by the requirements of ambulance, vehicles of law enforcement agencies and heavy vehicles of fire services. All these vehicles have the urge to reach the destination at a faster speed. So, it is necessary to take proper arrangement so that the emergency vehicles can move easily and smoothly.

Waste collection vehicles

The Paurashavas have their own vehicles for collection and disposal of waste. The movement of the waste collection and transport vehicles should be considered as one of the important issues in preparing the street design. While preparing the street network design, it should take into account that the design of street network is compatible with the planning of waste collection and transport system in the Paurashava areas.

Bus Stops

It is essential to consider the setting of public transport stops and related pedestrian desire lines at an early stage of design. Close co-operation is required between public transport operators and the Paurashavas.

Bus stops should be placed near junctions so that they can be accessed by more than one route on foot, or near specific passenger destinations (schools, shops, etc.) but not so close as to cause problems at the junction. Routes to bus stops must be accessible by disabled people.

Footways at bus stops should be wide enough for waiting passengers while still allowing for pedestrian movement along the footway. This may require local widening at the stop.

Inter district and inter Upazila bus stations should be on the fringe areas of the Paurashava so that it does not make traffic congestion within the Paurashava. However, it should be taken care of during the preparation of master plan of the Paurashavas.

In any of the said cases, there must have bus bays of standard size to avoid congestion. It is needed to accommodate the queue of passengers for waiting to get off from or get into the bus. The standard that may be followed has been figured out in the previous section.

B. Street Geometry

Major components of street geometry are as follows:

- (1) Street's Right of Way (ROW),
- (2) Street's width (in consideration of 'pavement/carriage way', 'foot path', 'shoulder', 'drain' etc.),
- (3) Intersection/More of multiple streets,
- (4) Horizontal and vertical alignment;
- (5) Arrangement of clear visibility around the intersection or more.

Paurashava Street Dimensions

In preparing the design for construction of Paurashava streets or the improvement of existing ones, following issues should take into account for determining the street dimension:

- ⇒ the volume and type of vehicular traffic and pedestrian activity,
- ⇒ the traffic composition,
- ⇒ the demarcation between carriageway and footway (e.g. kerb, street furniture or trees and planting),
- ⇒ parking distribution and management for vehicles,
- ⇒ the design speed (recommended to be 15 km per hour or less in residential areas), and
- ⇒ the curvature of the street (bends require greater width to accommodate the swept path of larger vehicles).

Cross Section of Street

The design/cross-section of Paurashava Tertiary Street compatible to residential use is determined considering maximum safety of pedestrians particularly the movement of children, old and disable people. What will be the minimum width of these streets are determined by considering footpath width (minimum 1.4 meter or 4.5 feet) and the space where two vehicles (private car or micro bus) can move freely (minimum 4.8 meter or 16 feet). That means, minimum width of Paurashava Tertiary Street should not less than 7.6 meter or 25 feet. These roads may be the access street to nearby areas or cul-de-sec street that would be compatible for the movement of vehicles with controlled speed.

Lane width of the streets should follow a standard. There are three types of streets in Paurashava depending on purpose, their utility and extent of access. They are- Primary, secondary and Local streets. Cross sections of these streets are shown in the following figure (Figure 3-7).

Sample of appropriate Right of Way of different type of Paurashava streets (tertiary, secondary and primary level) are presented in Table 3-3 and cross-section of these streets are presented in sample picture 3-5.

Table 3-4: Examples of Hierarchy based Street Cross Section

Street Type according to hierarchy	Suitability of Use	Carriage way (m)	Shoulder (m)	Footpath and Drain (m)	Road Divider (m)	NMV (m)	Natural boundary line (m)
Primary level street (80 ft or 24.38 m)	Primary and regional road and urban centre connecting street	3.7+3.7	2.1+2.1	2.4+2.4	0.6	2.4+2.4	1.2+1.2
Primary level street (60 ft or 18.29 m)	Streets connecting with Primary road and useful for mixed use in considering community needs	3.7+3.7	2.1+2.1	2.1+2.1	0.3	--	0.9+0.9
Secondary level street (50 ft or 15.24 m)	Connecting streets, residential streets, useful for community and mixed use	3+3	2.1+2.1	2.4+2.4	--	--	--
Secondary level street (40 ft or 12.19 m)	Connecting streets, residential streets, useful for community and mixed use	3.05+3.05	1.22+1.22	1.8+1.8	--	--	--
Local level street (25 ft or 7.62 m)	Streets useful for direct residential use and connecting with nearby areas, compatible for the movement of vehicles with controlled speed	2.4+2.4	--	1.4+1.4	--	--	--

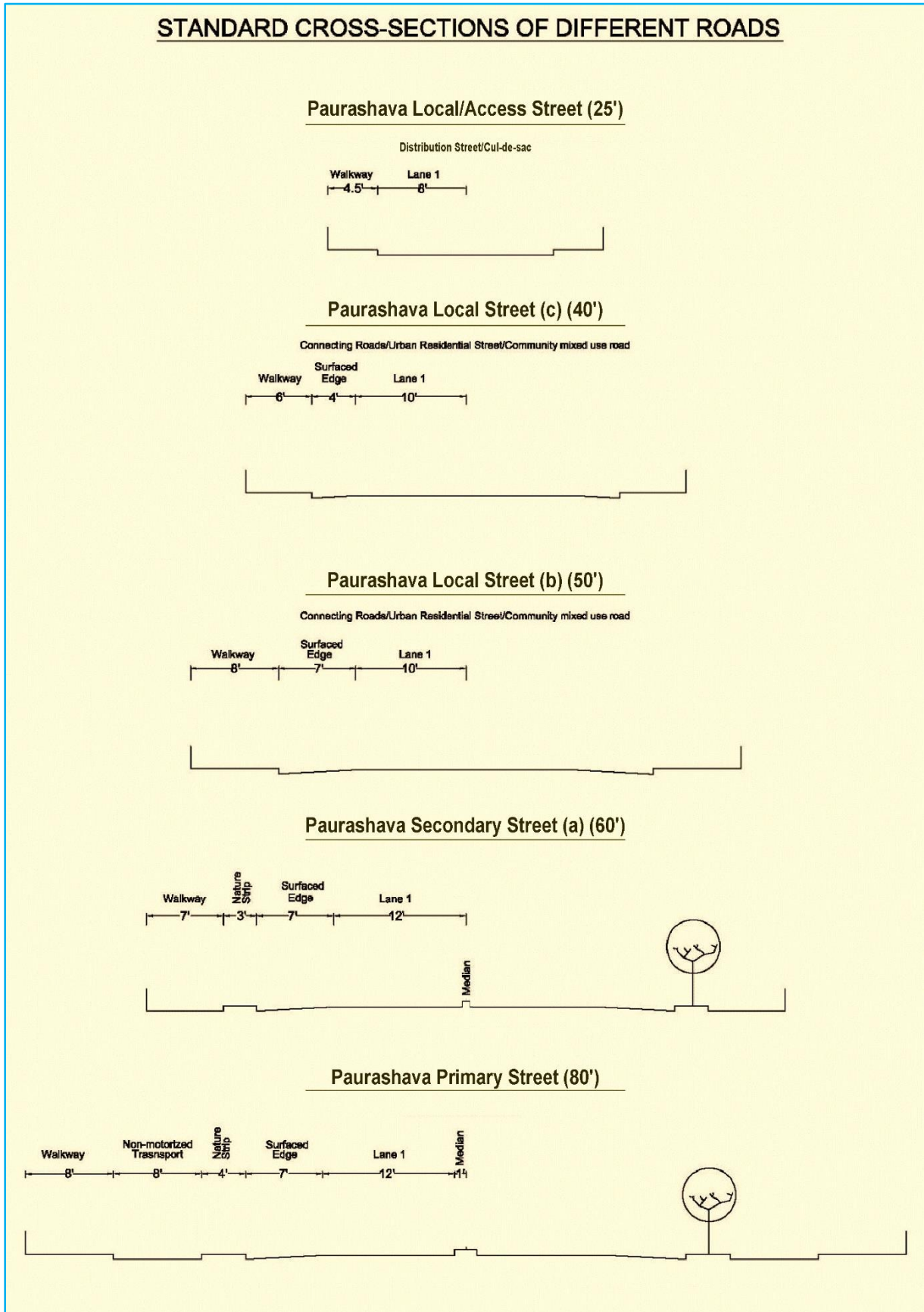


Figure 3-5: Sample Cross Section of Paurashava Streets based on Hierarchy

Grading

The grading of Paurashava level road should not be more than 3%. Everywhere, the angle of crest and sag curve should be avoided by making them smooth.

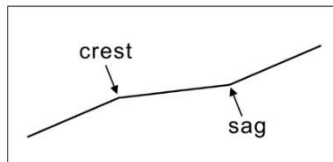


Figure 3-6: Crest and sag curve

Vehicles' Design Speed

It is necessary to control vehicle speeds below 15 kmph in residential areas so that pedestrian's activity is not hampered. In other areas within the Paurashava, the speed limit should not be more than 20 kmph. At the intersection, there should have signals to restrict the speed. In front of educational institutions and places of public gathering like school, parks and playground, there should have speed breakers to limit speed at a desired level. During the construction of such obstruction, it should be ensured that the shape of the obstruction is not the cause of accident. In the zigzag roads, super elevation would be provided calculating these maximum speeds.

Vehicle Type

Within the Paura area, all types of vehicle are allowed to ply on, but movement of inter-city buses should be under proper control. In this case, use of by-passes is necessary. Where there is no by-pass road, in such cases movement of these buses should control through maintaining the design speed. This should be fixed and maintained with the help of concerned bus operators.

Sight Distance (view obstructions)

Roads should be designed carefully so that the users face no view obstructions. It is very important for the vehicular traffic to avoid accidents. At the street, there must have a vertical clearance of 6 feet starting from 2 feet to 8 feet to have a clear visibility; i.e. a clear sight of 2 feet height to 8 feet from ground level is suggested so that, vehicles running at a different direction can easily have a look at the vehicles of opposite directions. At the intersection, a horizontal clearance up to 35 feet is suggested starting from the intersection. All types of boundary wall is prohibited at the intersection to improve the corner sight distance.

Intersection/More/Junctions:

Usually intersections/more are as follows;

- ⇒ Crossroads (four roads) intersection/more,
- ⇒ T and Y junctions/more, and
- ⇒ Roundabouts.

In preparing the design of Junctions/more, radius of the more, vehicles' speed and the places of big tree, hill or building at the corner of the more/intersection have to be considered. Often, the key to a well-designed junction is the way in which buildings are placed around it and how they enclose the space in which the junction sits. Building placement should therefore be decided upon first, with the junction then designed to suit the available space. Junction design should facilitate direct pedestrian movement.

Stopping sight distance

The users of vehicles should be provided necessary stopping sight distance. The table below is a list of required stopping sight distance for a street in a plain land.

Table 3-5: Required Stopping Sight Distance and Associated Matters

Design Speed (km/h)	Break reaction distance (m)	Breaking Distance (m)	Minimum Stopping Sight Distance	
			Calculated (m)	Design (m)
20	13.9	4.6	18.5	20
30	20.9	10.3	31.2	35

Note: Break reaction distance predicted to be 2.5 seconds; deceleration rate to be 3.4 m/s^2 [11.2 ft/s^2]

Source: ASSTHO A policy on geometric design of Highways and Streets, 2001

Footpath Height (Kerb/Curb)

Both side footpath of every street of Paurashava should be pedestrian friendly, and for this height of footpaths can be considered from 10 to 15 centimeters.

Camber and Crown

To drain rain water from the road, the roads need to be constructed with slope from the center line to both sides that keeps the damage of road surface under control. This kind of slope is called Camber. The camber for street should be parabolic and 5% to 7% at most. However, the camber for street can be parabolic, straight or combination of these two. All these conditions are presented below:

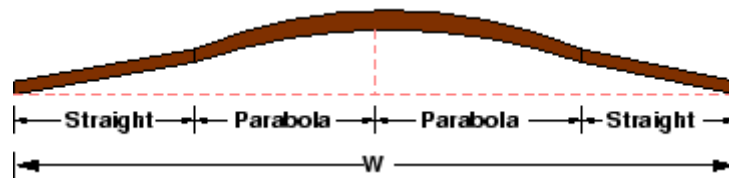


Figure 3-7: Camber and Crown

Gutter

Gutter is a shallow trough at the edge of a street for carrying off rainwater. All of the Paurashava road must have gutter. It will transport the storm water to the drain and hence it will keep the roadway free from waterlogging and at the same time, it will keep the streets lean. The gutters will have to be connected with the existing drains in every 100 meters.

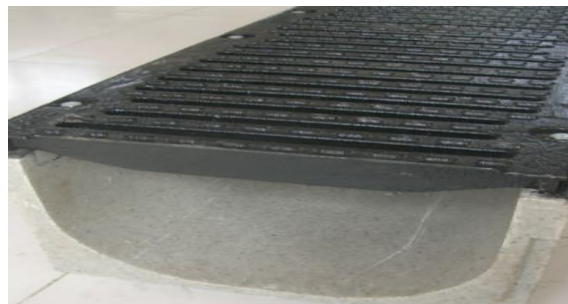


Figure 3-8: Sample picture of a usual Gutter

Oval shaped gutter is suggested for construction in the Paurashava streets and the width would depend on the width of street. If Paurashava can manage enough fund then surface of the gutter can be covered too Following measurement can be used while constructing or installing gutters.

