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Feasibility and construction of 4 lane bridge over river Ganga near Sahibganj in Jharkhand State (India)

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ABSTRACT

The National Highways Authority of India (NHAI), a Government of India undertaking is contemplating to enhance the traffic capacity and safety for efficient transportation of goods as well as passenger traffic on the heavily trafficked National Highway sections and engaged in the development of National Highways. NHAI is responsible for the Development, Maintenance and Management of National Highways and for matters concerned thereto. NHAI is proposed to construct a bridge on river Ganga near Sahibganj in the state of Jharkhand to connect the State of Jharkhand with Bihar via connecting NH-80 with NH-81. The project road of SH-62 under consideration starts from Purina at Km. 0.000 and ends at Km. 55.000 near Manchuria village in the state of Bihar with a bridge on River Ganga near Sahibganj in the state of Jharkhand of Indian Peninsula. An attempt has been made to assign the traffic onto the proposed bridge from possible alternative routes and to check the economic and financial viability of the bridge. It is concluded that, the construction of bridge is viable in economic perspective but it is not feasible financially.

Keywords: Feasibility, Financial Viability, Trip frequency, Trip length, Travel time.

Abbreviations: NHAI - National Highways Authority of India, TP – Toll plaza, AADT – Annual Average Daily Traffic

1. INTRODUCTION

Road transport in India is accounting for 70% of freight movement and 85% of passenger traffic. The National Highway network constitutes about 2% of the country's road network, but carries about 40% of the total traffic (Shabana Thabassum, 2013). Connecting these national highways internally can further increase mobility needs of the country. As a part of this endeavour, NHAI carried out a feasibility study for construction of 4 lane bridge over river Ganga (missing link connecting Manihari in the State of Bihar and Sahibganj in the state of Jharkhand of India) near Sahibganj in Jharkhand connecting NH-80 to NH-81 upto Katihar in the state of Bihar. The project road of SH-62 starts from Purnea (Katihar More) at Km. 0.000 in Purnea City and ends at Km. 25.000 at Kora Village Junction. The Katihar Manihari section of project stretch starts from Km. 25.000 of Kora Village Junction and ends at Km. 55.000 near Manihari (Figure 1).

2. PROJECT CORRIDOR IMPORTANCE

2.1. Connectivity

The Construction of proposed bridge on river Ganga will improve connectivity between the states of Bihar and Jharkhand with north-eastern states. In the present context the commercial vehicles are traversing long distances by crossing Ganga river either through Vikramshila sethu in the State of Bihar or Farakka barrage in the State of West Bengal. The distance between the two above said bridges is nearly 150 Km.

2.2. Economic Context

Jharkhand has rich deposits of natural resources such as coarse aggregates which are the fundamental requirements of different kinds of industries. The proposed bridge could become a vital link to transport these materials from Jharkhand to Bihar and other north-eastern states. Since the existing two bridges are 150 Km. apart, the proposed bridge would act as a prime route to expedite the exports.

3. SOCIO ECONOMIC PROFILE OF THE PROJECT AREA

Socio-economic characteristics of the project influence region would normally have a bearing on the present traffic and would further influence the traffic levels in the future. The Project stretch passes through the States of Jharkhand and Bihar, which is the eastern States of Indian peninsula. Jharkhand covers an area of 79,714 sq Km (www.Jharkhand.gov.in, 2012). The population of this State is 33 millions, as per 2011 census. The population density of 414 persons per sq. Km in the state greater than the national average of 382 person per sq. Km of area. The literacy rate of the state is 67% which is greater than that of India. The sex ratio of the state is 947 which is higher than that of India. Bihar is the 12th largest state in terms of Geographical area of 94,163 sq. km. and 3rd largest by population (www.gov.bih.nic.in, 2012). The Population of the state of Bihar is 10.38 crores, as per 2011 census. The population density of the State is 1,102 per sq. km. The literacy rate of Bihar as per the provisional population totals of census 2011 is 63.82%. The sex ratio of the state is 916 which is higher than that of India. The Gross State Domestic Product (GSDP) for the state of Bihar at constant (2004-05) prices in 2010-11 has been estimated at Rs. 144473 crore as against Rs. 125875 crore in 2009-10, registering a growth of 14.8% during the year and the GSDP for Jharkhand at constant (2004-05) prices in 2010-11 has been estimated at Rs. 78045 crore as against 73618 crore in 2009-10, registering a growth of 6.01% during the year. The above growth rates indicate the fruitful economic growth of the two states.

