GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS
(RAILWAY BOARD)

2025/Proj./PATNA-METRO/DBR/30/143 New Delhi, dated 29.07.2025

Managing Director,
Patna Metro Rail Corporation Limited (PMRCL)
Urban Development & Housing Department Vikas Bhawan,
New Secretariat,
Patna - 800015 (Bihar)

Sub: Approval of Design Basis Reports (DBRs) for Viaduct and Elevated Station of Patna Metro Rail Corporation Limited (PMRCL).

Ref: Document uploaded by PMRCL on Online Portal on 02.07.2025 along with its compliance.

The Design Basis Reports (DBRs) for Viaduct and Elevated Station (June, 2025) for Patna Metro Rail Corporation Limited (PMRCL) have been examined in consultation with RDSO and approval of Railway Board is hereby conveyed for the same.

Accordingly, approved copies of DBRs are enclosed.

Encl: As above

29.7.25

(**F. A. Ahmad**)
Director/Gati Shakti (Civil)-IV
Railway Board
Ph: 011-47845480
Email: dirgsc4@gmail.com

Copy to:

1. **Executive Director/UTHS**, RDSO, Manak Nagar, Lucknow w.r.t letter No.UT/125/Patna Metro/Civil dated 15.07.2025
2. **OSD/UT & Ex-Officio Joint Secretary**, Ministry of Housing & Urban Affairs (MoHUA), Nirman Bhavan, New Delhi-110001

Design Basis Report for Patna Metro

Part-1

VIADUCT

(June 2025)

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
Received on
29/7/2025
Railway Board

Office of CE / Design
DMRC

TABLE OF CONTENTS

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design
DMRC

Project Directorate
Railway Board
Dated on
29/12/2023

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
Railway Board
29/7/2021

Office of CE / Design
DMRC

1. INTRODUCTION

1.1 Brief Presentation of Project

Please refer Annexure – 1 for the details.

1.2 Geometric Design Feature

Please refer Annexure- 2 for the details..

1.3 Scope of the DBR

This design basis report pertains to the viaduct portions and is being submitted highlighting the proposed design methodology for the project. All design works, cost estimates and BOQ calculations shall be performed taking into consideration this Design Basis Report.

In the applicable codes/ manuals/ guidelines, the mentioned year of publication and number of last amendment/ correction slip issued till submission of DBR is minimum design requirement. Moreover, while carrying out actual design, should consider using amendment/correction slip issued after submission of DBR also.

This DBR is applicable for design of Viaduct for Metro Rail loading only. It shall not be applicable for structure carrying load other than Metro traffic like road, flyover etc.
For the design carried out prior to approval of DBR or drawings referred from other project, verification for compliance to the present DBR shall be ensured.

2. PROPOSED STRUCTURAL SYSTEM OF VIADUCT

2.1 Superstructure system

The superstructure shall be pre-tensioned twin U-girder (each U-girder supporting one track only)/, pre/post tensioned I girders with cast in situ deck. However, at major crossings over or along existing bridge, Balanced cantilever structure, special steel girder and concrete deck composite unit will be provided.

2.2 Emergency walkway

The evacuation of passengers in between stations shall be done from front and rare emergency doors of trains, hence no separate walkway is provided. However, space available between the track paths shall be used as walkway.

2.3 Bearing

Elastomeric, Spherical, Cylindrical and Pot-PTFE bearings.

Project Directorate Received on 29/7/2025 Railway Board

2.4 Substructure system

Pile, pile cap, pier, pier cap.

2.5 Foundation system

In general pile foundation but open foundation may also be provided based on soil parameters.

2.6 Parapets

Steel Railings with View cutter will be provided over deck slab, railing will be bolted on pedestal over deck (Non-structural).

In case of U girder, no separate parapet is provided.

Examined and found in order

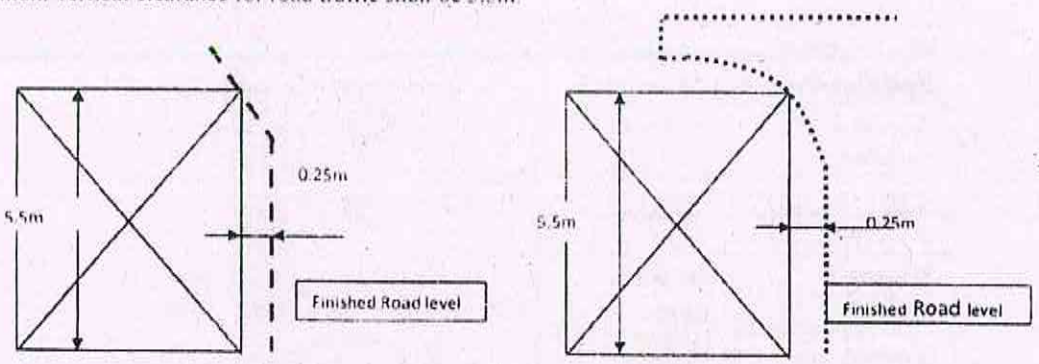
Director/UT/Civil
RDSO, Lucknow

Office of CE / Design DMRC

3. CLEARANCES FOR STRUCTURES

3.1 Clearance for Road Traffic

As per relevant IRC, minimum 5.5m at 0.25m (0.225m (width of 1m high Jersey type crash barrier) +0.025m (clearance between crash barrier and pier shaft) from pier shaft outer line.
Minimum vertical clearance for road traffic shall be 5.5m.



3.2 Clearances for Railway traffic

As per schedule of dimensions of Indian Railways. General arrangement drawing in such cases where viaduct crosses the railway tracks, the same shall be approved by the concerned Railway administration.
Minimum vertical clearance for railway traffic shall be 5.87m as per Schedule -I Clause 10 (c) + 0.275m for raising of track as per Clause 10 (Notes (e)) of Indian Railway SOD (Revised 2022) (corrected upto ACS-04)

3.3 Clearances for Metro Traffic

3.3.1 Vertical Clearance

The clearance will be as per approved SOD of Patna Metro.

3.3.2 Horizontal Clearance

The clearance will be as per approved SOD of Patna Metro.

4. STRUCTURAL MATERIALS AND PROPERTIES

4.1 Cement

As per Clause 4.1 of IRS CBC

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

4.2 Concrete

4.2.1 Young's Modulus:

Instantaneous modulus: E is given as per Cl 5.2.2.1 of IRS- CBC.

4.2.2 Modular Ratio

Modular ratio for concrete grades shall be taken as per Cl 5.2.6 of IRS-CBC

4.2.3 Density

As per IS 875 (part-1)

Project Directorate approved on 29/9/2023 Railway Board

Office of CE / Design DMRC

i. 25 kN/m³ prestressed concrete
ii. 25 kN/m³ for reinforced concrete
iii. 24 kN/m³ for plain concrete

4.2.4 Poisson's Ratio

Poisson's ratio for all concrete: 0.15

4.2.5 Thermal Expansion Coefficient

As per clause 2.6.2 of IRS Bridge Rules

$\varepsilon = 1.17 \times 10^{-5}$ /°C

4.2.6 Minimum grade of concrete and cover

4.2.6.1 Considering as per clause no.5.4.4 of IRS CBC minimum grade specified for various elements shall be considered as.

Structural Member	Minimum Grade
Pile	M-30
Pile Cap	M-30
Pier	M-30
Pier Cap	M-30
Superstructure	M-30
PSC members	M-35

4.2.6.2 The cover shall be as per clause 15.9.2 of IRS CBC

4.3 Reinforcing steel

As per clause 4.5 & 7.1.5 of IRS CBC. All properties of HYSD/TMT bars shall conform to IS: 1786 with elongation requirements as per Clause 5.3 of IS: 13920.

The grade of reinforcing steel shall be Fe 500D/Fe 550D.

Mixing of steel of different grade shall not be permitted and change of grade of steel shall be only through revision of design and drawings.

4.4 Prestressing hardware

4.4.1 Prestressing steel for tendons:

As per clause 4.6 of IRS CBC
Characteristic Strength- As per clause 16.2.4.3 of IRS CBC

4.4.2 Young's Modulus

As per clause 4.6.2 of IRS CBC:
E= 195,000 MPa (same value for 1 strand alone or 1 tendon).

4.5 Prestressing Units

i. **Jacking force:** Jacking force (maximum initial prestressing force) shall be as per clause 16.8.1 of IRS CBC.

ii. **Prestressing Losses:** As per clause 16.8.2 and clause 16.8.3 of IRS CBC.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design
DMRC

Project Directorate
29/7/2025
Railway Board

iii. **Sheathing:** As per Cl 7.2.6.4.2 of IRS CBC

iv. **Anchorages:** Cl 7.2.6.4.3 and Cl 16.8.3.4 of IRS CBC

4.6 Structural Steel for steel and composite bridges

i. Steel shall conform to IS: 2062.
ii. Fabrication shall be done as per IRS B1 (Fabrication code)
iii. Design of steel structures shall be done as per IRS: steel bridge code.
iv. IRS Steel bridge code and IS: 11384 - 2022 shall be referred for Steel-RCC composite construction.
v. Welding shall be done following IRS Steel Bridge Code provisions and Submerged Arc Welding (SAW) shall be done. Field Welding shall not be done.
vi. The Grade and quality of structural steel shall be E250 B0 and E350 B0.
vii. Mixing of steel of different grade shall not be permitted.
viii. Change of grade of steel shall be only through revision of design and drawings.

4.7 Structural Steel for Miscellaneous Use

i. Design shall be done as per IS: 800 and related provisions.
ii. Hollow steel sections for structural use shall be as per IS 4923.
iii. Steel tubes for structural purpose shall be as per IS: 1161
iv. Steel for general Structural Purposes shall be as per IS :2062
v. Relevant code may be adopted for stainless steel as per requirement.

5 LOADS

5.1 Dead Load (DL)

Dead load shall be based on the actual cross section area and unit weights of materials and shall include the weight of the materials that are structural components of viaduct and permanent in nature.

5.2 Super imposed Dead Load (SIDL)

Superimposed dead loads include all the weights of materials on the structure that are not structural elements but are permanent. It includes weight of track from plinth/rails /fasteners/cables/parapet/hand-rail/OHE mast/cable trough/signaling equipment etc. and will be considered in the design as per the site conditions.

Note: The SIDL can be of two types. Fixed or non-variable, and variable. In case metro certifies that a portion of SIDL is of fixed or non-variable type and is not likely to vary significantly during the life of the structure and a special clause for ensuring the same is incorporated in the Metro's maintenance manual, the load factors applicable for dead load may be considered for this component of SIDL.

5.3 Shrinkage and creep

As per IRS-CBC

5.4 Live Load (LL)

5.4.1. Vertical Train Live Load

Each component of the structure shall be designed/checked for all possible combinations of these loads and forces.

Project Directorate Approved on 29/7/2022 Railway Board

Office of CE / Design DMRC

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

22100 – one car

All axle loads = 16tons

Maximum number of successive cars: 6

Configuration (alternate) 1:
a= 2.25m
b = 2.50m
c = 12.60m

(2a+2b+c=22.1m)

Configuration (alternate) 2:
a= 2.605m
b = 2.29m
c = 12.31m

(2a+2b+c=22.1m)

Moving load analysis shall be carried out in order to estimate maximum longitudinal force, Max shear and max BM.

The maximum EUDL and LF for different span for single track live load (without CDA) is attached as Annexure-3.

Superstructure, bearing and substructure will be checked for one track loaded condition as well as both track loaded condition (Single span as well as both span loaded condition). However, for any other configuration (Axle load and axle spacing) of modern Rolling Stock including maintenance, machinery, crane etc., shall be within the loading envelope of present live load configuration.

5.4.2. Horizontal Train Live Load

Provision of clause 2.8.4 of IRS Bridge Rule be followed, when there is more than one track on single girder.

5.5 Coefficient of Dynamic Impact (CDA)

CDA shall be adopted as per IRS Bridge Rules.

