TO PROPOSE AN EFFICIENT DESIGN OF FLYOVER TO RESOLVE THE TRAFFIC ISSUES THAT OCCURRED ON THE SINHGAD ROAD

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ABSTRACT

Roads are the arteries of the city. Traffic congestion is like a blockage in a city which is very undesirable. Aggravation in traffic congestion reduces the efficiency of the road. To overcome this, various means and ways are available which are not commonly disclosed. Documentation and data analysis for giving appropriate solutions is the main motto of this project. The optimized solutions for suffocated Sinhgad Road and civilians around the area will be studied for the same by using appropriate advanced technologies. Objectives involved in this project are comprehensive transportation and techno-economic feasibility study, reducing congestion on the route, seeking opportunities to expand mobility options, route rationalization for public transport, minimizing adverse impacts on traffic mobility. The strategic action plan for this will include defining work area, plotting station points, traffic survey, and relevant data collection, finalization of transport models, planning and designing models and will be summarized in the form of a prototype. The work is beneficial for reducing travel time, traffic congestion and making public transport efficient. It will also improve the utility of existing traffic management

Keywords: Flyover, Traffic, Sinhgad Road, Traffic Problems, Transportation, Survey.

I.   INTRODUCTION

The Sinhgad road is one of the main traffic-carrying roads in Pune. And most importantly the lifeline for the many students, workers, and many more, Sinhgad Road has witnessed many changes throughout its life and yet manages to survive and meet up to expectations of the "Punker's". But as the growth of the adjacent area and overall Pune was on the crest, the design of the road was struggling to keep up. As a result, the problems like traffic jams, unsafe intersections, delays in travel, and utilities began to compromise. and as one of the main traffic-carrying roads this reputation needed to be restored, this can be done with the civil and planning practices by providing an effective solution to the current design. The government had taken the initiative way back in 2018 by proposing a flyover on this grounds but the political interference started to fill out and the project was delayed. but the development never stopped and the need for this topic of the Sinhgad road was brought up by multiple news editors. So we are to propose our model of the flyover which will help each and every individual who will use the road.

II.   METHODOLOGY

Understanding the large span of the area under consideration there were multiple procedures to be carried out to identify the accurate and exceptional properties of the area. To accomplish this task, a method of surveying and analysis was adapted on a full scale of work. Furthermore, the data collection part contains the investigation part as well. In continuation to that gathering, all the data with a single survey was impossible so there was a need for the multiple no. of surveys which will assist us during the analysis part.

The main surveys which were practiced are as follows: -

1) Topographic survey : Depending on the purpose of the survey and the desired output, there are a few types of topographical surveys to choose from, including a general land survey, boundary survey, and survey for construction projects.

2) Pavement condition survey : Study mainly involves the factors like the current condition of the existing pavement and its behavior while the project is under construction.

3) traffic surveys: (contains multiple terms related to the traffic flow and vehicle orientations) Mainly the traffic capacity and peak hour factor.

4)Photographic survey : it can be described as the time to time moderation of the certain characteristics of the traffic , it involves the capturing photographs of a specific place to identify its behavior throughout the day, to visualize the exact situation .

III.   MODELING AND ANALYSIS

MODEL PROPOSING STRATEGY:

Selecting a most efficient design of a flyover which will serve the people in upcoming times was quite an important concern. While selecting the design of flyover whether it will be single wing or double wing flyover some certain factors were to be considered .The multiple irregular junction points and turns of alignment causes a challenging environment for the single wing flyover to work in these flexible conditions .Different requirements of vehicles to travel on both lanes Each lane has different requirements which can be only satisfied by the two wing flyover . The two wing flyover design will manage the traffic flow by landing vehicles in the described location in order to maintain smooth and safe traffic flow. One more important factor to be taken under consideration is the greenery present at the existing site , to be exact the centre divider has no. Of trees which will unfortunately to be cut down if one wing design of flyover is adopted ,**To encounter all these factors and solve all the problems with the most efficient manner 2 wing design of flyover with desirable takeoff and landing locations is most suitable**.

