

# Green Urbanism: Adopting Sustainable Transport in Phuntsholing City

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DOI: <https://doi.org/10.17102/bjrd.rub.10.2.021>

## **Abstract**

The world today is facing a major crisis in energy, environment and climate. Human activities such as building, transportation and industries have caused tremendous impact on the natural environment. The irreversible growth of cities is an indication of more cars on the road, more mobility and ultimately to more energy consumption. The expansion of urban areas leads to the development of transportation routes and increase in the number of vehicle ownership. Bhutan has opened its doors from being a landlocked country to an internationally recognized country. Trade and industry have become an important sector in building the country's economy, with rapid infrastructure development. The realization of the energy crisis is as new as the urbanization trend although there is dire need to adopt green energy practices. This study explores various strategies based on the concept Green Urbanism, specified to the topic, Sustainable Transport. It presents the current transportation trend in one of the major cities of Bhutan to highlight the growth pattern and their issues that could possibly threaten the energy balance. The main emphasis is on how the issues can be solved with sustainable strategies to achieve a livable city.

**Keywords** – *Green Urbanism, Sustainable Transport, Phuntsholing, Pedestrianization.*

## **Introduction**

The influx of extensive construction and expansion of the transportation sector is threatening the energy balance the world is fighting for. Bhutan is

witnessing a rapid growth in urbanization with major infrastructure development in many parts of the country. The realization of the energy crisis in Bhutan may not be deemed as a late lesson as development started only during the 1970s. However, there is a need to implement green energy practices in various sectors such as building, industrialization and transportation. Transport sector is one of the major consumers of energy in Bhutan next to the building sector (Department of Renewable Energy, 2015). Evidently, the fuel consumption in the transport sector increases on an average of two folds for all fuel types (Department of Renewable Energy, 2015). Transportation is the most important backbone of urban mobility and thus requires major strategies for its sustainability.

The rapid and irreversible urban growth has led to the cities overlooking an urban standard for green and sustainable design. In fact, there is no adequate resources and standard planning which results in poorly managed urban fragments and the city on the whole. The ultimate result of all these, is haphazard transportation systems, unhealthy neighborhoods, unplanned street networks and lack of social spaces hindering the social cohesion of the city.

Phuntsholing is one of the biggest cities, known as the Gateway of Bhutan, located on the southern borders of Chhukha dzongkhag. It connects Bhutan to India through the Indian bordertown of Jaigaon, where major import and export of goods take place. Phuntsholing is thus known as the commercial hub of Bhutan, being the center for major trade activities in Bhutan. It has seen a tremendous development over the years due to rapid commercialization and industrialization which is leading to the demand for better transportation, housing and institutions.

Phuntsholing is well connected with other Dzongkhags of Bhutan through the national road network. The city has grown organically over the years and therefore, has no geometric planning system (Phuntsholing Thromde, 2004). The land use and transport system has been observed to be incompatible in terms of circulation and service delivery. In the proposed Development Plan, the urban transport system is treated as an integral part of the total urban system so that it would play a positive role in the overall development of the City and its surrounding Region

(Ministry of Works and Human Settlements, 2017).

Table 1 Number of vehicles registered in Bhutan (Source: RSTA, 2020)

<b>Sl. No</b>	<b>Region</b>	<b>Total</b>
1	Thimphu	59,405
2	Phuntsholing	37,417
3	Gelephu	7,410
4	S/jongkhar	5,452
5	Mongar	2,374
	Grand Total	112,058

According to the Phuntsholing Urban Development Plan (PUDP) 2002 to 2017, there has been an increasing car ownership and usage, resulting in the need for road upgradation, improved traffic management and parking facilities. In fact, Phuntsholing shares 33.4% of the total number of vehicles in Bhutan, being the second highest in the country after Thimphu (Ministry of Information and Communications, 2020). The number of car ownership in Phuntsholing has increased rapidly since the year 2000. The increase in motor vehicles is almost 6 folds in the span of 20 years, increasing every month by an average of 0.7 % rise (Ministry of Information and Communications, 2019).

There is a major increase in the ownership of light vehicles (LV) owing to 56 % of the total number of vehicles in Phuntsholing (Annual Info-Comm and Transport Statistical Bulletin, 2019). This is an indication of increase in private ownership of motor vehicles.

