vision of

mumbai - the bicycle friendly city

bicycle masterplan & design guidelines for central mumbai

diploma work
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Lina Hellström
Diploma work, 30 credit points
Master’s program of spatial planning,
Blekinge Institute of Technology, Karlskrona
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Mumbai – the city of contrasts, is home for more than 20 million people. It is the financial centre and the most modern city in India.

As most cities within developing countries Mumbai is striving to imitate the western model of growth and lifestyle to achieve a “developed” status. Motorization, especially private motorized modes, has become prioritized because they are seen as a big part of this development. This neglecting has also led to a significant prejudice against bicycle riding as a transport mode.

Over 300 new cars are registered every day in the city. Not only is congestion a big problem but pollution from vehicles are posing serious threats to peoples health and to the environment. 88% of the population is using public transport today but with a larger growing middle class, ready to buy private vehicles, traffic related problems are likely to worsen.

The gap between rich and poor is increasing, parts of the population can hardly afford to use the public transport system. Even though Mumbai is claimed to have the highest income per capita in India, 40 % of the inhabitants are still living below the poverty line.

There are many aspects in society that could have a positive effect if a well working bicycle infrastructure were to be developed in Mumbai. Bicycling is not something new in India, bicycles have been used for a long time both for commuting and transporting goods. India is the second largest producer of bicycles in the world.

3% - 7% of all trips are done by bicycles in Mumbai today but studies shows a sharp decline in bicycle journeys over the past two decades. It is likely that bicycles will disappear from the streets in less than a decade if no actions are taken from the government.

Six goals have been chosen to look at in this thesis, they are; Equality, Safety, Mobility, Urban life, Environment and Health. Some facts under each goals are presented and it is explained how a well working bicycle network could improve some aspects under each goal.

Design standards of how bicycle facilities should be constructed and an illustration of a bicycle masterplan is proposed based on interviews with the public, literature studies and analyzing of the existing roads. Recommendations on how to work with changing prejudices against bicycling and how the planning of a bicycle network could be implemented are given.
This thesis is the last part of the program for spatial planning at the Blekinge institute of technology in Karlskrona, Sweden. It covers one semester, 30 credit points, and was carried out from September 2010 to May 2011.

This project was able to be carried through by the help of a scholarship from SIDA. The Swedish Board of International Development Cooperation Agency (SIDA) support projects around the world in order to primarily reduce world poverty. I had the privilege of being assigned a scholarship from SIDA to make a Minor Field Study (MFS) in a developing country, in this case Mumbai in India.

Together with my classmate Oskar Bergström I went to Mumbai in the beginning of October 2010. While he was concentrating on studying a smaller neighborhood in Mumbai I decided to make a proposal for all of central Mumbai. We returned back to Sweden, at the end of December 2010, after an amazing and inspirational trip.

I would like to thank my tutor in India Faizan Jawed at I-TRANS, my tutor in Sweden Gunnar Nyström at Blekinge Institute of technology, my tutors in Copenhagen Lin Skaufel and Jeff Risom at Gehl architects and all others that have helped me with this assignment, both in India, Sweden and Denmark.

Lina Hellström
2011-05-03
PART I
work progress, introduction, bicycling in mumbai today
Aim of the thesis
“Vision” is synonymous with the words utopia, scenario, fantasy or revelation. The aim of thesis is to reach this vision, which is “Mumbai – the bicycle friendly city”. This is done by first explaining why a bicycle network would be a good idea in Mumbai, analyzing the study area, propose design standards for the bicycle facilities, propose a bicycle masterplan and finally suggest how all this could be implemented. If this project were to be developed, it would take several years to achieve, hopefully Mumbai would transform into a bicycle friendly city. 1

Goals
The reason for purposing this thesis has been focused on six different goals that are believed to be improved if Mumbai was turned into a bicycle friendly city. The different goals are; safety, mobility, equality, urban life, environment and health. To be able to fulfill the overall vision alls these goals should be improved or have been taken in consideration somehow. In part II all goals will be described further and it will be argued how they could be improved if a well working bicycle network were to be built.

Study area, inventory, interviews, categorization and inspiration
After describing the study area and the different goals the analysis of the area will be shown in part III. This part consist of an inventory of the area, categorization of roads, interviews with the public and looking at other cities for inspiration. The result from this will be the base on how the design guidelines and the masterplan are designed.

Design guidelines
The design guidelines show how the standard bicycle lanes and facilities should be constructed within the study area.

Implementation, masterplan, conclusions
In this part it is described how the implementation of a bicycle infrastructure should be carried through in Mumbai, how this idea could come to real life and which actors that would have to work together in order to create a bicycle network.

Finally is a suggestion of a bicycle masterplan of Mumbai presented. Some conclusions and final thoughts of the project are also found here.

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1 vision. www.ne.se/engelsk-ordbok/vision/524124,Nationalencyklopedin, gathered 2011-02-28
PART I

“Mumbai - the bicycle friendly city”

urban life  health  environment  safety  equality  mobility

PART II

goals, background, why bicycling?

PART III

study area, inventory, interviews, categorization, inspiration

PART IV

design guidelines

PART V

implementation, masterplan, conclusions
Mumbai, also known as Bombay, is the capital of the state Maharashtra and it is the most populous city in India. The city is situated on the west coast of India on an island that is connected by bridges to mainland. The city’s main commercial and cultural centre is situated in the southern parts of the island. Along with the neighboring areas Mumbai is considered as one of the most populous urban regions in the world, with a density as high as 29 000 people/km² in some areas.

Mumbai, a city of contrasts, is home for more than 20 million people. It is the financial centre and the most modern city in India. Even though Mumbai is claimed to have the highest income per capita in India, 40 % of the inhabitants are still living below the poverty line. ¹

History
Mumbai was initially a group of seven islands that were colonized by Portuguese explorers in 1534. They built several forts and churches but didn’t relies the city’s value and gave it away as a gift to the Charles II of England in 1661.

The Islands were later, in 1668, leased to the East India Company and soon developed as an important trading post.

During the 18th and 19th century the city grew fast. Constructions such as various buildings, offices, railways stations and banks were introduced in the city. The seven islands where coupled together in 1862, because of the railway.

Bombay flourishes as the Suez Canal opened in 1869. The international port soon transformed the city into India’s commercial and industrial hotspot.

Bombay was declared capital of Bombay state and later in the state Maharashtra 1960.

Bombay was named Mumbai after ‘Mumbadevi’, the patron goddess of Koli fisher folks in 1995. ²

The development of Mumbai today is a mix between the organic and the planned one. The old colonial British-based principles of planning are still present while many newcomers are settling down wherever there is space enough to create their own communities. ³

Climate & Topology
The climate in Mumbai is humid with a temperature between 16 C and 29 C degrees in winter and 23 C and 34 C degrees in summer.

The monsoon last from around mid June to September and Mumbai is the city that receives the most rain during this period in the whole country. Heavy rains in combination with high tides often causes major flooding in the city.⁴

Mumbai is very flat, with an average elevation of 14 m, which makes it suitable for cycling. ⁵

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² http://www.mumbai.org.uk/history.html, 2011-01-10
³ TRIPP, Bicycle Infrastructure Design Manual for Indian Subcontinent, 2009, p. 8
⁴ http://goindia.about.com/od/planningyourtrip/a/indiamonsoon.htm, 2011-04-05
⁵ http://www.mcgm.gov.in/, 2011-04-05
Bicycling is not something new in India, bicycles have been used for a long time both for commuting and transporting goods. India is the second largest producer of bicycles in the world.

The way people use the bicycle in Mumbai is a bit different from how it is used in western countries. The bicycle is mainly used for commuting or recreational trips here while in India many people need the bicycle for work, for example for transporting goods. The bicycle rickshaw is totally banned in Mumbai since it is believed to increase congestion.

There have been different surveys done to try to count how many people that are actually bicycling in Mumbai, the results vary from 3% up to 7% of all trips.

The neglecting of planning for bicycles
Mumbai, as most cities within developing countries, is striving to imitate the western model of growth and lifestyle to achieve a “developed” status. Motorization, especially private motorized modes, has become prioritized because they are seen as a big part of this development. This neglecting has also led to a significant prejudice against bicycle riding as a transport mode in some segments of the population.

A joint study done by the Netherland-based Interface for Cycling Expertise (I-CE) and Indian-based Transport Research and Injury Prevention Program (TRIPP) was conducted in India and some other Asian countries to measure each government’s attitude to cyclists.

India showed a sharp decline in bicycle journeys over the past two decades. There are still a lot of bicycles in India but according to this study it is likely that bicycles will disappear from the streets in less than a decade if no actions are taken from the government.

Bicycle facilities around India
Pune was the first city in India to have dedicated bicycle lanes. There are 80 km of lanes, they were constructed for the 2008 Commonwealth Youth Games. It was initially working well but due to poorly design and maintenance the bicycle lanes have been taken over by motorized vehicles and parked cars.

There is a newly built bus rapid transit system with segregated bicycle lanes in New Delhi. The system is working quite well but in some part you can find parked cars on the lanes or auto rickshaws driving here.

There is one bicycle lane being planned in the suburb of Bandra in Mumbai. A part from this there are no specific bicycle facilities for bicyclists but there are several possibilities within the city that could make the idea of Mumbai as a bicycling city work. In part II, under each goal, are a number of facts and arguments presented to why creating separate bicycle lanes would be a good idea.

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4 Field trip to the bicycle lane in New Delhi, 2010-10-12

10 PART I INTRODUCTION
PART II

goals
goals

Why working with goals?
To be able to concretize this vision six, so called, goals have been chosen to focus on in this project. They are equality, mobility, safety, urban life, environment and health.

