

GIS-Based Traffic Prediction and Traffic Management of Ganga Expressway, Uttar Pradesh, India

Sangam Dwivedi^{*1}, Prof. A.K. Singh²

^{*1}M.Tech Student, Department of Civil Engineering (Transportation Engineering), Motilal Nehru National Institute of Technology Allahabad, Prayagraj, India

²Professor, Department of Civil Engineering, Motilal Nehru National Institute of Technology Allahabad, Prayagraj, India

ABSTRACT

Article Info

November-December-2022

Publication Issue :

Volume 6, Issue 6

Page Number : 148-157

Article History

Accepted : 03 Dec 2022

Published : 30 Dec 2022

“Ganga Expressway Project” is an important project for Uttar Pradesh. This project will provide direct connectivity from Meerut to Prayagraj. Traffic prediction is the study the of numbers and types of vehicles that will use this expressway in the future. It is essential to know traffic load up to design period planning and design of an expressway. It also helps to maintain the level of service, estimate funds required in the present and future, and also the management of pavement health. In this paper, to establish the traffic growth rate up to 2060, the registration vehicles data and moving vehicles data were collected from the “Annual Report for the year 2021-22 of Uttar Pradesh Transport Department. The Ganga Expressway influences major districts of Uttar Pradesh. So, it is assumed that the growth rate of vehicles in Uttar Pradesh is similar to the proposed expressway. The traffic growth rate is calculated based on past data trends according to IRC 108 1996, and the elastic model is based on Per- Capita Income, NGDP, and Population of Uttar Pradesh as per IRC 108 2015. With the fluctuation of the developing economy, the Traffic Growth Estimation compared with nearby expressways and growth cars car, LCV and truck increased by 2%. After finding out the traffic growth rate, traffic is predicted and the required number of lanes is calculated for traffic management.

Keywords: DPR (Detail Project Report), AADT (Average Annual Daily Traffic), NGDP (Net Gross Domestic Product), PCI (Per Capita Income), Traffic Growth Rates, Traffic prediction, Capacity constraints.

I. INTRODUCTION

Ganga Expressway is an expensive infrastructure. After the construction of the expressway, it is

important to maintain its level of service for traffic movement. In terms of both goods and passenger traffic, the growth of road traffic has increased from 71 thousand to 12 lakh between 1980 and 2020 in Uttar Pradesh. As traffic increases beyond the design limit of any transport facility, it affects the structure

of pavement resulting in higher vehicle operating costs, an increase in the number of accidents, and a reduction in the reliability of transportation services. Good traffic management planning distributes the traffic load and reduces the excess load on the pavement. Hence, traffic management is important to estimate the cost required for construction as well as maintenance. Traffic data is also deciding factor for the width of the carriageway, for which capacity analysis is carried out by which, the required number of lanes is suggested.

II. STUDY AREA

The proposed Ganga Expressway begins at km NH-334 near village Bijoli (Dist. Meerut) and ends at Prayagraj Bypass on NH-19 near Judapur Dando. The expressway is 593.947 km long and has been divided into 12 packages, with 18 locations chosen along the expressway's alignment for Node development as shown in table 1.

Table 1 : Packages of Ganga Expressway

Package No.	Section Details	Chainage (km)		Length
		From	To	
I	Bijoli Village (Meerut) to Chandner Village (Hapur)	7.900	56.900	49.000
II	Chandner Village (Hapur) to Mirzapur Dugar Village (Amroha)	56.900	86.900	30.000
III	Mirzapur Dugar (Amroha) to Nagla Barah Village (Budaun)	86.900	137.600	50.700
IV	Nagla Barah Village (Budaun) to Binawar Village (Budaun)	137.600	189.700	52.100
V	Binawar (Budaun) to Girdharpur (Shahjahanpur)	189.700	236.400	46.700
VI	Girdharpur Village (Shahjahanpur) to Ubariya Khurd Village (Hardoi)	236.400	289.300	52.900
VII	Ubariya Khurd Village (Hardoi) to Pandra Lakhanpur Village (Hardoi)	289.300	341.700	52.400
VIII	Pandra Lakhanpur Village (Hardoi) to Raiyamau village (Unnao)	341.700	391.900	50.200
IX	Raiyamau Village (Unnao) to Sarso Village (Unnao)	391.900	445.000	53.100
X	Sarso Village (Unnao) to Terukha Village (Raebareli)	445.000	496.800	51.800
XI	Terukha Village (Raebareli) to Arro Village (Pratapgarh)	496.800	548.800	52.000
XII	Arro Village (Pratapgarh) to Judapur Dando Village (Prayagraj)	548.800	601.847	53.047
Total				593.947