MODEL PREPARATION:

The main goal is to prepare a model of the overall project which will include the following points : Resolved solutions to current problems. Regular traffic flow patterns will be effective and traffic friendly. It will give the idea of the scale and the quality of the project and the importance of the   design. The modeling part of the "**Tanaji Malusare flyover**" Was mainly done with the help of two software programs . The main motive behind this model preparation is to understand the wide-scale of work and its benefits. The software used while the process is **AutoCAD** and **Sketch-up**

Following are some views of the project which gives us a clear vision of the project
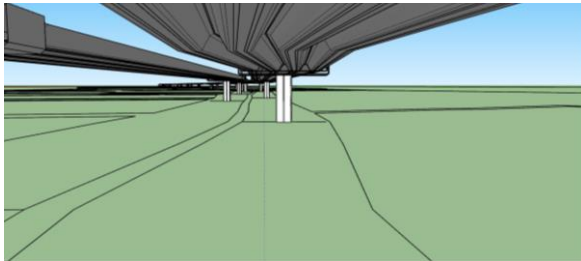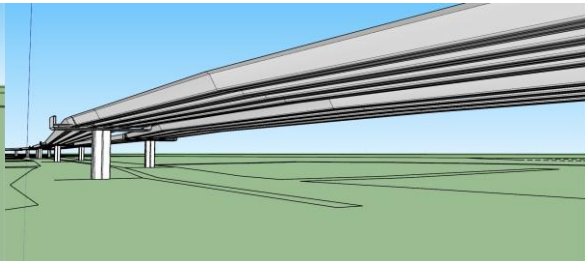

Figure 1: underneath 3D view
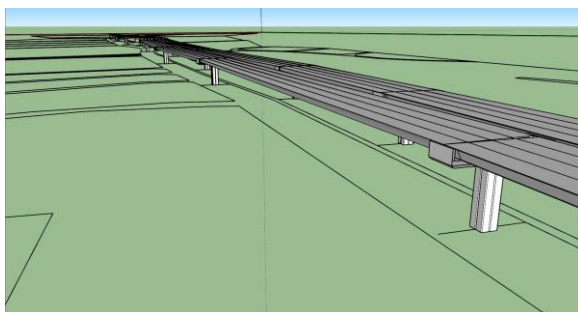

Figure 2: South east 3D view

Figure 3: north east 3D view
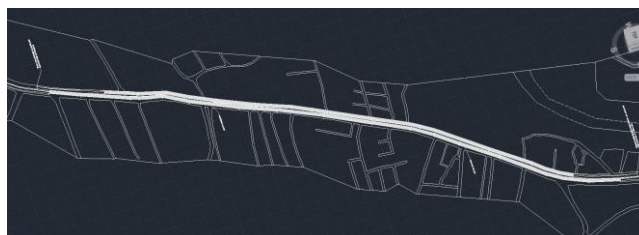

Figure 4 : Elevated 3D view

Figure 5 : Overall Top view

CHARACTERISTISTICS OF PROPOSED MODEL :

The proposed model possesses the following structural characteristics:

Length of 1st wing who's direction of traffic flow is from Rajaram bridge to Funtime multiplex is calculated to be **2.27 km** Starting point of the wing -1 which will endure the traffic coming from Tanaji Malusare road which is connected to the the road which brings the traffic from Saras Baug road also and also from Rajaram bridge and further, it will transfer this traffic towards the Nanded city and back side of Nhare and many more Beginning of this 1st wing is situated at 150m south from rajaram bridge chowk, which is also on the opposite lane of the water treatment plant, and it will end all the way just before funtime multiplex, on the opposite lane side of Sharad hospital. Coordinates are, Start point (18°29'11"N 73°49'42"E), End point (18°28'05"N 73°49'09"E)The 2 nd wing which allows traffic to reach from funtime multiplex towards Rajaram bridge was proposed to be **1.91km** Similarly the second wing of flyover which will be in the opposite lane will follow the same path . but there will be some exceptions ,In spite of starting in front of the funtime multiplex it will start slightly forth from Indian hume pipe Chowk which is also 170m to the north from Sharad hospital. And it will end 250m to the north from the water treatment plant present on one corner of Rajaram bridge also 80m to the south from pawan Maruti shri krishna mandir. Start point (18°28'10"N 73°49'12"E), End point (18°29'07"N 73°49'40"E)**'' these locations will help in minimising all the possible obstacles and counter any adverse condition ''**

IV.   RESULTS AND DISCUSSION

TOPOGRAPHIC SURVEY (INVESTIGATION)-

The main reason behind carrying out this investigation is to study the different physical properties as well as the characteristics of the area under consideration, in the context of classification of zones as well as the factors like core traffic generation or say traffic contribution of this area to the sinhgad road.

