

## 6. TRAIN OPERATION PLAN

### 6.1 PROJECT RIDERSHIP AND PHPDT DATA

Train operation plan for Panvel-Virar Corridor has been prepared based on following expected peak hour peak direction traffic (PHPDT) and Ridership data,

**Table 6.1 Projected PHPDT data**

Growth of PHPDT in Virar-Panvel Road Section				
Year →	2012	2021	2031	2041
Panvel-Diwa	4500	<b>10600</b>	23000	41100
Diwa-Virar	6100	<b>14300</b>	30900	55300

**Table 6.2 Ridership Data**

Daily Ridership in lakhs				
Year →	2012	2021	2031	2041
Daily Ridership	1.95	4.59	9.92	17.76

### 6.2 TRAIN OPERATION PHILOSOPHY

The underlying operation philosophy is to provide suburban Services at economical cost with fixed Infrastructure and Rolling Stock Planning.

- Selecting optimum Train frequency to provide sectional capacity commensurate with the peak direction traffic demand during peak hours.
- A minimum frequency of train service during lean period so as to make this service attractive during lean period also in comparison to other options.
- Basic unit will be 3-Coach unit with one motor coach and one trailer coach and one driving coach.
- Running of normal services for 19 hours of the day (5 AM to 12 PM i.e. midnight) with average station dwell time of 30 seconds,
- Make up time of 5-10% (on the tangent track) with 8-12% coasting and scheduled average speed for corridor shall be 45 kmph.

### 6.3 PASSANGER CARRYING CAPACITY OF TRAIN

Coach wise Passenger Carrying Capacity of existing DC-AC coaches plying in Mumbai suburban section is as under

**Table 6.3 Passenger Carrying Capacity of Various types of Coaches**

MC → Motor Coach		DC → Driving Coach		TC → Trailer Coach	
Coach Type	Seating Capacity	Standing Area in SQM	Standing @ 6 per SQM	Total Passengers	
MC	86	21.63	130	216	
TC	114	29.14	175	289	
DC	91	33.02	198	289	

Similarly Passenger carrying capacity of train with different configuration is also summarized as under

**Table 6.4: Passenger Carrying Capacity and Weight of train**

Passengers in each 12 car train			Weight of 12 car Rake in tonne			
With Pass Standing per sqm			Empty	With Pass Standing per sqm		
6	8	10		6	8	10
3175	3846	4516	480	671	711	751

Average weight of 60 kg per passengers and coach weight Of 40 T have been considered for above calculations.

## 6.4 TRAIN FORMATION

Train composition to be adopted is given as under;

**Table 6.5**

MC → Motor Coach	DC → Driving Coach	TC → Trailer Coach
9-Car Train	<b>DC + MC + TC + TC + MC + TC + TC + MC + DC</b>	
12-Car Train	<b>DC + MC + TC + TC + MC + TC + TC + MC + TC + TC + MC + DC</b>	

## 6.5 FREQUENCY OF TRAIN SERVICE

- **Year 2021**, Based on the projected PHPDT, train operations with 12 car service with a headway of 15minutes is considered in the inception year; there will be 4 trains per hour during peak period in both directions,

**Table 6.6**

Passenger Carrying capacity			
Headway	Passengers Standing per SQM		
	6	8	10
15 min	12701	15383	18064
20 min	9526	11537	13548
Projected PHPDT 12450 (average of 10600+14300)			

- **Year 2031**, train headway is planned at 8 minutes with 12-Car train during peak hours; there will be 15 trains in two hours of peak period in both directions.

**Table 6.7**

Passenger Carrying capacity			
Headway	Passengers Standing per SQM		
	6	8	10
8 min	23814	28842	33870
10 min	19052	23074	27096
Projected PHPDT 26950			

- **Year 2041**, train headway is planned at 5 minutes with 12-Car train during peak hours; there will be 12 trains per hour during peak period in both directions.