The goals have been carefully chosen together with the tutors for this project, from Gehl architects office, as they are areas which could have a positive effect on by a well working bicycle network. These goals are specifically chosen for Mumbai city, working with similar projects in other cities other primary goals might have to be considered that are more suitable for that city’s culture and conditions.

After interviewing professionals in the bicycling field it has come clear that there is only limited research done in this field, especially in India. These six goals are areas where one can find reliable statistics and facts to build arguments on.

In this part the different goals are described and it is argued why bicycling could have a positive effect on these. There are of course more aspects that could have positive, or negative, effects on by the realisation of this project.
Mumbai has the highest income per capita in the country. This financial capital attracts a large number of immigrants looking for work in the city. As space is limited, central Mumbai is surrounded by sea on three sides, real estate prices have risen alarmingly in recent years. South Mumbai has become the 7th most expensive place in the world to buy a home in.¹

All of this has led to large amounts of people living in slums. Slums are informal housing which have developed into community settlements. They are built without legal sanction and therefore often lack basic standards and needs. To be exact 54.1% of the inhabitants in Mumbai live in slums, or informal housing, but the slum areas only occupy 6.1% of the total land. Those who do not live in slums are dependant on the slums for its cheap supply of goods and services.²

One special thing about Mumbai is that poor and rich people live side by side in most areas. People from all different backgrounds live in the same geographical territory but occupy completely different economic, physical and social spaces. The wealthy neighbourhoods are organised while the poor ones develop freely wherever there is a space enough. In the study area the slum area Dharavi is situated. It is the one of largest slums in Asia with around 600 000 inhabitants. But it is not only here that the slum is situated, people are living in informal housing all over the city.

There are some rehabilitation programs going in where developers can rebuild low rise slums into developments where the developer has to give the squatters a place to live and the rest of the development can be sold. In other areas slums are being demolished and people are forced to move to other areas often far away from central Mumbai and work opportunities.³

Transport and poverty
Lack of a well working infrastructure is often a symptom of the inadequacy of the poor’s access to social assets. When people from the lower income groups are forced to move to geographical areas far away from different services access to transport can be limited. This can constrain this group of people participation in labour and product market which can limit their economical income and opportunities. Inadequate infrastructure and lack of affordable transport can contribute to a lack of income and consumption and the inability to accumulate private and social assets.⁴

The public transport system in Mumbai is among the best ones in India but a large part of the population can hardly afford to travel this way. Even though Mumbai has the highest income per capita in the country there are great disparities found here. People who are in the lowest income group, around 10% of the population, are earning less than 20 Rs a day. This is around 0.4 USD, a one way bus ticket costs at least 6 Rs.⁵

Those who are considered as poor (earning less than 5000 Rs/month) are walking and bicycling considerably more than people who are earning more (see table 2.9). By providing a well working bicycle network people, especially from the lower income groups, would have access to a cheap transportation mode. There could also be several job opportunities in the bicycle business such as running bicycle- and repair shops, bicycle rentals, parking guards etc.

² United nations development program Mumbai, p. 55
³ United nations development program Mumbai, p. 56
⁴ World bank, Poverty and Transport, Overseas Development Institute, London, 2000, p. 8-10
⁵ United Nations Development Program Mumbai, p. 154


The Cast system

The Cast system goes back around 3500 years in the Indian society. A cast in this case means belonging to a group of people according to your profession or by your partners cast. The system is based on the Hindu belief that one is born into castes, which determines one’s social status for life. The system was removed by law when India became independent, but it is still practiced and part of the Indian society.

This cultural phenomenon is a large topic of its own. Problems with encouraging people from all backgrounds to bicycle in Mumbai would most defiantly occur. The status of the bicycle in Mumbai today is very low, it is seen as a poor mans vehicle. Investing in a well working bicycle system could be one way of trying to diminish the large inequalities in the city as the opportunities for travelling and finding work increases.

Gender issues

You can not get away from the fact that the Indian society is very male dominated. The gender ratio between men and women are 809 females on 1000 men in Mumbai.

As Mumbai is one of the most modern cities in India you can see women from different income groups working in all kinds of professions but there many factors that still favor men. Around 54 % of the total male population is working while only 11% of the female population is. Literacy is 82 % of men and 72% for women in Mumbai.

Gender and transportation needs

There are some things that separates women’s and men’s need for transport. Women’s transport need and choice of transport mode is usually a mix between institutional processes (gender relations, religious and cultural norms) and structural conditions (geographical location and distances to different services).

As most women stay at home and take care of the home they are expected to do different kinds of chores, usually household chores like shopping, leaving kids at school etc.

The religious and cultural norm of the female seclusion constrains women’s freedom of movement outside the protection of the household sphere. Lack of mobility in the public sphere can reduce women’s economic opportunities by limiting their choice of work location, their direct access to final goods and factor markets and their access to information relevant to their work.

Initiatives

It is more common to see women bicycling in smaller cities and on the countryside in India than in the larger cities. There are several initiatives around the country being done to promote bicycling for women, one of them is a bicycle bank founded by The Action northeast trust. Their goal is to empower and increase women’s mobility by teaching them how to bicycle and promoting female micro enterprises. These kinds of ideas could be used in the Mumbai context to try to get more women to bicycle and get more independent.

How can bicycling improve the equality in Mumbai?

- Bicycling is an affordable way of travelling, most people in the city could afford a bicycle and people from all income groups are potential users.
- By providing well working bicycle lanes more people could choose to bicycle and it could become more socially accepted as a transport mode by all income groups.
- By providing a well working bicycle network the economical opportunities for people could increase since more are able to travel a longer distance to find work. There could also be several job opportunities in the bicycle business. This could create better opportunities for people in the “lower” casts.
- By creating bicycle lanes and encouraging women to bicycle women could get more independent by having access to a cheap transportation mode.
Pollution
As a result of Mumbai’s size and high growth rate air and noise pollution are posing serious threats to the quality of life for the city’s inhabitants. There are for example a high number of chronic respiratory problems among the population, see chart 2.7. According to WHO are air pollutants a major environmental health problem that is affecting everyone in the city. Exposure to air pollutants increases the risk of getting lung cancer, cardiovascular and respiratory diseases.¹

Vehicular pollution is a major contributing factor in causing air pollution in Mumbai, it is estimated that 60% of the total air pollution is caused by emissions from auto vehicles. According to the latest studies done by the Maharashtra pollution control board in 2009 air pollutants are increasing at an alarming rate. For example are the concentration levels of nitrogen oxides (NOx) twice as high as the prescribed limit and they had increased 13% in a four year period. The pollutant respi-rable suspended particulate matter (RSPM) was also found to be twice as high as the prescribed limit and it had increased 11%. The pollutant sulphur dioxide (SO2) levels are still below the set limit but it had increased 36% since it was last measured four years ago.²

Noise pollution
There are several types of noise that are affecting the overall noise pollution in the city but the increasing number of traffic has a close connection to this. The maximum noise levels are so far recorded at the air port and in industrial areas but noise levels are exceeding the prescribed limit all over the city. High levels of noise is a stress factor that can effect peoples hearing, sleeping- and concentration ability.³

Environmental winnings from bicycling
It is well known that cycling can improve the environment and reduce emissions of CO₂ as well as hazardous gasses like particles and NOx. In Copenhagen around 36 % of the all trips are done by bicycling. This reduces approximately 90, 000 tons of CO₂ emissions per year.⁴

Cycling and air pollution
It is of course less healthy to bicycle in polluted air than in clean air. But should one not bicycle because of the pollutions? If there is a cleaner alternative the answer would yes, but if the alternative is to drive or go by bus, the bicycle will not necessarily be the worst alternative, it might even be the healthiest one.

Bicyclists breathe more, so the exposure to pollutants can give a concentration that is relatively higher. Studies however find that the concentration of pollutants at rush hours are substantially larger inside the cars than outside. The reason is that the air intake of the cars is close to the exhaust tube of the car in front. Depending on relative speed and the relative volume of air taken in per minute bicyclists may or may not be exposed to a higher amount of pollutants over the same distance.⁵

How can bicycling improve the environment in Mumbai?

- Bicycling does not pollute the environment, neither by air or noise. By supplying a well working bicycling network hopefully more people would choose to bicycle and the amount of cars, and then pollutants, could decrease.

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3 Göteborgs stad, Ljud – så påverkas hälsan, Miljöförvaltningen, 2008, p. 5
5 Christian Ege, Cycling will improve the environment and health, The Danish Ecological Council, p. 4
Main causes of death
The number one cause of death in Mumbai is heart attack, followed by tuberculosis, cancer and other respiratory diseases. The increasing number of heart attacks in recent years is due to unhealthy diets and lack of physical exercise, see table 2.7.¹

By providing bicycle lanes and encouraging people to cycle they could improve their fitness and health. For example, according to WHO, a 50 year old person who bicycles five kilometers to work per day instead of taking the car has a 50 % lower chance of getting a heart related disease.²

According to a Danish study are children that are cycling to school almost 10% more physically fit than their classmates who walk or are driven by their parents.³ Society can actually save money by providing bicycle lanes. If people are exercising more their overall health get better and they will not get sick so often. This has been studied in a report by Naturvårdsverket in Sweden. In chart 2.6 and 2.8 on this page you can see the connection between lack of physical exercise, age and the cost for society to treat this kind of illnesses.

2 Koucky, Michael, Vägverket, Ökad cykling i kommuner och regioner, 2010, p. 26
3 City of Copenhagen, Copenhagen - City of bicyclists, Bicycle account 2008, p 10.

