


LIGHT METRO IN URBAN TRANSPORT SECTOR (MODE CHOICE)

By

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6th November 2017

10th URBAN MOBILITY INDIA & CODATU XVII CONFERENCE
INTELLIGENT, INCLUSIVE AND SUSTAINABLE MOBILITY

Little about Delhi Metro Rail Corporation

Delhi Metro Rail Corporation (DMRC)
At a Glance

- **Company Set up in May 1995 under the Indian Companies Act.**

- **A joint venture between the Government of India and the Government of Delhi State, with equal equity, the first company with such structure in India.**

- **DMRC has the responsibility for construction and operation of Delhi Metro.**

- **Has mandate to assist other cities in their Endeavour for developing Metro Rail.**

Delhi Metro Rail Corporation (DMRC) At a Glance(Contd.)

- **For Delhi , We have a master plan with 12 lines, covering 420 kms. to be completed by 2021 in four Phases.**
- **Phase-I – 65 kms. Cost US $ 2.5 billion (Euro 2.4 billion). Work started on 1st Oct. 1998 and completed by December 2005.**
- **Phase-II – 120 kms. Cost US $ 4.3 billion (Euro 4.1 billion). – Completed within 5 years by Oct.2010**
- **Phase-III consisting of 153 kms. to be constructed at an approximate cost of Rs. 6.92 billion Us $ (Euro 6.5 billion) is in progress .Works are now in progress and are to be completed by 31st March 2018.**

Delhi Metro Rail Corporation (DMRC) At a Glance(Contd.)

- **Total Metro Network of 217 Kms at Delhi is operational.**
- **About 3017 train trips a day – with 227 train sets (1394 Coaches) on 6 lines.**
- **Average Ridership – more than 2.9 million passengers per day with average lead of more than 16 Kms.**

Classification of Indian Cities for Urban Transport

- Tier I- Population more than 2 million
  - 19 Cities fall in this category
- Tier II- Population of 1 million and up to 2 million
  - 34 Cities fall in this category
- Tier III- Population of 0.5 Million and up to 1 million
  - 43 Cities fall in this category

Mass Rapid Transit System Modes

Modes- DMRC's Perspective

Heavy Metro Rail Transport – PHPDT more than 45,000	
Medium Metro Rail Transport – PHPDT more than 25000 but up to 45,000	
Light Metro– PHPDT more than 4000 but up to 25000	

Modes-DMRC's Perspective

Light Rail Transit System (LRT)- PHPDT up to 10000

Metro Bus(electric Buses)- PHPDT up to 8000

Comparison of Different Types of Mass Rapid Transit Systems

Sl. No.	Parameter	Heavy Metro	Medium Metro	Light Metro	LRT	Metro Bus
1	Axle Load	17 T	14T	11T to 12 T	11 T	11 T
2	PHPDT range	More than 45000	More than 30000 and upto 45000	Upto 30000	Upto 10000	Upto 8000
3	Number of cars	6 cars or more	4 to 6 cars	2 to 4 cars	3 to 7 cars	Electric Bus
4	Car dimensions	2.9 m/3.2 m wide 22 m long	2.9m/3.2m wide 22 m long	2.7m/2.9m wide 18 m long	2.5 to 2.7 Length 7-8 M and unit length 21m, 33 m,43m	Length 24 m Width 2.5 M
5	Car capacity	300 persons per car	300 persons per car	200 persons per car	160 per LRT Unit of 3 cars	150 per bus
6	Length of platform required	185m to 210m	140m	90m	50m	50m
7	Speed (Max)	80 KMPH	80 KMPH	80 KMPH	50 Kmph	50 Kmph
8	CAPEX/km (W/O Land cost)	40 Mill US $	35 Mill. US $	27 Mill Us $	19 Mill US $	12 Mill US $
9	Minimum Radius	120 m	120 m	60 m	25 m	25 m
10	Max. Gradient	4 %	4 %	6 %	6 %	6 %

WORKING GROUP ON URBAN TRANSPORT FOR 12TH FIVE YEAR PLAN

Mode Choice	PHPDT in 2021	Population as per 2011 census(mill.)
Metro	More than 15000 in 5 Km. stretch	More than, equal to 2
LRT at grade	Less than, equal to 10000	More than 1
Mono Rail	Less than, equal to 10000	More than 2
BRT	4000-20000	More than 1
Org. City Bus		>1 Lac, 50000 in case of hilly towns