Table 3-6: Width and Depth of Gutter According to Street's Width

Street's Right of Way (meter)	Width of Gutter (meter)	Depth of Gutter (meter)
> 40	0.30	0.15
24 to 30	0.30	0.15

18 to 24	0.15	0.08
12 to 18	0.15	0.08
6 to 9	0.15	0.08

Source: Developed by the consultant

Super Elevation

Super elevation is the difference between the height of inner and outer side of any street. In order to prevent accidents of traffic movement having fixed speed in any circular road due to centrifugal force, the height of the outer side of the road is kept higher than the inner side.

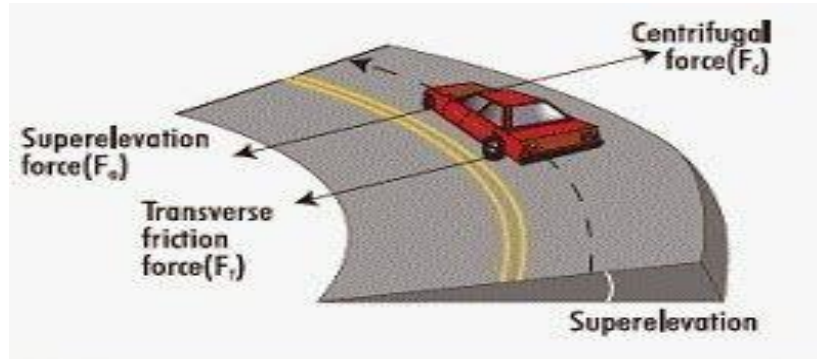


Figure 3-9: Super Elevation

Method to calculate Super Elevation:

Road's inner (towards centre) and

outer side's specific vertical elevation ratio =
$$\frac{\text{Design Speed}^2 \times g^2}{\text{Turning Radius}}$$

Turning Radius

In any case, the turning radius of the intersection of any connecting street to Paurashava Street would not be less than 10 meter as it is the requirement of large vehicles like firefighting trucks to turn. Zigzag road increases the possibility of accident by obstructing visibility of the road users.

Footpath

To support pedestrian movement, at Paurashava level, Footpath is essential in some streets. minimum width, need to be followed to construct footpath are as follows.

- | | | |
|------|-----------------------------|--|
| I. | For primary streets | 1.5m minimum. |
| II. | For secondary streets | 1.0 m minimum. |
| III. | For tertiary/access streets | Optional, that depends on land use type. |

Street island/divider and nature strip

Island would be an element of street wherever necessary. Paurashava may use the following standard for setting up Island.

- | | | |
|-----|-----------------------------|--|
| IV. | For primary streets | 0.5m to 2m with or without plantation in island. |
| V. | For secondary streets | 0.5m to 1.0m. |
| VI. | For tertiary/access streets | No divider. |

C. Parking

Parking is an important considerable element in most of the streets of big cities. Parking problems of personal cars and big vehicles are relatively low in Paurashava streets, whereas in Paurashavas there is a need for considering parking of rickshaw, cycles, motorcycles and, in some circumstances, service vehicles. Parking facilities can be provided in two ways- (1) on street parking and (2) off street parking.



Figure 3-10: On-street and off-street parking

Requirement of parking space is related to the land use and type of occupancy. The land use and occupancy types are residential, commercial, industrial, healthcare facilities, religious, educational. etc. The government of Bangladesh has developed “Dhaka city building construction regulations-2008” which have recommended for the minimum parking space requirements for each kind of occupancy type. But all these car parking spaces are to be within the building or the premises of the buildings. On street parking or parking lots in open spaces are not considered in regulation.

At Paurashava level, parking places can be considered in public places like stadium, shopping centers, parks and other recreational spaces, etc. where required. However, meeting the future demand construction of multi-storied parking building should be considered for large scale Paurashavas. If parking space can be arranged in residential building, then arrangement of discrete parking bays adjacent to the running lanes is often the preferred way of providing on-street parking. It is important to consider passing traffic and pedestrians crossing in this process. It is recommended that, in most circumstances, at least some parking demand in residential and mixed-use areas should be met with well-designed on-street parking.

It is recommended that parking bays for physically challenged people are designed so that drivers and passengers, either of whom may be disabled, can get in and out of the vehicle easily. They should allow wheelchairs users to gain access from the side and the rear. It is recommended that spaces for physically challenged people are generally located as close as possible to building entrances. It is also recommended that **5%** of residential car-parking spaces are designated for use by physically challenged people.

D. Traffic signs and markings

Traffic signs and markings are used for safe and regulated movement of vehicles and pedestrians on streets. Signing includes signs on posts, carriage way markings, beacons, studs, bollards, traffic signals and other devices.

Detail information can be found from BRTA’s Bangladesh Road Sign Manual about the use of traffic sign and marking as required.

E. Street furniture and street lighting:

Street furniture are provided on the street sides for safety and comfort of pedestrians and improve the aesthetic quality of streets. Street furniture are seating benches, guard rails, poles for lighting the streets etc. Pedestrians use these seating benches for short rest during walking and the guard rails provide safety for them from direct access to the carriage ways. Street lighting provides a sense of security and safety to the pedestrians from unwanted criminal activities at night and also add to the aesthetic view of the streets. Moreover, gardening or controlled plantation at road divider and beside of footpaths can contribute significantly to enhance road beautification.

3.2 Operation and Maintenance of Streets

The Executive Engineer (XEN)/Assistant Engineer (AE), as the head of Engineering Department of Paurashava, takes responsibility for Operation and Maintenance of all infrastructures in Paurashava. ‘Operation’ and ‘Maintenance’ of street network is one of the vital parts of Paurashava functions. To maintain the standard of street services related to the transportation of Paurashava, huge amount of money is invested in the development of the street network system. However, proper management and timely maintenance can ensure effective results of this investment. For this, it is considered as a major challenge for the Paurashavas to ensure proper management and maintenance of resources by introducing effective and efficient management practices in Paurashavas.

3.2.1 Operation of Street

Operation of street is a regular task of street management. To establish proper and fair street operation system, routine wise regular inspection have to be done, report has to be prepared on the existing situation found by the inspection, discussion about the report to be held in the Parishad and according to the decisions taken in this regard, the street operation system will be strengthened. The issues that must be emphasized during street inspection, some of them are mention bellow:

- Street and footpath are clean and free from any kind of waste;
- Street and footpath are free from water logging/ no water logging at anywhere of the street and footpath;
- No damage has been done at the surface of street and footpath;
- Quality of all street furniture of the street and footpath are intact all streets are functional;
- Plantation and bushes do not create any visual obstacle to the street users;
- No one accumulates waste materials on the street or footpath;
- Gutters and drains adjacent to street are clean;
- Street watering works are satisfactory;
- Rain water/water emitted from house-hold or industries or water leakage from Paurashava’s water distribution line are not causing any damage through logging on street;
- No one encroach any part/area of the street or footpath or not run any business or other activities at the encroach area; and
- No illegal parking system has developed at anywhere of the street.

Materials

The type and quality of materials to be used for street development works should meet the following requirements;

- ✓ Easy to maintain,
- ✓ Safe for purpose,
- ✓ Durable,
- ✓ Sustainable (including the manufacturing process and energy use), and
- ✓ Appropriate to the local character.

The use of good quality materials on the footpaths and frontages gives a sense of place without leading to excessive maintenance cost.

Planting:

Planting should also be integrated into street design wherever possible. Trees and shrubs should not obstruct pedestrians' sights. Slow growing species with narrow trunks and canopies above 2m should be considered. Care should be taken to preserve the existing trees during a change in alignment of a street.

Drainage:

One of the function of a street is to provide a route for foul water and surface water drainage.

Foul water drainage: In the Paurashava majority of the streets are not designed to accommodate the disposal of foul water from buildings. Instead the foul water from buildings are disposed to the surface drains after treatment through the septic tank as soak wells of buildings. If foul water sewer is planned in the Paurashavas, these are to be disposed into the central treatment plant outside or in the peripheral region of the Paurashava.

Surface water drainage: The street also provides a conduit for the storage and disposal of rain water and waste water from households. The drains are either of open/covered surface drain beside or below the footpath along the streets, or pipe drains below the footpath or along the carriage way with manholes at suitable intervals. The surface water from the carriage ways are delivered into the side drains through pipes below the footpaths.

Street Watering:

According to the Local Government (Paurashava) Act 2009, the Paurashava is the responsible authority for watering street. Street watering should be performed at a regular basis/ on demand which would be supervised by the Engineering Department.

Utilities:

Street are also to provide for the underground utility services viz. water, electricity and gas supply pipes. These should be placed along one side of the road on one bay. For easy installation and maintenance, the utility departments are to coordinate with the Paurashava before their installations.

Adoption:

Usually the Paurashavas adopt and maintain most of the street of Paurashava. The streets built by private owners or by private developers are handed over after completion of construction works. The Paurashava only adopts those streets when these are built to the Paurashava's standard and usable to the Paurashava's people. On the other hand, concerned parson or departments would be responsible for their repair and maintenance.

Maintenance:

A minimum standard of maintenance of the streets to be formulated by the Paurashava. These include;

- ⇒ Type and extent of maintenance work,
- ⇒ Specification of maintenance work,
- ⇒ Durability of maintenance work, and
- ⇒ Routine/periodic maintenance of streets

3.2.2 Supervision and Quality Control of Street Construction Works

A. Pre-construction Activities

Responsibilities of the Officers responsible for Technical Matters

‘Design’ and ‘Specifications’ for all construction, repair and maintenance work are to be prepared following the recognized national and international codes and based on these, Bill of Quantities (BoQ) are to be prepared. Construction works are to be supervised by the responsible Paurashava engineers implementing the quality control and quality assurance of the work following the drawings, BoQ and specifications of the works. Monthly/weekly report on construction supervision works are to be prepared that monitored by the Paurashava’s designated senior official and take necessary action.

Technical specification:

Technical specification and quality of the construction materials of street construction and maintenance works can be ensured by following method/process:

- ⇒ Description of construction materials viz. size, shape, color, thickness, weight, specified strength and to be tested in the laboratory conforming to international standards ASTM, ACI, AASHTO, IS, BS, BDS etc.
- ⇒ Ensure proper standards and procedure of workmanship for different works and trades viz. earth filling & compaction, sub grade, sub base course and base course preparation, bituminous carpeting etc.; and
- ⇒ Ensure that the correct procedure and rules-regulations are followed in accepting the measurement of work and preparing the bill and paying the bill

Verification of the Quantity and Quality of Construction Materials

Construction materials: sub grade soil, course aggregate, bricks, bituminous, concrete, cement, reinforcing bars etc. are to be tested prior, during and after construction as applicable. There must be an appropriate check list for this verification work. With the same, preparation, laying and roller compaction of subgrade, sub base, base course/macadam, bituminous carpeting, concrete mixing, laying and compaction to achieve specified compressive strength, fabrication of re bar and form work and their placing are to be verified according to design specification and measurement.

BOQ, cost estimates, bid documents and tendering

- ⇒ Prepare BOQ according to the design and for cost estimate and follow LGED schedule of rates for respective zones.
- ⇒ Prepare bid documents following the PPR, 2008.
- ⇒ Call, open, evaluate and award tender following PPR, 2008.

⇒ Introduce E-tendering wherever possible.

B. **Construction Phase (Construction Supervision)**

❖ **For new Street (BC, CC and RCC street)**

Following activities need to be followed after Study all the drawings and bid documents thoroughly and carefully:

- ⇒ Take pre-work measurement by detailed field survey and verify with the pre work measurement taken during preparation of BOQ and cost estimate;
- ⇒ Check the existing and proposed alignment of the street.
- ⇒ For pre-work survey take long section at close and reasonable intervals ($\leq 50\text{m}$) and X-Section at $\leq 30\text{m}$ with respect to PWD datum.
- ⇒ Keep TBM on permanent object at reasonable intervals along the street.
- ⇒ Mark the toe lines of the street embankment following the design side slope at existing topography of the land.
- ⇒ Provide and check the formation level along the alignment.
- ⇒ Check that the super elevation and top cross slopes are made in the formation level.
- ⇒ Check the California Bearing Ratio value of existing sub grade. For soft soil excavate earth down to achieve the specified CBR and measure the excavation and sand fill work.

- For Existing Street:

Conduct condition survey to find out the extent of damaged layers of the street with photographs. Verify these with condition survey done before preparation of BOQ and cost estimate.

Assess the quantity of layers which are to be removed and reconstructed and verify with the BOQ in tender documents. If remarkable difference is observed, documented it and notify immediately to higher authority.

Bituminous carpeted street (BC Street)

For the case of Sub grade and Improved sub grade

- ✓ Check California Bearing Ratio (CBR) value of the existing sub grade soil.
- ✓ Select and check the material of improved sub grade.
- ✓ Check the thickness of the Improved Sub Grade as per design.
- ✓ Check the compaction of Improved Sub Grade in layers to meet the designed California Bearing Ratio value.
- ✓ Check the roller made compaction compacted thickness and California Bearing Ratio to meet the specified design value.

For the case of Sub-base

- ✓ Check and approve the samples of ingredients of specified sub based materials (Sand, gravel, brick, metal, crushed stones, etc.) in the laboratory and verify the materials brought to the field with approved samples.
- ✓ Check the blending of the materials are in proper ratio as specified.
- ✓ Check thickness of the mix is placed in layers as specified.
- ✓ Ensure the layers are compacted by the specified roller type and weight and number of passes are done.
- ✓ Check the California Bearing Ratio value after compaction.

Base Course (WBM)

- ✓ Check and approve the sample of aggregates for their grading, water absorption, Abrasion Index value and Loss Angels Abrasion value to meet the specified values in the laboratory.