1.2. DATA COLLECTION

To find out the traffic growth rate and traffic predictive following data has been collected.

- Traffic survey data are taken from a detailed project report the of Ganga Expressway.
- Package-wise base traffic (AADT) for 2020 on the proposed expressway is calculated with help of the expansion factor, diversion percentage of traffic, and generated traffic in DPR.
- Registered vehicles data is collected from the Annual Report the for the year 2021-22 “कार्कलाप

पुस्तिका” of the transport department of Uttar Pradesh.

- Population data from 2011-20 of Uttar Pradesh is taken according to census 2011.
- Economic parameter (Net Gross Domestic Product and Per Capita Income) is taken from “Economic and Statistic Division State Planning Institute Planning Department, Uttar Pradesh”.

1.3. OBJECTIVES

- The main objectives of this paper are.

- To find the vehicle growth rate of Uttar Pradesh from 2020 to 2060.
- To forecast the population of Uttar Pradesh for 2060.
- To forecast the NGDP and PCI of Uttar Pradesh for 2060.
- To find out the capacity of 6 lanes and 8 lanes of the proposed expressway at peak hours.
- To check the suitability of predicted traffic and find out the year when will the number of lanes increases from 6 lanes to 8 lanes.
- Collected average daily traffic data from DPR is converted into AADT by applying a seasonal correction factor.
- Node-wise expanded matrices are developed by applying expansion factors which are developed by roadside interviews during the origin-destination survey.
- Candidate traffic that is moving parallel to the proposed expressway, is calculated from expanded matrices.
- Diversion percentage is calculated on basis of cost ratio on proposed road to alternate road.
- To find out base traffic / Toll able traffic, diversion percentage is applied and generated traffic is added.

2. BASE TRAFFIC ON PROPOSE EXPRESSWAY

To find out the base traffic on the proposed expressway, steps are followed.

Table-2 : Base Traffic for 2020

Section	Car	Bus	LCV	2 Axle Truck	3 Axle Truck	Multi Axle Truck	Total Vehicles (Nos.)	Total Vehicles (PCUs)
A-B	854	110	390	332	696	1817	4198	13,029
B-C	911	148	473	416	820	1949	4717	14,543
C-D	951	162	548	439	901	2014	5015	15,342
D-E	893	156	548	439	901	2012	4951	15,261
E-F	943	159	584	477	945	2062	5171	15,842
F-G	988	173	595	477	945	2062	5241	15,945
G-H	1000	142	616	548	1004	2211	5522	16,959
H-I	867	134	516	520	1000	2206	5242	16,528
I-J	1143	154	717	634	1128	2349	6126	18,540
J-K	1208	156	781	629	1183	2366	6323	18,931
K-L	1170	159	720	639	1155	2358	6201	18,720
L-M	1077	153	569	582	1084	2330	5795	17,871
M-N	1121	172	628	594	1121	2135	5696	17,183
N-O	1076	143	737	498	953	1942	5273	15,551
O-P	1103	135	695	436	804	1817	4915	14,298
P-Q	1287	164	727	457	799	1825	5185	14,704
Q-R	1237	159	713	457	799	1825	5116	14,618

3. TRAFFIC GROWTH RATE

To establish the future traffic growth rates, Approaches are preferred.

- Growth rate of registered vehicles.

- Growth rate of moving vehicles influenced by population and economic factors.
- Adopted growth rate.