2.6 Illustration showing how the cost of illnesses increased following inactivity among the population and an increasing age.

2.7 Main causes of death in Mumbai 2005

<table>
<thead>
<tr>
<th>Disease</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heart attack &amp; heart diseases</td>
<td>11591</td>
<td>8514</td>
<td>20105</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>5773</td>
<td>3063</td>
<td>8836</td>
</tr>
<tr>
<td>Cancer</td>
<td>3093</td>
<td>2780</td>
<td>5873</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2891</td>
<td>2251</td>
<td>3785</td>
</tr>
<tr>
<td>Bronchitis (Lower respiratory)</td>
<td>2066</td>
<td>1719</td>
<td>3785</td>
</tr>
</tbody>
</table>


2.8 The relation between obesity, illnesses and the cost for society

Source: Naturvårdsverket; Den samhällsekonominiska nytan av cykeltrafikåtgärder, rapport 5456, 2005, p. 54

How can bicycling improve the health of people in Mumbai?

- By bicycling people could improve their fitness, which could affect their overall health in a positive way.
- If more people choose to bicycle instead of driving the amount of dangerous pollutants would decrease which could result in people not getting sick so often.
- Bicyclists inhale less dangerous pollutants than people sitting in cars, see page 15.
Commuting patterns

Mumbai's main employment location is in the southern end which is the destination for nearly two million commuters. The employment centers along the eastern suburbs have been enlarging lately but south Mumbai is still remains the number one area for commuting. The central Mumbai areas of Parel, the locations of old textile mills are now emerging as centers of residence and commercial establishments.  

An interesting observation of the commuting behavior in Mumbai is the distribution of commute distances. The highest frequency is only 1-2km, and more than 40% of workers are commuting less than 2 km. There is also a layer of commuters that travel a long way to work, around 19% of all workers (11% of poor workers) commute more than 10 km. The average distance for all workers are 5, 3 km and 3, 9 km for poor workers (with an income less then 5000 Rs/month).  

Public transport

Mumbai, as a linear city, has an extensive commuting north-south. There are more than six million commuters who use the suburban railway system twice a day and there are 4, 5 million bus trips made a day. Only 25% of this commute by bus independent of railway commuting. These users of public transport constitute 88% of Mumbai’s commuters. Only 2, 7% travel by private car. (see chart below)

Trains

The fastest way to travel in Mumbai is to go by train. There are two suburban train systems that are operated by western and central railways, one starts from Churchgate and goes 60 km north to Virar and the other starts at CST, Shatrapati Shiva-ji Terminus, and goes to Karjat or Kasara. There is also a harbor line that goes from CST to Panvel or Andheri. The railways and the BEST buss service cater for around 10 million commuters per day.

The current position of railway commuting is at peak time commuting extends to nearly four hours in the morning and four hours in the evening and the coaches carry between 450 to 500 people each at super crush load while they should be carrying only about 200 commuters at crush load. Therefore there is considerable need to increase the capacity of North-South commuting.  

2.9 Ways of travelling to work in Mumbai (world bank 2004)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Total</th>
<th>Income less than 5000 Rs/month</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percent</td>
<td>Percent</td>
</tr>
<tr>
<td>Foot</td>
<td>43.8</td>
<td>60.8</td>
</tr>
<tr>
<td>Bicycle</td>
<td>3.1</td>
<td>6.1</td>
</tr>
<tr>
<td>Buss</td>
<td>16.1</td>
<td>14.5</td>
</tr>
<tr>
<td>Train</td>
<td>22.7</td>
<td>16.1</td>
</tr>
<tr>
<td>Auto rickshaw</td>
<td>1.8</td>
<td>1.3</td>
</tr>
<tr>
<td>Taxi</td>
<td>0.1</td>
<td>0.0</td>
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<td>0.7</td>
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<td>Own car</td>
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<td>Other’ s car</td>
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<tr>
<td>Other</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.00</td>
<td>100.00</td>
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</table>

Source: United Nations Development Programme Mumbai, p 207

**Table:**

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</tr>
<tr>
<td>Own car</td>
<td>2.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Other’ s car</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Other</td>
<td>1.0</td>
<td>0.4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Source: United Nations Development Programme Mumbai, p 207

2.10 Bus station. People are jumping on and of in the middle of the street. You have to be quick, the bus only stops for a few seconds at each station

2.11 Dadar train station, central Mumbai.
mobility

**Buses**
Under Bombay Municipal Corporation Act, BEST has been given exclusive rights to provide the public bus transport within Mumbai. BEST runs about 3380 buses on about 335 routes and carry around 4.5 million people every day. A problem with traveling by bus is congestion which can make traveling this way time consuming and unreliable.4

**Metro and monorail**
There are currently both a new metro and monorail being built.

Construction of the first stage of the metro has begun. The first line runs in the suburbs and is expected to be finished in three years. The three stages of finishing the whole system are estimated to be completed in 2021.5

The Mumbai monorail is currently under construction. It started in January 2009 and is expected to be completed in April 2011. It is the first monorail in India and the second longest one in the world.6

**Congestion**
Travelling in Mumbai can be very time consuming, especially during rush hour. Traffic congestion in Mumbai, like in most of the larger Indian cities, is a serious problem. Congestion is a result of many things, one of them being a large increase in private owned vehicles followed by an increasing population and a fast economic growth in an already dense area. There are several flyovers and bridges being constructed trying to ease congestion problems but there is a limit on how much additional infrastructure and rail lines the city can add. Creating more infrastructures is not a solution buy itself, its benefits are only short term.7

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6 http://mumbai.thecityfix.com/mumbai%E2%80%99s-monorail-breakthrough-or-blunder/, 2011-01-15
7 Traffic congestion in Indian cities: Challenges of a rising power, Azeem Uddin, 23 March 2009, p. 2-3

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2.12 The vicious circle of the provision of infrastructure for motorized transport.

Source: Buis, Jeroen; The Critical importance of non-motorised transport planning for modern Asian cities. Forth Regional Forum meeting, Soel, 2009, p 15

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2.13 Metro map, showing the planned lines of the future metro. One line in the suburbs are currently under construction.


2.14 First stage of the new monorail under construction.
In table 2.9 one can see that a very low amount of people are traveling to work by their own car, only 2.7% of all commuting. The economic growth of Mumbai, especially of the middle class who will soon buy their own cars, is likely to make the situation even worse.\(^8\)

**Increasing road capacity**

As we already know space in Mumbai is limited. The only way to utilize road space is to increase the capacity of the already existing network. By constructing segregated bicycle lanes the kerb side of the roads, which are currently already used by bicyclist, would be available to motorized traffic. This could improve the road space for cars up to 50% on a three lane road.\(^9\)

8 United Nations Development Program Mumbai, p 207
9 Tiwari, Geetam; Towards a sustainable urban transport system: Planning for non-motorized vehicles in cities, TRIPP, New Delhi, p 62

Also could the creation of segregated bicycle lanes result in better space utilization as they take up less space than cars. Car lanes need a lot more road space to able to carry the same amount of people as a bicycle road can.

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**How can bicycling improve the mobility in Mumbai?**

- Most people who are working in the city are not commuting very far. The average journey is 5.3 km which is a suitable distance to make by bicycle.

- Time is money! Creating a well working bicycling network could decrease the amount of time people spend on commuting. Instead of being stuck in traffic jams people would be able to choose to bicycle instead, saving both time and money.

- By creating segregated bicycle lanes road capacity would increase and as a result the congestion could decrease.

- Connectivity east-west is poor. Creating a good bicycle infrastructure east-west could improve the mobility for people traveling here.
Travelling in Mumbai today, either by foot or by vehicle, is quite dangerous. One out of five fatal traffic accidents in India occur in Mumbai. According to the Maharashtra transport department, 594 road accidents were reported in 2009 and 11,396 people were killed (all traffic related accidents).

A report done by Michigan University together with Strategic Worldwide Transportation in 2009 has focused on fatalities in traffic in India. They have compared the number of non-motorized traffic and pedestrians deaths in several different cities. According to their research, 86% of all deaths in traffic in Mumbai were pedestrians and bicyclists. The low amount of fatalities of private cars is due to a low ownership of private vehicles.¹

Figure 2.18 shows which kind of vehicle that was the striking component of the crashes in three different cities. The high involvement of trucks and busses are because they often have to use the curbside lane which then come into conflict with pedestrians and bicyclists who are present in the same space.²

1 UMTRI, Road safety in India, Challenges and opportunities, Ann Arbor, 2009, p 34-35
2 UMTRI, Road safety in India, p. 36

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2.19 Traffic fatalities in Indian cities with a population larger than one million, 2006  
source: UMTRI, Road safety in India, p. 30

source: UMTRI, Road safety in India, p. 37

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2.18 Circle diagram showing the deadliest causes of transport mode. Pedestrians top the list at 79%.  
source: UMTRI, Road safety in India, p. 35
Railway

Another major contributor when it comes to fatal accidents in Mumbai is the rail network. The suburban rail network here is the world’s deadliest commute with 17 fatal accidents every weekday. In total 4,357 deaths occurred in 2008. Many of them were caused by people being run over by trains while trespassing on the tracks but also by people being pushed or falling of the trains due to extreme overcrowding. 1

As most people in Mumbai use the public transport system it is important to provide safe and well working systems so that people don’t start buying and using private motor vehicles instead. Bringing in a new transport system, like bicycling, could decrease the amount of people taking the train or bus and therefore lower the amount of accidents related to overcrowded trains.

Bicycling - safety?

