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Review of the Segregated Cycle Tracks in Bhopal

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ABSTRACT

The cities today witness an unprecedented immigration influx, majorly in all developing countries, as is the case of India. This means more vehicles on city roads. With the unavailability of walking and cycling infrastructure, people are forced to use vehicles majorly powered by petrol and diesel engines, ultimately increasing the carbon emissions. With smart, sustainable and segregated cycling and walking paths, the use of cycles will be encouraged and will contribute immensely in combating climate change. The study involves a case study of Bhopal, the capital of Madhya Pradesh, India. The importance of cycle lanes and its need is discussed through survey of pedestrians and cyclists.

KEYWORDS: *Urban Mobility, Segregated Cycle Lanes, Carbon Emission, Walkability, Bikeability*

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INTRODUCTION

The advancement rate and industrialization pace vary in different countries, but the pattern has followed basic structure. Cities have emerged as economic hubs and roads are the basic infrastructural requirement for their development. While the roads today, fulfil only the needs of automobile users and not the pedestrians and cyclists. Owing to this, people today avoid walking or cycling to short distances and are indirectly forced to use vehicles. This has led to increased carbon emissions and unsustainable lifestyles with high carbon footprints of city dwellers, ultimately affecting the environment and leading to climate change.

Some of the basic issues observed in Indian cities are:

- Unavailability of footpaths: People are forced to walk on the sides of roads, which increases the number of accidents and further discourages the city dwellers from walking/cycling.
- Inaccessibility: There are sometimes no stairs to step up the raised footpaths. This majorly affects aged women and handicapped population.
- Encroachment: The footpaths are encroached by the shops adjacent to the footpath, forcing pedestrians to walk on roads, further discouraging to walk short distances.
- No street lights: This affects the walkability during evening and night. It also discourages women to walk owing to security as they are under threat because of low visibility.
- No Shade: Usually there are no shades available and hence the walkers/cyclist are at discomfort.
- City Heat: Cities are comparatively hotter than before, this has not only affected the working hours during the day, but is also a reason of decreasing efficiency and cause of discomfort.
- Pollution: The vehicular and industrial pollution is the cause of major lung, eye and skin diseases.

A. LITERATURE REVIEW

In 2015, 87% of the total CO2 equivalent emissions in the transport sector were emitted by road transport. This means cutting down vehicular emission is much impactful than a forestation and will show more immediate effects.

Figure 1- Transportation mode of work in Urban and Rural India. Source-

The study undertaken by the European Cyclists' Federation (Greenhouse gas emissions from transport in Europe, 2018) estimates that substituting 32% of the car trips in the European Union (EU-28) by bicycles could result in the annual fuel savings of €28 billion. Hence, not only this has ecological value but massive economic gains could be made by shifting the mode of local short distance transport. In the last decade itself, fuel use in the transport sector has more than doubled from 40.29 million tons of oil equivalent (INDIA CAN CYCLE IT'S WAY TO ECONOMIC SUCCESS, 2019)in 2006 to 86.70 MTOE in (Million Tons of Oil Equivalent) 2016. This unprecedented exploitation of fossil fuel has resulted in unprecedented carbon emission, leading to rapid climate change and rise in the global temperature. With rising income levels, the added prestige with the stigma of cycling being the vehicle of the economically weaker class is also one factor that people avoid this sustainable alternative. Absence of safe cycling infrastructure not only discourages the use of cycles but the users are left with no other choice. There are hardly any segregated lanes and parking spaces in convenient and major locations of the city.

Increased affordability of motorized vehicles (especially two-wheelers) is also a major factor that has led to a decline in the share of bicycles. Hence, increasing ownership and use of motorized vehicles not only has implications for the transport sector's energy-related CO2 emissions, which at present account for 8–10% of the total CO2 emissions in India.

The uptake of cycling has defined direct benefits. Benefits like, personal fuel savings, health benefits due to increased physical activity, reduced air pollution, and travel-time savings by marginal unskilled workers are quantified. These benefits can be realized by conducting awareness campaigns to highlight the various benefits of cycling and by dispelling the notion of bicycles as the poor person's mode of transport. Cycles are affordable and eco-friendly. They are the primary mode of transport of the urban poor population. Even in a large city such as Delhi, cycling accounts for over 10% of trips in the city, because of this section of society. Traffic surveys show that cycles are used around 15% of the time by the urban city dwellers. Cycles play a major role in enabling livelihoods of the urban poor; they provide a cost-effective transport option. Around 60% of trip lengths in Indian cities are of less than 5 km, and 80% of less than 10 km. These are ideal distances for cycling. It is one of the most sustainable modes of transportation. Benefits of cycling include zero emissions and pollution, health benefits from increased physical activity. This is an efficient option to shift to sustainable lifestyles without downscaling the living standards with twined benefit of good health.