Besides the alarming rate of increase in the number of motor vehicles, there are other challenges that hinder sustainable transport in Phuntsholing. One of the aspects lies in the structure of the city itself. The urban planning of Phuntsholing is rather an organic expansion of industries and shops that evolved with the unprecedented development in trade (Ministry of Works and Human Settlements, 2017). The city's

structure plan report also addresses the absence of proper linkage to surrounding areas like Karbeytar, Damdara and Amo Chhu (Phuentsholing, Thromde, 2013-2028). There is an urgent need to upgrade these roads as these areas are now in demand for new residential accommodation.

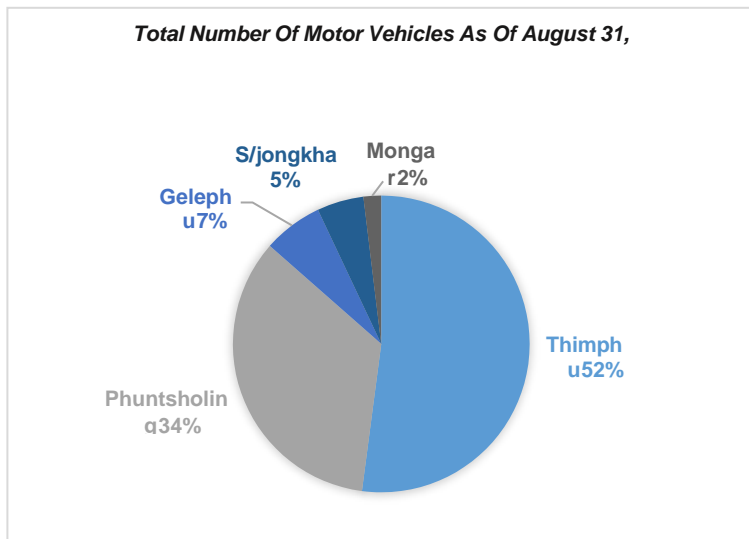


Figure 1 Total Number of Vehicles in Bhutan, (Source: RSTA, 2020)

The absence of road geometries in Phuntsholing has been considered as one of the major causes for the typical transportation issues seen in hilly areas (Phuentsholing Thromde, 2004). The existing road network is found to be inadequate in terms of capacity, quality and connectivity. If the current trend in the transport sector continues, it is viable that Phuntsholing will witness major traffic issues, road deterioration and energy crisis. Therefore, there is a dire need to adapt a sustainable practice in transportation to achieve a livable city.

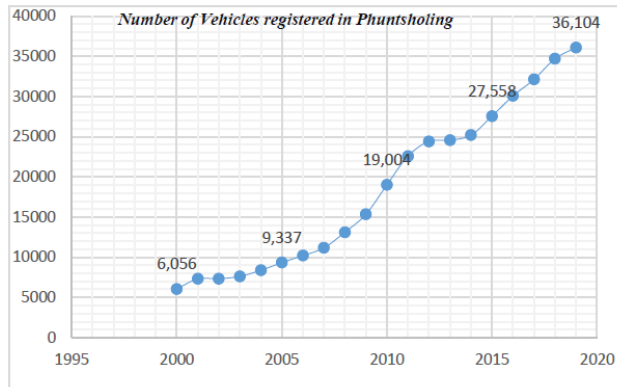


Figure 2 Chart showing the increase in motor vehicles since 2000 (Source: RSTA, 2020)

Green urbanism is an evolving concept in the world today. Every nation is trying in their own ways to mark an end to unsustainable developmental activities and shifting their ideal city image to a green and eco-friendly one. In doing so, they have managed to come up with different strategies for underdeveloped, developing and developed countries. Therefore, all those strategies should be adopted as the guiding principles to modify cities and towns of Bhutan; the scope of this project is being limited to a particular zone of Phuntsholing city.

The main aim of this study is to adopt the strategies of sustainable transportation in Phuntsholing city to create a livable and coherent society. This is done firstly by studying the transportation system that exists in the city so that it provides a background to the existing situation. The issues concerning transportation are identified and examined thoroughly through maps, data and figures. One of the most important aspects is to observe the behavioral trends of the people in the city through the traffic analysis in different nodes of the city. This provides the basis for the modal share of choice of means of transportation for various purposes ranging from work to leisure. Finally, this study provides a set of recommendations for the city to adopt the strategies for sustainable transportation. It presents the possible outcome of each recommendation through planning and strategies.