3.1. GROWTH RATE OF REGISTERED VEHICLES

The Ganga Expressway influences major districts of Uttar Pradesh. So, it is assumed that the growth rate of vehicles in Uttar Pradesh is similar to the proposed expressway. Past trends can be established from vehicle registration detail of Uttar Pradesh and assume the growth rate of the proposed expressway is equal to the average growth of vehicle registration in Uttar Pradesh. The growth rates for various modes of Vehicles are estimated and presented in the graph. This growth rate does not show a definite pattern

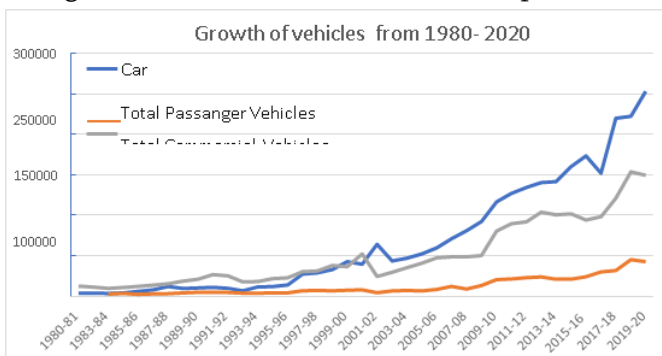


Figure 1 : Growth rate of vehicles from 1980-2020

Therefore, other rational approaches were explored to derive realistic growth rates. The Cumulative Average Annual Growth Rate of Vehicles (%) is calculated with the help of formulae as per IRC: 108-1996.

$$P_n = P_0 (1+r)^n$$

Where P_n and P = Traffic in the n th and base year n
 n = Number of years

r = Annual Rate

$$\log_e P_n = \log_e P_0 + n \log_e (1+r) \quad Y = a + b.n$$

$$a = \log_e P_0 \text{ and } P_0 = e^a$$

$$b = \log_e (1+r), \text{ and } (1+r) = e^b$$

Table 3 : Cumulative Average Annual Growth Rate of Vehicles from past traffic data

Year	Vehicle	Equation	CAAGR %	R ²
1980-20	Car	$P_n = 3854.513 (1.1213)^n$	12.13	0.9677
1980-20	Passenger Vehicle	$P_n = 1929 (1.078)^n$	7.81	0.9107
1980-20	Commercial Vehicle	$P_n = 10013.606(1.0711)^n$	7.11	0.9387

3.2. GROWTH RATE OF MOVING VEHICLES INFLUENCED BY POPULATION, ECONOMIC PARAMETERS

Traffic growth is also depending on economic parameters like Gross National Product (GNP) or Gross Domestic Product (GDP), Agricultural Output, Industrial, and Population. Elasticity of transport (traffic) demand, is defined as the ratio of percentage

change in traffic to the percentage change in socio-economic parameters. The concept of developing regression is widely used in transportation engineering. The preferred dependent variable is past traffic moving vehicles in Uttar Pradesh. Socioeconomic parameters are the independent variables. The selection of independent variables is determined by the type of vehicle. It is natural to

associate traffic growth with NSDP, PCI, and population growth. Estimate the past elasticity of traffic growth from the time series of registered vehicles of influencing states. Assessment of future elasticity values for major vehicle groups, namely, cars, buses, and trucks.

Table 4: Economic parameters of Uttar Pradesh from 2011 to 2020

Years	n	NSDP	PCI	Population
2011-12	0	645132	32002	203573106
2012-13	1	673552	32908	207644568
2013-14	2	707469	34044	211797459
2014-15	3	729686	34583	215609813
2015-16	4	790993	36923	219722687
2016-17	5	888453	40847	223897418
2017-18	6	923806	41832	227920005
2018-19	7	979159	43670	232072879
2019-20	8	1015735	44618	237095024

Growth Rate for Goods Vehicles = NSDP Growth Rate * Elasticity Value
 Freight: Rail is used for mainly for goods of the primary sector (Mining, and Agricultural), and the secondary sector (Manufacturing and construction sector). The road is used the for Tertiary sector

(mainly service industries). Freight traffic is directly linked to the growth in the “NSDP” of those regional and state economies.

