3 0 GROUND SURVEY AND ALIGNMENT

3.1 MAJOR CONSTRAINTS

3.1.1 There are various constraints towards development of the Project of this size and complexity has been dealt in best possible detail at the stage of feasibility study. These may need further detailed examination for implementation.

3.1.2 One of the major constraints is acquisition of private land/property and the revised alignment of the corridor as finalized aims at minimizing such acquisition, Efforts have been accordingly made to locate corridor within available Railway land to the extent possible and land acquisition in private land / property is kept minimal. In view of the above DFC alignment has been kept generally parallel to IR alignment in the entire stretch.

3.1.3 **Land availability:**

The alignment of DFCCIL passes through Hoogly and Bardhaman District in West Bengal and Dhanbad and Giridih in Jharkhand. Availability of Railway land is limited at the most location along the alignment and not sufficient for the construction of double line corridor. Additional land is also required for construction of DFC stations, TSS, SP, SSP etc. Acquisition of land is required for the aforesaid purpose and district wise requirement of the Private / Govt./ Forest land is mentioned below.

A. DISTRICT WISE DETAIL OF LAND REQUIRED for DFC ALIGNMENT

S.No.	District	No. Of Villages	Area Proposed For Acquisition			
			Private Land (in Ha)	Govt. Land (in Ha)	Forest Land (in Ha)	Total Land required (in Ha)
1	Hoogly	36	65.6933	0.539	'—	66.2323
2	Bardhaman	120	409.114	26.997	'—	436.1121
3	Dhanbad	51	123.0175	28.5000	1.0161	152.5336
4	Giridih	06	2.775	0.8835	0.0850	3.7435
	Total		**600.5998**	**56.9195**	**1.1011**	**658.6204**

DFC alignment traverses a route length of 48.50 km in Hoogly District. Acquisition of 66.2323 Hectares land is involved in 36 villages of Hoogly district out of which an approximate area of 0.539 Hectare is Govt. Land and 65.6933 Hectare is private land. There is no forest land/ reserve forest/wildlife sanctuary falling on or DFCCIL alignment in this district.

DFC alignment traverses a route length of 157.244 Km in Bardhaman District. Acquisition of 436.1121 Hectares land is involved in 120 villages of Bardhaman district out of which an approximate area of 26.997 Hectare is Govt. Land and 409.114 Hectare is private land. There is no forest land/ reserve forest/wildlife sanctuary falling on or DFCCIL alignment in this district.

DFC alignment traverses a route length of 74.436 Km in Dhanbad District. Acquisition of 152.5336 Hectares land is involved in 51 villages of Dhanbad district out of which an approximate area of 28.50 Hectare is Govt. Land and 123.0175 Hectare is private land. In Dhanbad district the alignment falls on 1.0161 hectares of forest land.

DFC alignment traverses a route length of 4.74 Km in Giridih District. Acquisition of 3.7435 Hectares land is involved in 6 villages of Giridih district out of which an approximate area of 0.8835 Hectare is Govt. Land and 2.775 Hectare is private land. In Giridih district the alignment falls on 0.085 hectares of forest land.

3.1.4 Another major constraint is the existence of large number of encroachments along the Railway track, which infringe the DFC alignment at a few locations as under:

(a) Between Km.15/14B and Km.15/30 at Dankuni beside DN HBC Line (See photograph below).

(b) Between Km.64/26 and Km.65/8A at Jaugram beside DN HBC Line.

(c) Between Km.55/10A and Km.55/6A at Hazigarh beside DN HBC Line. (See photograph below).

(d) A large number of encroachments exists at few level crossings. List of such level crossings are as under:-

S.No.	LC No.	Location	Between stations	TVU
1.	9	15/23-25	DANKUNI-GOBRA	70350
2.	11	16/23-25	DANKUNI-JANAI RD	12448
3.	12	17/7-9	GOBRA STN LIMIT	120435
4.	16	21/5-7	JANAI RD-BARUIPARA	7691
5.	18	22/5-7	JANAI RD-BARUIPARA	102505
6.	20	23/13-15	JANAI RD-BARUIPARA	25372
7.	24	29/1-3	BARUIPARA-KAMARKUNDU	35098
8.	27	33/5-7	KAMARKUNDU	493993
9.	44	57/35-37	GURAP	142191
10.	53	64/1-3	JAUGRAM	121420
11.	60	119/51-120/0	KHANA	121238

ENCROACHMENT AT DANKUNI

ENCROACHMENT AT HAZIGARH

ENCROACHMENT AT DANKUNI

3.1.5.1 Limited availability of Rly. Land

3.1.5.2 The railway land availabiltity at Mirzapur Bankipur, Balrambati and Porabazar is limited. Moreover, there are densly populated and built up area adjoining Railway land at these stations (see photographs below). To minimise extra land acquisition in such heavily built up localities, platform width at these three stations are to be reduced to accommodate DFC alignment with minim um land acquisition.

BALRAMBATI STATION

PORABAZAR STATION

3.1.5.3 There is limited space between DTPS siding and IR track. For accommodating DFCCIL alignment and for providing UP connectivity, 2 lines of DTPS sidings will be required to be dismantled and will involve remodeling of DTPS siding at Waria Station.

3.2 PLANNING AND DESIGN NORMS

3.2.1. PLANNING PARAMETERS

3.2.1.1 This report is applicable for Planning, Design, Construction and Maintenance of Sonnagar – Gomoh - Dankuni section of Eastern Dedicated Freight Corridor (EDFC) through Public Private Partnership (PPP) mode. Operation of the rail traffic is not included in this report as train operations are not covered in the scope of Concessionaire. The Scope of Work shall be as defined in the Concession Agreement. The Rail System shall be constructed, completed and maintained during the Concession Period by the Concessionaire as per the Specifications and Standards set forth herein. Some of the broad requirements are tabulated below :-

B. SALIENT DESIGN FEATURES

S/N	DESCRIPTION	DFCC
1	Moving dimensions height	5.1 m
2	Width of container stack	3.660
3	Train length	1500 m
4	Train load	15000 T
5	Axle load	Track Structure fit for 25 Tonne axle load and Bridges and formation fit for 32.5 Tonne axle load (DFC Loading)
6	Track loading density	12 T/m
7	Maximum speed	100 KMPH
8	Grade	1 in 200
9	Curvature	Upto 2.5 Degree
10	Traction	Electrical (2x25 KV)
11	Station spacing	Approx. 40 Km
12	Signaling	Automatic with 2 Km spacing
13	Communication	Mobile train radio.

3.2.1.2 These are further discussed in detail as under:-

i) The nominal DFC track gauge shall be 1676 mm measured at 14 mm below the top of the rail.

ii) The Formation and Bridges shall conform to DFC Loading (32.5T Axle Load) as per Annexure XXV (in 4 sheets) of IR Bridge Rules. However, the track structure shall be suitable for 25T loading 2008 as per Annexure XXII (in 4 sheets) of IR Bridge Rules.

iii) DFC section will have double line track.

iv) At Junction stations, yard layouts should suit the requirement of long haul (2x750 m) as planned in EDFC.

v) Crossing stations shall have minimum two loops (one UP & one DN) with 1500 m CSR (Provision of 750 m for present and an additional 750 m for future shall be kept).

vi) Entire rolling stock shall be owned/operated and maintained by MOR/DFCCIL.

vii) All operations shall be under MOR/DFCCIL.

viii) Role of Concessionaire shall be limited to constructing and maintaining fixed infrastructure.

ix) Construction of ROB in lieu of level crossings within Dankuni-Gomoh section is not included in the scope of concessionaire. However, construction of RUB/LHS in lieu of level crossings will continue to be within the scope of Concessionaire.

x) Traction System shall be 2 x 25 KV, 50 Hz AC AT feed system.

xi) SCADA system shall be provided for remote monitoring and controlling the Traction Power Supply System from Remote Control Centre (RCC).

xii) Signaling system for entire Dankuni - Gomoh section will be automatic signaling with 2 Km distances between signals.

xiii) Schedule of Dimensions for Broad Gauge shall conform to SOD for EDFC.

3.2.1.3 The rail systems built by the concessionaire shall be able to run the trains at maximum speed of 100 kmph and to carry the traffic projected in the DFCCIL business plan as mentioned in chapter 2 of this manual.

3.2.2 GEOMETRIC DESIGN PARAMETERS

a) **Horizontal Curves**

i) The minimum radius of curvature under unavoidable circumstances for horizontal curve is 292 m.

ii) However, it is recommended to provide a minimum radius of curvature of 700 m in normal conditions.

iii) The maximum Degree of Curvature is 6.0° and for elevated track (in case of flyovers) is 4.0°. The reason for such provision is to reduce the length of connection hence, reducing the area of land acquisition. Sharper Curve will result in reduction of speed at these locations.

iv) Cant deficiency (Cd) allowed may not exceed 75 mm and the Actual Cant (Ca) may not normally exceed 165 mm.

v) There are total 310 curves proposed along the Dankuni – Gomoh Section of the Corridor. List of these curves are given in **Annexure A**.

b) **Transition Curves:-**

i) All curves on mainlines shall be provided with transition curves to the straight which shall take the form of a cubic parabola with the equation as y=x3/6RL.

ii) Minimum length of the transition shall be the maximum length obtained from the following equations:

L = 0.008 * Ca*V

L = 0.008* Cd *V

L = 0.72* Ca

Where, Ca & Cd are the value of actual cant & cant deficiency respectively in mm and V is maximum permissible speed in kmph. The above requirement is based upon rate of change of cant and rate of change of cant deficiency as 35mm/sec.

iii) For design of transition length, value of Ca shall be calculated for speed of 100 kmph with Cd = 0, and V shall be taken as 100 kmph, where it is not practical to use 100km/h, a reduced speed may be utilized with the approval of the IE.

iv) To accommodate transition curve, Shift (S) in meters equal to $L^2/24R$ is to be provided, where L is the length of transition curve in meters and R is radius of curve in meters.

c) **Safe speed on curves**

The safe speed on curves is determined by the formula:

$$V_{safe} = 0.27 \sqrt{R\,(Ca + Cd}$$

where,

V safe	=	Safe speed in kmph
R	=	Radius in m
Ca	=	Applied Cant in mm
Cd	=	Cant deficiency in mm

d) **Vertical curves**

Vertical curves as specified in para 221 of Engineering Code (Para 419 of Indian Railways Permanent Way Manual) have been provided. As per Engineering Code, vertical curves have been provided only at those locations where the algebraic difference in change of grade is equal to or more than 4mm/m i.e. 0.4%. A minimum radius of the vertical curves of 4000 m as applicable for 'A' category lines for BG has been adopted. The details of the vertical curve are given in Annexure B.

e) **Ruling Gradients**

The ruling gradient for the proposed line has been kept as 1 in 200 (compensated). Grade compensation has been provided at the rate of 0.04% per degree of curvature as per Para 418 of Indian Railway's Permanent Way Manual. The details of gradients are given in **Annexure C.**

f) **Points and Crossings**

All the Point and Crossings/Crossovers on the main line, running line or in loops at yard shall be provided with 1in 12 turnouts. Only the siding of the loops may be connected to the loops with 1 in 8½ turnouts.

No part of Points and Crossing length should fall on a transition curve or a vertical curve of the track.

g) **Station/Depot yards**

i) At each crossing station, minimum two numbers of loops (one Up & one DN) with 1500 m CSR (Provision of 750 meter for present and with additional 750 meter for future) shall be kept.
ii) At junction stations, yard layouts should suit the long haul (2 x 750 m).
iii) Each Junction / Crossing station is provided with Station building as per typical plan shown in **Annexure D.**
iv) Yard lines should normally be flat/level; gradient may not be steeper than 1 in 1200. Curves in yard may be non-canted and non-transitioned.
v) Under unavoidable conditions the minimum gradient is 1 in 600 for Station and Yards.
vi) Integrated Maintenance depots (IMD) are provided @ 160 km apart and Integrated maintenance sub Depot (IMSD) is provided @ 40 Km apart along the route. Typical plan for IMD and IMSD are enclosed in **Annexure G**.

3.3 ENGINEERING SURVEY

3.3.1 The proposed alignment is generally parallel and falling on north & south side of existing IR alignment in various stretches as detailed below:

Dankuni to Palla road	-	North side
Palla Road to Raniganj	-	South side
Raniganj to Sitarampur	-	North side
Sitarampur to Kulti	-	South side
Kulti to Gomoh	-	North side

The alignment has been decided to minimise the relocation / reconstruction of major stations and to minimise displacements of residential and commercial areas falling in vicinity of Railway Land. A schematic alignment plan for Dankuni – Gomoh section is enclosed in **Annexure H**.

3.3.2 METHODOLOGY OF SURVEY WORK

For carrying out topographical survey for the project, work was started from Dankuni end. The procedure adopted for survey consisted of following steps:-

i) Carrying out closed circuit Traverse Using Total Station instrument and establishing traverse station.

ii) Carrying out Precision levelling using Double tertiary levelling method along the project length and establishing temporary Bench Marks on pillars and adjoining structures plinth, Bridge parapet etc. and connecting all traverse points to get their exact elevation i.e. (Z value).

iii) Carrying out topographical survey using Total Station along the traverse laid as per item (ii) above to cover all existing details for the required width on both sides of the track having least count of 1 sec and 1 mm.

3.3.3 REFERENCES USED:

For the above survey following references have been used:-

a. **Chainage:** Chainage from Dankuni station has been considered to be same as IR chainage. Chainage of centre of Dankuni station is 14.80 km (Ex.Howrah). This chainage is increasing towards Dhanbad upto Shaktigarh. At Shaktigarh, a junction of Main line and chord line is formed and from Shaktigarh onwards, IR follows the Main Line chainage, which is 12.33 km more than Chord line chainage. For uniformity, DFC chainage is also considered on similar pattern. ML/Chordline chainage of Shaktigarh station is 95.21/82.88. From Shaktigarh onwards, Chainage starts from 95.21 and increasing towards Dhanbad/Sonnagar.

b. **Co-ordinate Reference**:- Reference point has been taken from two GPS station. For entire section, this reference has been used for traversing and surveying purpose.

3.3.4 **LEVELLING: -** Survey of India GTS Benchmarks located on the parapet wall of bridges along the alignment has taken as a reference Bench Mark for all levels in this section. Leveling has been carried out from the referred benchmark using auto levels and with double tertiary leveling method fixing Temporary Bench Marks (TBM) along the route.

Photo Showing Temporary Bench Mark

3.3.5 **TRAVERSING: -** Traverse has been carried out and closed. Co-ordinates have been recorded for each pillar fixed along the alignment.

List of Temporary Bench Marks is attached as **Annexure-E.** List of GPS Co-ordinates is attached as **Annexure-F.**

3.3.6 **DETAIL SURVEY: -**

Topographical survey of the section has been started by teams one from Dankuni End Station proceeding towards Dhanbad and other from Dhanbad station proceeding towards Gaya covering details for required corridor up to existing Railway boundaries on the both side of the existing lines with additional width wherever needed. In the station yard areas, topographical survey has been carried out to cover the details of the entire existing tracks, and where new tracks are proposed. The detailed survey for feasibility study has been carried out using TOTAL STATION having an in built memory of 4000 points and least count of 1second.

All details such as existing railway track/yard, Railway quarters, water bodies, high-tension lines, villages, roads, structures etc were picked up. Levels have been taken at required interval to generate L-Sections & C-Sections. Additional Levels have been taken at every change of grades. During the survey all hydraulic details such as bed levels, HFL's have been surveyed for hydraulic calculations. Existing drain, gutters, extended substructures have been surveyed. Formation levels, Rail levels and adjoining ground levels have been recorded. Existing Land Boundary pillars were surveyed to know the extent of existing land boundary.

Data collected was downloaded to the PC & coded. The data was processed in Auto Civil 3D software and drawings were prepared. Efforts were taken to design alignment to suit the 100 kmph speed. Grades have been marked in such a way that existing formation level will generally confirm to the existing formation levels.

Topographical survey of the entire stretch was carried out by Total station picking up X, Y & Z coordinates of all objects. List of X, Y, Z coordinate of entire section are tabulated in **Annexure-F**. The Topographical Survey has been completed for the required corridor on the both sides.

3.3.7 PREPARATION OF PROJECT SHEETS:-

Project sheets are prepared on 1:2000 scales instead on 1:5000 scales as mentioned in the Engineering Code so that it is readable. Each project sheets depicts the L-section and detailed alignment plan of DFC alignment of approximately 2 km.

3.3.8 STAKING OUT ALIGNMENT

Horizontal controls were established using Total Station by running traverse line along the proposed line. A number of Traverse Stations are there on the nearby permanent structures to facilitate the staking out operation. Some structures like pillaring etc. made by RITES were also taken into account during survey. Traverse adjustment if required will be carried out. Co-ordinates were calculated for each station marked on the ground for staking out.

3.3.9 FIXING OF PILLARS

Concrete pillars have been fixed at center line of proposed alignment at 500 m interval. Pillars were also fixed at land boundary location at 150 m interval as well as change point of land boundary.

3.3.10 PREPARATION OF LAND PLAN

Village maps were collected from respective Tahsils / Districts. Tracing of the village maps were prepared along the railway track. Based on the boundary pillars, verification has been carried out on site for identification of survey. nos involved in the acquisition. After verification survey no. wise area to be acquired has been calculated. Khasara & Khatoni have been collected and owners have been identified.

3.3.11 GRADES

Grades have been marked on the L-Section. RUB has been planned on detour portions and hence grades have been marked accordingly. List of grades of the total alignment is given in the **Annexure- C.**

3.4 ALIGNMENT DESIGN

Horizontal and vertical alignment is designed based on specifications/ instructions given using AutoCAD civil 3D 2010 software. Following principals were adopted during the design of alignment.

a) To minimize the embankment height to the maximum extent as to minimize the land acquisition;
b) To maintain the design speed of 100kmph.
c) To design in such a way so that it has minimum infringement with existing railway infrastructures as well as private structures.
d) To avoid mosques, temples, churches, cemeteries, heritage listed structures etc.
e) To avoid high fills and deep cuts to facilitate ease in construction, safety during construction and less maintenance efforts during service;
f) Satisfy the clearance requirements of Road over Bridges/RUB.
g) To maintain adequate vertical overhead clearance for the road traffic i.e. Road under Bridges (RUB).
h) To provide adequate clearance from the flood level to both the top of the Formation as well as the bridge soffits.

i) To avoid any specified obligatory structures/ facilities/ utilities and heavily built up areas;
j) To minimize environmental pollution; and
k) To satisfy sound economic engineering practices.

3.4.1 Section Wise Details Of Proposed Alignment

3.4.1.1 DFCCIL alignment in Dankuni Gomoh section of Eastern Corridor is planned to be double line alignment taking off from Dankuni in Howrah Division and running generally parallel to the existing IR alignment. The alignment takes off from Dankuni and runs on the North side of existing IR alignment upto Palla road station. After Palla Road, DFC alignment crosses over on south side and the alignment remains on the south side upto Raniganj, where again the DFC alignment crosses over to North side. From Raniganj to Sitarampur, the alignment remains on North side. From Sitarampur to Kulti, the DFC alignment is on south side. At Kulti, the alignment again crosses over to north side and from Kulti onwards (upto Gomoh and beyond), the DFC alignment runs parallel to and on the north side of existing IR alignment. The details of the alignment proposed are mentioned below.

3.4.1.2 Near Dankuni Station, there is a temple and heavy built up area, because of which, the connectivity of the proposed DFCCIL line could not be taken off from Dankuni Station. Further the railway line boundary is also very narrow due to which 2 lines cannot be laid without further acquisition. This acquisition is also difficult on account of heavy built up area.

TEMPLE NEAR DANKUNI

3.4.1.2 The existing chainage of Dankuni is 14.80 Km at centre of Dankuni station. The proposed chainage of DFCCIL has been reckoned as 14.80 KM at Dankuni station. The proposed alignment of DN DFCCIL takes off at Ch. 15.441 from DN HBC line of Howrah – Delhi Rajdhani route. The UP DFCCIL takes off from proposed 4rth Line of IR at chainage 16.241. UP DFCCIL runs parallel to and on south side of UP Howrah – Bardhaman Chord Line upto Gobra and at Km.18.048, the UP DFC crosses the existing IR track to Down side. From here, the double line DFC alignment is running parallel to and on north side of existing IR tracks.

3.4.1.3 The proposed DFCCIL alignment traverses through Barddhman, Andal, Asansol, Sitarampur and Dhanbad and extends upto IR Chainage Km.310.00 short of Nimiaghat (at Chainage 310.51). The total route length of proposed DFCCIL line from Dankuni to Gomoh works out to Approx 282.22 Km.

3.4.1.4 The alignment passes generally through plain terrain between Dankuni to Gomoh. The soils are red and yellow in Jharkhand and alluvial in West Bengal.

3.4.1.5 There will be two important bridges one across the river Barakar and other near Bardhaman along with around 42 major bridges and around 630 minor bridges along the alignment.

3.4.1.6 Most of the alignment is running parallel to the existing IR tracks but alignment is taking a detour at some places to avoid heavily built up areas, sharp curves or other topographical hindrances. In Dankuni – Gomoh section, the DFCCIL alignment runs parallel to the existing IR tracks.

3.4.1.7 There are 61 IR stations between Dankuni and Gomoh on the existing lines. In this section, four crossing stations are proposed namely New Jaugram, New Rajbandh, New Mugma and New Pradhankhanta and four junction stations at New Dankuni, New Khana, New Andal and New Gomoh station for Junction and crossing arrangements. In addition, 2 nos cabin arrangements are proposed at Andal (East) and Andal(West) for providing connectivity of DFCCIL with IR.

