1 GENERAL

National Highways Authority of India (NHAI) is engaged in the development of National Highways. As a part of this endeavor, NHAI invited proposals for carrying out feasibility study for construction of 4 lane bridge over river Ganga near Sahibganj in Jharkhand connecting NH-80 to NH-81 upto Katihar along with Katihar Bypass in Bihar and 4 laning of Katihar - Purnea section along SH-62 in the state of Bihar. The work of conducting feasibility studies was awarded to the joint venture of M/s. Aarvee Associates Architects Engineers & Consultants Pvt. Ltd. and M/s. Nag Infrastructure Consulting Engineers Pvt. Ltd. vide consultancy agreement signed on 10/09/2012 and Letter of Commencement was issued vide letter No. NHAI/11012/BH/Sahib-Purn/2011/31607 dated 10.09.2012.

Subsequent to the award of the consultancy services, the missing link connecting Sahibganj and Manihari is declared as NH 133 B. The road connecting Punea, Katihar, Manihari became part of NH 131A connecting Malda in West Bengal with Purnea in Bihar. Thus, the scope of work w.r.t to the newly declared National Highways is given as under:

- New link (NH-133B) from Km 0.000 at Sahibganj bypass in Jharkhand to Km 15.900 (junction of NH-133B and NH-131A) in Bihar including 4 lane bridge across river Ganga and Construction of Manihari bypass from Km 0.000 (junction of NH-133B and NH-131A) to Km 6.000 near Narenpur of NH-131A in Bihar.
- Up-gradation of NH-131A from Km 6.000 to Km 55.000 near Purnea in the state of Bihar.

The details of the project stretch are presented in Table -1:

Table – 1: Project Details

Section	Chainage	NH	State	Length km
Purnea – Katihar	Km. 6.000 near Narenpur to Km. 55.000 near Purnea on NH-131A	NH 131A	Bihar	49.0
Katihar – Manihari				