**Table 6.8**

Passenger Carrying capacity			
Headway	Passengers Standing per SQM		
	6	8	10
6 min	32752	38456	45160
5 min	38103	46148	54193
Projected PHPDT 48200			

## 6.6 DESIGNED CAPACITY OF SYSTEM

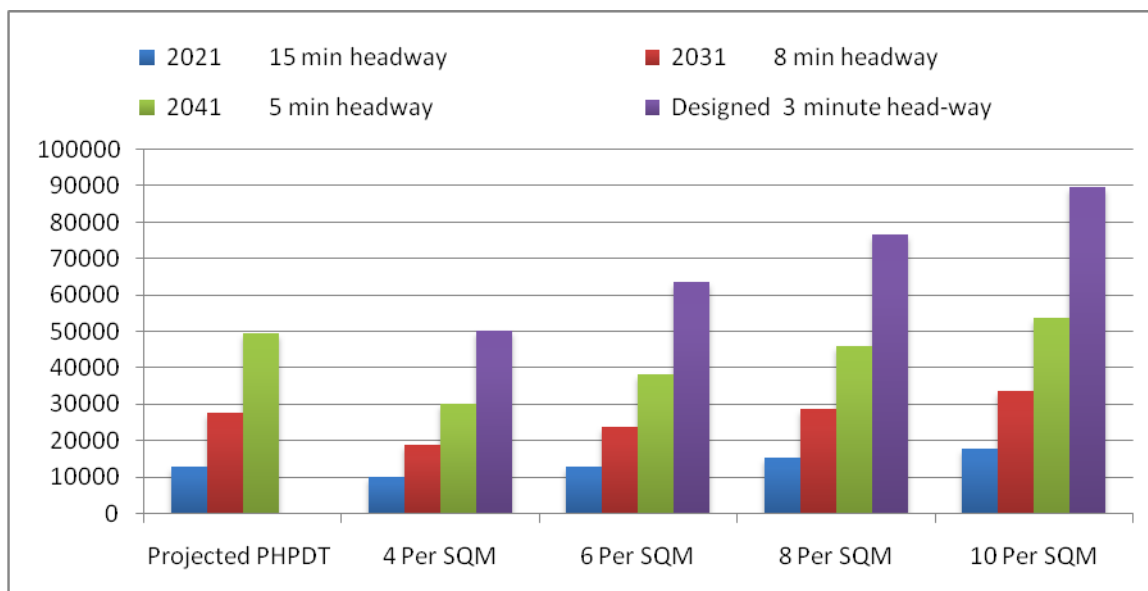
Year wise Projected Peak hour peak direction traffic demand and non peak hour traffic for the corridor is as below.

**Table 6.9**

No of Car per Train	Train-Headway	Passengers Standing per SQM	PHPDT
12-Car	<b>3 min</b>	10	89680

## 6.7 HEADWAY/TRAIN FREQUENCY

Year wise Projected PHPDT and Passenger Carrying Capacity with different headways i.e. 15 min, 8 min, 5 min and designed headway of 3 minutes is shown below



## 6.8 HOURLY TRAIN OPERATION PLAN

The number of train trips proposed to be operated daily during different hours in each direction for the period 2021-2041 is given in Table 6.10 below.

**Table 6.10**

Year	2021	2031	2041
Headway → Time (Hours)	15 min	8 min	5 min
5 to 6	3	5	6
6 to 7	4	6	10
7 to 8	4	7	12
<b>8 to 9</b>	<b>4</b>	<b>7.5</b>	<b>12</b>
<b>9 to 10</b>	<b>4</b>	<b>7.5</b>	<b>12</b>
10 to 11	4	7	12
11 to 12	4	6	10
12 to 13	3	5	6
13 to 14	3	5	6
14 to 15	3	5	6
15 to 16	4	6	10
16 to 17	4	7	12
<b>17 to 18</b>	<b>4</b>	<b>7.5</b>	<b>12</b>
<b>18 to 19</b>	<b>4</b>	<b>7.5</b>	<b>12</b>
19 to 20	4	7	12
20 to 21	4	6	10
21 to 22	3	6	8
22 to 23	3	5	6
23 to 24	3	5	6
<b>Trains / day / Direction</b>	<b>69</b>	<b>118</b>	<b>180</b>

