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Design of Cycle Track from Sakinaka to JVLR Flyover, Milind Nagar, Andheri East

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Abstract: As a result of increasing traffic in Mumbai region and the pollution caused by vehicles the future of the city is in great danger. People here are forced to travel by available transportation facilities like bus, rickshaw, taxi, trains and private vehicles like two wheelers and four wheelers. But if given them an option to travel by dedicated bicycle lane in the city they said they will be very glad to do it in a survey conducted by us to take public response for our project. With the concern to save the environment and improve public health we stated the benefits of cycling and added cycling as a mode of transportation by designing a dedicated cycling track from Sakinaka to Jogeshwari-Vikroli Link Road (JVLR). We studied various research papers and took an overview of dedicated cycle lanes all over the world. It is the best step to promote cycling and to make people aware of the benefits of our project. We selected the above location connecting a link to on-going project of green wheels along blue lines under MCGM, where we designed the track of stretch 2.2 KM with a width of 3m with the help of IRC 37-2012 by California Bearing Ratio (CBR) method of flexible pavement. We prepared a questionnaire based on our project to take public response and we got positive response for our efforts. We also introduced E-Bicycles, E-Toilets and various other facilities which are explained in the project in detail. The main motto of the project is to provide with a solution of sustainable mode of transportation which is cycling with various social, environmental and health benefits of it. Cycling in the coming years will become a need and trend in India where this is just a start.

Keywords: Dedicated bicycle lane, Green wheels along blue line, California Bearing Ratio, Sustainable mode of transportation.

I. INTRODUCTION

A cycle track is a way or a part of a roadway design and constructed for the use of pedal bicycles, and over which a right-of-way exists (IRC 11-1962).

A cycle track, separated bike lane or protected bike lane (sometimes historically referred to as a side path), is an exclusive bikeway that has elements of a separated path and on-road bike lane. A cycle track is located within or next to the roadway, but is made distinct from both the sidewalk and general purpose roadway by vertical barriers or elevation differences. In urban planning, cycle tracks are designed to encourage bicycling in an effort to relieve automobile congestion and reduce pollution, reduce bicycling fatalities and injuries by eliminating the need for cars and bicycles to jockey for the same road space, and to reduce overall confusion and tension for all users of the road.

Cycle tracks may be one-way or two-way, and may be at road level, at sidewalk level, or at an intermediate level. They all have in common some separation from motor traffic with bollards, car parking, barriers or boulevards. Barriers may include curbs, concrete berms, posts, planting/median strips, walls, trenches, or fences. They are often accompanied by a curb extension or other features at intersections to simplify crossing. There are different types of cycle tracks namely adjoining tracks, raised tracks, free cycle tracks and also those cycle tracks which are constructed independent of any carriage way.

II. OBJECTIVE

Following are the objectives of this study

A. Environmental Benefits

Bike riding uses minimal fossil fuels and is a pollution-free mode of transport. Bikes reduce the need to build, service and dispose of cars. Cycling 10 km each way to work would save 1500 kg of greenhouse gas emissions each year. Also, as traffic delays and interruptions to traffic flow in India's major cities account for around millions tonnes of greenhouse gas emissions each year, cycling during peak hours would contribute to further emission reductions by reducing congestion and improving traffic flow.

B. Health Benefits

Health professionals recommend at least 30 minutes of moderate-intensity physical activity each day. This is enough to maintain good health, even if the exercise is broken up into short 10 minute bursts. Riding to work, school, university or college, or taking your bike on short neighbourhood trips is a convenient and practical way to incorporate regular exercise into your busy day. Regular exercise, such as cycling and walking is important.

C. Social Benefits

Bicycles are more affordable to run. While only 10% of the world's population can afford a car, an estimated 80% of people can afford a bike. Cycling provides economic and independent travel for those who might otherwise have their travel options restricted. It offers increased mobility to many groups of the population with low rates of car ownership, such as low income earners, unemployed people, seniors and those under 18 years of age. Shared cycling and pedestrian facilities also create benefits for pedestrians and people with disabilities by providing an increased network of paths and improved road crossings. Cycling enables people to interact socially and feel more at home in their local community. More people cycling and walking provides additional opportunity for social interaction on the streets and this enhances a sense of community.