4. ALTERNATIVE ROUTES

The following alternative / competing roads to the project corridor have been identified.

- There is an existing bridge, Vikramshila sethu over river Ganga near Bhagalpur on NH-31 which is presently being used by traffic to reach North Eastern states.
- There is another existing bridge on river Ganga, Farakka barrage near Maldah which is being used by traffic of Eastern part to reach North Eastern states (Figure 2).

The traffic count locations are planned in such a manner that all the traffic getting diverted to the competing roads will be reflected in the traffic surveys.

5. TRAFFIC VOLUME COUNT ANALYSIS

An accurate estimate of the traffic that is likely to use the Project road is very important as it forms the basic input in planning, design, operation and financing. A thorough knowledge of the travel characteristics of the traffic likely to use the Project road as well as other major roads in the influence area of the study corridor is essential for future traffic estimation (Traffic report, Aarvee Associates, 2012). In order to capture the entire traffic, Classified Traffic Volume Count surveys are carried out at 7 strategic points, i.e., at Km. 23.000 and at Km. 35.000 on SH-62, Km. 299.000 on NH-57, Km. 399.000 on NH-31, at Sahibganj on NH-80, at Dagarua on NH-31 and at Dalkola on NH-31 for 7 days. To capture the traffic and travel characteristics of predominant category of vehicles and to assign the future traffic on to the Ganga bridge, Origin-Destination (O-D) surveys by Road side Interview (RSI) method are conducted at the same traffic volume count locations (Figure 3). Traffic data analysis has been carried out, to understand traffic characteristics and travel pattern in the study area and to provide basic input for financial analysis. The analysis has been carried out to derive Annual Average Daily Traffic (AADT) after seasonal correction and AADT Modal split.

5.1. Annual Average Daily Traffic

The Annual Average Daily Traffic (AADT) (Table 1) at the survey locations is obtained by multiplying the Average Daily Traffic (ADT) with the seasonal correction factor of 0.99 for petrol vehicles and 1.02 for diesel vehicles. The AADT of vehicles for the year 2012 at the seven survey locations is presented (Traffic report, Aarvee Associates, 2013).

5.2 AADT Modal Split

- Car Traffic varies from 4% to 15% in the total traffic along the corridor.
- The share of non motorized vehicles varies from 16% to 30%.
- The commercial vehicles contribution varies from 4% to 8% of the total vehicles using the corridor.
- Two wheelers and three wheelers together constitute 46% to 56% of the total traffic.

6. ORIGIN AND DESTINATION SURVEY AND ANALYSIS

The origin and destination of trips on the existing road is required to estimate the information regarding travel characteristics of different users on the project road. The O-D data is also essential for identifying the major influence zones along the road, as traffic growth of the project road is directly dependent upon the growth in economic activity of the influencing area and the road network. Appropriate locations are selected so as to conduct interviews without affecting movement of other vehicles and to assign future traffic on to the proposed Ganga bridge from the existing road network. This survey is limited to Standard Bus, Mini Bus and Car in passenger vehicles category, LCV, mini LCV and Trucks (2 Axle / 3 Axle / M Axle) in freight vehicle category. The sample size collected is 20 to 60% for goods and passenger vehicles. Pertinent information like origin and destination of trip, trip length, trip purpose, type of vehicle, commodity type and frequency of trips has been collected during the interview from the commuters.

6.1. Zonal Code

Traffic movement on a particular stretch depends on its zone of influence. The zones of influence can be external and/or internal. In this particular case, in order to assess the toll revenue trend through the stretch and to check the financial viability, the zones within 20 Km. around two survey locations are considered as internal zones for non commercial passenger vehicles and the zones with in Katihar district are considered as internal zones for commercial vehicles and those outside are considered as external zones. Appropriate zoning system is adopted and coding is done for zones, type of vehicle and its origin and destination (Table 2).