C. DETAILS OF THE EXISTING IR STATIONS IN DANKUNI – GOMOH SECTION

SL. No.	Station Name	Station Code	Distance From HWH	Inter station Distance
1	DANKUNI JN	DKAE	14.81	
2	GOBRA (FLAG)	GBRA	17.29	2.48
3	JANAI ROAD	JOX	20.24	2.95
4	BEGAMPUR (FLAG)	BPAE	22.08	1.84
5	BARUIPARA	BRPA	26.08	4.00
6	MIRJAPUR BANKIPUR (FLAG)	MBE	29.12	3.04
7	BALARAM BATI (FLAG)	BLAE	31.18	2.06
8	KAMARKUNDU JN.	KQLF	32.93	1.75
9	MADHUSUDANPUR (FLAG)	MDSE	35.81	2.88
10	CHANDANPUR	CDAE	40.22	4.41
11	PORABAZAR (FLAG)	PBZ	44.51	4.29
12	BELMURI	BMAE	46.44	1.93
13	DHANIYAKHALI HALT	DNHL	48.71	2.27
14	SIBAICHANDI (FLAG)	SHBC	51.34	2.63
15	CHERAGRAM B.H	CRAE	52.97	1.63
16	HAJIGARH	HIH	55.15	2.18
17	GURAP	GRAE	57.46	2.31
18	JHAPANDANGA (FLAG)	JPQ	62.20	4.74
19	JAUGRAM	JRAE	64.49	2.29

SL. No.	Station Name	Station Code	Distance From HWH	Inter station Distance
20	NABAGRAM (FLAG)	NBAE	68.82	4.33
21	MOSAGRAM	MSAE	71.59	2.77
22	CHANCHAI HALT	CHC	74.84	3.25
23	PALLA ROAD	PRAE	77.58	2.74
24	SHAKTIGARH	SKG	82.88	5.30
25	GANGPUR	GRP	87.49	4.61
26	BARDDHAMAN JN.	BWN	106.73/94.4	6.91
27	TALIT	TIT	113.90	7.17
28	KHANA JN.	KAN	119.88	5.98
29	GALSI	GLI	129.71	9.83
30	PARAJ	PAJ	136.19	6.48
31	MANKAR	MNAE	144.24	8.05
32	PANAGARH	PAN	154.70	10.46
33	RAJBANDH	RBH	162.31	7.61
34	DURGAPUR	DGR	170.05	7.74
35	DCOP. SKL	DCOP	173.50	3.45
36	WARIA	OYR	178.94	5.44
37	PINJRAPOLE B.H	POL	180.29	1.35
38	ANDAL J.N	UDL	186.41	6.12
39	BAKHTA NAGAR B.H	BQT	189.33	2.92
40	RANIGANJ	RNG	193.93	4.60
41	NIMCHA B.H	NMC	198.17	4.24
42	KALIPAHARI- SKL	KPK	206.94	8.77
43	ASANSOL JN.	ASN	212.12	5.18
44	BARACHAK JN.	BCQ	217.27	5.15
45	SITARAMPUR JN.	STN	221.05	3.78
46	KULTI	ULT	226.14	5.09
47	BARAKAR - SKL	BRR	229.40	3.26
48	KUMAR DUBI- SKL	KMME	231.92	2.52
49	MUGMA	MMU	236.53	4.61
50	THAPAR NAGAR	TNW	241.87	5.34
51	KALUBATHAN	KAO	246.10	4.23
52	CHHOTA AMBANA	CAM	255.46	9.36
53	PRADHANKHUNTA JN.	PKA	261.31	5.85
54	DOKRA HALT	DOKM	265.80	4.49
55	DHANBAD	DHN	270.88	5.08
56	BHULI B.H	BLI	274.61	3.73
57	TETULMARI	TET	280.01	5.40
58	NICHITPUR	NPJE	285.51	5.50
59	MATARI	MRQ	290.68	5.17
60	GOMOH JN.	GMO	300.15	4.48
61	BHOLIDIH BH	BLME	304.99	4.84

D. LIST OF PROPOSED JUNCTION & CROSSING STATIONS

S/N	Name of Station	Type of Station	Chainage (Ex. HWH)	Inter station Distance (in Km.)
1	New Dankuni	Junction	23.684	8.874 (From Dankuni)
2	New Jaugram	Crossing	66.00	42.316
3	New Khana	Junction	116.481	38.151
4	New Rajbandh	Crossing	160.450	43.969
5	Andal (East)	Cabin	178.364	17.914
6	New Andal	Junction	192.300	13.936
7	Andal (West)	Cabin	204.500	12.200
8	New Mugma	Crossing	236.121	31.621
9	New Pradhankanta	Crossing	263.418	27.297
10	New Gomoh	Junction	306.500	43.082

3.4.1.8 GEOGRAPHICAL BREAKUP :

(i) Dankuni – Gomoh Section traverses through two states and 4 districts as under:

State	Approx Route KM	District
West Bengal	45.80	Hooghly
	157.244	Barddhaman
Jharkhand	74.436	Dhanbad
	4.74	Giridih

(ii) The proposed route falls under the jurisdiction of three Divisions of two zonal Railways as mentioned below:

SN	Railway Division	Zonal Railway	Approx Route KM
1	Howrah	Eastern Railway	93
2	Asansol	Eastern Railway	140
3	Dhanbad	East Central Railway	49

(iii) The entire length of 282.22 km from Dankuni to Gomoh has been divided into five sections as given below:

S/N	From station	To station	Parallel/ detour	Approx Route Km
1	Dankuni	Shaktigarh	Parallel	67.44
2	Shaktigarh	Panagarh	Parallel	59.50
3	Panagarh	Asansol	Parallel	57.42
4	Asansol	Dhanbad	Parallel	58.76
5	Dhanbad	Gomoh	Parallel	39.12

3.5 FINAL ALIGNMENT

SECTION-I : DANKUNI-SHAKTIGARH

3.5.1 INTRODUCTION

3.5.1.1 **The description of alignment has been made taking into account the Dankuni chainage as 14.80 km**.

3.5.1.2 Section-1 starts at Dankuni in West Bengal at Km: 14.80 and ends at Shaktigarh station at Km 68.07. The section traverse through different divisions/ zones/ districts/ states is as follows.

S/N	From	To	Division	Railway	District	State
1	Dankuni 14.80 km	Shaktigarh 68.07 km	Howrah	Eastern Rly.	Hooghly and Bardhaman	W.B.

3.5.1.3 The proposed alignment of DFCCIL takes off near Dankuni station. UP DCCIL alignment takes off at Ch.16.241 km from the proposed 4rth Line of IR and crosses IR tracks to Down side at Ch. 18.048 km. DN DFCCIL alignment takes off at Ch. 15.441 km from the DN line of the IR track of Howrah Delhi Rajdhani Route. DN DFCCIL alignment runs parallel to IR DN Line. Beyond ch.18.048 km, both UP and DN DFCCIL line runs parallel to DN Howrah Burdwan Cord line.

3.5.1.4 In between Janai Rd. and Baruipara, one Junction station New Dankuni has been proposed at Ch. 23.684 km near Begumpur station.

3.5.1.5 The proposed alignment passes almost parallel to Howrah-Bardhaman Chord (HBC) line keeping up an average track centre (TC) of 6 m upto Kamarkundu Jn. (Ch. 32.93 km) due to existence of heavily built up areas to minimize dislocation.

3.5.1.6 Existing Sheoraphulli - Tarakeswar line passes over the existing HBC line by a flyover near Kamarkundu. DFC line, which runs parallel to DN HBC, is required to cross the bank of Sheoraphulli - Tarakeswar line.

3.5.1.7 The alignment then traverses almost parallel to the HBC line upto Palla Road station at Ch. 77.572 km.

3.5.1.8 From Palla Road, the DFC alignment crosses the Howrah-Bardhaman chord line with a flyover at Ch. 78.041 km and then runs parallel on the South side of the Howrah-Bardhaman chord line and then passes under the existing NH-2. upto Shaktigarh Station at Ch. 82.895 km. Another crossing station has been proposed in between Jaugram and Nabagram at Ch. 66.000 km.

3.5.1.9 This section (Dankuni-Shaktigarh) of alignment traverses through 91 no curves, 132 nos. of minor bridges, 10 nos. of major bridges and 32 nos. of manned level crossings.

3.5.1.10 There are 24 IR stations between Dankuni and Shaktigarh on the existing lines whereas two stations are proposed on DFC route as below:

S/N	Station name	Chainage	Type of yard	Remark
1	New Dankuni	23.684	4 line yard	Junction station
2	New Jaugram	66.000	4 line yard	Crossing station

3.5.1.11 Two Rail flyovers have been proposed in this section as under.

S/N	Section	Jurisdiction	Proposed Chainage in Km	SL / DL RFO	Span	
					No	Length in RM
1	Gobra-Janai Road	Howrah Div.	18.048	SL	1	61.00
2	Palla Road - Shaktigarh	Howrah Div.	78.523	DL	1	61.00

3.5.1.12 First RFO at Chainage 18.048 is required as take off of UP DFC and DN DFC has been planned from UP IR yard and DN HBC line respectively to enable transfer of UP and DN traffic between IR and DFC seamlessly. For DFC alignment to run parallel and on North side of IR alignment, UP DFC is required to cross over IR tracks, which has been proposed through a RFO at Ch.18.048.

3.5.1.14 The second Rail Flyover has been proposed at Ch. 78.523 Km. This is required to cross the DFC track from North to South of IR track. This has been proposed to avoid following constraints:-

(i) Shaktigarh Yard (Junction of Main Line and Chord line).
(ii) Burdwan Diesel Shed.
(iii) Burdwan RRI cabin.
(iv) New Burdwan – Katwa BG line.

3.5.2 SALIENT FEATURES:

S/N	Description	Details
	From: Dankuni	15.441
	To: Shaktigarh	82.88
	Total Length	67.44
	Curves :	
1	No of curves	91
2	Maximum Degree of curvature	2.5 (4.0 in fly over approaches)
	Bridges/Flyover	
3	Number of Important bridges	NIL
4	Number of Major Bridges	10
5	Number of RUB	7
6	Number of Minor Bridges	132
7	Number of Rail Flyovers	2
8	One DFC line flying over a single existing Railway line	1 (at Gobra)
9	Two DFC lines flying over a double existing Railway line	1 (at Palla Road)
	Road Crossing:	
10	Number of level Crossing	32
11	Junction Stations	New Dankuni
12	Crossing Stations	New Jaugram
13	IR Stations	24

3.5.3 CONSTRAINTS: OPTION STUDIED AND SUGGESTIONS:

3.5.3.1 As there is infringement at the initial stage of take off due to close proximity of habitation, high density of market area and a nearby big temple at Dankuni station, it is proposed to take off the alignment from the DN line of the existing Howrah-Bardhaman Chord (HBC) Line at a distance of 641.290 m from Dankuni station. UP DFC Line takes off from proposed 4rth line of IR at chainage 16.241. UP DFC line runs parallel to existing UP HBC line upto Gobra and crosses the existing HBC line to north side (DN HBC side) with a rail flyover at Ch. 18.048 km.

3.5.3.2 Existing Sheoraphulli-Tarakeswar line passes over the existing HBC line by a flyover near Kamarkundu. DFC line, which runs parallel to DN HBC, is required to cross the embankment of Sheoraphulli-Tarakeswar line. There is constraint of vertical clearance for passage of DFC line through this bank. Three alternatives have been proposed as below.

a) To regrade the existing Tarakeswar-Sheorafuli line by raising DN Tarakeswar-Sheorafuli line by upto 1.3 m over a length of 2.5 km so as to enable the box pushing in the existing formation of Tarakeswar-Seoraphulli line.

b) By providing a diversion of Tarakeswar-Seoraphulli line towards Howrah. For this, the following are required to be constructed.

- New Girder Bridge on Tarkeshwar – Sheoraphuli line for crossing three HB chord lines and two DFC lines.
- Station building at Kamarkundu on Tarkeswar – Sheoraphuli line.
- By Lowering the RCC Box accommodating the DFC line suitably to provide the required vertical clearance.

It has been decided to adopt the third option i.e. by lowering the RCC Box of DFC Line. However, this would require shifting of Level crossing no.27 at Kamarkundu station towards Delhi end by approximately 140m.

3.5.3.3 Modification of Janai Road yard to facilitate connection of SAIL Siding & Coal Complex with DFC yard. This will also require relocation of existing panel building to suitable location.

3.5.3.4 To avoid extra land acquisition in heavily built up localities, platform width at three stations namely Mirzapur Bankipur, Balrambati and Porabazar have to be reduced to accommodate DFC alignment with minimum land acquisition at thes stations.

3.5.3.5 As Traction Distribution Depot at Belmuri is situated on the North side of IR track and infringing the DFC alignment, relocation of the same is required.

SECTION-2 :SHAKTIGARH-PANAGARH

3.5.4 INTRODUCTION

3.5.4.1 Section-2 starts at Shaktigarh in West Bengal at Km: 95.21 and ends at Panagarh station at Km 154.7. This section is parallel to and on south side of the existing IR track on Howrah-Delhi Rajdhani Route.

3.5.4.2 This alignment passes through 50 no curves, 122 Nos of minor bridges, 9 nos major bridges and 33 nos. of manned L/C.

3.5.4.3 There are 8 IR stations in between Shaktigarh and Panagarh on the existing lines. One junction station has been proposed on DFC route for crossing arrangements as given in the table below.

S/N	Station name	Chainage	Type of Yard	Remarks
1	New Khana	116.481 km	4 line yard	Junction station

3.5.4.4 This section runs parallel to the left of UP line of Howrah-Bardhaman Chord (HBC) at an average track centre of 10 - 12 meters.

3.5.4.5 In parallel alignment generally the land is available for single line. However, for double line land acquisition is required.

3.5.5 SALIENT FEATURES:

S/N	DESCRIPTION	DETAILS
	From: Shaktigarh	95.21
	To: Panagarh	154.70
	Total length	59.50
	Curves :	
	No of curves	50
1.	Maximum Degree of curvature	2.5
	Bridges :	
2	Number of Important bridges	1
3	Number of Major Bridges	9
4	Number of RUB	0
5	Number of Minor Bridges	122
6	Number of Rail Flyovers	0
7	Nos of existing ROB	1
8	Two DFC lines flying over a single existing Railway line	0
9	Two DFC lines flying over a double existing Railway line	0
	Road Crossing:	
10	Number of level Crossing	33
11	Junction Stations	New Khana
12	Crossing Stations	NIL
13	IR Stations	8

3.5.6 CONSTRAINTS: OPTION STUDIED AND SUGGESTIONS:

The only major constraint in this section is Bardhaman Junction Station and adjoining structures like goods shed, GRP office, Running room, AEN office, other Railways Office buildings, existing ROB etc.

Major modifications are proposed for Bardhaman Station to accommodate DFC alignment. These modifications are as under:-

(i) Dismantling of Good Shed of Bardhaman station and shifting the same to the down side.
(ii) Dismantling station building, GRP office, AEN office, running room, IOW office & store, New booking office, MFC building, etc. and reconstruction of the same.
(iii) Converting the Home Platform No. 1of Bardhaman station to Island Platform.
(iv) Dismantling Delhi end of Platform No. 1 for 180 m length & extending the same towards Howrah end to accommodate DFC alignment.
(v) Extension /modification to existing FOB's to provide connectivity to all platforms from newly constructed circulating area.
(vi) Remodelling of circulating area.

SECTION-3: PANAGARH-ASANSOL

3.5.7 INTRODUCTION

3.5.7.1 This section of DFCC alignment starts from Panagarh Station (Ch. 154.7 km) and ends at Asansol Jn. (Ch. 212.12 km) which is almost parallel to the existing IR track on Howrah-Delhi Rajdhani Route. This alignment passes through 65 no curves, 12 nos major bridges, 12 nos RUB, 167 nos. of minor bridges and 18 nos. of manned L/C.

3.5.7.2 The section traverse through Asansol divisions is as follows.

S/N	From KM	To KM	Division	Railway	District	State
1	154.824	213.014	Asansol	Eastern Rly.	Bardhaman	W.B.

3.5.7.3 It runs parallel to and on the left of the UP line of existing Howrah –Delhi Rajdhani route upto Raniganj (Ch. 194.493 km). After crossing Raniganj station, it crosses over to the right side of DN IR line with a proposed flyover in order to avoid the vast extension of Asansol Junction, yard and Asansol Town area.

3.5.7.4 After crossing over, the alignment section runs parallel to the DN line of existing IR line upto the end of this section i.e. Asansol.

3.5.7.5 In this alignment section, one crossing station at New Rajbandh (Ch. 160.540 km) and one junction station at New Andal (Ch.192.300 km) have been proposed.

S/N	Station name	Chainage	Type of Yard	Remarks
1	New Rajbandh	160.540	4 line yard	Crossing station
2	New Andal	192.300	4 line yard	Junction Station

3.5.7.6 Connectivity of DFCCIL with IR at Andal has been proposed at both ends of Andal yard i.e. at Andal East and at Andal West. Connectivity at both ends is proposed for both UP and DN lines. At Andal East, down connectivity is proposed from Pinjrapole cabin. Up connectivity is proposed through DTPS yard. At Andal West, UP and DN connectivity is planned from UP & DN DSP line of Andal Yard. For this, one new RFO will be required parallel to existing UP DSP flyover. Connectivity will be provided at New Andal Yard. It is proposed to provide 2nd connectivity to Mejia Themal Power Plant from Andal through New Andal Yard.The proposed connectivity of Andal yard is shown in concept plan for Andal connectivity, which is enclosed in Annexure I.

3.5.7.7 Existing Mejia Themal Power Plant siding takes off from Raniganj. In the proposed scheme of Andal Connectivity, it is proposed to take Mejia load on DFC route and accordingly, Mejia connectivity from Raniganj has been provided from Delhi end of New Andal Yard. Major traffic for Mejia is received through South Eastern Line at Kalipahari (Mohishilla Link). At Kalipahari, a connectivity is provided from this line at DN Kalipahari yard to DN DFC Line through a flyover, which is shown in the concept plan enclosed at Annexure-I.

3.5.7.8 This section has 6 nos rail flyovers. Details are as under :

S/N	Section	Jurisdiction	Proposed Chainage in Km	SL / DL RFO	Span	
					No	Length in RM
1.	Durgapur-Andal	Howrah Div.	178.364	DL	1	30.50
2.	Durgapur-Andal	Asansol Div.	178.530	SL	1	61.00
3.	Durgapur- Andal	Asansol Div.	185.000	DL	1	61.00
4.	Andal-Raniganj	Asansol Div.	188.425	SL	1	61.00
5.	Andal-Raniganj	Asansol Div.	188.901	SL	1	30.50
6.	Raniganj-Kalipahari	Asansol Div.	199.200	DL	1	61.00
7.	Raniganj-Kalipahari	Asansol Div.	204.500	SL	1	30.50

3.5.7.9 Double line Rail flyover near Waria station of existing Howrah-Delhi Main Line has been proposed for DFCCIL line to cross the existing DVC line. This Railway flyover has been proposed at Km 178.364 with 1 x 30.5 m span with through girder, RCC abutment & pile foundation.

3.5.7.10 Single line Rail flyover near Waria station has been proposed for DFCCIL line to cross the existing IR lines from North Side (from DN Andal yard at Pinjrapole) to South Side at Ch 178.530 with 1 x 61.00 m span with RCC abutment and pile foundation. This Rail flyover provides connectivity of DFC with Andal Down yard at Pinjrapole.

3.5.7.11 Double Line Rail Flyover near UP Marshalling Yard has been proposed for DFC alignment to flyover UP Marshalling Yard and C& W Repair Shop Siding from North Side to South Side with a span of 1x 61.00 with RCC abutment and Pile Foundation. This flyover is required to avoid dismantling or relocation of UP Marshalling Yard and C& W Repair Shop siding.

3.5.7.12 Single line Rail flyover at Baktharnagar has been proposed for DFCCIL line to cross the existing IR Lines from North Side (from Durgapur Steel Plant line) to south Side at Ch 188.425 with 1 x 61.00 m span with RCC abutment and pile foundation. This rail flyover will be constructed parallel to the existing UP Durgapur Steel plant flyover. This Rail flyover will provide connectivity of DN Andal yard to DN DFC line.

3.5.7.13 Single line Rail flyover at Baktharnagar has been proposed for DFCCIL line originating from Andal yard and crossing UP & DN DFCCIL lines at Chainage 188.901 having a span of 1 x 61.00 m span, RCC abutment & pile foundation. This rail flyover is a extension of rail flyover mentioned at 3.5.7.13.

3.5.7.14 Double line Rail flyover with a span of 1 x 61.00 m between Raniganj and Kalipahari station has been proposed to cross the existing Howrah-Delhi electrified double line for going north side of existing track at Km. 199.200.This flyover is required to avoid Asansol Town and Asansol Station on the southside.

3.5.7.15 Single line Rail flyover with a span of 1 x 61.00 m between Raniganj and Kalipahari station has been proposed originating from Kalipahari DN yard and crossing UP DFCCIL line at Chainage 204.500 having a span of 1 x 61.00 m span, RCC abutment & pile foundation. This rail flyover is required for providing connectivity from S.E Railway line (Mohishila Link) to DFC alignment.

3.5.7.16 In parallel alignment generally the land is available for single line. However, for double line land acquisition is required to be done.

3.5.7 SALIENT FEATURES :

S/N	Description	Details
	From: Panagarh	**154.7**
	To: Asansol	**212.12**
1.	Total length	57.42 Km
	Curves :	65
2.	Maximum Degree of curvature	2.5 (4.00 in case of flyover zone)
	Bridges :	
3	Number of Important bridges	0
4	Number of Major Bridges	12

5	Number of RUB	12
6	Number of Minor Bridges	165
7	Number of Rail Flyovers	6
8	One DFC line flying over existing Railway line	4
9	Two DFC lines flying over existing Railway line	2
	Road Crossing:	
10	Number of level Crossing	18
11	Number of existing ROB	2
12	Crossing Stations	1
13	Junction Stations	1
14	DFCCIL Cabins	2
15	IR Stations	11

3.5.9 CONSTRAINTS: OPTION STUDIED AND SUGGESTIONS:

3.5.9.1 In order to avoid the infringement posed by existing Damodar Valley Corporation (DVC) siding taking off at Ch. 178.166 km in the mid-section of Durgapur Coke Oven Project (DCOP) and Waria, one flyover has been proposed at Km.178.530.

3.5.9.2 There is limited space between Durgapur Thermal Power Station (DTPS) siding and IR track. For accommodating DFCCIL alignment and UP connectivity and for providing Rail Flyover over Damodar Valley Corporation (DVC) Line, 2 lines of Durgapur Thermal Power Station (DTPS) sidings will be required to be dismantled and will involve remodelling of Durgapur Thermal Power Station (DTPS) siding. Also exiting boundary will be required to be shifted. DFC alignment will have to be provided on Viaduct between L.C. No.118 B/T to RFO at Km 178.530 for limited space available.