III. METHODOLOGY

In this study, after going through the literature and resource material, a small questionnaire has been prepared to explore the people's perspective for cycling and research of the ongoing MCGM project of "Green Wheels along Blue Lines" was done which helped to shape our project.

Considering all the above components a design of dedicated cycling track i.e. the pavement design with its components is done by using the CBR method for flexible pavement as per IRC 37-2012

Methodology to achieve the above objective is as below:

- 1) *Step 1:* Literature survey was carried out from the relevant journal papers, manuals. This helped in getting updated knowledge of the past and present scenario of efforts to provide dedicated cycle lanes in India and all over the world. Benefits of providing dedicated lanes in the city with all the required facilities were discussed.
- 2) *Step 2:* To conduct the site visit for collection of data and getting an overview regarding the ongoing project of MCGM named Green Wheels along Blue Lines.
- 3) *Step 3:* To conduct site visits to different places like Worli, Ghatkopar, Vidya Vihar, Marol, Sakinaka and Mulund where the MCGM offices were located and to meet the authorized Engineers to discuss about our project, to collect necessary data and to select the location of our site.
- 4) *Step 4:* To conduct a survey for collecting data regarding the approach of people towards cycling by the means of google forms.
- 5) *Step 5:* To visit the actual location of the site and study the condition to finalize it.
- 6) *Step 6:* To study the IS codes to design a flexible pavement for the cycling track.
- 7) *Step 7:* To prepare the result.

IV. DATA COLLECTION

During our research for dedicated cycle tracks we came across the MCGM project of Green Wheels along Blue Lines in Mumbai which is explained further in detail in the next chapter of Design of Cycle track. We discussed our project with the Sub Engineers in charge and they helped us by providing the necessary data required for our project.

So we collected the data of Green Wheels along Blue lines which is explained below in detail which was very helpful for our project. We also did a questionnaire survey using google forms with the people of that area to get response regarding our project. And also created a schedule of our visits to the sites mentioning the purpose.

A. Green Wheels along Blue Lines

Considering the fact that the biggest issue facing Mumbai is traffic, and to promote a healthy mode of transport, MCGM begun the work of construction of a Cycle Track along the Tansa Mains. The project Green wheels Along Blue Lines is being carried out by Hydraulic Engineering Department for the length of approximate 36Km, spread across various area under MCGM jurisdiction. The work is to be carried out along trunk mains on encroachment free zone for width of 10meters. In this Project, there is a Cycle Track (3m) and walkway (3m) on one side and service road (4m) and plantation on other side. This shall Mumbai's first dedicated cycle track and the shortest route connecting Mumbai in the N-S and E-W direction. This shall enable the cyclist to have short travels in a cycle to connect to any mode of public transport that is convenient. This project opens a whole new transport corridor in suburban

Mumbai, and promises to alter the traffic scenario of the city. It is also proposed to use the “Pipes as a Canvass”, thereby providing an opportunity for artistes of the city to showcase their talents. Other attractions planned are the Mumbai Books Route, Bollywood Walk of Fame, the “Cocoon Track”, biodiversity route, etc. The entire work is expected to be completed within three years.

The proposed route has 40 exits and connects to 10 CR stations, 5 WR stations, 4 Harbour line stations, 7 Metro stations, 2 Monorail stations, the Lokmanya Tilak and Bandra Railway stations, in addition to the WEH, the Mumbai Agra Road and Dr. B.A. Road.

The work is proposed to be executed in phases as mentioned below:-

- 1) *Phase I:* From MCGM Boundary at Mulund (T-Ward) to Sahar Road in Andheri admeasuring 14.10km.
- 2) *Phase II-A:* From Parsekar Chowk, Ghatkopar to King’s Circle, Matunga and from Airport Boundary, Santacruz to Ali Yawar Jung Road, Bandra admeasuring total 12.09km.
- 3) *Phase II-B:* From JVLR, Powai to Asalpha and Kurla Station and from Bandra Station to Mahim, admeasuring total 9.88km.