B. CASE STUDY: CYCLE TRACKS AT HOSHANGABAD ROAD

Bhopal the capital of Madhya Pradesh is one of the greenest cities in India. In today's date, it has emerged as a major educational, economic and political center in India. As an urban agglomeration Bhopal is the second largest city of Madhya Pradesh, after Indore (Limited, 2012). It is divided into two major areas, "Old Bhopal" being a historical city and has narrow roads and "New Bhopal" which has broad roads that are flanked by landscaped greenery (Rishabh Jain, 2015)

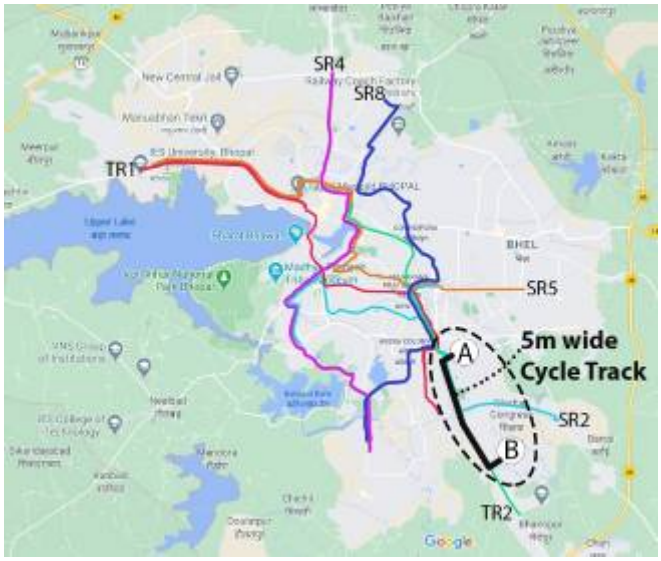

Figure 1- Map showing BRTS Corridors in Bhopal and Cycle Track on Hoshangabad Road. Source- Author

While footpaths are present alongside several main roads in the city, relatively fewer roads have segregated cycle tracks beside them. Although the scope of development of cycle tracks in the narrow and congested roads in the older regions of the city is limited; the construction of a segregated cycle track has been done in the newly developed road along the Hoshangabad road in the city. Developed by the Bhopal Smart City Development Corporation Limited, this dedicated track stretches across 5.5 km from one side of the road and runs for 11km if both sides of the road are considered. The track has been developed as a part of the Public Bike Sharing scheme in the city and was inaugurated in 2017. This bike sharing scheme allows users to rent a cycle from docking stations, set up across the Bus Rapid Transport corridors that run along the city's main roads.

The segregated cycle track was therefore constructed to experiment the feasibility of such tracks and cycle infrastructure in Bhopal. According to Chandramauli Shukla, CEO, Bhopal Smart City Development Corporation Limited (BSCDCL), the aim of these cycle corridors is to "promote a bike culture" in the congested city where government transport, private vehicles and commercial mini-buses clog the roads every day.

The officials claimed that if this prototype was successful, they planned to implement it on a 24km long corridor that would have more docking stations and connect various prominent public places, colonies and markets.

The Bhopal Public Bike project, started with a capital cost of Rs 2.95 crore. Adopting a new revenue model, the project plans to raise operating costs of Rs 6.7 lakh per month from membership, rental income, advertisement revenue, sponsorship contracts, parking fee and CSR funding, among others.

C. FEATURES OF CYCLE TRACK

Width of Tracks: The Hoshangabad road is an Arterial road that is approximately 53 meters wide on. Of these 53 meters, 7 meters is dedicated to the BRT corridor in the center. An 8 meters wide main road has been made on either side of the BRTS corridor. The cycle track measures 5 meters wide and separated from the main riad through kerb stones. A6 meters wide service lane on both sides of the road has been provided

beside the cycle tracks on each side. Between the service lane and the cycle track a3.8 meters wide line for tree plantation has also been provided. The cycle track on either side consists of two-way lanes for both cyclists and pedestrians.