3.5.9.3 Similarly, Andal Station Building and other. Railway structure at Andal infringes the proposed DFC alignment and is required to be relocated suitably.

3.5.9.4 DFC alignment at Durgapur Station is infringing with the station building and booking office and these will require to be reconstructed.

SECTION - 4 : ASANSOL – DHANABAD

3.5.10 INTRODUCTION

3.5.10.1 This alignment section starts from Asansol (Ch. 212.12 Km) and ends at Dhanbad (Ch. 270.88 Km). It runs parallel to the DN line of existing Howrah Delhi Rajdhani Route and near Sitarampur (at Km.219.117) it crosses the

existing IR line with a proposed flyover to go to left of the existing UP IR line. DFC alignment runs parallel to existing UP IR line upto Km.224.508 (near Kulti station). At Km.224.508, DFC alignment crosses IR line through flyover to the right of the existing IR DN line. From here, DFC alignment runs almost parallel to and on north side of the alignment upto the end of this section i.e. Dhanbad.

3.5.10.2 These two flyovers in close succession have been required to be proposed in order to overcome three lines in close proximity i.e. Patna line emerging out of DN main of existing IR line at Sitarampur Jn. Station, one loop line from Sitarampur to Andal and third loop line originating before Kulti station.

3.5.10.3 As per the approved proposal of Maithon Power Ltd., their siding is taking off near Mugma and Thaparnagar forming Y-connection. As per Railways approved GAD, MPL siding taking off from Thaparnagar station will fly over the proposed alignment of DFCC. MPL siding taking off from Mugma station will be dismantled when the construction of DFCCIL line is taken up.

3.5.10.4 This alignment passes through 70 no curves, 120 nos of minor bridges, 7 nos major bridges, 13 nos RUB, one important bridge and 13 nos. of manned Level crossings.

3.5.10.5 There are 12 IR stations between Asansol and Dhanbad on the existing lines. Two crossing station has been proposed for crossing and junction arrangements.

S/N	Station name	Chainage	Type of yard	Remarks
1	New Mugma	236.121	4 line crossing	Crossing station
2	New Pradhankhunta	263.418	4 line Crossing	Crossing station

3.5.10.6 Two Rail flyovers have been proposed in this section as given in the table.

S/N	Section	Jurisdiction	Proposed Chainage in Km	SL / DL RFO	Span	
					No	Length in RM
1	Barachak – Sitarampur	Asansol Div.	219.117	DL	1	61.00
2	Sitarampur-Kulti	Asansol Div.	224.508	DL	1	61.00

3.5.10.7 Flyover near Sitarampur station has been proposed for DFCCIL double line to cross the existing Howrah-Delhi Main Line at chainage 219.117 from north side to south side of IR alignment with 1 x 61.00 m spanning arrangement with through girder, RCC abutment & pile foundation at Km.This flyover is required for avoiding the Sitarampur – Patna line and Sitarampur – Barachak line on the north side.

3.5.10.8 Flyover in between Sitarampur and Kulti station has been proposed for DFCCIL double line to cross the existing Howrah-Delhi Main Line at Chainage 224.508 km from north side to south side of IR alignment with 1 x 61.00 m spanning arrangement with through girder, RCC abutment & pile foundation. From here onwards DFC alignment continues on North side of IR track till Gomoh and beyond.

3.5.10.9 In parallel alignment generally the land is available for single line. However, for double line land acquisition is required to be done.

3.5.11 SALIENT FEATURES :

S/N	Description	Details
	From: Asansol	**212.12**
	To: Dhanbad	**270.88**
1.	Total length	58.76 Km
2.	**Curves :**	70
3	Maximum Degree of curvature	2.5 (4.0° in case of flyover zone)
	Bridges	
4	Number of Important bridges	1
5	Number of Major Bridges	7
6	Number of RUB	13
7	Number of Minor Bridges	120
8	Number of Rail Flyovers	2
9	One DFC line flying over existing Railway line	Nil
10	Two DFC lines flying over existing Railway line	2
11	Number of existing ROBs	4
	Road Crossing:	
12	Number of level Crossing	13
13	Crossing Stations	2
14	Junction Stations	0
15	IR Stations	12

3.5.12 CONSTRAINTS: OPTION STUDIED AND SUGGESTIONS:

3.5.12.1 Relocation of Sitarampur Station is required as the DFC alignment is falling along the Sitarampur Station.

3.5.12.2 In the section, between Barakar and Pradhankanta, there are continuous gradients ranging from 1 in 200 to 1 in 400. Provision of New Mugma yard is not

possible with stipulated gradient of 1 in 1200. Hence, this station is provided with a grade of 1 in 600.

SECTION – 5: DHANABAD – GOMOH

3.5.13 INTRODUCTION

3.5.13.1 This alignment section starts from Dhanbad (Ch. 270.88 Km) and ends at Nimiaghat (Chainage 310.00 Km). It runs parallel to the DN line of existing Howrah Delhi Rajdhani Route in the entire section.

3.5.13.2 This alignment passes through 31 no curves, 91 nos of minor bridges, 5 nos major bridges and 10 nos. of manned L/C.

3.5.13.3 There are 6 IR stations between Dhanbad and Gomoh on the existing lines. One Junction station has been proposed for crossing and junction arrangements.

S/N	Station name	Nearest IR station KM	Type of yard	Remarks
1	New Gomoh at Km. 306.580	Gomoh at 300.15 km	4 line crossing	Junction station

3.5.13.4 One Rail flyover has been proposed in this section as given in the table.

S/N	Section	Jurisdiction	Proposed Chainage in Km	SL / DL RFO	Span	
					No	Length in RM
11	Gomoh - Bholidih	Dhanbad Div.	303.30	SL	4	61.00

3.5.13.5 Flyover in between Gomoh and Bholidih station has been proposed for DFCCIL Single line from Gomoh DN yard to cross the existing Howrah-Delhi Main Line & DFCCIL UP & DN Lines at Ch.303.300 with 1 x 61.00 m spanning arrangement with through girder, RCC abutment & pile foundation. This flyover is required for providing connectivity of Gomoh DN yard (on south side) to New Gomoh DFC station on (north side of IR).

3.5.13.6 In parallel alignment generally the land is available for single line. However, for double line land acquisition is required to be done.

3.5.14 SALIENT FEATURES :

S/N	Description	Details
	From: Dhanbad	**270.88**
	To: Gomoh	**310.00**

1	Total Length	39.12 km
2	**Curves :**	31 nos
3	Maximum Degree of curvature	2.5 (4.0° in case of flyover zone)
	Bridges	
4	Number of Important bridges	0
5	Number of Major Bridges	4
6	Number of RUB	0
7	Number of Minor Bridges	91
8	Number of Rail Flyovers	1
7	Number of existing ROB	2
	Road Crossing:	
9	Number of level Crossing	10
10	Stations	6
11	Junction Stations	1
12	Crossing Stations	0

3.5.15 CONSTRAINTS: OPTION STUDIED AND SUGGESTIONS:

3.5.15.1 Relocation of several structures & utilities are involved in Dhanbad & Gomoh Station. Relocation of these structures is being planned in consultation with Railways.

4. UTILITIES

4.1 Utilities and Services:-

4.1.1 A large number of surface and over head utility services viz. overhead power transmission lines, traffic signals, quarters, station building, cabins, microwave towers etc. exist all along the proposed alignment.

4.1.2 Apart from the above utilities, Railway's huge network of Traction Power Installations, SPs and SSPs, Signal & Telecommunication utilities, traction OHE masts and structures, Signal posts, power supply cubicles, location boxes etc. are spread along and across the entire alignment.

4.1.3 The proposed corridor has been planned near Railway's ROW and the some of the utility services and Railways vital installations are encountered at number of locations.

4.1.4 These utility services are essential and have to be maintained in working order during different stages of construction, by temporary / permanent diversions and relocation or by supporting in position. Any interruption to these will have serious repercussions on sensitive train operation services and direct impact on the commuters besides setback in construction and project implementation schedule. Meticulous planning, therefore, will be necessary in tackling the issue of protection / diversion of these utility services and as well as Railway's vital installations.

Shifting of Railway utilities:

Railway Utilities affecting operations will be shifted by Railways. Adequate provision of funds have been made in the estimate. Funds will be allocated to Railways for shifting of such utilities in 5 instalments (each instalment of 20%) depending on progress and utilisation of funds. Other Railway utilities not affecting train operations are to be shifted by the Concessionaire. Adequate funds will be allocated for this purpose.

Shifting of utilities Railway (Other than Railways)

These include mainly Power line crossings and pipelines. These utilities will be generally shifted by the respective utility owners at DFCCIL's cost.

Long Lead items

Shifting of power line crossings, reconstruction of major stations like Burdwan, Durgapur and Dhanbad, panel cabin at Janai Road and RRI at Gomoh station will involve substantial time and are considered long lead items. Advance action is planned for shifting / reconstruction of these long lead items by the respective utility owners.

4.1.5 The proposed alignment is generally parallel and falling on north & south side of existing IR alignment in various stretches as detailed below.

Dankuni to Palla road	-	North side
Palla Road to Waria	-	South side
Waria to Sitarampur	-	North side
Sitarampur to Kulti	-	South side
Kulti to Gomoh	-	North side

Also the same has been shown in the alignment diagram in **Annexure I.**

4.2 Concerned Organisations/ Departments

The details of various utilities have been compiled after conducting joint survey with the concerned organisations.

Sr. No.	ORGANISATION/ DEPARTMENT	Area	UTILITY SERVICES
1.	Railway: Howrah Division, ER	Dankuni - Khanna	Quarters, station building, cabins, microwave towers, SP/SSP/TSS, LC boxes & Railway Service buildings.
2.	Railway: Asansol Division, ER	Khanna- Pradhankhanta	
3.	Railway: Dhanbad Division, ECR	Pradhankhanta - Gomoh	
5.	M/s WBSETCL, Kolkata	Dankuni - Dhanbad	OH Transmission lines
6.	M/s WBSEDCL, Kolkata	Dankuni - Dhanbad	OH lines
7	M/s DVC, Kolkata	Dankuni - Gomoh	OH Transmission lines
8.	M/s PGCIL, Ranchi & Kolkata	Dankuni - Gomoh	OH Transmission lines
9.	M/s DPSC,Durgapur	Dankuni - Dhanbad	OH/UG Electric lines.

Assessment of the type and location of utilities running along and across the proposed route alignment between Dankuni – Gomoh has been undertaken with the help of data available with concerned authorities and joint survey with the utility owners.

4.3 SIGNAL AND TELECOMMUNICATION UTILITY

The underground network of S&T cables is spread over the entire alignment on both the sides and across the tracks. A large number location boxes will be affected, which need shifting.

The alignment of the proposed corridor is mostly near Railways ROW. It is seen that the network of S&T cables will be encountered frequently during construction activities and relocation of these cables in advance will become necessary.

4.4 Relocation philosophy:

Railway officials have expressed serious concern over the likely incidences of Signaling & Telecommunication cable damages during construction activities in the

vicinity of tracks and resultant repercussions thereof on the passenger & Goods services and emphasized that there should be least disruption to the train services during execution of the work on the proposed corridor.

PLANNING:

Summary of Signalling utilities is as under.

ITEMS	RELAY ROOM	MW TOWERS	MW/CABLE/OFC/HUTS	S&T SERVICE ROOM	Location Box	Gate Barrier & Signal
NOs.	17	15	24	22	943	84

Adequate funds have been provisioned for shifting of these utilities.

4.5 POWER LINE CROSSINGS:-

All 440V/11KV/33KV overhead lines need converting into underground cables. Other overhead lines require modifications, raising, shifting is mentioned below.

Summary of Power Line Crossings:-

Voltage	440v	11Kv	33Kv	132Kv	220Kv	400Kv	765Kv	Total
Nos	5	73	31	0	03	03	0	115

Details of these crossings are enclosed at **Table 4.1.**

4.6 Utilities Power Supply Installation (PSI) & Over Head Equipment(OHE)

4.6.1 Railway's Electrical and S&T Utility

Railway's entire Traction Power Supply installations, networks for power supply to traction, general lighting stations, colonies, S&T installations are spread along both sides of the proposed alignment. Utilities falling on the DFC side and on DFC ROW are required to be shifted.

4.6.2 Relocation Philosophy

The power supply installations getting affected have been identified. The affected installations will have to be relocated in the vicinity only.

Relocation of the affected Traction Power supply Installation(PSI) and other installations will have to be done in such a way that

- Power supply and signaling supply does not get affected
- No changes are made in the system configuration

- Relocation to be in the vicinity of the affected ones.

4.7 Power Supply Installations

Keeping in view the sensitive train services in West Bengal & Jharkhand area, the affected Power supply installations in the Traction substations(TSS), Sub Sectioning Post(SSP), Sectioning Post(SP) and Over Head Equipment(OHE) will be relocated at the same chainage/ in the vicinity of the affected ones. The details of affected PSI, their relocations and the cost of relocation have been arrived at accordingly.

4.8 Details of SP/SSP/TSS from Dankuni to Gomoh requiring shifting

9 nos SP/SSP/TSS are falling on DFC ROW which are required to be shifted. Details of the same are furnished below :

SL. No.	Station	KM	Description	Remarks
1	Mankar	145/31A-146/1A	SP	Distance of this SP is at 1.180 mt from nearby DFCC Track
2	Rajbandh	162/43-47A	SSP	DFCC track infringe this SSP
3	Waria	178.433	FP	Fly Over
4	Andal	186/23	SSP	Distance of this SSP is at 0.85 mt from nearby DFCC Track
5	Kaliphari	203/34A-36A	SP	DFCC track infringe this SP
6	Sitarampur	220/19A-17A	SSP	Distance of this SSP is at 1.110 mt from nearby DFCC Track
7	Kulti	226/3	SP	DFCC track infringes this SP
8	Dhanbad	270/6-8	SSP	Distance of this SSP is at 1.650 mt from nearby DFCC Track
9	Bhuli	273/18-20	SSP	DFCC track infringess this SSP

Sketch plans showing existing locations of these structures with respect to the proposed DFC alignment is attached in **Annexure _**

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4.9 OHE:

Few OHE masts, AT masts in Dankuni - Gomoh section will involve minor modifications such as slewing, adjustments, minor modifications, relocation of

Masts and structures etc. needing crane and wiring train operation under local traffic and power blocks.

Total 54 AT and 92 nos OHE Mast masts are affected by DFC alignment and require modifications/ relocations. Details of such OHE masts and AT masts are enclosed at **Table 4.2**

4.10 HV Power Transmission Lines Between Dankuni - Gomoh

There are 6 nos multi circuits EHV Power Transmission lines belonging to WBSETCL (3 Nos.), DVC (One No.) and PGCIL (Two Nos). These are crossing the Railway tracks at 6 locations. Due to the proposed alignment, these power line crossings will get affected and will therefore need to be suitably modified to achieve the statutory clearances as per IE Rules and provisions of the Indian Railway's Regulations for Power lines crossing Electrified Railway tracks.

The Power supply authorities (owners of these lines) were advised to furnish cost estimates for modifications to these lines. Discussions were also held with them.

These Power lines are feeding power to Kolkata City and Region and any modification to these power lines involves:

a) Additional land beyond their ROW
b) Long outages-about a month's duration for each line.
c) Very high cost of modification.

WBSETCL proposed to modify the crossing by providing taller towers and submitted the cost estimates. The following will be needed from Eastern Railway.

i) The cost of modifications shall be borne by Railway

ii) Mega blocks of 8-hour duration for each circuit (2 Mega blocks)

ii) Space will have to be made available (two plots of 20 M x 20M and two plots of 15 Mx15 M) for erecting 4 Nos. of towers - Two on each side of the railway tracks and also ROW clearances.

4.11 UTILITIES – STATION BUILDINGS/BOOKING OFFICES

4.11.1 UTILITIES – QUARTERS

Total type I 167, type II 255 and type III 8 are required to be shifted to accommodate DFC alignment. As per Board's policy no type I quarters are to be constructed. All replace of type I quarter are done by type II quarters. Accordingly, 422 nos. type II, 8 nos. type III Quarters are required to be constructed along with necessary facilities e. g approach roads, drains, fencing,

lighting, water supply etc. These quarters are to be constructed as per the list of quarters to be dismantled and the likely location is attached. The location of new quarters to be built is finally be decided in consultation with respective DRMs/Zonal railways.

4.11.2 UTILITIES- BOOKING OFFICES / STATION BUILDINGS

A number of booking offices falling on DFC alignment are required to be relocated. These are at Mirzapur Bankipur, Madhusudhanpur, Porabazar, Dhaniakhali, Sibaichandi, Hazigarh and Gangpur of Howrah Division. In Asansol Division, booking offices at Ishanchandi Halt, Kulti and Asansol (North Side) will have to be reconstructed. In Dhanbad Division, booking offices at Nichitpur and Gomoh will have to be reconstructed. These booking offices ae required to be reconstructed as per Eastern Railway Standard drawing.

A number of station buildings are also affected due to DFC alignment which are required to be econstructed. They are Shaktigarh, Burdwan, Durgapur, Andal, Raniganj (South Side), Kalipahari, Sitarampur, Kmardhubi Thaparnagar, Chota Ambona and Dhanbad. Out of these, Burdwan, Durgapur and Dhanbad are large stations having major involvement.

4.11.3 CABINS / PANEL BUILDINGS / RRI

The following cabins are required to be relocated to accommodate DFC alignment : Coal complex cabin (Janai Road), Baruipara East cabin, Shaktigarh East cabin, Burdwan cabin, Galsi, Panagarh, Rajbandh, Durgapur, Andal, Raniganj, Nimcha, Kalipahari, Asansol, Barachak west cabin, Kulti East cabin, Barakar, Dhanbad west cabin and Ncihitpur,

In addition to the above, panel cabins are required to be relocated at Janai Road, Sitarampur and Kumardhubi. Gomoh RRI is also required to be shifted to accommodate DFC alignment.

4.11.4 UTILITIES- GATE LODGES

45 nos. gate lodges falling on DFC alignment are required to be shifted suitably including shifting of Gate barriers, etc. These Gate lodges are to be replaced by new gate lodges constructed as per Indian Railway's standard drawing. Details of gate lodges to be shifted are mentioned in **Table 4.3.**

4.11.5 UTILITIES- MICROWAVE TOWERS

15 nos. microwave towers falling on DFC alignment are required to be shifted suitably. List of such microwave towers are mentioned in the table below.

4.11.6 UTILITIES – OTHER STRUCTURES

In addition to the above several other structures are required to be shifted as under:-

Rest Houses: 2 nos. at Andal Junction
Crew Bookings office : 1no. at Andal junction
Relay rooms / Battery rooms – 17 nos.
Pump room:- 15 nos. at Gobra, Madhusudanpur, Porabazar, Saktigarh, Khana, Galsi, Andal, Kalipahari, Sitarampur, Barakar, Kumardubi, Mugma, Chhota Ambona, Nichitpur and Gomoh.
Goods Shed: - 09 nos. at Burdwan, Panagrah, Kalipahari, Kumardubi, Mugma, Chhota Ambona, Tetulmari, Matari and Gomoh.
TRD Depot & Office: - 04 nos. at Belmuri, Andal, Kulti and Dhanbad.
PWI Godown :- 11 nos.
RPF/GRP Office/Barrack:- 11 nos.
Details of these structures are mentioned in **Annexure .**

Annexure- Q

Distribution Line Details from Dankuni to Gomoh

Sl. No	Voltage	Rly. KM	In between station	Owner	Distance of tower from ex. Nearest track	Distance of proposed DFCC first track from Ex. Rly track
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	11KV U.G.	16/2A	Dankuni - Gobra	WBSEDCL	11.000	14.60
2	11KV U.G.	16/2A	Dankuni - Gobra	WBSEDCL	11.000	14.600
3	11KV O.H.	16/2A	Dankuni - Gobra	WBSEDCL	11.000	14.600
4	11KV O.H.	16/2A	Dankuni - Gobra	WBSEDCL	11.000	14.600
5	11KV U.G.	DFC Ch. 6419	Gobra-Janai	WBSEDCL	11.000	12.80
6	33KV U.G.	25/2A	Begumpur - Baruipara	WBSEDCL	7.750	6.10
7	11KV U.G.	25/22B	Begumpur - Baruipara	WBSEDCL	7.750	11.60
8	440 Volt	25/22B	Begumpur - Baruipara	WBSEDCL	7.750	11.60
9	11KV U.G.	26/30A - 32A	Baruipara - Mirzapur	WBSEDCL	24.80	7.150
10	11KV U.G.	30/8A - 10A	Mirzapur - Balaram Bati	WBSEDCL	15.20	8.620
11	440Volt	31/2A - 6A	Mirzapur - Balaram Bati	WBSEDCL	9.200	6.500
12	33KV O.H.	32/34A - 36A	Balaram Bati - Kamarkundu	WBSEDCL	6.00	17.210
13	33KV O.H.	32/34A - 36A	Balaram Bati - Kamarkundu	WBSEDCL	6.00	17.210
14	11KV U.G.	33/24A - 26A	Kamarkundu - Madhusudhanpur	WBSEDCL	4.50	6.60
15	11KV U.G.	34/32A - 35/2A	Madhusudhanpur - Chandanpur	WBSEDCL	13.40	7.00
16	11KV U.G.	40/28A- 30A	Chandanpur - Porabazr	WBSEDCL	18.20	7.70
17	11KV U.G.	44/2A	Chandanpur - Porabazr	WBSEDCL	25.50	6.00
18	11KV U.G.	46/34A - 36A	Porabazr - Belmuri	WBSEDCL	9.00	6.00
19	33KV O.H.	46/34A - 36A	Porabazr - Belmuri	WBSEDCL	9.00	6.00
20	11KV U.G.	48/14A	Belmuri - Dhanikhali	WBSEDCL	30.00	7.00
21	11KV U.G.	55/26B	Hazigar - Gurap	WBSEDCL	33.00	6.00
22	11KV U.G.	56/32A -34A	Hazigar - Gurap	WBSEDCL	19.00	7.80
23	11KV U.G.	JRAE /1002 - 1004	Jhaqpandanga - Jaugram	WBSEDCL	13.05	12.30