B. Survey Questionnaire

Following questions were asked to the commuters those are frequently travelling from Sakinaka to Jvlr. Google form was created and share with the commuters to get their response.

1) *How do you travel from Sakinaka to Jvlr?*

- a) Bus
- b) Taxi
- c) Rickshaw
- d) Cycle

2) *How much amount do you Spent to reach your destination?*

- a) Rs20-30
- b) Rs30-50
- c) Rs50 and above

3) *How much time it takes to reach your destination?*

- a) 15 mins
- b) 20 mins
- c) Above 20 mins

4) *Would you like to travel by bicycle if given an option?*

- a) Yes
- b) No

5) *What will be the main purpose of the trip?*

- a) Transportation to and from work
- b) Recreation/leisure
- c) Visit family/friends
- d) Purchasing/shopping
- e) Transportation to and from school
- f) Others

6) *Do you thing bicycling is a good idea considering environmental, health, fuel, monitory and other advantages of it?*

- a) Strongly agree
- b) Agree
- c) May be
- d) Disagree

- 7) *What kind of travel and infrastructure would you like to prefer by bicycle?*
 - a) Facility to carry bicycle on public transportation/Roads
 - b) Dedicated bicycle lane
 - c) Bicycle sharing services
 - d) Special treatment at intersections for bicycles

- 8) *If we provide a dedicated bicycle lane from Sakinaka to Jvlr along with bicycle would you like to use it?*
 - a) Yes
 - b) No

- 9) *Are you satisfied with the solution of providing a dedicated bicycle lane in term of safety?*
 - a) Yes
 - b) No

- 10) *Are you happy with the project of dedicated cycling tracks in Mumbai to encourage people to take cycling as a travel option?*
 - a) 100%
 - b) Can't say
 - c) Somewhat
 - d) Not at all

V. SITE SELECTION

During our research on dedicated cycling tracks in Mumbai we came across the great initiative of MCGM of constructing about 36-40 km long dedicated cycling track along with jogging track named “Green Wheels along Blue Lines”. It was a great opportunity for us to study their project as it would benefit our project too. So we contacted the MCGM Engineers working on this project and arranged site visits with college’s permission. And then we discussed our project with them and they helped us with all the required information and data which we needed.

After studying their project and routes we found a route from Sakinaka to JVLR which was occupied by the locals with tents and temporary shelter for them. This was the government land and was reserved for the development purpose. After discussing on this topic with the Sub Engineers we came to know that the court has ordered to clear the land for government encroachment for the cycle track project. So as it was a long process of encroachment, designing the track and implementing it, we told them that as we were also in search of a location for our project, so if we can take this route as our location and design a cycle track according to our needs. And they supported us with agreeing to it and also assured to help us with all the necessary design data. With all the available data we designed the track with the help of IRC 37-2012 by CBR method and also designed drainage system for it.

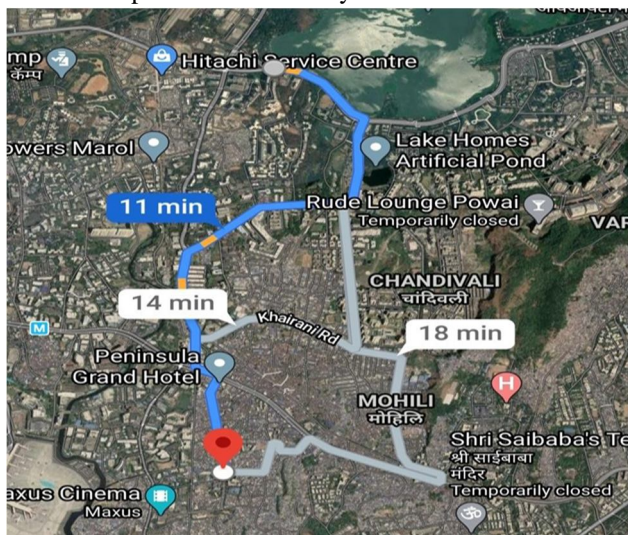


Fig no. 1 (Connectivity from Sakinaka to Jvlr)

Estimate time to reach Jvlr to Sakinaka is about 15 minutes, but during peak hours it takes to reach 30 to 40 minutes. As ongoing project of Metro line 3 is also lead more traffic congestion on the route of jvlr to sakinaka. But if commuter took cycling track from Jvlr to Sakinaka it takes 20 min to reach the destination.