To achieve desired information through topographic investigation the method of neighborhood planning was used.

Neighborhood planning-

Figure 6: Area under consideration

AREA CALCULATION

The total area is 160.86 hector

The perimeter of zone is = 6345.17m

The total area is classified into different zones according to their characteristics

The zones are as follow

1) RESIDENCIAL ZONE

It is again divided into 4 categories

a) High income group (HIG) = 14.31 hector

b) Medium income group (MIG) = 28.81 hector

c) Low income group (LIG) = 25.02 hector

d) economically weaker section (EWS) = 2.96 hector
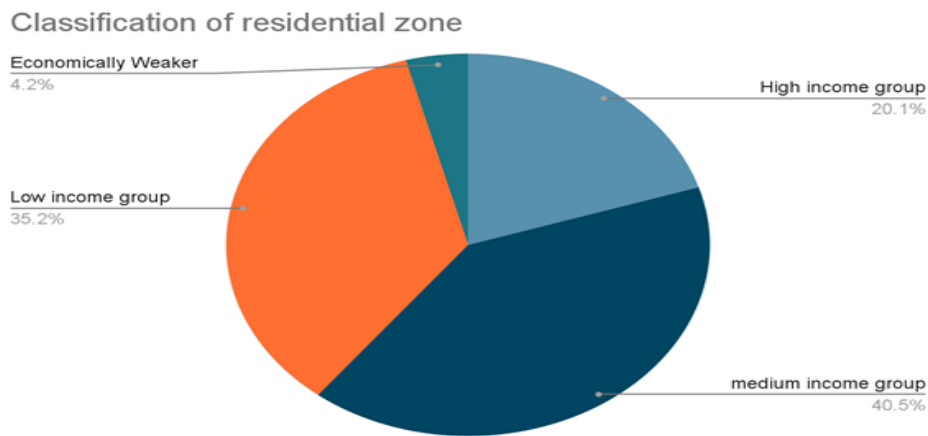
Total residential zone =71.1 hector

Figure 7 : Pie chart- Classification of residential zones

2)COMMERCIAL ZONE

The commercial zone mainly consists of the shopping malls , small retail shops and hotels .

It also includes the business offices and larger wholesale sellers, the street vendors are also present in quite remarkable numbers But due to the variation of the locations it could not be included. Other than that this area has shown a tremendous amount of growth in the commercial sector .Total occupation of the commercial area including all categories is 5.73 hectares.

3) ADMINISTRATIVE AREA

This zone does not actually have much of the administrative zone other than the water treatment plant and some government officials Total occupation of the administrative area is around 3.48 hector

4)EDUCATIONAL INSTITUTES

Educational institutes like colleges, private coaching centers are very few in this area as a result the localities have been suffering a small discomfort. This could be because the major has the institute in the adjoining area. The total sum of the educational zone round off to 0.36 hector

5) OPEN / GREEN ZONE

Despite the busy and congested buildings, this area shows the remarkable presence of greenery and openness. It possesses a total of 16.34 hector of open and green area

6) PUBLIC / REGIONAL

Social gathering places are also an important part which mainly includes the marriage hall, temples, community centers, churches, etc. Its value adds up to 0.45 hector

7) ROAD AREA

This is also the important section of study, the area under consideration has shown a very wide and critical type of road network including the main sinhgad road the total occupation by the road is 6.35 hector

8) UNUTILISED AREA

It is very surprising to find this much busy area possesses this kind of free unused space which could be useful for better purposes. Also, the river around one side has occupied a large space which can be utilized in any better way.

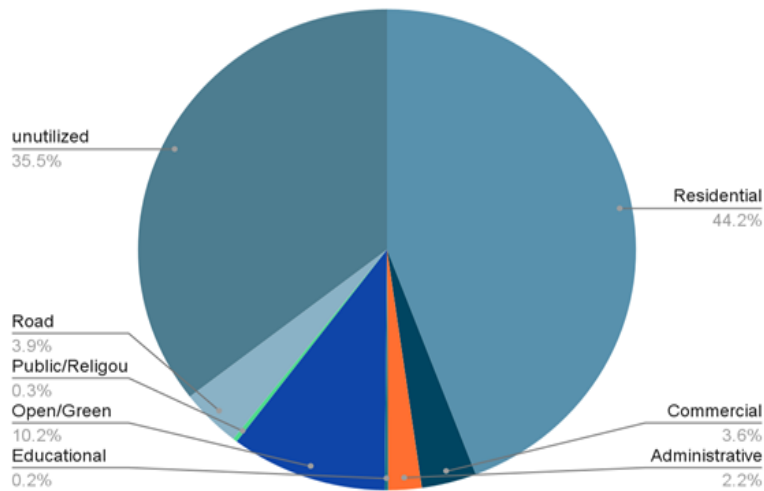The total free space which can be utilized is 57.6 hectares.