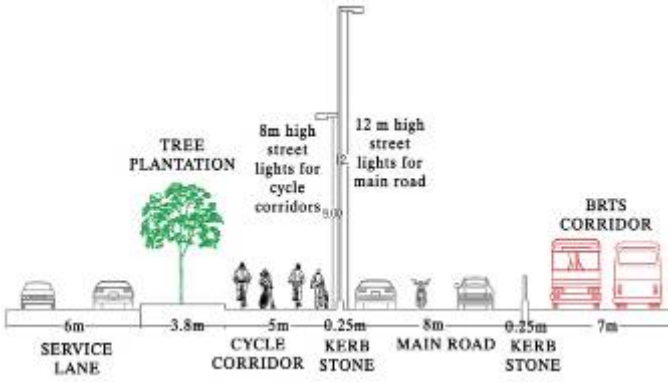

Figure 2- Section of road one way. Source- Author

Separation: The cycle tracks are separated by the main road by kerb stones that 150mm high and separated from the service lane through a tree plantation area. This green patch was developed to further beautify the visual aesthetics of the road and provide shade. Yet only some parts of these plantation areas are covered with trees that can provide shade. Also, stops in the form of 1-meter-high poles have been erected at intersections to avoid the entrance of vehicular traffic on the cycle track. These polls are laid adjacent to each other in such a way that the width of 750mm between two consecutive poles allows only the cycles and the pedestrians to pass. Thus, the entrance of two-wheeler vehicles and auto rickshaws on these paths can be avoided.

Markings: The tracks have been painted in a crimson color and have markings that are in the white color. Additional markings on this path further enhance the cycling experience by providing directions for using the shared path. Centerline stripping that are painted in white color help in determining the direction of the cycles and pedestrians on the two-way path. Additionally, zebra crossings that are also painted on the track and at road intersections help pedestrians to cross the track amidst the bicycle traffic.

Figure 2- Images of cycle tracks at Hoshangabad Road with markings and stoppings. Source- Author

Lighting: Poles for lighting can be seen between the main road and the cycle lane and each pole has two luminaries mounted on it. These luminaries are mounted on the heights of 12 meters and 7 meters for the main road and the cycle track respectively. Such a provision reduces the number of poles required and the vertical clutter on the road. The luminaries give a yellowish light.

Drainage: For drainage, weep holes have been provided on the cycle corridors that open towards the main road. These weep holes have been placed at a distance of 3 meters. But as the cycle corridors and the main road are at the same level, there is no proper facility for watershed management. Due to this, these corridors get clogged with water during the rainy season. Additionally, the track also has underground cabling system and storm water drainage.

Cycle Stands: The bike renting and booking facilities are provided through Chartered Bike Pvt. Ltd. through an android application which includes services of searching and booking different bike types, viewing rental history, reporting problems, and emergency contact facility. The bike stands can be browsed through a real time map and cycles can be booked by a simple QR scan.

Out of the total 90 bicycle docking stations in Bhopal, 11 are located on this stretch of cycle tracks. The Chartered mobile application displays the number of available bikes and racks for parking the bike on each station.

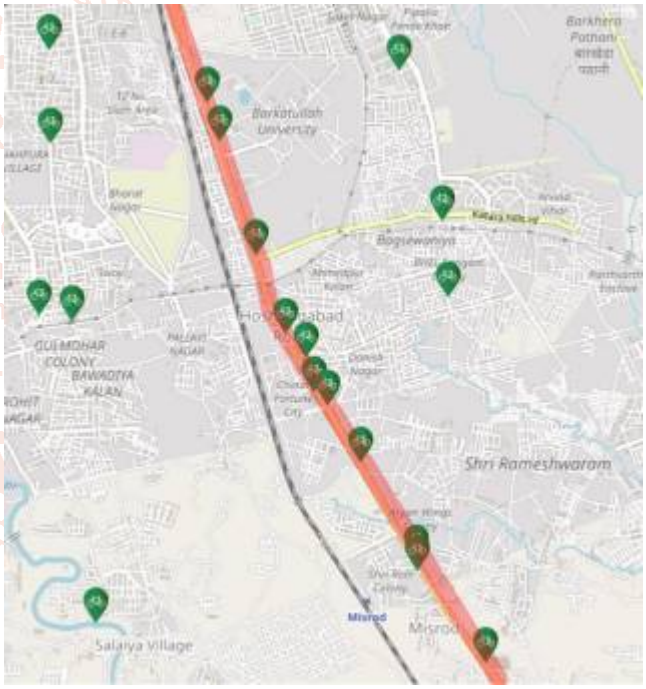

Figure 3- Docking Stations along Hoshangabad Road Cycle corridor, highlighted in red.
Source- (Chartered Bike Search Bhopal, n.d.)