As stated on the previous page there is a great need for safer traffic solutions in Mumbai. It is important when planning a bicycle network to think about the real but also the experienced safety of the bicycle network. If more people were to feel that it is safe to bicycle maybe they would choose to bicycle more.

An interesting point that Gehl bring up in his book, Cities for people, is that the higher amount of bicycles you have in a city the higher the safety becomes for them. When there are more and more bicyclist coming in to the city car drivers get used to them. See chart to the below. 2


2 Gehl, Jan: Cities for people, p. 186

How can bicycling improve the safety Mumbai?

- Creating good bicycle lanes and sidewalks could lower the amount of fatal accidents.
- Well working intersections would make it easier for cars, trucks and busses to spot bicyclists which then could lower the amount of accidents.
- By providing another transport system more people could bicycle and the amount of people travelling by overcrowded trains could decrease.
- With more and more people bicycling, the safety increases, as car driver’s gets used to bicyclists.
- With a good bicycle network the experienced safety increases which could make more people bicycle.
Urban Life

Public space
Mumbai has grown quickly in recent years. This global city has from the early 1990s transformed from a manufacturing hub to an international finance, banking and trading centre. A change in political will during these years led to the privatization of basically all developments. This free market has led to the neglecting of planning a well working city for its inhabitants.¹

This is very visible while walking around in the city. The lack of public space, let alone public space of good quality, is alarming. There are for example only a handful of green spaces in central Mumbai which are used exclusively for cricket playing. The lack of public space has led to public life taking place on overcrowded streets, or wherever there is little space.

Jan Gehl, a Danish architect and professor in Urban design, talks in his book, Cities for people, about the situation in developing countries. How people use the public space here is more complex than in most western countries. Large parts of the population, as in Mumbai, use the city space for many different daily activities. As public space is decreasing, as a result of planning for cars, there is almost a competition for the city space going on. Gehl strongly believe that by inviting people to walk and bicycle the city will become more sustainable.²

Gehl also pinpoints how the human scale for many years has been neglected when planning cities. Cities are often not seen as meeting places which has led, for example, to the extensive planning for cars while neglecting other areas such as the number and quality of public spaces. The mistreating of people who are still using the city space is going on in most part of the world. Limited space, pollution, noise, and risk of getting in an accident are just some of the factors what city dwellers are facing, both in Mumbai and other cities.³

Bicycling and city life
An important thing that the bicycle does support is the public life. Gehl writes, in another earlier book of his Life between buildings, about the need for contact and how that requires daily activities and opportunities for meetings in the public space. There must be opportunities to be among people, to see and to hear others, to experience other people functioning in various situations. The relatively low speed that you are traveling in when you are bicycling makes it possible for oneself to experience the social life with all your senses. In the same time you are contributing to social life when you are just showing yourself. This is not possible in the same extent when you are sitting in a car.⁴

How can bicycling improve the urban life in Mumbai?

- Public life is supported just by people bicycling, by being among people, instead of sitting in a car.
- Most of the public life in Mumbai takes place on the street. By creating well working bicycling lanes and sidewalks the public life is being supported.

¹ Dossal, Mariam; Revisioning Mumbai: Democratizing public space, Mumbai University, 2007
² Gehl Jan; Cities for people, Island press, Washington DC, 2009, p. 6
³ Gehl Jan; Cities for people, p. 3
⁴ Gehl, Jan; Life between buildings, using public space, Danish architectural press, Archi grafisk, 2006
PART III

inventory, interviews, street typology, inspiration
method

Part III includes the results from the inventory of the study area, interviews with the public, the classification of roads in different categories and some practical inspiration from other cities.

The outcome from all of this will be weighed together and will then be the base from how the masterplan and the design guidelines are designed.

Study area
First is the study area described and it is explained why this area have been chosen.

Inventory
In this step different major connections and key points in the city are identified. Under this category are different spots listed such as train stations, larger work places, tourist spots, markets, sports- and playgrounds.

This can give an idea of where in the city the most important functions are concentrated and where people are going.

Interviews
It was crucial to get the bicyclists point of view. This was done by conducting interviews around south Mumbai. A translator had to be hired because not all people are fluent in English in Mumbai.

Typology & classification
All roads within the study area have been categorized into one out of seven different categories. The different categories are chosen after their speed and width.

This was done by visiting all areas and road by road. All roads was marked down according to how many lanes they had, speed, amount of traffic, if it was a key path, if there where many bicycles or pedestrians, parked cars and sidewalks. All this was then put together and all roads within the study area were able to be categorized.

Inspiration
Three different cities have been chosen to study deeper to get some inspiration from other bicycle cities for the masterplan and the guidelines.

- First one is Bogotá in Colombia, a city in another developing country that has succeeded in their work for bicyclists.
- Copenhagen has also been studied as it is one of the best bicycle cities in the world.
- Finally many ideas were gathered from Gehl architects proposal for transforming Mexico City in to a bicycle friendly city.

Key Issues
On this page are problematic issues presented that are not brought in the other parts, and that are important for this project, taken up.
Mumbai is divided into two distinct areas, Mumbai City District and Mumbai Suburban District. Mumbai City District starts at the southern tip Colaba and ends after the neighbourhoods Sion and Mahim.

The suburbs are the areas beyond Sion and Mahim, but they are not suburbs in the classical sense of being just residential areas on the outskirts of the city. This suburban area hosts some of the richest neighborhoods in the city and you can find pockets of intense trading, shopping, offices and industries here.

Mumbai city district and Mumbai suburbs are together called Greater Mumbai. Areas next to Greater Mumbai, for example Thane and Raigad, and some smaller towns form together with Greater Mumbai the Mumbai Metropolitan Region.

For administrative purposes, Greater Mumbai is divided into 6 zones, each consisting of 3 to 5 wards named alphabetically. Central Mumbai belong to zone 1 and zone 2, with the wards A to F.

Central Mumbai has many different neighborhoods with different character. In general the eastern and central side are poorer than the west waterfront side and therefore have higher densities. The waterfront can not be reached on the eastern side because it is either used by the military or by shipping companies.

The study area might seem as a large area to be working within but this thesis will not go into too much detail, it will focus on creating design standards that could work in central Mumbai and it will give recommendations on how a bicycle infrastructure and masterplan could be implemented.

**Study area**

The study area has been defined to Mumbai city district, with a total area around 68 km².

The reason for choosing to work here is the coherency of the traffic in the area. Auto rickshaws are allowed in the suburbs but not in central Mumbai, which make the traffic situation here a bit different. Bicycle rickshaws are not allowed in any part of central or suburban Mumbai. The enormous commuting to this part also makes it an interesting area to work with.

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1 United Nations development program Mumbai, p. 33-35
In this inventory the main connection points, working areas, tourist spots and markets are identified. This shows where people are going and where bicycle lanes would be of most need.

The study area has in this part has been divided into three maps to be able to show in detail where things are situated. The whole inventory was done after visiting each area, interviewing and discussing with several different people and from facts gathered from the document “the United Nations Development Program Mumbai”.

South central Mumbai
The most central parts of Mumbai are found in the south, around the train stations CST, Churchgate and the area Colaba. Here you can find the most important tourist spots, hotels, shops, markets and larger office areas.

There is an enormous commuting in to this area, see part II. The busiest places for commuting are the end train stations C.S.T and Churchgate. Here many people transfer from train to bus to go further south.

The neighborhoods of Nariman point and Fort host the largest office areas in Mumbai.

Most tourists live in Colaba, where you can find the famous India gate and the hotel and shopping mall Taj Mahal. Marine drive, nr 7, is a beach promenade that has become very popular for morning or evening runs/walks.

As you go up further north space is getting more limited as the density is getting higher and higher. Congestion is a serious problem here, especially around the train station C.S.T. ¹

¹ Inventory done by the help of the United Nations development program, visiting each area, interviews.
inventory

In the middle of central Mumbai many wealthy residential areas are found. On the west side are the neighborhoods Kemps Corner, Malabar Hill and Worli situated. These are some of the most exclusive areas in Mumbai, and some of the most expensive in the world.

Malabar Hill is the highest point in Mumbai (around 50 m above sea-level). Chief minister of Maharashtra lives here. Here you can also find the Hanging Gardens which is one of few parks open for the public.

The east side is home for the middle class and people in the lower income groups. Informal house settlements are common along the streets of Byculla and Parel. The south central areas here have some of the highest densities in the world, up to 29 000 people/km² live here.

The waterfront is not open for the public on the east side. The west side has waterfront promenades along most of the coast that are popular, though you can not swim in the water cause it is to polluted. South is one of the most populated areas in Mumbai.

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1 Inventory done by the help of the United Nations development program, visiting each area, interviews.

main connection points and functions

<table>
<thead>
<tr>
<th>Train stations</th>
<th>Visitors attractions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sandhurst Road</td>
<td>13. Chowpatty Beach</td>
</tr>
<tr>
<td>2. Dockyard Road</td>
<td>14. Hanging Gardens</td>
</tr>
<tr>
<td>3. Reay Road</td>
<td>15. Haji Ali mosque</td>
</tr>
<tr>
<td>5. Sewri</td>
<td>17. Mahalaxmi Race-course</td>
</tr>
<tr>
<td>6. Byculla Road</td>
<td>18. Walshkeswar temple</td>
</tr>
<tr>
<td>7. Chinchpokli</td>
<td>19. Phoenix mills</td>
</tr>
<tr>
<td>8. Curry Road</td>
<td></td>
</tr>
<tr>
<td>9. Grant Road</td>
<td></td>
</tr>
<tr>
<td>10. Mumbai Central</td>
<td></td>
</tr>
<tr>
<td>11. Mahalaxmi</td>
<td></td>
</tr>
<tr>
<td>12. Lower Parel</td>
<td></td>
</tr>
</tbody>
</table>

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METHOD PART III 27
inventory

In the northern part of central Mumbai you will find the different neighborhoods of Dadar, Dadar west, Mahim, Worli, Dharavi and Sion. Here like in the rest of central Mumbai the western side is richer than the eastern side.