Thiruvananthapuram Light Metro

- Route : Technocity to Karamana
- Route Length : 21.82 Kms.
- Alignment : Elevated
- Stations : 19 Nos.
- PHPDT : 11296(2021)-16000(2041)
- Trains : 3 coach, 2.7 m wide
- Traction : 750 V DC
- Signaling : CBTC with ATO & ATP
- Fare Collection : Automatic
- Viaduct width : 7 Metre on straight

Kozhikode Light Metro

- Route : Medical College to Meenchanda
- Route Length : 13.3 Kms.
- Alignment : Elevated
- Stations : 14 Nos.
- PHPDT : 6079(2021)- 11000(2041)
- Trains : 2 coach, 2.7 m wide
- Traction : 750 V DC
- Signaling : CBTC with ATO & ATP
- Fare Collection : Automatic
- Viaduct width : 7 Metre on straight

Light Rail Transit System (LRTS)

Light Rail Transit System(LRTS)-Definition

- **Light rail**, **light rail transit** (**LRT**) or **fast tram** is urban Public Transport using rolling stock similar to a Tramway, but operating at a higher capacity, and often on an exclusive right-of-way.(Wikipedia)

Some of The Trams and LRTs

Tram Vienna

Tram in Adelaide

Singapore LRT

TRAX Light Rail System US

St. Level LRT Manchester

LRT of Manila Fully Elevated

World Scenario

- In some of the world cities even Tramways are named as LRTs.
- Worldwide there are more than 100 types of Transit Systems named as LRT.
- The situation is “name the city of the world, this may have LRT with different type of Permanent way and different type of rolling Stock”.
- Multiplicity of rolling stock(Steel wheel/Rubber Tyred wheels).
- It creates the situation of “what to follow ?”

DMRC's Perception

- Permanent Way for LRT has to be necessarily rail based.
- LRT is a Transit System having dedicated Right of Way (ROW) with the train length varying up to 53 metre
- Alignment may either be Elevated or Underground.LRT at grade may not be desirable except new township.
- Peak Hour Peak Direction Traffic carried by LRT may go up to 10000 (Maximum)

Limitation of at grade LRT (Light Rail Transit System)

- Indian Two tier cities are having roads with narrow ROW. Therefore, LRT at grade may not be possible.

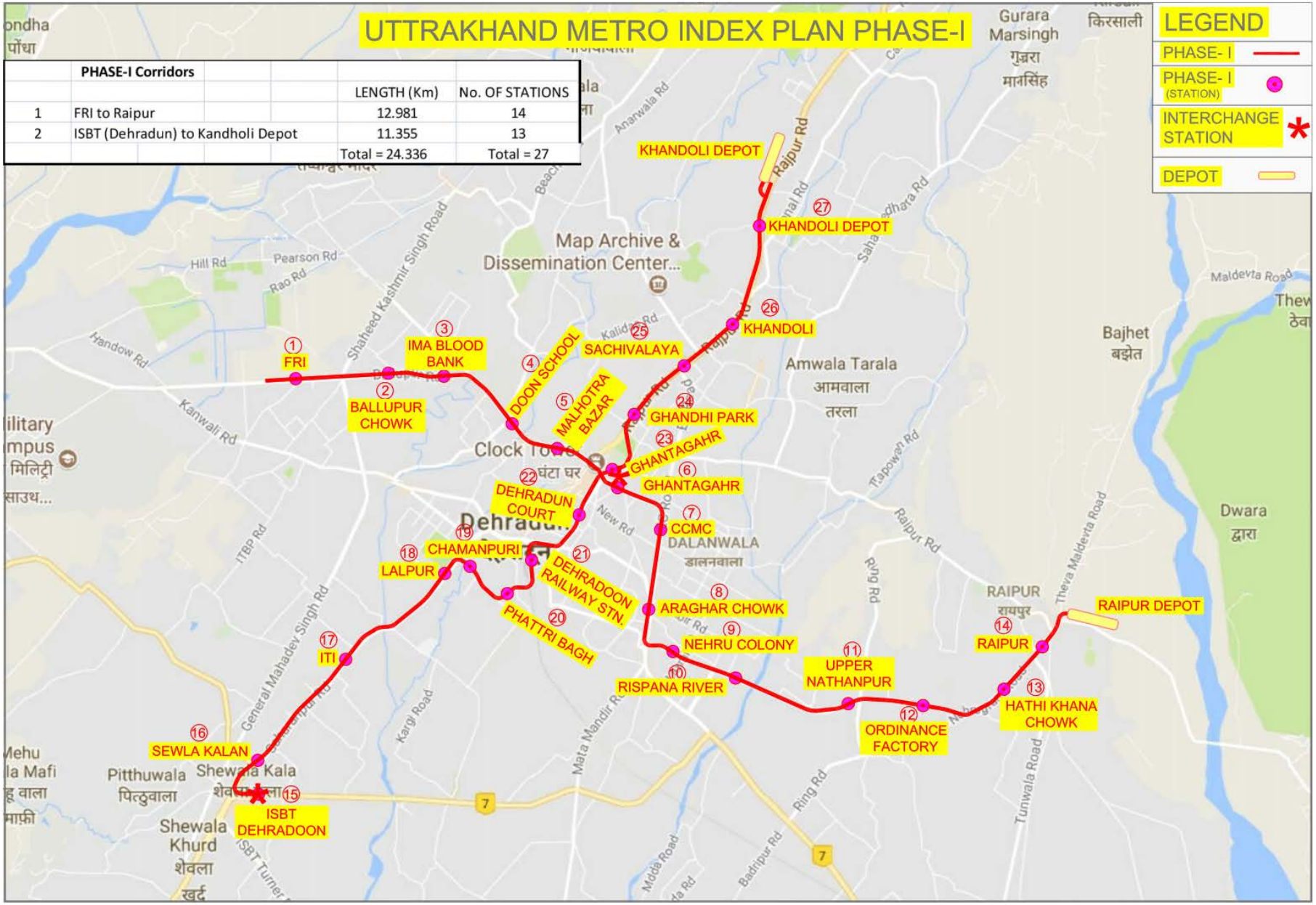
- Normally, the ROW of roads in two tier cities of India is two lane each way with a narrow median. Therefore, these cities may allow only elevated or underground LRT