Figure 8 : pie chart - Classification of zones

POPULATION DENSITY :

Area in sq.m

High income group (HIG) = 143100 sq.m

Medium income group (MIG) = 288100 sq.m

Low income group (LIG) = 250200 sq.m

Economically weaker section (EWS) = 29600 sq.m

Assume area of apartments

HIG = 450 sq.m

MIG = 300 sq.m

LIG = 185 sq.m

EWS = 130 sq.m

CALCULATION OF NO. OF FLATS , APARTMENTS , BUNGALOWS:-

HIG and MIG also contain the multistorey buildings so in order to get accurate results we have to consider the no. of floors while calculating the no. individual apartments and bungalows , and for LIG and EWS we can take its value as 1.

For HIG no. of average floors is 5 and for MIG it is 3

Therefore

- For HIG total numbers of flats =(total area /assumed area for one flat of HIG) * no. of floors

    = (143100/450)*5

    = 1590

- For MIG = (288100/300)*3

    = 2881

- For LIG = (250200/185)*1

    = 1352

- For EWS = (29600/130)*1

    = 227

Now let's assume no, of people for each group in order to find the population of each class Let no of people 4,5,5,5 for HIG, MIG, LIG, EWS. respectively.

Therefore total no. of peoples for each class is as follows

HIG = No. of flats * Assumed no. of peoples of single flat

    = 1590*4

    = 6360

 MIG = 2881*5

    = 14405

LIG = 1352*5

    = 6760

 EWS= 227*5

    = 1135

Total population = 28660

Population density =Total No. of population / Area under consideration

        = 28660/71.1

        = 403 persons / hector

Core traffic generation / total traffic contribution

In order to complete this study certain assumptions about the vehicles were to be made are given below, Assume

For HIG there is 1 four wheeler and 2 two wheelers in each unit

For MIG 1 four wheeler and 2 two wheelers in each unit

For LIG and EWG only 1 two wheeler for each unit

This brings us to the conclusion that the no. of four wheelers and two wheelers are

Table 1. Core traffic Generation assumptions.

Type of group	No. of Four wheeler assumed per unit	No. of Two wheeler assumed per unit
HIG	1	2
MIG	1	2
LIG	0	1
EWG	0	1

Furthermore multiplying the assumed no. of vehicles with respective income group will give exact no. of vehicles , it can be described as follows

Table 2. Total core traffic contribution .

Types of groups	Total no. of 4 wheelers	Total no. of 2 wheelers
HIG	1590	3180
MIG	2881	5762
LIG	0	1352
EWG	0	227
TOTAL	**4471**	**10521**

As a result we can say that the traffic contribution of the area under consideration is **4471** no. of four wheelers and **10521** no. of two wheelers Commercial vehicles like autorickshaws , private taxis, and buses are in very fewer amounts. So these can be neglected.

PAVEMENT CONDITION SURVEY-

In interest of building a flyover the heavy structure of piles and retaining walls must be constructed on this pavement to support the structure. Also understanding the earth Excavation and piling processes the pavement can be affected very badly if not taken under consideration .In the current scenario the part of the road which we considered is constructed with a rigid type of pavement and material used is concrete. As a theory suggests during construction of the retaining wall as well as pillars /columns of supper structure the escalation work can be reduced in some extent reason behind this is the rigid pavement provides the good compacted surface which helps in decreasing the additional earth work This can result in no requirement of additional work to be done on existing pavement and traffic flow can be easily carried out during the construction and also after the project completion.