- ✓ Verify the materials brought to the site with those samples and if required get some materials from the field tested again in the laboratory.
- ✓ Check the materials are placed and spread to sufficient loose thickness to achieve the specified thickness after compaction (maximum 75mm). If necessary, loose thickness can be determined through several trials.
- ✓ After course aggregates are thoroughly keyed and set by rolling, check the screening are spread uniformly to fill the interstices.
- ✓ Compact with dry rolling first and at this condition, fill up all voids and pores by eventually distributed micro aggregates through sweeping by broom.
- ✓ After that watering lightly and at the same time continuing the compaction until a thick pest on the top of the surface is made.
- ✓ Continuing the compaction works by specified type and weight of roller until all the voids are filled in and check the quality of the thickness.
- ✓ Ensure the compacted road section is allowed to dry overnight and a layer of sand or soil about 6mm thick is spread on the surface lightly and sprinkled with water and rolled.

Bituminous Surfacing:

For the case of Densely Graded Bituminous Carpeting (BC)

- ✓ Check and approve the course aggregate (broken stone, singles) and fine aggregate (sand, crushed stone dust) are tested in the laboratory to achieve the specified results.
- ✓ Check and approve the Bitumen for specified grade in laboratory.
- ✓ Ensure all the materials brought to site conform to the approved sample tested in the laboratory. If necessary, get the materials brought to site tested again in the laboratory.
- ✓ Check that asphalt mix is tested by Marshall Method in the laboratory to determine the optimum bitumen content.
- ✓ Check the asphalt mix is prepared with proper ratio of course and fine aggregates and specified Bitumen content.
- ✓ Check the hot mix is placed on tack coated base course and rolled to specified thickness and compaction.
- ✓ If necessary, loose thickness can be determined through several trials for achieving specified compact thickness.
- ✓ Check that the compaction works is done by specified type and weight of roller for achieving specified compaction.

Cement Concrete (CC), Reinforced Cement Concrete (RCC) street.

⇒ Sub-grade preparation

Same as Bituminous Carpeting (BC) street

Sub-base preparation

Same as Bituminous Carpeting (BC) street

To do in Cement Concrete (CC) laying:

- ✓ Check quality of course aggregates (brickbats) and fine aggregates (sand, cement) and M.S. reinforcement bar/rod from LGED lab or any other approved lab;
- ✓ Verify compatibility of the materials in the field as per sample tested in the lab.
- ✓ Mix all the aggregates to specified ratio in mechanical mixture machine.
- ✓ Concrete slump to be tested to remain within the specified value.
- ✓ Laying of concrete to be done avoiding segregation & compaction by mechanical/electrical vibrator.

- ✓ CC to be placed with specified thickness & side slopes.

To do in Reinforced Cement Concrete (RCC) laying

- ✓ Arrange the reinforcing bars and set these at specific layers as per approved design after cleaning upper part of sub-base/base course for design specified laying.
- ✓ Concreting as of CC.
- ✓ Expansion & construction joints to be provided as specified in the drawings.
- ✓ Curing to be done by specified method and for specified period.

Guide wall & hard shoulder

Guide wall (brick or RCC) to be provided on both side of the RCC road as per Design.

Hard shoulder also to be provided as per design.

3.2.3 Street Maintenance Activities

There is no alternative of regular maintenance of street network to ensure traffic system functioning with highest quality. Excess damages of street have been done due to the delay of routine maintenance and for this, maintenance cost will be high naturally. Besides, if the maintenance work is more delayed, major repairs should be done under the rehabilitation of the concern street; it may even need to be rebuilt.

Routine Maintenance:

The works that are done during the whole year to keep the street infrastructures in good and workable condition is known as “Routine maintenance” work. Regular maintenance cost is comparatively low. Regular maintenance works include: street sweeping, grass cutting, do small-scale repair works, cleaning road side drains, for some cases, repair small holes or pot-holes, etc.

Periodic Maintenance:

AS per requirement, it is necessary to repair the comparatively heavy damaged portion of the street after some time, which is known as “periodic maintenance work.” Some examples of periodic maintenance are as follows:

- Replacement of seal coat of street.
- Replacement of carpeting along with repair of pot holes in old streets;
- Removal of waste and weeds from the drains before monsoon season;

Emergency Maintenance:

Emergency maintenance cannot be predicted earlier. Examples of emergency maintenance work are as follows:

- ⇒ Repair of streets damaged due to flood flow;
- ⇒ Replacement of carpeting along with repair of pot holes in old streets;
- ⇒ Removal of waste and weeds from the drains before monsoon season;
- ⇒ Repair of infrastructure damaged due to cyclone and any other natural calamity.

Rehabilitation:

In the absence of regular and periodic maintenance, streets and street infrastructures are badly damaged and in such a case, the maintenance works done to restore streets and street infrastructures by performing large-scale repair works is called rehabilitation work.

3.2.4 Method of Maintenance Works according to Street Type/ Street Type wise Method of Maintenance Works

Maintenance of Earthen Roads:

Pot-holes repair.

Pot-holes created in earthen road to be cleaned of loose soil, water and waste. The hole to be re-shaped for effective repair. The pot-holes to be refilled with similar type of existing road soil with proper moisture content. The soil to be compacted in ± 150 mm layer to 95% MDD.

Repair of ruts:

The ruts are to be cleaned out of grass and loose soil. The higher-level soil is to be removed. Ruts to be refilled with similar type of soil with proper moisture content and compacted to 95% MDD and specified camber.

Repair of rain cuts:

Eroded areas of soil of rain cut are to be reshaped for easy repair. The eroded soil deposited below the slope are to be removed.

The eroded area are to be refilled with proper soil (better to be the same type of soil with which road was constructed.) or other type of soil ($LL < 50\%$ & $PI < 15\%$) with proper moisture content to be used and compacted in layers of max:150mm. to 95% MDD (standard). The side slope and shoulder of the road are to be covered by grass turfing.

Repair of cross slope

A. The depression and bulging areas of road are to be identified first.

- ⇒ The bulged out area are to be cut and depressed area are to be reshaped and all loose soil to be removed. After that the cut areas are to be refilled with proper quality of soil (better to be the same type of soil with which road was constructed) and moisture content.
- ⇒ The soil to be compacted, leveled and dressed to shape in specified cross slope (about 3 to 5%).

Repair of Side slope:

- ⇒ The correct areas section of roads is to be established by rope and pegs so that the areas and quality of earth filling required can be well estimated.
- ⇒ 300mm deep continuous benching to be cut longitudinally. For irregular or scattered areas, the benching may be at 1.5m intervals and 0.5m vertically staggered.
- ⇒ Proper filling soil ($LL < 50\%$ and $PI < 15\%$) to be collected. The moisture content should be $\pm 5\%$ OMC.
- ⇒ Soil to be filled up starting from toe to upward in steps and compacted in layers (< 150 mm) to min. 95% MDD.
- ⇒ The side slope to be measured by wooden triangle and grass turfing to be done on top of slope.

B. Repair and maintenance of bituminous road:

Pot-holes:

Upper layers of road get damaged due to the movement of vehicles specially during the rainy season and small holes are created. Such holes of less than one square meter area are called as pot-holes. Pot-holes can be repaired in the following methods:

- ⇒ The pot holes are to be dug to at least 37mm (1.5 inch.) depth with vertical cuts on the sides.
- ⇒ All the loose materials are to be removed and the cut area to be made dry.
- ⇒ Tack coat at 140-160 deg. C. Temperature to be applied at the bottom and sides of the hole(around 0.75 kg in 1sqm area).
- ⇒ Stone or brick chips are to be placed in the hole at sufficiently high level than the surrounding road top level and to be lightly compacted by roller or hand compactor.
- ⇒ Bitumen 3.5 kg per sqm area are to be spread on top of the stone or brick clips. The repaired top should be well compacted until the top gets leveled with the existing top level of the road around. On the repaired compacted new top level must be kept up to 12mm higher than the existing side levels. In no case the top level shall be kept lower than the surrounding level.
- ⇒ Coarse sand to be spread on top of bitumen layer so that the sticky condition is avoided.

Deep pot-holes.

When the bottom layers of the pavement become very weak or the pot-holes remains unattended for long time, deep pot holes are created, and the lower layers of pavement become damaged. Such deep pot-holes can be repaired in the following method:

- ⇒ The damaged portion of the road are to be cut and removed. The sides of the holes must be cut vertically.
- ⇒ The hole is to be filled up by mixture of coarse aggregate and sand in layers less than 100mm and to be compacted well.
- ⇒ All lose materials are to be removed from the top of compacted base. The top surface to be made dry before application of bitumen.
- ⇒ Tack coat of hot- bitumen of 140-160 deg. cal. temperature is to be applied on sides and bottom of the hole that it covers 50% of the area.
- ⇒ The remaining part of the hole to be filled by stone/brick clips and compacted lightly.
- ⇒ Bitumen @ 3.5 kg/sqm are to be spread on top of the layers and compaction is to be done until it reaches the same level with the original surrounding level. The top of compacted layer may be kept 12mm above than the side levels. But in no case it should be lower.
- ⇒ Coarse sand are to be spread over the bituminous coating so that no sticky condition remains.

Repair of deformation of streets:

- ⇒ The deformed area to be cleaned & made dry;
- ⇒ Tack coat bitumen to be applied at 140-160 degree centigrade;
- ⇒ The depressed area to be filled with stone/brick chips first;
- ⇒ The chips area to be compacted by roller or hand compaction and bitumen to be spread at 140-160 degree centigrade on top. The top level should be made leveled with existing street level on 12mm higher.
- ⇒ Sand to be spread on top to avoid sticky nature.

Repair of hump:

The humped portion to be cut and compacted to level. Tack coat to be applied on top & sand to be spread over.

Repair of cracks:

Following types of crack may be seen:

- ⇒ Hair crack.
- ⇒ Alligator crack.
- ⇒ Longitudinal crack
- ⇒ shrinkage crack.

Crack repair method:

Hair crack, alligator crack, longitudinal crack and shrinkage crack can be seen in the bituminous roads. All these cracks can be repaired by following method:

- ✓ All rubbish on top to be removed by brush.
- ✓ All pot-holes (if any) to be repaired first.
- ✓ Top of pavement must be made dry.
- ✓ Tack coat @ 0.75 kg/sqm to be applied on top.
- ✓ Bitumen & shingles are to be heated separately at 140-160 deg c. .017m³ of shingles are to be mixed with 1.27 kg. bitumen until the color of the mixed material becomes uniform bitumen & shingles must be mixed outside the oven.
- ✓ If diversion of vehicles is possible then the bitumen to be spread over to entire length & width of the road. Other time, bitumen to be applied on the half width of the road. When bitumen is applied on the other half part it should over lapped with the old one.
- ✓ The bitumen and aggregate mixture to spread on top and compacted with light roller so that aggregate do not break.
- ✓ Usually 2 to 4 passes of 4-ton roller and 1 to 2 passes of 8-ton roller is sufficient.
- ✓ The compacted layers to be covered by sand (F.M > .8) @ .09 m³ per sqm. of surface. Vehicle movement to be prohibited for 6 hrs. after the repair.

C. Maintenance of concrete streets:

Cracking:

Concrete in the concrete streets is shrinkage and expanded due to temperature rise and fall. Concrete is strong in compression and weak in tension criteria. For this, cracks can be created in the pavement of Concrete Street, part of it can be damaged and somewhere component of the concrete can be separated. Apart from this, this kind of damages can be done in concrete streets due to natural disaster or road use. These types of cracks can be repaired by following method:

Crack repair

- The cracks to be cleaned thoroughly.
- The cracks are to be cut from top with V-shaped groove so that the top width is 6mm and the depth to reach the bottom of crack.
- All loose concrete are to be removed from the V-shaped groove.

- The cracked areas are to be soaked with water for 24 hours. Creating a water pool on concrete surface so that no more water is absorbed by the concrete.
- The water pool to be dismantled and cement grout to be applied on the prepared surface.
- The V-groove to be filled up with 1:2 cement sand mortar and with finished surface as repaired.
- The repaired area to be covered for 14 days.
- It is also better to repair the cracks with non-shrink grout or epoxy.

Spalling repair:

- The spalled out concrete to be removed with some more probable spalling area around to the depth until hard & fresh concrete is exposed.
- The exposed area to be kept wet so that no further water can be absorbed by the concrete
- 16 swg wire mesh of 30 mm x 30 mm mesh opening to be placed on this spalled areas keeping clear cover of at least 25 mm.
- Cement grouting to be applied.
- Concrete of similar mix of the existing concrete with 12 mm downgraded aggregate and coarse sand to be placed, surface to be finished and curing to be done for 14 days.
- Another better method is to use epoxy to bond old concrete with new concrete. Non-shrink grout to be used for concrete.

Disintegration repair:

Disintegration of concrete of streets are identified when the concrete is cracked and broken into pieces of small lumps but remain in place due to bonding of the reinforcement. This type of damages usually happens in the corner of the slab. These types of cracks can be repaired by following method:

- ⇒ The disintegrated parts of the concrete are to be removed keeping re-bars in their positions;
- ⇒ The sides of concrete to be vertically cut to full depth;
- ⇒ Corner reinforcement to be provided as required, thickness of concrete may be increased as required;
- ⇒ Bonding comical or apoxy to be applied for bonding with old concrete with new concrete;
- ⇒ Concrete of same mix proportion and aggregate to be used, surface to be finished and curing to be done for 14 days; and
- ⇒ The exposed sides of the concrete slab to be protected by brick edging so that water cannot penetrate below the slab preventing pumping affect.

3.3 Street Lightning

Objective and Purpose of Street Lightning

For safe movement at night Paurashava streets have to be lightning well as vehicles, cyclist and pedestrians can move easily. Street lights are usually installed at open space, turning of the street, street of densely populated community or busy street, long distance street between two destinations, connecting road towards or from city centres, etc.

