

Construction of new link (NH-133B) from Km 0/000 (Km 200/870 of Sahibganj Bypass) in Jharkhand to Km 15/885 (Junction of NH-133B and NH 131A on Manihari Bypass) and Construction of Manihari Bypass from Km 0/000 (junction of NH-133B 131A and on Manihari Bypass) to Km 6/000 near Narenpur of NH 131A in Bihar including Ganga Bridge to 4 lane standard

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EXECUTIVE SUMMARY

1.0 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 15.885 (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
Sahibganj - Manihari	Km 0.000 (Corresponding to Km 200/870 of Sahibganj Bypass) to Km 15.885 (Jn. of NH 131A and 133B)	NH-133B	Bihar & Jharkhand	15.885
Manihari Bypass	Km. 0.000 (Jn. Of NH 131A and 133B) to Km. 6.000 near Narenpur	NH 131A	Bihar	6.0

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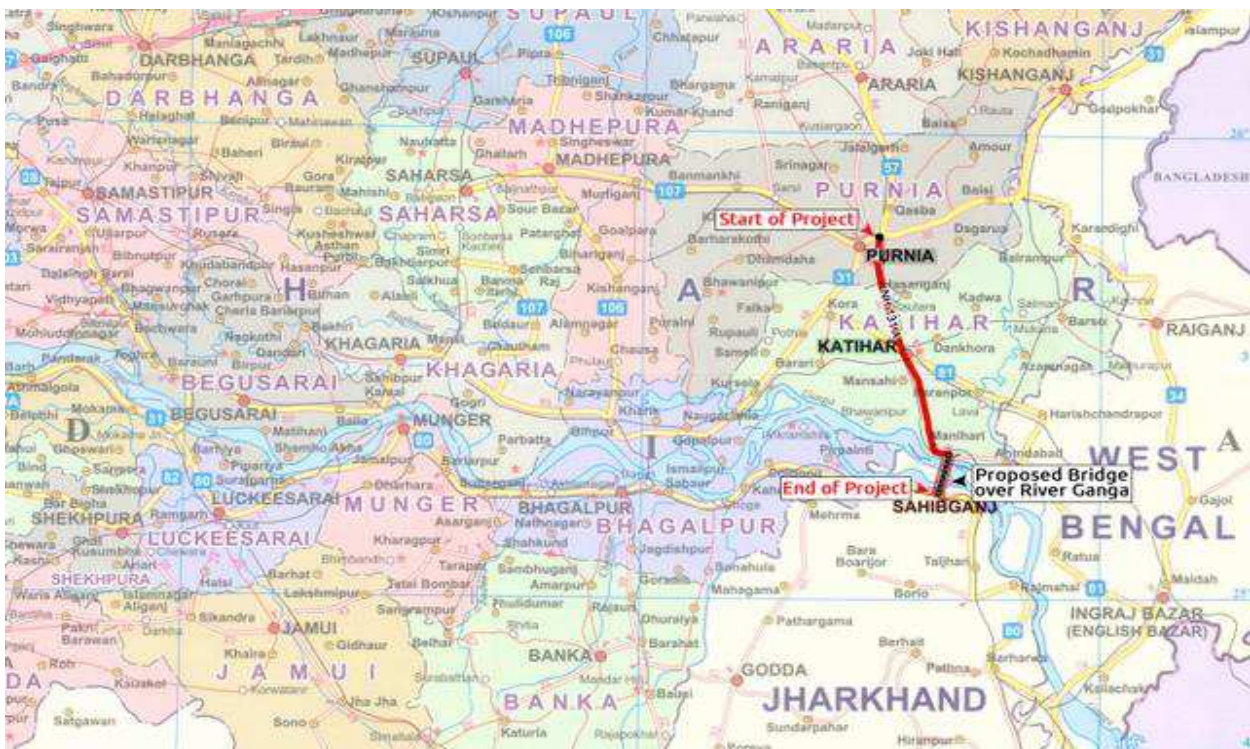
2.0 DESCRIPTION OF THE PROJECT CORRIDOR

The corridor consists of two NHs.

- Section I starts from Km 0.000 (Km 200/870 of Sahibganj Bypass) at Sahibganj bypass in Jharkhand to Km 15.885 at Junction of NH-133B and 131A in Bihar including 4 lane bridge over river Ganga and Manihari Bypass.
- The project road including part of NH 131A (i.e Manihari Bypass) from Km 0.000 at Junction of NH-133B and 131A to Km 6.000 near Narenpur.

The Project location map is shown in Figure - 1.

Figure - 1 : Project Location Map



Section I of the project road traverses through Sahibganj in the state of Jharkhand and Manihari districts in the state of Bihar. From Km. 0.000 to Km. 15.885, the project road is starts from Sahibganj bypass to Junction of NH-133B and 131A including 4 lane bridge over river Ganga. The project road is also including Manihari Bypass from Km. 0.000 to Km. 6.000. The project stretch passes through villages such as Ambadiha, Sriram Chauki, Sobhanpur Ganga Prasad, Har Prasad, Krishna Prasad, Rampur Balva Toli, Rampur Ogairah, Ramnagar in Jharkhand state and Mirjapur, Medanipur, Bhagar Kantakosh, Mirganj, Sosna Bharjana,

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Baghar Milik, Mahmadpur, Hanswar, Kewala, Nawabganj, Pagalwadi, Baulia, Narayanpur in Bihar state.