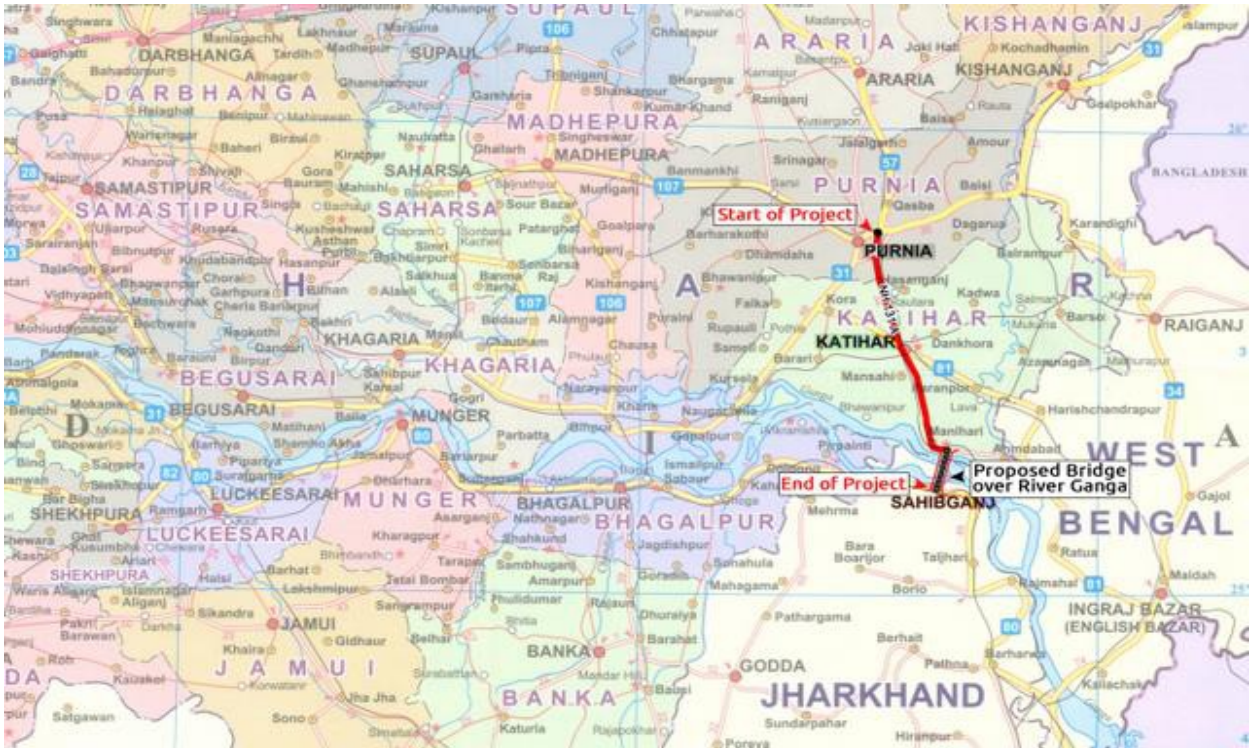
E.2 DESCRIPTION OF THE PROJECT CORRIDOR

The project corridor starts from.

- Section II starts from Km 6.000 near Narenpur to Km 55.000 near Purnea of NH-131A in Bihar including proposed Katihar bypass.

The Project location map is shown in Figure – 1.

Figure E.1 : Project Location Map



The project road traverses through Katihar and Manihari districts of the state of Bihar. the project road starts from Km 6.000 near Narenpur to Km 55.000 near Purnea. The existing road from Km 50.100 to Km 25.200 has intermediate lane configuration with 5.5 m wide carriageway and has two lane configuration in the rest of stretch i.e. from Km. 81.000 to Km 50.100. The project stretch passes through villages such as Narayanpur, Baulia, Kutubpur, Pagalbari, Lakhpura, Manoharpur, Jagbati, Kumaripur, Bhearmara, Mohanpur, Basantpur, Katihar, Ghasi Tola, Naraonpur, Marangi, Raghunichak, Sirnia, Chitauria, Daharia, Mehdai, Sahisia, Baigna, Tiarpara, Dalan, Bawada Pargana Haveli, Kadepura, Rampur, Hathia Ramana, Champi, Baisi Ramana, Sadpur Rajwara, Routara, Singhia, Dewanganj, Dimia Chattarjan, Raziganj, Raipur Ranipatra, Chandi, Gopalganj, Bilauri, Abdullahnagar and Khuskibagh in Bihar.

The project corridor passes entirely through plain terrain. The predominant land use along the project road is cultivation which accounts for about 50% of the project road. Jute and Paddy are the two crops that are widely observed.

3 EXISTING PROJECT ROAD

The Carriageway width varies from 5.5m to 7.5m. The following are some of the deficiencies in existing Project highway.

- Horizontal and vertical profiles are sub-standard at few locations.
- Provisions for safety and pedestrian amenities are inadequate.

- There are five railway level crossings which are causing traffic delays.

4 OBJECTIVE OF STUDY

The project ToR (Clause 1.1) envisages study of the feasibility of the following

(i) A major 4 lane Bridge over river Ganga connecting NH-80 at Sahibganj in Jharkhand to Manihari in Bihar. As already stated, this new link is declared as NH 133B.

(ii) Four laning of NH 131A from Manihar to Purnea via Katihar in Bihar

5 SURVEY AND INVESTIGATIONS

The details of surveys including inventory studies and investigations carried out during the preparation of supplementary Inception report are presented below:

- Traffic surveys such as Traffic Volume Count, Origin-Destination survey by Road Side Interview method, Number Plate survey, Axle Load survey and Turning Movement counts.
- Investigations of the existing pavement and sub grade, evaluation of the existing pavement as well as collection of samples of the existing pavement and their laboratory testing
- Collection of samples from pits adjacent to the existing road.
- Identification of borrow areas for road and bridge construction material, collection of samples and their analysis
- Inventory and condition surveys for culverts and bridges

6 EXISTING, DIVERTED AND PROJECTED TRAFFIC

The classified Traffic Volume Count (TVC) surveys were carried during the month of October 2012 at Km. 32.000 of NH 131A and Km. 20.000 on MDR, Km. 299.000 on NH-57, Km. 399.000 on NH-31, Dagarua on NH-31 and at Dalkola on NH-34. The seasonal variation factors for the month of October 2012 have been established. The estimated ADT was converted into AADT as shown in Table - 2, after applying the seasonal variation factors applicable to the area. Seasonal Variation factor is explained in para 3.3.3 of Chapter-3.