Usefulness to install street light with specified quality and quantity at Paurashava street:

- ⇒ Street light reduce the risk of potential crime in the risky/crime prone areas;
- ⇒ Assist to improve the visual appeal to the pedestrians' movement and other object at road side and footpath and traffic movement on the road.
- ⇒ Reduce accident risk at the streets and junctions/mores where huge traffic are run and huge number of pedestrians are crossing and at the dangerous sharp turning.

Paurashava usually apply to the local Rural Electrification Board (REB) or Power Development Board (PDB) for installing street lights according to their demand. REB or PDB mainly set up the electric pole and provide power besides of the selected streets. After installing electric pole and providing the power Paurashava mainly arrange lighting facilities with cover and complete street light arrangement. However, it is necessary to install street lights with specified quality and quantity on the street, because more light can actually create glare, reducing the eye's ability to see objects in the periphery, and improving visibility for those that commit crimes.

Necessary Activities to install planned Street Light

Obtain a Street Light Inventory and Map

One of the first steps for Paurashava is to obtain an inventory and a map of Paurashava Street Lights. This inventory will include a list of municipal street lights, including the fixture ages, types, and wattages. Paurashava can preserve this list and inventory through GIS-based map. In case of not having the inventory and a map of Paurashava Street Lights, the Paurashava should prepare this inventory and map by conducting survey.

Preparing a Demand List

By Conducting a Street-by-Street assessment with a map in hand walk-through of the entire municipality to get a demand lists where the street light is truly important to be installed. Again at the same time whether it is necessary to be repaired or maintained or replace the bulb, etc.

Layout Plan of Light Posts

Spacing of the light posts depends on the illuminating capacity of the light source. Usually light posts placements are considered in both sides of primary & secondary streets and on one side for tertiary and access streets. Generally, nearest source of electricity connection is considered for the power connection and mark the probable location of switch box. Light post Locates at the outside of footpath or road and switch box should be installed at safe place. By this process layout plan of light posts can be prepared.

Design of Light Posts

For designing aspects usually various type of light post are used in the Paurashava and these are GI or MS pipe pole, RCC or pre-stressed concrete pole etc. New design of light posts is also adopted if it is suitable to install considering level of energy consumption, beautification,

Electrical design

For electrical design aspects following steps are considered:

- Choose the number of light in one circuit,
- Calculate the load,
- Find the cable sizes and then
- Connect to switch boxes with breakers.

The cable may be laid underground or over ground as found suitable to meet the purpose.

Maintenance of street lights.

It is not enough if just streetlights are provided; but they have to be maintained properly. The Paurashava authority should check street-lights on regular basis and have the capacity to do instant repair and maintenance works as required. Otherwise objective to install street lighting cannot be achieved. Necessary tasks for this are described below:

Preventative Maintenance

The causes for which street lights are refurbished by salvaging used or damaged street lighting equipment can be prevented by taking measures through regular inspection and this process can be called as preventive maintenance. Component parts are repaired or replaced, and fixtures are upgraded or modified to reduce future maintenance. Besides, Other issues related to not on the bulbs include- photo cell replacement, and contactor repair or replacement can be included in preventive maintenance.

On the other hand, physical damage includes knock-downs of street lights or controllers and unintentional damage from dig-ups of the distribution conduits. Maintenance cost will be reduced if these damages can be controlled. Repairs may take minutes or days depending on the extent of the damage.

Routine Maintenance:

- Identify and replace fused bulbs as required from regular inspection or complain and keeping registered in the store.
- While inspection, identify other electrical fittings like- bulb covers, electrical wires & accessories and repair or replace them as required and keeping registered in the store.
- Make routine maintenance work by PS electrical team using vehicles with automatic lift.
- Regular inspection and audit the stock registrar and store include bulb and other electrical equipment necessary for regular maintenance works by the relevant officer of Engineering Department and take proper measures to purchase these items through determining future demand.

Periodic Maintenance:

Periodic maintenance works include- repair/replacement of poles, electric cables, switch gear and substation, etc. Major maintenance work should be done by engaging contractor, and minor maintenance work should be done from own resources of Paurashava.

- Costing of Street Lighting Maintenance works
- ⇒ Costing of Routine Maintenance.

Repair works for routine maintenance are done through in houses arrangement by utilizing own materials, own mechanical equipment and human resources. Necessary equipment for this kind of maintenance works are taken instantly from the Paurashava store. For purchasing these items, demand and costing should be prepared following proper process and submit to the authority in case of not available in the store. For this purpose, the volume and time of damage to be assessed through field survey and total cost estimate to be prepared considering the cost of materials need to be purchased, fuel and operational cost of mechanical equipment and casual labor hire cost.

- ⇒ For periodic maintenance.

Periodic maintenance repair works should be done by engaging contractors through competitive bidding. For this type of maintenance, a detailed survey of the work to be done, BOQ, cost estimate to be prepared. Calling for tender, submission of bids and award of contract to be done following PPR-2008.

3.4 Control and Coordination of the Construction of Private or GoB/Non-Government organization owned streets in the Paurashava area

It is the responsibility of Paurashava to construct and maintain streets in its jurisdiction. The streets built by private owners or by government agency or private developers are handed over to Paura authority for maintenance after completion of their construction works. Some examples of these type of roads are given below:

- (a) Internal road related with building construction in private land;
- (b) Internal street network related to residential project implementation by the initiative of non-government institutes;
- (c) Internal street network related to satellite township project implementation by the initiative of government agencies; and
- (d) Observation and coordination of the construction of roads owned by Roads and Highway Department in the Paurashava area.

To make the Paurashava street network more efficient and effective, it is must to apply power establish control

(a) Control of the development of internal road related with building construction in private land

In the Paura area plot owners sited close together and neighbors who for their own movement leave some space both sides for road purpose. In this case, plot owners want to leave very minimum space. So, width of these roads become very narrow. As a result, it is very difficult to provide footpath, drain, water supply line, street light and other urban facilities to these roads along with traffic movement problems. Moreover, these streets create hindrance for the movement of emergency service vehicles like: ambulance, fire fighting vehicles, vehicles deployed for law & order, waste collection vehicles, etc. It is mentionable that most of the residential areas in all Paurashavas of Bangladesh are built through this process that this is the main obstacle for developing planned urbanization in our country.

According to the serial 35 and 36 under 2nd schedule of the Local Government (Paurashava) Act, 2009, the power of control and approval of building design for construction and reconstruction within Paurashava area has vested on Paurashava. According to Building Construction Rule and Paurashava's related by-laws, Paurashava approves design of all buildings to be constructed within its jurisdiction and inspect and control construction of those buildings. Minimum road width is one of the major conditions for building design approval. On the other hand, according to the serial 3 of that schedule, without prior approval of Paurashava and fulfill conditions mentioned in that approval paper, no new road can be constructed within Paurashava area. Considering these issues, minimum width of this type of internal road related to the approval of building construction or reconstruction in the private plot can be ensured. (b) Control of the development of internal roads related with implementation of Housing Project by Private Developers

In the recent days, housing project by the initiatives of non-government/private entrepreneurs has been implemented in the Paurashava area or in the Master Plan demarcated area prepared for Paurashava. Lands under those projects are subdivided into small plots to accommodate building construction. At the same time footpath, street light and drains of the project area along with wider roads, school, play field, health centre, park, entertainment places, etc. and the connectivity of the internal major road with Paurashava road or other road and highways

are displayed in the design of those land development projects. Buyers of such plots purchase those plots with high price after seeing these facilities. But most of the time the design would have changed later on. Width of roads become decreasing and number of plots will be increased by reducing other facilities. As a result, buyers are deprived/damaged, and the area become an unplanned residential area.

According to the serial 34 under 2nd schedule of the Local Government (Paurashava) Act, 2009, layout plan and other necessary documents of this kind of land development project should be submitted to the Paurashava through specified process for approval. Among other issues, the Paurashava has to verify that whether the width of the road is compatible with the number of floor of the building to be constructed as per plan, whether spaces at both side of road has identified for constructing footpath drain, street light, water supply line etc. or not and after all, whether the connection of the internal major road with Paurashava road or other road and highways and internal drainage network with nearby Paurashava drainage network has been made properly or not. Paurashava can control the implementation of these type of housing project in light of Paurashava Act, construction rules and Paurashava by-lays regarding building construction and approval of land development project.

(c) Observation and Repair of internal roads related with implementation of Satellite Town by Government Agencies

National Housing Authority under the ministry of Housing and Public Works develop Satellite Towns in Paurashava areas through land development project. In these projects, roads, footpath, drain, street light etc. are accommodated as per Government approved standard. As a result, Paurashavas do not need to do something for the design of internal roads.

As the maintenance works of those roads will hand over to Paurashava in future, so it is an important responsibility for Paurashava to observe these works combined with respective authorities. It is the responsibility of Paurashavas to observe and coordinate the issues especially, whether the internal drainage network has been made in coordination with Paurashava drainage network or not, whether the internal drainage network properly connected with nearby Paurashava drainage network or not, whether the connection of the internal major roads with Paurashava road network or nearby other road and highways has been made or not.

(d) Observation and Coordination of Roads and Highways Department's roads located in Paurashava areas

Roads owned by Roads and Highways Department are passes in most of the Paurashavas that play vital role to establish transport network connection of the Paurashava areas with outer areas or regions. Design of those roads are prepared as per national standard and in this case, Paurashavas do not need to control anything. But in case of passing this type of new roads in the Paurashava area, the Paurashava can verify whether the road is compatible with the Paurashava Master Plan or not. Moreover, in coordination with Roads and Highways Department, Paurashava has to ensure proper connection of the Paurashava road network with the design of existing or new highways and proper connection of the existing or new road side drain with Paurashava drainage network. Paurashava in coordination with Roads and Highways Department, the Paurashava has to settle issues like provision of footpath, streetlight at the Paurashava part of these highways.

Chapter Four: Procedure to follow for the development of Street and street lighting in Paurashava area

Paurashava needs to follow a systematic approach in street and street lighting development works through ensuring optimum utilization of limited resources. From decision making to execution, it might bring maximum benefit for the Paurashava if it follows step by step process and procedure described in the following diagram:

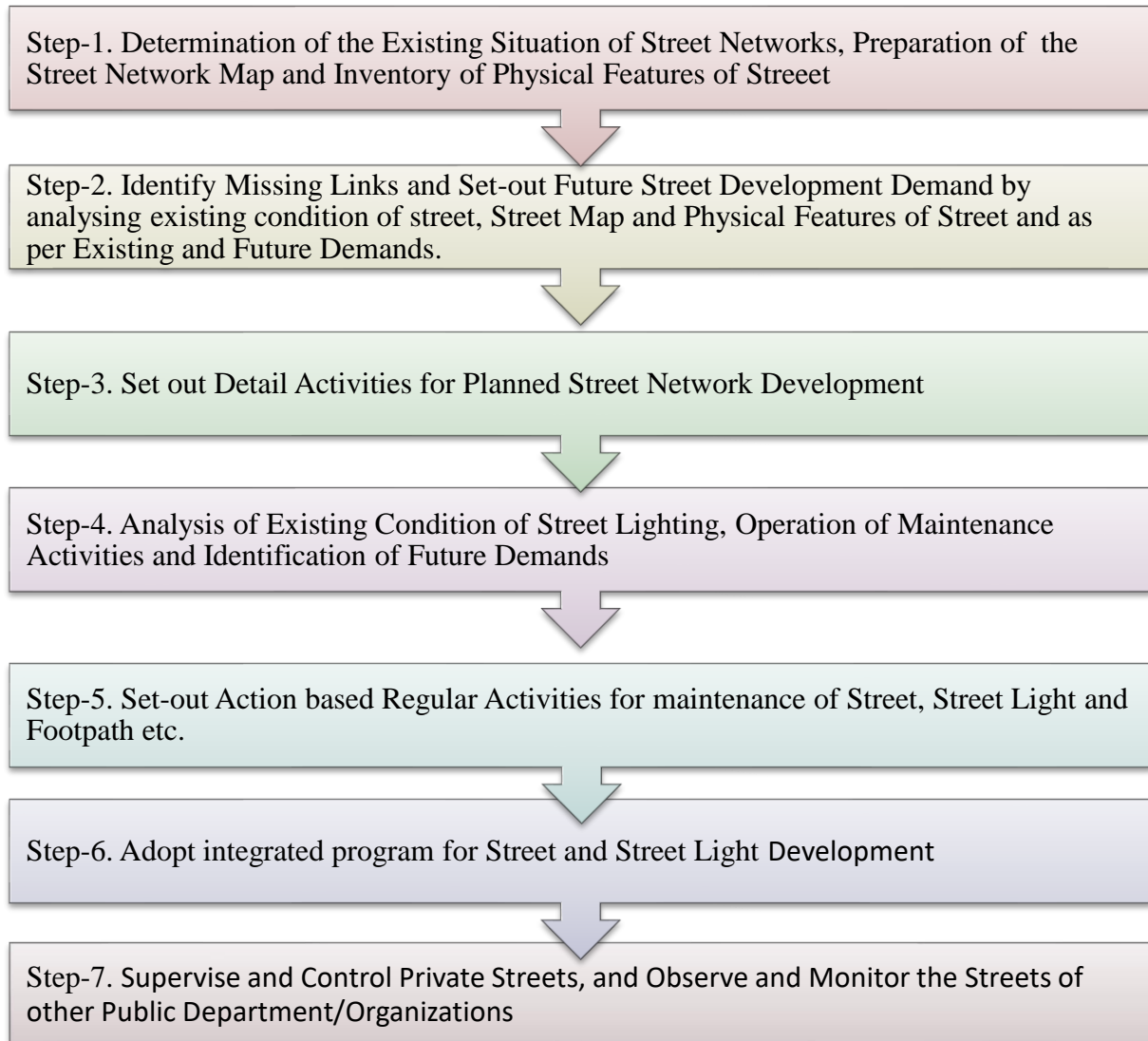


Figure 4-1: Flow Diagram of the procedure of Paurashava Street and Street Light Development, Maintenance, Observation and Coordination

4.1 (Step-1): Determination of the Existing Situation of Street Networks, Preparation of the Street Network Map and Inventory of Physical Features of Street.