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.

3.0 EXISTING PROJECT ROAD

The project road from Km 0.000 at Sahibganj bypass to Km 15.885 at junction of NH133B and 131A is completely new alignment. There is no existing road. The existing road of NH-131A starts from Km 25.200 at Junction of NH-131A and 133B to Km 81.000 near Purnea in Bihar. The existing chainage of NH 131A at the end of Manihari Bypass is 34.578

4.0 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 Km 0.000 at Junction of NH-133B and 131A to Km 6.000 near Narenpur in Bihar (i.e Manihari Bypass).

5.0 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

6.0 EXISTING, DIVERTED AND PROJECTED TRAFFIC

The classified Traffic Volume Count (TVC) surveys were carried during the month of October 2012 near Sahibganj on NH-80. The seasonal variation factors for the month of October 2012

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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 – E.2: AADT

Description	Sahibganj on NH-80
AADT in Vehicles	877
AADT in PCUs	1136

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 – 3 and diverted traffic is given in Table 4(a). A detailed summary of traffic volume projections is tabulated in Table – 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

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Vehicle Type	Towards Purnea	Towards Sahibganj	Total vehicles in No.s	Total vehicles in PCUs
Mini LCV	24	18	42	42
Total Vehicles			698	1574

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

Year from	Year To	Sahibganj on NH-80	
		No.s	PCUs
2012	2013	184	303
2017	2018	235	387
2022	2023	300	494
2027	2028	383	630
2032	2033	488	804
2037	2038	623	1026
2042	2043	795	1310

7.0 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				
	Total Traffic In PCU's	Capacity Criteria			Recommendation based on V/C ratio	Total Traffic In PCU's	Capacity Criteria			Recommendation based on V/C ratio
		Capacity for divided C' way (PCUs/day)	V/C ratio	LOS			Capacity for divided C' way (PCUs/day)	V/C ratio	LOS	

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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

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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-Purnea/ 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.

8.0 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 Kaihar 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

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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.

9.0 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 of bypasses, VUPs, Flyovers, ROBs, Toll Plazas are given below. The bridge over River Gange will start at the end of Manihari bypass. The salient features of the proposed corridor are summarized in Table- 5.

Table – 5 : New Project Road Proposals

Item	Description
Length	21.885 Km
Ganga Bridge	5.20 Km
Viaducts	2
Bypasses	Manihari
VUPs/PUPs	2
Flyovers	0
ROBs	2
Toll Plazas	1

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10.0 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 – 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

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.

11.0 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 – 7: Abstract of Cost

NH-133B including Manihari Bypass	
Description	Cost (Rs. Crores)
4-Lane Configuration	1643.96

Abstract of Cost Estimate	
Item Description	Total cost in Rs.
SITE CLEARANCE	3,871,269
EARTHWORKS	1,526,907,088
SUB-BASE AND BASE COURSES	268,476,837
BITUMINOUS WORKS FOR FLEXIBLE PAVEMENT	292,614,049
RIGID PAVEMENT	43,856,105

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CULVERTS	77,229,449
BRIDGES	13,237,264,308
REPAIR AND REHABILITATION OF EXISTING BRIDGES	-
DRAINAGE AND PROTECTION WORKS	783,332,777
JUNCTIONS	3,854,853
TRAFFIC SIGNS, MARKINGS AND APPURTENANCES	34,233,912
MISCELLANEOUS	167,933,994
MAINTENANCE DURING CONSTRUCTION	-
Total Construction Cost	16,439,574,642

12.0 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 4.500 on NH-133B	Total Toll revenue after construction (Crores / Year) at proposed toll plazas
From	To		
2012	2013	5.81	5.81
2013	2014	6.49	6.49
2014	2015	7.17	7.17
2015	2016	7.89	7.89
2016	2017	8.67	8.67
2017	2018	9.60	9.60
2018	2019	10.57	10.57
2019	2020	11.66	11.66
2020	2021	12.89	12.89
2021	2022	14.22	14.22
2022	2023	15.73	15.73
2023	2024	17.34	17.34
2024	2025	19.15	19.15

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Year		Toll Plaza At Km 4.500 on NH-133B	Total Toll revenue after construction (Crores / Year) at proposed toll plazas
From	To		
2025	2026	21.19	21.19
2026	2027	23.37	23.37
2027	2028	25.83	25.83
2028	2029	28.54	28.54
2029	2030	31.54	31.54
2030	2031	34.90	34.90
2031	2032	38.54	38.54
2032	2033	42.63	42.63
2033	2034	47.15	47.15
2034	2035	52.16	52.16
2035	2036	57.69	57.69
2036	2037	63.92	63.92
2037	2038	70.74	70.74
2038	2039	78.42	78.42
2039	2040	86.77	86.77
2040	2041	95.95	95.95
2041	2042	106.30	106.30
2042	2043	117.79	117.79
2043	2044	125.52	125.52
2044	2045	138.98	138.98
2045	2046	154.01	154.01
2046	2047	170.67	170.67
2047	2048	189.28	189.28

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:

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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.

13.0 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.