The cl. no. 2.4.1.1 of IRS bridge rule for steel bridges and cl. no. 2.4.2.1 of IRS bridge rule for concrete bridges shall be referred for calculation of CDA.

5.6 Footpath Live Load

As per clause 2.3.2 of IRS Bridge rules.

Project Directorate Approved on 29/7/2025 Railway Board

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design DMRC

5.7 **Braking and Traction (BR/TR)**

to be decided by Metro.

The value of braking and traction forces will be taken as per rolling stock used. For twin tracked decks carrying traffic in opposite directions, consideration should be given to braking forces from one train and traction forces from another, acting simultaneously which will be maximum longitudinal loading on a deck. For more than two tracks, Clause 2.8.4 of IRS Bridge Rules shall be considered.

As per Clause 2.8.5 of IRS Bridge rules, when considering seismic forces, in transverse/longitudinal seismic condition, only 50% of gross tractive effort/braking force will he considered.

Dispersion of longitudinal forces is not allowed as per Clause 2.8.3.4 of IRS Bridge Rules.

5.8 **Centrifugal Force**

On curved track, centrifugal forces shall be determined in accordance with Clause 2.5 of IRS Bridge rules.

5.9 **Gradient effect**

The load due to longitudinal gradient effect shall also be considered as applicable.

5.10 **Wind Load**- Wind loads shall be as per clause 2.11 of IRS Bridge Rule.
The applicable basic wind speed shall be 47 m/sec for Patna Zone (as per National Building Code).

5.11- Seismic Design- Seismic analysis of Viaduct shall be done accordings to the IRS SEISMIC CODE-2020. The concept of ductility and over -strength, capacity design, provision for dis-loading of girder in the bearings, use of vertical hold-down devices, stopper, restrainer and horizontal linkage elements for preventing failing of span, minimum width of seating of super-structure over substructure to avoid dislodging of span from atop the substructure etc. shall be done in accordance to the IRS Seismic Code.

5.12 **Temperature Effect**

As per Clause 2.6 of IRS Bridge Rules.

5.12.1 Overall temperature (OT)

As per Clause 215.2 of IRC:6.
Maximum temperature considered as per Annexure-F of IRC 6: +46.6°C
Minimum temperature considered as per Annexure-F of IRC 6: +1.4°C

5.12.2 Differential Temperature (DT)

As per IRC:6.

5.12.3 Temperature Gradient

As per Clause 215 of IRC:6

5.13 **Differential Settlement**

Differential settlement between two adjacent viaduct piers will be:
12 mm for Long Term Settlement
6 mm for Short Term Settlement (50% of long term)

Project Directorate Approved on 29/7/2024 Railway Board

Office of CE / Design DMRC

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Differential settlement is to be considered only in the design of continuous structures, if any.

5.14 a) **Vehicle collision load on pier:** As per Clause 222 of IRC 6.

b) Rules specifying the loads for the design of superstructure and substructure of bridges and for assessment of strength of the existing bridges should be done as per IRS: Bridge Rules.

5.15 **Buffer load**

Provision of Buffers is contemplated at the end of temporary terminal stations during stage opening of the Corridors, at Pocket track ends and at the terminal stations of the corridors (at the end of turn back/stabling lines). Such buffers will be of friction type. These Buffers will be designed to have stopping performance based on mass of fully loaded train and its deceleration to avoid damage to the train or buffer.

Viaduct elements need to be designed for such Buffer load. The exact Buffer loads need to be interfaced and ascertained during the detailed design

5.16 **Rail-Structure Interaction Forces (LWR Forces)**

Guidelines vide BS Report No. 119 "RDSO Guidelines for carrying out Rail-Structure Interaction studies on Metro System (Version-2)" shall be followed. These guidelines shall be read alongwith IRS Bridge Rules clause no. 2.8.2.4.3.

5.17 **Racking forces**

As per clause 2.9 of IRS bridge Rules.

5.18 **Vibration Effect**

Effect of vibration due to movement of metro train on station bridge structure will be taken into consideration.

5.19 **Forces on Parapets**

As per Clause 2.10 of IRS bridge Rules.

5.20 **Derailment Load**

Derailment loads shall be considered as per Appendix XXV of IRS Bridge Rules with Standard gauge in place of Broad Gauge. For ULS and stability check, loading shall be proportioned as per maximum axle load.

Sacramento derailment criteria may be used for U-girders. This criterion corresponds to the application of 40% of one coach weight (including the dense crush load) applied horizontally as a 3m long uniform impact load on the U girder top flange.

This derailment load corresponds to ULS load. For SLS combination 5 of IRS-CBC a 1/1.75 co-efficient shall be applied to the derailment load.

5.21 **Erection Forces**

As per Clause 2.13 of IRS Bridge Rules.

Project Directorate 29/7/2013 Railway Board

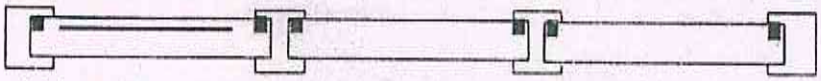
Examined and found in order

Director/UT/Civil
RDSO, Lucknow

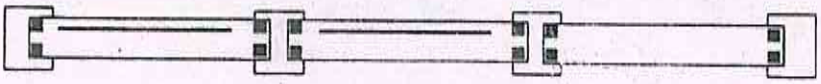
Office of CE I Des DMRC

5.22 **Elementary Loads Definition**

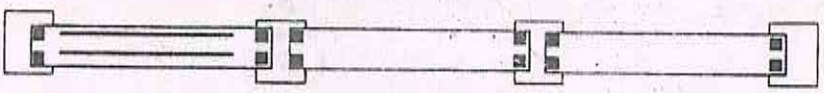
Elementary load			
Dead Load			DL
Super Imposed Loads			SIDL
Shrinkage & Creep			SC
Live load	LL	Train Weight	TW
		Dynamic Impact	I
		Force due to curvature or Transverse eccentricity	CF
		Longitudinal Force (Tractive, Braking)	LF
	Live Load on Foot Path* When live load on footpath is considered, then no CDA shall be applied on Train Live load to account for stationary train under emergency condition.		LFP
Overall temperature effect			OT
Differential Temperature			DT
Long welded rail forces			LR
Racking forces			RF
Forces on parapets			PP
Wind pressure effect :	WL	Longitudinal Direction	WL x
		Transverse Direction	WL z
Earthquake	EQ	Longitudinal direction	EQ x
		Transverse direction	EQ z
		Vertical direction	EQ y
Buoyancy			B
Differential settlement (Applicable for continuous units only)			DS
Derailment Load			DR
Frictional Restraint			FR



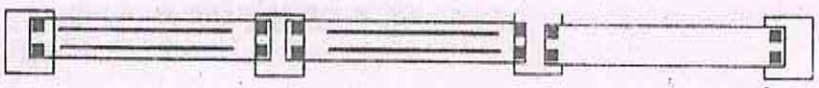
LL1: used for Deck Torsion, Bearing Compression, Uplift, Shaft check, Foundation check



LL2 : LL2 used for Shaft check, Foundation check



LL3: used for Deck check, Bearing Compression check, Shaft check, Foundation check;



LL4 : used for shaft check, Foundation check, Shear Key check.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design DMRC

6. LOAD COMBINATIONS

6.1 **Methodology:** For seismic cases, IRS seismic code 2020 shall be followed. Provision of IRS CBC shall be followed for load combination other than Seismic cases.

6.2 The superstructure/bearing, sub-structure and foundation will be checked for one track loaded condition as well as both track loaded condition, for single span and both spans loaded conditions, as the case may be.

6.3 Design of Viaduct shall be done in accordance with the construction methodology/ construction sequence to be adopted during construction sequence.

7. DESIGN PARAMETERS

7.1 Units for Design

The main units used for design will be: [t], [m], [mm], [KN], [KN/m^2], [MPa], [^{0}C], [rad]

7.2 ULS Check

As per IRS Concrete Bridge Code.

7.3 SLS Check

As per IRS Concrete Bridge Code.

7.3.1 Crack Width:

Crack width in reinforced concrete members will be checked for SLS combination-1. Crack width will be as per Clause 15.9.8.2 of IRS CBC. Crack width shall not exceed the admissible value based on the exposure conditions given in Clause 10.2.1 of IRS CBC.

For crack control in columns, Clause 15.6.7 of IRS CBC will be modified to the extent that actual axial load will be considered to act simultaneously.

Clause no. 10.4.1, 11.3.4, and 13.3 of IRS CBC shall be kept in view while calculating vertical deflection at mid span.

7.4 Fatigue Check

7.4.1 For RCC and PSC structures, fatigue check shall be as per Clause 13.4 of IRS CBC.

7.4.2 Steel Structure

Clause 3.6 of Steel Bridge Code shall govern. For fatigue reflection detailed, counting of cycles shall be done.

7.5 Durability

i. Provisions of IRS: Concrete Bridge Code shall be followed. Exposure conditions as defined in Cl 5.4 of IRS CBC will be decided by Patna Metro and structure shall be designed accordingly.

ii. For cover to reinforcement refer Cl 15.9.2 of IRS CBC

7.6 Design life

As per Clause 15.1.3 and 16.1.3 of IRS CBC

Project Directorate Railway Board 29/7/2025

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design DMRC

7.7 Drainage

The drainage of deck shall be designed to cater the maximum envisaged rainfall intensity and suitable longitudinal and transverse slope should be provided. Moreover, the provisions of clause 10.4.1.1 and 15.2.2 of IRS CBC shall be followed.

8. DESIGN METHODOLOGY

8.1 Bearing System

i. Elastomeric bearings shall be designed in accordance with EN 1337 Part 1 and Part III, in conjunction with cl. 4.2.3 of IRS Seismic Code 2020.
ii. Design of Spherical & cylindrical bearings shall be as per IRC:83 Part-IV.
iii. Design of POT-PTFE bearings shall be as per IRC:83 Part-III.
iv. Clause 15.9.11.3 & 15.9.11.4 of IRS CBC should be followed for considering replacement of bearings.
v. Bearing seat width shall be according to clause 14 of IRS Seismic Code 2020.
vi. Anti-dislodgement elements like reaction blocks and seismic arrestors shall be designed as per clause 15 of IRS Seismic code 2020.

8.2 Pier cap and pier

For designing the pier cap as corbel, the provisions of clause 17.2.3 of IRS CBC should be followed. In case of shear span to effective depth ratio being more than 0.6 pier cap will be designed as flexural member.

The effective length of a cantilever pier for the purpose of slenderness ratio calculation will be taken as per IRS CBC.

8.3 Foundation

8.3.1 Foundation shall be designed as per IRS Bridge substructure and foundation code, IRS Concrete Bridge Code, Manual on the design and construction of well and pile foundation, IS-2911 and IRC-45 should be followed for design of foundation.

8.3.2 Soil structure analysis:

When designing elements forces or estimating displacements the soil stiffness shall be assessed based on the actual ground data. General soil conditions are described in Annexure-4.

9. LIST OF DESIGN CODES AND STANDARDS

The IRS codes shall be followed in principle. Although main clauses have been mentioned in the DBR, the other relevant clauses as available in the IRS codes shall also be followed, wherever applicable. If provisions are not available in IRS, the order of preference shall be as follows, unless specifically mentioned otherwise in the relevant clause of DBR:

For Railway loading related issues

i. UIC Codes
ii. Euro Codes
iii. Any other code which covers railway loading

For other Design/detailing related issues

i. IRC
ii. IS
iii. Euro Code

Project Directorate approved on 29/7/2025 Railway Board

Office of CE / Design DMRC

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

iv. Other national codes.

List of latest design codes and standards referred in this DBR are given in Annexure 5.