6.2. Zone of influence

The data collected from the O-D survey is analysed to assess the project influencing zones for different categories of goods vehicles. It is observed that, Purnea, Katihar and Kishangunj in the state of Bihar, Sahibganj in the state of Jharkhand are the major influencing zones in terms of trip generation and attraction (Table 3).

6.3. Opinion Survey

During RSI survey, a separate interview is conducted in order to collect the information from the users who are willing to use the proposed Ganga Bridge after the completion of project (Table 4).

Table 1

Annual Average Daily Traffic (AADT)

Vehicle Type	Km. 23.000 on SH-62	Km. 35.000 on SH-62	Km. 299.000 on NH-57	Location: Sahibganj on NH-80	Km. 399.000 on NH-31	Location: Dagarua on NH-31	Location: Dhalkola on NH-34
2W / 3W	3107	4205	4140	582	10612	7235	1691
Car / Jeep / Van	911	276	966	98	2356	1841	415
RTC/ Pvt. Bus	196	18	91	12	967	510	117
Mini Bus	34	33	49	2	142	73	24
2 Axle	153	99	494	1	796	1793	529
3 Axle	78	59	974	30	1185	1988	1195
M Axle	5	15	659	8	466	1178	115
LCV/LGV	52	18	110	4	177	372	84
Mini LCV	215	104	362	11	316	474	52
Tractor and Tractor Trailers	283	270	199	129	470	417	72
Non Motorized Vehicles	1001	2151	287	0	3301	2174	713
Govt. Exempted Vehicles	20	17	41	0	74	68	38
Total Traffic	6054	7266	8372	877	20862	18123	5045

Table 2

Zonal code for O-D analysis

Zone	Description
1	Satroop, Agotola, Chadi Agotola, Ranipatra, Shreenagar, Beewanganj, Routara
2	Harijan Tola, Govindpur, Bhasnapur, Sirsa, Katihar, sherifgunj, Teenghachiya
3	Batnaha, Marangi, Ladayanpur, Nawabgunj, Amdavad, Manihari
4	Paranpur, Ahmdavad, Lava
5	Kadwa, Dankora, Azamnagar, Barsoi, Balrampur
6	Kora, Pothia, Barari, Kursela, Sameli
7	Purnea
8	Dagarua, Baisi, Amour, Baisa, Srinagar, Banmakhi, Kirtianandnagar
9	Kishanganj, Kochadamin, Pothia, Tatabpur, Thakurganj, Araria
10	Baharakothi, Dhamdaha, Bhawanipur, Falka, Rupauli
11	Bhagalpur, Narayanpur, Kharik, Naugachia, Shahkund, Akbarnagar, Jagdishpur
12	Banka, Chandan, Rajauri, Amarpur, Sambhuganj, Phulidamar, Belhar
13	Nawada, Jamui, Shekhpura, Luckeesarai, Munger
14	Begusarai, Khagaria, Samastipur, Saharsa, Madhepura, Supaul, Darbhanga
15	Paschim Champaran, Purba Champaran, Vaishali
16	Buxar, Bhojpur, Rohtas, Hajipur
17	Sahibgunj
18	Taljhari, Borio, Barhati
19	Godda, Thakur Gangti, Meherma, Bara Baonj
20	Mahagama, Singapur, Dumaria, Korka Ghat
21	Barharwa, Udhwa, Rajmahal
22	Dumka, Amrapara, Pakaur, Hiranpur, Maheshpur, Pakuria, Shikaripara
23	Poria, Ramgarh, Sundarpahari, Lithipara, Kathikund, Gopikandar