Table – 2: AADT Summary

Description	km. 32.000 on NH-131A	km. 20.000 on SH 131A	km. 299.000 on NH-57	km. 399.000 on NH-31	Dagarua on NH-31	Dalkola on NH-34
AADT in Vehicles	6054	7266	8372	20862	18123	5045
AADT in PCUs	6459	6566	13405	26270	29942	8621

The projection of traffic is an important exercise for assessing the toll revenue that would accrue in future years. The traffic on the project corridor was projected with growth rates as shown in Table – E.3 and diverted traffic is given in Table E.4(a). A detailed summary of traffic volume projections is tabulated in Table – E.4(b), as shown below.

Table – 3: Traffic Growth rates

Year	Car	Bus	2 Axle	3 Axle	M Axle	LCV	Mini LCV
Upto 2014	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2015-2019	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2020-2024	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2025-2029	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Beyond 2029	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Table – 4(a): Diverted Traffic

Vehicle Type	Towards Purnea	Towards Sahibganj	Total vehicles In No.s	Total vehicles In PCUs
Car White	104	69	173	173
Car Yellow	24	14	38	38
Bus	31	13	44	132
Mini Bus	0	2	2	3
LCV	39	18	58	85
2 Axle	82	72	154	462
3 Axle	70	65	135	405
M Axle	25	27	52	234
Mini LCV	24	18	42	42
Total Vehicles			**697**	**1574**

Table – 4(b): Total tollable traffic volume in Vehicle numbers and PCUs

Year from	Year To	km. 32.000 on NH 131A		km. 20.000 on MDR	
		No.s	PCUs	No.s	PCUs
2012	**2013**	1792	2718	707	1141
2017	**2018**	3178	5479	1793	3466
2022	**2023**	4056	6993	2289	4424
2027	**2028**	5177	8925	2921	5646
2032	**2033**	6607	11391	3728	7206
2037	**2038**	8432	14539	4758	9197

Year from	Year To	km. 32.000 on NH 131A		km. 20.000 on MDR	
		No.s	PCUs	No.s	PCUs
2042	**2043**	10762	18555	6073	11737

7 Capacity Analysis

The Highway Capacity Manual has introduced the concept of "Level of Service" (LoS) to denote the level of facility one can derive from a road under different operating conditions and traffic volumes. National and State Highways in rural areas are normally designed for LOS B giving a design service volume of 15,000 PCU per day for 2 lane road, 17,500 per day for 2lane road with paved shoulders, 40,000 PCUs per day for 4 lane divided carriageway based on level of service criteria with a V/C ratio less than 0.5.

The present and anticipated capacity on the project stretch for 2 lane and 4 lane options are listed below:

Year	Purnea to Katihar Section					Katihar to Manihari Section				
		Capacity Criteria					Capacity Criteria			
	Total Traffic In PCU's	Capacity for divided C' way (PCUs /day)	V/C ratio	LOS	Recommendation based on V/C ratio	Total Traffic In PCU's	Capacity for divided C' way (PCUs /day)	V/C ratio	LOS	Recommendation based on V/C ratio
2012	6301	17500	0.18	B	2-Lane	6502	17500	0.19	B	2-Lane
2013	6590	17500	0.19	B	2-Lane	6768	17500	0.19	B	2-Lane
2014	6893	17500	0.20	B	2-Lane	7048	17500	0.20	B	2-Lane
2015	7212	17500	0.21	B	2-Lane	7341	17500	0.21	B	2-Lane
2016	7546	17500	0.22	B	2-Lane	7648	17500	0.22	B	2-Lane
2017	9907	17500	0.28	B	2-Lane	9980	17500	0.29	B	2-Lane
2018	10375	17500	0.30	B	2-Lane	10417	17500	0.30	B	2-Lane
2019	10867	17500	0.31	B	2-Lane	10876	17500	0.31	B	2-Lane
2020	11382	17500	0.33	B	2-Lane	11358	17500	0.32	B	2-Lane
2021	11924	17500	0.34	B	2-Lane	11862	17500	0.34	B	2-Lane
2022	12492	17500	0.36	B	2-Lane	12392	17500	0.35	B	2-Lane
2023	13088	17500	0.37	B	2-Lane	12947	17500	0.37	B	2-Lane
2024	13714	17500	0.39	B	2-Lane	13529	17500	0.39	B	2-Lane
2025	14370	17500	0.41	B	2-Lane	14140	17500	0.40	B	2-Lane
2026	15060	17500	0.43	B	2-Lane	14781	17500	0.42	B	2-Lane
2027	15783	17500	0.45	B	2-Lane	15453	17500	0.44	B	2-Lane
2028	16542	17500	0.47	B	2-Lane	16158	17500	0.46	B	2-Lane
2029	17339	17500	0.50	B	2-Lane	16897	17500	0.48	B	2-Lane
2030	18176	40000	0.23	B	4-Lane	17673	17500	0.50	B	2-Lane
2031	19054	40000	0.24	B	4-Lane	18487	40000	0.23	B	4-Lane
2032	19975	40000	0.25	B	4-Lane	19341	40000	0.24	B	4-Lane

2033	20943	40000	0.26	B	4-Lane	20236	40000	0.25	B	4-Lane
2034	21958	40000	0.27	B	4-Lane	21176	40000	0.26	B	4-Lane
2035	23024	40000	0.29	B	4-Lane	22163	40000	0.28	B	4-Lane
2036	24143	40000	0.30	B	4-Lane	23197	40000	0.29	B	4-Lane
2037	25317	40000	0.32	B	4-Lane	24283	40000	0.30	B	4-Lane
2038	26550	40000	0.33	B	4-Lane	25423	40000	0.32	B	4-Lane
2039	27844	40000	0.35	B	4-Lane	26618	40000	0.33	B	4-Lane
2040	29203	40000	0.37	B	4-Lane	27873	40000	0.35	B	4-Lane
2041	30629	40000	0.38	B	4-Lane	29189	40000	0.36	B	4-Lane
2042	32126	40000	0.40	B	4-Lane	30571	40000	0.38	B	4-Lane
2043	33698	40000	0.42	B	4-Lane	32021	40000	0.40	B	4-Lane
2044	35348	40000	0.44	B	4-Lane	33543	40000	0.42	B	4-Lane
2045	37080	40000	0.46	B	4-Lane	35140	40000	0.44	B	4-Lane
2046	38898	40000	0.49	B	4-Lane	36816	40000	0.46	B	4-Lane
2047	40807	40000	0.51	C	6-Lane	38575	40000	0.48	B	4-Lane

From the above table it is seen that the traffic in the project road exceeds 2-lane with paved shoulders capacity in the years 2030 and 2031 in Purnea to Katihar and Katihar to Manihari Sections respectively.

As per ToR, financial analysis of the project was carried out and the Authority was appraised vide our letter supplementary inception report dated 21/01/2013 that the project was not viable to be taken up under BOT. After reviewing various possible alternatives, Authority has finally given clearance for taking up the project on EPC mode vide letter No. No. NHAI/ PIU-Purnia/ Pur-sahib/ RO-Pat/ 2014/ 7304 dated 16.01.2014

While, four lane with paved shoulder option would have been adequate from capacity considerations, the following aspects are to be taken into account for finalizing the up-gradation option.