The bikes can be rented on the Chartered App by both members and non-members. In order to avail membership, Monthly and Annual passes are issued. Monthly passes include unlimited 30-min rides for a day and Annual memberships include unlimited 30-min rides for a year.

Table 1 Showing Rental Charges for Bicycle in Rupees. Source-

Time	Member	Non-Member
0-30 minutes	5	0
30-60 minutes	10	5
Additional 30 minutes	+15	+15
60-90 minutes	25	20
90-120 minutes	40	35

D. BIKEABILITY ASSESSMENT OF THE TRACK

The Bike ability Assessment of these tracks was done by conducting a survey of about 30 people who used the cycle tracks regularly. For this assessment, the following questionnaire was prepared.

Table 2 Questionnaire for survey for Bike ability Assessment

Sr. No.	Question	Yes	No
1.	Corridors wide enough to accommodate both the pedestrian and cycle traffic?		
2.	Corridors in good condition, without any large cracks or dips?		
3.	Corridors routinely cleaned of trash and litter?		
4.	Adequate street lighting?		
5.	Adequate shade from the trees beside the cycle track?		
6.	Did you feel safe while using these corridors? a. If yes, why? b. If no, why?		
7.	Do you think renting cycles from the cycle station is affordable?		
8.	Do drivers respect cyclists along the intersections?		
9.	Provision for drainage along the track?		
10.	Any difficulties you encounter when crossing roads?		
11.	Any suggestions to improve the situation		
12.	What safety measures do you use while riding		
13.	Are there provisions of parking cycles on track?		
14.	The rules and regulations of riding are followed?		
15.	Built Encroachments (steps, railings, walls) by shops/stores/petrol pumps/restaurants)		
16.	Parked Vehicles: Parking by residents, customers of a commercial establishment, by auto garages etc. beside cycle track?		
17.	Exit and entry ramps cutting across the corridors, hoardings (political, shops) which obstruct)		
18.	Slippery corridor/water logging (during monsoon)		
19.	Any other Vehicles driving on the corridor		
20.	Hawkers and Vendors T Temporary: Anyone who is selling without any structures and for a limited time (e.g. vegetable sellers in the evening) Permanent: Anyone who uses a permanent or permanent structure		
21.	Any other issue (not listed)		

Results of survey: The survey revealed that while a majority of cyclists were content with the width and felt safer on cycling on these tracks than the road; they were dissatisfied by the shade and lighting provision on the tracks. Almost all the cyclists were dissatisfied with the absence of adequate provision for shade which is why they preferred to use these tracks only during the morning and the evening hours. Although most of the cyclists were satisfied with the lighting provision, some women cyclists revealed that they avoided using the tracks during the night due to the low illumination levels. Although the corridors were in good condition, some cyclists stated that they were not cleaned routinely. Few cyclists also felt that the cycling renting system was expensive when the cycles were rented for more than two hours. The provision of drainage was considered good enough for most part of the year except the rainy season when due to the heavy rains in the city, the rain water clogged up on the tracks and also made them slippery. Additionally, the pedestrians also complained that there was no separate provision for parking their cycles near the cycle track, which forced them to park in the vehicular parking which was already overcrowded. The cyclist further revealed that they felt safe cycling on the tracks as the entry of two wheelers onto the track was avoided by barriers at each intersection. Due to these barriers and the strict impositions laid by the authorities there are no encroachments of any kind on the cycle corridors. Further the lack of respect for cyclists among the drivers at the intersections revealed a lack of awareness amongst the local residents of the city.

E. WALKABILITY ASSESSMENT OF THE TRACK

The Walk ability Assessment of these tracks was done by conducting a survey of about 30 pedestrians and joggers who used the cycle tracks regularly.