Mayor including all members of the Parishad must be informed about the existing situation of street network before adopting street development and maintenance works, like:

- (1) Paurashava's existing traffic and transportation related short or medium term plan;
- (2) Type of existing streets and their total length;
- (3) Major problems relevant to daily traffic on the street;
- (4) Development and maintenance demand of existing street network; and
- (5) Prediction about how much street could be developed and maintained during the tenure of existing Parishad.

In this case, Mayor and Councilors can fix their duties/course of action in respect of any of the following two possible circumstances:

a) Paurashava Has the Master Plan/Traffic and Transportation Plan

If the Paurashava already has a Master Plan, it should follow Traffic and Transportation Management Plan of the Master Plan for development of streets. In this circumstance, Engineering Department (ED) prepares a draft transportation network map from the existing street network shown in the existing physical feature map of update this map through conducting necessary surveys. Moreover, ED prepares existing situation report and present to the Parishad by collecting information about existing situation of streets, footpath, drains, street light etc. through conducting field survey; as the Parishad, by detail discussion and review of the report, can determine proper course of actions.

b) Paurashava does not Have any Master Plan/Traffic and Transportation Management Plan

Paurashavas those do not have any Master Plan, should prepare Map and report on Existing Street Network through conducting detailed survey of the existing street network. Engineering Department of these Paurashavas prepare a base map first and plot the existing street network on that. The Map will show correct alignment of existing streets, Right of Way, existing pavement width, drainage arrangements, road side footpath, drain, street and related to other physical components. For the purpose concerned departments like R&H Department or LGED might be consulted. An inventory of the existing street network should be prepared after completion of the preparation of existing street network map. In this case, ED should conduct necessary field surveys. Existing Street Network Map and Existing situation report prepared by this process will be presented to the Parishad meeting and the Parishad will take decision by detail discussion and review on these.

Steps need to be followed in the preparation of survey work by the ED to prepare the map are as follows:

- ⇒ Collect all the latest version of mouza maps (SA or RS) of the Paurashava area from Department of Land Records and Survey (DLRS) or local land office;
- ⇒ Join all the sheets of mouza maps covering the whole Paurashava and according to the plot and Khatian numbers mentioned in Paurashava formation gazette, identify Paurashava boundary and prepare base maps;

- ⇒ Conduct field visit for plotting the existing alignment, width and topography of the road. Plot numbers of each portion of road shall be correctly demarcated with the assistance of the govt. land surveyor of land department;
- ⇒ Other existing features associated with the streets viz. drainage, footpaths, light posts etc. are also need to be marked in the map.

Paurashava's existing street network map to be prepared by compiling and incorporating all the field survey data and plotting in the base map.

Engineering Department completes all the tasks related to map preparation and coordinate all tasks under step one. It is essential to consult with local people/stakeholders for identifying correct alignment of road while plotting road alignment on mauza maps. In this case, using 'Google Earth' technology will be very helpful to prepare Paurashava's existing street alignment map. After completion of the preparation of map, related personnel of ED prepares the inventory of the physical features of streets. ED may use the sample standard format to record the details of physical features of the streets as shown in Table 4-1.

Table 4-1: A Sample Standard Table to Prepare Inventory of Physical Feature of Street

Sl. No.	Street ID	Name of Street		Length (M)	Type of Street	Types of Pavement (BC/CC/RCC/WBM/HBB/Earthen)	Crest Levels (mPWD) (M)	Distance of the Physical Feature							
		From (Started)	To (Connected place)					Footpath (M)	Shoulder (M)	(Carriage way) (M)	Median (M)	RoW (M)	Street light spacing (M)	Street side Drains (M)	Nature stripe
1	Primary-1 (Ward No:1-2)	Sadar Road		1250	Primary	BC	3.33	0-0	1.5-1.5	9	0	12	33	1.5 m (Under the footpath)	---
		Paura Bazar	Bodikhali Bazar												
2	Secondary-2 (Ward No: 6,7,9)	Bazar Road		1180	Secondary	HBB	3.24	0-0	1-1	6	0	8	33	1.0 m (Under the footpath)	---
		Adjacent to Saidul's House	Near Paurashava Road												
3	Secondary-3 (Ward No:9)	Thana Road		1438	Secondary	BC	3.11	0-0	1-1	4	0	6	---	3.5 m (Under the footpath)	---
		From Dighi Moor	Near Bazar												
4	Tertiary-4 (Ward No: 7,8)	College Road		321	Tertiary	RCC	3.21	0-0	1-1	4	0	6	---	--	---
		From Degree College	Near Bazar Sarak												
	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

4.2 (Step-2): Identify Missing Links and Set-out Future Street Development Demand by analyzing existing condition of street, Street Map and Physical Features of Street and as per Existing and Future Demands

With the prepared map and inventory, the ED prepares a draft future Street Network Plan for the Paurashava, with support from Standing Committee on Communication and Infrastructure and after that, finalize the future Street Network Plan through open discussion with citizens at Paurashava level. The plan can be discussed in TLCC meeting or an open discussion at Paurashava level may be carried out for its finalization. Detailed step by step activities mentioned bellow can be followed to prepare/formulate Paurashava street network Plan:

A. Condition Survey of Streets

Condition survey need to be done first to collect necessary data and information for determining demands of widening, reconstruction, rehabilitation and repair of streets. The condition survey includes:

- Identify extent and quantity of the damages of each layer of street like: surfacing (BC, CC, HBB, etc.), base course, sub-base course.
- Extent/quantity of the damages of earthen street.
- Extent/quantity of the damages of shoulder/hard shoulder.
- Condition of the road side drain, footpath, guide wall, etc.
- Condition of road related bridge, culvert, etc.

Photographs can play vital role to understand and analyze existing situation of the field sitting from the office. Photographs especially play effective role to present existing condition to public representatives.

Table 4-2 can be used to tabulated data and information collected form survey, conceptualize this matter and their convenient analysis.

Table 4-2: A Sample Table of Existing Condition of Streets containing data and Information from Survey

Sl.	Street Type and ID No.	Name of Street	Total Length (m)	Right of Way of the Street (m)	Pavement Type (BC/CC/RCC/WBM/HBB/Earthen)	Intensity of Traffic Flow* (Heavy/Moderate/Low) ¹	Description of the Existing Condition of Street
1	Primary Road No.-1	Sadar Street	1250	12	BC	Heavy	- Deep pit-holes are created in most of the places in around 300 meter long pavement; - No footpath with necessary width for pedestrian movement; - Shallow and open drains exist at both side of the street, that are inadequate compared to the requirement; - The street is narrow compared to the traffic movement; and - Number of street light is less than the requirement and most of them are out of order.
2	Secondary Road No.-2 (Ward 6, 7, 9)	Bazar Street	1180	08	HBB	Moderate	- Pavement of the street is uneven or - Deep holes are created in around 30% of the street; - The street is unsuitable for movement of any kind of vehicle;

Sl.	Street Type and ID No.	Name of Street	Total Length (m)	Right of Way of the Street (m)	Pavement Type (BC/CC/RCC/WBM/HBB/Earthen)	Intensity of Traffic Flow* (Heavy/Moderate/Low) ¹	Description of the Existing Condition of Street
							- Street height is not enough compared to surrounding land; - The street is narrow compared to the traffic movement;
3	Secondary Road No.-3 (Ward 9)	Thana Street	1438	06	BC	Heavy	- 40% bricks of this street has opened in that 20% has already lost; - No footpath arrangement for pedestrian movement; - No gutter/drain arrangement for drainage; - The street is quite narrow compared to requirement; - No street light arrangement at the street.
4	----	----	----	----	----	----	----

B. Traffic Survey

Traffic Survey at Peak hour and Off-peak hour

Traffic survey refers to the count of the quantity of traffic movement per unit of time at a specified location/intersection of streets. This survey include the count of traffic according to their type (like: rickshaw, van, bicycle, private car, bus, truck, lorry or other transport vehicle, etc.). The Engineering Department should know traffic number of more/junction for future designing of multiple mores/junctions.

Traffic survey should be conducted at Paurashava's important streets on working day, local hat day or any other day except hat day and the holiday to know the type and quantity of traffic movement for peak hour and off-peak hour. Table 4-3 can be used for counting the number of traffic move of any street/intersection.

Table 4-3: Sample Format of Traffic Count Survey

Survey Day: <input checked="" type="checkbox"/> Local hat day & working day, <input type="checkbox"/> local hat day and holiday, <input type="checkbox"/> Any working day except local hat day, <input type="checkbox"/> Any holiday except local hat day										
Name of Street: Sadar Road										
Street Identification Number (ID) : Main Road No-1 (Ward 01-02)										
Date:										
Name and Designation of Surveyor: Name and Designation of Supervisor:										
Traffic Survey Point (Chainage of street/intersection): Thana more										
Direction : from Thana more to Bazaar										
Time	Direction (From/To)	Motorized Vehicle					Non-motorized Vehicle			Pedestrian
		Car/Jeep/Microbus	Bus	Truck/Lorry/Heavy Vehicle	3 Wheeler Auto Rickshaw/CNG/Tempo	Motorcycle	Rickshaw	Bicycle	Van	
6.00 - 8.00	From	9	0	3	22	22	37	11	24	47
	To	7	0	7	24	20	38	17	26	43
8.00- 11.00	From	31	0	10	42	60	85	40	47	136
	To	26	0	5	31	70	76	44	55	149
11.00- 14.00	From	48	0	10	46	69	93	50	60	160
	To	26	0	4	38	83	82	56	54	158
14.00- 17.00	From	16	0	8	32	46	53	41	45	143
	To	17	0	7	24	47	53	42	37	123
17.00-	From	68	0	11	38	79	77	49	56	128

Time	Direction (From/To)	Motorized Vehicle					Non-motorized Vehicle			Pedestrian
		Car/Jeep/Microbus	Bus	Truck/Lorry/Heavy Vehicle	3 Wheeler Auto Rickshaw/CNG/Tempo	Motorcycle	Rickshaw	Bicycle	Van	
20.00	To	53	0	8	37	70	76	46	42	134
20.00-	From	30	0	15	23	51	52	31	30	114
22.00	To	17	0	4	21	36	47	23	20	91
22.00-	From	9	0	19	15	26	18	21	12	61
24.00	To	7	0	4	12	24	13	19	8	45
Total	From	211	0	76	218	353	415	243	274	789
	To	153	0	39	187	350	385	247	242	743
		364	0	115	405	703	800	490	516	1532

The ED (preferably XEN/AE and where applicable, urban planner or sub-assistance engineer) analyzes the traffic volume and traffic type using data as obtained from traffic count survey. ED analyzes volume and type of traffic by road through using sample table 4-4 presented below:

Table 4-4: Traffic Volume and Percentage of Traffic Modes at Different Time of Major Street

Street Name	Time period	Traffic Volume			Percentage (%)		Pedestrian	Peak/ Off-peak
		MT	NMT	Pedestrian	MT	NMT		
Sadar Street	6.00-8.00	114	153	90	3.36	4.51	5.87	Off-peak
	8.00-11.00	275	347	285	8.10	10.23	18.60	Peak
	11.00-14.00	324	395	318	9.55	11.64	20.76	Peak
	14.00-17.00	197	271	266	5.81	7.99	17.36	Off-peak
	17.00-20.00	364	346	262	10.73	10.20	17.10	Peak
	20.00-22.00	197	203	205	5.81	5.98	13.38	Off-peak
	22.00-24.00	116	91	106	3.42	2.68	6.92	Off-peak
Thana Street	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-

Data and information to be found from this survey will help to construct new streets or widening existing street or rehabilitation/reconstruction or maintenance of existing street and to help preparing plan of proper action through analyzing existing condition of footpath, drain, street light, etc.

Primary estimation of future traffic mode and volume can be obtained through considering existing traffic mode and volume playing in the streets, type of intra and inter street network and type of existing and future land use type adjacent to streets. And initiatives of new street construction or widening of existing street or rehabilitation/reconstruction or maintenance of existing street or installation of footpath, drain or street light should be taken on the basis of this estimation of future traffic.

C. Determine Future Alignment through identifying the Missing Links

The ED under the guidance of Mayor finds out the missing links of street network and mark them in the map that was prepared previously. The team marks the possible alignment of the link too. The following criterions need to be conceptualized to achieve sustainable street network for Paurashava.

- ⇒ The sustainable street network works in harmony with present and future land uses.
- ⇒ The sustainable street network works in harmony with other transportation networks, such as pedestrian, bicycle, transit, and private vehicle networks.

- ⇒ The sustainable street network maximizes social and economic activity.
- ⇒ The sustainable street network privileges trip by foot for old, children, disables and all, by bike, and have the transit facilities.
- ⇒ The sustainable street network protects, respects, and enhances a city’s natural features and ecological systems and works as disaster responsive.
- ⇒ The sustainable street network shapes and responds to the natural and built environment.

While selecting the missing links, the ED considers following aspects also:

- Whether local level logical demand exist or not;
- Whether it will reduce the traffic volumes in existing circulation channel (streets) or not; and
- Whether it will reduce the travel distances from and to various places within the Paurashava or not.

ED should follow the steps mentioned bellow to identify future path of the street network considering existing street network, strategies of achieving sustainable street network and important aspects identifying the missing links.

