

#### LINEAR INFRASTRUCTURE THROUGH FOREST AREA

Construction of six - lane access- controlled highway between Ganeshpur & Dehradun section (NH-72A) for NHAI.



ING-IABSE Workshop on "Design, Construction and Maintenance of Steel Bridges", Dehradun, 19th & 20th October, 2024



Mr. Atul D. Bhobe has done his M.S.E. from University of Michigan, USA. He is an alumnus of Victoria Jubilee Technical Institute of the University of Mumbai having done his B.E. in Civil Engineering with Honors in 1985.

He joined services of the then M/s. S. N. Bhobe & Associates in 1986, after completion of his Masters degree and continues to lead the organization as the Managing Director of TPF Engineering Pvt. Ltd. Mr. Bhobe has nearly 40 years of experience in the field of bridge and structural engineering consultancy.

He has published/presented over 200 papers at national and international conferences.

He is currently the President of Indian Institution of Bridge Engineers.

#### Mr. Atul D. Bhobe



### **PROJECT INTRODUCTION**



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#### **INTRODUCTION**

The National Highways Authority of India (the "Authority") is engaged in the development of National Highways and as part of this endeavor, the Authority has decided to undertake the Development of sixlane access-controlled highway from design chainage 0+000 (Ganeshpur) to design chainage 8+130 (near Mohand), and chainage 8+130 (near Mohand) to design chainage 16+380 (Daat kali Tunnel) of Ganeshpur – Dehradun section of NH-72A in the state of Uttar Pradesh under Bharatmala Pariyojana (Package-1) (the "Project") through an Engineering, Procurement and Construction (the "EPC") Contract



#### **LOCATION PLAN**







# LOCATION ALONG ALIGNMENT – RAJAJI NATIONAL PARK-







#### WILDLIFE INSTITUTE OF INDIA (WII)REPORT



ING-IABSE Workshop on "Design, Construction and Maintenance of Steel Bridges", Dehradun, 19th & 20th October, 2024



Rapid Assessment of Wildlife and Suggested Mitigation Measures for Development of Delhi Dehradun Highway in the Shivalik Hills

12/2020

<u>ANNEXURE I</u> Details of the 25 species camera trapped during the study











### WILDLIFE INSTITUTE OF INDIA (WII)REPORT



ING-IABSE Workshop on "Design, Construction and Maintenance of Steel Bridges", Dehradun, 19th & 20th October, 2024

#### **Zone wise Animal Crossing**



Crossing zone for various species across three zones from Ganeshpur to Dehradun

Figure 14: Schematic diagram depicting critical crossing zones of all species on the 20 km stretch between Ganeshpur and Dehradun on NH72



### **MITIGATION MEASURES BY WII**



- Wild Animal movements Asiatic Elephants, Chital, Leopard, Tigers, Nilgai, Wild pig, etc.
- Height of 2.5 to 3.0 m for Wild Animals other than Elephant Habitats
- Height of 6-8m for Animal Underpass in Elephant Habitats.



#### LOCATION ALONG ALIGNMENT – (RAJAJI NATIONAL PARK-MOHAND RANGE)

























### **SALIENT FEATURES**



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- Client- National Highways Authority of India (NHAI)
- Total Project Length 19.785 Km
- Total Project Cost Rs. 1,492,37,38,000/-
- Construction Period AS Per Tender- 730 Days.
- Actual Construction Period Approx. 1100 Days.

(Due to Restricted working hours from sunset to sunshine)





Tunnel Section	Length 370 m, Single Tube, 3 Lane
Cross section	11.82dia m
Width	11.40 m
EUP- (6.0 m VC)	2 Nos. (400m) (Pkg-3:- 400m)
AUP- (3.5 m VC)	6 Nos. (Pkg-1:- 3 Nos. & Pkg-3:- 3 Nos.)
VUP- (5.5 m VC)	1 No. (Pkg-1:- 1 No.)
Major Bridges	3 Nos. (Pkg-2:-3 Nos.) Spans 20 m x 3 Nos, 25 m x 3 Nos
Minor Bridges	16 Nos. (Pkg-2:-13 Nos, & Pkg-3:-3 Nos.





Elevated Section	Length 12.013 Km (Pkg-1:- 5.775 Km & Pkg-2.:- 6.238 Km)
Nos of span	11m x 1 Nos, 13m x 1 Nos,21 m x 558Nos,23 m x 1 Nos, 32m x 1 Nos, 35m x 2Nos, 40m x 2Nos, 60m x 1Nos, Steel truss span
Width	25 m- 6 Lane
Max. Pier height	22 m
Type of Foundation	Open foundation
Type of Substructure	RCC Piers
Type of Superstructure	Steel through type truss; Composite Steel I Girders
River	Non-Perennial river
Type of Bearing	Elastomeric Bearing
Design speed	100 km/h
Pavement	Flexible pavement
Total Quantity of Steel used (Tonnes):	28,969 M.T.
Superstructure	6 lanes
Superstructure Erection Methodology	Erection by cranes