## 6.9 ROLLING STOCK REQUIREMENT

Based on Train formation and headway as decided above to meet Peak Hour Peak Direction Traffic Demand in different years, Rake requirement has been calculated. The Requirements of coaches has been calculated as per following assumptions-

- i) Coach requirement has been calculated based on headway during peak hours.
- ii) Traffic/Operational spares have been considered @5% of bare requirement to cater to operational exigencies on the corridor.
- iii) Repair and maintenance has been estimated as 8% of total coach requirement (Bare + Traffic Reserve) based on Intermediate overhaul and periodic overhaul interval.
- iv) The calculated number of rakes in fraction is rounded off to next higher number.
- v) Journey time for end to end will be around 90 minutes ie Schedule speed is 45 Kmph.

## 6.10 RUNNING TIME

Average inter-station distance with 24 halts on PNVL-VIRAR corridor is 2.9 km. Actual average speed has been taken as 80% of theoretical average speed calculated for 2.9 km inter-station distance without considering any speed restriction, curve, gradient and dwell time. Time consumed and distance travelled during different driving modes of train run between two halts to cover typical inter station distance of 2900 m is summarized below in table 6.13

**Table 6.13**

Driving mode	<u>Acc./dec.</u> m/sec- sec	<u>Speed</u> kmph <u>From</u>	<u>Speed</u> kmph <u>To</u>	<u>Speed</u> m/sec From	<u>Speed</u> m/sec To	Time taken in sec	Distance metre
Accelerating	0.54	Zero	100	0	27.78	51.44	714.56
Powering	0	100	100	27.78	27.78	47.59	1322.17
Coasting	-0.15	100	92	27.78	25.53	15	399.83
Braking	0.86	100	50	27.78	13.89	16.15	336.51
	0.76	50	13.89	13.89	zero	18.28	126.93
<b>TOTAL</b>						<b>148.47</b>	<b>2900.00</b>

Theoretical Average speed  $(2.9 \times 3600 / 148.47)$  = 70.32 kmph

Actual Average Speed = 80% of Theoretical Average speed  $(0.8 \times 70.32)$  = 56.26 kmph

Travel Time for PNVL-Virar corridor  $(69.5 \times 60 / 56.26 + 24 \times 30 / 60)$  = 89.13 minutes

Actual Running Speed with dwell time of 30 seconds for every stop = 46.78 kmph

## 6.11 RAKE REQUIREMENT

Based on Train length and headway as decided above to meet Peak Hour Peak Direction Traffic demand in different years, Rake requirement has been worked out in as under

**Table 6.11: Rake Requirement**

Year	2021	2031	2041	Designed
<b>No. of Cars / Train</b>	12	12	12	12
<b>Headway in min</b>	15	8	5	3
<b>Bare Rake Requirement</b>	16	28	42	68
<b>Traffic Spare @5%</b>	1	2	2	4
<b>Maint. Spare @8%</b>	2	3	4	6
<b>Total Rakes</b>	19	33	48	78
<b>Total Coaches</b>	228	396	576	936
<b>Motor Coach</b>	76	132	192	312
<b>Driving Coach</b>	38	66	96	156
<b>Trailer Coach</b>	114	198	288	468

## 6.12 PROVISION FOR STABLING LINES

Requirement of stabling line for efficient train operation has been assessed as under in table 6.12

**Table 6.12: Stabling Line Requirements**

Year	2021	2031	2041	Designed
Stabling Requirements	19	33	48	78
Inside Depot for Maintenance and POH	8	8	10	10
Stabling Lines in Depot	12	27	28	38
Stabling Lines in the section	nil	nil	10	30