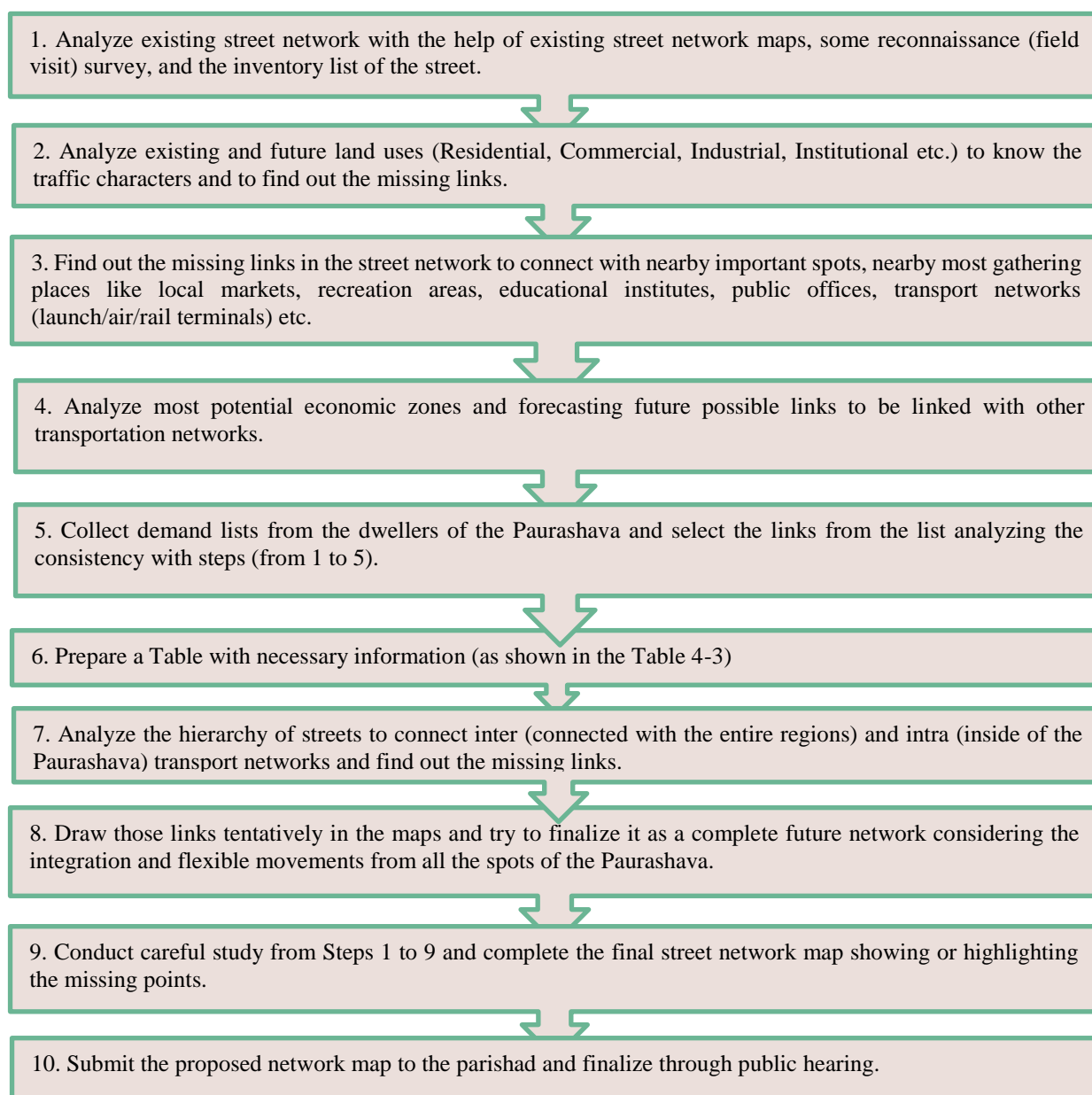


Figure 4-2: Steps for Identification of future path of Street Network

Following above steps ED fills the sample Table 4-5 and also incorporates the missing links in the Map as proposed future network map.

Table 4-5: Proposed New Streets (missing links) to complete the Transportation Networks

Sl.	Street ID	Proposed Length (m)	Name of connecting Road with Proposed Road	Immediate Impact	Future Impact	Daily Expected Movement (Traffic)			Proposed RoW (m)	Remarks
						MV	NMV	Pedestrian		
1	Primary Road No.-1 (Ward 7, 9)	327	Paura Bazar to High School Road	It will connect two Mazor spots and will reduce traffic from Bazar Street.	This street will be the future connector to the settlements located in south side of the Paurashava .	500	400	950	12	Approved by the dwellers of Paurashava and the Parishad
2	Proposed local road-2 (Ward-3)	220	Paura Degree College to Bazaar Road	It will ease the movement to college and increase connectivity between other region adjacent to Degree college and Bazar road.	This street will be the future connector to the settlements located in middle part of the Paurashava .	250	500	1200	12	Approved by the dwellers of Paurashava and the Parishad
3		---	---	---	---					

4.2.1 Analysis of Street Development Activities

For achieving developed urban street network, proper quality street development is essential.

For the development of proper quality street network, ED determines development activities for existing and future streets through verifying existing and future demand. In this case ED prepares sample table 4-6.

By this table, idea can be found about the measurement of the Right of Way of any specific street (existing/proposed) through analyzing connecting demand (present & future) and importance of land uses (present & future) and the position of that street (primary/secondary/tertiary) according to hierarchy.

In this case, all surveyed data mentioned in the Tables from 4-2 to 4-5 of this Handbook need to be analyzed. ‘D’ mentioned in the Table 4-5 indicates ‘Demand’ and ‘P’ indicates ‘Proposal’.

Process to prepare the Table:

Column D1: ED prioritizes the linking demands as High/Moderate or Low through understanding the existing and future demands of connecting with different landscapes, analyzing the importance of inter and intra connection of the Paurashava.

Column D2: Analyzing the existing traffic flow of both MT and NMT and requirements of the streets for heavy vehicles flow Ed prioritizes the linking demands as High/Moderate or Low

Column D3: Analyzing the existing Traffic flow from both directions of the street Ed prioritizes the linking demands as High/Moderate or Low.

Column D4: Analyzing the opportunities of the street or intersection points to connect with other Transport, like water way, airway, railway etc. ED prioritizes the linking demands as High/Moderate or Low.

Column D5: Analyzing the volume of pedestrian flow of different occupation Ed prioritizes the linking demands as High/Moderate or Low.

Column D6: Analyzing the characteristics of present and future land uses (residential, commercial, institutional, recreational, mixed use, etc.) adjacent of the streets Ed prioritizes the demand as High/Moderate or Low.

Column P1: Analyzing the demands from D3, D5 and D6, ED proposes for pedestrian ways and sets the design of the pedestrian way (its width) to support the nearby land uses and traffic.

Column P2: Analyzing demands of D3, ED considers medians only for Primary and Secondary Streets.

Column P3: ED may consider nature strip for both beautification and environmental aspect for Streets.

Column P4: Analyzing present and future Street side drainage alignments and types of drains (Primary secondary tertiary), ED needs to consider Street side drainage alignments.

Column P5: Analyzing the demands from D1 to D6 ED identifies the street as primary/Secondary or Tertiary streets.

For Primary street:

If the demands are found high for columns D1 to D4 and the length of the street is more than 1 km, ED may consider the street as Primary Street.

For Secondary street:

If the demands are found moderate for columns D1 to D4 and high for columns D5 to D6 (other than residential) considering the length of the street is more than 0.5 km, ED may consider the street as Secondary Street.

For Tertiary Street:

If the demands are found moderate/low for columns D1 to D4 and high for columns D5 to D6 considering the length of the street is less or equal than 0.5 km, ED may consider the street as Tertiary Street.

Based on the Tables 4-5 and 4-6, the ED also updates the Street map showing alignment of new streets. The Paurashava discusses and select the streets to be materialized in the Paura Parishad after all of the exercises mentioned above are discussed in TLCC meeting.

Table 4-6: Street Development Activities for Both Existing and Proposed New Streets

Sl.	Street ID	Street Name	Demand Analysis						Proposals					
			D1	D2	D3	D4	D5	D6		P1	P2	P3	P4	P5
			Linking Demands (Considering existing and Future demands) High/Medium/Low	Traffic Volume (MT:N MT)	Traffic flow from both Direction	Importance for Integration with other Transports	Pedestrian Demands High/Medium/Low	Land Use Importance (Existing and Future) High/Medium/Low	Proposed width of Footpath (m)	Proposed Medians (m)	Proposed Nature strips	Proposed Drain Alignment	Proposed RoW (m)	
								Ext.	Future					
1	Existing Street: Primary Road No.-1 (Ward 1, 2)	Sadar Street	Medium	Medium 12:88	High 55-45	Medium	High	low	high	10 ft	Primary 60 ft	3ft	3 ft on both sides	Tertiary 3 ft besides of the Footpath
	-	-	-	-	-	-	-			-	-	-	-	-
	-	-	-	-	-	-	-			-	-	-	-	-

4.2.2 Street Alignment and Land Acquisition Survey

For new street alignment, the street is to be drawn on existing Mouza Maps and physical feature map of the area. Alignment shall be so chosen that the street has the minimum length avoiding habitation and low land as far as possible.

The crest level of the streets to be above High Flood Level (HFL) and the land acquisition proposal should be prepared considering this issue. The land acquisition width for street alignment should be like as it can include the crest width, slope length, berm and borrow pit of the road (Right of Way). The Land Acquisition width may vary along the alignment depending on the topography on the land.

For re-construction and rehabilitation of existing street alignment, survey may be necessary where widening of streets is required. The street may be widened on either sides or one side depending on the existing street side permanent structures and easiness alignment of the street.

The following table can be used for land acquisition survey.

Table 4-7: Sample Land Acquisition Survey Results

Street ID: Primary Road No.-1 (Ward 1, 2) Street Name: Sadar Street Proposed/Planned Width of Carriage Way: 18 meter								
Chainage (From-To)	Mauza Name	Crest Level	Plot No (CS/RS/BS)	Total Area of Plot (Acres)	Required Acquisition Area (Acres)	Estimated Cost of Acquisition	Remarks (Number of Affected structure, Affected People etc.)	
000-250	Setabdi	6.61	RS 250	0.247	0.085	1,22,500	Affected HH: 12 Affected People: 68	
	Setabdi		RS 251	1.114	0.024	80,000		
	Setabdi		RS 252	1.213	0.016	18,325		
	Setabdi		RS 280	0.560	0.015	12,475		
	Setabdi		RS 283	0.137	0.009	8,000		
251-298	Konda	6.5	RS 18	0.240	0.005	3,650		
	Konda		RS 19	0.364	0.157	1,12,495		
	Konda		RS 158	0.168	0.800	65,000		
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---		---	---	---	---	---		
---		---	---	---	---	---		
Total						---	---	

4.3 (Step-3): Set out Detail Activities for Planned Street Network Development

4.3.1 Vision of Street Development

Based on the analysis of existing condition and forecasting the future demands of streets and street lighting, Paurashava needs to formulate the Street Development vision statement with target time of its achievement. For this purpose, standing committee on UPCSD organizes one day workshop comprising members of the standing committee, concerned officials of the ED and head of other departments.

A vision statement can be developed by the following the steps mentioned below:

Steps 1: ED makes a presentation of the existing conditions/situations based on different surveys (Condition Survey, Traffic Count Survey, etc.) conducted earlier, analysis on maintenance priority, development priority (Missing links) & future development demands, financial situation, available human resources, etc. and present it.

Steps 2: Holding discussion on the presentation to prioritize maintenance of streets & street lights; to prioritize street widening including provision for footpath and drain; and to new street development (missing links and street light, etc.).

Steps 3: Holding a detail discussion on existing financial condition of Paurashava and it's projection over 10 to 20 years and required manpower.

Steps 4: Development of a Paurashava vision statement based on above discussions.

The participants would discuss the following issues in a few groups and considering the results of Step 1, 2 & 3 would propose draft vision statement:

- What should be the period to be considered for vision realization (10 to 20 years)?
- What kind of transportation network do the Paurashava want to create?
- What changes in the transportation network do the present Paura parishad want to see in the next 10-20 years?
- What issues are the most important for the overall benefit of the citizen (maintenance, expansion, widening of the existing streets, development of new streets) for next 10 to 15 years?

Steps 5: Formulation of draft vision statement by each group and presented in plenary, hold discussion and finalize the vision statements for street development.

Note: A vision statement should be clear, short, and realizable. The examples of transport network and street development related vision statement are given below.

Samples of a Vision Statement

“By the Year 2027, thePaurashava will be able to provide reasonable level of transport network facilities ensuring the connectivity among wards and major land uses and through establishing hierarchy-based street network, footpath, street lighting as per need and development of traffic system.”

4.3.2 Prioritization of Street Development Works

Out of the tables (Table 4-4, 4-5 and 4-6) prepared as above, the ED and the standing committee prioritizes the work which will be implemented during next 1 to 5 years considering the following aspects:

- a) The proposed street development work will not give benefit to a small group of people only, but instead a large population of the Paurashava will be benefitted.
- b) The work will not be un-implementable on technical and financial consideration.
- c) The work will not have any adverse impact on environment or on a group of people like women, children etc.
- d) The work will have long term impact on the development of the area.
- e) The work will give privilege to women, poor and other marginal population.

Considering aspects mentioned above, some quantitative criteria for prioritization can be developed. Table 4-8 presented below containing factors, weightage/marks and marking criteria that can be used for this purpose.

Table 4-8: Selection Criteria for Prioritization of Street Development Work.