Dadar is a major transit point because it is the only station where the eastern and western train lines meet. Dadar west is an upper middle class residential area, popular with the closeness of Shivaji Park and the seafront. Dadar and Matunga is a hub of education, many schools and colleges are situated here.

Worli is mainly a commercial area with many larger office buildings. The sea promenade here is popular. There are some residential areas with extremely expensive real estate prices.

From Worli the Worli Bandra sealink starts. It is a bridge going from Worli to the suburb Bandra, it is the largest infrastructure investment in Mumbai so far built to decrease congestion. No public transportation is aloud on the bridge, and it would not be suitable for bicyclists since it is too long.¹

Furthest up north in the study area is the famous Dharavi situated. This is a large slum area with a population with around 600 000 people. Even though it is a slum area there many facilities here that are not found in other slums, such as schools and hospitals. In this area there are a large number of small scale factories and businesses and many immigrants come here to find work.²

¹ Inventory done by the help of the United Nations development program, visiting each area, interviews.
² Field trip to Dharavi with a guide from the organisation Reality tours and travel, 2010-11-20
A survey was conducted to get some knowledge of who are bicycling and what people who were bicycling actually thought about different aspects of bicycling.

A questionnaire with 11 different questions where directed to people who were bicycling around south Mumbai. Questions like; if they felt safe, if they preferred to bicycle on smaller or larger roads and why they were bicycling were of most interest.

A translator had to be hired because not all people in Mumbai are fluent in English, especially not people from lower income groups and they are most likely to be bicycling.

The results are shown in circle diagrams on this and next page. Note that 58 bicyclists were asked during a period of three days, Wednesday, Friday and Sunday week 45 2010. The result could vary if more people were interviewed, but it can give an idea of the situation.

3.3 Translator Trypti helping out interviewing a man who is working with delivering newspapers by bicycle.

3.4 No women where seen bicycling during the time that the interviews took place. This could have to do with most of the people interviewed used the bicycle for work and a large part of the women in Mumbai stay at home and do not work outside their homes, (see page 14). Working with delivery, as most of the interviewed did, may not be seen a feminine type of work either.

3.5 Most of the interviewed people are young men working as delivery boys for different types of small businesses. Many restaurants and shops have delivery boys that quickly can transport food or other goods for a low cost in the near area.

3.6 The bicyclists were asked if someone else in their family used to bicycle. Also here you can see that no one of the interviewed persons had stated that a female family member used to bicycle.
3.7 All bicyclists were asked if they were using their bicycle to or from work or if they were used for another purpose. Interesting answers from some delivery boys were that they did not own their own bicycle, they just used one that was owned by their boss. At the end of the day they walked home, a bicycle was just too expensive for some of them.

3.8 An question that was of most interest was where the bicyclist mostly tended to bicycle and why. A larger part of the interviewed people said that they prefer to bicycle on larger roads. This is because smaller local roads are just too crowded and busy to be able to bicycle on. This question is crucial for next step in this process, categorizing roads and choosing witch ones that would be suitable for creating separate bicycle lanes on.

3.9 A surprising finding was the answer to the question if the bicyclists felt safe in traffic while bicycling. Around 70 % of the asked bicyclists stated they felt safe. But a reason for this could be that most of them have bicycling as a job. By saying that you are experienced and feel safe can be another way of saying that you are good at your job.

Those who stated that they felt unsafe were asked why they felt this way. Most of them said that there is just too much traffic and not enough road space. Some were afraid of getting hit by taxis and buses.
street typology

To be able to describe the street hierarchy in the area a classification of all roads have been done. The seven different categories have been chosen after speed and width of the streets but also from how different categories have been divided in a study done by TRIPP, Transportation Research and Injury Prevention Program in New Delhi, in the document Bicycle Infrastructure Design Manual for Indian Subcontinent.¹

There is little research and statistics in this field so this part had to be done by observations alone. The classification was done by walking around or travelling by public transport in all neighbourhoods in study area. All streets except some local ones have been visited and street width, number of lanes and speed were noted down and then all streets where photographed. In this step are first the seven different categories described and after that are three different maps presented that shows all roads in the study area and which category they belong too.

¹ TRIPP, Bicycle Infrastructure Design Manual for Indian Subcontinent, 2009, New Delhi, p. 38 - 40

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Highways

1. Speed: 80 -150 km/h

There are no actual highways within the study area, they start immediately after, in the suburbs.

Not suitable for making bicycle lanes on. The speed and flow of cars are too high.¹

¹ TRIPP, Bicycle Infrastructure Design Manual for Indian Subcontinent, 2009, New Delhi, p. 42

Flyovers

2. Speed; 50 - 100 km/h

A flyover usually consists of four car lanes constructed on pillars going above some of the main streets in Mumbai. They are not suitable for making bicycle lanes on. They are leaning too much to be able to bicycle up on and space is too limited.¹

Bicycle lanes should go along the roads underneath the flyovers and be constructed in the same way as other streets.

¹ Interview with Faizan Jawed, 2010-10-15
street typology

Arterial roads

Speed 50 - 80 km/h.

The arterial roads are the highest level in the hierarchy of roads in the township. They are the primary carriers of traffic within the city connecting all major activity centers and nodes within the study area.

They mostly consist of six lanes divided by a barrier. The quality of this type of street varies within the study area. Some of the arterial roads have marked lanes in the street and tree planting along the sides while others have almost no maintenance at all.

Bicycle lanes with a wider median are suitable for this type of street as the speed here is high.¹

Sub-arterial roads

Speed 50 - 70 km/hour

The Sub-arterial roads are the next level of hierarchy within planning area. They mostly consist of a four lane divided carriageway.

There should be separate bicycle lanes on these kinds of streets. Preferably with a wide median to ensure the safety of bicyclists. In this it is not possible a smaller barrier between cars and bicyclist could be constructed.¹

Collector roads

Speed: Around 30 - 60 km/h

Collector roads are collecting and distributing traffic to and from distributor roads to arterial/sub-arterial roads.

Separate bicycle lanes with a barrier between cars and bicycles should be constructed.¹

¹ Bicycle Infrastructure Design Manual for Indian Subcontinent, p. 43
Distributor road

Speed: around 30 - 40 km/h

Distributor roads are the ones serving the local roads. The speed is usually quite low due to parked vehicles, people walking in the street or other obstacles in the way.

Bicycle roads could be constructed were needed and were there is enough space. If not then traffic calming methods could be used to ensure the safety of bicyclists.¹

Local road

Speed less then 30 km/h

Local streets are the streets that are providing access to residential neighbourhoods or individual plots. Speed is usually slow and no specific bicycle lanes are necessary. Traffic calming methods could be used on streets where speed is a bit faster.¹

¹ Bicycle Infrastructure Design Manual for Indian Subcontinent, p.44
classification

In this part all roads within the study area are classified after the different typologies suggested on pages 31 to 33. The classification has been by observations alone since there are little studies and statistics done in this field. All neighborhoods and all roads have been visited within the study area to able to classify the roads.

The most central part of Mumbai is situated here, in the south central Mumbai. The streets tend to be wider and a bit more organized here than in the rest of central Mumbai. As you go further north the density gets higher and higher. Most of the roads in this area suffer from heavy congestion during rush hour, especially around the main train station C.S.T.
In the south of this area the density is very high, among the highest in the world. People and street vendors are almost fighting for space. The high amount of people and street vendors keep the speed of traffic very low here.

There are some larger arterial roads within the area that would require separated bicycle lanes. There are several flyover’s, some with large and complicated intersections.
classification

This part of the study area has several arterial roads that would require separated bicycle lanes. The western side streets tend to be wider and more organized than on the eastern side. The large bridge, the Worli-Bandra sealink, is situated here and would not be suitable to make bicycle lanes on.

In the north the slum area Dharavi is situated, most of the streets within the slum (local streets are not shown on the map since they are seen as informal they have not been properly put in on maps) are narrow and would not require separate bicycle lanes.
key issues

Here are some issues that are not brought up in the previous parts that would need to be solved to make a good bicycle network work. This part are conclusions after visiting all the neighborhoods in the study area between 2010-10-15 and 2010-12-05.

Technical issues

- Sidewalks. There are sidewalks on most major roads around the city but many of them are in bad condition. The are often different obstacles in the way such as potholes or badly placed lighting poles or trees. Another problem is the height of the pavements, they are often more then 15 cm high which can make them difficult to step up on. All of these thighs make people walk out on the street among cars instead of walking on the sidewalk, this causes stops in traffic.

- Water drainage. The water drainage system takes up a lot of unnecessary space on the streets of Mumbai, see picture on the right. The design is dangerous for bicyclists, who can easily fall if they go too far to the left, as the curb sides have a sharp decline towards the sidewalks.

- Car parking. Cars parked in wrong places create problems for both pedestrians and bicyclists.

- Bus stops. Unorganized bus stops causes stops in traffic when people are waiting, getting on and off the buss.

- Shading. The hot weather during summer can be a factor of why people choose not to bicycle. This could be prevented by providing shade, either by trees or other solutions.