10. DESIGN SOFTWARE

Any commercial or proprietary software can be used for analysis/design provided the same is validated with manual computations or other standard software in multiple scenarios.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

ANNEXURE-1

(Brief Description of the Project)

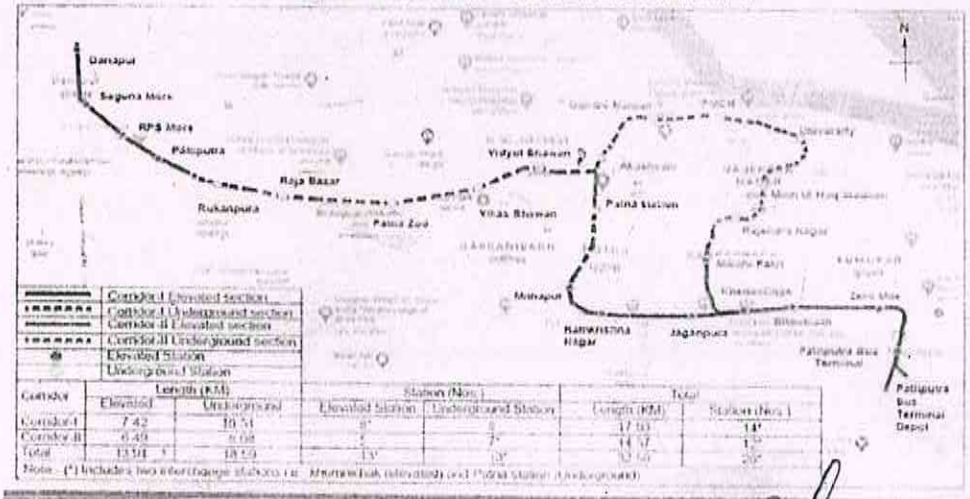
The brief description of project is as follows:

1. **Sanction letter:** Copy/reference of the approval or sanctioned letter issued by Government of India is enclosed at end of Annexure-I.
2. **Project Title:** Patna Metro Rail Project which comprises of two corridors having elevated and underground section:
   a. Corridor- I: Danapur to Mithapur
   b. Corridor-II: Patna Railway Station to New ISBT
3. **Corridor Length:** Total elevated corridor is of 13.91Km in Corridor-I & Corridor-II
   a. Corridor-I – 7.42 Km
   b. Corridor-II – 6.49 Km
4. **Total number of Stations along with type of platform:** Total 13 nos. of elevated station in Corridor-I & Corridor-II.

S.No.	Station Name	Type of Platform
Corridor-I		
1	Danapur	2-Side Paltform
2	Saguna More	2-Side Paltform
3	RPS More	2-Side Paltform
4	Patliputra	2-Side Paltform
5	Mithapur	2-Side Paltform
6	Ramkrishna Nagar	2-Side Paltform
7	Jaganpura	2-Side Paltform
8	Khemni Chak	2-Side Paltform (Interchange Station)
Corridor-II		
1	Malai Pakri	2-Side Paltform
2	Khemni Chak	2-Side Paltform (Interchange Station)
3	Bhootnath	2-Side Paltform
4	Zero Mile	2-Side Paltform
5	New ISBT	2-Side Paltform

5. **Information and location of depots** – Patliputra Bus Terminal Depot
6. **Project Map:**

PATNA METRO ALIGNMENT - CORRIDOR - I & CORRIDOR - II



Corridor	Length (KM)		Station (Nos.)		Total	
	Elevated	Underground	Elevated Station	Underground Station	Length (KM)	Station (Nos.)
Corridor-I	7.42	10.51	5*	3	17.93	13*
Corridor-II	6.49	8.08	5	2	14.57	15
Total	13.91*	18.59	13*	5*	32.50	28*

Note – (*) Includes two interchange stations i.e. Khemni Chak (elevated) and Patna Station (underground)

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Page 12

Project Directorate
Received on
29/7/2025
Railway Board

Office of CE / Design
DMRC

F.No. K-14011/P-1/2016-UT-V
Government of India
Ministry of Housing and Urban Affairs
Urban Transport Division
(UT-V Desk)

111-B, Nirman Bhawan, New Delhi
Dated the 27th February, 2019

To,

The Chief Secretary,
Government of Bihar,
Main Secretariat, Patna-800 015, Bihar

Subject: Patna Metro Rail Project.

Sir,

I am directed to convey the approval of the Government of India (GoI) for implementation of the rail-based Mass Rapid Transit System (MRTS) called the "Patna Metro Rail Project" which comprises two corridors of a total length of 31.39 km viz. (i) Danapur to Mithapur (16.94 km) and (ii) Patna Railway Station to New ISBT (14.45 Km) at a total completion cost of Rs. 13,365.77 crores (Rupees thirteen thousand three hundred sixty five crores and seventy seven lakhs only) with contribution of GoI in the form of Equity and Subordinate Debt as per the details given in para 4 below and subject to the conditions as given in para 8 below.

2. Patna Metro Rail Corporation Limited (PMRCL) shall function as a Special Purpose Vehicle (SPV) for the implementation of the project which shall be jointly and equally owned by Government of India (GoI) and Government of Bihar (GoB). The project will be implemented in 05 years from the date of approval.

3. **Legal Framework:** Legal cover for the Patna Metro Rail Project shall be under the Metro Railways (Construction of Works) Act, 1978; the Metro Railways (Operation & Maintenance) Act, 2002; Metro Railways (Amendment) Act, 2009 and the Railways Act, 1989, as amended from time to time.

4. **Project Financing**: The cost of the project will be financed as per the funding pattern given below:

Funding Pattern - Patna Metro Rail Project

S.No.	Source of Fund	Amount (Rs. in Crores)	% Contribution
1	GoI Equity	1441.12	15.66%
2	GoI Subordinate Debt for CGST (50% of Central Taxes)	399.19	4.34%

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Page 15

3	Govt. of Bihar Equity	1441.12	15.66%
4	Govt. of Bihar Subordinate Debt for CGST (50% of Central Taxes)	399.19	4.34%
5	Loan from bilateral/ multilateral agencies	5520.93	60.00%
6	**Total cost excluding Land, R&R and PPP components**	**9201.55**	**100.00%**
7	PPP component (AFC for Stations)	96.36	
8	**Total**	**9297.91**	
9	Govt. of Bihar Subordinate Debt for Land including R&R cost	3401.66	
10	Subordinate Debt for SGST (100% of State taxes) to be borne by Govt. of Bihar	645.48	
11	IDC for Loan & Front End Fee to be borne by Govt. of Bihar	20.72	
12	**Total Completion Cost**	**13365.77**	

5. The component-wise cost of Patna Metro Rail Project is given at **Annexure-I.**

6. **Institutional Arrangements**: This Project is proposed to be implemented by Patna Metro Rail Corporation Limited (PMRCL), the existing Special Purpose Vehicle (SPV) of State Government of Bihar (GoB) which shall be converted into a 50:50 Joint Venture company of Government of India (GoI) and Government of Bihar (GoB) i.e. equal equity participation of GoI and GoB. The joint ownership company will continue to be named as PMRCL. The promoters, the GoI and GoB, shall nominate five Directors each to the Board of Directors (BoD) of the SPV totaling 10 nominee Directors. The ex-officio Chairman of BoD will be among the five nominee Directors from GoI and the full-time Managing Director (MD) with adequate technical experience, among the five nominee Directors from GoB, will be appointed with the prior written permission of GoI. The Managing Director shall not be given any other/additional assignment by GoB without the prior written permission of MoHUA. Functional and other Directors shall be appointed by the SPV as per the requirement.

7. **High Powered Committee**: During implementation of the project, a High Powered Committee under the chairmanship of the Chief Secretary to the Government of Bihar, with other concerned Secretaries as members will be constituted to take expeditious decisions on matters relating to land acquisition, shifting of utilities and other structures in the project alignment, rehabilitation of Project Affected Persons, Multi modal Integration and such other matters where the State Government has to facilitate quick action including various conditions of sanction of this project.

Project Directorate Received on 29/11/2019 Railway Board

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design DMRC

8. **Terms and Conditions of Sanction**

i. There will be no liability on the part of the Government of India if the ridership does not materialize and/or the project does not make adequate profits/surplus.

ii **Central Laws**, i.e., the Metro Railways (Construction of Works) Act, 1978, the Metro Railways (Operation & Maintenance) Act, 2002 as amended through Metro Railways (Amendment) Act, 2009 and the Railways Act, 1989 would be applicable. Central Government's decisions with regard to safety, standardization and indigenization of rolling stock across all metro systems would be applicable.

iii The project shall be implemented by a 50: 50 joint owned Special Purpose Vehicle (SPV) of GoI and Govt. of Bihar.

iv. GoI and Govt. of Bihar, shall nominate five Directors each to the Board of Directors (BoD), of SPV totaling 10 nominee Directors. The ex-officio Chairman of BoD will be amongst the five nominee Directors from GoI and the full-time Managing Director (MD) with adequate technical experience, among the five nominee Directors from Govt. of Bihar, will be appointed with the prior permission of GoI. The Managing Director shall not be given any other/additional assignment by Govt. of Bihar without the prior written permission of MoHUA.

v. The Special Purpose Vehicle (SPV), which shall implement this project, shall generally adopt the guidelines of Department of Public Enterprises, the Department of Economic Affairs and the Central Vigilance Commission as necessary to strengthen the Corporate Governance and shall be subject to the Parliamentary scrutiny.

vi. The SPV shall be bound by such directions on question of policy, as the Central Government may give in writing from time to time after giving due opportunity to the SPV to express its views before giving any direction.

vii. The complete cost of land acquisition, resettlement and rehabilitation (including escalation) shall be met by the State Government. The State Government would ensure that land acquisition does not become reason for delay in implementation of the project.

viii. **Procurement of Additional Rolling Stock:** Government of India will not share any cost towards procurement of additional rolling stock in the second and subsequent years of operation, as this would not be a part of the project cost.

ix **Cost Escalation:** GOI's proposed funding in the form of equity and subordinate debt will be completely ring - fenced to Rs. 1840.31 crore in terms of Para (F) (iii) (c) of Metro Rail Policy, 2017, which includes grant and subordinate debt for central taxes (customs duty and CGST). This should be suitably incorporated in Memorandum of Association (MoA) and/or Shareholder Agreement. Cost escalation due to price escalation or exchange rate variation leading to increase in the cost of the project within or beyond the approved project time limit, inclusion of any item not referred to in DPR and also any other cost escalation due to change in scope or delay beyond the approved time cycle shall be borne/met/arranged by the State Government. This should be suitably incorporated in Memorandum of Association (MoA) and/or Shareholder Agreement.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate Approved 29/5/2025 Railway Board

Office of CE / Design DMRC

Page 15

x. The Government of India would not finance cash losses and capital expenditure during the operational phase and its requirements would be financed by the SPV and/ or the State Govt. from its own resources.

xi. **Taxes**

a. The State Government will either exempt the SPV from its State/local taxes and duties/levies or reimburse the same.

b. The State/local taxes would not form part of the project cost to be shared by the Government of India.

c. There will be no waiver of Central taxes/duties by the Government of India.

xii. **Repayment of Loan:** In case of SPV not being able to repay the loan (as and when it becomes due), the responsibility for the same shall be borne by the State Government, and not by the Government of India.

xiii. The State Government is also advised to rework the DPR on realistic basis with adequate deliberation on the issues, if any, raised by various stakeholders before going ahead with implementation to ensure sustainability of the project.

xiv. **Dedicated Urban Transport Fund:** The State Government should set up a dedicated urban transport fund at the state level as well as at the city/metropolitan area level to create pool of resources for replacement of assets and providing operational subsidies, if any, not only for this project but other Urban Transport projects as well.

xv. **Multimodal Integration**

a. Integration of various modes of transport which would act as feeder/evacuation system to the proposed metro for improved Ridership including adequate parking space for bicycles & cars and bus/taxi/auto stands at the stations, improvement in city bus service to introduce modern ITS-enabled buses, should be given high priority by the State Government.

b. The State Government should provide multimodal integration, including sub-urban railways (by involving Ministry of Railways) to provide a well-connected network in the region.

c. The State Government should ensure that the metro rail project provides for first and last mile connectivity, accessibility and appropriate security arrangements.

d. The State Government should provide common mobility card to provide integrated ticketing and seamless travel across all modes and all operators in the city.

xvi. **Price-Based Measures to promote and facilitate Metro Rail Ridership**: The State Government should ensure price based measures to promote and facilitate Metro Rail Ridership, as part of integrated traffic rationalization plan and Comprehensive Mobility Plan for the city with a view to ensure that the projected Ridership is realized.

xvii. **Land Use Densification**: Land Use densification as per the TOD guidelines around the stations also needs to be done to increase the ridership and decrease the overall travel demand.