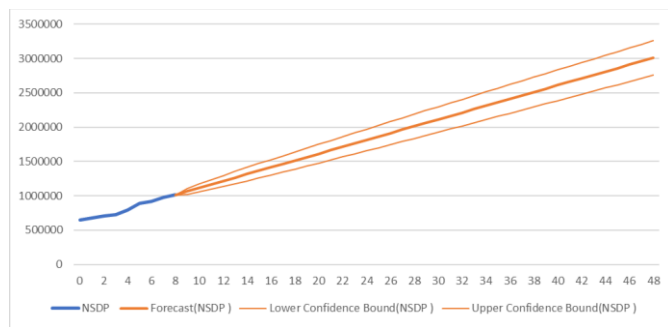


Figure 2: Forecast of NSDP of Uttar Pradesh

Passenger: In Uttar Pradesh, total vehicle ownership is 10.26 per 100 population, but car ownership is only

0.75 per 100 population. As a result, passenger traffic is directly related to population growth and average per capita income growth in Uttar Pradesh.



Figure 3: Forecast of Per Capita Income of Uttar Pradesh 2020 to 2060

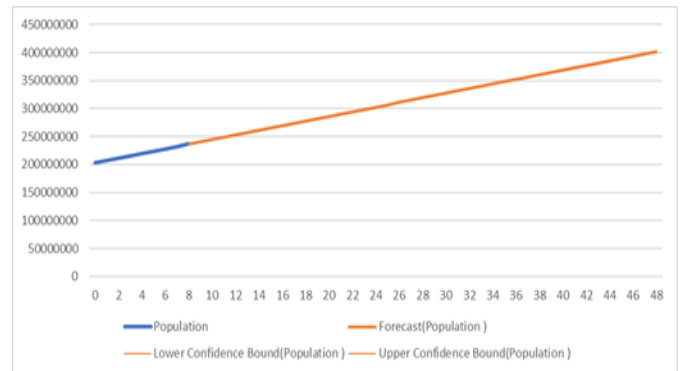


Figure 4: Forecast the population of Uttar Pradesh 2020 to 2060

After regression analysis of cars with PCI, Passenger with population, and Truck with NSDP, the following relationship is developed.

Table 5: Economic Models for the growth rate of traffic

Vehicles	Econometric models	R ²	Elastic Value
Car	Ln P = -11.317 + 2.487 Ln (PCI)	0.9671	2.4387
Bus	Ln P = -131.49 + 7.4187 Ln (Population)	0.9894	7.4187
Truck	Ln P = -11.218 + 1.7978 Ln (NSDP)	0.9597	1.7978

ADOPTED GROWTH RATE

The growth rate of multi-axle vehicles is assumed to be 0.25 percent higher than that of LCVs. Developing countries at a similar stage of development have seen significant growth in these vehicles. The growth rate of vehicles is a prediction of some parameters which

may vary with time. So, the best way to compare the growth rate nearby expressways. So, here I compared the growth rate to the growth rate of NH19, the Purvanchal expressway growth rate calculated from past data and elastic modal. The adopted growth rate is taken at maximum value by comparing specified above.

Table 6: Comparison of growth rate

Year	Car+Jeep+Van (CJV)	Bus	Mini Bus	Light Commercial Vehicle (LCV)	2-Axle Truck	3-Axle Truck	Multi Axle Vehicle (MAV) Trucks
NH19 Growth Rate %							
2012-17	6.91	14.62	0.81	0.27	5.65	5.65	6.34
Purvanchal Expressway Growth Rate %							
2015-20	11.07	6.67	6.67	9.8	8.06	10.17	10.7
2020-30	9.97	5.86	5.86	9.14	7.34	9.51	10.03
2030-40	7.22	3.83	3.83	7.5	5.55	7.86	8.35
Ganga Expressway Growth Rate % (Past Data Regression)							
1980-20	12.13	7.81	7.81	7.11	7.11	7.11	7.11
2000-20	9.5	11.5	11.5	8.8	8.8	8.8	8.8
2010-20	7.72	8.2	8.2	5.5	5.5	5.5	5.5
Ganga Expressway Growth Rate % (Elastic Model)							
2010-20	10.44	14.27	14.27	10.81	10.56	10.56	10.56
2020-30	8.20	11.85	11.85	7.59	7.34	7.34	7.34
2030-40	6.03	10.43	10.43	5.52	5.27	5.27	5.27

After comparison of the above highways and uncertainty in the growth of traffic, a 2% increase is added in cars, LCVs, and Trucks in the Elastic Model.