(1)	(2)	(3)	(4)	(5)	(6)	(7)
24	11KV U.G.	70/20A	Nabagram - Masagram	WBSEDCL	39.00	6.10
25	11KV U.G.	94/23 - 25	Palla Road - Shaktigarh	WBSEDCL	9.00	9.700
26	33KV U.G.	96/25 - 27	Shaktigarh - Gangpur	WBSEDCL	19.850	18.50
27	33KV O.H.	96/29	Shaktigarh - Gangpur	WBSEDCL	4.80	13.80
28	33KV O.H.	103/19 - 21	Gangpur - Bardwaman	WBSEDCL	93.80	14.20
29	11KV U.G.	103/21 - 23	Gangpur - Bardwaman	WBSEDCL	25.660	14.20
30	11KV U.G.	107/19 - 21	Bardwaman - Talit	WBSEDCL	8.30	13.00
31	11KV U.G.	107/25 - 108/1A	Bardwaman - Talit	WBSEDCL	11.20	13.00
32	11KV U.G.	109/7 - 9	Bardwaman - Talit	WBSEDCL	42.80	9.50
33	33KV O.H.	110/ 23 - 25	Bardwaman - Talit	WBSEDCL	25.250	18.50
34	33KV U.G.	114/17 - 19	Talit - Khana	WBSEDCL	42.80	9.50
35	11KV U.G.	128/27A - 129 /1A	Khana - Galsi	WBSEDCL	22.840	11.50
36	33KV U.G.	143/15A - 17A	Paraj - Mankar	WBSEDCL	30.650	11.80
37	11KV U.G.	144/53A - 57A	Mankar - Panagarh	WBSEDCL	22.10	8.800
38	33KV U.G.	146/8	Mankar - Panagarh	WBSEDCL	23.230	8.900
39	11KV U.G.	152/29-153/1A	Mankar - Panagarh	WBSEDCL	26.400	13.00
40	33KV O.H.	152/3-5	Mankar - Panagarh	WBSEDCL	26.770	8.900
41	11KV U.G.	155/25-29A	Panagarh - Rajbandh	WBSEDCL	26.450	9.00
42	11KV O.H.	155/43-45	Panagarh - Rajbandh	WBSEDCL	22.200	8.50
43	11KV U.G.	162/31A-35A	Rajbandh - Durgapur	WBSEDCL	29.00	9.600
44	33KV O.H.	163/33-35	Rajbandh - Durgapur	WBSEDCL	33.500	6.700
45	11KV U.G.	167/5-8	Rajbandh - Durgapur	DPL	25.400	7.00
46	11KV U.G.	168/11-14	Rajbandh - Durgapur	DPL	200.00	6.640
47	11KV O.H.	169/35 - 37	Rajbandh - Durgapur	DPL	13.000	19.00
48	11KV U.G.	171/23-25	Durgapur - Waria	DPL	26.800	11.000
49	33KV O.H.	171/33-35	Durgapur - Waria	WBSEDCL	25.90	10.50
50	11KV O.H.	171/33-35	Durgapur - Waria	DPL	24.600	10.200
51	11KV O.H.	173/15-17	Durgapur - Waria	DPL	23.000	11.000
52	33KV O.H	175/23 - 25	Durgapur - Waria	DVC	46.000	14.400
53	33KV O.H	175/25 - 27	Durgapur - Waria	DVC	40.000	14.000

(1)	(2)	(3)	(4)	(5)	(6)	(7)
54	11KV U.G.	176/12-13	Durgapur - Waria	WBSEDCL	23.00	9.200
55	11KV U.G.	176/25-27	Durgapur - Waria	WBSEDCL	16.280	9.00
56	11KV U.G.	179/31-180/1A	Waria - Andal	WBSEDCL	26.10	10.00
57	33KV O.H.	181/13A-15A	Waria - Andal	DVC	37.50	7.50
58	11KV U.G.	186/15-17	Waria - Andal	WBSEDCL	80.00	14.40
59	11KV U.G.	187/17A-19A	Waria - Andal	RAILWAY	13.50	30.75
60	11KV O.H.	189/15A-17A	Andal - Raniganj	DSPCL	23.50	17.50
61	11KV U.G.	191/3A-5A	Andal - Raniganj	WBSEDCL	48.00	33.00
62	11KV U.G.	194/7A-9A	Ranigauj - Nimcha	WBSEDCL	24.65	48.00
63	11KV U.G.	194/7A-9A	Ranigauj - Nimcha	WBSEDCL	24.65	48.00
64	11KV O.H.	196/6A-8A	Ranigauj - Nimcha	DSPCL	24.00	17.70
65	11KV O.H.	197/14A - 16A	Nimcha - Kalipahari	DSPCL	30.00	28.00
66	11 KV U.G.	203/30A - 32A	Nimcha - Kalipahari	DSPCL	8.00	8.50
67	33KV O.H	203/28A - 30A	Nimcha - Kalipahari	DSPCL	10.000	9.00
68	33KV O.H	207/18A-20A	Nimcha - Kalipahari	DVC	44.00	25.00
69	11KV U.G.	208/10A-12A	Kalipahari - Asansol	WBSEDCL	20.70	9.00
70	11KV O.H	207/10A - 12A	Kalipahari - Asansol	DSPCL	15.000	35.00
71	11KV U.G.	208/22A-24A	Kalipahari - Asansol	DSPCL	15.000	6.50
72	33KV U.G.	209/10A-12A	Kalipahari - Asansol	WBSEDCL	21.75	13.20
73	33KV U.G.	209/10A-12A	Kalipahari - Asansol	WBSEDCL	21.75	13.20
74	11KV U.G.	209/10A-12A	Kalipahari - Asansol	WBSEDCL	21.75	13.20
75	11KV U.G.	209/10A-12A	Kalipahari - Asansol	WBSEDCL	21.75	13.20
76	11KV U.G.	209/26A-28A	Kalipahari - Asansol	DSPCL	16.000	13.200
77	11KV U.G.	214/18A-20A	Kalipahari - Asansol	WBSEDCL	12.000	18.800
78	11KV O.H	216/18A - 16A	Asansol - Barachak	DSPCL	20.00	10.30
79	33KV U.G.	217/30-32	Barachak - Sitarampur	DSPCL	21.30	86.00
80	11KV U.G.	218/17A-19A	Barachak - Sitarampur	WBSEDCL	30.00	28.800
81	11KV U.G.	219/5-7	Barachak - Sitarampur	DSPCL	17.00	21.60
82	11KV U.G.	220/19A-23	Barachak - Sitarampur	WBSEDCL	40.90	13.60
83	440 L.T. U.G.	221/15-17	Sitarampur -Kulti	WBSEDCL	17.75	14.00
84	11KV U.G.	223/17-15	Sitarampur -Kulti	DSPCL	15.000	10.000
85	11KV U.G.	225/14A-16A	Sitarampur -Kulti	WBSEDCL	23.00	9.00
86	33KV U.G.	228/2-4	Kulti - Barachak	DVC	24.00	12.00
87	11KV O.H.	228/10	Kulti - Barachak	DSPCL	28.50	19.50
88	11KV U.G.	229/20	Kulti - Barachak	DSPCL	100.00	13.50
89	33KV O.H.	232/6-8	Kumardhubi - Mugma	DVC	21.00	8.00
90	11KV parallel	235/6-8	Kumardhubi - Mugma	JSEB	27.00	8.00

(1)	(2)	(3)	(4)	(5)	(6)	(7)
91	440 Volt.	235/30A-32A	Kumardhubi - Mugma	JSEB	18.00	13.00
92	11KV U.G.	236/26B-28B	Kumardhubi - Mugma	JSEB	22.00	12.00
93	11KV U.G.	MMU/44-45	Mugma - Thapannagar	JSEB	23.00	15.00
94	11KV U.G.	242/12-14	Thapannagar - Kalubathan	JSEB	16.00	15.00
95	33KV O.H.	242/12-14	Thapannagar - Kalubathan	JSEB	16.00	15.00
96	11KV U.G.	246/18-20	Kalubathan - Chota Ambana	JSEB	25.00	12.00
97	33KV	266/14-16	Dokra - Dhanbad	DVC	32.00	9.00
98	11KV U.G.	268/16-18	Dokra - Dhanbad	JSEB	16.00	8.00
99	33KV O.H	268/16 - 18	Dokra - Dhanbad	JSEB	16.00	8.00
100	11KV O.H	268/26-16	Dokra - Dhanbad	JSEB	12.00	8.00
101	440 Volt.	268/26-16	Dokra - Dhanbad	JSEB	12.00	8.00
102	11KV	273/14-16	Dhanbad-Bhuli	RAILWAY	32.000	7.91
103	33KV parallel	273/22-274/14	Dhanbad-Bhuli	JSEB	12.50	8.00
104	33KV O.H parallel	273/4-274-14	Dhanbad-Bhuli	JSEB	19.00	8.00
105	33KV	274/8-10	BBH-Gomoh	JSEB	16.000	12.15
106	33KV	274/8-10	BBH-Gomoh	JSEB	18.50	8.00
107	11KV	298/28-30	Matari-Gomoh	JSEB	17.00	9.00
108	11KV O.H	298/28-30	Matari-Gomoh	JSEB	17.00	9.00
109	11KV parallel	299/2-10	BBH-Gomoh	JSEB	20.00	9.00

Annexure - R

Shifting details of High Tension Power Line Crossings:-

Sl. No	Voltage	Rly. KM	In between station	Owner	Proposed formation level	Difference of level (8-7)	Height of bottom conductor from ex. Rly level	Height of bottom conductor from Prop. DFCC level (10-9)	Estim-ated cost (in Lakh)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(09)	(10)
1	400KV	191/11A-13A	Andal - Raniganj	WBSETCL	127.031	13.613	22.108	8.495	427.43
2	220KV	192/9A-11A	Andal - Raniganj	WBSETCL	131.781	15.064	16.21	1.146	130.84
3	220KV	218/13A-15A	Barachak - Sitarampur	WBSETCL	161.549	8.642	15.05	6.408	103.51
4	220KV	218/23A-25A	Barachak - Sitarampur	DVC	160.149	5.995	15.8	9.805	-
5	400KV	223/11-13	Sitarampur -Kulti	PGCIL	180.388	9.371	13.53	4.159	-
6	400KV	223/20A-22A	Sitarampur -Kulti	PGCIL	179.259	7.048	13.050	6.002	-

Annexure- S

LIST OF OHE MAST, AT AND PORTALS REQUIRING RELOCATION

ITEM	LOCATION	PRESENT STATUS
AT Mast	1 AT Mast Km 17/8A-17/10A	Distance-5.80 mtr
	2 AT Mast at Km 23/14A-23/18A	Distance-5.35 & 5.90 mtr
	1 AT Mast at Km 31/4A-31/6A	Distance-5.20 mtr
	1 AT Mast at Km 35/24A-35/26A	Distance-6.0 mtr
	1 AT Mast at Km near 38/8A	Distance-6.0 mtr
	2 AT Mast at Km 44/14A-44/16A	Distance-10.0 mtr
	4 Gantry mast at Janai Rd at Km 20/22B-20/26B	
OHE Mast	OHE Mast Km 13/120 & 13/118 both Up & Dn of TAK Branch line	
	Feeder wire anchor post in between Km 47/12A-47/22A including Neutral section.	Distance-5.50 mtr
	All OHE mast at Janai Rd Yard	
A.T.Mast.	Up A.T. Mast at gate no76	
	Up A.T. Mast at gate no78	
	Up A.T. Mast at gate no79	
	Up A.T. Mast at gate no80	
	Up A.T. Mast at gate no81	
	Up A.T. Mast at gate no82	
	Up A.T. Mast at gate no83	
	Up A.T. Mast at gate no84	
	Up A.T. Mast at gate no85	
	Up A.T. Mast atkm 136/3	
	Up A.T. Mast at gate no86	
	Up A.T. Mast at gate no87	
	Up A.T. Mast at gate no88	
	Up A.T. Mast at gate no89	
	AT Km 144/1-2	
	Up A.T. Mast at gate no96	
	Up A.T. Mast at gate no 97	
	Up A.T. Mast at gate no 99	
	Up A.T. Mast at gate no 102	
	A.T mast in front of West cabin	
	A.T 4 nos mast at 154/45T-154/67B,155/9	
	A.T mast at gate no 104	
	A.T mast at gate no 105	
	A.T mast at gate no 107	
	A.T mast at gate no 108	

	LOCATION	PRESENT STATUS
	A.T mast at gate no 110	
	A.T mast at gate no 111	
	A.T mast at gate no 112	
	A.T mast at gate no 113	
	Up A.T	
	UP A.T 2 nos	
	A.T at KM 173/5	
	A.T mast at gate no 117	
	A.T mast at gate no 118	
	A.T mast 181/1A-3A	
	A.T mast 186/17A-19A	
	A.T mast Dn	
	A.T mast Dn	
	A.T mast DN Kalipahari	
	AT mast a DN 208/30A East outer cabin ASN	
	AT mast at DN 210/22H	
OHE Mast	Portal Km123/9-17	FUNCTIONAL
	OHE mast - 36 nos at Panagarh bet. Km153/19A-155/9	FUNCTIONAL
	TTC 03 nos at KM 153/19A-155/9	FUNCTIONAL
	Portal 07 nos KM 153/19A-155/9	FUNCTIONAL
	Portal 07 nos At Mankar	FUNCTIONAL
	Portal Km 210/18 D Kalipahari- ASN	FUNCTIONAL
	OHE mast 01 no at km.210/22H	FUNCTIONAL
AT.MAST	1. AT MAST LOC - ULT/SS	9.80 mtr.
	1.AT MAST LOC - 238/32-34	6.15 mtr .
	1.AT MAST LOC - 241/28	9.77 mtr.
OHE MAST	OHE MAST LOC - 220/7A,7B-2 (portal)	10.37 mtr.
	OHE MAST LOC - 232/3(portal)	8.42 mtr
	OHE MAST LOC - 232/1-1 (portal)	4.18 mtr.
	OHE MAST LOC - 236/12B	2.60 mtr.
	OHE MAST LOC - 236/10B	2.49 mtr
	OHE MAST LOC - 236/8B	2.43 mtr
	OHE MAST LOC - 236/4C	2.95 mtr.
	OHE MAST LOC -MMU/58A	3.12 mtr.
	OHE MAST LOC -MMU/58	2.80 mtr
	OHE MAST LOC -MMU/59	2.90 mtr.
	OHE MAST LOC -MMU/60	2.83 mtr
	OHE MAST LOC -MMU/64(TTC)	2.93 mtr.
	OHE MAST LOC -MMU/62B	2.81 mtr.
	OHE MAST LOC -MMU/62	2.95 mtr.
	OHE MAST LOC -MMU/62A	2.81 mtr.

	LOCATION	PRESENT STATUS
	OHE MAST LOC(TTC) -MMU/65	2.85 mtr.
	OHE MAST LOC -MMU/59 A	2.95 mtr
	OHE MAST LOC -MMU/61	2.75 mtr.
	OHE MAST LOC - 255/2B	3.05 mtr.
	OHE MAST LOC - 255/4B	3.05 mtr.
	OHE MAST LOC - 255/6B-1	3.15mtr.

Annexure- T

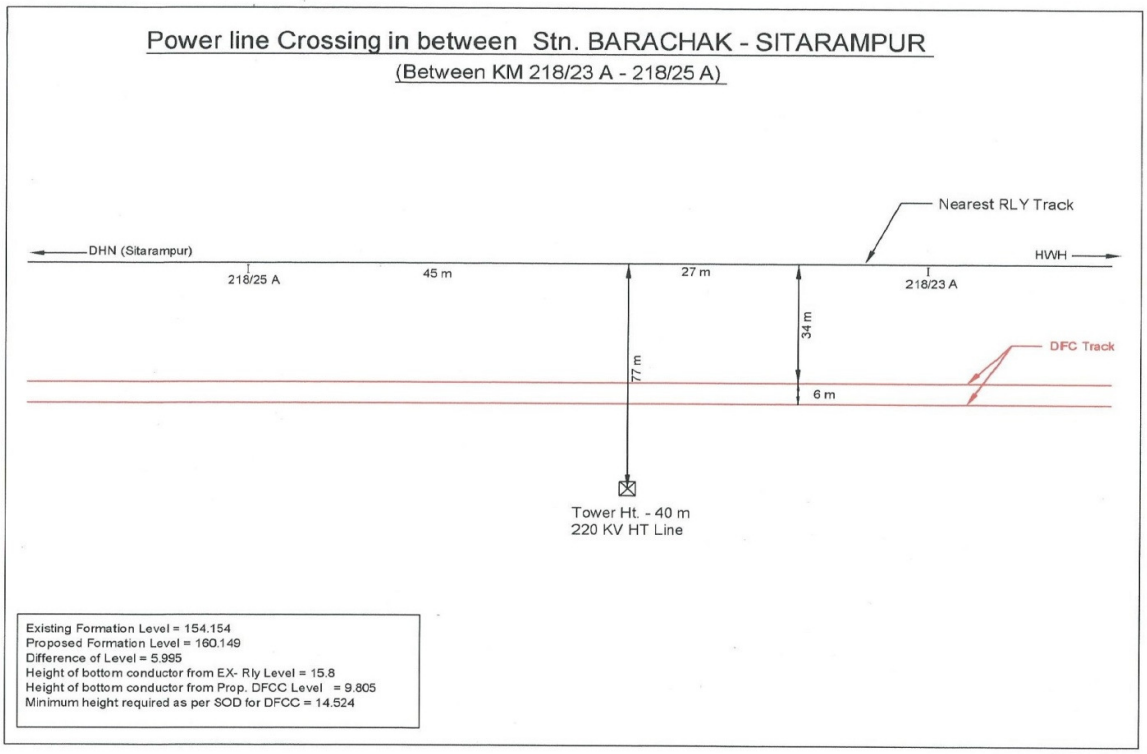
LIST OF LEVEL CROSSING							
Sl No	LC No	Section	Location		Census carried out on	TVU	Proposed Conversion
			Existing	Propsed			
1	9C-T	Dankuni-Gobra	15760	947.611	09/07	70356	2 Lane ROB
2	11CE	Dankuni-Janai Rd	16790	1970.089	09/07	12448	RUB
3	12CE	Dankuni-Janai Rd	17225	2457.718	07/07	120435	2 Lane ROB
4	14CE	Dankuni-Janai Rd	19070	4282.921	07/07	1608	RUB
5	15CE	Janai Rd	19725	4966.454	07/07	5335	Single Lane ROB
6	16B	Janai Rd-Baruipara	21165	6369.755	07/07	7691	Single Lane ROB
7	17C	Janai Rd-Baruipara	21593	6754.3	07/07	17341	Single Lane ROB
8	18B	Janai Rd-Baruipara	22204	7384.2	07/07	102505	2 Lane ROB
9	20CE	Janai Rd-Baruipara	23400	8622.383	07/07	25372	Single Lane ROB
10	21CT	Baruipara	25729	10926.042	08/07	115365	**ROB Sanctd**
11	24CE	Baruipara-Kamarkundu	29031	142590.608	08/07	35098	Single Lane ROB
12	26AT	Baruipara-Kamarkundu	31190	16381.531	08/07	100229	2 Lane ROB
13	27BT	Kamarkundu	31167	18292.913	08/07	493993	**ROB Sanctd**
14	28CT	Kamarkundu-Chandanpur	33968	19093.85	08/07	1576	Single Lane ROB
15	31CT	Kamarkundu-Chandanpur	35842	21006.408	08/07	7098	RUB
16	34CE	Kamarkundu-Chandanpur	38145	23348.697	09/07	3811	RUB
17	38CE	Chandanpur-Belmuri	44431	29639.36	09/07	10214	Single Lane ROB
18	40AT	Belmuri	47061	32277.851	10/08	60419	2 Lane ROB