Table 2
Zonal code for O-D analysis

Zone	Description
24	Banka, Devgarh, Madhavpur, Narayanpur, Devipur, Jamtara
25	Masalia, Raneeshwar, Kundahith, Paragana
26	Koderma, Markacho, Jainagar, Govindpur, Tundi, Nirsa
27	Chatra, Pratapur, Hazaribagh, Bokaro, Peterwar, Gola
28	Garhwa, Ramna, Daltonganj, Latehar, Hussainbad, Bishrampur
29	Lohardaga, Gumla, Ghagra, Sisai, Simdhega, Bolba
30	Ranchi, Numkam, Biru, Khunti, Angara,Paschim Singhbhum
31	Jamshedpur, Purba Singhbhum
32	Murshidabad, Birbhum
33	Barddhaman, Hugli, Howrah
34	Puruliya, Bankura, Medinipur, East Medinipur
35	North 24 Paraganas, South 24 Paraganas, kolkata, Nadia
36	Maldah, Dakshin Dinazpur, Uttar Dinazpur
37	Darjiling, Jalpaiguri, Koch Bihar
38	Orissa, Rest of Jharkhand, Chattisgarh
39	North east states
40	Andhra Pradesh, Karnataka, Tamil Nadu, Kerala
41	Gujarat, Maharashtra, Rajasthan, Madhya Pradesh, Goa
42	Jammu & Kashmir, HP, Punjab, Haryana, Uttaranchal, Uttar Pradesh
43	Nepal

Table 3
Zone of Influence

Vehicle Type	Zone of Influence	Percentage Attraction
2 Axle	Purnea	34%
	Katihar	28%
3 Axle	Katihar	33%
	Purnea	19%
	Kishanganj	17%
M Axle	Katihar	29%
	Purnea	27%
	Kishanganj	12%
	Sahibganj	11%

Table 4
Opinion Survey Result

Vehicle Type	Km. 23.000 on SH-62	Km. 35.000 on SH-62	Sahibganj on NH-80	Km. 399.000 on NH-31
Car	65%	22%	44%	19%

Table 4
Opinion Survey Result

Vehicle Type	Km. 23.000 on SH-62	Km. 35.000 on SH-62	Sahibganj on NH-80	Km. 399.000 on NH-31
Bus	54%	67%	50%	19%
Mini Bus	68%	73%	100%	50%
LCV	76%	92%	67%	33%
2 Axle	56%	88%	0%	46%
3 Axle	64%	87%	74%	40%
M Axle	100%	100%	75%	40%

Table 5
Percentage Diverted Traffic

Vehicle Type	Maranga on NH-31		NH-31 Dagarua		NH-80 Sahibganj		NH-57 Qasba		NH-34 Dhalkola	
	To Guwahati	To Bagalpur	To Purnea	To Kishangunj	To Bagalpur	To Sahibganj	To Jogbani	To Purnea	To Raigunj	To Dalkola
Car White	5%	3%	6%	4%	19%	14%	5%	2%	5%	5%
Car Yellow	6%	2%	3%	4%	0%	0%	4%	10%	0%	0%
Bus	4%	0%	5%	4%	0%	0%	6%	10%	3%	0%
Mini Bus	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%
LCV	11%	2%	6%	9%	100%	0%	9%	14%	14%	16%
2 Axle	7%	3%	5%	2%	0%	0%	4%	6%	6%	9%
3 Axle	4%	4%	1%	1%	13%	27%	2%	2%	4%	4%
M Axle	3%	1%	3%	1%	0%	0%	1%	1%	14%	13%
Mini LCV	4%	2%	6%	4%	0%	25%	4%	2%	0%	0%

Table 6
Total Diverted Traffic

Vehicle Type	Towards Purnea	Towards Sahibganj	Total vehicles
Car White	104	69	173
Car Yellow	24	14	38
Bus	31	13	44
Mini Bus	0	2	2
LCV	39	18	58
2 Axle	82	72	154
3 Axle	70	65	135
M Axle	25	27	52
Mini LCV	24	18	42

Table 6

Total Diverted Traffic

Vehicle Type	Towards Purnea	Towards Sahibganj	Total vehicles
Total Vehicles			**697**