Table 7: Adopted growth rate %

Year	Cars	All Buses	2-Axle Trucks	3-Axle Trucks	MAV (4+ axles)	LCV
2020-21	11.95	11.09	11.0 4	11.0 4	11.0 4	11.2 9
2021-22	11.15	12.74	10.3 9	10.3 9	10.3 9	10.6 4
2022-23	10.82	12.52	10.0 2	10.0 2	10.0 2	10.2 7
2023-24	10.51	12.31	9.68	9.68	9.68	9.93
2024-25	10.22	12.11	9.36	9.36	9.36	9.61
2025-26	9.95	11.92	9.07	9.07	9.07	9.32
2026-27	9.70	11.73	8.81	8.81	8.81	9.06
2027-28	9.47	11.55	8.56	8.56	8.56	8.81
2028-29	9.24	11.37	8.33	8.33	8.33	8.58
2029-30	9.04	11.20	8.11	8.11	8.11	8.36
2030-31	8.84	11.03	7.91	7.91	7.91	8.16
2031-32	8.65	10.87	7.72	7.72	7.72	7.97
2032-33	8.48	10.71	7.55	7.55	7.55	7.80
2033-34	8.31	10.56	7.38	7.38	7.38	7.63
2034-35	8.15	10.41	7.22	7.22	7.22	7.47
2035-36	8.00	10.27	7.08	7.08	7.08	7.33
2036-37	7.85	10.13	6.94	6.94	6.94	7.19
2037-38	7.72	9.99	6.80	6.80	6.80	7.05
2038-39	7.59	9.86	6.68	6.68	6.68	6.93
2039-40	7.46	9.73	6.56	6.56	6.56	6.81
2040-41	7.34	9.60	6.45	6.45	6.45	6.70
2041-42	7.23	9.48	6.34	6.34	6.34	6.59
2042-43	7.12	9.36	6.24	6.24	6.24	6.49
2043-44	7.01	9.24	6.14	6.14	6.14	6.39
2044-45	6.91	9.13	6.05	6.05	6.05	6.30
2045-46	6.81	9.02	5.96	5.96	5.96	6.21
2046-47	6.72	8.91	5.87	5.87	5.87	6.12
2047-48	6.63	8.81	5.79	5.79	5.79	6.04

2048-49	6.54	8.70	5.71	5.71	5.71	5.96
2049-50	6.46	8.60	5.64	5.64	5.64	5.89
2050-51	6.38	8.50	5.57	5.57	5.57	5.82
2051-52	6.30	8.41	5.50	5.50	5.50	5.75
2052-53	6.23	8.31	5.43	5.43	5.43	5.68
2053-54	6.16	8.22	5.37	5.37	5.37	5.62
2054-55	6.09	8.13	5.30	5.30	5.30	5.55
2055-56	6.02	8.04	5.24	5.24	5.24	5.49
2056-57	5.95	7.96	5.19	5.19	5.19	5.44
2057-58	5.89	7.87	5.13	5.13	5.13	5.38
2058-59	5.83	7.79	5.08	5.08	5.08	5.33
2059-60	5.77	7.71	5.03	5.03	5.03	5.28