- The bridge is inter-state (Connects Jharkhand with Bihar) and of economic importance for Jharkhand State since it provides direct access for Jharkhand to North Bihar and North-East states.
- There is a likely spurt in economic activity in Sahibganj and adjoining districts in Jharkhand State due to the proposed Inland Water Container Depot near Sahibganj.
- The bridge at Bagalpur on the upstream side is becoming old. The nearest bridge on downstream side is at Farakka. In the event of closure of any of these bridges for maintenance or otherwise, the entire traffic in the region requiring to cross the river would be diverted to the proposed bridge.
- There is demand from Jharkhand Government for construction of four lane bridge and approaches.

In view of above, the stretch has been proposed to be upgraded to 4-lane and the up-gradation proposals are discussed in the subsequent section.

8 ALIGNMENT AND BYPASS OPTIONS

As already mentioned, the consultants submitted supplementary inception report in Jan, 2013 regarding project viability on BOT basis. Authority gave consent for taking up the project on EPC mode in Jan, 2014. Various alignment options for Katihar bypass, Manihari bypass including siting of Ganga Bridge were prepared and these were submitted to PIU in June, 2014. The options were reviewed by the representatives of NHAI, MoRTH and representatives from the State Governments of Bihar and Jharkhand. The alignment for Manihari bypass including the siting of bridge was approved and certain suggestions were made for finalizing the alignment of Katihar bypass in the MoM issued by PD, PIU vide letter No. NHAI/PIU-Purnia/ Pur-Sahib/ Feas/2014/ 8021 dated 16/09/2014.

As per the directions in the said letter, Katihar bypass alignment is revised duly considering various site constraints and final alignment is submitted to PIU in January, 2015.

The revised alignments were submitted to the State Governments of Bihar and Jharkhand and NOC from the State Governments for the stretches of alignment falling in their States have been obtained.

9 UP-GRADATION PROPOSALS

- The up-gradation proposals are proposed in accordance with Four Lane Manual IRC : SP-84-2014.
- It is proposed to widen the existing two/intermediate lane carriageway to 4-lane carriageway with paved shoulders.
- Taking into account the available ROW, constraints of utilities, feasibility of acquiring additional ROW, either Concentric widening or eccentric widening is proposed.
- Decision regarding existing CD works will taken taking into account the feasibility for widening, hydrological adequacy etc.
- Traffic signs, pavement markings, pedestrian and other miscellaneous provisions are proposed as per the manual.
- Summary of upgrade proposals (The proposals given are tentative and subject to change based on detailed designs).
- Proposal comprises bypasses, VUPs/PUPs, Flyovers, ROBs, are given below. The salient features of the proposed corridor are summarized in Table 5

Table – 5 : Up-gradation Proposals

Item	Description
Length	49.0 Kms
Bypasses	Katihar
VUPs/PUPs	6
Flyovers	2

ROBs	3
Toll Plazas	1

10 PAVEMENT DESIGN

From the traffic volume count survey, the number of commercial vehicles which would ply on the project corridor was estimated. The Preliminary Pavement design is performed for both flexible and rigid options. IRC: 37-2001 was referred during the design of flexible pavement design. The area of toll plaza including the flared portions shall be provided with rigid pavement. Therefore, Rigid pavement for toll plaza has been designed in accordance with IRC:58-2011 for the stretch after considering vehicular distribution. The flexible pavement composition is given below in Table – E.6.

Table – E.6: Pavement Composition as per 5% growth Rates

H.S.	Crust Composition in mm				
	BC	DBM	Base	Sub base	Total
1	40	80	250	200	570*

***Note:** The pavement design has adopted for present and diverted traffic. The design traffic of 20 MSA considered for above pavement composition.

Substantial portion of the project road is with high embankment. The type of embankment available is silty material which undergoes settlements over a period of time. In view of the possibility of long term settlements of embankment rigid pavement option is not recommended.

11 COST ESTIMATES

The Construction cost of the project proposed is based on current applicable schedule of rates. The cost of the project is given in the Table – 7.

