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Capacity Analysis of Existing National Highway Network between Lucknow to UP/Bihar Border (Ghazipur)

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Abstract

This Study highlights the concept of traffic capacity analysis along with safe traffic operations in the highways. The Traffic Management system is needed to movement of Men and Material from one place to another place safely, economically and comfortably. The safe and economical movement of people and goods depends upon the effectiveness of Traffic Management System. A significant effort has been made in order to study the traffic assessment for a Greenfield Expressway. For better understanding of present status and estimation of traffic along the proposed Greenfield Expressway, a reconnaissance study was conducted before finalization of traffic survey location along the alternate routes. The development and extension of transportation are intrinsically linked to the progress of the human race, which has occurred in tandem with those developments and expansions. The roadways were never used for anything other than as pedestrian paths. The single most significant step forward in the development of technology related to road transportation was the discovery of the wheel. At first, people and animals were responsible for moving various sized and shaped vessels on wheels. Later on, motors were used instead of humans or animals.

1. Introduction

A major issue in the field of transportation is mobility and, more specifically, how this mobility is manifested in a broad range of environmental and social contexts. Mobility is a geographical endeavour in that it requires the exchange of space for a fee. Although technological and economic pressures have altered the structure and features of mobility several times in the past, a rising quantity of space has become available at a comparable cost in recent decades. As a result, it should come as no surprise to learn that technological advancements have enabled increases in transportation speed, capacity, and efficiency throughout time. Because of this increased mobility, both people and organisations have been able to take use of it to their benefit. The ability of transportation networks to convey enormous amounts of freight while also accommodating large numbers of people is the driving force behind the global economy in the modern era. The globe has grown more linked on a variety of scales. This new spatial view on transportation goes beyond the more conventional perspective of transportation, which was previously centred primarily on the city. Road transportation is one of the oldest ways of transportation available among the many kinds of transportation. Early civilizations relied on road transportation and travel, which may be traced back to very ancient times. Because of its progress during the previous fifty years, the country's economic structure has undergone radical transformation.

Traffic volume study was conducted to access the number of vehicles at selected location. Traffic operation in India is Heterogeneous. The traffic volume can be expressed in Passenger Car Unit (PCU) per hour. The main goal of this study is to estimate the existing traffic volume and capacity on the alternate and expressway traffic by using the diversion equations.

A. Objective

- To assess the traffic in existing National Highway between Lukcnow and UP/Bihar Border.
- To make dataset for the traffic volumes categorizing into the majority vehicles and at different times.
- To analyse the traffic data of existing highway for decongestion of existing network.

B. Scope

- Identify the survey locations based on reconnaissance study.
- Conducting the traffic volume study and Origin-Destination Survey at control points along the National Highways.
- Reduce the congestion along the existing routes.
- Lower the travel time and vehicle operation cost of Road users.

2. Literature Review

- Abhishek et al. (2017) the transient and stationary queue-length distributions of a class of service systems with associated service times should be investigated. Determine, via the use of statistics, how the average length of the line is affected by variations in the total number of consumers who make use of the service during a single session of operation.
- Abhishek, Boon and others, (2016) The unsignalized crossroads that is utilised by two different traffic streams is the focus of this article. One stream of vehicles gets precedence over another stream that is utilising a secondary route because the principal road is being used. When the distance between two successive automobiles on the main road is greater than their critical headways, cars that belong to the later stream will move over to the primary road to continue their journey.
- Queija et al. (2018) Within the scope of this study, we investigate a single server queue with semi-Markovian service times and batch arrivals. In addition to this, we incorporate the possibility that the distribution for the first service of each busy period may be different from the distribution for subsequent service times. By using a technique that is based on generating functions, we are able to establish the heavy traffic limit of the scaled queue-length distribution.
- Nallathiga, Ramakrishna. (2019) Since the late 1990s, India has placed a high premium on the construction of highways, which has allowed the country to accelerate the speed at which it builds roads. The economic liberalisation that began in 1992 is a significant factor in the background of this situation. The National Highway Development Initiative (NHDP), which was the first major programme to be established in 1997 to create a huge highway network throughout the nation, began operations in 1998. Given the greater obstacles and the need of leveraging private investments into the sector, India began using the Public Private Partnerships (PPP) model of road and highway construction in 2001. This was done in response to the requirement to leverage private investments. As a direct result of it, a significant number of contracts were given out in accordance with Build, Operate and Transfer (BOT) variations of PPP as well as other PPP models. This article first examines the development of India's road and highway sector in terms of the method that has been adopted, and then goes on to highlight some of the industry's most important characteristics. In conclusion, it also examines the most significant problems and obstacles that have recently arisen in the industry.
- K. Tiaprasert, Y. Zhang, X. B. Wang, and X. Zeng, (2015) In this study, a mathematical model for real-time queue estimates using technologies derived from connected vehicles (CV) and wireless sensor networks is presented. Estimating the length of the queue in order to perform queue-based adaptive signal control is the goal here. The suggested model may be used in situations when essential inputs such as signal timing, traffic volume, or queuing characteristics are not present. In addition, the model is constructed such that it is compatible with signals that have either a fixed or an actuated time interval.
- A. Y. S. Lam, Y.-W. Leung, and X. Chu, (2016) [37] The technology behind autonomous cars (AVs) is maturing, and in the not-too-distant future, we may expect to see an increase in the number of AVs on the roads. AVs become linked with the assistance of a variety of vehicular communication technologies, and they possess a high degree of control to react to immediate conditions collaboratively while maintaining a high level of efficiency and flexibility. In this article, we provide a case for the adoption of autonomous vehicles (AVs) over existing public transit networks.