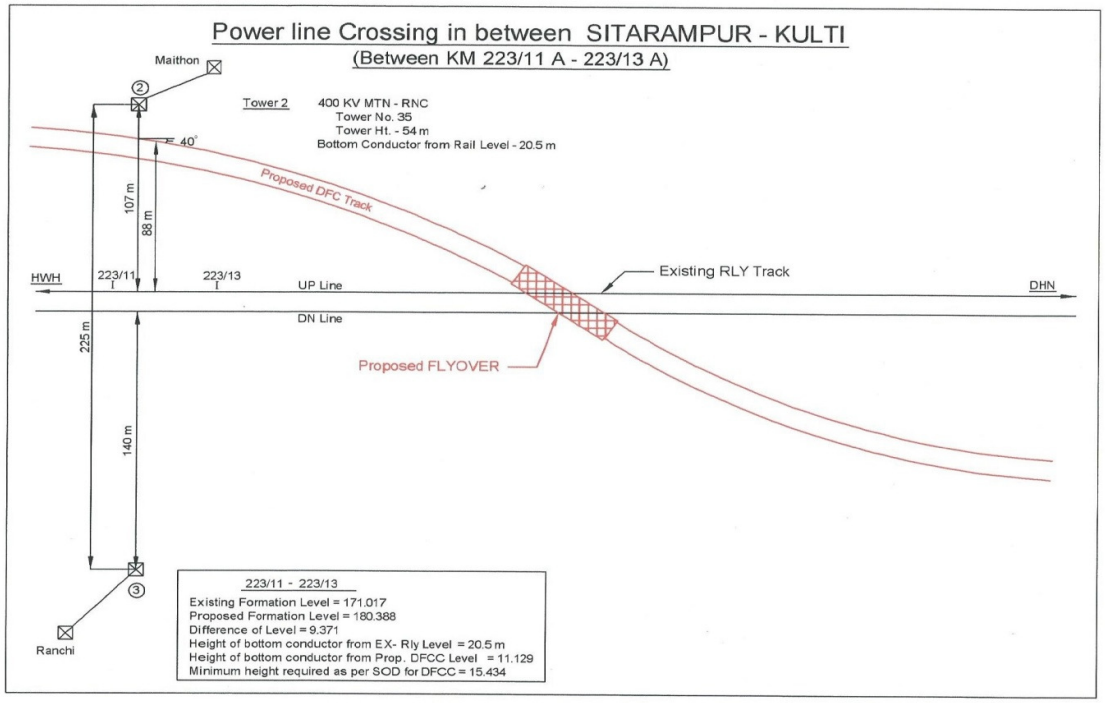
Sl No	LC No	Section	Location		Census carried out on	TVU	Proposed Conversion
			Existing	Propsed			
19	41CE	Cheragram-Gurap	55342	40534.986	09/07	10259	Single Lane ROB
20	44AT	Gurap	57929	43116.73	10/08	142191	2 Lane ROB
21	48CE	Gurap-Jaugram	60640	45827.19	09/07	2368	RUB
22	51CE	Gurap-Jaugram	63161	48387.853	09/07	19075	RUB
23	53 A	Jaugram	64050	49307.038	10/08	121420	2 Lane ROB
24	55 CT	Jaugram-Masagram	65857	50968.29	10/08	10305	RUB
25	56 BE	Jaugram-Masagram	67941	53518.45	01/07	38500	Single Lane ROB
26	57 CE	Jaugram-Masagram	68632	53964.08	01/07	3900	RUB
27	58 CE	Jaugram-Masagram	69659	54864.848	01/07	5500	RUB
28	59 AT	Masagram	70653	55901.763	01/07	316500	**ROB Sanctd**
29	62 CE	Masagram-Palla Rd.	72930	58150.257	01/07	9250	RUB
30	63 CE	Masagram-Palla Rd.	73676	58620.095	01/07	100100	2 Lane ROB
31	68 CT	Palla Rd.	77669	62398.427	01/07	38600	Single Lane ROB
32	44-B	Saktigarh	94735	67638.42	02/09	343210	4 Lane ROB
33	47/C/E/2	Saktigarh-Barddhaman	97433	85096.4	01/07	80400	2 Lane ROB
34	48-C/2	Gangpur	99700	86909.147	01/07	21600	RUB
35	49-C-T-2	Gangpur	100419.283	88143.565	01/07	12300	RUB
36	50/A/T/3	Barddhaman	104840	92569.506	07/10	470366	**ROB Sanctd**
37	52-CE	Barddhaman-Talit	110120	97780.678	07/10	15236	RUB
38	53-CE	Barddhaman-Talit	110720	98500	07/10	72673	2 Lane ROB
39	54-CE	Barddhaman-Talit	110600	99340.782	07/10	10093	RUB
40	55-C	Barddhaman-Talit	112360	100043.902	07/10	208452	2 Lane ROB
41	56-CB	Talit	114420	101983.04	07/10	197454	2 Lane ROB
42	58-C	Talit-Khana	117235	116850	07/10	13317	RUB
43	59-C	Talit-Khana	117952	117563.297	07/10	28211	RUB
44	60/A/T/3	Khana	119986	119480.99	07/10	121238	2 Lane ROB
45	76 B/T	Khana- Galsi	123000	122961.1	03/11	14797	Single Lane ROB
46	77/C/E	Khana- Galsi	123720	123657		95425	**CLOSED**
47	78 Spl/E	Khana- Galsi	123984	123913.1	03/11	36215	Closure by Diversion
48	79 C/E	Khana- Galsi	126050	125979	01/11	17861	Single Lane ROB

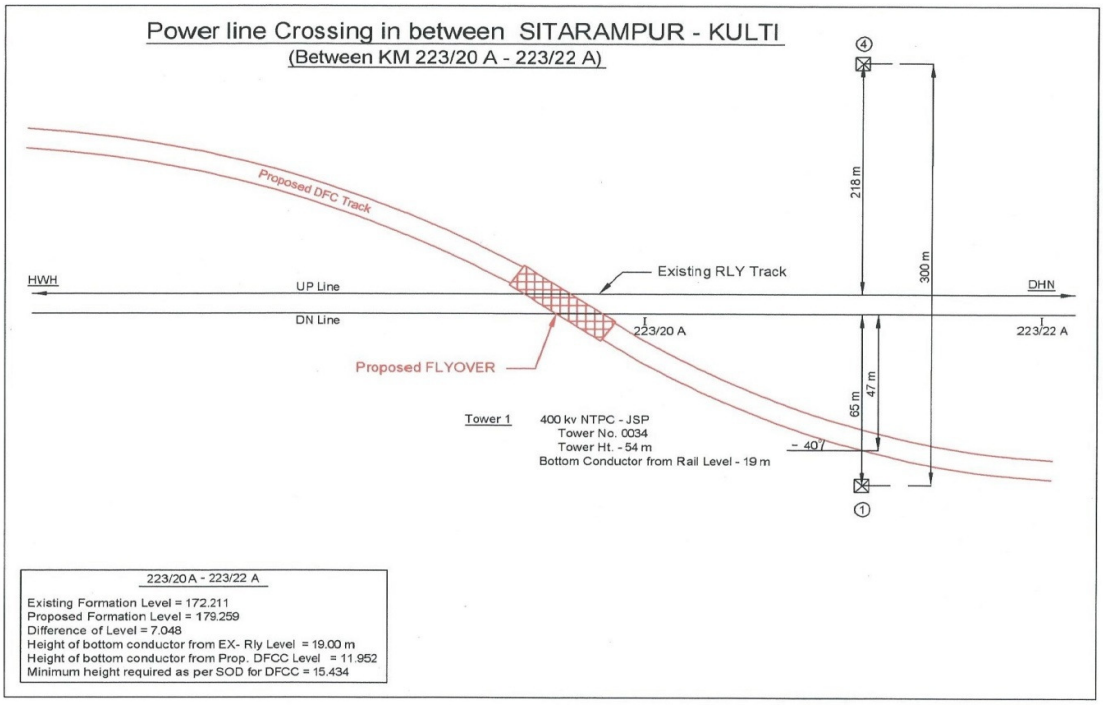
Sl No	LC No	Section	Location		Census carried out on	TVU	Proposed Conversion
			Existing	Propsed			
49	80 C/E	Khana- Galsi	127671.374	127600	03/11	303	Closure by Diversion
50	81 B/T	Galsi/East Cabin	129326	1292618	09/08	175885	2 Lane ROB
51	82 C/T	Galsi/West Cabin	130300.526	130242.1	08/08	1460	Closure by Diversion
52	83 Spl/E	Galsi-Paraj	131608.79	131580.8	03/11	72527	2 Lane ROB
53	84 C/E	Galsi-Paraj	132780	132816.3	12/09	404	RUB
54	85 C/E	Paraj/West Cabin	133867.615	133814.1	12/09	201	Closure by Diversion
55	86 Spl/E	Paraj-Mankar	136660	136320.4	12/08	92730	2 Lane ROB
56	87 C/E	Paraj-Mankar	138808.308	138766.3	12/09	5831	Single Lane ROB
57	88 C/E	Paraj-Mankar	139980	139944.9	01/11	8021	Single Lane ROB
58	89 C/E	Mankar- Panagarh	140448.386	140389.116	12/09	1614	Closure by Diversion
59	92 B/T	Mankar- Panagarh	144080	143975.7	01/11	195453	2 Lane ROB
60	93 B/T	Mankar- Panagarh	144630	144690.2	03/11	14069	Single Lane ROB
61	94 C/T	Mankar- Panagarh	145000	144950	03/11	6327	Closure by Diversion
62	96 C/E	Mankar- Panagarh	147643.115	147702.573	01/11	42561	Single Lane ROB
63	97 C/E	Mankar- Panagarh	148499	148461.7	01/11	11832	RUB
64	99 A/E	Mankar- Panagarh	150308	150291.6	3/08	89794	2 Lane ROB
65	102 B/T	Mankar- Panagarh	154090	154116.529	12/08	156315	2 Lane ROB
66	103 B/T	Panagarh-Rajdandh	155100	155026.8	12/08	1089122	4 Lane ROB
67	104 C/T	Panagarh-Rajdandh	155750	155817.6	12/09	9439	Closure by Diversion
68	105 C/E	Panagarh-Rajdandh	156600	156600	12/09	19275	Single Lane ROB
69	106 B/E	Panagarh-Rajdandh	158450	158590	12/08	59724	2 Lane ROB
70	107 C/E	Panagarh-Rajdandh	159700	159693	1/11	22944	Single Lane ROB
71	108 B/T	Panagarh-Rajdandh	162000	162017	12/08	186105	2 Lane ROB
72	110 C/E	Rajdandh-Durgapur	164420	164506	11/10	29160	Single Lane ROB
73	111 Spl/E	Rajdandh-Durgapur	167000	167129	10/08	39468	Single Lane ROB
74	112 B/E	Rajdandh-Durgapur	168425	168593.8	11/10	48780	2 Lane ROB
75	113 B/T	Rajdandh-Durgapur	169831.32	169962.2	8/08	1110038	**ROB Sanctd**
76	114 A/T	Durgapur-Durgapur Coke oven plan	170750	170852	12/10	547758	4 Lane ROB

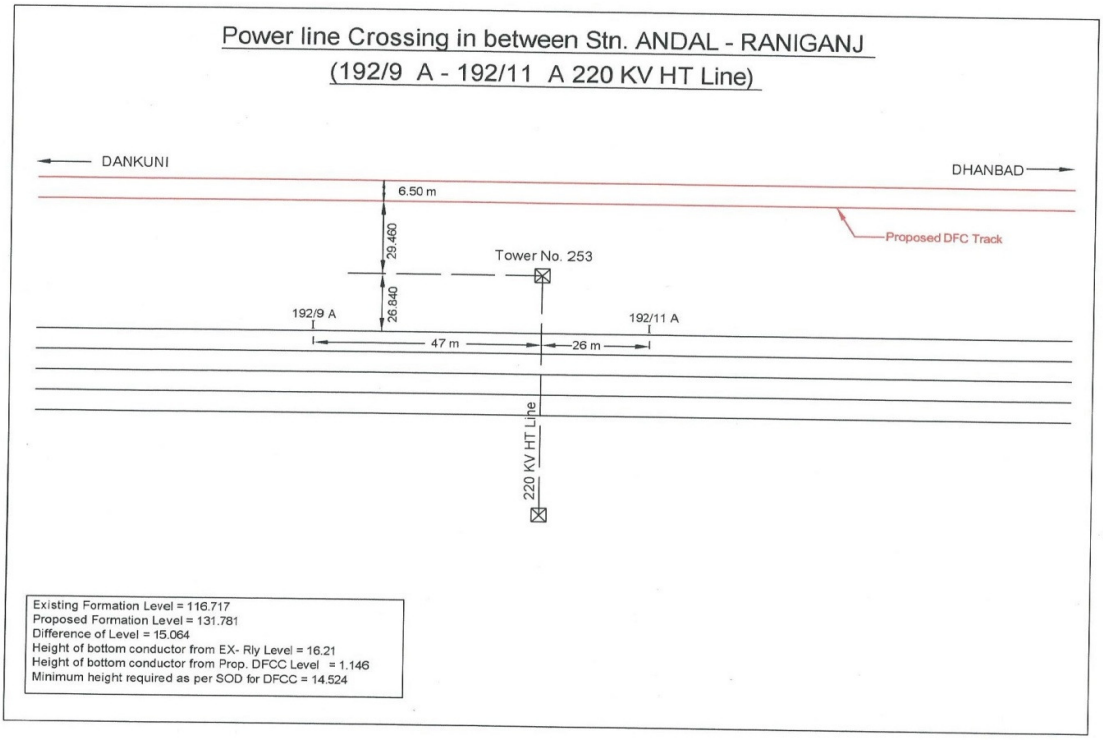
Sl No	LC No	Section	Location		Census carried out on	TVU	Proposed Conversion
			Existing	Propsed			
77	117 C/E	Durgapur Coke oven plan-Waria	176417.0	176580.372	3/11	1405	Closure by Diversion
78	118 B/T	Durgapur Coke oven plan-Waria	176941.2	177115.8	12/10	851067	4 Lane ROB
79	119 B/T	Waria-Andal	179652.647	179821	12/10	48951	2 Lane ROB
80	123 B/T	Andal-Raniganj	187291.800	187730	10/11	325	RUB
81	124 C/E	Andal-Raniganj	189402.1		10/11	172	**CLOSED**
82	125 A/C	Andal-Raniguanj	190035	190035.4	10/9	31330	Single Lane ROB
83	128 Spl/E	Ranigunj-Nimcha	199050	199809	9/10	63742	2 Lane ROB
84	131/C/T	Barachak-Sitarampur	219.657	220658.244	3/11	6300	RUB
85	1A/3T	Kulti-Barakar	226240	227282.5	7/10	283338	4 Lane ROB
86	3B/2T	Barakar-Kumardhubi	231333	232372.5	7/10	49714	2 Lane ROB
87	4B/2E	Kumardhubi-Mugma	233922	234988	7/10	46072	Single Lane ROB
88	5B	Kumardhubi-Mugma	235150	236199.5	3/11	5194	RUB
89	5A	Mugma-Sitarampur Limit	236800	237834	3/11	43014	Single Lane ROB
90	6B	Mugma-Thapannagar	238866	239863.947	3/11	42586	Single Lane ROB
91	7B	Mugma-Thapannagar	241604.92	242905.3	3/11	24072	Single Lane ROB
92	10C/A UP	Kalubathan-Chota Ambana	249042	250218	3/11	22728	RUB
93	11C/E	Kalubathan-Chota Ambana	250431	251570	3/11	21522	RUB
94	12C	Kalubathan-Chota Ambana	251925	253024	3/11	1260	RUB
95	14C	Chota Ambana-Pradhankhanta	255735	256900.6	3/11	21420	Single Lane ROB
96	15Spl	Chota Ambana-Pradhankhanta	260770	261949.45	02/08	110207	**ROB Sanctd**
NOTE- CHAINAGE . CONSIDERED 0.00 FROM C/L DHANBAD STATION							
97	2/SPL/T	Bhuli-Tetulmari	2523.05	2526.55	03/11	122266	**ROB Sanctioned**
98	4/C/E	Bhuli-Tetulmari	5715.1	5717.656	11/09	16296	RUB
99	5/C/T	Bhuli-Tetulmari	6635	6637.26	08/11	22790	RUB
100	6/C/T	Tetulmari-Nichitpur	9081.25	9033.056	08/11	12040	RUB
101	7/C/T	Tetulmari-Nichitpur	11450.12	11425.419	07/11	13655	RUB
102	8/C/E	Nichitpur-Matari	15371.00	15370.88	12/10	O	Proposed for closure
103	9/B/T	Matari-Gomoh	27410.10	27407.64	03/11	139728	**ROB Sanctioned**
104	10C/E	Gomoh - Bholidih	31665.1	31658.88	03/11	86443	**ROB Sanctioned**
105	10/A/C	Bholidih-Nimiaghat	30637.50	34762.54	04/11	19772	LHS sanctioned
106	11/C/T	Bholidih-Nimiaghat	30962.5	37974.45	04/11	8650	LHS sanctioned

DIAGRAM OF POWER LINE CROSSINGS

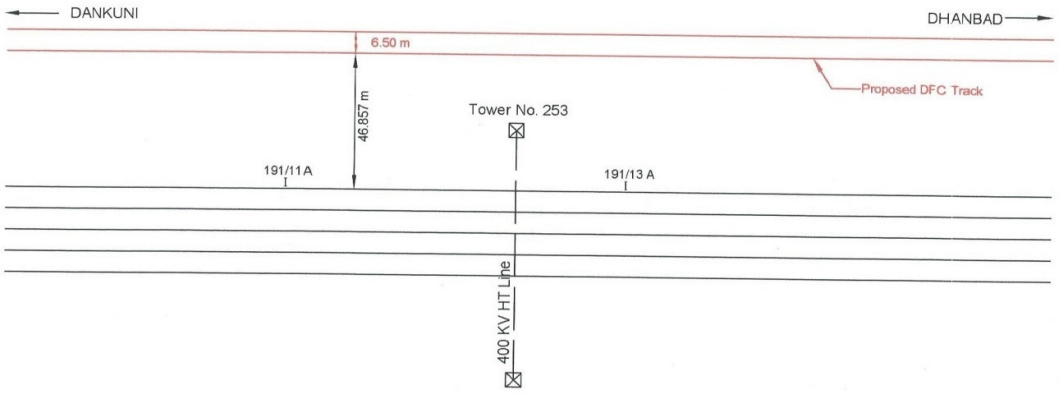





Power line Crossing in between SITARAMPUR - KULTI
(Between KM 223/20 A - 223/22 A)
Proposed DFC Track
Existing RLY Track
HWH
UP Line
DN Line
DHN
223/20 A
223/22 A
Proposed FLYOVER
218 m
300 m
65 m
47 m
Tower 1
400 kv NTPC - JSP
Tower No. 0034
Tower Ht. - 54 m
Bottom Conductor from Rail Level - 19 m
223/20 A - 223/22 A
Existing Formation Level = 172.211
Proposed Formation Level = 179.259
Difference of Level = 7.048
Height of bottom conductor from EX- Rly Level = 19.00 m
Height of bottom conductor from Prop. DFCC Level = 11.952
Minimum height required as per SOD for DFCC = 15.434

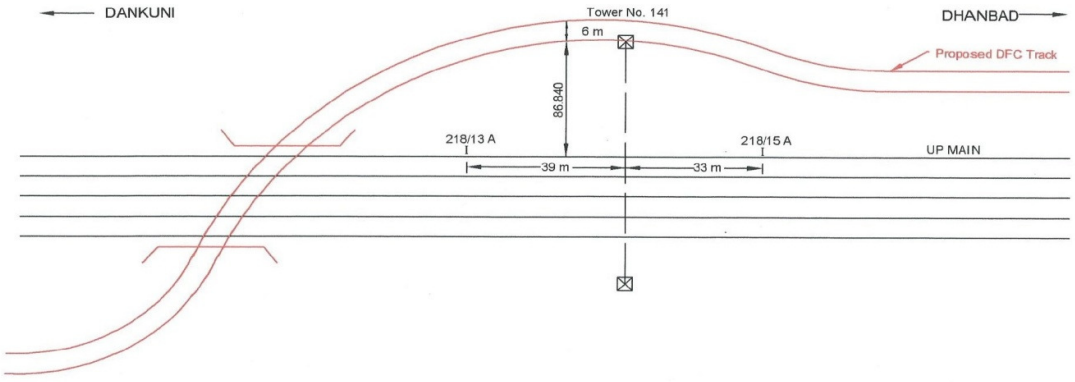

Power line Crossing in between Stn. ANDAL - RANIGANJ
(192/9 A - 192/11 A 220 KV HT Line)
DANKUNI
DHANBAD
6.50 m
29.460
26.840
Proposed DFC Track
Tower No. 253
192/9 A
192/11 A
47 m
26 m
220 KV HT Line
Existing Formation Level = 116.717
Proposed Formation Level = 131.781
Difference of Level = 15.064
Height of bottom conductor from EX- Rly Level = 16.21
Height of bottom conductor from Prop. DFCC Level = 1.146
Minimum height required as per SOD for DFCC = 14.524

Power line Crossing in between Stn. ANDAL - RANIGANJ
(191/11 A - 191/13 A 400 KV HT Line)



Existing Formation Level = 113.418
Proposed Formation Level = 127.031
Difference of Level = 13.613
Height of bottom conductor from EX- Rly Level = 22.108
Height of bottom conductor from Prop. DFCC Level = 8.495
Minimum height required as per SOD for DFCC = 15.434

Power line Crossing in between Stn. SITARAMPUR - BARACHAK
(Between KM 218/13 A - 218/15 A)



Existing Formation Level = 152.907
Proposed Formation Level = 161.549
Difference of Level = 8.642
Height of bottom conductor from EX- Rly Level = 15.05
Height of bottom conductor from Prop. DFCC Level = 6.408
Minimum height required as per SOD for DFCC = 14.524/11.730

5.0 STATION PLANNING

1. General

1.1 Stations will be required for:-

a) Transferring traffic to and fro from Indian Railway network. Such stations will be termed as Junction Stations.

b) For crossing the trains running on DFC system. Such stations will be termed as Crossing Stations.

1.2 Junction stations have been identified based upon the traffic needs. The concessionaire shall provide the necessary facilities as per yard plan already developed and approved by DFCC. At junction stations, yard layouts should suit the long haul operations (2 x 750 m loops). Each Junction station is provided with Station building as per typical plan shown in **Annexure L.** Also, each junction station will have provision of a tower wagon shed/siding and a machine siding of 300 m length.

1.3 Crossing stations will be provided at suitable locations in consultation with DFCCIL at inter station distance of approximately 40Km with automatic blocks in between. Each crossing stations should have minimum two loops (one UP and one DN) with 1500 m CSR (Provision of 750 m for present and 750 m for future shall be kept). Each crossing station is provided with Station building as per typical plan shown in **Annexure L.** The concessionaire shall provide the necessary facilities as per yard plan already developed and approved by DFCCIL.

2.0 Centralized control of the Station Equipments

2.1 All station buildings shall have BMS for supervision and control of all major E&M equipment so that O&M staff can have control over them. The BMS shall also interface with the requirements of control, monitoring and supervision as required at RCC.

3.0 Features for Station Design

3.1 General

a) Stations shall be open, spacious and well lit so as to maximize visibility of people, platform, other building/structure areas, and parking areas.

b) Hiding areas shall be minimized.

c) Access points to parking area shall be minimized.

d) Adequate lighting shall be provided, minimizing shadows and avoiding dark areas.

e) Shatter guard protection shall be provided for glass windows/doors.

f) Planning shall provide for open lines of sight to as much area as possible.

g) Make efficient use of space which aesthetically integrates lighting, ventilation and electrical system and provision of natural light.

h) Provide Lightning protection and primary surge protection system for incoming power supply to the building and for sensitive relays and electronic equipment.

i) Fire protection system to be located in Station offices complete with firefighting equipment as per requirement of concerned authorities.

j) Provision of Signage, name boards aesthetically designed & placed at vantage points.

3.2 Fire Precautions

a) The station design shall conform to the following standards;

- BIS Codes
- National Building Code;
- NFPA codes wherever subject matter is not covered under relevant BIS Codes/NBC;

b) The choice of materials in Stations should be such as to keep the fire load and the smoke and toxic gas generation in the event of a fire to the minimum practicable level.

c) An electrical fire detection and alarm system shall be installed in accordance with IS 3218: Code of Practice for Fire detection and Alarm Systems.

d) Firefighting equipment should be provided as per Applicable Law.

3.3 Platform/Walkway

a) Platform/Walkway shall have clearances as per DFC Schedule of Dimensions.