- At grade may be considered only for new cities being developed, for example Greater NOIDA, Amaravati Capital city or new Development area.

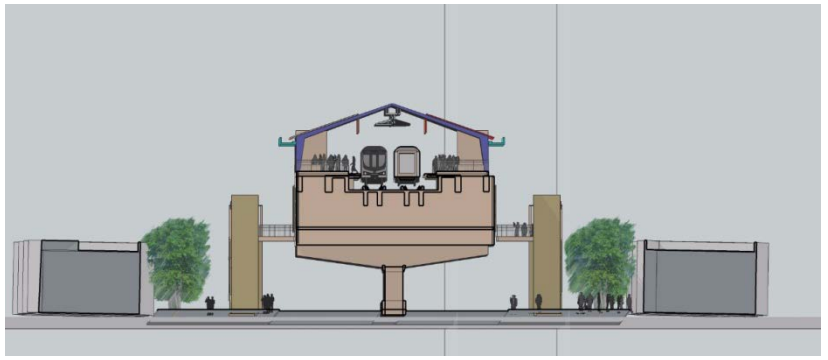
DMRC's Initiative for Development of LRT

- DMRC has proposed LRT for Dehradun City where projected PHPDT is only 2200 in 2021 and 9000 in 2051

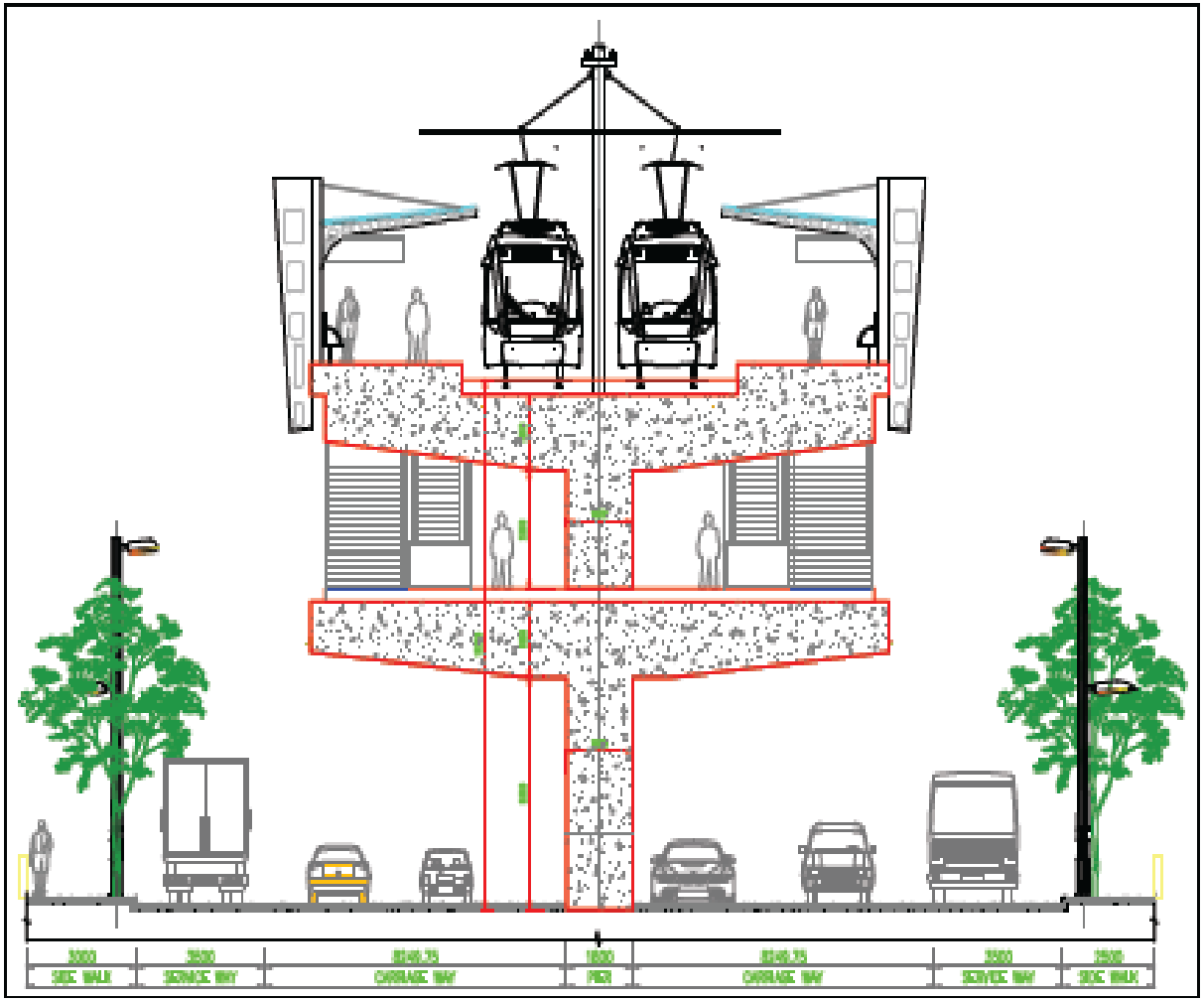
S. No.	Corridor	Length (Kms.)
1.	Kandholi Depot – ISBT Dehradun	11.1
2.	FRI – Raipur	12.9

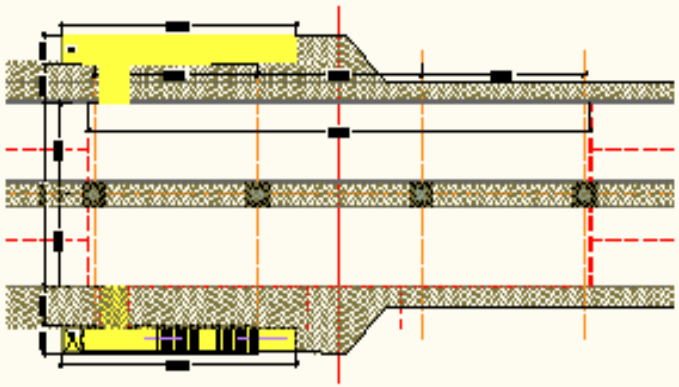

UTTRAKHAND METRO INDEX PLAN PHASE-I
PHASE-I Corridors
LENGTH (Km) No. OF STATIONS
1 FRI to Raipur 12.981 14
2 ISBT (Dehradun) to Kandholi Depot 11.355 13
Total = 24.336 Total = 27
LEGEND
PHASE- I
PHASE- I (STATION)
INTERCHANGE STATION
DEPOT
KHANDOLI DEPOT
KHANDOLI DEPOT
KHANDOLI
SACHIVALAYA
GHANDHI PARK