3. Methodology

The Traffic Volume study may be conducted either manually or by using the mechanical or Automatic counters.

Manual count employs a field team of enumerators at the count location. The enumerators do the count of vehicles which are passing the selected location and record them on prescribed sheets.

The automatic traffic counters cum classifiers are mechanical counter which can automatically record the total number of vehicles crossing the selected location.

There are number of methods for conducting the Origin – Destination survey i.e., Road Side Interview method, Licence Plate method, Return Post Card method, Tag on car method and home interview method.

For the present study, Manual count method for traffic volume count and Road side interview method for has been adopted in order to estimate the traffic on existing alternate routes.

A. Location:

In order to Achieve the goals, traffic volume count and Origin-Destination surveys were conducted at 2 locations along various section of highways.

Table No. 1: Survey Locations

S. No	Location Name	Section Name
1	Ahmadpur Toll plaza	Barabanki - Faizabad section of NH-27
2	Bara Toll plaza	Lucknow - Sultanpur section of NH-731

4. Data Collection and Analysis

The traffic data was collected by conducting the traffic surveys at the selected locations. the PCU factors adopted for the study is mentioned below.

Table 2: PCU factors

Motorized Traffic		**Non-Motorized Traffic**	
Vehicle Type	**PCU**	**Vehicle Type**	**PCU**
2-Wheeler	0.5	Bi-Cycle	0.5
3-Wheeler / Auto rickshaws	1.0	Cycle-Rickshaw	2.0
Car / LMC / Jeep / Van	1.0	Animal Drawn Vehicle (ADV)	6.0
LCV / LGV (Mini Truck)	1.5	Hand Cart	3.0
Mini Buses	1.5	Other Non-Motorized Vehicle	3.0
Buses / Truck (2 Axle)	3.0		
3 Axles commercial vehicles	3.0		
MAV (4-6) Axles	4.5		
Heavy Construction Machine (HCM)	4.5		
Earth Moving Equipment (EME)	4.5		
Oversized (more than 6 axles)	4.5		
Agri. Tractor without Trailer	1.5		
Agri. Tractor with trailer	4.5		

The survey result was used to assess the intensity of traffic, hourly & daily variation and traffic characteristics. The average traffic at the survey locations in Nos and PCUs are:

Table 3: ADT

S. No	Location Name	Traffic	Traffic PCUs
1	Ahmadpur Toll plaza	41169	50674
2	Bara Toll plaza	14781	18122

In order to analysed the diverted traffic on greenfield expressway, the cost ratio diversion curves have used to estimate the amount of traffic. Traffic that is expected to be diverted from the alternate route to New Greenfield Route is evaluated using diversion curves, which compute the ratio of perceived costs on the competitive/alternative facilities in this technique. According to the model, if the perceived cost on the study route is lower than the perceived cost on the alternate route, the vehicles will divert to the study road.

Table 4: Diversion Curve Equations

Vehicle	Cost Ratio Interval	Relationship
Car	R <4.465 4.465 <=CR <= 2.00	98.75 – ((CR/0.634)* 8.125) 90.625-((CR-0.634)/0.831)*84.375 %Div = 6.25-((CR-4.465)/0.535))*5.25
Truck & Buses	CR <=4.25 4.25<=CR <=2.00	100-(CR/0.75)*5 95-((CR-0.75)/.5)*90 % Div= ((2-CR)/0.75)*5

The Greenfield expressway represents an overabundance of control. Only traffic from the exit/entry nodes may enter and depart the expressway. There are 13 exit/entry nodes. The estimated average diverted traffic on greenfield expressway from various alternate routes is 11500 PCUs in year 2021-22. The corridor would have three components of traffic i.e. Diverted traffic, Development traffic and Generated / Induced traffic.

Development traffic is that traffic which is result of development of new nodes along the study routes.

Generated / Induced traffic is the traffic which comes on study route because of new infrastructures along the study area.

5. Conclusions

Once the study corridor is developed, it improves the connectivity between important places and towns with fast movement and it will attract more traffic. This section presents the assessment of this additional traffic on the Study Route. The findings of this study will be used as inputs for traffic predictions, pavement design, and the development of capacity augmentation ideas. Currently, existing routes are running about to reach its capacity. Once, Purvanchal expressway will opened to traffic, congestion along the existing route will be reduced.

Purvanchal expressway is an Access Controlled Expressway. it would provide benefits like fuel-saving, time saving and Control in Pollution level, along with reduction in accidents. The areas along the Expressway would be benefited in a Social & Economical also.

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