- Heavy rains. During the monsoon period heavy rains can prevent people from bicycling. Better solution when it comes to day water handling would be necessary to provide. This can be done by creating better water drainage systems or increasing the amount of trees and green areas that could absorb some of the water. During the days with the heaviest rainfalls some of these methods might not be enough though.

- Safe parking for bicycles. While talking to some bicyclists after the interviews with the public, see part III, many said that they were afraid of getting their bicycle stolen. There are no facilities for bicycle parking today. Good parking both guarded and unguarded would have to be provided.

- Little space. In very high density areas it is almost impossible to bicycle, let alone making bicycle lanes. The amount of pedestrians and street vendors are too high. Traffic calming methods could be possible in some of these areas.

- Rules and regulation. Car driver’s tend to not follow the traffic rules and regulations in the city. Especially after dark, then not even traffic lights are followed. Bicycle lanes would need a physical barrier to prevent cars from driving on the lanes. Once driver’s get used to bicycle facilities the barriers can be removed.

Non technical issues

- Prejudices. While interviewing and talking to people about bicycling many prejudices against bicycling were met. There would be a need to inform people on the effects that bicycling could have to try the rise the status of the bicycle.
inspiration

Bogotá, Colombia

Bogotá’s Cicloruta is one of the most extensive bicycle networks in the world. It covers around 340 km and connects major transition points, parks and communities.

The system has not only helped lowering the amount of CO2 but has also changed the behavior in the city. In 2007 4 % of the population were bicycling, compared to 0, 2% in 2002, which translate to around 320 000 trips a day.

The project started in 1996 with a strong political will, especially from the then mayor Enrique Penalosa.¹

How does the Bogotá system work?

The system is divided into three sections:

1. The Main Network connects the city centre’s main educational and work areas with the most populated residential areas. It also connected with the secondary bicycle network.

2. The Secondary Network connects housing areas, parks, facilities and attractions with the main network. These paths are mostly designed to serve as feeders to the main network. All main stations have guarded bike parking facilities.

3. The Complementary Network links recreational networks, and external routes to the system. These paths are located along the river banks.

Which part of the Bogotá bicycle system could work in Mumbai?

Mumbai and Bogotá are of course different in many aspects. Parts of their bicycle system that could work in Mumbai are:

- How they have divided the system in categories with a main and secondary network.
- Guarded bicycle parking at major connection points.
- Good connections with other transportation modes.
- Rules and regulation for bicyclists, pedestrians and car owners.
- Intersections and traffic signals that are safe and easy to understand.

Which part of the Bogotá bicycle system would not work in Mumbai?

- Lanes with bicyclist going in both directions. Bicyclist in Mumbai should always follow the direction of cars, to prevent dangerous meetings. ²

¹ http://www.c40cities.org/bestpractices/transport/bogota_cycling.jsp, 2011-01-16
² Tutoring with Lin Skaufel, Gehl architects, 2010-10-01
Copenhagen, Denmark
Copenhagen is one of the most bicycle friendly cities in the world. In 2008 37% of the population was commuting by bicycling.

How does the Copenhagen system works?
There are around 350 km of bicycle paths that are separated from car lanes and another 20 km on-road bicycle lanes, marked by a broad painted line.

The city of Copenhagen are currently constructing a system of green bicycle routes going through green areas connecting with bicycle lanes on main roads.

In crossings are the bicycle lanes painted by a blue color to increase visibility of the bicyclists.¹

Which part of Copenhagen's bicycle system would not work in Mumbai?
- On road bicycle lanes. This would not work in Mumbai because of the lack of following traffic rules. A median or barrier would need to be there to keep cars away from the bicycle lanes.
- Green routes would not be possible to make in Mumbai. There are almost no green areas in Mumbai due to high density. The ones that are there are usually private and fenced.²

Which part of the Copenhagen bicycle system could work in Mumbai?
- Separate one way bicycle lanes a long main roads, the design here could be used in Mumbai.
- Design for parking along streets and at connection points could be used in Mumbai.
- Colored bicycle lanes through crossings could also be useful in the Mumbai system.

¹ http://www.cycling-embassy.dk/, 2011-01-15
² Interview with Faizan Jawed, 2010-10-15
inspiration

**Mexico City**

Gehl architects have together with Mexico City developed a bicycle strategy for Mexico City. They have put together six different documents focusing on different aspects of bicycling.

Some of the inspiration for this thesis comes from the two documents Mexico Bicycle City; Toolbox and Mexico bicycle; A best practice.

3.21 The documents Mexico bicycle city; Toolbox and A best practice.
In this part are number of suggestions done on how the future bicycle lanes and bicycle facilities within the study area should be designed. The suggestions and measurements are based from what was gathered and analyzed in part III (from interviews, literature studies, study trips, examples from other cities and from tutoring).

The guidelines are shown in plans, perspectives, sections and photos to get a good visual understanding of how the bicycle lanes and facilities should look. The guidelines suggest which type of bicycle lanes that would be suitable on the different kind of streets that was categorized in chapter III. There are also a number of technical solutions that are proposed that should increase the safety and comfort of the bicycle lanes.

The idea with this part is that it would be possible to just look at the design guidelines, without reading the whole thesis, when planning the construction of the lanes to see how they should be designed.

It should be noted that these are suggestions of the standard bicycle lanes and bicycle facilities. In some places these suggestions might not be possible to create and they could then be arranged in another more suitable way.
These are the main principles of the design guidelines designed for Mumbai. It is an absolute must that they are followed. By creating lanes that look and work the same way users will easily recognize them and know how to use the bicycle facilities wherever they are in the city.

- Bicycles go to the left, cars go to the right
- Cars parked right of bicycles lanes.
- Median or a barrier between bicycle lanes and cars.
- One way bicycles lanes, with bicycles always going in the same direction as cars to avoid accidents.
- Integrated water drainage for maximum usage of road space.
- Traffic calming on local streets.
- Bicycle parking at connection points around the city.
- Well lit bicycle lanes and parking facilities during night.
- Tree planting along bicycle lanes or sidewalks, for shade and water absorbing, where there is space.

“make sidewalks as wide as you value your citizens”
Gil Penalosa, former mayor of Bogotá, Colombia
vehicles

These are two types of vehicles that are aloud to travel on the bicycle lane. Regular two wheeled bicycles and three wheeled handicapped bicycles are aloud on the bicycle lanes.

**Mopeds and motorbikes**

Mopeds, motorbikes and rickshaws are not aloud on the bicycle lanes.

In many cities are mopeds aloud to travel on the bicycle lanes, for example in Copenhagen. By not allowing it on a new bicycle could make it clearer that no motorized vehicles at all are aloud to be in this area.

Traffic rules are not always followed in Mumbai. If you let mopeds go on the lanes then it probably would not take long until motorbikes or even cars are found in this space.¹

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¹ Gehl architects, Mexico City tool box, p. 12 and interview with Geetam Tiwari 2010-10-12
It is important to know who the bicycle lanes are designed for and how much space they would require.

In Mumbai many bicycle users transport goods on their bicycles and therefore should, if possible, the lanes be a little wider than in some western countries.

The different non motorised vehicles that are aloud to travel on the bicycle lanes are regular bicycles, with or without bicycles and handicapped bicycles.

Measurements: Bicycle Infrastructure Design Manual for the Indian subcontinent, p. 12 - 18
bicycle lanes

How wide the bicycle lanes should be is a tricky question in Mumbai since there is very little space and bicycles would need more space than a western model since people are often transporting goods.

Gehl architects have done a bicycle masterplan over Mexico City and their space requirements will be the base on how the measurements are suggested for the Mumbai model.

Standard bicycle path
The standard measurement for a bicycle lane in Mumbai should be 220 cm wide. This makes it possible for one bicyclist traveling with goods to overtake another bicyclist.

The minimum measurement to be able to overtake another bicyclist safely is on a 190 cm wide lane. Lanes can not be narrower than 130 cm.

Narrow bicycle lanes should be avoided as they can cause bicyclists to feel stressed when they can’t overtake others and the lack of space can cause accidents.¹

¹ Gehl architects, Mexico City, tool box, p. 28
There is a natural segregation of traffic modes on the streets in Mumbai today, bicycles tend to drive to the left and cars to the right. But as bicycles drive slower than cars the overall road capacity decreases while the risk of accidents increases.  

Barriers between bicycles and cars are necessary to avoid accidents and to create a better flow in traffic.

The absolute best and safest solution when it comes to separate motorized traffic and bicycles is to create a wide median. A larger median provides several advantages such as:

- Extra protection for bicyclists from moving traffic.
- Serves as a waiting place for pedestrians when they are going to cross the street.
- Bicyclists are protected from being hit by open car doors.
- Creates space for temporary of and unloading.
- Function as an island for bus passengers without interrupting the flow of bicycles and cars.
- The median can be furnished with trees, bicycle parking, sings etc. without disturbing pedestrians.

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1 Tiwari, Getam, Road designs for improving traffic flow: A bicycle masterplan for Delhi, Indian institute of technology, New Delhi, 2005, p. 2
2 Nelson, Alyse, Livable Copenhagen, The design of a bicycle city, Centre for public space research, Copenhagen, p. 23
The density in Mumbai is high and finding enough space to create wide and well-functioning bicycle lanes could be a problem. A wide median will not be able fit in some areas or streets. There still need to be some kind of physical barrier to separate cars from bicyclists. Where space is limited a lighter barrier can be used.

The barrier should be created in a way that stop cars from driving and parking on the bicycle lane.