GHANTAGAHR
GHANTAGAHR
CCMC
DEHRADUN COURT
CHAMANPURI
DEHRADOON RAILWAY STN.
PHATTRI BAGH
ARAGHAR CHOWK
NEHRU COLONY
RISPANA RIVER
UPPER NATHANPUR
ORDINANCE FACTORY
HATHI KHANA CHOWK
RAIPUR
RAIPUR DEPOT
LALPUR
ITI
SEWLA KALAN
ISBT DEHRADOON
IMA BLOOD BANK
DOON SCHOOL
MALHOTRA BAZAR
BALLUPUR CHOWK
FRI
घंटा घर
Map Archive & Dissemination Center...
Amwala Tarala
आमवाला तरला
Bajhet
बझेत
Dwara
द्वारा
DALANWALA
डालनवाला
RAIPUR
रायपुर
Pitthuwala
पित्थुवाला
Shewala Kala
शेवला कला
Shewala Khurd
शेवला खुर्द
Raipur Rd
Rajpur Rd
Hill Rd
Pearson Rd
Rao Rd
Handow Rd
Kanwali Rd
ITBP Rd
General Mahadev Singh Rd
Shaheed Kashmir Singh Road
Kalidas Rd
New Rd
Tapowan Rd
Ring Rd
Thera Malderta Road
Maldevta Road
Tunwala Road
Mata Mandir Rd
Kargi Road
Badripur Rd
ISBT Turner Rd
Gurara Marsingh
गुज्ररा मानसिंह
किरसाली