Directorate Railway Board 29/7/2025

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design DMRC

xviii. **Periodic Fare Revision**: A suitable arrangement, independent of the SPV formed to implement the Metro Rail project, shall be provided for periodic fare revision for the Metro Rail as well as other competing modes.

xix. **Unified Metropolitan Transport Authority**: The State Government should set up a Unified Metropolitan Transport Authority (UMTA), duly backed by legislation, to facilitate coordinated planning and implementation of projects related to urban transport and their integrated management.

xx. **Traffic Information Management Control Centre**: The State Government should set up a traffic information management control center for effective traffic monitoring and enforcement as well as for data generation and data collection for future planning.

xxi. **National Public Transport Helpline**: The State Government should implement National Public Transport Helpline to provide information regarding various aspects of public transport such as routes, arrival departure times, route planning, ticketing etc. in the city.

xxii. **Parking Policy**: The State Government should come up with a parking policy wherein parking fee represents the true value of the land occupied, which is used to make public transport more attractive; banning of parking on arterial/ring roads; provision of multi-level parking centers in city centers with park-and-ride facility etc.

xxiii. **Advertisement Policy**: The State Government should come up with an advertisement policy which taps advertisement revenue on public transport, intermediate public transport, public utilities and street furniture.

xxiv. **Memorandum of Understanding**: The State Government, the SPV and the Government of India shall enter into a tripartite Memorandum of Understanding regarding detailed terms and conditions for implementation of the project in accordance with sanction of the Union Cabinet. GoI share will not be released till the tripartite MoU is signed.

xxv. Metro stations should be designed and constructed with toilets in the paid area. The toilets should be part of the project cost and meet the needs/ requirements of the Persons with Disabilities.

xxvi. The State Government will endeavor to economize on the cost of the project through value engineering, minimum land acquisition, adoption technological innovation during project life cycle.

xxvii. Expenditure on O&M and debt servicing should be the responsibility of the SPV. In case the SPV fails in respect of this, the liabilities will be borne by the State Government in terms of Para (D) (iv) (d) of Metro Rail Policy, 2017.

xxviii. The SPV will explore the possibility of minimizing land cost after obtaining NOC for the government land from the Government Departments. 90% land should be in possession of the SPV before start of the work. It may also be ensured that land acquisition of private land is completed at the earliest and does not delay the project in any way.

xxix. The SPV will explore the possibility of PPP in other areas of activities related to the metro project in terms of Para (E) (iii) (b) of Metro Rail Policy, 2017.

xxx. The external funding will be on back to back basis as per the Standard arrangement of Department of Economic Affairs.

Project Directorate 29/7/2021 Approved by Railway Board

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Page 5

Office of CE I Design DMRC

Page 17

xxxi. In view of overarching fiscal consolidation path, State Government should ensure flow of realisable VCF in the SPV account in terms of Para (D) (vii) (b) of Metro Rail Policy, 2017 for meeting O&M, escalation, debt servicing etc. of the project in a manner that will reduce burden on the State exchequer

xxxii. The State Government of Bihar should enable the SPV to raise cheaper long term debt in the domestic market by allowing it to issue corporate debt bond in terms of Para (D) (xi) of Metro Rail Policy, 2017.

9. This issues with the concurrence of Integrated Finance Division of this Ministry vide their note in e-file No. 3123361 dated 21st February, 2019 and with the approval of Secretary(HUA) vide above e-office number dated 22nd February, 2019.

Yours faithfully,

Jasbir Singh

(Jasbir Singh)
Under Secretary to the Government of India
Tel: 011-23062285

Copy to:

1. Principal Secretary, Urban Development & Housing Department, Government of Bihar, 1st Floor, Vikash Bhawan, New Secretariat, Patna-800015, Bihar.
2. Resident Commissioner, Government of Bihar, Bihar Bhawan, Kautilya Marg, Chanakyapuri, New Delhi-110021.

Copy forwarded for information to:

1. Principal Secretary to Prime Minister, Prime Minister's Office, South Block, New Delhi-110001.
2. Chief Executive Officer, NITI Aayog, Yojana Bhavan, New Delhi-110001.
3. Secretary, Ministry of Home Affairs, North Block, New Delhi-110001.
4. Secretary, Department of Expenditure, Ministry of Finance, North Block, New Delhi-110001.
5. Secretary, Department of Economic Affairs, Ministry of Finance, North Block New, Delhi-110001.
6. Secretary, Department of Revenue, Ministry of Finance, North Block, New Delhi-110001.
7. Chairman, Railway Board, Rail Bhawan, New Delhi -110001.
8. Secretary, Ministry of Environment, Forests & Climate Change, Indira Paryavaran Bhavan, Jor Bagh, New Delhi-110003.
9. Secretary, Ministry of Road Transport & Highways, Parivahan Bhavan, Sansad Marg, New Delhi -110001.
10. Secretary, Ministry of Statistics and Programme Implementation, Sardar Patel Bhavan, Sansad Marg, New Delhi-110001.

Project Directorate Received on 29/7/2025 Railway Board

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Officer on CE / Design DMRC

Page 18

11. Director (Cabinet), Cabinet Secretariat, Rashtrapati Bhavan, New Delhi with reference to their communication No. 8/CM/2019 (i) dated 18th February, 2019.

Copy also to:

1. PS to Minister of State (Independent Charge) for Housing & Urban Affairs.
2. Secretary (HUA), MoHUA.
3. Additional Secretary (W & H), MoHUA.
4. Joint Secretary & Financial Adviser, MoHUA.
5. OSD (UT) & ex-officio Joint Secretary, MoHUA.
6. Director (MRTS-I)/Director (MRTS-II)/Director (UT-II)/DS(UT-I), MoHUA.
7. Chief Controller of Accounts, MoHUA, Nirman Bhavan, New Delhi.
8. PAO (Sectt), MoHUA, Nirman Bhavan, New Delhi.
9. Under Secretary (D-II), Integrated Finance Division, MoHUA.
10. Budget Section, MoHUA.
11. Sanction Folder.

(Jasbir Singh)
Under Secretary to the Government of India
Tel: 011-23062285

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
29/7/2025
Railway Board

Office of CE./ Design
DMRC

F.No. K-14011/P-1/2016-UT-V
Government of India
Ministry of Housing and Urban Affairs
Urban Transport Division
(UT-V Desk)

Annexure-1

Component-wise cost of Patna Metro Rail Project's Corridors from Danapur to Mithapur (16.94 km) and from Patna Railway Station to New ISBT (14.45 Km).

(All amount is in Rs crores)

S. No.	Item	Corridor-1	Corridor-2	Total
1	Alignment and Formation	1324.6	788.43	2113.04
2	Station Buildings incl. Civil works, EM works, ECS, TVS, Lift, escalators & Architectural Finishes etc	1607.89	859.43	2467.32
3	Depot including civil, EM, Machinery & plants, general works & OCC Building	168	110	278
4	P-Way for main line, depot and depot connectivity	136.92	118.68	255.6
5	Traction & power supply for main line and depot incl. OHE, ASS, GIS etc.	267.58	197.64	465.22
6	Signaling and Telecom etc	174.35	157.57	331.92
7	Environmental Cost	2.63	2.42	5.05
8	Miscellaneous Utilities, road works, Topographic Surveys, Geotechnical Investigation, Barricading, Tree Cutting and replanting, other civil works such as signage's, Environmental protection and traffic management	101.64	86.73	188.37
9	Capital Expenditure on Security including civil and EM works	4.44	4.44	8.88
10	Staff Quarters including civil, electrical works	27.61	0	27.61
11	Capital Expenditure on Inter modal integration including Footpath for pedestrians	36	36	72
12	Rolling Stock (RS)	480	336	816
13	**Total Cost at Dec-2018 price levels (Excluding Land, R&R, PPP, IDC, General Charges, Contingencies, Central & State Taxes and)**	**4331.66**	**2697.34**	**7029.00**
14	General Charges including Design charges @ 5%	216.58	134.87	351.45
15	Contingencies @ 3 %	129.95	80.92	210.87

Project Directorate
Received on
29/Apr/2025
Railway Board

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of DE / Design
DMRC

16	Total Cost at Dec-2018 price levels incl. General Charges and Contingencies (Excluding Land, R&R, PPP, IDC, Central & State Taxes)	4678.19	2913.13	7591.32
17	**Total Cost at Dec-2018 price level including General Charges, (Excluding Land, R&R, PPP, IDC, Contingencies, Central & State Taxes)**	4548.24	2832.21	7380.45
18	Escalation at 5 % p.a on all items except contingencies	500.31	311.31	811.85
19	**Total Cost including General Charges, Contingencies, Escalation, (excluding Land, R&R, PPP, IDC, Central & State Taxes)**	**5178.50**	**3224.67**	**8403.17**
20	Central Taxes including basic customs duty	444.56	274.7	719.26
21	Escalation at 5 % p.a on Central Taxes including basic customs duty	48.90	30.22	79.12
22	**Total of Central Taxes including escalation**	**493.46**	**304.92**	**798.38**
23	**Total Cost including General Charges, Contingencies, Escalation, Central Taxes (excluding Land, R&R, PPP, IDC, State Taxes)**	**5671.96**	**3529.59**	**9201.55**
24	State Taxes	357.31	224.2	581.51
25	Escalation at 5 % p.a on State Taxes	39.30	24.66	63.97
26	**Total of State Taxes including escalation**	**396.61**	**248.86**	**645.48**
27	Land Cost	2227.78	1162.72	3390.51
28	Cost of Rehabilitation & Resettlement (R&R)	5.83	5.32	11.15
29	**Total of Land and R&R Costs**	**2233.61**	**1168.04**	**3401.66**
30	PPP component (AFC installations) including Central and State Taxes, escalation etc	48.18	48.18	96.36
31	Interest during Construction (IDC) including Front End Fee	12.77	7.95	20.72
32	**Total Completion Cost**	**8363.15**	**5002.62**	**13365.77**

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

(Jasbir Singh)
Under Secretary to the Government of India
Tel: 011-23062285

Project Directorate ... Railway Board
29/7/2025

Office of CE / D...
DMRC

Page 21

ANNEXURE-2

Geometric Design Parameters

Geometric Design Parameters used for this project are as below:

1.	**Track Gauge**	: Standard Gauge (1435mm)
2.	**Maximum Permissible Gradient**	: 4% (Maximum)
3.	**Maximum Design Speed**	: 90 Kmph
4.	**Design Axle Load**	: 16T
5.	Radius of Horizontal Curve	: 120m (Minimum)
6.	Radius of Vertical Curve	: 1500m (Minimum)

Note: All the above parameters are as per the SOD of Patna Metro.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate Approved on 29/7/2025

Office of GE / Design DMRC

ANNEXURE-3

The maximum EUDL and LF for different span for single track live load:

S.No.	Span	EUDL		LF	
	(m)	SF (in Tons)	BM (in Tons)	TE (in Tons)	BF (in Tons)
1	15	95.930	87.910	13.60	12.20
2	16	98.430	90.916	13.60	12.20
3	17	100.640	93.568	13.60	12.20
4	18	102.600	95.925	13.60	12.20
5	19	104.360	98.035	13.60	12.20
6	20	105.940	99.933	13.60	12.20
7	21	107.380	101.650	16.00	14.40
8	22	109.700	103.212	17.00	15.30
9	23	112.320	104.637	19.20	17.30
10	24	114.950	105.944	20.40	18.40
11	25	118.510	107.146	20.40	18.40
12	26	121.800	108.769	20.40	18.40
13	27	124.840	111.036	20.40	18.40
14	28	128.060	113.142	20.40	21.40

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
29/7/2025
Railway Board

Office of CE / Design
DMRC

ANNEXURE-4

As per the soil investigation report, it is revealed that the sub-soil strata from EGL to 1.0m - 4.50 m depth consist of filled up strata and followed by silty Clay / sandy clay / silty sand of different classifications upto termination depth, which is varying from place to place.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Received on 29/7/2025

ANNEXURE-5

List of latest design codes and standards referred in this DBR are as below:

1. IRS Concrete Bridge Code - Reprint September 2014 (Incorporating A&C 1 to 13 & upto ACS 11, 19.07.2024)
2. IRS Bridge Rules - Reprint 2014 (Incorporating A&C upto 53)
3. IRS Seismic Code 2020 (Incorporated upto ACS 02)
4. IRS Bridge Sub Structure and Foundation 2013 (Incorporating A&C upto 11, 25.04.2024)
5. IRS: Steel Bridge Code 2017 (Incorporating A&C upto 24)
6. IRS B1 (Fabrication Code) 2008 (Incorporating A&C upto 12)
7. RDSO Guidelines for carrying out Rail Structure Interaction studies on Metro System (Version-2)
8. IRC:6 2017 (Upto amendments no. 08)
9. IRC: 83 Part-III (2018)
10. IRC: 83 Part -IV (2014)
11. IS 875 (Part-1) (Reaffirmed 2023, upto amendment no. 01)
12. IS: 1786 (Reaffirmed 2023, upto amendment no. 04)
13. IS: 13920 (Reaffirmed 2021, upto amendment no. 02)
14. IS: 2062 (Reaffirmed 2021, upto amendment no. 01)
15. IS:800 (Reaffirmed 2022, upto amendment no. 02)
16. IS: 4923 (Reaffirmed 2023, upto amendment no. 03)
17. IS: 1161 (Reaffirmed 2024, upto amendment no. 02)
18. IS: 2911: Part 1 (Reaffirmed 2020)
19. IS: 2911: Part 2 (Reaffirmed 2021)
20. IS: 2911: Part 3 (Reaffirmed 2021)
21. IS: 2911: Part 4 (Reaffirmed 2023)
22. EN 1337 Part 1: 2000
23. EN 1337 Part III: 2005

These codes with latest revisions including all addendums/notifications and correction slips only shall be used.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Design Basis Report for Patna Metro

Part-2

STATION

(June 2025)

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

29/7/2025

Project Directorate
Railway Board

Office of CE / Design
DMRC

TABLE OF CONTENTS

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design
DMRC

Directorate
Railway Board
29/7/2021

1. INTRODUCTION

1.1. Brief Description of the Project

Please refer Annexure – 1 for the details.

1.2. Geometric Design Feature

Please refer Annexure – 2 for the details.

1.3. Scope of the DBR:

This design basis report pertains to the Elevated Stations and is being submitted highlighting the proposed design methodology for structural design of Elevated Stations of the project. Extended platform portion which is generally on single column or portal type structure shall be designed as part of viaduct. All design works, cost estimates and BOQ calculations shall be performed taking into consideration this Design Basis Report.

The structural elements connected to the member on which metro live loads are supported may also be designed with taking loads applicable as specified in "Design Basis Report (DBR) for Viaduct ".

Load combination as per "Design Basis Report (DBR) for Viaduct of Metro System" shall also be considered. Other structure elements such as secondary beams, stub column etc may be design as per IS 456-2000.

Structures where Metro Live loads are not applicable, the design of Plain & Reinforced concrete structure will generally be governed by per IS 456-2000, pre-stressed concrete structures shall generally be governed by IS 1343. Steel structures shall generally be governed by IS 800.Seismic design shall generally be governed by IS:1893.

This is meant to serve as guide to the designer but compliance with the rules there in does not relieve them in any way of their responsibility for the stability and soundness of the structure designed. The design of Elevated stations requires an extensive and thorough knowledge and entrusted to only to specially qualified engineers with adequate practical experience in structure designs.

In the applicable codes/ manuals/ guidelines, the mentioned year of publication and number of last amendment/ correction slip issued till submission of DBR is minimum design requirement.

Moreover, while carrying out actual design, should consider using amendment/correction slip issued after submission of DBR also.

This DBR is applicable for design of Station only. It shall not be applicable for structure carrying load like road, flyover etc.

For the design carried out prior to approval of DBR or drawings referred from other project, verification for compliance to the present DBR shall be ensured.

1.4. Units

The main Units used for design will be: [t], [m], [mm], [kN], [KN/m2], [Mpa],[°C], [rad.].

2. DESIGN SPECIFICATION FOR STATION BUILDING

2.1. Materials

2.1.1. Cement

For plain and reinforced concrete structures cement shall be used as per clause 5.1 of IS:456 and in case of pre-stressed concrete structures as per clause 5.1 of IS:1343.

2.1.2. **Concrete**

As per clause 6, 7, 8, 9 and 10 of IS:456 in case of Plain and Reinforced concrete structures and clause 6, 7, 8, 9 and 10 of IS:1343 for pre-stressed concrete Structures.

Short term modulus of elasticity (Ec) shall be taken as per cl. 6.2.3.1 of IS:456 for Plain and Reinforced Concrete structures and IS:1343 for pre-stressed concrete structures.

The modular ratio for concrete grades shall be taken as per Annex B of IS:456.

The Density of concrete shall be as per IS:456.

2.1.3. **Pre-stressing Steel for Tendons**

As per clause 5.6.1 of IS:1343.

2.1.3.1. Young's Modulus:

As per pre-stressing steel used in accordance with Para 2.1.3 above.

2.1.3.2. Pre-stressing Units:

As per clause 13 of IS:1343.

2.1.3.3. Maximum Initial Prestress:

As per clause 19.5.1 of IS:1343.

2.1.3.4. Density:

Weight of strands shall be as per relevant clauses of IS codes as per material being used as indicated in para 2.1.3 above.

2.1.3.5. Sheathing:

As per clause 12.2 of IS: 1343.

2.1.4. **Structural Steel**

Structural steel used shall confirm to

a) Hollow steel sections as per IS: 4923.
b) Steel for General Structural Purposes as per IS: 2062.
c) Steel tubes for structural purpose shall be as per IS:1161.

Note:

(i) Grade of steel to be used shall be E250 B0 and E350 B0, based on whether structure is taking moving loads or not and relevant code as indicated in note (ii) and (iii) below.
(ii) Mixing of steel of different grade shall not be permitted.
(iii) Change of grade of steel shall be only through revision of design and drawings.
(iv) Design of steel structure will be governed by IRS Steel Bridge Code in case structure is taking moving loads of Metro, otherwise will be governed by IS: 800. In case of composite (steel-concrete structures) it will be governed by IS:11384 & IS:3935.
(v) Fabrication shall be done in accordance with IRS B1 (Fabrication Code) in case structure is taking moving loads of Metro, otherwise shall be done as per IS: 800.

2.1.5. **Reinforcement**

As per clause 5.6 of IS:456 for Plain and Reinforced concrete structures and as per clause 5.6.2 of IS: 1343 for Pre-stressed concrete structures.

Project Directorate Railway Board 29/7/2023

Office of CE / Design

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Note: For Seismic zone III, IV & V HYSD steel bars having minimum elongation of 14.5 percent and conforming to requirements of IS: 1786 shall be used.

The grade of reinforcing steel shall be Fe 500D/Fe 550D.

Mixing of steel of different grade shall not be permitted and change of grade of steel shall be only through revision of design and drawings.

2.1.5.1. **Reinforcement Detailing**

All reinforcement shall be detailed in accordance with clause 12 and 26 of IS:456 for Plain and Reinforced concrete structures, as per clause 12.3 and 19.6.3 of IS: 1343 for prestressed concrete structures. Ductile detailing of seismic resisting RC elements, shall comply with ductile requirements of IS: 13920.

2.2. **Durability**

Durability of Concrete shall be as per clause 8.0 of IS: 456 for Plain and Reinforced Concrete structures, as per clause 8.0 of IS:1343 for Prestressed, Concrete structures and Section 15 of IS:800 for Steel Structures.

2.2.1. **Concrete Grades**

Grade of concrete for RCC/PCC shall be as per Table 5 of IS456 for Plain and Reinforced Concrete structures and for prestressed concrete it shall be as per Table-4 of IS:1343.

Structural Member	Minimum Grade
All RCC members Including piles	M-25
PSC members	M-30
Blinding Layer/ Leveling course	M-15

2.2.2. **Cover to Reinforcement**

As per clause 26.4 of IS:456 for Plain and Reinforced Concrete Structures and clause 12.3.2 of IS: 1343 for prestressed concrete structures. Cover to prestressing steel shall be in accordance with clause 12.1.6 of IS:1343.

2.2.3. **Fire Resistance period**

All the structure elements in the station building shall be designed for minimum fire resistance period for 2hours. The minimum element thickness for this fire resistance Shall be as per clause 21 of IS:456 for concrete structures and as per section 16 of IS:800 for steel structures.

2.2.4. **Crack Width Check**

All structural concrete elements shall be designed to prevent excessive cracking due to flexure, early age, thermal and shrinkage. Flexural crack width shall be checked in accordance with clause 35.3.2 and 43 of IS:456- Plain and Reinforced Concrete Structures and clause 20.3.2 and 24.2 of IS:1343 for Prestressed Concrete structures.

2.3. **Clearances**

a) **Clearance for Road Traffic:** As per relevant IRC specifications and Road Authority requirements. Minimum vertical clearance for road traffic shall be 5.5m.

b) **Clearance for Railway Traffic:** Indian Railway schedule of Dimension (SOD) shall be applicable. Minimum vertical clearance for railway traffic shall be 5.87m as per Schedule -

Project Directorate Railway Board 29/7/2025

Office of CE / DMRC

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

1 Clause 10 (c) + 0.275m for raising of track as per Clause 10 (Notes (e)) of Indian Railway SOD (Revised 2022) (corrected upto ACS-04).

c) **Clearance for Metro Traffic**: As per approved SOD of Patna Metro.

d) **For Utility services**: The clearance to utilities, drainage etc. shall be as mandated by the utility owner/department.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
Received on
29/11/2023
Railway Board

Office of CE / Design
DMRC

2.4. **Design Loads**

Elementary Loads to be considered for design are:

a) Dead Loads	DL
b) Super Imposed Loads	SIDL
c) Imposed (Crowd Live) loads	LL
d) Earthquake loads	EQ
e) Wind Loads	WL
f) Collision/Impact Loads/Derailment Loads	CL*
g) Construction & Erection Loads	EL
h) Temperature Loads	OT
i) Shrinkage	S
j) Creep	C
k) Earth & water Pressure	EP
l) Surcharge Loads (Traffic, building etc.)	SR
m) Pre-stress Force	PR
n) Long Welded Rail Force	LWR
o) Differential Settlement	DS

*Load as applicable shall be taken.

2.4.1 **Dead Loads**

Dead load shall be based on the actual cross section area and unit weights of materials and shall include the weight of the materials that are structural components of Elevated Station and permanent in nature.

2.4.2 **Superimposed Dead Loads (SIDL)**

Superimposed dead loads include all the weights of materials on the structure that are not structural elements but are permanent.

Note: *The SIDL can be of two types: Fixed or non-variable, and variable. In case Metro certifies that a portion of SIDL is of fixed or non-variable type and is not likely to vary significantly during the life of the structure and a special clause for ensuring the same is incorporated in the Metro 's maintenance manual, the load factors applicable for dead load may be considered for this component of SIDL*

The minimum distributed and concentrated loads shall be in accordance to IS:875, wherever available for remaining Metro railway shall specify the loads.