Table 7

Trip Length Matrix (Km) Without Project

O/D zones	6	7	9	14	17	18	19	22	36	37	39	43
6	0	0	0	0	150	160	152	185	0	0	0	0
7	0	0	0	0	170	180	172	205	0	0	0	0
9	0	0	0	0	266	276	268	301	0	0	0	0
14	0	0	0	0	240	250	242	275	0	0	0	0
17	150	170	266	240	0	0	0	0	285	393	1047	256
18	160	180	276	250	0	0	0	0	295	403	1057	266
19	152	172	268	242	0	0	0	0	287	395	1049	258
22	185	205	301	275	0	0	0	0	255	459	1113	392
36	0	0	0	0	285	295	287	255	0	0	0	0
37	0	0	0	0	393	403	395	459	0	0	0	0
39	0	0	0	0	1047	1057	1049	1113	0	0	0	0
43	0	0	0	0	256	266	258	392	0	0	0	0

Table 8

Trip Length Matrix (Km) With Project

O/D zones	6	7	9	14	17	18	19	22	36	37	39	43
6	0	0	0	0	40	50	126	190	0	0	0	0
7	0	0	0	0	60	70	146	210	0	0	0	0
9	0	0	0	0	156	166	242	306	0	0	0	0
14	0	0	0	0	130	140	216	280	0	0	0	0
17	40	60	156	130	0	0	0	0	175	283	937	146
18	60	70	166	140	0	0	0	0	185	293	947	156
19	126	146	242	216	0	0	0	0	261	369	1023	232
22	190	210	306	280	0	0	0	0	325	433	1087	296
36	0	0	0	0	175	185	261	325	0	0	0	0
37	0	0	0	0	283	293	369	433	0	0	0	0
39	0	0	0	0	937	947	1023	1087	0	0	0	0
43	0	0	0	0	146	156	232	296	0	0	0	0

Table 9

Travel time Matrix (Hours) Without Project

O/D zones	6	7	9	14	17	18	19	22	36	37	39	43
6	0	0	0	0	9	9.8	5.1	6.2	0	0	0	0
7	0	0	0	0	9.7	10.5	5.7	6.8	0	0	0	0
9	0	0	0	0	12	12.8	8.1	9.2	0	0	0	0
14	0	0	0	0	11.1	11.9	7.1	8.2	0	0	0	0
17	9.0	9.7	12.0	11.1	0	0	0	0	13	16.6	33	11.4
18	9.7	10.5	12.8	11.9	0	0	0	0	13.9	17.5	33.8	12.2
19	5.1	5.7	8.1	7.1	0	0	0	0	9.1	12.7	29.1	7.5
22	6.2	6.8	9.2	8.2	0	0	0	0	8.5	15.3	31.7	11.45
36	0	0	0	0	13	13.9	9.1	8.5	0	0	0	0
37	0	0	0	0	16.6	17.5	12.7	15.3	0	0	0	0
39	0	0	0	0	33	33.8	29.1	31.7	0	0	0	0
43	0	0	0	0	11.4	12.2	7.5	11.5	0	0	0	0

Table 10

Travel time Matrix (Hours) With Project

O/D zones	6	7	9	14	17	18	19	22	36	37	39	43
6	0	0	0	0	0.5	1.3	3.5	5.6	0	0	0	0
7	0	0	0	0	1.3	2.1	3.6	5.8	0	0	0	0
9	0	0	0	0	3.1	3.9	5.9	8.1	0	0	0	0
14	0	0	0	0	2.2	3	5	7.2	0	0	0	0
17	0.5	1.3	3.1	2.2	0	0	0	0	4.1	6.2	22.5	2.5
18	1.3	2.1	3.9	3.0	0	0	0	0	5	7	23.8	3.3
19	3.5	3.6	5.9	5.0	0	0	0	0	7.9	9	25.4	5.3
22	5.6	5.8	8.1	7.2	0	0	0	0	10.4	11.2	27.5	7.5
36	0	0	0	0	4.1	5	7.9	10.4	0	0	0	0
37	0	0	0	0	6.2	7	9	11.2	0	0	0	0
39	0	0	0	0	22.5	23.3	25.4	27.5	0	0	0	0
43	0	0	0	0	2.5	3.3	5.3	7.5	0	0	0	0

Table 11

Toll Revenues in INR Crores

Year From	Year To	TP-1 @ Km. 5.000	TP-2 @ Km. 65.000	Total (INR Crores)
2016	2017	10.11	16.94	27.05
2017	2018	11.01	18.62	29.63
2018	2019	12.31	20.50	32.81
2019	2020	13.63	22.60	36.24