## **Green Urbanism: *Concepts***

Green urbanism is the term used to describe cities or settlements which are sustainable and adopt energy efficient measures within their environment. Cities adopting green urbanism are focused on utilizing renewable energy, reduction of carbon emission and being a carbon neutral city (Newman, 2010).

Sustainable transport system is defined as the transportation system that uses renewable and nonrenewable resources without exceeding the regeneration rate and rate of development of sustainable resources and limited emission that do not exceed the capacity of the environment (Vashisth, Kumar, & Sharma, 2018). Sustainable transportation must provide safe and easy accessibility to commuters with various modes of transportation that provide less emission to the environment. (Mohan & Tiwari, 1999).

## **Technological Solutions for Sustainable Transport System**

### **1) Non-Motorized Transport in Guangzhou, China**

Guangzhou, is a rapidly expanding city in the south of China. In 2011 it was awarded Sustainable Transport Award (ITDP, 2011) for its high performance in energy efficiency by adopting the BRT network. Its biggest achievement was providing the people with a high level of infrastructure for implementing bicycle facilities and also introducing bike sharing. Such innovative moves toward sustainable transportation have helped in improving car-free public spaces in Guangzhou.

### **2) A Proposed Sustainable Transportation and Urban Mobility Design**

Transportation issues in the streets of metro Manila, Philippines, have been identified and determined which lead to a comprehensive urban

mobility design. In this design, certain aspects were covered such as User priorities, Cyclist and pedestrian environment and Carriageway width.

## Sustainable Transportation in Phuntsholing City

### A. Area of Study

The area of study is based in Phuntsholing, the second largest town next to Thimphu. The city developed as quite later to Thimphu, although it existed way earlier as a border town to the Indian town Jaigoan. The first Urban development plan was formulated in the year 2002 and the Structure plan in 2013. The growth of the city and the opportunity in further development seeks for a sustainable approach which is the reason why the area has been chosen for study. Most studies and research on urban transport are focused on the transport issues in the core area, which is known to be the only substantial urban space in the city (JICA Report, 2014). Therefore, this particular study focuses on the industrial zone which lies in the radius of 1km from the core of the town.

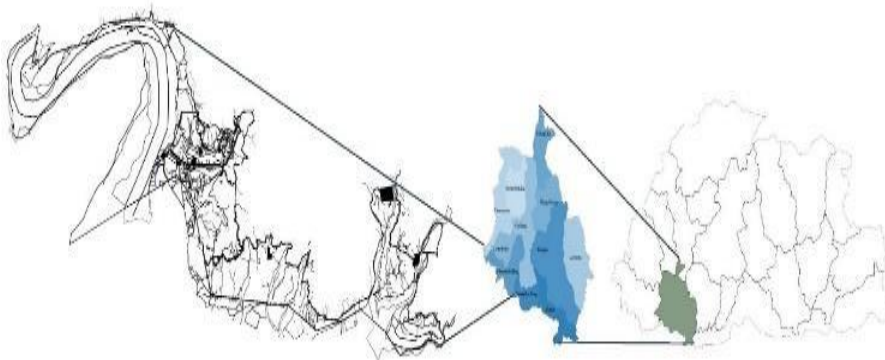


Figure 3. Area of Study: Context (Source: Phuntsholing Thromde, 2005, Composed by Author)

## Urban Transport

### 1) Road Network

Phuntsholing is located on Asian highway which connects India and inland Bhutan. Phuntsholing being the central business district is connected to almost all the dzongkhags. The business and commercial activities are concentrated within the core of the town which has direct accessibility to the neighboring border town. Within this region the vehicular movement is very rapid and constantly moves in and out of the city directing towards various directions.

The capacity of a particular stretch of a road depends on road and traffic characteristics. Most of the roads are single lane and the traffic composition comprises heavy vehicles, medium and light vehicles. Taxi plays a major role as a transportation option along all roads of Phuntsholing. The national highway passing right through the core of the city is sandwiched between residential and commercial buildings. This leaves no place for expansion or widening of the road and parking facilities also can't be accommodated alongside the highway.