2.4.3 **Imposed (Crowd Live) Load**

Imposed loads on station buildings are those arising from occupancy and the values includes, normal use by persons, furniture and moveable objects, vehicles, rare events such as concentrations of people and furniture, or the moving or stacking of objects during times of re-organization and refurbishmem, this shall be as per clause 19.3 of IS 456.

2.4.4 **Earthquake Loads**

Earthquake design shall follow the seismic requirements of IS:1893 (Part -1). The provision as per Design Basis Report for Viaduct of Metro System shall be followed where structures are taking moving loads of metro.

2.4.4.1. Drift Limitation

The storey drift in the building shall satisfy the drift limitation specified in cl. 7.11.1 i IS:1893.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

2.4.4.2. Seismic Detailing

(i) For reinforced concrete structures as per IS:13920.
(ii) For other structures as per IS:4326.

2.4.5 **Wind Loads**

The wind load shall be calculated as per IS 875: Part-3

The applicable basic wind speed shall be 47 m/s for Patna Zone (as per National Building code).

2.4.6 **Collision/Impact Loads/Derailment Loads**

(i) For road traffic as per IRC 6.
(ii) For metro as per IRS Bridge Rule.

2.4.7 **Construction and Erection loads**

The weight of all temporary and permanent materials together with all other forces and effects which can operate on any part of structure during erection shall be taken into account. Allowances shall be made in the permanent design for any locked in stresses caused in any member during erection.

2.4.8 **Temperature**

As per clause 19.5 of IS:456, Temperature Gradient shall be considered as per clause-215 of IRC-6, if applicable.

Maximum temperature considered as per Annexure-F of IRC 6: +46.6°C

Minimum temperature considered as per Annexure-F of IRC 6: +1.4°C

2.4.9 **Shrinkage**

The shrinkage strain shall be evaluated as per clause 6.2.4 of IS:456 of Plain and Reinforced concrete structures and clause 6.2.4 of IS:1343 for Prestressed concrete Structures.

For structure supporting Metro loading the effects of shrinkage as per clause Cl. 5.2.3 of IRS-CBC shall be considered.

2.4.10 **Creep**

The creep strain shall be evaluated as per clause 6.2.5 of IS:456 of Plain and Reinforced concrete structures and clause 6.2.5 of IS:1343 for Prestressed concrete Structures.

For structure supporting Metro loading the effects of creep as per clause Cl. 5.2.4 of IRS-CBC shall be considered.

2.4.11 **Earth & Water Pressure**

In the design of structures or part of structures below ground level, such as retaining walls and underground pump room/water tank etc. the pressure exerted by soil or water or both shall be duly accounted for. When a portion or whole of the soil is below the free water surface, the lateral earth pressure shall be evaluated for weight of soil diminished by buoyancy and full hydrostatic pressure. (as per IS:875-Part-5)

Project Directorate 29/7/2025

Office of CE / Design DMRC

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

All foundation slabs/footing subjected to water pressure shall be designed to resist a uniformly distributed uplift equal to the full hydrostatic pressure. Checking of overturning of foundation under submerged condition shall be done considering buoyant weight of foundation.
If any of the structure supporting metro loading is subject to earth pressure, the loads and effects shall be calculated in accordance with Cl. 5.7 of IRS-Substructure code.

2.4.12 **Surcharge Load**

In the design of structures or parts of structures below ground level, such as retaining walls and underground pump room/water tank etc, the pressure exerted by surcharge from stationary or moving load, shall be duly accounted for.

2.4.13 **Pre-stressing Force (PR)**

The pre-stressing force should be as per IS-1343.

2.4.14 **Long welded Rail Force**

Guidelines vide BS Report No. 119 "RDSO Guidelines for carrying out Rail-Structure Interaction studies on Metro System (Version-2)" shall be followed. These guidelines shall be read alongwith IRS Bridge Rules clause no. 2.8.2.4.3.

2.4.15 **Settlement**

Maximum and differential settlement shall not exceed, as provided in Table-1 of IS:1904.

2.4.16 **Other Forces and Effects**

As per clause 19.6 of IS:456.

2.5. Design Load Combinations

2.5.1. Ultimate Load Combinations

Each component of the structure shall be designed and checked for all possible combinations of applied loads and forces. They shall resist effect of the worst combination. Following shall be considered:

(i) Load combinations and factors as per Table 18 of IS:456 for Plain and Reinforced Concrete Structures.
(ii) Load combination and factors as per Table 7 of IS:1343 for prestressed concrete structures.
(iii) Load combination as per Section 3 and factors as per Section 5 of IS:800 for Steel structures.
(iv) Load combination as per clause 6.3 of IS:1893 (Part-1).
(v) Where metro live loads are applicable, Load Combination (other than Seismic Load) as per IRS CBC-Reprinted September 2014 (Incorporating ACS 1 to 13).

Note:

(i) Load combination for construction load case shall be decided by Metro as per methodology of construction.

(ii) Reference of IRC:6 be taken for collision case if collision of road vehicles is involved.

29/7/2025

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

(iii) For seismic design of structures, IRS Seismic Code-2020 (Incorporated up to ACS .01) shall be referred.

2.5.2. Serviceability Load Combinations

The following load combinations and load factors shall be used for design for Serviceability limit state:

(i) Load combinations and factors as per Table 18 of IS:456 for Plain and Reinforced Concrete Structures.
(ii) Load combination and factors as per Table 7 of IS: 1343 for prestressed Concrete Structures.
(iii) Load combination as per Section 3 and factors as per Section 5 of IS:800 for Steel structures.
(iv) Load combinations as per IRS CBC where Metro live loads are applicable.

2.6. Deflection Criteria

The deflection limitations as per clause 23.2 of IS:456 for Plain: and Reinforced Concrete Structures and Clause 20.3.1 of IS:1343-for Prestressed concrete structures shall be followed.

2.6.1 Lateral Sway

The lateral sway at the top of building due to wind loads should not exceed H/500, where H is the height of building.

2.7. Fatigue Check

Fatigue phenomenon needs to be analyzed only for those structural elements that are subjected to repetition of significant stress variation (under traffic load). Fatigue checks for

(i) **RCC and PSC structures** -As per clause 13.4 of IRS CBC.
(ii) **Steel Structures-**

(a) In case of Metro live loads, as per clause 3.6 of IRS Steel Bridge Code shall govern. For fatigue verification detailed counting of cycles shall be done.

(b) For other cases as per section 13 of IS:800.

*Damage equivalent factors (As per IRS Steel Bridge code).

2.8. Foundations

2.8.1. Types of Foundation

Considering the nature of ground, type of proposed structures, expected loads on foundations, the following type of foundations are considered practical. General soil conditions are described in Annexure-3.

a) Spread or pad foundation.
b) Raft foundation.
c) Pile foundation.

No matter the type of foundation to be adopted, the following performance criteria

Project Directorate Railway Board 29/7/2025

Office of CE I Design DMRC

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

shall be satisfied.

(i) Foundation shall not fail in shear.

(ii) Foundation must not settle more than the settlements permitted as per Table-1 of IS:1904.

2.8.2. **Design of Pile**

IS 2911 shall be followed for design of pile, load capacity etc.

Pile Settlement

Methods of estimating the settlement of deep foundation depends upon the type of deep foundation and the manner of transfer of loads from the structure to the soil. Theoretical estimation of settlement shall be done in accordance with IS 8009 (part II) by integrating the vertical strain for the entire depth of soil and Rock formation.

The settlement of each pile and/or pile group should be determined and it should be demonstrated that such total and/or differential settlement can be tolerated by the structure

2.8.3. **Foundations**

IS: 1904 shall be followed for design of foundations in soil. The safe bearing capacity for shallow foundations shall be calculated in accordance with IS:6403. As per the soil investigation report, it is revealed that the sub-soil strata from EGL to 1.0m - 2.50 m depth consist of filled up strata and followed by silty Clay / sandy clay / silty sand upto termination depth.

Computation of Settlements of Foundations

The calculation for settlement of foundations shall be done as per:

i. IS:8009 Part-1 for shallow foundations
ii. IS:8009 Part-2 for deep foundations

2.9. **Design of Water Retaining Structure**

It should be designed as per IS:3370.

3. List of Design Codes and Standards

The designs of station buildings shall be carried out as per provisions of this Design Specifications. Reference shall be made to following codes for any additional information.

a. Order of preferences of codes shall be as follows: -
i. IS
ii. IRS
iii. IRC
iv. BS or Euro Code
v. AASHTO

List of latest design codes and standards referred in this DBR are given in Annexure – 4.

Project Directorate Railway Board 29/7/2025

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design DMRC

ANNEXURE-1

(Brief Description of the Project)

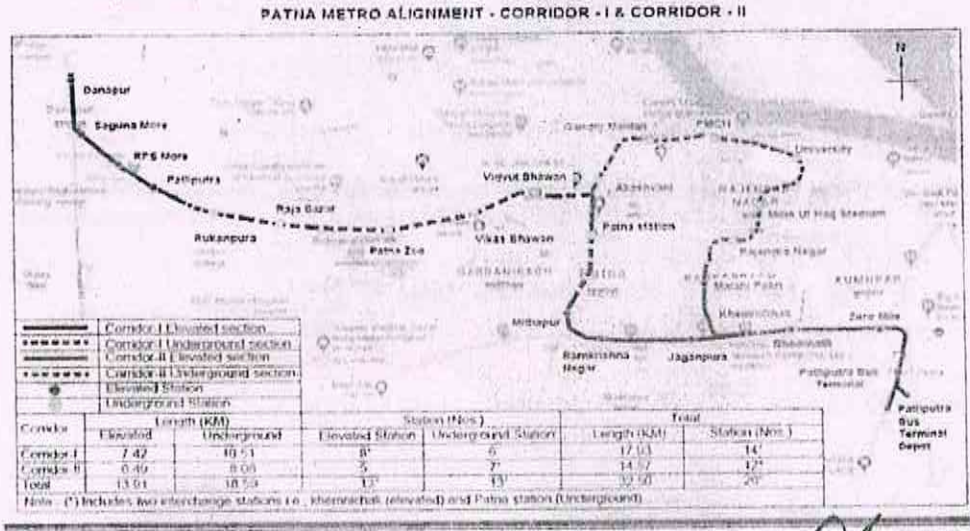
The brief description of project is as follows:

1. **Sanction letter:** Copy/reference of the approval or sanctioned letter issued by Government of India is enclosed at end of Annexure-I.
2. **Project Title:** Patna Metro Rail Project which comprises of two corridors having elevated and underground section:
   a. Corridor- I: Danapur to Mithapur
   b. Corridor-II: Patna Railway Station to New ISBT
3. **Corridor Length:** Total elevated corridor is of 13.91Km in Corridor-I & Corridor-II
   a. Corridor-I – 7.42 Km
   b. Corridor-II – 6.49 Km
4. **Total number of Stations along with type of platform:** Total 13 nos. of elevated station in Corridor-I & Corridor-II.

S.No.	Station Name	Type of Platform
Corridor-I		
1	Danapur	2-Side Paltform
2	Saguna More	2-Side Paltform
3	RPS More	2-Side Paltform
4	Patliputra	2-Side Paltform
5	Mithapur	2-Side Paltform
6	Ramkrishna Nagar	2-Side Paltform
7	Jaganpura	2-Side Paltform
8	Khemni Chak	2-Side Paltform (Interchange Station)
Corridor-II		
1	Malai Pakri	2-Side Paltform
2	Khemni Chak	2-Side Paltform (Interchange Station)
3	Bhootnath	2-Side Paltform
4	Zero Mile	2-Side Paltform
5	New ISBT	2-Side Paltform

5. **Information and location of depots** – Patliputra Bus Terminal Depot
6. **Project Map:**

PATNA METRO ALIGNMENT - CORRIDOR - I & CORRIDOR - II



Corridor	Length (KM)		Station (Nos.)		Total	
	Elevated	Underground	Elevated Station	Underground Station	Length (KM)	Station (Nos.)
Corridor-I	7.42	10.51	8*	6	17.93	14*
Corridor-II	6.49	8.05	5	7*	14.54	12*
Total	13.91	18.56	13*	13*	32.47	26*

Note – (*) Includes two interchange stations i.e., Khemnichak (elevated) and Patna station (Underground).