There should be gaps in the barrier so that rain water can run though to the water drainage system.¹

¹ Gehl architects, Mexico City, tool box, p. 21
median & barrier

Wide median
A wide median between bicycle lanes and motorized traffic can be furnished trees, lights, bicycle parking etc. The median should be at least 60 cm wide and be created in a way that makes it impossible for cars to enter the lane. ¹

Lighter barrier
A lighter barrier must also be created in way that stops cars from entering the bicycle lanes. They should be at least 20 cm wide, up to 60 cm. The wider they are the safer the bicyclists are.

The barrier has to be designed so that it is safe for bicyclists, the pedals should not be able to hit the barrier. It should also be possible for a car to open a door without hitting the barrier.

¹ Tutoring with Jeff Risom, Gehl architects, 2011-01-30

50 PART IV DESIGN GUIDELINES
Segregated bicycle lanes with a wide median is to recommend.

Segregated bicycle lanes with a wide median if possible. Lanes with a lighter barrier can be made where there is not enough road space.

If there is space for segregated lanes a light barrier would work on this type of street. If bicycle lanes are not built traffic calming methods could be used to slow down the motorized traffic.
Bicycle lanes should not go on the flyovers, this is because they lean too much and getting up on them would be too difficult for most bicyclists. Bicycles should not go under the flyovers either. Cars are often parked here and where the flyover starts or finish a complicated traffic situation would occur.¹

Bicycle lanes should go next to the sidewalks on the opposite side of the flyover along the same direction as cars go, just as an ordinary street. What can vary is if a median or a barrier is used. Trees should be planted where there is space enough on the median or on the sidewalks.

¹ Interview with Faizan Jawed, TRIPP, New Delhi, 2010-10-15

Flyover in Dadar, central Mumbai.
traffic calming

On streets where there is not enough space for bicycle lanes, mostly on local streets, different actions can be done to slow the speed of motorized vehicles and prevent accidents from happening.

Some of these actions could also be made on larger streets together with traffic lights, for example in larger crossings. Raising pedestrian crossings from the ground force cars drivers to slow down. As traffic rules are not always followed in Mumbai this kind of prevention could be a good idea to lower the speed of traffic.¹

By narrowing the lanes cars are forced to drive slower. This also provides more space for pedestrians.

Where there are crossings without lights the street should be narrowed and the pedestrian crossing raised from the street. This slower the cars and makes pedestrians more visible. Photo taken in Lund, Sweden.

Speed bumps helps to slow down the speed of traffic. Photo taken in Lund, Sweden.

Parts of the street can be made in a different and more uneven material to help slow down the motorized traffic.

¹ Gehl architects, Mexico City, tool box, p. 47-49
The most dangerous situation for bicyclists is when they are going to cross the street in an intersection. Turning in a large crossing can be dangerous for bicyclists when car drivers are looking at other traffic, traffic lights or pedestrians. It can also be difficult for car drivers who are turning left to detect bicycles coming from behind.¹

To avoid dangerous accidents and make the crossings more visibly clear they should be arranged in the following order:

- Colored bicycle lanes going through crossings.
- Colored bicycle boxes in front of the motorized vehicles to wait in while the traffic light is red.

**The bicycle box**

Bicyclists who are bicycling left of cars are often hard to spot for car drivers. Many accidents occur when cars are turning left and the car driver is not aware of bicyclists that are going straight or turning right through the crossing.

A bicycle box gives bicyclists their own space to stop at in front of motorized vehicles. This increases the visibility and safety for bicyclists, especially those who are going straight or turning right. The only difference for the motorized vehicles is that they have to stop a couple of meters further back than before.²

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¹ Gehl architects, Mexico City, tool box, p. 55-59
² http://www.stockholm.se/TrafikStadsplanering/Stockholmstrafiken/Cykla/Cykelbox1, 2011-03-10

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56 PART IV DESIGN GUIDELINES

**Plan showing how an intersection with colored bicycle lanes and boxes should look.**

**Perspective over an intersection showing how colored bicycle lanes and colored bicycle boxes can improve the visibility of bicyclists.**

**A bicycle box in Portland, the number one bicycle city in the US.**
In intersections with a lighter barrier the idea with the colored lanes and boxes are the same as in crossings with bicycle lanes with a wider median.

The most important issue to think about when creating crossings like this are the safety for the non motorized traffic and to design the lighter barrier so that it is impossible for cars to enter the lanes.
In t-intersections a colored bicycle lane should go through the crossing. While turning left it can be difficult for car drivers to spot bicyclists who are going straight through the crossing.

If a smaller street meets a street with heavy traffic it should be shown in a visibly clear way how you should behave in the crossing. If a colored bicycle lane is not enough it could be mixed together with a traffic calming methods to slow down the traffic. For example could the whole crossing be raised from the ground which would force car drivers to drive slower.¹

¹ Gehl Architects, Mexico Bicycle city, toolbox, p. 62
Roundabouts are not common in Mumbai, but there are a few, most of them being really large ones, with more than four streets meeting.

A colored lane for bicyclists should, as in intersections, improve the visibility of the bicyclists. It is also important to create safe and well working pedestrian crossings. By raising the pedestrian crossing from the ground the safety increases both for pedestrians and bicyclists as cars have to slow down.\footnote{Field trip to Copenhagen, 2010-31-09}
Parking facilities should be provided at several locations close to the bicycle lanes, especially close to connection points such as train- and bus stations. There should also be parking facilities at schools and work places all around the city.

Parking can be both guarded and unguarded. Especially around train stations larger guarded parking areas could be necessary.

It is necessary for the parking to be close to where the bicyclists are going. If it’s not close enough then people will start to park their bike at locations that are not meant for bicycle parking.

This is how far away from the destination that different bicycle parking facilities should be arranged.\(^1\)

- Short-term parking < 2h 0 - 15 meter
- Day parking 2-12h 30 - 50 meter
- Long term/night parking >12 h up to 100 meter

Parking safety

When making interviews with bicyclists, it was clear that many people where afraid of getting their bicycle stolen. Creating well visible and well lit parking facilities is a must to make people feel safe to leave their bicycle. Also could guarded parking facilities be good to start out with in the beginning.

\(^1\) Gehl Architects, Mexico City, tool box, p. 76

At main connection points such as train stations larger parking facilities would need to be arranged. As space is limited in Mumbai a good solution for street level parking is the one, as in Santa Monica, where you can park two bicycles on top of each other. If there is space to build parking facilities inside is could be solved like in Bogotá with guarded indoor parking.
Bus stops are a major stopping point in traffic in Mumbai. People are waiting on the street among cars because of the fear of missing a bus, which only stops for a few seconds at each stop.

This causes people running out in the street when the bus comes which is both dangerous and stops the flow of traffic.

In the interviews with the public, see part III, it was clear that some of the interviewed people were afraid of getting hit by buses.

It is necessary to create safe waiting places for people who are waiting for the bus. It should be visibly clear where you should wait and where should not wait. Well visible pedestrian crossings over the bicycle lanes prevent pedestrians to get run over by bicyclists.

Here are two suggestions on how bus stops could be arranged. The best option would be to have the bus stop on a median. If the bicycle lane has a lighter barrier the bus stop will have to be placed on the sidewalk.

1 Gehl architects, Mexico City, tool box, p. 45

Bus stops

On streets with a wider median the median can serve as a waiting place for bus passengers. There should be pedestrian crossings where people are crossing the bicycle lane to get to the bus.

On streets with a lighter barrier the waiting place for bus passengers will be on the sidewalk. Pedestrian crossings should also be placed here, where people are crossing over to get to the bus.

Bus stop in Copenhagen. Passengers can wait both on the sidewalk or on the median.
bicycle rental

In today’s Mumbai it would not be possible for people to bring their bicycle on the train or the bus, due to the already overcrowded public transportation system. A solution to this could be to rent a bicycle, for a low cost, when for example going from the train station to work.

There is a pilot project going on in the suburb of Mulund, in north-east Mumbai. Here students at the local college can rent a bicycle at the train station, cheaper than taking a taxi, and then hand it in at the college to a person who guards the bicycles there. At the end of the day they bring their rented bicycle back to the train station.¹

This idea could easily be adopted at other main connection points and larger work places around Mumbai. With more people bicycling more work opportunities could come along, like bicycle repair and rental shops and parking guards.

¹ Interview with organization founders Raj N. Jangam and Jui Gangan, Cycle Chalao in Mulund, Mumbai, 2010-12-05

Bicycle rental in New Delhi.

There are several small bicycle shops like this around Mumbai, most of them have a couple of bicycle’s to let.

Cycle Chalao, a bicycle rental project in the suburb of Mulund in Mumbai. Student’s can rent a bicycle at the trainstation and ride it to school instead of taking a taxi. Photo taken outside the train station.
technical solutions

Water drainage
There are huge problems with water drainage during the monsoon period. But as the drainage system is designed today it is stealing too much space from the street and it is dangerous for bicyclists who can easily fall if they go too far to the left. The drainage system should be designed in a way that is integrated with the street and that is safe for bicyclists to ride on.

Preventing cars from entering the bicycle lanes
It is important to keep cars away from the bicycle lanes. As rules and regulations are not always followed in Mumbai it could be necessary to build the lanes so that it is impossible for cars to enter the bicycle lanes. This could be done, like in New Delhi, where pillars are put where the lane start and end. As car drivers get used to the bicycle lanes the pillars could be removed.

1 Gehl architects, Mexico City, tool box, p. 20,26
2 Field trip to New Delhi’s only bicycle lane, 2010-10-12
trees

In some areas in Mumbai are there plenty of trees while in others there are none. During summer the weather is very hot and trees can provide well needed shade. Trees can also provide protection and help to absorb some of the rainwater during the monsoon period.