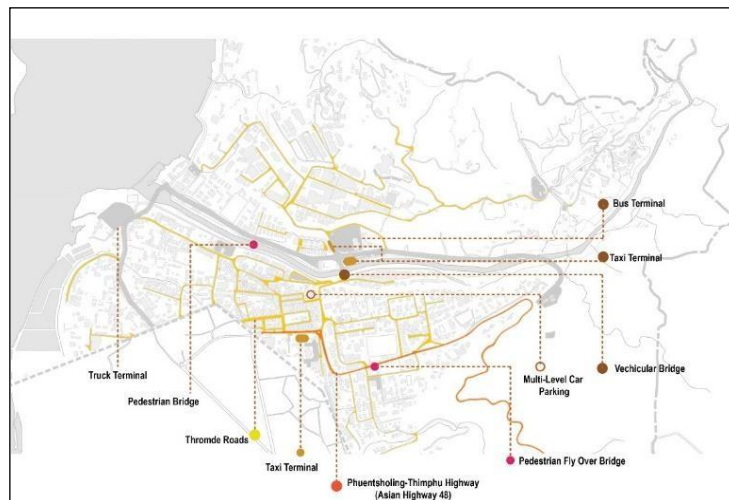


Figure 4. Road Network, Source: Author, 2019



## 1) Traffic Characteristics and Pedestrian Walkways

Transportation and traffic congestion in Phuntsholing have only accelerated over the years. Some of the conditions like inadequate public transport, roadside encroachment, and parking problems have further added to the issue of traffic congestion to Phuntsholing town. Other factors that lead to such conditions are the undeniable effect of rapid urbanization, urban sprawl and increasing import of vehicles in Phuntsholing. Referring to all the alarming conditions it can be concluded that the number of various types of vehicles may double within next two decades (JICA Report, 2014). This pattern of increasing traffic in the city results in a high rate of fuel consumption and deteriorated urban conditions. The pedestrian network of the city is shown in the map below. It features the existing footpath, proposed footpath and the connectivity with the overall road network.

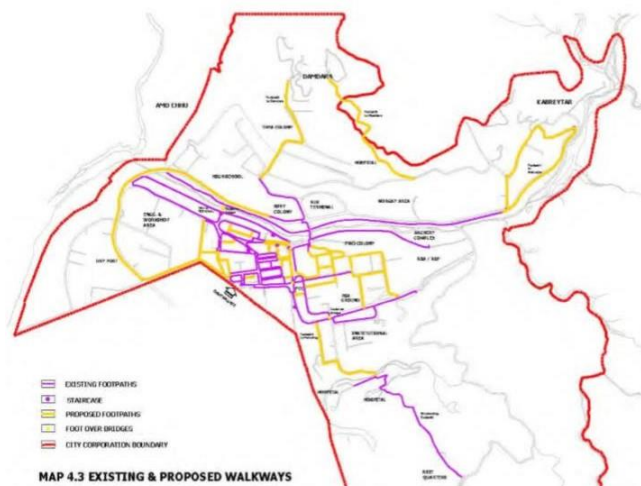


Figure 5: Pedestrian network, Source: PUDP 2013-2022

## 2) Modal Split

The compact urban structure and confusing road networks has made it inconvenient for vehicles to have smooth flow within the town region. Out of all the modes of transportation observed in the town the use of bicycles is the minimum with only 3% people opting for it. However, the use of bicycles is only for leisure purposes rather than as a mode of transportation (JICA Report, 2014). Moreover, there is no bicycle infrastructure in the town to support such a system as a mode of transportation.

Altogether, the absence of bicycle routes and lack of well-maintained and continuous pedestrian networks leads to concentration of traffic towards motorized vehicles. This ultimately results in traffic congestion and unsafe urban areas for pedestrian and urbandwellers.