4. REQUIREMENT OF NUMBER OF LANES

4.1. TRAFFIC PROJECTION

Table 8: Total traffic (PCUs) from 2020 to 2060

Section	B-C	C-D	D-E	E-F	F-G	G-H	H-I	I-J	J-K	K-L	L-M	M-N	N-O	O-P	P-Q	Q-R
2020	14,543	15,342	15,261	15,842	15,945	16,959	16,528	18,540	18,931	18,720	17,871	17,183	15,551	14,298	14,704	14,618
2021	16,159	17,048	16,956	17,603	17,718	18,844	18,363	20,601	21,036	20,801	19,857	19,260	17,447	16,056	16,509	16,413
2022	17,860	18,842	18,741	19,456	19,584	20,825	20,292	22,767	23,248	22,988	21,945	21,287	19,284	17,748	18,252	18,145
2023	19,675	20,758	20,645	21,432	21,575	22,937	22,349	25,078	25,608	25,322	24,171	23,450	21,244	19,553	20,112	19,993
2024	21,609	22,798	22,673	23,538	23,696	25,188	24,539	27,539	28,121	27,807	26,543	25,755	23,332	21,476	22,096	21,964
2025	23,666	24,970	24,831	25,778	25,954	27,581	26,869	30,156	30,795	30,451	29,065	28,207	25,553	23,523	24,207	24,061
2026	25,852	27,277	27,125	28,159	28,353	30,124	29,343	32,937	33,636	33,259	31,745	30,813	27,914	25,699	26,451	26,291
2027	28,172	29,727	29,559	30,685	30,900	32,822	31,968	35,888	36,650	36,240	34,589	33,579	30,420	28,008	28,835	28,659
2028	30,633	32,324	32,140	33,365	33,601	35,682	34,750	39,016	39,845	39,400	37,603	36,512	33,076	30,457	31,365	31,171
2029	33,240	35,076	34,874	36,203	36,463	38,710	37,695	42,329	43,229	42,746	40,795	39,619	35,891	33,052	34,045	33,833
2030	35,998	37,989	37,768	39,206	39,492	41,915	40,811	45,834	46,810	46,286	44,173	42,908	38,869	35,798	36,884	36,652
2031	38,915	41,069	40,828	42,382	42,696	45,301	44,104	49,539	50,595	50,029	47,743	46,385	42,018	38,702	39,887	39,634
2032	41,997	44,323	44,060	45,737	46,081	48,879	47,581	53,452	54,592	53,982	51,514	50,059	45,345	41,771	43,062	42,786
2033	45,251	47,760	47,473	49,279	49,655	52,654	51,250	57,381	58,611	58,154	55,493	53,937	48,857	45,011	46,416	46,115
2034	48,684	51,385	51,073	53,016	53,427	56,635	55,119	61,937	63,261	62,554	59,690	58,029	52,562	48,430	49,956	49,629
2035	52,303	55,208	54,869	56,955	57,404	60,831	59,196	66,527	67,951	67,192	64,114	62,343	56,468	52,034	53,690	53,335
2036	56,117	59,236	58,869	61,106	61,594	65,250	63,488	71,362	72,891	72,077	68,772	66,888	60,583	55,832	57,626	57,242
2037	60,132	63,478	63,080	65,476	66,008	69,901	68,006	76,450	78,090	77,218	73,676	71,674	64,916	59,832	61,773	61,357
2038	64,358	67,942	67,511	70,075	70,653	74,794	72,757	81,804	83,560	82,628	78,835	76,711	69,475	64,041	66,139	65,689
2039	68,802	72,637	72,172	74,911	75,539	79,938	77,752	87,432	89,311	88,315	84,259	82,008	74,270	68,468	70,734	70,248
2040	73,474	77,574	77,071	79,996	80,676	85,343	83,000	93,346	95,354	94,291	89,958	87,576	79,309	73,122	75,567	75,043
2041	78,383	82,761	82,219	85,337	86,075	91,020	88,510	99,558	1,01,702	1,00,569	95,944	93,427	84,604	78,012	80,647	80,082
2042	83,538	88,209	87,625	90,947	91,746	96,980	94,294	1,06,078	1,08,365	1,07,159	1,02,228	99,571	90,163	83,148	85,985	85,377
2043	88,950	93,929	93,300	96,835	97,699	1,03,233	1,00,361	1,12,921	1,15,357	1,14,074	1,08,822	1,06,021	95,999	88,539	91,591	90,937
2044	94,629	99,931	99,254	1,03,013	1,03,947	1,09,791	1,06,724	1,20,097	1,22,691	1,21,328	1,15,738	1,12,788	1,02,121	94,196	97,477	96,773
2045	1,00,584	1,06,227	1,05,499	1,09,493	1,10,501	1,16,666	1,13,393	1,27,621	1,30,380	1,28,932	1,22,989	1,19,885	1,08,541	1,00,130	1,03,653	1,02,897
2046	1,06,828	1,12,828	1,12,046	1,16,286	1,17,373	1,23,872	1,20,381	1,35,505	1,38,438	1,36,902	1,30,588	1,27,326	1,15,271	1,06,351	1,10,131	1,09,320
2047	1,13,372	1,19,746	1,18,908	1,23,404	1,24,577	1,31,419	1,27,700	1,43,765	1,46,879	1,45,251	1,38,548	1,35,124	1,22,323	1,12,870	1,16,923	1,16,054