Table 3 Questionnaire for survey for Walk ability Assessment

Sr. No.	Question	Yes	No
1.	How do you go to your working place, shops, etc.?		
2.	Do you use these footpaths?		
3.	Walk ability and cross ability of roads: do you think that roads and traffic junctions are convenient for walking and crossing over? a. If yes, why? b. If no, why?		
4.	Do cyclists and drivers respect pedestrians along the intersections?		
5.	What are the main difficulties you encounter when walking on footpaths? Examples:		

	- Narrow footpath - Incomplete or broken footpath - Uneven footpath - Obstructed footpath (trees, objects, bus stops, vehicles, people, etc.) - Slippery footpath - Poorly lit footpath		
6.	What are your suggestions to improve the situation?		
7.	Are you aware of: a. IRC norms for footpath width b. IRC norms for how much time pedestrians should get when crossing the road c. National Policy for Street Vendors?		
8.	What are the main difficulties you encounter when crossing roads? Examples - Inadequate footpaths or refuges - Lack of signalization (zebras, stop lines for vehicles, green man, etc.) - Lack of time to cross - Lack of discipline from the drivers.		
9.	Are there provisions of shade and rest?		
10.	Are there any ramps for the differently abled along the track?		
11.	Narrow footpath (less than 1.5mtr)		
12.	Complete footpath-Does it end after a certain length thus forcing pedestrians to use the road		
13.	Uneven footpath: - Missing tiles/blocks - Broken tiles/blocks - Protruding pipes/wires - Broken manhole covers or higher than footpath level		
14.	Construction material like debris, sand, pipes etc. on footpath		
15.	Garbage or waste containers on footpath		
16.	Children squatting on footpath		
17.	Vehicles driving on footpath.		
18.	Trees that partially or completely block the footpath/ Low hanging branches/overgrown shrubs and bushes		
19.	Broadband/BSNL utility boxes and poles on footpath		
20.	Signage Poles on footpath		
21.	Bus stops on footpath		
22.	Exit and entry ramps cutting across the footpath, hoardings (political, shops) which obstruct)		
23.	Built Encroachments (steps, railings, walls) by shops/stores/petrol pumps/restaurants)		
24.	Parked Vehicles: Parking by residents, customers of a commercial establishment, by auto garages etc		
25.	Hawkers and Vendors T Temporary: Anyone who is selling without any structures and for a limited time (e.g. vegetable sellers in the evening) Permanent: Anyone who uses a permanent or permanent structure		
26.	Lack of ramps for private entries which forces walkers to go down the footpath and then climb on it again.		
27.	Slippery footpath/water logging (during monsoon)		
28.	Dirty walls adjacent to footpath		
29.	Any other issue (not listed)		

Results of survey: The survey revealed that the pedestrians were pleased with the spacious provisions of the footpath cum cycle lane and frequently used them for travelling short distances and exercising. Although the markings on the cycle corridors and road intersections aided the pedestrians in crossing the road, a lot of pedestrians complained about the disrespect of the drivers on the road. Despite this lack of discipline, the zebra crossings and stop lights installed at all the junctions gave them enough time to the to cross the road. The lack of adequate resting infrastructure was seen as major issues by the pedestrians especially the women and the elderly, who then used the kerb stones as seating while walking on the tracks. The absence of ramps for the differently abled to climb the track was also seen as a problem by many users, who had to enter the footpaths from the main road by stepping over the kerb stones. The users seemed satisfied with the comparatively low heighted street lights that were pedestrian friendly. While the majority suggested more CCTV and surveillance provisional; some complained about the unavailability of shade, due to the absence of enough plantation of trees in the tree plantation area beside the track. The footpath is well maintained and is separated from the vehicular traffic and the roads through foot long divisions. The presence of Broadband utility boxes on the edge of the cycle track was not seen as a disruption by the pedestrians. The signage poles present on the tracks was appreciated by the pedestrians. The absence of bus stops beside the cycle corridor were an issue. These bus stops were

only present on the BRTS corridor, to access which the pedestrians had to cross the main road to reach the BRTS corridor. This crossing of the main road was seen as inconvenient by many. There were no encroachments on the cycle track which seemed to greatly please the pedestrians as in the absence of these, they could use the tracks for jogging and walking without any disruptions. The presence of a tree planation area and service lane beside the track was also appreciated by many who thought that these enhanced the visual appeal of the track and rendered it a spacious look. The poles that have been placed at the entry point to stop automobiles and bikes from entering the path, were seen as inconvenient by the wheelchair users as these poles have been placed only 700mm apart. There was little to no awareness among the pedestrians about IRC norms.

CONCLUSION

In order to encourage the use of cycles in the city, it is extremely important to upscale the existing cycling infrastructure. The shading, resting and drainage facilities along this track need to be examined carefully and upgraded to make these features more user friendly. Additionally, the economics of the public bike sharing scheme can also be revised for the benefit of the users. A general awareness regarding the benefits of cycling also needs to be spread in the city. This can lead to a major shift in attitude of the general public towards the existing cycling infrastructure and result in a cleaner and a safer environment along these tracks.