Trees should be placed so that there is good visual contact between traffic modes. The stems need to be high enough so branches and leaves don’t get in the way of bicycles and cars. Maintenance is important to keep trees healthy.¹

One issue, probably only found in India, are cows eating from trees and other plants in the city. The trees could need some kind of protection around the stem to be saved from vandalism.

Trees should be placed either on the median or on the sidewalk.

¹ Gehl architects, Mexico City, tool box, p. 34-35

Trees planted in the median in Lund, Sweden.

A cow eating on a tree in Colaba, Central Mumbai.

Trees planted on the sidewalk along a bicycle lane in Beijing, China.
How lights should be arranged in a city is a huge field of knowledge in itself but there are some guidelines that should be followed while creating a bicycle network.

The street lights should be arranged in a conscious way and follow some kind of set standard to create a unity in the city. The non motorized traffic should always be first in mind when it comes to planning street lights.\(^1\)

Street lights are mainly provided for:
1. Safety, real or experienced safety. Lights make it possible for bicyclists to travel at night. The feeling of safety increases if bicycle lanes and parking’s are lit up at night.
2. Orientation, lights should guide you where to go or not to go. This is especially important when planning bicycle lanes.
3. Beautification, lights can beautify certain parts or objects in the city at night.

In Mumbai’s case number one and number two would be most important since there is little to non street light provided. It would also be necessary organize the lights for bicycle facilities with street lights for pedestrians and auto vehicles. On this page are some suggestions on how lights could be arranged for bicycle lanes and bicycle parking’s.

Crossings and lights
Intersections with bicycle lanes, and pedestrian crossings, should be more lit up and than the ordinary bicycle lane. This is to notify car drivers that something is happening in the traffic here and to increase the visibility of the non motorised traffic, all to prevent accidents. \(^2\)

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1 Lunds kommun, Belysningsprogram, 2009, p. 4-5
2 Gehl Architects, Mexico Bicycle City, toolbox, p. 66
Part V

implementation, masterplan, final thoughts and reflections
Implementation
This chapter includes some recommendations for how a new bicycle infrastructure should be planned. Focus on the planning should be to collaborate with different stakeholders and to have a dialogue and provide information to the public. Five different steps are suggested to work with to get the best result of the planning stage.

Masterplan
An illustration of a bicycle masterplan for central Mumbai is presented. There should not be too much focus on the plan since it is suggested in the implementation chapter to work in smaller areas or neighborhoods and not plan the whole city at once. The masterplan shows how the bicycle network could look if all lanes in all neighborhoods were constructed after the recommendations in part III and part IV.

Final thoughts and reflections
Some final thoughts are presented and some suggestions are made on further discussions or studies within this field.
The document “The significance of non-motorized transport for developing countries”, funded by The Netherland Trust Fund in 2000, contributes to the World Bank’s Urban Transport Strategy and gives suggestions on how non-motorized traffic should be planned in developing countries.

They have suggested working in five steps when it comes to implementing bicycle infrastructure. The recommendations focus on non-technical issues that often are forgotten in transport planning.

While the study in Mumbai was taking place many prejudices against bicycling were met, the bicycle is often referred to as the “poor man’s vehicle”. Working with these five steps could hopefully help changing people’s attitudes towards planning for bicyclists and bicycling.

The steps should be followed while planning the network in Mumbai and after the construction is finished.

1. **Users/stakeholders participation**
   - User/stakeholder participation has been mentioned as a key factor to success in the report “The significance of non-motorized transport for developing countries”. Lack of participation by users and other stakeholders could lead to a weak and unsustainable result which in the end could harm the interests of bicyclists and pedestrians. At policy making level, participation belongs to a much wider administrative reform process.

2. **Urban planning**
   - The neglect by urban planners of the effects of their planning on transport modes has worsened the position of bicyclists in many cities. Raising the awareness among urban planners about planning consequences for transport, and also environment and economic/poverty issues, could overcome this problem.

3. **Removing professional biases**
   - Planning and design professionals often have their own biases when it comes to the development of non-motorized vehicles. Ways to overcome this could be:
     - Training and awareness rising among staff.
     - Showing cases of successful participatory planning and design; experts may become more aware of the benefits of participation.
     - Political commitment and pressure.

5.1 Table showing all of the stakeholders that would need to participate in the creation of a new bicycle infrastructure. There are many different actors with different interests but most of them should be consulted to get the best result. 

source: I-ce, “The significance of non-motorized transport for developing countries”, p. 26
4. Communication and awareness-raising
There need to be a strategy on how to inform citizens. Convincing people to change behavior can not easily become effective without taking into consideration the determinants of behavior (products and incentives that may facilitate the desired behavior and the social environment of the citizens). Information will only be effective if the message presented is attractive and result in personal benefit.

Places to promote bicycling could be in schools, at work places and offices, on tv or for example creating events such as bicycle rallies or car free days.

5. Incentives
Reducing consumer tax (VAT) or import tax on bicycles and providing better facilities could be some ideas to lower the price on bicycles. Better infrastructure, more parking opportunities, showers and dressing rooms at schools/work could have a positive impact on bicycle use. Financial compensation or bonuses for people who walk or bicycle to work could increase the number of bicyclists as well.¹

Planning together
The planning of a bicycle network in Mumbai should follow the five steps that are previous mentioned. The planning for non motorized traffic should also be integrated both in plans and in policies related with different relating issues such as poverty easement, economic and social development, employment generation, urban and regional planning, urban upgrading and environmental protection.

The planning should be a mixture of a top-down perspective and a bottom-up perspective. Planning from a top-down perspective could in this case mean that urban planners look at which roads and target points that should prioritized for creating bicycle lanes based on statistics or facts. Bottom-up planning can in this case mean that stakeholders and users in different communities bring up their views and opinions on how to plan a good bicycle infrastructure in their neighborhood.²

5.2 Table showing a quick illustration of how the planning could work. Professionals and politicians should meet with the users somewhere in the middle to get a good result of the planning of a bicycle network.

source: I-ce, “The significance of non-motorized transport for developing countries”, p. 46

The masterplan suggested in this thesis is an illustration of how the bicycle network could look if all neighborhoods in Mumbai completed their bicycle lanes after how the classifications of roads were done in part III.

¹ Interface for Cycling Expertise, “The significance of non-motorized transport for developing countries”, The Netherlands, 2000, p. 91-96
² I-ce, “The significance of non-motorized transport for developing countries”, p. 96-99
The masterplan is an illustration of how Mumbai’s bicycle network could look in the future if all bicycle lanes were to be developed as recommended in this thesis.

Note that bicycle networks within smaller areas or neighborhoods first should be developed, see page 70 and 71.

If all neighborhoods worked together to develop bicycle lanes in their communities the final result could look like this.

Going from the slum area Dharavi in the north to the most central area Colaba in the south would take around 35 minutes to bicycle, if you travel at a speed of 20 km/hour.
Main network, separated bicycle lanes with a wide median.

Secondary network, separated bicycle lanes with a wide OR a lighter barrier.

Third network, separated bicycle lanes with a lighter barrier.

Local streets, without separated bicycle lanes.
There are many aspects in society that could have a positive effect if a well working bicycle infrastructure were to be developed in Mumbai, as argued in part I.

As there is a long culture of using bicycles in India and Mumbai the idea of creating a bicycle system is not something that would be completely new as a transport mode. In fact if nothing is done to create better environment for bicycle riders they will soon become history in the city of Mumbai, see page 10.

But only a bicycle network is off course not the solution on its own. The system should work together with a well working public transport system. Good connection points between bicycle lanes and other transportation modes are necessary. Examples on this can be found all over the world, se pages 38-40.

The most difficult task in the process of implementing this would be to change people’s attitudes and behavior. The status of owning a car is something that exists all around the world and off course do people in developing countries want to be able to buy a private vehicle in the same extent as in western countries.

When it comes to Mumbai there really is a great need to plan for sustainable transport modes, if new cars keep being brought in to the city in the same speed as it is today the city will soon become uninhabitable. Pollution and noise from vehicles are already posing serious threats to people’s health.

Investing in a project like this would also mean to invest in the people who are in the lower income groups in society. The gap between rich and poor is enormous and is something that should be taken in consideration in all planning in Mumbai.

On the positive side the interest for sustainability is emerging in the city. There are several organizations and private persons that are promoting bicycling. While the study took place in Mumbai the project was covered by three different newspaper and it was part filmed for a documentary movie.

A good example that shows that it could actually work to create something like this is the Bogotá example, see part III. Their success on planning for bicycles came in the beginning from a very strong political will, especially from their former mayor Gil Penalosa. There is little political interest in Mumbai today to prioritize the planning for non motorized vehicles. Even though there are many stakeholders who would need to participate on creating this there would still need to be a strong political will to make a big change like this come to reality. By informing people and politicians on better transport solutions hopefully the public and then the political interest would rise and the vision of Mumbai as a bicycle friendly city would come to reality.

Further discussion
As there are almost no studies done in this field in Mumbai there are plenty of things that could be discussed and studied further. As this project does not go in to detail in the planning of the network within smaller areas or neighbourhoods this could be a good idea to keep on studying.

Some other questions that could be developed from this project:
• How should bicycle plans for smaller areas/neighbourhoods in Mumbai be designed?
• Participation planning. How do bicycle users want the bicycle network to be constructed? How should participation planning be carried through in a large city like Mumbai?
• Why is there little interest from politicians and planners to create sustainable transport modes?
• What went wrong with the bicycle network in Pune? What can Mumbai learn from this?

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pictures

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