TRAFFIC SURVEYS :

To perform the different surveys various methods were adopted, to collect the data the certain junction points were fixed and at the close investigation was made about the vehicles In order to achieve the accurate traffic data and to analyse and compare the data of traffic flow in order to give conclusion about the most used or say most preferred type of transportation Arranging the data in overall time format will help the most As we know from the observations, traffic on Sinhgad road follows a very irregular and uncertain pattern and analyzing this data in an efficient way can give us an outcome which can be used to improve the design .To fulfill this need work plan was made in which a junction point was selected on the basis of busiest traffic and critical vehicle flow conditions on sinhgad road it turned out there are multiple junction points who fits in this conditions but the most favorable conditions to collect data with zero errors and maximum accuracy was manik baug chowk .To gain desired data and information 2 step survey were needed to be carried out reason behind this is traffic shows peaks twice a day which can be referred as peak hours or rush hours so to cover this all the information , actual counting of the vehicles were carried out twice a day which was in morning 8am to 11am and 4 pm to 7 pm in the evening as shown below .

MORNING :

Table 3 :Morning hours traffic readings.

TIME → VEHICLES ↓	8 to 9	9 to 10	10 to 11
Two wheeler	7502	8512	7904
Four wheeler	1120	1251	1501
6 seater	450	512	641
Trucks	55	47	75
Heavy vehicles	82	52	61
Buses	75	81	94

EVENING:

Table 4 : Evening hours traffic readings.

TIME → VEHICLES ↓	4 to 5	5 to 6	6 to 7
Two wheeler	6982	7242	8101
Four wheeler	932	1004	1201
6 seater	331	541	409
Trucks	88	92	103
Heavy vehicles	75	81	92
Buses	71	79	83

PEAK HOUR FACTOR-

Peak hour factor has a strong impact on traffic analysis result , its is most useful in determining the situation of the road on the basis of the traffic flow .Our goal is to find a peak hour factor corresponding to the above data in order to determine the current situation of the road which will be provided by the range of peak hour factor. It can be calculated as follows

Peak hour factor

$$(PHF) = V / (v15*4)$$

Where ,

V is Hourly volume of traffic

v15 maximum 15 min flow rate within hourly volume

Therefore, As above table table no. 4 it suggests hourly volume i.e. **V** is 8479

Also the maximum 15 min flow rate within hourly volume was found to be i.e. **v**15 is 2231

Now

$$PHF = 8479/ (4*2231)$$
$$= 0.95$$

As per IRC range for the "PHF" is as follows

FOR CONGESTED AREA:0.95

FOR URBAN AREA :0.92

FOR RURAL AREAS :0.88

This suggests that the rush hour traffic at sinhgad road is at a very crucial point and could be harmful for the people using it if not taken care of .

TRAFFIC CAPACITY

Term traffic capacity means it is the maximum number of vehicles in a lane or a road that can pass a given point in unit time, usually an hour. Also we can describe it as vehicles per hour per lane or roadway.

In the interest of determining whether the current design of the road can sustain the traffic volume there are certain parameters that it should uphold.

As per IRC 106-1990 traffic capacity for six lane two way road is considered to be 5400 PCU

To compare with this standards the data we collected must be converted into the **PCU** units which can also be done with the use of **IRC 106-1990**

PCU - (Passenger car unit) it is equivalent used in transportation engineering to assess the traffic flow on the highway

In other words any road consist of mixed type of traffic containing bikes, cars , trucks, buses, etc . as a result when there is actual comparison between these vehicles each have different speed and dimensions PCU encounter this situation by giving a specific value to each vehicle according to its speed and dimensions ,

In this factor passenger car is considered to be 1 that's why it is termed as pcu. Following are some values of PCU which will help us in our study .

EQUIVALENT PCU FACTOR

Table 5 : Equivalent PCU Factors for different vehicles as per IRC

Vehicle type	5%	10% and above
Fast vehicles		
1)Two wheeler motorcycle or scooter, etc	0.5	0.75
2) passenger car , pickup van	1.0	1.0
3) Auto-rickshaw	1.2	2.0
4)light commercial vehicle	1.4	2.0
5)truck or buses	2.2	3.7
6) Agricultural tractor trailer	4.0	5.0
Slow vehicles		
7) Cycle	0.4	0.5
8) Cycle Rickshaw	1.5	2.0
9) Tonga (Horse drawn vehicle)	1.5	2.0
10) Hand cart	2.0	3.0

Hence to calculate the traffic capacity let us consider the one hour data of the morning session from 8am to 9am from table no.4Calculating all the factors according to the PCU we get the value which is **7735 PCU**

This indicates that the current design of the sinhgad road has already crossed its maximum traffic capacity which is **5400 PCU.**

This leaves us to the only conclusion that the proper management of traffic must be carried out with full efficiency , this can be achieved by proposing a design of flyover which will encounter these problems very effectively .