### **SPECIAL TENDER CONDITIONS**



- Superstructure type:-
  - Steel composite superstructure with module size of 105.0 m for viaduct
    - Being Eco sensitive zone
    - Speed of construction, sustainability, and structural integrity
- Substructure:-
  - The pier shall be Single pier.
    - Reduced footprint
    - Lower environmental disruption
    - Simplified construction process





#### Vertical Clearance for wild Animal Passage :-

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10	2+258 to 8+033	Elevated Structure	5775	165x35	Animal Pass	6m	Additional passes for wild Animal
11	8+130 to 13+178	Elevated Structure	5048	144x35	Animal Pass	6m	Additional passes for wild Animal
12	13+292 to 14+482	Elevated Structure	1190	34x35	Animal Pass	6m	Additional passes for wild Animal
13	14+630	Minor Bridges	32	2x16		2.5m	Additional passes for wild Animal
14	14+710	Minor Bridges	40	2x20		2.5m	Additional passes for wild Animal
15	15+140	Major Bridge	60	3x20	Major-Minor	2.5m	Additional passes for wild Animal
16	15+440	Minor Bridges	24	1x24	bridge/Addition	2.5m	Additional passes for wild Animal
17	15+535	Minor Bridges	20	1x20	al passes for wild animals.	2.5m	Additional passes for wild Animal
18	15+610	Minor Bridges	12	2x6		2.5m	Additional passes for wild Animal
19	15+700	Minor Bridges	24	1x24		2.5m	Additional passes for wild Animal
20	15+770	Major Bridge	75	3x25		2.5m	Additional passes for wild Animal
					dillinga,	200270-	and a second of the feature of the second
28	18+500	EUP	200	2x28.5+5x28. 6	EUP	6.0m	Passage as advised by Chief Wildlife Warden and Will in Joint Site Inspection
29	19+050	EUP	200	2x28.5+5x28.	EUP	6.0m	Passage as advised by Chief Wildlife Warden and Will in Joint Site Inspection



#### TYPICAL STRUCTURAL MODULE FOR 5X21 M SPAN







### **TYPICAL CROSS-SECTION DETAILS**



- Carriageway :-
  - Dual carriage way for 3 Lane traffic on each side with central median.
  - Carriageway width =11.5 m.
  - Deck width = 12.5m.
  - Common Substructure & foundation supporting duel carriageway.





### **STRUCTURAL ARRANGEMENT**



- Superstructure :-
  - Steel composite I girder
  - Wedge plate as per long. Grade.
- Bearings:-
  - Elastomeric Bearing with Seismic Arrester (Seismic Zone-IV).
- Substructure:-
  - RCC Rectangular Single pier supporting both carriageway.
  - RCC/PSC Pier cap
- Foundation:-
  - RCC Open Foundation







#### **TYPICAL SUBSTRUCTURE DETAILS**















### **MATERIAL PROCUREMENT**



- Grade of Steel:
  - E350: As per IS 2062:2011 (both steel plate & rolled section)
- Material Receiving Inspection
  - Dimension and Quantity checked as per the invoice
  - Visual Inspection
  - Marking on the Raw material
  - Check whether MTC is received





#### **MATERIAL INSPECTION:-**









### **TESTING OF RAW MATERIAL:** VISUAL INSPECTION Governme ING-IABSE Workshop on "Design, Construction and Maintenance of Steel Bridges", Dehradun, 19th & 20th October, 2024







#### MANUAL UT







#### **IMPACT TEST**







#### **DIMENSIONAL INSPECTION**







#### **TENSILE TEST**





















#### **MACRO STRUCTURE INSPECTION**



Public Works Department, Uttarakhand





#### **FABRICATION PROCESS**



#### Public Works Department, Uttarakhand





### **MARKING & CUTTING :**



Public Works Department, Uttarakhand

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- •Adherence to Cutting Plans
- •Flame Cutting Methods
- Plasma Cutting:

For steel plates up to 20 mm

• Oxygen-Acetylene Cutting:

For steel plates thicker than 20

- Identification of Plates.
- Preparation for Welding
- Edge Preparation:







#### **ROBOTIC PLATE CUTTING**









#### Plate Cutting by PUG Machine:



#### Plate Cutting by CNC Machine:





#### **PLATE STRAIGHTENING**







#### **FIT UP PROCESS**







#### **PRE-HEATING OF I-BEAM**







#### FIT UP & WELDING:









### **WELDING REQUIREMENTS**



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Consumables Specifications :

### • Welding Process:

(1)SMAW : AWS/A/SFA5.5/5.5M

(2)SAW : AWS/A/SFA/5.23/5.23M

(3)GMAW : AWS/A/SFA/5.28/5.28M

(4)FCAW : AWS/A/SFA/5.29/5.29M

#### > Welding Position:

- 1. F Flat 1F or 1G
- 2. H Horizontal 2F or 2G
- 3. V Vertical 3F or 3G
- 4. OH Overhead 4F or 4G
  - F---- For Fillet welding
  - G---- For Groove welding



### **WELDING PROCESSES**



- SAW & FCAW Used in fillet welds
- GMAW used in butt welds
- SMAW used for weld repair and welding in confined spaces
- Welding Positions:-