As explained above we choose the site from Sakinaka to JvLR as it was connecting the ongoing project of green wheels along blue lines.



Fig no. 2 (Connectivity through cycle track from Jvlr to Sakinaka)

In the figure the Yellow lines show the routes of the project Green Wheels along Blue Lines from Kurla to Mahim and the blue line shows the route of our designed track connecting Sakinaka to JVLR.

A. Present site conditions of cycle track from Sakinaka to Jvlr



Fig no. 3 (Site conditions of bicycle track)

This bicycle route from Sakinaka to Jvlr will also benefit the surrounding areas as it connects many nearby places listed below:

- 1) Kala Vidya Mandir High School.
- 2) Asmira Academy's English High School.
- 3) Indian Education Society Primary School, Marol.
- 4) Bamandaya Pada Playground (MCGM)
- 5) Milind Nagar Playground.
- 6) Ashok Towers Marol.
- 7) Connectivity to Krishanlal Marwah Marg.
- 8) Connectivity to Bamandayapada Road.
- 9) Saki Vihar Telephone Exchange. And many more such places.

VI. DESIGN OF CYCLE TRACK

A. Design of Pavement

We are designing a cycle track by flexible pavement from Jvlr to Sakinaka for a length of 2.2km and width of 3m.

The design of cycle track is done as per IRC 37-2012:

Given:

$L = 2200m$ $B = 3m$

Assumptions: [We assume the data as pre IRC 37-2012] $r =$ Annual growth rate be 5%

$n =$ Design life in years = 15 years

$D =$ Lane distribution factor, $D = 1$ for single lane $F =$ Vehicle damage factor = 1.5

$A =$ Initial Traffic volume in terms of commercial vehicles per day be 150cvpd

Initial traffic volume in terms of commercial vehicles per day	Terrain	
	Rolling/Plain	Hilly
0-150	1.5	0.5
150-1500	3.5	1.5
More than 1500	4.5	2.5

Table no.1 Initial traffic volume in cvpd

$$N = \frac{365 \times [(1 + r)^n - 1] \times A \times D \times F}{r}$$

$$N = \frac{365 \times [(1 + 0.05)^{15} - 1] \times 150 \times 1 \times 1.5}{0.05}$$

$$= 1172139.53$$

$$= 1.77 \approx 2$$

The MSA will be 2

The design of flexible pavement is done by CBR method.

CBR value is 9.45

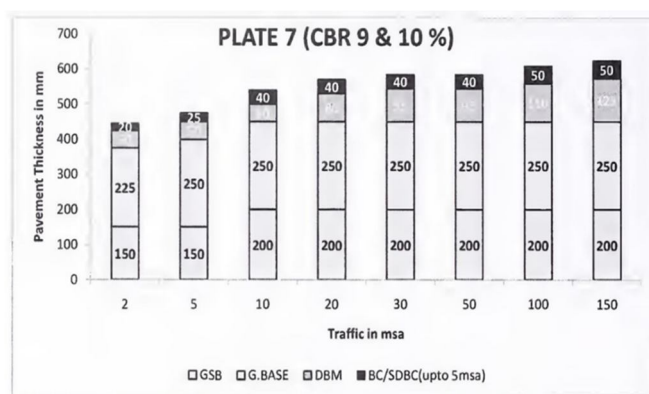


Fig no. 4 (CBR plate 7 graph)

From the above graph for 9.45% CBR and 2MSA the following crust is required: Granular Base (GB): 225mm

Granular Sub Base (GSB): 150mm

Dense Bituminous Macadam (DBM): 50mm

Bituminous Concrete Mixture (BC): 20mm

Total thickness of crust will be 445mm.

2% camber was provided as per IRC: SP: 50-2013.