PHOTOGRAPHIC SURVEY :

It can be described as it is a method most useful for the accurate visualization of the desired area in the interest of gathering the suitable information , during execution of this survey different locations of the study area was selected and then their photographs were taken in order to analyse the proper flow of the vehicles and also the point of maximum interests can be investigated closely and if there are any problems or uncertainties they were rectified efficiently . Following are some images which will help us in our studies .

Figure 9 : Traffic signal at Sinhgad khau galli   **Figure 10 :** Traffic flow moderation at junction

Figure 11 : Commercial zone on road   **Figure 12 :** Different vehicles moderation

Figure 13 : Roadside parking space   **Figure 14 :** High altitude image for overall view

V.   JUNCTION POINTS / POINTS OF INTERSECTIONS

Furthermore, the various junction points which were established over the span of the years were found to be affecting the traffic on the road by creating unnecessary traffic to stop on the multiple locations. Our source and destination points are Funtime multiplex and Rajaram road respectively. These destination points are usually heavy on traffic. The reason being, all the prominent places lie in between these places. 4 prominent chowks invite traffic all around the Pune right here at this place, namely:

1. Veer Baji pasalkar chowk -

Veer Baji Pasalkar chowk is a school road, where all the school buses pass from. The school bus stop is here itself, which leads to traffic during school hours. Especially morning and noon hours.

Figure 15 : Satellite photograph of Veer Baji Pasalkar chowk

2. Manik Baug chowk:-

This chowk has a garden nearby. Hence evening hours are highly occupied.Also, early mornings are occupied where people are out for a morning walk.

Figure 16 : Satellite photograph of Manik Baug Chowk

3. Hingane chowk: This Hingne chowk has quite a busy road because of traffic signals which again accumulated to stagnant traffic.

Figure 17 : Satellite photograph of Hingane Chowk

4) Rajaram chowk: Rajaram chowk is used for commute purposes to travel to main places like Swargate and Kothrud.This leads to heavy traffic

Figure 18 : Satellite photograph of Rajaram Chowk

Another reason for increasing traffic is excess traffic signals which are due to increased demographics in this prominent area. There are total 5 signals between Fun Time multiplex and Rajaram Bridge they are:-

1 - Near khau GalliBaug(Sinhgad college road) near bhavani medical

2- manikbag chowk (near hotel Bramha)

3- near Santosh hall

4- hingne chowk (near brand factory)

5- canal road connect sinhgad road

FUTURE GROWTH PERSPECTIVE:

One of the main reasons behind all the problematic situations occurring on the Sinhagad road is the unplanned growth of the area under consideration. When the road was proposed initially, the width of the road and the surrounding population were found to be only 30% today. Over the years the humongous growth and development of residential as well as the commercial sector were seen to be at a very rapid rate to sustain this rapid growth rate the road was widened many times. But the widening of the road only gave relief from the problem for a certain amount of time but didn't rectify it thoroughly. So to provide the solution that will not only solve the current problems but also sustain the future growth by not violating the environment as well as a human habitat. Topographical studies were carried out over the surface, it shows that the growth of this surrounding area is exceeding on a very tremendous rate, in future, it will result in an overcrowding and unhygienic neighborhood. Furthermore, the population of the area which was derived from the increase in residential area growth was found to be growing at the annual rate of 1.50% studies have also found that the traffic flow on the road is getting affected by the improper and unmanaged population growth Analyzing every factor of the traffic and the adjacent area the only solution to these multiple problems is proposing a superstructure of a flyover. The planning of this large-scale project was tremendous work that required days of work. The most challenging part of the design of this structure was the small amount of space we have to work on, as we know the existing road is suffering from a shortage of space and not fulfilling its demands .

VI.   CONCLUSION

Studying and analyzing all the data

It was found that the travel time of the regular vehicle on current design is 13 to 14 minutes (with proper working traffic signals) Our studies suggest that with the flyover **we can reduce this time upto 3 to 4 min That means we are able to reduce travel time by 70%**

- also the flyover is proposed in such a way that all the junction points and critical points of intersection are avoided which ultimately **reduce the chances of accidents**

- as the traffic data suggests New design of flyover will encounter **60%** of traffic resulting in low panic situations at the time of **rush hour.**

ACKNOWLEDGEMENTS

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