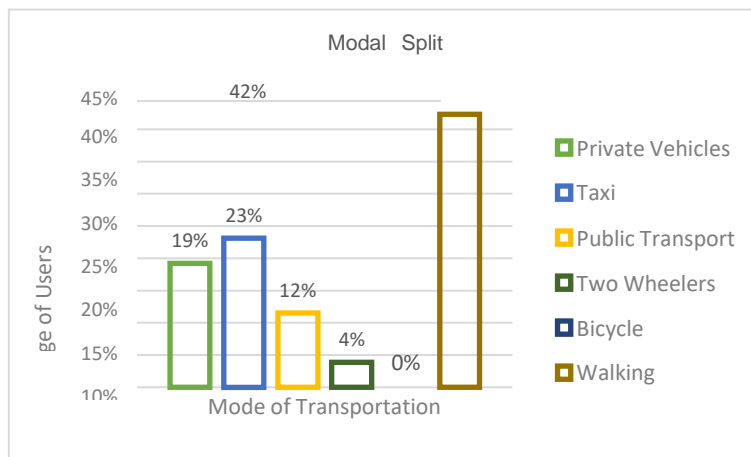


Figure 5: Modal Split, Survey, Authors

The above chart is the result of a survey carried out in the zone of study. In the survey 26 people were considered from different parts of the zone of study and consisted of various income groups of people. As per the chart, the majority of the people in this zone use walking as the mode of transportation.

## Data analysis

### A. Existing Transportation Infrastructure

#### 1) *Pedestrian Walkway*

In the areas of the industrial zones, the road widths were 5m wide with a narrow footpath of 1m. However, in some of the areas such as in the main primary road, the roads were 18m wide enough to accommodate bicycle lanes. Children, elderly people and physically challenged people have the toughest time if the walkways are not up to standard. Lack of proper walkways has hence encouraged a greater number of vehicle users.

#### 2) *Bicycle Lanes*

The site lacked infrastructure development for cyclists which has surged the number of vehicles and it is a potential cause of traffic congestion in the region. There are no bicycle lanes in Phuntsholing. According to the result of a traffic survey in this study, 13 % of counted vehicles are motorcycles in Phuntsholing, out of which 10 % belongs to the Indian individuals who travel daily to Bhutan for work (Phuntsholing Thromde, 2004). Therefore, the bicycle usage is bare minimum accounting to only 3 %, which is observed to be fairly for leisure rather than a modal choice of transportation (JICA Report, 2014).

### B. Traffic Survey

The Traffic Analysis has been done around different nodes of the area of study. The chart below shows the combined traffic concentration around nodes 1, 2 and 3 for particularly the modes of transportation namely heavy vehicle, medium vehicle, light vehicle, two-wheeler and bicycle. From the survey it was observed that the most frequently spotted mode of transportation is light vehicle followed by heavy vehicle while the use of bicycle was observed to be zero. It can be concluded that the preference given to bicycle or energy efficient mode of transport is negligible.

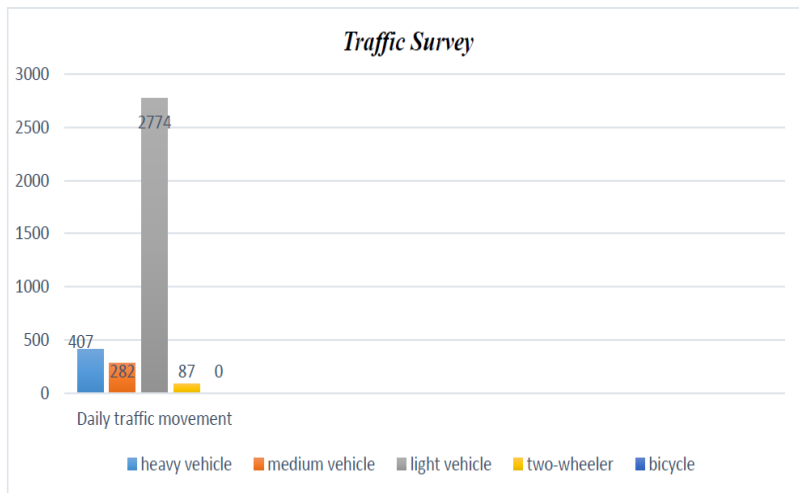


Figure 6 Traffic Survey, Authors

## Recommendations

### A. *Pedestrianization*

The main aim of pedestrianization is to provide safe and accessible pedestrian infrastructure. The impacts of pedestrianization can be grouped into three categories environmental, economic and social impacts. Pedestrianization in the selected zone can be achieved through traffic calming. The proposal includes widening of existing pedestrian pathways, improving the condition of existing pedestrian pathways, improving the safety measures required for the pedestrians and considering the needs of the people with disabilities.

### Widening of Existing Pathway

The existing width of the pedestrian pathways were inadequate and lacked provision for the people living with disabilities. The width of the

existing pedestrian pathway measures to 1.5m along the main highway and 1.0m-1.2m along the road in the industrial zone. The minimum width required for two wheelchairs to pass each other is 1.8m. Therefore, the existing pedestrian pathway is proved to be inefficient for people living with disabilities.