3.4 Stairs

All steps in a flight of stairs should have the same dimensions.

a) Tread of steps should be minimum 300 mm.

b) Riser shall not be more than 150 mm.

c) Hand rails shall be provided at a height of about 900 mm.

d) Step noses shall be rounded and color contrasted.

e) Minimum width of stairs shall be 1500 mm

f) Minimum head room over a stair shall be 3.0 m.

g) The stairway must be well lit.

h) For fire escape stairs, relevant BIS Codes shall apply

3.5 Fencing

The Concessionaire shall provide appropriate vandal-proof perimeter fencing at suitable locations.

3.6 Environmental Protection Requirements

The Concessionaire shall implement the environmental protection requirements applicable to the Works. All parts, including non-structural parts, of the structures shall minimize as far as practicable the radiation of noise due to vibration caused by the passage of trains. Particular attention shall be paid to the minimization of noise at the low end of the acoustic frequency spectrum.

3.7 Rain Water Harvesting

The rain water harvesting of the runoff water within the Station areas shall be planned as per the policy, rules, norms, requirements and methods of the local bodies, State and the Central Government.

3.8 Station Architecture

The Stations shall be visually appealing, tastefully designed reflecting local culture and flavor, functional aesthetics, user friendly, energy efficient and with a Station architecture that is site specific and environmentally compatible. The design should identify significant architectural features which should be taken into account.

3.9 Facilities for Differently Abled Persons

Facilities to staff and other users with mandatory requirement as per Indian Disability Act for differently abled persons shall be provided.

4.0 Materials and Station Finishes

The materials selected and finishes adopted for floors, walls and ceilings should provide comfort and safety, improve the aesthetics and be durable, operable and maintainable with minimum resources. The materials chosen should be durable, fire resistant, vandal resistant, environment friendly and pleasing. Basic requirement are as under:-

a) Fire Resistance and Smoke Generation

Use materials with minimum burning rates, smoke generation, and toxicity characteristics for station finishes, consistent with requirements of Fire/Life Safety requirements. Interior finishes including doors/windows shall meet requirements of the code and the fire/life safety requirement:

b) Attachment

Eliminate hazard from dislodgment due to temperature change, vibration, wind, seismic forces, aging, or other causes, by using proper attachments of adequate bond strength.

c) Skid resistant (for walking surfaces)

Entrances, stairways, platform edge strips, and areas around equipment shall have flooring having high skid-resistant properties. Following static coefficients of friction shall be provided as a minimum:

(i) horizontal surfaces, interior-0.5;

(ii) horizontal surfaces, exterior-0.6;

(iii) stairs, ramps, sloping sidewalks-0.8; and

(iv) area around equipment-0.6.

d) Durability

Materials shall have wear resistance, strength, and weathering qualities consistent with their initial and replacement costs, and their location in the Station. The materials must maintain good appearance throughout their useful life. Materials shall be colorfast.

e) Ease of Maintenance.

(i) Cleaning: Materials should not soil or stain easily, have surfaces that are easy to clean in a single operation, and minor soiling should not be apparent. Materials shall be cleanable with standard equipment and cleansing agents.

(ii) Repair or Replacement: Materials, if damaged, are easily repairable or replaceable without undue interference with the operation of the System.

f) Resistance to Vandalism

Materials and features that do not encourage vandalism and are difficult to deface, damage or remove shall be provided. All

surfaces exposed to the public are to be finished in such a manner that the results of casual vandalism can be readily removed with normal maintenance techniques. The Concessionaire is required to describe procedures for removal of more serious defacement for each finish in public areas and within 3 m of the floor surface, as part of the Maintenance Manual.

g) Aesthetic Qualities

Create feeling of warmth, attractiveness, quality, and civic pride in the facility.

h) Cost

Materials shall be selected for long life, low maintenance, easy to replace and overall aesthetic and functional qualities.

i) Availability

Materials selected should be easily available.

j) Installation Standards

Materials shall be detailed and specified to be installed in accordance with industry standards and manufacture's printed directions.

5.0 Auxiliary power supply and Station Lighting

5.1 Power for station will be received from the local power grid at 11/33 kV by 2 independent feeders (double circuit) from single source at initial stage with provision for second source in future. The power receiving stations shall be interconnected for transfer of power from one to another through Fire Retardant Low Smoke (FRLS) cable feeders. These receiving stations should be remote controlled from Centralized operation control centre through Supervisory Control & Data Acquisition system (SCADA). In the event of total power failure, DG sets will be automatically switched on and feed the station.

The station designer will prepare a load analysis for determining the total power requirements. The load analysis should include but are not limited to:

1. Capacity
2. All domestic electrical consumption (fixtures, outlets, switches etc.)
3. All commercial consumption (food service, concessions, etc.)
4. All mechanical equipment (pumps, compressors, etc).
5. All Signal and Telecom equipments.
6. All internal and external lighting

This analysis shall be prepared in conformance with the National Building Code of India and the Bureau of Indian Standards and submitted to IE for

review and approval. Station metering and sub-metering shall be designed so as to be able to do the following:

a) Distinguish power consumption by mechanical equipment, lighting and other equipments by major station components and areas.

b) Monitor all energy efficiency protocols and consumption as required by energy management plan for the station.

5.2 Lighting shall be energy efficient. The following general guidelines shall be followed:

a) Lighting levels shall be uniformly distributed throughout as far as possible and be designed to prevent glare, dark recesses and areas of poor lighting levels. Lighting levels should be graduated consistent with safety and comfort, avoiding abrupt changes in illumination levels. in Station Control Rooms shall be positioned so that no reflected glare from dials or monitor screens interferes with the operator's vision;

b) Stairways shall be well illuminated;

c) All Station premises, including foot bridges, subways, stairways, steps and ramps should be permanently lit when there is no day light;

d) Lighting shall not blind Train operators(TOs);

e) Outdoor lighting shall be provided as required outside Stations;

7.0 CONSTRUCTION PLANNIING

7.1 APPROACH

The Ministry of Railways has envisioned construction of a double line freight corridor running parallel to the existing IR alignment in order to enhance the freight carrying capacity of Indian Railway. The aim of this chapter is to briefly explain the design concept and construction methodology proposed for various structures. Detailed survey has been conducted to know the exact

extent of the railway land and also the space available between the railway boundary and the centre line of extreme track.

7.2 CIVIL ENGINEERING WORKS AND STRUCTURES

7.2.1 GENERAL

This chapter lays down standards for Civil Engineering works covering loading standards, Design, drawings, alignment (gradient and curves) and important schedule of dimensions, earth work, blanketing, formation drainage, ballast, railway bridges including Rail Fly Over's (RFOs), Road Under Bridges (RUBs), buildings and track i.e rails, sleepers, fastening, welding, special track layouts like points & crossings, switch expansion joints, glued joints, Level Crossings, system signage and fencing.

7.2.2 LOADING STANDARDS

Loading standards shall conform to "Rules specifying the loads for design of super-structure and sub-structure of bridges and for assessment of the strength of existing bridges" – IR Bridge Rules. The Formation and Bridges shall conform to DFC Loading (32.5T Axle Load) as detailed in Appendix XXV (in 4 sheets) of Bridge Rules. However, the track shall be suitable for 25T loading 2008 as per Appendix XXII (in 4 sheets) of IR Bridge Rules.

7.2.3 DESIGN

Concessionaire shall fulfill the requirements for the preparation and submissions of the design of the works to cover the design phase as well as construction phase including those which are necessary for interface with various existing systems & agencies and those that are of general application.

All technical solutions, schemes, structures, materials should be fully compatible with requirement of DFCCIL and should not be in conflict with the applicable rules/codes/manuals & standards as well as the legislation in India.

7.2.4 REQUIREMENTS DURING THE DESIGN PHASE

7.2.4.1 The principal requirements during design phase are the production of the documents by the concessionaire, which shall fully describe the works and include the preliminary design, definitive design and "Good for Construction Drawings".

7.2.4.2 The volume and contents of the documents shall be in accordance with the applicable regulations/legislation in India, existing codes, manuals and standards applicable on Indian Railways/DFCCIL, or suitable international norms.

7.2.4.3 The concessionaire shall obtain all necessary approvals and agreements for his designs on his account in accordance with the applicable legislation in India & current practices.

7.2.4.4 The preliminary design shall incorporate the design and reference drawings included in the bidding documents, and to be developed by the concessionaire sufficiently to define the main structures including formation, bridges, buildings, track alignment & track components and building services etc. In addition, general construction, manufacture, installation, testing and commissioning methodologies and documentation needed to develop the definitive design shall be submitted.

7.2.4.5 The definitive design shall accord with and incorporate the concessionaire's proposals and shall be the design developed to the stage at which all elements of main structures including formation, bridges, buildings, track alignment & track components and building services etc are fully defined and specified. In particular definitive design shall be complete when.

i. All calculations and analyses are complete including verification;

ii. All main and other significant elements are defined;

iii. All tests, trials and selection of materials &equipments are complete; and

iv. The effects on the permanent works of the proposed methods of construction, installation, testing and commissioning and of the temporary works are assessed.

7.2.4.6 During the preparation of the definitive design, all surveys, investigations and testing necessary to complete the design of the permanent & temporary works shall be undertaken by the concessionaire.

7.2.5 REQUIREMENTS DURING THE CONSTRUCTION PHASE

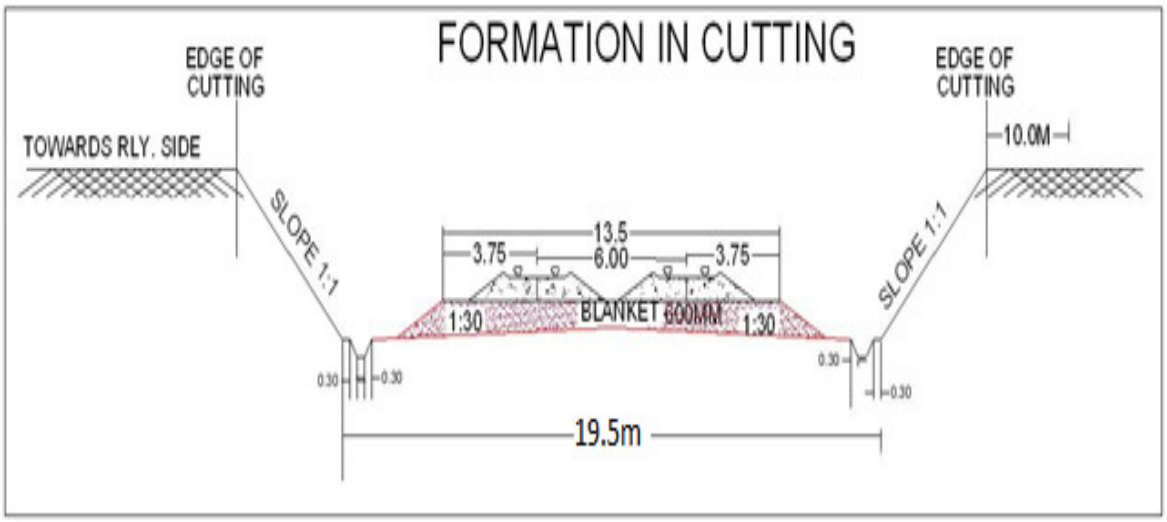
The principal requirements relating to the concessionaire's documents during the construction phase are the production by the concessionaire of working drawings and documents, preparation of technical submissions, compilation of the final design and the production of the as-built drawings and final documentation.

7.3 SPAN CONFIGRATION

Based on the various detailed survey data, the following two types of formation have been established:

7.3.1 EARTHWORK IN CUTTING:

The total length of alignment in cutting is 54.769 Tr. Km. A bottom width 13.50 m with 1:1 slopes including side drains on both sides has been kept. Typical cross section of formation of Dedicated Freight corridor in cutting is shown below

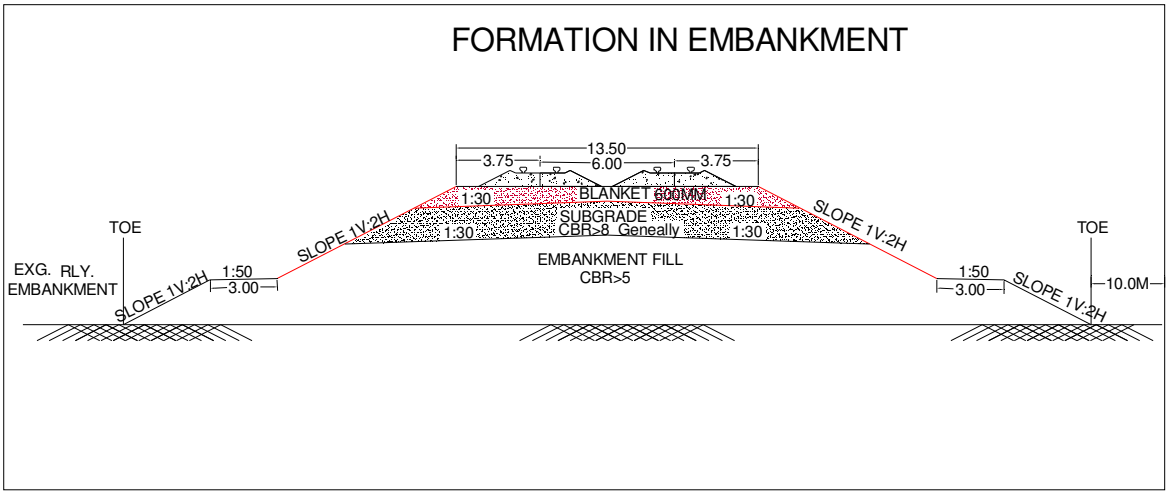


7.3.2 EARTHWORK IN EMBANKMENT:

Being a double line construction, a top width of 13.50 m has been proposed for embankment with side slopes of 2:1.For Banks higher than 4.5 metres, suitable slope stability analysis to be carried out to adjudge the slope suitability. Following minimum factor of safety shall be ensured in the design and construction of high embankment :- where the required factor of safety is not achieved, suitable ground improvement shall be carried out:

- Bearing Capacity - 2.0
- Lateral sliding - 1.5
- Foundation extrusion - 1.5
- Deep seated slip failure - 1.2 (short term)
  - 1.4 (long term)

Typical cross section of the proposed embankment for freight corridor is presented in the below given figure.



On curves, extra formation width is provided to account for increase due to extra ballast on outside of curves and due to extra clearances on double line for super-elevation.

7.3.3 MAJOR BRIDGES:-

For estimation, quantities have been calculated based on Standard G.A.D. for 12.2 m & 18.3 m span. For 24.4 m & 30.5 m spans, quantity estimation is based on RDSO drawing for H.M. Loading for these spans.

7.3.4 MINOR BRIDGES:-

As per advance correction slip no 25 dt.17.12.2012 to the Indian Railway Bridge Manual, the minimum clear span for new bridges has been kept as 1m to ensure proper inspection and maintenance of bridges.All existing minor bridges with a span of less than 1m has been extended with to a minimum span of 1.2m opening for crossing the proposed alignment. Minimum size of RCC Box with or without fill shall be 1.2 x 1.2 m.

7.3.5 RAIL FLY OVER:

The span configuration of Flyover is mentioned below:

S/N	Section	Jurisdiction	Proposed Chainage in Km	SL / DL RFO	Span	
					No	Length in RM
1	Gobra-Janai Road	Howrah Div.	18.048	SL	1	61.00
2	Palla Road - Shaktigarh	Howrah Div.	78.523	DL	1	61.00
3	Durgapur-Andal	Howrah Div.	178.364	DL	1	30.50
4	Durgapur-Andal	Asansol Div.	178.530	SL	1	61.00
5	Durgapur-Andal	Asansol Div.	185.000	DL	1	61.00

6	Andal-Raniganj	Asansol Div.	188.425	SL	1	61.00
7	Andal-Raniganj	Asansol Div.	188.901	SL	1	30.50
8	Raniganj-Kalipahari	Asansol Div.	199.200	DL	1	61.00
9	Raniganj-Kalipahari	Asansol Div.	204.500	SL	1	30.50
10	Barachak – Sitarampur	Asansol Div.	219.117	DL	1	61.00
11	Sitarampur-Kulti	Asansol Div.	224.508	DL	1	61.00
12	Gomoh - Bholidih	Dhanbad Div.	303.30	SL	4	61.00

7.3.6 RUB (MINOR):-

A minimum of 5.5.m X 3.5 m. size has been proposed for crossing village roads. To cross the district roads & state highways RUBs having span of 5.5m x 4.5 m and 5.5 m x 5.5 m have been proposed.

7.4 FOUNDATION SYSTEM:

Indian Railway Standard Code of Practice for the design of Sub- structures of Bridges (Bridge Sub- Structure Code). For design of foundations, in addition to above loads, following loads as per Sub-Structure Code are to be considered:-

i. Earth pressure including earth pressure due to surcharge on abutments and other earth retaining structures like wing wall, return walls.
ii. Forces due to water current on any part of the bridge substructure which may be submerged in running water.
iii. Buoyancy effects may be considered for foundations due to HFL / LWL as per critical combinations.

7.4.1 COMBINATION OF LOADS:-

Combination of loads will be as per relevant code i.e. Sub-structure code/ Steel bridge code/Concrete bridge code.

7.4.2 CONDITIONS FOR STABILITY OF FOUNDATIONS:-

This shall be adjudged as per sub-structure code.

7.4.3 VARIOUS LOADS TO BE CONSIDERED IN DESIGN:-

For the purpose of computing stresses, following loads as applicable, shall be taken into account. The details of loads are to be as per Bridge Rules.

(a) Dead load

(b) Live load

(c) Dynamic effects

(d) Forces due to curvature or eccentricity of track

(e) Temperature effect

(f) Frictional resistance of expansion bearings

(g) Longitudinal force

(h) Racking force

(i) Forces on parapets

(j) Wind pressure effect

(k) Forces and effects due to earthquake

(l) Erection forces and effects

(m) Derailment loads

(n) Load due to Plasser Quick Relay System (PQRS)

Longitudinal forces shall include tractive effort, braking forces, forces due to resistance to movement of bearings and forces due to combination of LWR/CWR over bridges. To this extent, "Abeyance till further orders" as mentioned in para 2.8.1(d) of Bridge Rules is superseded by this manual. Forces due to continuation of LWR/CWR will be as per provision of UIC 774-3R Oct'2001 edition with latest modifications, if any, subject to the provision that track resistance of 60 KN/m in loaded condition shall be taken.

The criteria for seismic analysis shall be carried out as per IITK-RDSO Guidelines on Seismic Design of Railway Bridges, Nov 2010, with latest seismic maps.

7.4.4 HYDROLOGICAL INVESTIGATIONS:-

These are required to assess the flow channels, design discharge, High Flood Levels, afflux, scour depths etc for safe design of bridge and river training works. Sub Structure Code may be referred to in this regard.

7.4.5 DISCHARGE

The estimation of design discharge for waterway shall preferably be based, wherever possible, on procedures evolved from actual hydro meteorological observations of the same or similar catchments. All bridges shall be designed with adequate waterway for design discharge (Q).

Design Discharge for Foundations (Qf) shall be computed by increasing the design discharge (Q), by the percentage indicated below:

Catchment Area	% Increase
Catchment less than 500 Sq.km	30%
Catchment more than 500 Sq.km and upto 5,000 Sq.km.	30% to 20% (decreasing with increase in area)

Catchment more than 5,000 Sq.km. and upto 25,000 Sq.km.	20% to 10% (decreasing with increase in area)
Catchment more than 25,000 Sq.km	Less than 10%

7.4.6 FLOOD RECURRENCE INTERVAL

Important and Major Bridges: Once in 100 years

Minor Bridges: Once in 50 years

7.4.7 SCOUR DEPTH

In the case of natural channels flowing in alluvial beds where the width of waterway provided is not less than Lacey's regime width, the normal depth or Scour (D) below the foundation design discharge (Qf) level may be estimated from Lacey's formula as indicated below:

$$D = 0.473 (Qf / f)^{1/3}$$

where D is depth in m, Qf is in cumecs and 'f' is Lacey's silt factor for representative sample of bed material obtained from scour zone.

Where due to constriction of waterway, the width is less than Lacey's regime width for Qf or where it is narrow and deep as in the case of incised rivers and has sandy bed, the normal depth of scour may be estimated by the following formula:

$$D = 1.338 (Qf^2 / f)^{1/3}$$

Where Qf is the discharge intensity in cubic metre per second per metre width and f is silt factor.

To obtain maximum depth of scour for design of foundations, protection works and training works, the calculated scour shall be increased as indicated below:-

Nature of the river	Depth of scour
In a straight reach	1.25D
At the moderate bend conditions e.g. along apron of guide bund	1.5D
At a severe bend	1.75D
At a right angle bend or at nose of piers	2.0D
In severe swirls e.g. against mole head of a guide bund	2.5 to 2.75D

7.3.8 AFFLUX (H)

For streams with non-erodible beds, the afflux may be worked out by Molesworth formula given below:-

$$h = [V^2/ 17.88 + 0.01524] \times [(A/a)^2 - 1]$$

Where,
h = Afflux in m
V = Velocity in un-obstructed stream in m per second.
A = Un-obstructed sectional area of the river in square metres.
a = Sectional area of the river at obstruction in square metres.

7.3.9 CLEARANCE

The minimum clearance for bridges excluding arch bridges, siphons, pipe culverts and box culverts from the water level of design discharge (Q) including afflux shall be in accordance with Table below :

Discharge (in cumecs)	Vertical clearance (mm)
0 – 30	600
31 – 300	600-1200 (Pro-rata)
301 – 3000	1500
Above 3000	1800

When rebuilding bridges on existing lines or building new bridges on these or new lines, with the personal approval of Chief Engineer/Chief Bridge Engineer, the clearance can be relaxed to the limits shown below:

Discharge (in cumecs)	Vertical clearance (mm)
Less than 3	300
3– 30	300-400 (Pro- rata)
31 – 3000	400-1200 (Pro-rata)
301 – 3000	1500
Above 3000	1800

7.3.10 FREE BOARD (F)

The free-board from the water level of the design discharge (Q) to the formation level of the Railway embankment or the top of guide bund shall not be less than 1m. In cases where heavy wave action is expected, the freeboard shall be increased suitably. In special circumstances, where the freeboard can be safely reduced and where adoption of the prescribed values would result in heavy expenditure and/or serious difficulties in construction,

the free-board may be relaxed at the discretion of the Chief Engineer/Chief Bridge Engineer as indicated below :-

Discharge (in cumecs)	Vertical clearance (mm)
Less than 3	600
3 – 30	750
More than 30	No relaxation

7.5 SUPERSTRUCTURE

Various types of superstructure – Steel (Solid web and open web), RCC (Slab type, T type), PSC (Slab, I-Girder, Box, Segmental construction) and composite (Steel and concrete) may be chosen. Post tensioned precast segmental box girder construction is not permitted for this work.