LRT- Civil Structures

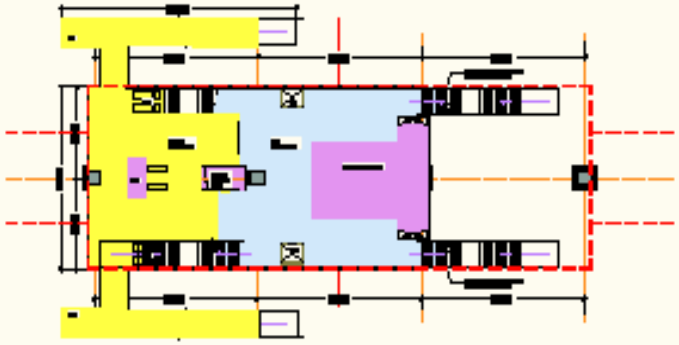
Typical Cross section through Station	
Side view of the Station	
View of the Station at Street Level	

CROSS SECTION OF LRT

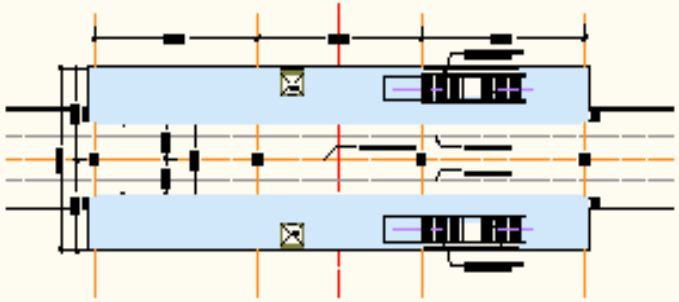




GROUND LEVEL PLAN



CONCOURSE LEVEL PLAN



PLATFORM LEVEL PLAN

Rolling Stock features

Feature	
Gauge	1435 mm
Traction	750 V DC OHE
Length of train	44 Metre (7 cars, Articulated)
Train Capacity	370 passengers per train
Axle Load	11 Tonne
Maximum Opertion Speed	50 Kmph
Platform height	350 mm from rail Level, will be examined for keeping high level Platform
Sharpest curvature	60 Metre

Train Operation Plan

- Trains will be run every 7 minutes to start with and ultimately 3 minutes headway in 2051.

- Trains will be operated manually with signaling (Panel Interlocking) only in depot and terminal stations