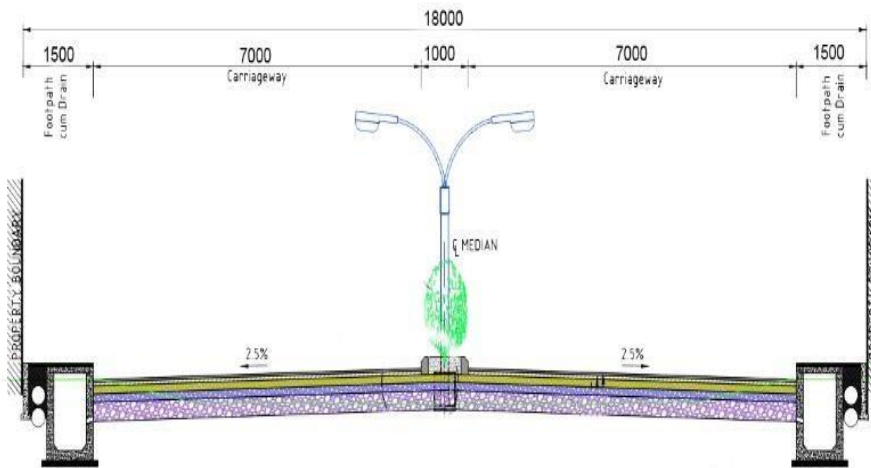


Figure 7: Section of the road along the highway

The proposed plan includes categorization of road into primary road and secondary road according to the width of the vehicle lane. The road with its vehicular lane more than five meters is considered primary while the roads with its lane width less than 5 meter are considered secondary roads. The identification of primary road and secondary road in the area of study is shown in the map given below.

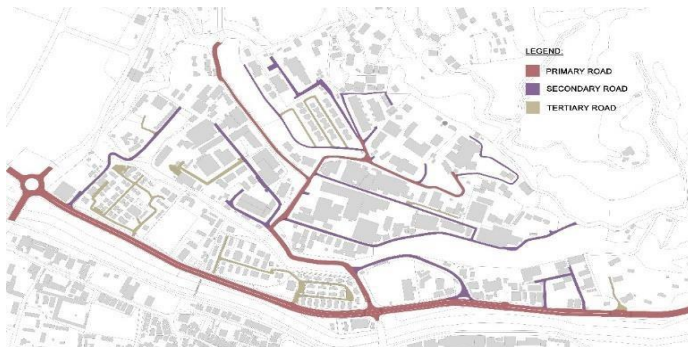


Figure 8: Map showing the road categories

The width of the pedestrian pathway along the main highway is increased to 1.8m. The pedestrian pathways are elevated at height of 250mm from the road and separated by L-shaped drain of width 500mm in order to ensure safety of the pedestrian. Along the primary road in the industrial zone, where the road width is 10m, the road is divided into vehicle lane and pedestrian lane with bicycle lane. The width of the vehicular lane is reduced to 7m which was initially 8.8m and the pedestrian pathway is widened to 1.7m provided along with a bicycle lane of 0.8m width. The bicycle lane and the pedestrian lane is elevated to a height of 150mm from the road surface separated by a curb of 500mm.



Figure 9: Section through road in Industrial zone

### Improving the conditions of Walkways

A properly linked and well paved pedestrian with proper signage is proposed. Dumbleinterlocking pavers are proposed for the pedestrian pathways. A porous pavement of 5mm gap between the blocks helps seepage of surface water and reduces the surface runoff. Proper pedestrian crossings are provided near the schools and bus stops.

## A. Bicycle Lanes

The following is the master plan of the proposed road interventions shown on three different roads. The road is sloped at an angle of 2.5 % on both the sides to channel surface water runoff towards the drain. The following three roads are considered due to its interconnectivity to other sites as well as to other districts outside the site.

1. Road 1 is a 18m wide road which will route heavy traffic out of the town without disturbing the traffic within the city.
2. Road 2 is a 10m wide road which serves as a tertiary road which joins the main Phuntsholing-Samtse highway.
3. Road 3 is 7.6 m wide, and it connects Kabreytar area located at a distance of 1.2km away from RSTA.