7.5.1 STEEL SUPERSTRUCTURE

Steel superstructure of bridges shall be capable of carrying through LWR/CWR. Forces due to continuation of LWR/CWR shall be as per provisions of UIC 774 - 3R Oct' 2001 edition with latest modification (if any) read along with the amendment slip No. 45 dated 27/9/2013 to IR Bridge Rules.

7.5.2 SPACING AND DEPTH OF GIRDERS

For steel superstructures, spacing and depth of girders will be as per provisions of Steel Bridge Code. For road bridges and special cases of railway bridges the limits mentioned in the Steel Bridge Code may be exceeded with the approval of IE.

7.5.3 MINIMUM SECTIONS

Minimum sections of steel components shall be provided as per Steel Bridge Code.

7.5.4 CAMBER

Camber is to be provided as per provision of Steel Bridge Code.

7.5.4.1 Steel channel/H-Beam sleepers will be provided on steel superstructure.

7.5.5 CONCRETE SUPERSTRUCTURE

Concrete wearing course of same grade as of deck slab with minimum thickness of 40 mm and cross slope of 1 in 40 shall be used on the deck of all the ballasted bridges. For pre-stressed girders, no external strands shall be allowed for permanent pre-stress. The provision for imparting 15% design prestress at a future date shall be made in the pre-stressed girders and suitable anchorages, bulk heads, diaphragm etc. shall be constructed for this purpose.

7.5.6 SPAN/DEPTH RATIOS

Span-to-depth ratio should as far as possible be restricted as indicated below:

Reinforced concrete member	- 10
Pre-stressed concrete member	- 14
Composite members	- 16

For Box girders, these ratios shall be further subject to stipulations with regard to internal dimensions required for inspection and future pre-stressing. For road bridges and special cases of rail bridges, these limits may be exceeded with the approval of IE.

7.5.7 DESIGN SURFACE CRACK WIDTH

For the serviceability limit state of cracking, design surface crack width of reinforced concrete and pre-stressed concrete structures shall not exceed values given in IRS Concrete Bridge Code.

7.5.8 TEMPERATURE EFFECTS

Temperature effects shall be taken into account in accordance with the requirements of IRS CBC, where applicable.

7.5.9 MINIMUM THICKNESS OF MEMBERS

Desirable minimum thickness of any concrete member

Deck	- 200 mm
Web of T-beam	- 250 mm
Web of pre-stressed girders	- 150 mm + d
If there are 2 cables at any level	- 150 mm + 3d

(Where d is the outside diameter of the cable duct)

Box Girders	**Minimum thickness of member**
Deck slab	200 mm
Bottom flange	300 mm
Web	250 mm

Or as required by IRS Concrete Bridge Code, whichever is greater.

7.5.10 ABUTMENTS/WING WALLS/REINFORCED SOIL WALLS

All bridge abutment to be designed to carry the applicable combination of loads. Bridge abutments are to be designed with appropriated drainage system which should be adequate to drain off the expected run off without

dripping along the bridge structure. Pier/Abutment cap shall have sufficient plan area so as to accommodate the inspection/access ladders & OHE mast pedestals.

To protect the adjoining slope of earthwork, wing wall/ return wall is to be provided. The wing walls are to be designed for long term deformations considering creep strains. Maximum deflection after such consideration shall be confined to L/250, where L is height of the wall.

Reinforced soil walls/slopes and other earth retaining structures may be used in RUBs as well as RFOs, but shall not be designed as an alternative to the abutments or the wing walls.

7.5.11 APPROACH SLABS & BACKFILL ARRANGEMENT

In order to reduce impact effect and to obtain improved running, properly designed approach slabs may be provided on both the approaches of non-ballasted deck bridges having spans of 12.2 m or more. One end of the approach slab may be supported on the abutment and other end on the formation. Length of the approach slab and backfill arrangement behind the abutment shall be as per RDSO report no. GE-R-50.

7.5.12 BEARINGS

Bearings shall be designed in accordance with the requirements of UIC 772/BS: 5400/BS EN 1337/IRC 83.

7.5.13 STRAY CURRENT CORROSION CONTROL

The continuous electrical path shall be provided by ensuring full and reliable electrical connection throughout the structure. The electrically continuous path shall be provided through the steel reinforcement, either by continuous welding of structural reinforcement or by the provision of additional welded mesh reinforcement.

The continuity of current between 30 m isolated spans shall be ensured by copper connectors.

The Concessionaire shall demonstrate during construction that the electrical continuity between all metallic structures has been achieved.

7.5.14 SAMPLING, STRENGTH TESTS AND ACCEPTANCE CRITERIA

Frequency of sampling & Sampling Procedure, Test Specimen, Test Strength of Sample, Standard Deviation, Acceptance Criteria and Quantity of Concrete Represented by Strength Test Results will be as per clause 8.7 of Concrete Bridge Code.

7.5.15 LOAD TEST OF STRUCTURES OR PARTS OF STRUCTURES

This will be governed by the provisions of concrete bridge code. For acceptance of piles, vertical and lateral load, testing of piles as required will

be carried out as per procedure laid down in IS : 2911 (Pt-IV)- Code of Practice for Design and Construction of Pile Foundation - Load test on piles.

7.5.16 RUB/LHS

Construction of ROB in lieu of level crossings within Gomoh-Dankuni section is not included in the scope of concessionaire. However, RUB/LHS in lieu of level crossings will continue to be within the scope of concessionaire. RUB will be governed by relevant IRC codes/MOSRT&H.

Relevant provisions of Railway Board letter no. 97/CE-I/BRO/158(Policy) Pt.II, Dtd. 31.07.2009 for "Safety measures to be observed during execution of RUB works" and of Railway Board letter no. 2006/CE-I/AC-1(pt.), dtd 27.10.2009 for "Safety precautions and measures of RUB works" are to be followed.

For locations having restriction of headway, limited height subway with vertical clearance, as agreed between Railway and Road Authorities, will be provided.

Work of RUB/LHS will include provision of adequate approach roads including connections to both approaches after suitable profiling, drainage facilities and road diversions etc.

7.6 SEQUENCE AND METHODOLOGY OF CONSTRUCTION

The sequence of construction will depend upon land acquisition from various authorities and contractor's work schedule.

7.6.1 EARTHWORKS

This section deals with the Selection of Materials for Earthwork, Execution of Earthwork in excavation and formation, Quality Control of the Earth work, Maintenance of Records and Quality Assurance. In principle the earth work shall be carried out as per the provisions of "Guidelines and Specifications for Design of Formation for Heavy Axle Load, Report No. RDSO / 2007 / GE: 0014 – November 2009) and "Guidelines for Earthwork in Railway Projects, Guideline No. GE: G-1 – July 2003 (with latest amendments)" issued by RDSO/ Luck now except for specific provisions made herein in these Specifications.

7.6.1.1 Survey and Establishment of Working Benchmarks and Alignment References

The concessionaire will make necessary arrangements for:

- Validation of the data provided by the Employer and additional survey if considered necessary for design of the Alignment;
- Setting Out Survey for setting out of the center-line of the Alignment and

- ❖ Taking cross sections as necessary (and as consented by the Engineer) along the entire Alignment, bridges & its approaches and other structures and facilities included within the Scope of work.

7.6.1.2 Soil Investigation

In order to ensure proper bonding of earthwork and soil compatibility behavior of old and new earthwork (particularly for the portion of the alignment near to the existing lines of Indian Railways), samples of soils from mid-slope of existing bank at about 1 m depth and 500m length or closer intervals should be collected and tested for particle size, natural moisture content, natural dry density and consistency limits.

7.6.1.3 Borrow Areas

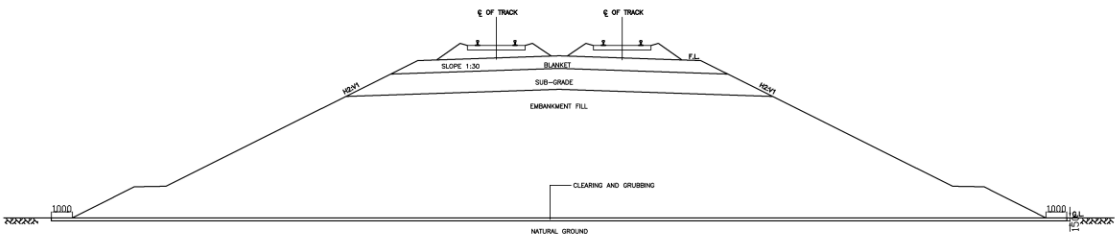
Contractor should arrange the land for Borrow Area required for carrying out the work in such a manner that borrow pits (to be excavated with in the borrow areas) are sufficiently away from the toe of the embankments to prevent slope/base failures due to lateral escapement of soil. The borrow areas / pits shall not be within the DFCC / IR land. The borrow pits shall be at least at a distance equal to height of the embankment from the Right of Way.

Exploratory boring with hand / auger samplers and soil sampling should be undertaken from the proposed borrow areas, Geotechnical Investigation of these samples are required therein.

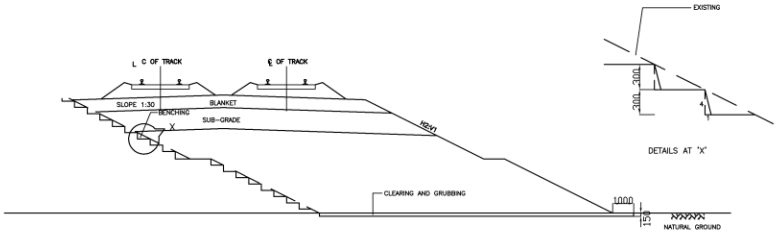
7.6.1.4 Clearing and Grubbing and Stripping

The clearing and grubbing shall consist of cutting, removing, disposing and clearing the designated areas of all the obstructions like trees having girth 300mm or less, bushes, shrubs, roots, grass, weeds, snags, vegetation, loose and deleterious / organic material, pavement materials & signages / markers (if any), top organic soil not exceeding 150 mm in thickness, rubbish and objectionable material etc., which in the opinion of the Engineer are unsuitable for incorporation in the works and shall include grubbing stumps and roots and disposing of all material resulting from the clearing and / or grubbing from the Right of Way containing embankment, drains, structures etc. and such other areas as may be specified by the Engineer.

X–SECTION OF EARTHWORK PREPARATION (CLEARING AND GRUBBING)



X–SECTION OF EARTHWORK PREPARATION (BENCHING ON THE SLOPE)



7.6.1.5 Earthwork in Excavation

a. Excavation of all materials for formation work in cutting, ditches, berm ditches, drains and flumes.
b. The removal and disposal of existing surfacing, footpaths, curbs or curbs and gutters (if any) within the limits of construction.
c. The demolition, removal and disposal of all existing foundations, foundation walls (concrete / masonry), basement, masonry, and pipe culverts etc. within the limits of construction and otherwise provided for in the Contract.
d. Excavation for removal of slides, breakages and cave-ins.
e. Excavation required for formation in cuts and / or under embankments below the lowest normal limit of excavation indicated on the Drawings or below ground line, for the removal of unsuitable material, and below the ground line under embankments where benching is required, or as otherwise directed.
f. Prevention of erosion of exposed surfaces and water pollution.

7.6.1.6 Earthwork in Embankment

This work shall consist of the construction of embankment by furnishing, placing, compacting and shaping suitable material of acceptable quality obtained from consented sources in accordance with these Specifications, and to the lines, levels, grades, dimensions, and cross-sections shown on the Drawings and as required by the Engineer.

In principle the embankment shall be constructed as per the provisions of “Guidelines and Specifications for Design of Formation for Heavy Axle Load, Report No. RDSO / 2007 / GE: 0014 – November 2009) and “Guidelines for

Earthwork in Railway Projects, Guideline No. GE: G-1 – July 2003 (with latest amendments)" issued by RDSO/ Lucknow except for specific provisions made herein in these Specifications.

Blanket Layer

To avoid failure of track formation due to inadequate bearing capacity and to safeguard against swelling and shrinking, a blanket layer having adequate thickness and constructed with suitable materials should be provided.

For this purpose, blanket system consisting of two layers shall be used. Two layer system shall consist of blanket as top layer and under laid by prepared sub grade on embankment. Properties, specifications and thickness of each layer of blanket and that of prepared sub-grade shall be as detailed below:

a. The blanket material should be coarse granular, hard and well graded.

b. Two layer system consisting of blanket as top layer and under laid by prepared sub grade on embankment fill shall be as per the specifications given below:

A. Blanket Layer: Well graded Sand Gravel layer

a) Cu>7 and Cc between 1 and 3

b) Fines (passing 75 micron): 3% to 10%

c) Los Angeles Abrasion Value < 35 %

d) Minimum required Soaked CBR value 25 of the Blanket material compacted at 100 % of MDD

e) Size gradation:

I. Particles size grading percentages shall be within the range as specified below:

Sl. No.	**IS Sieve Size**	**Percent Passing** (by weight)
1	40 mm	100
2	20 mm	80 – 100
3	10 mm	63 – 85
4	4.75 mm	42 – 68
5	2 mm	27 – 52
6	600 micron	13 – 35
7	425 micron	10 – 32
8	212 micron	6 – 22
9	75 micron	3 - 10

II. Particle size gradation curve shall be within the Enveloping Curves of blanket material as shown in Figure 9 of "Guidelines and Specifications for Design of Formation for Heavy Axle Load" Report No. RDSO / 2007 / GE : 0014, published by RDSO.

f) Filter criteria should be satisfied with sub-grade layer, as given below

- ❖ Criteria – 1: D15 (blanket) < 5 x D85 (subgrade)
- ❖ Criteria – 2: D15 (blanket) > 4 to 5 x D15 (sub-grade)
- ❖ Criteria – 3: D50 (blanket) < 25 x D50 (sub-grade)

g) Minimum EV2 (determined from 2nd Step Plate Load Test on top of compacted blanket layer, Ref German Code: DIN 18134 – 2001) = 120 MPa as in-situ assurance test.

h) Its thickness shall be :

450mm, in case of soil below blanket is of SQ3 quality i.e. soil containing fines (size less than 75 micron) < 12% and compacted at 100% of MDD

OR

600mm, in case of soil below blanket is of SQ2 quality i.e. soil containing fines (size less than 75 micron) from 12% to 50% and compacted up to 100% MDD.

B. Layer 1 : Prepared Sub-grade

a) Using soil of SQ2 quality i.e. soil containing fines (size less than 75 micron) from 12% to 50% / SQ3 quality i.e soil containing fines (size less than 75 micron) < 12%,

b) Plasticity Index < = 12,

c) CBR > = 8 (but not < 7 in isolated cases)

d) Compaction at 98% of MDD.

e) Minimum EV2 = 60 MPa

f) Its thickness shall be 1000mm.

7.6.1.7 Tolerances and Acceptance Criteria

A. Soil Formation should meet the following requirements

(i) The cross fall slope to be at least 1:30 or 3% with tolerance of 0.5%

(ii) The finished top levels of soil formation should be within + 30 mm

(iii) The finished top of blanket layer shall be permitted to have variation from design level by + 25mm.

(iv) The ballast should be placed only on level formation without ruts or low pockets

B. For Compacted earth and Blanket Layer:

(i) Coarse grained soils which contains fines passing 75 micron IS Sieve, upto 5%, should have the Density Index (Relative Density) a minimum of 70% as obtained in accordance with IS: 2720 – 1983 (Part 14).

(ii) For other soils, field dry density should not be less than maximum attainable dry density obtained in field compaction trial. However in field compaction trial, the maximum attainable dry density should not be less than 98% of MDD values for prepared sub-grade, 97% of MDD value for Embankment fill and 100% of MDD value for Blanket Layer, as obtained by Heavy Compaction Test (IS: 2720 Part 8 – 1983) in the laboratory.

(iii) Formation width should not be less than the specified width.

(iv) Side Slopes should in no case be steeper than designed side slopes. Provision of Berm Width should not be less than the designed width.

(v) All the material should conform to the specified requirements.

7.6.2 BRIDGES

7.6.2.1 Alignment for Bridges:

In order to facilitate the setting out of the work, the centre line of the bridges must be accurately established by the Contractor and shall be consented by the Engineer.

7.6.2.2 Survey Tower:

For carrying out accurate survey work for major river crossings, survey tower shall be built one on each bank and one inside the river where required and possible. The tower shall be built in duplicate, securely founded and braced, the inner tower shall support instrument only and outer one shall support the observer. The two towers should be entirely independent of each other. The height of the tower shall not be less than the pier height. The Concessionaire shall be solely responsible for planning and erection of suitable types of towers, which should be maintained throughout the construction period.

7.6.2.3 Open Foundations

i) Where the bearing surface is earth, a layer of M-15 concrete shall be provided below foundation concrete. Thickness of lean concrete shall be 100mm minimum, unless otherwise specified.

ii) Before laying lean concrete layer, the earth surface shall be cleaned of all loose materials. No construction joint shall be provided in lean concrete.

iii) For foundation concrete work, side formwork shall be used. Form work for top of foundation shall also be provided, if top has slopes steeper than 1(vertical) to 3(horizontal). Where concrete is laid in slope without top form

work, the slump of the concrete shall be carefully maintained to ensure that compaction is possible without slippage down of freshly placed concrete.

iv) Foundation concrete of required dimensions and shape shall be laid continuously up to the location of construction joint shown on the drawings. Dewatering, where necessary for laying the concrete shall be carried out adopting the method duly consented by the Engineer.

v) Form work shall be removed not earlier than 24 hours after placing of concrete. Where form work has been provided for top surface, the same shall be removed as soon as concrete has hardened.

vi) Before backfilling is commenced, loose sand on foundation shall be removed & disposed. Protective works where provided shall be completed before the floods so that the foundation does not undermined

7.6.2.4Sub-Structure

7.6.2.4.1 Piers and Abutments:

(i) In case of concrete piers, the number of horizontal construction joints shall be kept minimum. Construction joints shall be avoided in splash zones unless specifically consented by the Engineer and provided they are treated in accordance with special provisions. No vertical joint shall be provided.

(ii) In case of tall piers and abutments, use of slip-form shall be preferred. The design, erection and rising of slip-form shall be subject to special specifications which shall be furnished by the Contractor. The concrete shall also be subject to additional specifications as necessary. All specifications and arrangement shall be subject to consent of the Engineer.

(iii) In case of abutments likely to experience considerable movement on account of backfill of approaches and settlement of foundations, the construction of abutment shall be followed by filling up of embankment in layers to the full height to allow for the anticipated movement during construction period before casting of super-structure.

(iv) Where pier type abutments are provided without wing walls and return walls, the earth fill around the abutment shall be protected by providing properly designed stone pitching on slopes and apron at toe of the fill.

(v) Stone pitching on the slopes of the embankment on approaches of the bridge shall be as per the Specifications contained herein.

7.6.2.4.2 Pier Cap and Abutment Cap:

Surface of the cap shall have slope for draining of water. For short span slab bridges with continuous support on pier caps, the surface shall be cast horizontal. The top surface of the pedestal on which bearings are placed shall also be cast horizontal. The surface on which elastomeric bearings are to be placed shall be wood float finish to a level plane which shall not vary more than 1.5mm from straight edge placed in any direction across the area. The surface on which other bearings are to be placed shall be cast about 25mm below the bottom level of bearings and as indicated in drawings.

7.6.2.4.3 Pedestal below Bearing

The pedestal should be so proportioned that a clear offset of 150mm beyond edges of bearings is available.

The two layers of mesh reinforcement – one at 20mm from top and the other 100mm from top of the pedestal or pier cap, each consisting of 8mm bars at 100mm in both directions shall be provided directly under bearings.

For other details, clause 710.10 of IRC: 78 – 2000 may be referred.

7.6.2.4.4 Ballast Wall, Return Wall, Retaining Wall and Wing Wall :

In case of cantilever return walls, no construction joint shall generally be permitted. Wherever feasible, the concreting in cantilever return wall / retaining wall shall be carried out in continuation of ballast wall. For gravity type return / retaining and wing walls, no horizontal construction joint shall be provided. Vertical expansion gap of 20mm shall be provided in return wall / wing wall / retaining wall at every 10 meter intervals or as consented by the Engineer.

7.6.2.4.5 Joints:

Butt joints should be provided between wing walls and abutment, wing wall and return walls and for various tracks when the bridge is for more than one track to cater for differential settlement in case of poor soil.

7.6.2.4.6 Weep Holes:

(i) Weep holes shall be provided through abutments, wing or return walls / Retaining wall and parapets. Weep holes shall be provided with 100mm dia pipe for structures in plain / reinforced concrete. Weep holes in the ballast wall shall be provided with 75mm dia pipes. Weep holes shall extend through full width of the concrete with slope 1 vertical : 20 horizontal towards draining face. Spacing of the weep holes shall generally be 1m in either direction in a staggered manner with the lowest at about 150mm above the low water level or ground level whichever is higher.

(ii) For abutment of canal crossing, culverts, weep holes may be provided only above full supply level. To drain away the water from the backfill of the abutment, wing or return walls, open jointed pipes or boulder drains may be provided at suitable levels.

7.6.2.4.7 Backfill Material and Approach Slab:

A. Backfill Behind Abutment, Wing Walls, Retaining Wall and Return Walls

Behind abutments, wing walls and return walls / Retaining wall, boulder filling and backfill material shall be provided as per clause 7.5 of 'Code of Practice for the Design of Sub-structures and Foundations of Bridges. Boulder filling shall consist of well hand packed boulders & cobbles to thickness not less than 600mm with smaller size towards the back. Behind the boulder filling, backfill material shall consist of granular materials of GW, GP, SW groups as per IS: 1498-1970.

B. Approach Slabs

In order to reduce impact effect and to obtain improved running, properly designed approach slab may be provided on both the approaches of non-ballasted deck bridges having spans 12.2m and more. One end of the approach slab may be supported on the abutment and other end on formation. Length of the approach slab shall be minimum 4 meters.