The up scaling of the road infrastructure is a definite need of the hour to make the cities more livable. This is an affordable and practical approach to combat climate change. The roads with segregated infrastructure for cycling/walking will promote the people to cycle/walk short distances and hence, would decrease the use of private automobiles. It will also encourage people to commute via public transport, since the latter has fixed station and the users are bound to travel short distances. All this would decrease the carbon emissions from the roads, with the decrease in air pollution and noise pollution and help citizens adapt to heathier and more sustainable lifestyles.

REFERENCES

[1] Anne Lusk, P. H. (June 10, 2016). *Promoting Cycling through Creative Design: Innovations for Bicycles and Cycling Facilities .*

[2] asbl, E. C. (Ed.). (n.d.). *THE EU CYCLING ECONOMY.* Retrieved from https://ecf.com/sites/ecf.com/files/FINAL%20THE%20EU%20CYCLING%20ECONOMY_low%20res.pdf

[3] *Chartered Bike Search Bhopal*. (n.d.). Retrieved from Chartered: http://charteredbike.in/bhopal/?page_id=1033

[4] Denver, U. o. (n.d.). *Cycling lanes reduce fatalities for all road users, study shows.* Retrieved from https://www.sciencedaily.com/releases/2019/05/190529113036.htm

[5] Ghatwai, M. (2017, 24 January). *Bhopal: 500 GPS-enabled German bicycles, 50 stations in city's 'smart' project*. Retrieved from The Indian Express: https://indianexpress.com/article/india/bhopal-500-gps-enabled-german-bicycles-50-stations-in-citys-smart-project-4488527/

[6] *Greenhouse gas emissions from transport in Europe.* (2018). Retrieved from https://www.eea.europa.eu/data-and-maps/indicators/transport-emissions-of-greenhouse-gases/transport-emissions-of-greenhouse-gases-11

[7] *Guide for the Development of Bicycle Facilities.* (2011). Retrieved from https://njdotlocalaidrc.com/perch/resources/aashto-gbf-4-2012-bicycle.pdf

[8] He, M. (2019). *Study of a Piezoelectric Energy Harvesting Floor Structure with Force Amplification Mechanism.*

[9] *INDIA CAN CYCLE IT'S WAY TO ECONOMIC SUCCESS.* (2019). Retrieved from https://pedalandtringtring.com/2019/01/28/india-can-cycle-its-way-to-economic-success-teri/#:~:text=In%20the%20last%20decade%20itself,of%20bicycle%20use%20is%2019%25.

[10] Kumar. (n.d.). *Power Generation from Footpaths.* Retrieved from https://www.skyfilabs.com/project-ideas/power-generation-from-footpaths

[11] Limited, U. M. (2012). *Public Bike Sharing Scheme.* Bhopal: Municipal Corporation, Bhopal.

[12] *MAINTENANCE OF STREET LIGHTING.* (2013). Roads and Maritime Services of New South Wales.

[13] Marina Monteiro Lunardi, J. P.-G. (2017). *A Review of Recycling Processes for Photovoltaic Modules.* doi:10.5772/intechopen.74390

[14] *Part 2: Road Lighting Maintenance Volume 4 – Intelligent Transport Systems and Electrical Technology.(2016). Traffic and Road Use Management.* (Vol. 4). (n.d.). Retrieved from https://www.tmr.qld.gov.au/-/media/busind/techstdpubs/Traffic-management/Traffic-and-Road-Use-Management-manual-TRUM/Volume-4/Volume4Part2.pdf?la=en

[15] Rishabh Jain, H. K. (2015, November 24). *Bus Rapid Transit System in Bhopal City: A Review.* Retrieved from Researchgate: https://www.researchgate.net/publication/266317402_Bus_Rapid_Transit_System_in_Bhopal_City_A_Review

[16] Said, M. N. (n.d.). *Dual axis solar tracker with IoT monitoring system using arduino.* International Journal of Power Electronics and Drive System (IJPEDS).

[17] TERI. (2018). *Benefits of Cycling in India An Economic, Environmental, and Social Assessment.*

[18] *The Opportunities of Solar Panel Recycling.* (2020). Retrieved from https://www.greenmatch.co.uk/blog/2017/10/the-opportunities-of-solar-panel-recycling

[19] *Times of India*. (2020, June 26). Retrieved from Madhya Pradesh: India's longest cycling track blocked by rub ..: https://timesofindia.indiatimes.com/city/bhopal/indias-longest-cycling-track-blocked-by-rubble/articleshow/76632860.cms