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

F.No. K-14011/P-1/2016-UT-V
Government of India
Ministry of Housing and Urban Affairs
Urban Transport Division
(UT-V Desk)

311-B, Nirman Bhawan, New Delhi.
Dated the 27th February, 2019.

To,

The Chief Secretary,
Government of Bihar,
Main Secretariat, Patna-800 015, Bihar.

Subject: Patna Metro Rail Project.

Sir,

I am directed to convey the approval of the Government of India (GoI) for implementation of the rail-based Mass Rapid Transit System (MRTS) called the "Patna Metro Rail Project" which comprises two corridors of a total length of 31.39 km viz (i) Danapur to Mithapur (16.94 km) and (ii) Patna Railway Station to New ISBT (14.45 Km) at a total completion cost of Rs. 13,365.77 crores (Rupees thirteen thousand three hundred sixty five crores and seventy seven lakhs only) with contribution of GoI in the form of Equity and Subordinate Debt as per the details given in para 4 below and subject to the conditions as given in para 8 below.

2. Patna Metro Rail Corporation Limited (PMRCL) shall function as a Special Purpose Vehicle (SPV) for the implementation of the project which shall be jointly and equally owned by Government of India (GoI) and Government of Bihar (GoB). The project will be implemented in 05 years from the date of approval.

3. **Legal Framework:** Legal cover for the Patna Metro Rail Project shall be under the Metro Railways (Construction of Works) Act, 1978; the Metro Railways (Operation & Maintenance) Act, 2002; Metro Railways (Amendment) Act, 2009 and the Railways Act, 1989, as amended from time to time.

4. **Project Financing:** The cost of the project will be financed as per the funding pattern given below:

Funding Pattern - Patna Metro Rail Project			
S.No.	**Source of Fund**	**Amount (Rs. in Crores)**	**% Contribution**
1	GoI Equity	1441.12	15.66%
2	GoI Subordinate Debt for CGST (50% of Central Taxes)	399.19	4.34%

Examined and found in order
Director/UT/Civil
RDSO, Lucknow

Project Directorate Approving Board 29/7/2025

Office of CE/De... DMRC

Page 11

3	Govt. of Bihar Equity	1441.12	15.66%
4	Govt. of Bihar Subordinate Debt for CGST (50% of Central Taxes)	399.19	4.34%
5	Loan from bilateral/ multilateral agencies	5520.93	60.00%
6	**Total cost excluding Land, R&R and PPP components**	**9201.55**	**100.00%**
7	PPP component (AFC for Stations)	96.36	
8	**Total**	**9297.91**	
9	Govt. of Bihar Subordinate Debt for Land including R&R cost	3401.66	
10	Subordinate Debt for SGST (100% of State taxes) to be borne by Govt. of Bihar	645.48	
11	IDC for Loan & Front End Fee to be borne by Govt. of Bihar	20.72	
12	**Total Completion Cost**	**13365.77**	

5. The component-wise cost of Patna Metro Rail Project is given at **Annexure-I.**

6. **Institutional Arrangements**: This Project is proposed to be implemented by Patna Metro Rail Corporation Limited (PMRCL), the existing Special Purpose Vehicle (SPV) of State Government of Bihar (GoB) which shall be converted into a 50:50 Joint Venture company of Government of India (GoI) and Government of Bihar (GoB) i.e. equal equity participation of GoI and GoB. The joint ownership company will continue to be named as PMRCL. The promoters, the GoI and GoB, shall nominate five Directors each to the Board of Directors (BoD) of the SPV totaling 10 nominee Directors. The ex-officio Chairman of BoD will be among the five nominee Directors from GoI and the full-time Managing Director (MD) with adequate technical experience, among the five nominee Directors from GoB, will be appointed with the prior written permission of GoI. The Managing Director shall not be given any other/additional assignment by GoB without the prior written permission of MoHUA. Functional and other Directors shall be appointed by the SPV as per the requirement.

7. **High Powered Committee**: During implementation of the project, a High Powered Committee under the chairmanship of the Chief Secretary to the Government of Bihar, with other concerned Secretaries as members will be constituted to take expeditious decisions on matters relating to land acquisition, shifting of utilities and other structures in the project alignment, rehabilitation of Project Affected Persons, Multi modal Integration and such other matters where the State Government has to facilitate quick action including various conditions of sanction of this project.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate Railway Board 29/7/2025

Office of the Chief Design DMRC

8. **Terms and Conditions of Sanction:**

i. There will be no liability on the part of the Government of India if the ridership does not materialize and/or the project does not make adequate profits/surplus.

ii. **Central Laws,** i.e., the Metro Railways (Construction of Works) Act, 1978, the Metro Railways (Operation & Maintenance) Act, 2002 as amended through Metro Railways (Amendment) Act, 2009 and the Railways Act, 1989 would be applicable. Central Government's decisions with regard to safety, standardization and indigenization of rolling stock across all metro systems would be applicable.

iii. The project shall be implemented by a 50: 50 joint owned Special Purpose Vehicle (SPV) of GoI and Govt. of Bihar.

iv. GoI and Govt. of Bihar, shall nominate five Directors each to the Board of Directors (BoD), of SPV totaling 10 nominee Directors. The ex-officio Chairman of BoD will be amongst the five nominee Directors from GoI and the full-time Managing Director (MD) with adequate technical experience, among the five nominee Directors from Govt. of Bihar, will be appointed with the prior permission of GoI. The Managing Director shall not be given any other/additional assignment by Govt. of Bihar without the prior written permission of MoHUA.

v. The Special Purpose Vehicle (SPV), which shall implement this project, shall generally adopt the guidelines of Department of Public Enterprises, the Department of Economic Affairs and the Central Vigilance Commission as necessary to strengthen the Corporate Governance and shall be subject to the Parliamentary scrutiny.

vi. The SPV shall be bound by such directions on question of policy, as the Central Government may give in writing from time to time after giving due opportunity to the SPV to express its views before giving any direction.

vii. The complete cost of land acquisition, resettlement and rehabilitation (including escalation) shall be met by the State Government. The State Government would ensure that land acquisition does not become reason for delay in implementation of the project.

viii. **Procurement of Additional Rolling Stock:** Government of India will not share any cost towards procurement of additional rolling stock in the second and subsequent years of operation, as this would not be a part of the project cost.

ix. **Cost Escalation:** GOI's proposed funding in the form of equity and subordinate debt will be completely ring - fenced to Rs. 1840.31 crore in terms of Para (E) (iii) (c) of Metro Rail Policy, 2017, which includes grant and subordinate debt for central taxes (customs duty and CGST). This should be suitably incorporated in Memorandum of Association (MoA) and/or Shareholder Agreement. Cost escalation due to price escalation or exchange rate variation leading to increase in the cost of the project within or beyond the approved project time limit, inclusion of any item not referred to in DPR and also any other cost escalation due to change in scope or delay beyond the approved time cycle shall be borne/met/arranged by the State Government. This should be suitably incorporated in Memorandum of Association (MoA) and/or Shareholder Agreement.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
29/7/2025
Railway Board

Office of GE/D
DMRC

Page 13

x. The Government of India would not finance cash losses and capital expenditure during the operational phase and its requirements would be financed by the SPV and/ or the State Govt. from its own resources.

xi. **Taxes**

a. The State Government will either exempt the SPV from its State/local taxes and duties/levies or reimburse the same.

b. The State/local taxes would not form part of the project cost to be shared by the Government of India.

c. There will be no waiver of Central taxes/duties by the Government of India.

xii. **Repayment of Loan:** In case of SPV not being able to repay the loan (as and when it becomes due), the responsibility for the same shall be borne by the State Government, and not by the Government of India.

xiii. The State Government is also advised to rework the DPR on realistic basis with adequate deliberation on the issues, if any, raised by various stakeholders before going ahead with implementation to ensure sustainability of the project.

xiv. **Dedicated Urban Transport Fund:** The State Government should set up a dedicated urban transport fund at the state level as well as at the city/metropolitan area level to create pool of resources for replacement of assets and providing operational subsidies, if any, not only for this project but other Urban Transport projects as well.

xv. **Multimodal Integration**

a. Integration of various modes of transport which would act as feeder/evacuation system to the proposed metro for improved Ridership including adequate parking space for bicycles & cars and bus/taxi/auto stands at the stations, improvement in city bus service to introduce modern ITS-enabled buses, should be given high priority by the State Government.

b. The State Government should provide multimodal integration, including sub-urban railways (by involving Ministry of Railways) to provide a well-connected network in the region.

c. The State Government should ensure that the metro rail project provides for first and last mile connectivity, accessibility and appropriate security arrangements.

d. The State Government should provide common mobility card to provide integrated ticketing and seamless travel across all modes and all operators in the city.

xvi. **Price-Based Measures to promote and facilitate Metro Rail Ridership**: The State Government should ensure price-based measures to promote and facilitate Metro Rail Ridership, as part of integrated traffic rationalization plan and Comprehensive Mobility Plan for the city with a view to ensure that the projected Ridership is realized.

xvii. **Land Use Densification**: Land Use densification as per the TOD guidelines around the stations also needs to be done to increase the ridership and decrease the overall travel demand.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate 29/7/2023

Office of CE / Design DMRC

xviii. **Periodic Fare Revision**: A suitable arrangement, independent of the SPV formed to implement the Metro Rail project, shall be provided for periodic fare revision for the Metro Rail as well as other competing modes.

xix. **Unified Metropolitan Transport Authority**: The State Government should set up a Unified Metropolitan Transport Authority (UMTA), duly backed by legislation, to facilitate coordinated planning and implementation of projects related to urban transport and their integrated management.

xx. **Traffic Information Management Control Centre**: The State Government should set up a traffic information management control center for effective traffic monitoring and enforcement as well as for data generation and data collection for future planning.

xxi. **National Public Transport Helpline**: The State Government should implement National Public Transport Helpline to provide information regarding various aspects of public transport such as routes, arrival/departure times, route planning, ticketing etc. in the city.

xxii. **Parking Policy:** The State Government should come up with a parking policy wherein parking fee represents the true value of the land occupied, which is used to make public transport more attractive; banning of parking on arterial/ring roads; provision of multi-level parking centers in city centers with park-and-ride facility etc.

xxiii. **Advertisement Policy**: The State Government should come up with an advertisement policy which taps advertisement revenue on public transport, intermediate public transport, public utilities and street furniture.

xxiv. **Memorandum of Understanding:** The State Government, the SPV and the Government of India shall enter into a tripartite Memorandum of Understanding regarding detailed terms and conditions for implementation of the project in accordance with sanction of the Union Cabinet. GoI share will not be released till the tripartite MoU is signed.

xxv. Metro stations should be designed and constructed with toilets in the paid area. The toilets should be part of the project cost and meet the needs/ requirements of the Persons with Disabilities.

xxvi. The State Government will endeavor to economize on the cost of the project through value engineering, minimum land acquisition, adoption technological innovation during project life cycle.

xxvii. Expenditure on O&M and debt servicing should be the responsibility of the SPV. In case the SPV fails in respect of this, the liabilities will be borne by the State Government in terms of Para (D) (iv) (d) of Metro Rail Policy, 2017.

xxviii. The SPV will explore the possibility of minimizing land cost after obtaining NOC for the government land from the Government Departments. 90% land should be in possession of the SPV before start of the work. It may also be ensured that land acquisition of private land is completed at the earliest and does not delay the project in any way.

xxix. The SPV will explore the possibility of PPP in other areas of activities related to the metro project in terms of Para (E) (iii) (b) of Metro Rail Policy, 2017.

xxx. The external funding will be on back to back basis as per the Standard arrangement of Department of Economic Affairs.