1	F	Flat	1 F or 1 G
2	Н	Horizontal	2 F or 2 G
3	V	Vertical	3 F or 3 G
4	ОН	Overhead	4 F or 4 G





#### SUBMERGED ARC WELDING IN PROGRESS







### STUD WELDING AT FABRICATION YARD







### **TRIAL ASSEMBLY**



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- Final Clearance :
- a) Camber on jack
- b) Dead load deflection
- c) Dimension
- d) Fairness of holes
- e) Temporary fasteners
- f) Infringement
- g) Butting of Compression edges
- h) Splice gap
- i) Verticality

• Surface Preparation :

#### As per IRS B1: 2001

- a) Surface Condition after blasting
- b) Shop painting



#### PAINTING



Sequence of Coating	Required
Surface Profile/Roughness	SA 2.5 (40 to 60 Microns)
Quick Drying Primer (2 Coat)	-
Alkyd type Paint (1 Coat)	-
Final Coat Alkyd type Paint	-
Total	130 to 150 μ





### CHECKING THE GIRDER & BOLTS AFTER TRANSPORTING IT ON THE SITE



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#### • Checking of the Transported Girder on site.

- After Fabrication the Girder is transported on site from the fabrication yard. It is necessary to check the Members of the Girder.
- Check for right Angles at joint of flanges and web
- Checking the stiffeners Open space are not permitted in stiffeners
- Bows or Kinks in steel shall not be present
- Cracked or Broken weld shall not be seen in the Shipped Girder
- Checking of Shipping Bolts

#### • Checking of Bolts

- Rotational capacity on bolts shall be conducted under inspection
- Retest wherever the bolt condition changes.



### PRECAUTIONS REQUIRED TO BE TAKEN DURING STACKING, ASSEMBLY ETC.



- Ground shall be Firm and Flat
- The Girder shall be stored at least 150mm above the ground upon platforms or skids.
- The Girder shall be away from moisture
- The Girders shall be stacked and braced properly to avoid any distortion in sections.
- The stacking and storage shall be as per IS 4082:1996 or as per specified in the specification.
- Do not allow oil/grease on the steel.
- Storage of Bolts on the site shall be done properly away from moisture and dirt.



### ASSEMBLY & ERECTION SCHEME OF I- GIRDERS:



- Preassembly of the I-Girders
  - Shall be done on Ground.
- Torquing of I-Girders
  - After Assembly and Nut-Bolt verification, the Torquing of the member shall be started.
- Erection of I-Girders
  - After Assembly & Torquing activities verification and clearance, the Erection of the I- Girders shall started.
- Final Inspection
  - After Complete erection of the I- Girders, Final inspection of the Complete Span shall be done.
- Alignment Check & Camber Check
- Site Painting :- After final inspection and confirmation Final Coat of the Paint as per procedure shall done.







### POINTS TO BE CHECKED FOR/DURING LAUNCHING OF GIRDER



- Proper flat Ground Preparation shall be done for stacking of Girder at site during erection.
- Ground preparation is also required for access and movement of crane on site for further Launching process
- The choice of the crane shall be as per following :
  - Site Condition & lifting positions of the crane
  - Clear height between Ground level and soffit level
  - Erection Methodology i.e. erection of Single Girder or 2 Girders (2 Girder joined by intermediate diaphragm), its merits and demerits etc.







- The inspection of the crane shall be conducted on the site for various points such
  - Age of the crane
  - Capacity of the Crane based on weight of the girder to be lifted
  - Radius and height of the crane movement
  - Condition of the lifting belts and its capacity
  - Condition of shackles etc.
  - Experience of the rigger.







- To ensure all the safety and precautions to be taken on the site during the launching of the Girders
- Points to be checked after erection in case of Single
  Girder launching scheme
  - Its position
  - Alignment
  - Level
  - Stability etc.







- After launching of all girders & bolting of the Latten and Bracing as per the designed check on all bolting, alignment and levels in all respect shall be done.
- Give final torque to all bolts as per the Bolting sequence mentioned in the specification (further details provided).
- All the Assembling, launching and bolting shall be in accordance with the respective codal provisions and as per mentioned in the Drawings





### **ASSEMBLY & ERECTION OF I- GIRDERS:**







#### **TECHNICAL PROBLEMS FACED-SOLUTIONS**



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 As the project comprise of majorly composite steel structure and also the same runs through an eco-sensitive zone disallowing contractors to work round the clock, the design was modified to reduce the span arrangement to 21m from 35m which subsequently cut short the time in launching of composite steel girders and to complete the project faster.



#### **SITE PHOTOS**

















Deck slab concreting is in progress at span P33-P34 LHS truss bridge.



P32-P33 deck slab shuttering work is in progress.



Grouting work is in progress at psc pier cap P-61.



P34-P35 rhs deck slab reinforcement work is in progress.







Bridge load test has conducted on span A1-P1 at eup-2 RHS.



Expansion joint work is in progress at eup-2 RHS.



NDT test conducted at eup-1.



Noise barrier installation is in progress at eup.



### **SITE PHOTOS:- AERIAL VIEW**











## Rajaji National Park & Tiger Reserve













# Thank you!