Table – E.7: Abstract of Cost

NH-131A from Km 6.000 to Km 55.000	
Description	**Cost (Rs. Crores)**
4-Lane Configuration	826.77

Abstract of Cost Estimate	
Item Description	**Total cost in Rs.**
SITE CLEARANCE	18,215,463
EARTHWORKS	1,489,489,123
SUB-BASE AND BASE COURSES	1,388,966,550

BITUMINOUS WORKS FOR FLEXIBLE PAVEMENT	1,541,667,144
RIGID PAVEMENT	43,394,419
CULVERTS	457,790,029
BRIDGES	1,169,250,000
REPAIR AND REHABILITATION OF EXISTING BRIDGES	5,440,737
DRAINAGE AND PROTECTION WORKS	1,784,028,375
JUNCTIONS	64,791,574
TRAFFIC SIGNS, MARKINGS AND APPURTENANCES	122,932,567
MISCELLANEOUS	170,164,478
MAINTENANCE DURING CONSTRUCTION	11,570,502
Total Construction Cost	8,267,700,961

12 TOLL REVENUE AND FINANCIAL VIABILITY

The total toll revenue that would be collected at the proposed toll plazas along project stretch during the concession period is given below in Table – 8.

Table – 8: Toll revenue summary

Year		Toll Plaza At Km 45.000 on NH-131A	Total Toll revenue after construction (Crores / Year) at proposed toll plazas
From	To		
2012	2013	7.17	7.17
2013	2014	8.07	8.07
2014	2015	8.86	8.86
2015	2016	9.86	9.86
2016	2017	10.74	10.74
2017	2018	11.89	11.89
2018	2019	13.21	13.21
2019	2020	14.42	14.42
2020	2021	15.98	15.98
2021	2022	17.70	17.70
2022	2023	19.57	19.57
2023	2024	21.67	21.67
2024	2025	23.98	23.98
2025	2026	26.41	26.41
2026	2027	29.20	29.20
2027	2028	32.14	32.14

Year		Toll Plaza At Km 45.000 on NH-131A	Total Toll revenue after construction (Crores / Year) at proposed toll plazas
From	To		
2028	2029	35.47	35.47
2029	2030	39.15	39.15
2030	2031	43.06	43.06
2031	2032	47.95	47.95
2032	2033	52.82	52.82
2033	2034	58.75	58.75
2034	2035	64.66	64.66
2035	2036	71.72	71.72
2036	2037	79.58	79.58
2037	2038	87.50	87.50
2038	2039	96.87	96.87
2039	2040	107.90	107.90
2040	2041	119.31	119.31
2041	2042	131.99	131.99
2042	2043	146.41	146.41
2043	2044	157.45	157.45
2044	2045	174.83	174.83
2045	2046	193.76	193.76
2046	2047	214.67	214.67
2047	2048	238.77	238.77

Financial viability has been carried out taking into account the estimated toll revenues and costs. The assumed Debt, equity ratio, provision for interest during construction, maximum grant to be considered etc., required for Financial Modeling conform to those given in the RFP (Cl. 3.15). It is further assumed that equity IRR of 15% would make the project viable. Table – E.9 shows the summary of financial analysis. The Financial EIRR for proposed option (considering 40% grant and 30 Years Concession Period) are given in table 9:

Table – 9: Financial Viability

Grant	Concession Period	Project FIRR	Equity FIRR	Equity NPV @ 12%
40%	30	-	-	-

It was seen that the project returns are not adequate to service the grant and interest components and hence it is not possible to calculate the FIRR of the project and the project is not viable under DBFOT.

13 DECISIONS REQUIRED

The consultants request the approval of the Authority for

i. **Upgradation option**: The proposal for upgrading the entire project road to four lane.

ii. **LA**: Consultants propose acquisition of 60 m ROW for new and 45 m ROW along existing. The proposed ROW width may please be approved..

iii. **Draft Feasibility Report**: The Authority may issue comments on the Draft Feasibility Report for making necessary modification in the Final Feasibility Report..

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