Table 11
Toll Revenues in INR Crores

Year From	Year To	TP-1 @ Km. 5.000	TP-2 @ Km. 65.000	Total (INR Crores)
2020	2021	14.83	24.94	39.78
2021	2022	16.42	27.54	43.96
2022	2023	18.18	30.29	48.46
2023	2024	20.15	33.43	53.58
2024	2025	21.94	36.90	58.84
2025	2026	24.23	40.72	64.95
2026	2027	26.78	44.90	71.68
2027	2028	29.52	49.56	79.08
2028	2029	32.62	54.73	87.35
2029	2030	36.02	60.47	96.48
2030	2031	40.05	66.74	106.79
2031	2032	44.20	73.76	117.97
2032	2033	48.78	81.54	130.32
2033	2034	54.16	90.10	144.26
2034	2035	59.62	99.51	159.13
2035	2036	66.26	109.97	176.23
2036	2037	72.83	121.64	194.47
2037	2038	80.85	134.70	215.55
2038	2039	89.42	148.85	238.27
2039	2040	99.20	164.77	263.96
2040	2041	109.69	182.40	292.09
2041	2042	121.18	201.82	322.99
2042	2043	134.18	223.41	357.58
2043	2044	149.15	247.45	396.61

Table 12
Project cost (INR Crores)

Location of Toll Plaza	Road Cost	Structure Cost	Total Civil Cost (INR Crores)
TP-1 @ km. 5.000	306.955	0	306.96
TP-2 @ km. 65.000 including Ganga bridge	80.898	1352.2	1433.10

Table 13

Financial Analysis Results

Sections	Grant	Concession Period	Project FIRR	Equity FIRR	Equity NPV @ 12%
TP-1 @ Km. 5.000	40%	25	2.55	0.54	-1445
TP-2 @ Km. 65.000	40%	25	-0.23	-3.07	-7988