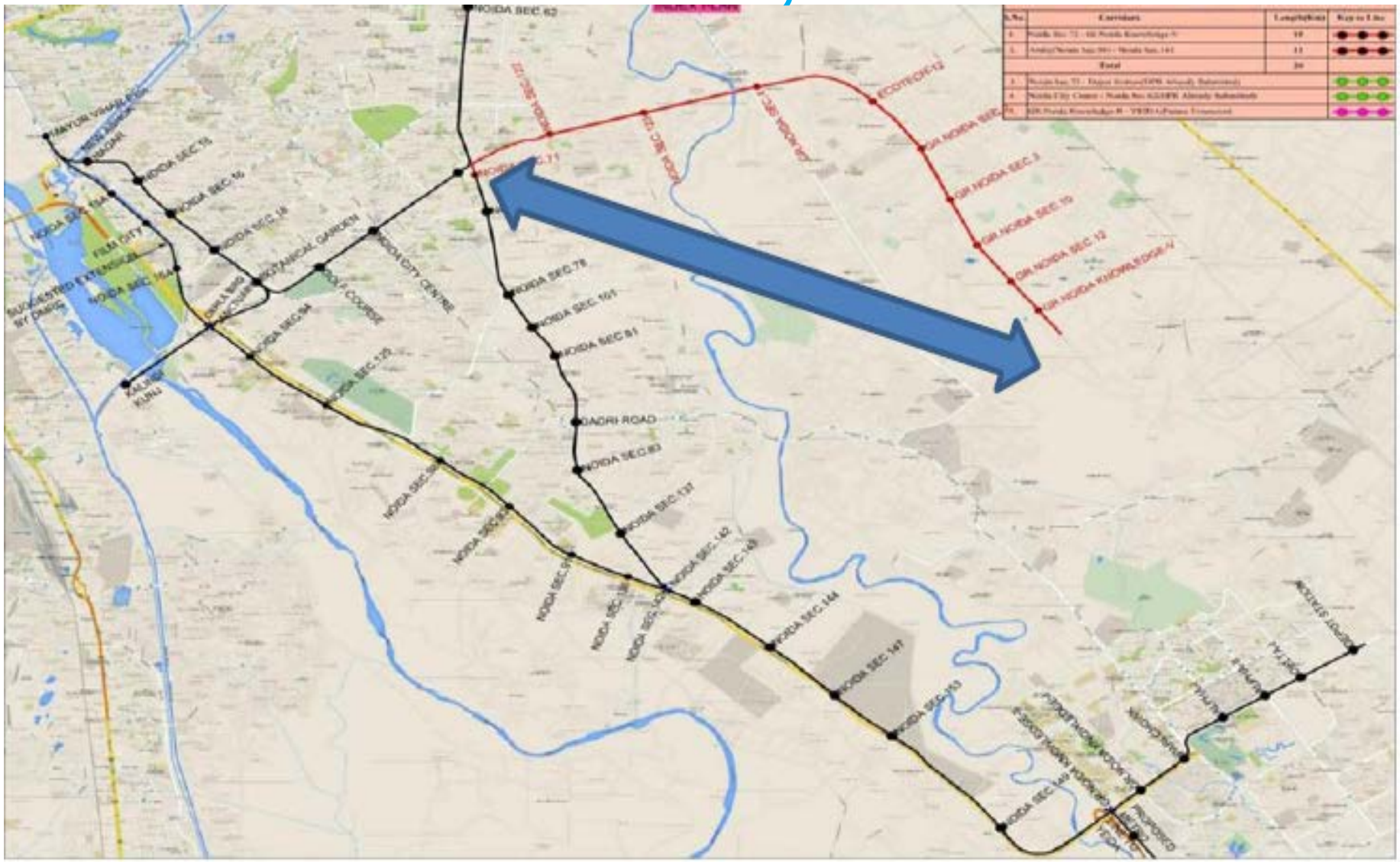
- Average running speed will be 25 kmph.

Cost of LRTas MRTS (for PHPDT of 2500)

- Rs 19 Million US $ per Km.
- Or
- 17 Million Euros per Km.

Metro Bus as Public Transport- A Case Study

NOIDA sector 71 to Knowledge Park V,



NOIDA sector 71 to Knowledge Park V,

- Corridor length- 14.958 km
- Numbers of elevated station (140 meters long) - 9
- Likely date of commissioning 2020-21
- Peak Hour Peak Direction Traffic (PHPDT)

Year	2021	2031	2041	2051
PHPDT	3043	5795	10128	13067

Metro Bus Features

- Interchange station facility at NOIDA sector-71 station with existing Metro Line.
- **Designed for 24mtrs bi-articulated bus.**
- Viaduct of 8 Mtrs of width (2*4 Mts) .
- Sleek bus stops with stainless steel/glass structure to accommodate 2 buses separate on each direction.
- Two lifts (13 pass. each) and one staircase from road level to viaduct on each direction.
- Road lighting masts on both side of viaduct for illumination.
- 2 buses can come in close proximity as per the loading pattern.
- For PHPDT of 3600 as in 2021, 35 buses required with headway of 2.5 minutes & for PHPDT of 6000 in 2031, 54 buses will be required with headway of 1.5 minutes.

Metro Bus Features(Contd.)