2048	1,20,227	1,26,995	1,26,096	1,30,861	1,32,124	1,39,323	1,35,363	1,52,414	1,55,718	1,53,995	1,46,884	1,43,293	1,29,710	1,19,700	1,24,043	1,23,112
2049	1,27,407	1,34,586	1,33,623	1,38,670	1,40,030	1,47,596	1,43,383	1,61,468	1,64,971	1,63,148	1,55,610	1,51,848	1,37,445	1,26,852	1,31,502	1,30,505
2050	1,34,922	1,42,534	1,41,504	1,46,845	1,48,307	1,56,253	1,51,773	1,70,942	1,74,654	1,72,726	1,64,742	1,60,803	1,45,541	1,34,340	1,39,315	1,38,249
2051	1,42,788	1,50,853	1,49,751	1,55,400	1,56,971	1,65,308	1,60,549	1,80,852	1,84,783	1,82,746	1,74,294	1,70,175	1,54,013	1,42,176	1,47,496	1,46,355
2052	1,51,017	1,59,557	1,58,379	1,64,349	1,66,037	1,74,778	1,69,724	1,91,216	1,95,375	1,93,224	1,84,283	1,79,980	1,62,874	1,50,373	1,56,058	1,54,840
2053	1,59,623	1,68,662	1,67,402	1,73,709	1,75,520	1,84,677	1,79,314	2,02,050	2,06,449	2,04,179	1,94,726	1,90,234	1,72,141	1,58,947	1,65,018	1,63,717
2054	1,68,622	1,78,182	1,76,837	1,83,494	1,85,438	1,95,022	1,89,335	2,13,373	2,18,022	2,15,628	2,05,640	2,00,955	1,81,828	1,67,911	1,74,390	1,73,002
2055	1,78,028	1,88,133	1,86,698	1,93,722	1,95,805	2,05,831	1,99,803	2,25,203	2,30,113	2,27,591	2,17,044	2,12,161	1,91,951	1,77,281	1,84,191	1,82,711
2056	1,87,856	1,98,533	1,97,003	2,04,410	2,06,641	2,17,120	2,10,734	2,37,558	2,42,742	2,40,086	2,28,954	2,23,870	2,02,529	1,87,071	1,94,437	1,92,860
2057	1,98,124	2,09,399	2,07,768	2,15,574	2,17,963	2,28,908	2,22,147	2,50,461	2,55,930	2,53,134	2,41,392	2,36,102	2,13,577	1,97,299	2,05,147	2,03,466
2058	2,08,848	2,20,749	2,19,012	2,27,234	2,29,789	2,41,214	2,34,059	2,63,929	2,69,697	2,66,755	2,54,376	2,48,877	2,25,113	2,07,980	2,16,337	2,14,548
2059	2,20,045	2,32,600	2,30,751	2,39,407	2,42,140	2,54,056	2,46,489	2,77,986	2,84,065	2,80,972	2,67,927	2,62,215	2,37,157	2,19,132	2,28,026	2,26,122
2060	2,31,734	2,44,973	2,43,005	2,52,114	2,55,035	2,67,456	2,59,455	2,92,652	2,99,057	2,95,807	2,82,067	2,76,137	2,49,726	2,30,773	2,40,233	2,38,209