7.6.2.5 Superstructure

7.6.2.5.1 Reinforced Concrete Construction:

(1) **Solid Slabs:**

a. Where adjacent span of slab has already been cast, then expansion joint and filler board shall be placed abutting the already cast span and shall form the shutter on that side of the new span to be cast. The whole of the slab shall be cast with reinforcement embedded for the kerb and railing (wherever required). No other construction joint shall be allowed.

b. Where wearing coat is required to be provided, after the deck slab has been cast, the surface of the slab shall be finished rough but true to the lines and levels as shown on the drawings.

c. Where the slab is resting on bearings, the same shall be placed in position before casting of deck slab

(2) **RCC T-beam and Slab:**

a. Provision of construction joint shall conform to the drawings or as consented by the Engineer. No construction joint shall be provided between bottom bulb and the web. If not indicated on the drawing, the construction joint may be provided at the junction of the web and the fillet between the web and the deck slab with the consent of the Engineer.

b. The portion of deck slab near expansion joints shall be cast along with reinforcements and embedment's for expansion joints. For this purpose, the portion of deck slab near expansion joints may be cast in subsequent stages if consent by the Engineer. Surface finish of the deck slab shall be finished rough but true to lines and levels as shown on the drawings. Care shall be taken for setting of bearings as indicated on the drawings

7.6.2.5.2 Pre-stressed Concrete Construction

(1) **PSC Girder and Composite RCC Slab:**

PSC Girder may be precast or cast- in-situ as consented by the Engineer. Girders shall be cast in single pour and may be post-tensioned or pre-tensioned. Where precast construction is required to be adopted, selection of casting yard and details of methodology and of equipment for shifting and launching of girders shall be subject to consent of the Engineer. In case of cast- in-situ construction, the sequence of construction including side shifting of girders, if applicable, and placing on bearings shall be subject to the consent of the Engineer. The PSC girder constituting the top flange, web and the bottom flange shall be concreted in a single operation without any construction joint. The portions of deck slab near expansion joints shall be cast along with reinforcements and embedment's for expansion joints. For this purpose, the portion of deck slab near expansion joints may be cast in a subsequent stage, if consented by the Engineer.

(2) **Box Girder:**

Box girders may be simply supported or continuous. Simply supported box girders. It shall preferably be cast in single pour. However if unavoidable due to exceptional cases, the construction joint may be provided subject to consent of the Engineer. In the case of continuous box girders the sequence of construction and location of construction joints shall be subject to consent of the Engineer. The portions of deck slab near expansion joints shall be cast along with reinforcements and embedment's for expansion joints. For this purpose, the portion of deck slab near expansion joints may be cast in a subsequent stage, subject to consent of the Engineer.

(3) **Cantilever Construction:**

Continuity of un-tensioned reinforcement from one segment to the next must be ensured by providing full lap length as necessary. The design of the superstructure shall take into account the following aspects:

a. Stability against over-turning for each statical condition through which the assembly passes, shall be checked.
b. Stresses at each preceding segment joint with the addition of every segment or change of statical conditions shall be checked. The load of equipment as well as construction live load shall be taken into account.
c. Pre-cambering of the superstructure during construction shall be done in such a manner that the finally constructed structure under permanent load attains the final profile intended in the drawings.

(4) Other Requirements

a. During concreting, care shall be taken to ensure that sheathing is not damaged and clogged. It shall be ensured that the cable move freely inside the sheath before, during and after concreting.

b. HTS strands should be moved in both directions during the concreting operations. This can easily be done by light hammering the ends of the wires / strands during concreting. It is also advisable that 3 to 4 hours after concreting, the cable should be moved both ways through a distance of about 20 cms. With such movement, any leakage of the mortar which has taken place in spite of all precautions, loses bond with the cables, thus reducing the chance of blockage. This operation can also be done by fixing pre-stressing jacks at one end, pulling the entire cable and then repeating the operation by fixing the jack at the other end. Compressed air should also be pumped to clear leaked mortar. However the methodology of moving the cable during and after concreting shall be subject to consent of the Engineer.

c. All precast slabs / parapet blocks used in gang paths etc. are to be table vibrated

d. Permeability testing shall be as per Clause 9.4 of these Specifications.

e. Additional testing (in addition to the testing as specified herein), if considered necessary by the Engineer, shall also be carried out by the Contractor at no extra cost to the Employer

7.6.2.6 Drainage Outlets

The drainage outlets shall be in conformity to the requirements and code of practice. The spacing of the drainage outlets shall be as per approved drawing or as directed by the Engineer. The down spouts shall be adequately fixed to the deck and shall be of rigid corrosion resistant materials not less than 100 mm dia in the least dimension and shall be provided with suitable clean out fixtures. These outlets shall be so provided that the discharge of the rain water drained by them is not directed towards any part of the super-structure or substructure component.

7.6.2.7 Installation of Bearings

(1) Care shall be taken during installation of the bearings to permit their correct functioning in accordance with the design scheme. It will be desirable that the representatives of the manufacturer be present at the time of installation of bearings at least for first few girders. The suppliers of the bearings shall dispatch the bearings in its true shape / position from the workshop with the top & bottom plates suitably clamped. Dismantling of the bearings at site shall not be permitted under normal circumstances.

(2) The load shall be transferred on to the bearing only when the bedding materials has developed sufficient strength.

(3) In case of cast in situ construction, the bearings shall be carefully protected during concreting operations. Any mortar contaminating the bearings shall be completely removed before it sets.

(4) Details of seating of the bearings shall be strictly as per the manufacturer's recommendations.

7.6.2.8 Painting on Bridges

(1) Permanent markers like Bridge number, Direction of flow, Bridge Plaques, Bridge Boards, Flood Gauges, HFL, Danger level etc. shall be provided as per Indian Railway Standards by the Contractor. Contract cost shall be deemed to have included the cost of all these items.

(2) The date of painting of superstructure should be painted in white on the outside of the left girder of the first span. In the case of important bridges, the left girder at each end should bear the date of painting

(3) The highest flood level line should be painted distinctly by a 25mm broad white line along with the year of its occurrence, in figures 100mm deep as follows :

a) For bridges upto 60 metres in length, on the downstream side of one abutment.

b) For bridges over 60 metres in length, on each of the abutments on the downstream side or on the downstream side of the piers of the end spans.

c) For buried type abutments, on the piers near the end spans.

(4) At all the bridges, flood level gauges should be provided on abutments or on piers of the end spans. The marking should be in metres divided into ten parts commencing from the underside of the girders towards the bed. The marking and the figures should be painted in black on white background. Where necessary, piers and abutments may be plastered with cement mortar 400 mm wide for providing the gauges. The HFL mark in white paint should be made by the side of the gauge.

(5) The direction of flow should be distinctly marked in white on both the abutments or adjacent piers.

(6) Plaques showing particulars of foundations should be fixed over every abutment and pier in accordance with instructions contained in Annexure 11/7 of Indian Railways Bridge Manual -1998.

(7) Name boards at all the bridges should be fixed at either approach at a distance of about 15 meters from the abutment indicating the name of the river and the number and length of spans.

(8) Plaques containing Bridge numbers and indicating direction of flow should be provided on parapet wall as detailed in Annexure 2/1 of Indian Railways Bridge Manual -1998.

(9) At all canal crossing, the full supply level should be marked distinctly in the same way as the HFL line for other bridges.

(10) Danger level should be distinctly marked in red

7.6.2.9 Tolerances

Tolerances for the finished concrete bridge structures shall be as specified in Table 9.11 below

TOLERANCES FOR FINISHED CONCRETE BRIDGE STRUCTURES

SL. NO.	DESCRIPTION	TOLERANCES
1	Shift from Alignment	+ 25 mm
2	Deviation from plumb or specified batter for face of exposed piers	1 in 250, subjected to a miximum value of 0.5 times the least lateral dimension of pier
3	Deviation from plumb or specified batter for face of back filled abutments	1 in 125
4	Cross Sectional dimensions of piers, abutments and girders.	- 5 mm + 20 mm
5	Thickness of deck slab of bridges	+ 6 mm - 3 mm
6	Size and location of openings	+ 12 mm
7	Plan dimensions of footings (formed)	+ 50 mm - 25 mm
8	Plan dimensions of footings (unformed excavation)	+ 75 mm - 00 mm

7.6.3 ARCHITECTURAL AND BUILDING WORK

The general requirements for the Building Works shall be but not limited to the following ;

1) Building layout plan and detailed design with adequate ventilation.
2) All station buildings shall have covered varanda in the front.
3) Site clearance & leveling shall be as per requirement.
4) Excavation (in soil / soft rock / hard rock) for foundations, pipes, drains, cables and backfilling and disposal of surplus earth shall be carried out as per requirement.
5) Filling in plinth and under floors shall be provided as per requirement.

6) Anti termite treatment (pre-construction) shall be provided as per requirement.

7) Foundation work including Damp Proof Course (at Plinth) shall consist of cement concrete of specified proportions and thickness (Cement Concrete 1:2:4 and thickness 50mm). Damp proof course shall be cured for at least seven days.

8) All masonry work shall be with cement-sand mortar. The grade for mortar in brick work masonry shall be as per Clause 3.2 to 3.2.1.1 of CPWD specifications – 2009, published by Director General of Works, Central Public Works Department, Govt. of India.

   Brick work in half brick wall shall be done in cement mortar 1:4 (1 cement: 4 coarse sand) Brick work in HALF bricks shall be reinforced with 2 Nos. Mild Steel bars of 6 mm dia., shall be embedded in every third coarse. The mortar interposed between the reinforcing bars and the brick shall not be less than 5 mm.

9) Reinforced cement concrete shall be of design mix as required.

10) Doors, windows & ventilators frames shall be of approved quality.

11) All doors shall have flush door shutters.

12) All the windows shall have pelmets with curtain rods or vanishing blinds / strips, as required and all the doors shall have curtain rods with pelmets.

13) All the external doors, windows & ventilators shall have wire gauge shutters and shall also be provided with RCC sun-shade.

14) Wood work in contact with masonry shall have preservative / anti termite treatment.

15) All windows and ventilators shall have glass pan shutters and MS safety grill of approved design.

16) Windows shall be designed such that the air-conditioners and / or desert coolers can be fixed.

17) All steel works shall be painted with synthetic enamel paint.

18) All the residential buildings shall be provided with fixed type storage cupboards as required.

19) All the office buildings shall be provided with partitions as / if required.

20) All wood work shall be painted with synthetic enamel paint or sprit polished as required and approved.

21) Roofing, basements / underground structures (if required) shall have appropriate water proofing treatment.

22) All the RCC Roofs shall be accessible through lockable staircase and shall have parapet wall of height not less than 1 meter.

23) All the staircases shall be as per the requirements of National Building Code and shall be of Mild Steel with PVC handrail.

24) Landscaping shall be provided as per requirement.

25) Washrooms / toilets shall be provided with
    (i) white vitrified ceramic sanitary fittings
    (ii) looking glass of standard size
    (iii) exhaust fans
    (iv) all other fittings and fixtures as required

26) All the kitchens / pantry rooms shall be provided with kitchen shelves with top, fixed type storage cupboards and exhaust fans

27) Kitchen sinks in residential buildings / pantry rooms shall be of stainless steel with drain board and size not less than 460x915mm with bowl depth 178mm.

28) Storage Geysers (wherever required) shall be of capacity not less than 15 liters.

29) Ceiling fans shall be of size not less than 1200mm.

30) Fire detection & alarm system including fire points shall be provided as per requirement.

31) All the individual residential quarters shall be provided with
   (i) Independent overhead water storage tank of capacity as specified in Attachment 12.1 and of approved type & quality. Overhead water storage tanks shall be kept at the roof top.
   (ii) Water supply lines directly from the source as well as from overhead water storage tank.

32) Any other requirements as considered necessary by the Engineer from safety and operational considerations.

33) The work shall be carried out as per the Design Criteria specified in Employer's Requirements – Design, Volume II of the Bid Documents and Specifications as detailed herein and as per CPWD Specifications – 2009 as published by Director General of Works, Central Public Works Department, Govt. of India.

7.6.4 CONSTRUCTION, METHODS AND PROCEDURES FOR TRACK WORK

Mechanized method of track laying shall be used. This will involve "Laying or re-laying of rail panels of 250 / 260 meters or more welded by mobile / stationary / flash butt welding plant under control conditions in depots. Track linking to be done by use of rail threader, track laying machines and use of tamping machines, dynamic track stabilizers and shoulder ballast compactors for making track fit for traffic movement.

The mechanized track laying shall include welding, de-stressing and fastening, laying of concrete sleepers, ballasting including tamping & compaction (suitable for operation of 25 tonne axle load at the maximum permissible speed of 100 KMPH for the main lines and connecting lines and 50KMPH for the lines other than main lines & connecting lines), track boards & signage's etc.

Bottom ballast will be placed initially and accurately levelled. Concrete sleepers will be lifted by frames and set to the required spacing on the ballast to the correct alignment.

Concessionaire shall transport 250 / 260 meter long rails from welding depot to laying site by special rakes / track relaying train. Use of Thermit welding will be restricted to special locations in exceptional cases and with the prior consent of the Engineer and approval of the Employer.

De-stressing will be carried out within the appropriate neutral temperature range for each section as per the provision of LWR Manual of Indian Railways.

Track boards & signages shall include but not limited to kilometer posts, hectometer posts, gradient posts, curve posts, transition curve posts, fouling marks, bridge no. plaques, inscription plaques on bridges, station name boards, whistle boards, jurisdiction boards etc.

7.6.4.1 Track Laying Tolerances

The following tolerances in track geometry shall be permissible in floating condition measured three months after the restoring the speed to normal i.e. 100 km/hr.

Table 13.6: Dimensional Tolerances in Track Laying

Sl. No.	Description	Value
1	Maximum difference of any point in relation to the designed layout	a) Vertical : +/-10 mm b) Horizontal : +/-10mm
2	Gauge (with reference to 1676 mm)	a) Maximum variation over the prescribed track gauge : +3mm to 0mm b) Maximum variation in track gauge from sleeper to sleeper : 2mm c) Average track gauge (mean over 100 m length): +1.8mm to 0mm
3	Misalignment :	+/-5mm
4	Vertical Un-evenness (left & right hand rails)	+2mm to (-)1 mm
5	Maximum deviation of measured versine over its designed value on a 20 m chord (half overlapping)	+/-5mm
6	Cant/Cross Level (to be measured at every 4th sleeper)	a) Straight track and curved track: +/- 3mm b) Sleeper to sleeper variation of cant/x-level : +/- 1mm
7	Twist (maximum value on base of 3 m)	a) Straight and circular portion of curve = +/- 1mm/m b) On transition portion of curve (over designed value) = +0.5mm/m
8	Turnouts	a) Stock rail joint (longitudinal location) : +/-15 mm b) Nose to nose of Xing in crossovers : +/- 10mm c) Flangeway clearance at the end of the switch planning : +5mm to (-) 0mm d) Switch toe opening : +1mm to (-) 0mm e) Switch toe squareness : 5 mm f) Deviation of measured versine over its designed value for switches, lead track and

7.8 CONSTRUCTION SITES AND THEIR PLANNING- MANAGEMENT AND STORAGE OF CONSTRUCTION MATERIAL:-

Locations for the casting yard have been identified based on following points:

- Proximity to the site.
- Space available for the casting yard.
- Transportation of segments from casting yard to the construction site.

During construction period, huge quantities of construction materials like rails, sleepers, Points and crossing, reinforcing bars, cement, steel sections, shutters, pre-cast segments etc. are to be stored. Sufficient land is required for storage of these materials.

- Railway vacant sites are identified along the corridor which can be utilized for temporary storage of construction materials.

- ❖ Extra land acquired for the construction of Station building shall be utilized for storage of construction materials.
- ❖ The proposed construction depot sites are given as follows:

7.9 ROAD TRAFFIC DIVERSION PLANNING:

Construction of ROB in lieu of level crossings within Gomoh-Dankuni section is not included in the scope of concessionaire. However, RUB/LHS in lieu of level crossings will continue to be within the scope of concessionaire. RUB will be governed by relevant IRC codes/MOSRT&H.

Relevant provisions of Railway Board letter no. 97/CE-I/BRO/158(Policy) Pt. II, dt. 31.07.2009 for "Safety measures to be observed during execution of RUB works" and of Railway Board letter no. 2006/CE-I/AC-1(pt.), dt. 27.10.2009 for "Safety precautions and measures of RUB works" are to be followed.

For locations having restriction of headway, limited height subway with vertical clearance, as agreed between Railway and Road Authorities, will be provided. Work of RUB/LHS will include provision of adequate approach roads including connections to both approaches after suitable profiling, drainage facilities and road diversions etc.

7.9.1 Objectives

7.9.1.1 To minimize disruption to the movement of traffic on roads adjacent to the proposed Corridor, especially near the station areas.

7.9.1.2 To provide safer system of transportation at junction point of train and road services.

7.9.1.3 To provide for uninterrupted access to all stations.

8.0 SYSTEM DESIGN AND MAINTENANCE FACILITIES

8.1 DESIGN BASIS

(i) Track shall be laid down to Broad gauge of 1676 mm, the track gauge being the distance between the inner sides of the head of rails measured 14 mm below top of rails.

(ii) The track shall be designed to carry 25 MT loading 2008 on formation and 32 MT loading for bridges at speed of 100 kmph.

(iii) Vide Railway Board letter no. 2007/Infra/6/8 Pt. 3, Dtd. 28.10.2011, track structure consisting of 60 Kg rails, ERC Mk-V,

(iv) All the rails to be laid in the track structure shall be Flat Bottom Rails as per specifications: IRS T-12-2009. Only new rail will be used for permanent work. The broad requirements are as under:

a) Rail Steel Grade : 880

b) Rail Section Profile : As per Appendix-II of IRS T-12-2009 for UIC 60

c) Class of Rail : A

d) Rail Ends : Undrilled

e) Colour Code : As per Appendix IV of IRS T12-2009

(v) 10 mm thick composite Rubber pad: RDSO T-7010 has been approved for ballasted track.

8.2 RAIL SYSTEM PLANNING

S/N	DESCRIPTION	DFCC
1	Moving dimensions height	5.1 m
2	Width of container stack	3.660
3	Train length	1500 m
4	Train load	15000 T
5	Axle load	Track Structure fit for 25 Tonne axle load. Bridges and formation fit for 32.5 Tonne axle load (DFC Loading)
6	Track loading density	12 T/m
7	Maximum speed	100 KMPH

8	Grade	1 in 200
9	Curvature	Upto 2.5 Degree
10	Traction	Electrical (2x25 KV)
11	Station spacing	Approx. 40 Km
12	Signaling	Automatic with 2 Km spacing
13	Communication	Mobile train radio.

10.CAPITAL EXPENDITURE AND FINANCIAL ANALYSIS

10.1 COST ESTIMATES

10.1.1 ESTIMATION

Estimate is prepared as per the guideline given by corporate office of DFCCIL. Estimate has been divided in various heads such as Preliminary expenses, OHE, PSI, SCADA Work & General Electrical Works for easy analysis of costing. These heads have been further divided in to sub heads.

10.1.1.1 QUANTITY, RATES & RATE ANALYSIS:-

Quantities for various sub heads have been calculated in detail. The rates adopted while framing the estimates are based on unit rate is based on the rate of 2009 vetted estimate of 2x25Kv Vina-Katni Section. Revised rates for copper conductor and steel structure considered as per latest rates of CORE/ALD. Revised quantity for concrete and steel structure considered as per requirement design of OHE. Rate analysis has been prepared for each item of the estimate.

10.1.1.2 Preliminary Expenses:-

A. Arrangement of Traction Power Supply

B. Arrangement of General Power Supply

C. Construction of 220Kv/132Kv double Circut 3 a Transion Line

10.1.1.3 Modification/Shifting of Railway Installations:-

The total cost of Modification/Shifting of Railway Installations (TSS,SP,SSP,FP, Yard Modification, 11Kv Substation, OHE Mast, AT Mast, OHE Depot & Pump with Tank) The total cost comes out to be **Rs. 3092.50 Lacs.**

10.1.1.4 Modification of HT crossing above 33KV:-

Modification of OH Crossing (132Kv) – 1 Nos.

Modification of OH Crossing (220Kv) – 3 Nos.

Modification of OH Crossing (400Kv) – 3 Nos.

The total cost comes out to be **Rs. 14039.63 Lacs.**

10.2 OHE, PSI, and SCADA Work:-

10.2.1 Modification of EHT crossing upto 33Kv

Modification of OH Crossing (11/22Kv) – 74 Nos

Modification of OH Crossing (33Kv) – 31 Nos

The total estimated cost for this work has been worked out is Rs. 2592.11 Lack.

10.2.2 Over Head Equipment

a. In open Route

b. In Yard

c. Provision of PTFE neutral Section

d. Planning of Switching Station (05 nos. SP & 10 no. SSP) T & P for OHE Depots and T & P for PSI Depot

The total cost comes out to be **Rs. 31271.42 Lacs**

10.2.3. Traction Sub – Station

TSS 220/132Kv 2x25 Kv Double Transformer double line 5 nos.

The total cost comes out to be **Rs. 18913.33Lacs**

10.2.4 SCADA

a. SRC Equipment

b. Spares for SCADA (LS)

The total cost comes out to be **Rs. 180.5 Lacs**

10.3.3 General Electrical Works

10.3.3.1 Internal Electrification:-

(a) Electrification & Air Conditioning ofRCC
(b) Electrification of OHE/PSI depots (IMD)
(c) Electrification of TW Sheds
(d) Electrification of SP & SSPs
(e) Electrification of TSS control rooms and switch yard
(f) Electrification & Air conditioning of Relay rooms and battery room
(g) Electrification of Cable

Hut
(h) Electrification of Repeater Room
(i) Electrification of Station Building
(j) Electrification of Station Yard

The total cost comes out to be **Rs. 444.607 Lacs**

10.3.3.2 Electrification of Staff Quarter:-

(i) Type II
(ii) Type III
(iii) Type IV
(iv) Type V

The total cost comes out to be **Rs120.485 Lacs**

The Total cost including the

Project Management Charges @1%
Escalation from Feb. 2012 to sep 2013 @9%
Provision of Training@1% of total cost

Comes out to be (Except Preliminary expenses) = 59409.92Lacs

And (Including Preliminary expenses) = 74993.91Lacs.