Factors	Highest Marks	Marking Criteria
1. Existing volume and type of traffic	10	The more volume of traffic (including Pedestrian), the more mark would be given and this marks will be comparable among intra/inter streets.
2. Road hierarchy:	10	i. Primary street ii. Secondary street iii. Tertiary/local street
3. Connectivity (to important establishment, e.g. School, market, hospitals, etc. or to highway, growth/ urban centers etc.)	20	Mark of this would be based on importance of the connectivity
4. Nos. of people benefitted	20	The more number of people would be benefitted, the more mark would be given
5. Existing road condition (for repair and re-construction work)	10	Streets of good condition would carry low marks and worse condition would get high mark
6. Length and width of road	10	The highest length road would get Highest weight, lower length road would get lower weight
7. Cost estimation of new construction, re-construction and repair	10	The highest cost of street would get Lowest weight, lower cost of street would get higher weight
8. Other	10	From own perception
Total	100	

Analyzing above issues for each street, ED prepares the following table 4-9 to list down about all development schemes analyzing Tables from 4-6 to 4-8 for both existing and new streets stating the demands and required activities including prioritization.

Table 4-9: Street Network Development Activities (Sample)

Sl.	Street ID	Street Name	Existing/ Proposed	Length (m)	Beneficiaries (description and number)	Proposed RoW and Type of Street	Required activities based on Future Traffic Demands	Required activities based on Existing Traffic Demands	Amount of Acquisition for Future Travel demand (Acres)	Cost and possible source of Fund	Total Number of Priority Rating	Priority Serial
1	Existing Street, Primary Street No.-1, (Ward -1 & 2)	Sadar street	Existing	1200 m	Paurashava's all dwellers (5,500)	18 m, Secondary Minor	Inclusion of Drains and Street lights, construction of 0.3 meter divider, plantation at both sides and need to be widened up to 18 me	Footpath construction (1.5+1.5) and need to be widened up to 12 m	0.25	2 crores, Climate Change Fund		03
2	Proposed Local New Street No.-1	New Paka Street (Paura Bazar to High school Road	New	327	All dwellers of Ward 7, 8 and 9 (5,500)	12 m, secondary	Widening up to 12 meter along with inclusion of street light.	772 m street construction	1.8	1.8 crores		05
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4.4 Step-4: Analysis of Existing Condition of Street Lighting, Operation of Maintenance Activities and Identification of Future Demands

Survey of the Existing Condition of Street Light

Street lighting facilitation works are more or less going on to all the Paurashavas of Bangladesh. Every year the Paurashava are gradually extending the lighting facility to more streets depending on the demands of the citizen. There are no criteria/guidelines developed yet for priority selection of streets to be lightened. ED can conduct a detail survey for the maintenance of existing street light and estimation of future street lighting demand. The following sample Table 4-10 can be used for inventory of existing situation of the street lighting.

Table 4-8: Inventory of the Existing Condition of Street Lights (Sample)

Sl.	Street Identification Number (ID)	Street Name	Street Type and Existing Condition	Street Length (m)	Length of the Part completing Street Lamp (m)	No. of Pole	No. of Light	Type	Condition	Maintenance Requirement	Street Light installation/Extension Requirement (m)
1	Primary Street No.-1 (Ward -1 & 2)	Sadar Street	Primary Street, Paved	1200	1000	31	62	Led bulb	Good	4 Bulbs from 3 light posts need to be replaced	200
2	Secondary Street No.-2, (Ward -6, 7 & 9)	Bazar Street	Secondary Street, Paved	1180	0	0	0	Not applicable	Not applicable	Not applicable	1180
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Maintenance of Street Lights

By analyzing existing conditions found in the above table, it is possible to easily calculate the demand for maintenance. Moreover, under regular maintenance, Paurashava regularly works on bulb changes, switch repair etc. But for the major repairs like: braking of poles or any problem in the distribution line, etc., implementation should be done through proper estimation and process.

Identification of the Future Demand of Street Light

By analyzing existing conditions found in the Table 4-10, it is very easy to identify what streets of Paurashava have street light or not. But considering optimum use of very limited resource aspect, it is essential to prioritize the demand of street lighting earlier than the start of initiative for street light extension program and it is logical to take steps for lighting all streets of the Paura area sequential basis as per demand. However, there is no standard or criteria in Bangladesh for prioritizing demand for street lighting. In this circumstance, this Handbook suggests to use following criterions for prioritizing:

Component of the Criteria	Component based Maximum Marks	Number determination Criteria	Marks Obtained	Remarks
Volume of MT traffic at night	15	High	15	
		Medium	10	
		Low	5	
Volume of NMT traffic at night	15	High	15	
		Medium	10	
		Low	5	

Number of Pedestrian at night	15	High	15	
		Medium	10	
		Low	5	
Street class considering urban importance	20	Primary Street	20	
		Secondary Street	15	
		Local Street	10	
Location of Street	20	Core area	20	
		Fringe area	15	
		Peripheral area	10	
Street's nearby land use	15	Residential	15	
		Commercial	10	
		Agriculture	5	
Total	100			

Prioritization of Street for Street Lighting

Priority based selection can be done for street lighting extension/new installation by using the criterions mention in Table 4-11. Following two sample tables can use for this work:

Table 4-9: Selection of Priority based Street for Street Light Extension (Sample)

Sl.	Street Identification Number (ID)	Street Name	Street Length (m)	Marks of the Priority selection criteria	Priority Serial	Remarks
1	Primary Street No.-1, (Ward -1 & 2)	Sadar Street	1200	75	01	
2	Secondary Street No.-2, (Ward -6, 7 & 9)	Bazar Street	1180	60	02	
	--	--	--	--	--	--

Table 4-10: Selection of Priority based New Street for Street Lighting (Sample)

Sl.	Street Identification Number (ID)	Street Name and Intermediate Connectivity	Street Length (m)	Marks of the Priority selection criteria	Priority Serial	Remarks
1	Secondary Street No.-1, (Ward -7 & 9)	Bazar Street, Paura Bazar to High School	327	70	05	
	--	--	--	--	--	--

While placing street light according to above mentioned priority the following conditions should be considered:

- The light posts should be placed on both sides of the primary and secondary streets and for tertiary/local streets, those should be placed on one side.
- Nearest source of electricity connection should be identified and probable location of switch box should be marked.
- The light posts should be placed at the outside of footpath or street.

After completion of selection of the location of light posts, identification of the place of electricity connection, selection of the location of switch box, selection of bulb types etc. through conducting survey as per above conditions, proper estimation should be prepared and approval should be taken from authority. Later on, approval should be taken from Power Development Board/Rural Electrification Society through communicating with their officers and take necessary steps for implementation of these activities.

4.5 (Step-5): Set out Action based Regular Activities for Maintenance of Streets, Street Lights and Foot paths etc.

The Paurashava engineering division shall form a survey team to inspect the condition of each road. The team prepares a monthly report and recommend for the type and extant of maintenance work required with costing. The report may be done in the following format.

Table 4-11: **Inventory for Maintenance Work of Street (Sample)**

Street ID	Street Name	Length (m)	Existing Condition of the Street Components		Damages		Proposed remedial measures	Estimated cost (in Lac)	Previous maintenance			Remarks
			Component	Type	Location (Chainage)	Extent (Quantity)			Type	Duration	cost (in Lac)	
Primary Street No.-1, (Ward -1 & 2)	Sadar Street	1250	Pavement	BC	240 to +600	Pathhole at Base course, 12 cubic meter	Repair with BC	2.00	Seal Coat	March 2015	13.00	
			Footpath	HBB	160 to 200	Damaged HBB, 40 sqm	HBB replacement	0.35	--	--	--	
			Street Light	Sodium	From 200 up to 600	5 light completely broken	Light need to replace	0.50	--	--	--	
			Street side drain	Earth filling	From 300 up to 500	Filled 150 cubic meter	Re-excavation	0.15	--	--	--	
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4.6 (Step-6): Adopt integrated program for Street and Street Light Development

The ED shall determine detail street development program by taking help from Table 4-2 (required maintenance works), Table 4-7 (proposed development for existing and new streets) and Table 4-11 and 4-12 (Proposed development to install street lights). To set out detail development activities ED follows the design requirement according to the proposed hierarchy of streets from Table 4-7. It is also to be noted that for street design specifications (for material and thickness of sub grade, improved sub grade, sub base, base course and bituminous carpeting), ED may follow Paurashava Infrastructure Design Manual of LGED, 2015.

Table 4-12: Measures to be followed to achieve the Standard Street Network for Paurashava

Street ID	Street Name (Ward No.) (Ward Nos.)	Street Condition				Required Types analyzing future Demands	Proposed Width of Feature to adjust with the Type of Street										Design Speed	Required other Transport Facilities	Proposed RL	
		Existing		New Construction			Proposed Pedestrian Ways	Proposed NMT Provisions	Carriage Way (M)	Proposed Median	kerb	Camber	Crown	Proposed Nature stripes	Proposed types of Street Light	Proposed Drainage				
		Length (ft)	RoW	Proposed Length (ft)	Proposed Type/RoW															
Street No.-1; (Ward - 1 & 2)	Sadar Street	1250	12	1250	18	Primary	1.5+1.5 m; CC, Bricks	---	---	0.3	0.3 m height, cement concrete, Rectangular Shape	Parabolic, 5%	15 cm	One side, 0.31 m	Centered, LED bulb, 30m interval, MS Pipe Pole, 9m height, Points Plotted in the Map	Beneath the Footpath, 0.92m width, RCC	25 km/hr	Passenger Shed/ Camber and Crown	--	
Street No.-2; (Ward - 1)	Bazar Street	1180	18	1180	12	Secondary	2 m, Either side, CC Bricks	--	---	---	0.3 m height, cement concrete, Rectangular Shape	--	--	---	---	Beneath the Footpath, 0.92m width, RCC	15 km/hr		-----	
Street No.-3; (Ward - 9)	College Street	1438	6	1438	12	Secondary	1.5 m, Either side, CC Bricks	1.5 m, Either side, CC Bricks	--	--	0.31 m height, cement concrete, Rectangular Shape	Parabolic, 5%	15 cm	One side, 0.31 m	Centered, Sodium bulb, 30m interval, MS Pipe Pole, 9m height, Points Plotted in the Map	Beneath the Footpath, 0.92m width, RCC	30 km/hr	NMT Parking	--	
New Proosed Street No.-1; (Ward - 7 & 9)	New Street	321	6	321	6	Local Street	---	---	---	---	--	--	--	---	---	--	15 km/hr	SIGN, SYMBOL/ Marking	---	
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

From the exercises done above, the Engineering Division of the Paurashava under the supervision of Mayor and with the help of concerned Standing Committee, approves the activity lists relating to street development and then prepares an implementation schedule considering priority-based demands and also considering availability of necessary funds.

4.7 (Step-7): Supervise and Control Private Streets, and Observe and Monitor the Streets of other Public Department/Organizations

Private owned Street Control and Supervision

According to the serial 39 under 2nd schedule of the Local Government (Paurashava) Act, 2009, no new streets shall be laid out except with the previous approval of the Paurashava and inconformity with the terms and conditions of such approval. Paurashava can take necessary measures to establish control over private street construction. Regarding this Paurashava can prepare application and other form for street development approval, sample of those are presented at the later part of this Handbook through Annex-1, 2, 3 and 4. Steps to be followed for completion of approval process are presented in annex-5. A Paurashava may, by notice require, that any street may be paved, drained, channeled, improved or lighted in such manner as may be specified in the notice, and in the event of default, the Paurashava may have the necessary work done through its agency, and the cost incurred thereon by the Paurashava shall be deemed to be a tax levied on the person concerned under this Act.

Observation and Coordination of Streets constructed by Other Public Department/Agencies

Following public agencies are also responsible for planning, designing, construction and maintenance of Roads in Paurashavas.

Streets owned by Roads and Highways Department (RHD)

RHD also provide drains besides of the national or international highway. If the drain considered in the Paurashava area, then it also need to be adjusted with exiting drainage plan. For this purpose, Paurashava should liaison with RHD to ensure the above requirements.

National Housing Authority (NHA)

National Housing Authority (NHA) is another public department under the ministry of Public Works is another authority to develop Satellite Township at Paurashava level. The township includes plot developments, internal drainage system & other civic facilities. In this case also, Paurashava should ensure that the drainage are laid with standard in consistence with requirement of Paurashava drainage network system and also constructed with proper size, gradient and invert level connecting the drainage network system of the Paurashava. For this purpose, Paurashava should observe NHA's relevant activities and liaison with NHA to ensure coordination of the activities and demand of Paurashava with their tasks.

Chapter-Five: Monitoring and Evaluation Activities for Paurashava Street Development

5.1 Introduction

Monitoring is a systematic process for measuring the progress of the implementation, quality control, identification of obstacles and reviewing the way to achieve its intended goal of a plan of action. On the other hand, Evaluation is actually an assessment that measures whether the objectives of any work/particular purpose have been achieved on the basis of some evidence/indicator. Range of advantage or disadvantage of any completed task can be identified through evaluation that, in the later stage, help any organization to take right decision.

Without proper implementation of the street development initiatives or plan through monitoring and evaluation, development will exist in the Plan only, rather create any value. Monitoring and evaluation are very vital for Paurashava street development. Monitoring and evaluation activities should consider all kind of development activities those have direct impacts on streets and integration with other transportation network need to developed day by day to achieve better transportation system.

Updating of information is very important for monitoring and evaluation. For this purpose, Street Maps and Inventory lists of the Paurashava should be regular updated according to the existing situation.