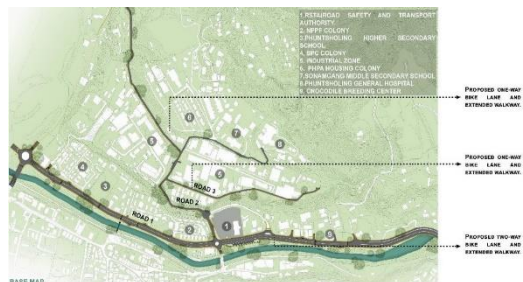


Figure 10: Base map showing the proposed bicycle lane

### Road 1

Two-way bicycle lane is provided at primary road 1 which runs on both sides of the road. The road is provided with an interchange of lanes. The lane is designed along with a channel gully that directs the water towards the main drain.

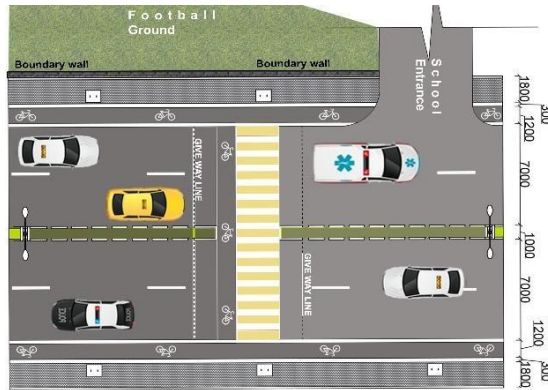


Figure 11: Road Details, Authors

The cycle lane is provided with even surfaces without any obstructions to assure a safe and comfortable walkway. This road is provided with a double lane bicycle running on both the side of road to allow users to experience the river views as well as the occupants near the site can use it.

**Road 2**

Road 2 is provided with a single bicycle lane running on one side of the road buffered with a 50cm wide planter box which acts as a bioswale. The 80cm wide bicycle lane is provided along with a 1.7 m wide pedestrian walkway, and a channel gully along the edge of the lane to collect surface runoff water



Figure 12. Road Sections, Authors



### Road 3

The road is a 7.6 m wide road with a buffered bicycle lane of 600mm wide and an open L-drain at its edge to channel the storm water. This road connects to Kabreytar, thus it is provided with a bicycle lane as well as pedestrian walkway to encourage non-motorized way of transportation. The road surface is inclined at an angle of 2.5% to prevent stagnant water formation and to channel storm water to the drain. Some of the water will seep through the porous pavement and recharge the groundwater. The drains are designed using a height to width ratio of 1:3.

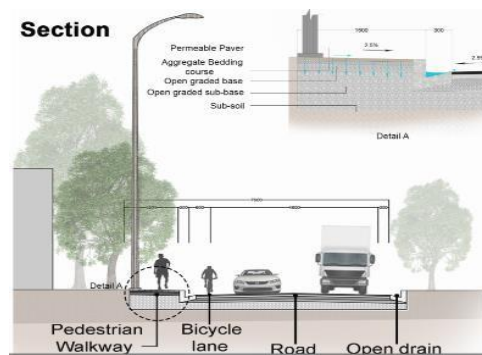


Figure 13. Road Sections, Authors

### Acknowledgment

This study is a collaborative work of the group under the guidance of Mr. Chimi, our module tutor. We are truly grateful for the constant guidance and suggestions, and for never failing as the guide rather, being the best. Mr. Chimi has always been insightful and open to any sort of discussion regardless of the possible lunacy we might have presented. This topic would have been merely a success without his support. Our sincere thanks also go to Ms. Sehba Saleem for finding time to answer the questions we had during the study. We would also like to thank the Phuentsholing Thromde, for providing us with the necessary information and data.

We extend our heartfelt gratitude to all our friends who have always been open to discussions and suggestions throughout our study notwithstanding the time and energy. This study would not have been possible without the collaborative support of all the mentioned individuals.

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### About the Authors

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**Dhan, Karma, Kinley and Sonam** have a bachelor's degree in Architecture from College of Science and Technology. This study was carried out as an analysis for an urban design project during their final year. They worked under the guidance of their tutor Mr. Chimi, who also shared their interest in the possibility of pedestrianizing Phuentsholing city. Mr. Chimi has a Master's degree in Architectural Design and a bachelor's degree in Architecture. The authors have a shared interest in the concept of Green Urbanism and how the principles can be applied in the sustainable planning of cities.