CAPACITY CONSTRAINTS

The capacity analysis is important to determine the carriageway width to be provided at any point in a road network concerning the volume and composition of traffic. For peak hour flow of 8% of AADT, the design service volume for the 6-lane expressway shall be 98000 PCU per day. The expressway design service volumes (DSV) for Level of Service B (LOS-B) and peak hour traffic in the range of 6% of AADT for plain terrain shall be 1300 PCU/hr/lane. (IRC SP: 99-2013)

Table 9: Capacity Constraints

Peak Hour	4-Lane	6-Lane	8-Lane
6%	86000	130000	173000
8%	65000	98000	130000

Table 10 : Threshold limit of capacity

6-Lane requirement	6-Lane Capacity (Design – Max.)	8-Lane requirement	8-Lane Capacity (Design – Max.)
86,000 PCUs	98000 - 130000	130,000 PCUs	130,000 - 173000

III. CONCLUSION

- The design Capacity of the expressway is 98000 PCU for 8% peak hour traffic. (As per UPEIDA guideline peak hour traffic is 8 -12 %). As per IRC 99 2013 recommendation, Peak hour traffic is no more than 6% of AADT. Hence it is the maximum capacity of the expressway. This capacity can easily identify from the figure given

- below. The width of the colour shows the capacity.
- In the year 2044, segment Node C – Node D reached its design capacity (V/C = 1.01). There is a need to manage traffic during peak hours. A paved shoulder of 3-meter width is also provided on both sides of the main carriageway. In peak, this shoulder can be taken into use for the management of traffic up to max capacity reached.

- The year 2044 – 2049, is a period in which traffic is within the limit of design and maximum capacity. It is necessary to manage the traffic otherwise it damages the pavement structure and increases the cost of maintenance.
- In 2049, segment Node C – Node D reached its maximum capacity. Hence, 8 lanes are required to distribute the traffic otherwise it is a cause of congestion, accidents, and an increase in maintenance costs.
- Similarly in the year 2054, segment Node C – Node D reached its maximum capacity of 8 lanes. The expressway is expandable up to 8 lanes. Hence, a new traffic management strategy is needed to manage traffic load otherwise it causes congestion, accidents, and an increase in maintenance costs.

- [8]. Tapashetti, P., & Patil, N. (2018). Study of traffic Volume and traffic forecasting on Karnataka state highway 41. International Research Journal of Engineering and Technology (IRJET).
- [9].

Cite this article as :

Sangam Dwivedi, Prof. A.K. Singh, "GIS-Based Traffic Prediction and Traffic Management of Ganga Expressway, Uttar Pradesh, India", International Journal of Scientific Research in Civil Engineering (IJSRCE), ISSN : 2456-6667, Volume 6 Issue 6, pp. 148-157, November-December 2022.

URL : <https://ijsrce.com/IJSRCE1226516>

IV. REFERENCES

- [1]. Detail Project Report of Ganga Expressway.
- [2]. Official Website of Uttar Pradesh Expressways Industrial Development Authority, Government of Uttar Pradesh, India. Setup by State Government under UP Industrial Area Development Act-1976
- [3]. Annual Report for year 2021-22 “Karyakalaa Pustika” UPTD Karyakalaap Pustika 2021-22.pdf (upsc.gov.in)
- [4]. Population of Uttar Pradesh 2011-20
- [5]. Uttar Pradesh Population Sex Ratio in Uttar Pradesh Literacy rate data 2011-2022 (census2011.co.in)
- [6]. Kamplimath, H. M., & M, V. (2013). Traffic growth rate estimating using transport demand elasticity method, a case study of national highway 63. International Journal of research in engineering and technology.
- [7]. Economic Parameters of Uttar Pradesh. Diary 2020(English).pdf (up.nic.in)