5.2 Objectives of Street Development Monitoring and Evaluation

Objectives of street development monitoring and evaluation are:

1. to complete any street development related scheme in time for its completion within estimated cost, and for this to complete all pre formalities;
2. Ensure sequential development of the future path of Street network by following street hierarchy and real and sustainable development of future street network by following street development plan,
3. Ensure coordination of the construction, operation and maintenance works and ensure implementation of timely required activities solving identifies problems.
4. Ensure control on private streets through analysing Paurashava's future land uses.

5.3 Monitoring Tools

Some monitoring tools are described below that can be applied for monitoring purpose:

- (a) Monthly Progress Report;
- (b) Regular Periodical Inspection;
- (c) Regular Meeting of the Parishad;
- (d) Yearly Progress Report;
- (f) Yearly Meeting.

Regular field inspections and inspection reports would be the strong monitoring tool for street development activities. Discussions on Monitoring & Evaluation Report of street development activities should be one of the agenda of Paura Parishad meeting for achieving the sustainable street development goal of the Paurashava.

The ED shall prepare monthly progress report (Report can be presented by the Tables 5-1 and 5-2 presented below) by monitoring it through the verification list according to the Street Development Plan and submit the same to the Parishad for verification.

The standing committee on UPCSD arranges yearly meeting and prepares written observations/recommendations for Parishad meeting.

ED prepares also the yearly compiled progress report and submits the same to the Parishad for discussion aiming to monitor and evaluate yearly performance of street development activities.

5.4 Evaluation

Evaluation of street development activities involves analyzing monitoring status of ongoing development activities and implementable proposed schemes of the Street Development Pan. It is important to conduct evaluation of street development activities at least once in every three months. Street Development Evaluation Report can be comprised with some essential items like;

- ⇒ Introduction
- ⇒ Evaluation Findings (supported by evidence)
- ⇒ Lesson Learned
- ⇒ Recommendation
- ⇒ Annexures

Information should only be included in the report if it significantly affects the analysis and serves to clarify issues. Regular progress report (Table 5-1) and target-based progress report (Table 5-2) may include in that evaluation report.

Monitoring and Evaluation of Target based Street Development Activities

Table 5-1: Regular Progress Report

June, 2018

Fiscal Year: 2017-2018

Sl.	Street ID	Scheme Name	Implementation Duration as per Contract		Extended Time	Progress	Brief about Incomplete Part	Remarks
			Start	End				
1	Primary Street No.-1	Sadar Street (No.-1): Widening and Footpath Construction	June, 2017	January, 2019	--	38%	Land acquisition and footpath construction have completed. Widening works are still pending	
2	Secondary Street No.-4	Repair of College Road	December, 2017	January, 2018	May, 2018	50%	Drains and footpath beside the streets are yet to be completed.	

Table 5-2: Target based Progress Report

Fiscal Year: 2017-2018

Report Period*: June, 2018

Sl.	Street ID	Scheme Name	Yearly Target & Progress		Quarterly Target & Progress								Reasons for not achieving the Target
			Target (%)	Progress (%)	1 st Quarter		2 nd Quarter		3 rd Quarter		4 th Quarter		
					Target (%)	Progress (%)	Target (%)	Progress (%)	Target (%)	Progress (%)	Target (%)	Progress (%)	
1	Primary Street No.-1	Sadar Street (No.-1) Widening and Footpath Construction	50	383	5	3	15	20	20	10	10	15	
2	Secondary Street No.-4	Repair of College Road	100	570	100	05	25	20	4075	425	250	25	Delayed due to illegal encroachment on drain

* Reporting month means latest month, progress of that month are presented

f. Connections with other Transports mode (Rail/Air/Water):

g. Tentative cost of the proposed road and source of fund:

04. Information regarding Land Ownership:

- I. Information regarding land ownership to be used for the proposed road (as per the Latest Khotian),
- II. Whether the owners of the land to be used for the proposed road are agreed or not?
- III. Whether any case/dispute (civil/criminal/revenue) has filed regarding the land to be used for the proposed road or not?

05. Following documents are attached with this application

- a. Cross-section of the proposed road,
- b. Mouza map showing alignment of the proposed road,
- c. Short description of existing and possible future use of the land adjacent to the proposed road,
- d. Documents regarding land ownership of the proposed road,
- e. Consent letter of the land owner(s) of proposed road,
- f. Certification of the owner(s) about no case/dispute (civil/criminal/revenue) has filed regarding the land to be used for the proposed road,
- Original copy of the application form purchase receipt.

I/We declared that all information provided in this application, as per my/our knowledge, are correct. In this circumstances, requesting to provide the road construction approval.

Applicant's Signature (1) :.....

Name:.....

Date:.....

Applicant's Signature (2) :.....

Name:.....

Date:.....

Annexure 2- Paurashava Field Verification Report on Approving the New/private Street Construction

Form 'B'

.....Paurashava,District

Engineering Department

Paurashava field verification report to approve new/private street construction

Name and designation of the visitor:

I am the signatory, have visited following site onand collected/verified information regarding the site that has given below through observing and verifying information provided by the applicants:

Alignment of the proposed road:

Ward no.:, Para/Maholla:

Sl. no of the Application:, Receipt no. of date of form purchase:

Field verification report on provided information regarding Location of the proposed Road:

Criteria	Observation (Yes/No)	Remarks
Information regarding the location of the proposed road mentioned in the application found correct.		
Description of proposed road mentioned in the application found correct.		
Documents attached with the application found correct.		

Effectiveness of the proposed road to Paurashava's overall development:

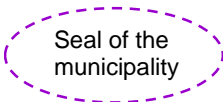
Criteria	Observation (Yes/No)	Remarks
The proposed road, so far my knowledge, found compatible with Paurashava Master Plan/Development Plan.		
The proposed road, so far my knowledge, found compatible with Development Plans of other development authorities.		
RL of Proposed street shall be above the Highest Flood Level (HFL) (If construction of the proposed road not possible to construct above flood level, in that case, acceptable solution that mentioned in the design need to be mentioned in the remarks columns)		
Any scope to construct future utility services at both underground and surface level.		
No objection from neighborhood/any development authority regarding construction of the proposed road.		
During construction of the proposed roads, is there any possibility creating financial liability of Paurashava?		

Signature and Date

(Name:)

Field Inspector (Work Assistant/Sub-
Assistance Engineer/ Assistant Engineer)

Annexure 3- Sample of Authorization Format to approve New/private Street Constructon

 Form 'C'

-----Paurashava, -----District

Ref No.: Date:

Mr./Ms.
.....

Subject: Regarding approval/clearance of road construction

Considering your (s) application dated onapproval/clearance letter for the proposed road located in Paurashava area is given with terms and conditions.

1. Road alignment:
2. Street length:
3. Width:
4. District:
5. Thana:
6. J.L. No.:
7. Mouza:
8. CS/RS Khatian No.:
9. CS/RS Plot No.:
10. Paurashava's Ward No.:
11. Para/Maholla Name:

Terms and Conditions:

1. The Street must be constructed according to the alignment specified in the Application;
2. All expenditures regarding this street construction should bear by the Applicant(s);
3. Should inform a construction plan with mentioning start and ending time of the construction earlier than the commencement of construction work;
4. Should follow the Purashava specified standard while construction of the Street and later on it's repair;
5. For the sake of supervision and quality control, Engineering Department of the Paurashava should be notified at every step of the construction;
6. Officers of the Engineering Department of Paurashava can inspect the street construction works at any time and development related information should be provided to the inspector/visitor; and
7. After completion of the construction, should notify immediately to the Engineering Department of Paurashva in written about the completion.

Paurashva deserves the right to cancel this approval at any time if found disorder of all or any one of the mentioned terms and conditions or found the proposed street incompatible with the development plan to be prepared in future by other development authorities.

Signature and date
(Name:)
Mayor, Paurashava

Annexure 4- Evaluation Report on the Newly constructed street

Farm 'D'

-----Paurashava, -----District

Engineering Department

Evaluataion Report on the New constructed Street

Name and designation of the Authorize person:

As per instruction of the section head, I the undersigned, have visited/inspected construction works of the on going/completed street as per street development approval/clearance no.: dated: I have submitted this report based on that inspection.

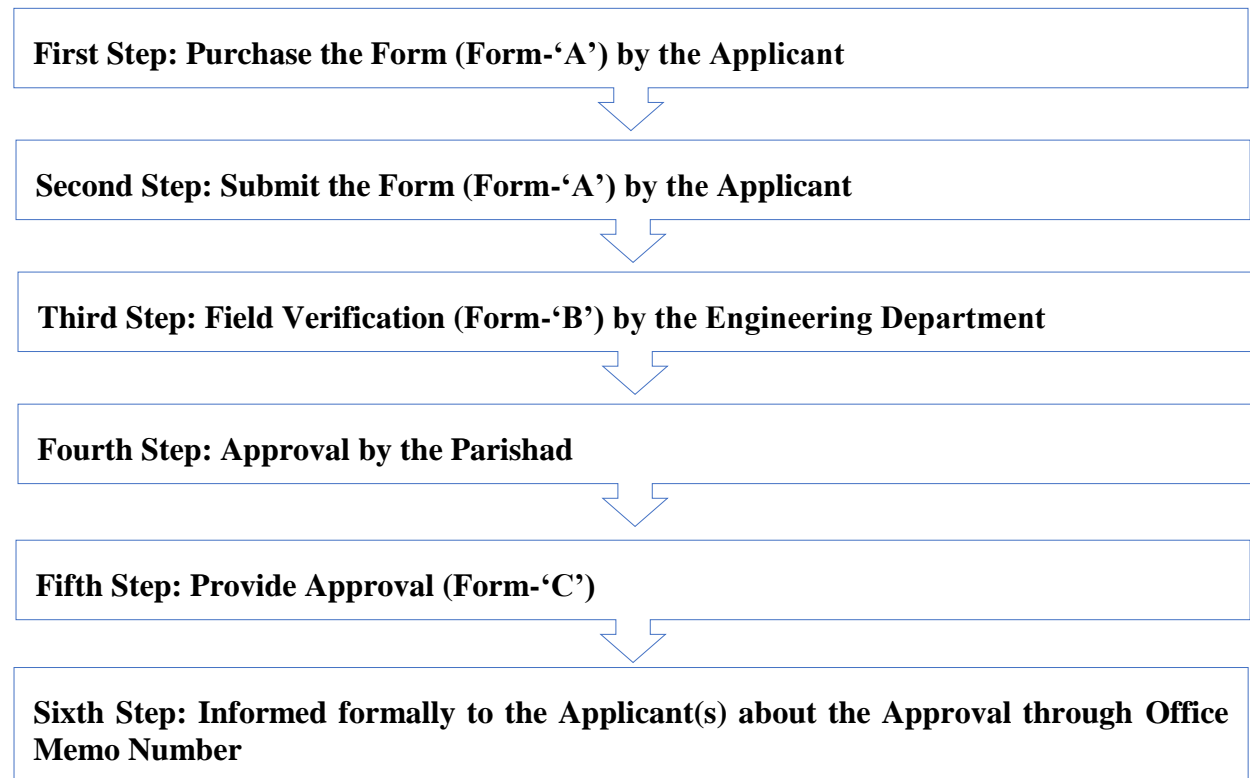
Observation Issues	Observations (Yes/No)	Remarks
1. Construction works of the street has been implemented as per approved alignment.		
2. Right of Way of the street found correct as per approval.		
3. Width and alignment of footpath found correct as per the approval.		
4. Construction works of the street is going on/has been completed as per approved cross-section		
5. Street light found correct as per approval.		
6. Width and alignment of constructed drain found correct as per approval.		
7. Height (RL) of the street found correct as		
8. There has scope to provide future utility services		
9.		

If one or more answer found no/negative, then necessary remedial measures can be taken through providing show cause letter to the applicant.

Other comment (if any):

Signature and Date
 (Name:)
 Assistant Engineer/Executive Engineer

Annexure 5- Steps to be followed in Approval Process



Annexure 6- Good Practice on Infrastructure (Street and Drainage System) Development

Good Practice on Infrastructure Development

Trainings on both 'Street Development' and 'Drainage System Development' have provided to the Mayor, Councilor (Chairman of Urban Planning and Citizen Service Development related standing committee), Engineers, and (work) assistants of Kanaighat Paurashava. After participating in training, some positive changes were noticed among mayor, councilor and the concerned officials of engineering division of the Paurashava.

With the support of Ward Councilors, asst. engineer started to prepare of existing networks both for street and drainage system. Unique identity, name, information on existing situation and its importance have mentioned in the Inventory lists and the base map was aligned with the inventory list. To prepare a future network map (both for street drainage system) Paurashava has started to follow the prepared base maps. According to the guideline mentioned in the handbook, engineering division is now trying to follow the direction of hierarchy based Right of Way for gradual extension of exiting Street-Width during construction and re-construction of Paurashava streets. Understanding the trend of future urban growth and requirements to meet the demands of drainage system developments they are trying to protect the natural drainage system also. Besides of those activities, Paurashava has taken initiatives to apply priority-based scheme selection for the development works following the directions mentioned in the handbooks.

As a part of follow-up activities a team of consultants (infrastructure) used to visit Kanaighat Paurashava regularly and have guided Paurashava concerned officials about the process to follow relevant handbooks during developments of street and drainage system. SPGP team consulted with the Mayor, Engineers and Councilors about decisions making process regarding selection of priority-based development schemes to achieve integrated developments on Paurashava infrastructures (Street and drainage). The Engineering Division is now able to prepare and regular update the network map by ensuring ID for each of the streets and drains along with necessary information based on existing situation as well as following the future demands also. That information will help to find out missing links by analyzing existing situation and future land use direction to establish the future network plans. That information will also support during preparation of drainage system development by analyzing the functionalities of existing drainage system identifying the catchment area, water logged areas, current and future uses of natural drains, etc.