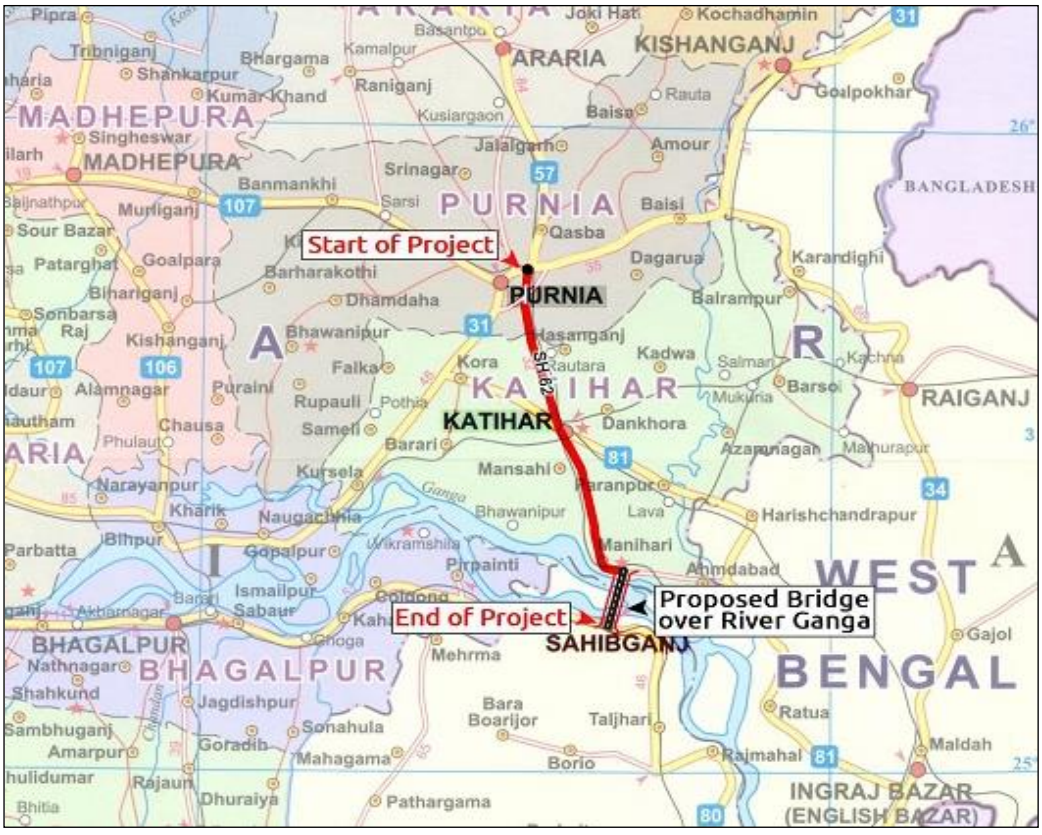

Figure 1

Project Location Map

Figure 2

Alternative routes

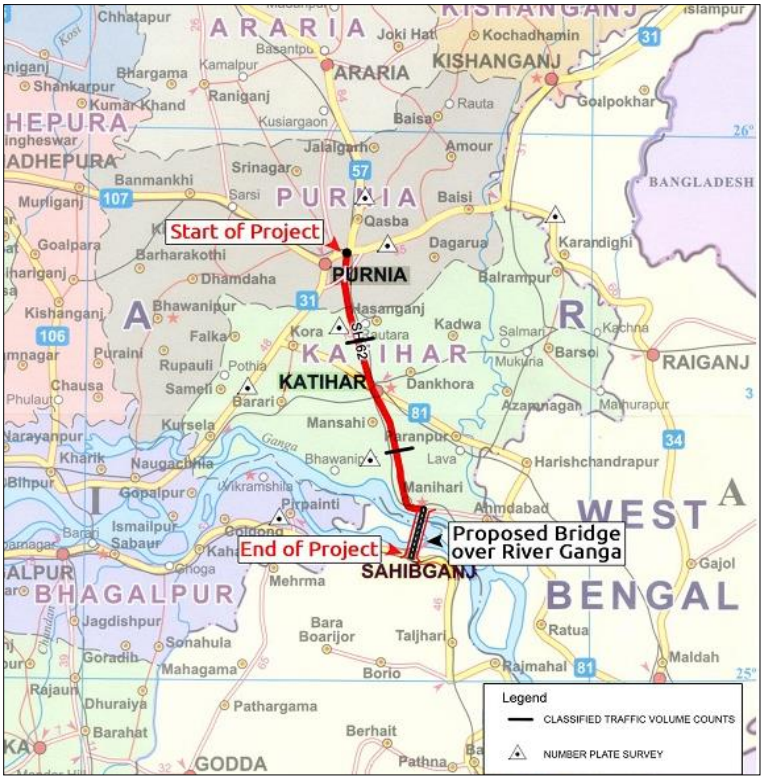

Figure 3

Traffic Survey Location Map

6.4. Traffic Assignment

The following alternative / competing roads to the project corridor have been identified in the road network.

- The existing bridge (Vikramsila sethu) over river Ganga near Bhagalpur on NH-31 in the State of Bihar, is presently being used by traffic from southern part of Bihar and northern part of Jharkhand to reach north-eastern states.
- The existing Farakka bridge on river Ganga near Maldah in the State of West Bengal is being used by traffic of eastern states and southern part of Jharkhand to reach north-eastern states.

The major commodity which is transported from nearby places (quarries) of Sahibganj district is coarse aggregate and quarry material. The present scenario of transportation of these materials from Sahibganj district is through ferry service over river Ganga. Otherwise the vehicles need to travel approximately 145 km. on NH-80 and NH-31 to reach the Sahibganj from Katihar. While traveling between Purnea - Sahibganj, vehicles have to pay toll at three toll plazas namely Kursela, Vikram sethu and Kehalgaon. The major advantage of providing the proposed bridge and project corridor is to minimise the scarcity of coarse aggregate and quarry material in the northern region of Bihar and north-eastern states and also reduce the travel time and travel cost between Jharkhand / Sahibganj and Bihar / North east States. The total diverted traffic from all RSI locations on to the proposed Ganga bridge and on to the project stretch is shown (Table 5 and 6). This additional traffic is to be added to the present traffic on the project stretch. Commercial vehicles (2 and 3 Axle) carry coarse aggregate, quarry material and sand from Sahibganj quarries to Manihari ghat on ferry service available on river Ganga. Two ferries operate with a frequency of 5 round trips per day, and run for an average 10 number of months in a year. One ferry carries 6 loaded trucks or 9 empty trucks along with 1 to 2 cars in one move. Small boats are also running which only carry passenger traffic. The total truck traffic carried by two ferries in 5 round trips per day is approximately 75 commercial vehicles and 5 to 10 cars. This total traffic is to be added to the present and assigned traffic on to the proposed Ganga bridge.