- A stabling maintenance depot for 35 buses (open parking), a covered shed for 5 buses,
- Air-conditioned e-buses.
- AFC gates at stations based on smart card. No conductor required.
- GPS monitoring & CCTV on e-Buses.
- Differently abled friendly e-buses and stops.
- CCTV surveillance on the platform.
- No concourse.
- Interchange of platforms via zebra crossing at platform level

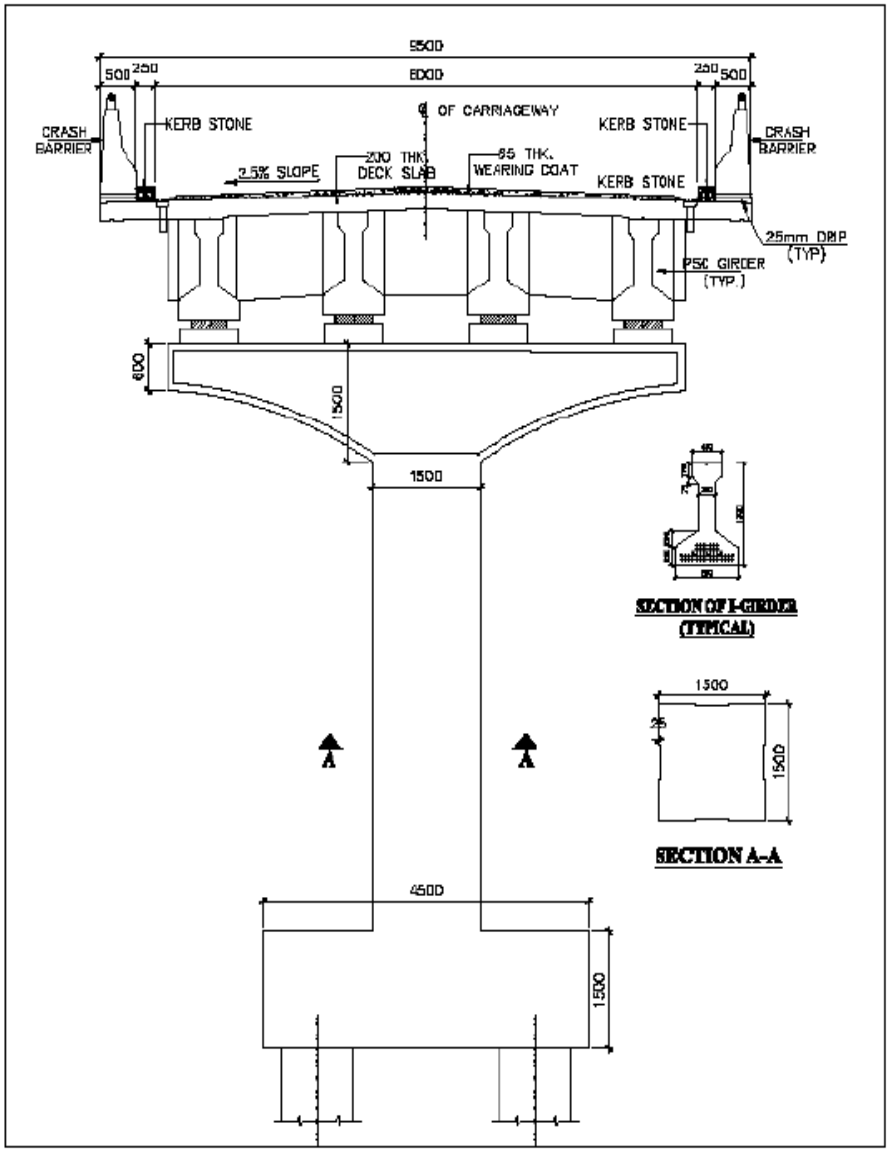


Fig.13: Proposed design of I-Girder.