Project Directorate on Railway Safety
29/7/2021

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Officer/ CE I Design
DMRC

xxxi. In view of overarching fiscal consolidation path, State Government should ensure flow of realisable VCF in the SPV account in terms of Para (D) (vii) (b) of Metro Rail Policy, 2017 for meeting O&M, escalation, debt servicing etc. of the project in a manner that will reduce burden on the State exchequer.

xxxii. The State Government of Bihar should enable the SPV to raise cheaper long term debt in the domestic market by allowing it to issue corporate debt bond in terms of Para (D) (xi) of Metro Rail Policy, 2017.

9. This issues with the concurrence of Integrated Finance Division of this Ministry vide their note in e-file No. 3123361 dated 21st February, 2019 and with the approval of Secretary(HUA) vide above e-office number dated 22nd February, 2019.

Yours faithfully,

Jasbir Singh

(Jasbir Singh)
Under Secretary to the Government of India
Tel: 011-23062285

Copy to:

1. Principal Secretary, Urban Development & Housing Department, Government of Bihar, 1st Floor, Vikash Bhawan, New Secretariat, Patna-800015, Bihar.
2. Resident Commissioner, Government of Bihar, Bihar Bhawan, Kautilya Marg, Chanakyapuri, New Delhi-110021.

Copy forwarded for information to:

1. Principal Secretary to Prime Minister, Prime Minister's Office, South Block, New Delhi-110001.
2. Chief Executive Officer, NITI Aayog, Yojana Bhavan, New Delhi-110001.
3. Secretary, Ministry of Home Affairs, North Block, New Delhi-110001.
4. Secretary, Department of Expenditure, Ministry of Finance, North Block, New Delhi-110001.
5. Secretary, Department of Economic Affairs, Ministry of Finance, North Block New Delhi-110001.
6. Secretary, Department of Revenue, Ministry of Finance, North Block, New Delhi-110001.
7. Chairman, Railway Board, Rail Bhawan, New Delhi -110001.
8. Secretary, Ministry of Environment, Forests & Climate Change, Indira Paryavaran Bhavan, Jor Bagh, New Delhi-110003.
9. Secretary, Ministry of Road Transport & Highways, Parivahan Bhavan, Sansad Marg, New Delhi -110001.
10. Secretary, Ministry of Statistics and Programme Implementation, Sardar Patel Bhavan, Sansad Marg, New Delhi-110001.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate Approved 29/7/2025

Office of CE/I Design DMRC

11. Director (Cabinet), Cabinet Secretariat, Rashtrapati Bhavan, New Delhi with reference to their communication No. 8/CM/2019 (i) dated 18th February, 2019.

Copy also to:

1. PS to Minister of State (Independent Charge) for Housing & Urban Affairs.
2. Secretary (HUA), MoHUA.
3. Additional Secretary (W & H), MoHUA.
4. Joint Secretary & Financial Adviser, MoHUA.
5. OSD (UT) & ex-officio Joint Secretary, MoHUA.
6. Director (MRTS-I)/Director (MRTS-II)/Director (UT-II)/DS(UT-I), MoHUA.
7. Chief Controller of Accounts, MoHUA, Nirman Bhavan, New Delhi.
8. PAO (Sectt), MoHUA, Nirman Bhavan, New Delhi
9. Under Secretary (D-II), Integrated Finance Division, MoHUA
10. Budget Section, MoHUA.
11. Sanction Folder.

Jasbir Singh

(Jasbir Singh)
Under Secretary to the Government of India
Tel: 011-23062285

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
29/7/2019

Office of PED (Urban)
DMRC

Page 17

F.No. K-14011/P-1/2016-UT-V
Government of India
Ministry of Housing and Urban Affairs
Urban Transport Division
(UT-V Desk)

Annexure-1

Component-wise cost of Patna Metro Rail Project's Corridors from Danapur to Mithapur (16.94 km) and from Patna Railway Station to New ISBT (14.45 Km).

(All amount is in Rs crores)

S. No.	Item	Corridor-1	Corridor-2	Total
1	Alignment and Formation	1324.6	788.43	2113.04
2	Station Buildings incl. Civil works, EM works, ECS, TVS, Lift, escalators & Architectural Finishes etc	1607.89	859.43	2467.32
3	Depot including civil, EM, Machinery & plants, general works & OCC Building	168	110	278
4	P-Way for main line, depot and depot connectivity	136.92	118.68	255.6
5	Traction & power supply for main line and depot incl. OHE, ASS, GIS etc.	267.58	197.64	465.22
6	Signaling and Telecom etc	174.35	157.57	331.92
7	Environmental Cost	2.63	2.42	5.05
8	Miscellaneous Utilities, road works, Topographic Surveys, Geotechnical Investigation, Barricading, Tree Cutting and replanting, other civil works such as signage's, Environmental protection and traffic management	101.64	86.73	188.37
9	Capital Expenditure on Security including civil and EM works	4.44	4.44	8.88
10	Staff Quarters including civil, electrical works	27.61	0	27.61
11	Capital Expenditure on Inter modal integration including Footpath for pedestrians	36	36	72
12	Rolling Stock (RS)	480	336	816
13	**Total Cost at Dec-2018 price levels (Excluding Land, R&R, PPP, IDC, General Charges, Contingencies, Central & State Taxes and)**	4331.66	2697.34	7029.00
14	General Charges including Design charges @ 5%	216.58	134.87	351.45
15	Contingencies @ 3 %	129.95	80.92	210.87

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Office of CE / Design
DMRC

Project Directorate
29/7/2025
Railway Board

Page 18

16	**Total Cost at Dec-2018 price levels incl. General Charges and Contingencies (Excluding Land, R&R, PPP, IDC, Central & State Taxes)**	4678.19	2913.13	7591.32
17	**Total Cost at Dec-2018 price level including General Charges, (Excluding Land, R&R, PPP, IDC, Contingencies, Central & State Taxes)**	4548.24	2832.21	7380.45
18	Escalation at 5 % p.a on all items except contingencies	500.31	311.31	811.85
19	**Total Cost including General Charges, Contingencies, Escalation, (excluding Land, R&R, PPP, IDC, Central & State Taxes)**	5178.50	3224.67	8403.17
20	Central Taxes including basic customs duty	444.56	274.7	719.26
21	Escalation at 5 % p.a on Central Taxes including basic customs duty	48.90	30.22	79.12
22	**Total of Central Taxes including escalation**	**493.46**	**304.92**	**798.38**
23	**Total Cost including General Charges, Contingencies, Escalation, Central Taxes (excluding Land, R&R, PPP, IDC, State Taxes)**	5671.96	3529.59	9201.55
24	State Taxes	357.31	224.2	581.51
25	Escalation at 5 % p.a on State Taxes	39.30	24.66	63.97
26	**Total of State Taxes including escalation**	**396.61**	**248.86**	**645.48**
27	Land Cost	2227.78	1162.72	3390.51
28	Cost of Rehabilitation & Resettlement (R&R)	5.83	5.32	11.15
29	**Total of Land and R&R Costs**	**2233.61**	**1168.04**	**3401.66**
30	PPP component (AFC installations) including Central and State Taxes, escalation etc	48.18	48.18	96.36
31	Interest during Construction (IDC) including Front End Fee	12.77	7.95	20.72
32	**Total Completion Cost**	8363.15	5002.62	13365.77

Jasbir Singh

(Jasbir Singh)
Under Secretary to the Government of India
Tel: 011-23062285

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
29/7/2025
Railway Board

Office of Chief Design
DMRC

ANNEXURE-2

Geometric Design Parameters

Geometric Design Parameters used for this project are as below:

1.	Track Gauge	: Standard Gauge (1435mm)
2.	Maximum Permissible Gradient	: 1 in 1200 (Maximum)
3.	Maximum Design Speed	: 90 Kmph
4.	Design Axle Load	: 16T
5.	Radius of Horizontal Curve	: 1000m (Minimum)
6.	Radius of Vertical Curve	: Nil

Note: All the above parameters are as per the SOD of Patna Metro.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
Approved on
29/7/2025
Railway Board

Office of CE / Design
DMRC

ANNEXURE-3

As per the soil investigation report, it is revealed that the sub-soil strata from EGL to 1.0m - 4.50 m depth consist of filled up strata and followed by silty Clay / sandy clay / silty sand of different classifications upto termination depth, which is varying from place to place.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
Railway Board
29/7/2025

Office of GM
DMRC

ANNEXURE-4

List of latest design codes and standards referred in this DBR are as below:

1. IS:456 (Reaffirmed 2021, upto amendments no. 06)
2. IS:1343 (Reaffirmed 2022, upto amendments no. 01)
3. IS:800 (Reaffirmed 2017, upto amendments no. 02)
4. IS: 1893: Part -1 (Reaffirmed 2021, upto amendments no. 02)
5. IS: 4923 (Reaffirmed 2023, upto amendments no. 03)
6. IS: 2062 (Reaffirmed 2021, upto amendments no. 01)
7. IS: 1161 (Reaffirmed 2024, upto amendments no. 01)
8. IS: 11384: 2022
9. IS: 3935 (Reaffirmed 2022)
10. IS: 1786 (Reaffirmed 2023, upto amendments no. 04)
11. IS: 13920 (Reaffirmed 2021, upto amendments no. 02)
12. IS: 4326 (Reaffirmed 2018)
13. IS 875: Part-3: 2015 (Reaffirmed 2020, upto amendments no. 02)
14. IS 875: Part-5: 1987 (Reaffirmed 2023, upto amendments no. 01)
15. IS: 1904: 2021
16. IS: 2911: Part 1 (Reaffirmed 2020, Sec-1,2,3&4)
17. IS: 2911: Part 2 (Reaffirmed 2021)
18. IS: 2911: Part 3 (Reaffirmed 2021)
19. IS: 2911: Part 4 (Reaffirmed 2018)
20. IS: 8009: Part 1: 1976 (Reaffirmed 2023, upto amendments no. 03)
21. IS: 8009: Part 2: 1980 (Reaffirmed 2020, upto amendments no. 01)
22. IS: 3370: Part 1: 2021(Upto amendments no. 01)
23. IS: 3370: Part 2: 2021(Upto amendments no. 01)
24. IS: 3370: Part 3: 2021
25. IS: 3370: Part 4: 1967 (Reaffirmed 2018, upto amendments no. 02)
26. IS: 3370: Part 4: Sec 1: 2021(Upto amendments no. 01)
27. IS: 3370: Part 4: Sec 2: 2021(Upto amendments no. 01)
28. IS: 3370: Part 4: Sec 3: (Upto amendments no.-01)
29. IRS Concrete Bridge Code - Reprint September 2014 (Incorporating A&C 1 to 13 & upto ACS 11, dt. 19.07.2024)
30. IRS Bridge Rules - Reprint 2014 (Incorporating A&C upto 53)
31. IRS Seismic Code 2020 (Incorporated upto ACS 02)
32. IRS Bridge Sub, Structure and Foundation 2013 (Incorporating A&C upto 11, dt.25.04.2024)
33. IRS: Steel Bridge Code 2017 (Incorporating A&C upto 24)
34. IRS B1 (Fabrication Code) 2008 (Incorporating A&C upto 12)
35. RDSO Guidelines for carrying out Rail Structure Interaction studies on Metro System (Version-2)
36. IRC:6 2017(Upto amendments no. 08)

These codes with latest revisions including all addendums/notifications and correction slips only shall be used.

Examined and found in order

Director/UT/Civil
RDSO, Lucknow

Project Directorate
29/7/2025
Railway Board

Office of CE / Design
DMRC