6.5. Economic Benefits

This section describes the overall benefits after the construction of proposed bridge and road stretch associated with the project. These benefits are in terms of trip length, travel time and the associated positive implications of the project. The trip length matrices for the case of with and without proposed Ganga bridge are prepared (Table 7 and 8). From these matrices, the distance between different zones can be derived. The average speed of the roads, which could influence the traffic on the project stretch, is also considered while deriving the travel time matrices between the zones for with and without the proposed Ganga bridge (Table 9 and 10). For instance, the NH-81 from Sahibganj is in very poor condition and passes through the urban section. Hence, the average speed for the vehicles commuting between Sahibganj and Bhagalpur is assumed as 12 Kmph. As shown, the travel time to commute between sahibganj and purnea has curtailed down from 9.0 hrs to approximately 1.0 hr. Therefore, the diminution of exiting travel pattern can be inferred after the construction of proposed bridge and the road.

7. FINANCIAL VIABILITY

The viability of a road project refers to the assessment of whether the project has the capacity to meet the defined objectives, and in addition to generate significant financial and economic gains to the stakeholders and to the economy in general (Chapter 8, 2011). The main objective of financial analysis is to assess the likely returns to the investors under realistic conditions. For this purpose the prevailing market rates and return on debt and equity issues in local capital markets are the important factors. In the present studies, the financial viability of the project is assessed on the basis of project's financial internal rate of return on investments and Rate of Return on Equity, which is estimated on the basis of cash flow analysis (Traffic report, Aarvee Associates, 2011).

The financial analysis attempts to ascertain the extent to which the investment can be recovered through toll revenue and the gap, if any, be funded through Grant / Subsidy. This covers aspects like financing through debt and equity, loan repayment, debt servicing, taxation, depreciation, etc. The viability of the project is evaluated on the basis of Project FIRR (Financial Internal Rate of Return) on total investment). The FIRR is estimated on the basis of cash flow analysis, where both costs and revenue have been indexed to take account of inflation. Financial analysis has been carried out for the entire project road with debt equity ratio of 70:30. The new NHAI Toll policy – 2008 with couple of amendments has been used for calculation of traffic revenues. Two Toll plazas (TP) are proposed at Km. 5.000 and at Km. 65.000 along the Project stretch. Toll revenue is the product of the forecast traffic expected to use the road and the appropriate toll fee for the vehicle category (Table 11). The cost of civil works of the project includes the improvement of existing carriageway and cost of toll plaza (Table 12).

The main objective of undertaking this study is to assess whether the project is financially viable or not. It is important to note that the proposal should be an attractive proposition for private sector participation under Build, Operate and Transfer (BOT) system.

The basic methodology followed for estimating the financial viability of the project is to calculate the FIRR (Financial Internal Rate of Return) on the investment for the project. Based on the project structure traffic study and toll rate analysis, financial feasibility analysis has been carried out as per the methodology. The objective of the financial analysis is to ascertain the existence of sustainable project returns, which shall successfully meet the expectations of its financial investors. The analysis reveals various FIRR values corresponding to each year of toll operation. FIRR for the Returns on Investment and Returns on Equity for the concession period of 25 years has been examined (Table 13).

8. CONCLUSIONS

A minimum return on equity of around 15% could be considered satisfying the requirement of prospective concessionaire. In view of this, it can be concluded that the project is not viable for taking up on BOT basis. However, the project is economically viable for taking up on EPC mode as the project is linking Bihar and Jharkhand states and is likely to facilitate the economic development of the Jharkhand state.

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