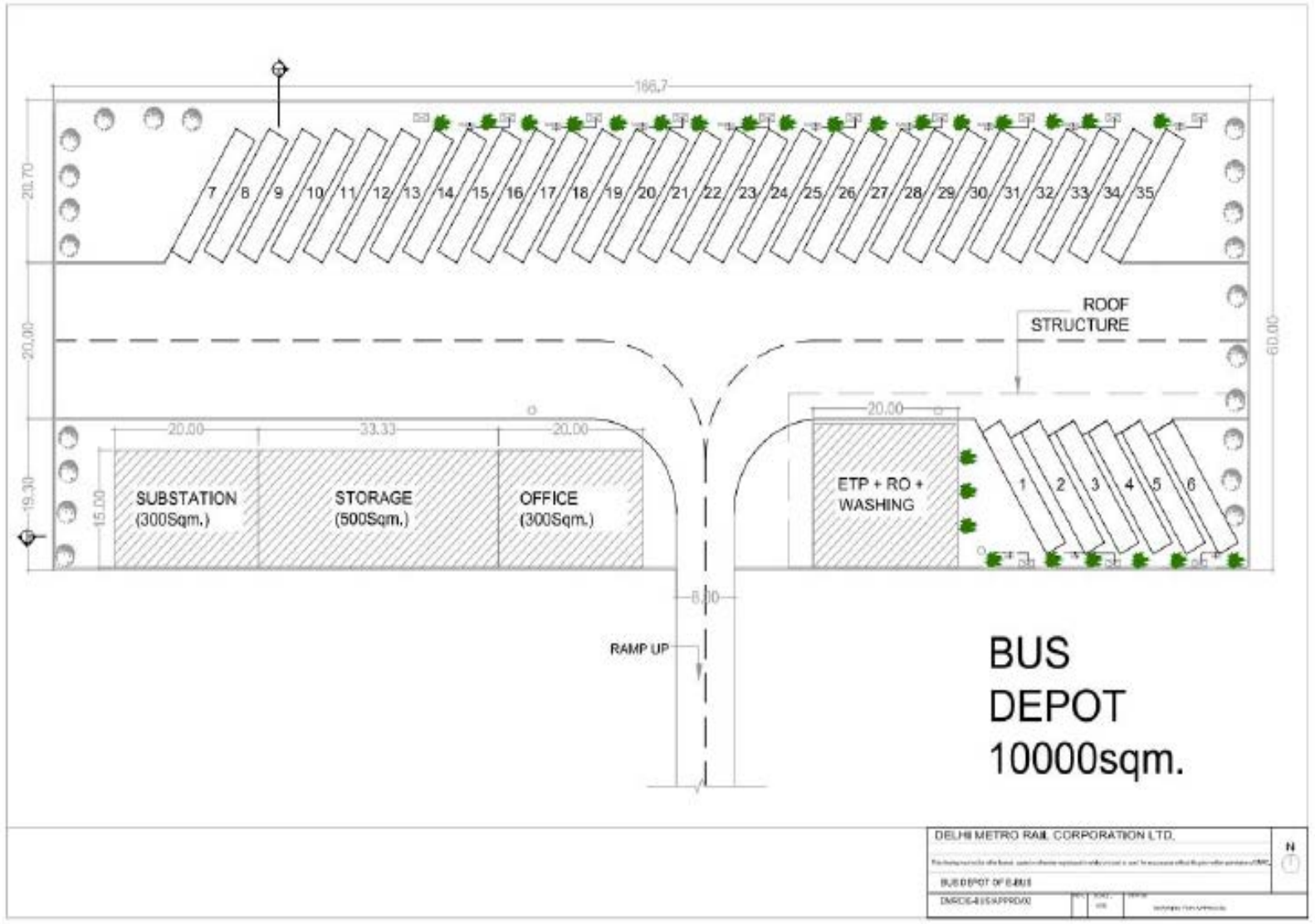


Fig.14: Proposed layout of depot.

Salient Features

S.No.	Subject	Unit	Details as in 2021	Details as in 2031
A	Bus Length	Mts	24	24
B	Average Speed	Kmph	25	25
C	Route Length (One Side)	Km	15	15
D	Passengers/Bus	Nos	150	150
E	Headway	Mins	2.5	1.5
F	PHPDT	Nos/Hr	3600	6000
G	Round Trip Time	Mins	72	72
H	Buses required	Nos	29	48
I	**Total buses required including 6 Nos as "Spare"**	**Nos**	**35**	**54**

Cost of Electric Bus as MRTS (for PHPDT of 3600)

- Rs12 Million US $ per Km.
- Or
- 10 Million Euros per Km.

Fig 2: Sunway, Malaysia BRT: e-Buses running on dedicated elevated corridor

Fig 3: Sunway, Malaysia BRT: Typical Station, Control Room and e-Bus interiors

Fig.5: Opportunity Charging Bus-Bombardier

Conclusions

- In Two tier cities of India even Light Metro may not be cost effective. Hence LRTS may be a viable solution.
- These cities may not permit Light Rail Transit System(LRTS) at grade because of the less width of Urban Roads.
- Permanent way for LRTS should necessarily be rail based.
- LRTs should be designed to have the sleek structures namely viaduct as well as stations so as to reduce the cost.
- Minimum length of LRT train to start may be 33 M and subsequently increased .
- Future demand to be kept in view while deciding the Capacity.
- Cost of LRT should not be more than 60% of cost of heavy metro.
- Light/ Medium/Heavy Metro to be selected for a corridor only when LRTS and other modes are not considered adequate.

THANKS