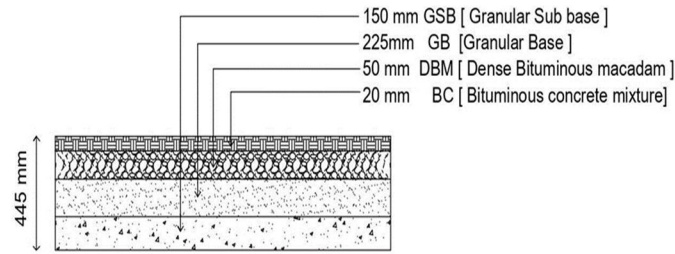


Fig no.5 (Bituminous surfacing with Granular Base and Sub Base)

B. Design of Drain

We have also designed a drainage system by most economical rectangular channel section.

Given:

Length of track = 2200m

Width of track = 3m

Rational method is used to determine the Discharge (Q). Assumptions: [As per IRC: SP 50-2013]

Q = Runoff in m³/s

i = 100mm/hr (Average rainfall intensity in Mumbai as per Regional meteorological centre)

c = Coefficient of runoff = 0.8

A = 6600m² (Area in hec)

Q = 0.0028 × C × i × A

Q = 0.028 × 0.8 × 100 × 0.66

Q = 0.147 m³/s

Dimensions of drain:

The drain is design as a most economical rectangular channel.

Given:

Q = 0.147m³/s

For most economical channel section:

Width = 2d

Hydraulic mean depth = d/2

Assumptions: [As per IRC: SP 50-2013]

$C = \frac{1}{N} m^{1/6}$ (N= 0.012 Mannings constant)

$i = \frac{1}{300}$

$Q = A \times C \times \sqrt{m \times i}$

Area = b × d = 2d × d = 2d²

$c = \frac{1}{0.012} m^{1/6}$

$i = \frac{1}{300}$

$Q = A \times C \times \sqrt{m \times i}$

$0.147 = 2d^2 \times \left[\frac{1}{0.012} \times \left(\frac{d}{2} \right)^{1/6} \right] \times \sqrt{\frac{d}{2} \times \frac{1}{300}}$

d=0.4m

b= 2d=0.8m

Width of drain = 0.8m

Depth of drain = 0.4m

Velocity of flow = $\frac{Q}{\text{Area of drain}}$
 $= \frac{0.147}{0.4 \times 0.8}$
 $= 0.459\text{m/s}$

Free board of 0.15 is provided.

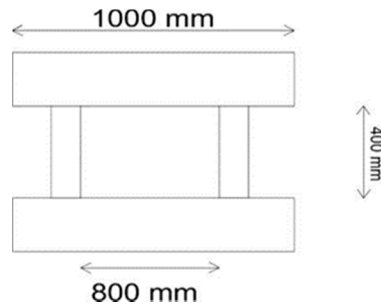


Fig no.6 (Drain dimensions)

VII. CONCLUSION

Mumbai a city with population being more than 18 Million, where more than 10 Million people travel everyday by public and private transport. The traffic condition in Mumbai is very bad and as predicted by scholars, vehicular emission to be the worst polluter in Mumbai by 2030. For all these problems the only solution is to use sustainable mode of transportation one of which is bicycling. But unless the riders are not assured of their safety it is not possible to convince them to do so. So by designing a bicycle friendly infrastructure we have provided them safety and confidence to ride the bicycle and also stated the benefits of choosing this mode of transportation where they can help improve their health and also contribute to the environment by not polluting it.

A. Some of the major Advantages Are

- 1) Faster, inexpensive mode of transportation
- 2) Safe for all
- 3) Minimal parking required
- 4) Minimal time frame for development
- 5) Minimal project cost
- 6) Well connected to existing transport network
- 7) Pollution free
- 8) Environment friendly

On a final note projects like these should be given more importance and not only in Mumbai but all over India initiatives should be taken to construct bicycle friendly infrastructures and promote bicycling.

RIDE NOW – WALK LATER

VIII. ACKNOWLEDGMENT

We feel immense pleasure in expressing our propounded regards and deep sense of gratitude to our project "DESIGN OF CYCLE TRACK" faculty Mr. Sagar Butle for his constructive criticism, constant encouragement and especially for creating in us the spirit of independent thinking. His keen interest and untiring assistance enabled us to complete this project.

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