# DESIGN & CAPACITY ANALYSIS OF FLEXIBLE PAVEMENT

*A Dissertation Submitted in Fulfilment of the Requirement for the Award of the Degree of*

MASTER OF ENGINEERING

in Infrastructure

Submitted By

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## DECLARATION

I , Puneet Thakur hereby declare that the work presented in the Dissertation entitled **" Design & Capacity Analysis of flexible Pavement"** in fulfilment of the requirement for the award of degree of Master of Engineering (infrastructure Engineering) submitted at the Department of Civil Engineering , Thapar Institute of Engineering and Technology (deemed to be University),Patiala is an authentic record of work carried out under the supervision of **Dr. Tanuj Chopra ,Assistant Professor, CED, TIET, Patiala and Mr. Prashant Mahajan, Technical Manager ,NHAI,PIU Ludhiana .** The matter presented in this has not been submitted either in part or full to any other university or institution for the award of any other degree.

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This is to certify that the above declaration made by the student concerned is correct according to the best of my knowledge and opinion.

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Puneet Thakur

## ABSTRACT

Flexible pavement is the most commonly type of pavement used in construction of roads. Design and analysis of flexible pavement of Delhi – katra expressway is done. The allowable horizontal and vertical strain is compared with actual stain using IIT PAVE software.

Capacity analysis of phase II of Delhi – Katra expressway is done as per IRC : SP 99 -2013.

Capacity analysis is fundamental to the planning, design and operation of National Highways and provides among other things , the basis for determining the carriageway width to be provided at any point of time with respect to the volume and composition of traffic .It is an important tool for evaluation of the investment needed for the future construction and improvements and for working out priorities of road projects.

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# ABBREVATIONS

| | |
|---|---|
| AADT | Annual Average Daily Traffic |
| ADT | Average Daily Traffic |
| CBR | California Bearing Ratio |
| CVPD | Commercial Vehicles Per Day |
| DBM | Dense Bituminous Macadam |
| DPR | Detailed Project Report |
| GSB | Granular Sub Layer |
| IRC | Indian Road Congress |
| IS | Indian Standard |
| MORTH | Ministry of Rural Transport and Highways |
| NH | National Highway |
| ROB | Railway Over Bridge |
| ROW | Right of Way |
| LDF | Lane Distribution Factor |
| DDF | Directional Distribution Factor |
| VDF | Vehicle Damage Factor |
| VUP | Vehicular Under Pass |
| ISD | Intermediate Sight Distance |
| SVUP | Small Vehicular Underpass |
| PROW | Proposed Right of Way |
| PCU | Passenger Car Unit |

# CHAPTER 1
# INTRODUCTION

## 1.1 About the Company

**A Parliamentary Act constituted the National Highways Authority of India in 1988,termed "An Act to provide for the constitution of an Authority for the development, maintenance, and management of national highways and for matters connected with or incidental thereto." It has been entrusted with the National Highways Development Project, which has vested in it 50329 kilometres of National Highways for progress, maintenance, and management, along with other small projects.**

National Highways are the country's arterial roads for interstate movement of people and goods. They run the length and breadth of the nation, connecting national and state capitals, major ports, and rail interchanges, together with border roads and foreign highways. While highways and expressways account for only about 1.7 percent of all road length, they carry roughly 40% of all road traffic.

## 1.2 The Project

The Delhi Amritsar Katra Expressway is among ten expressways being built as part of the 'Bharatmala Pariyojana.' The expressway will ease religious tourism by connecting Delhi to Vaishno Devi via Katra and the Golden Temple in Amritsar. The expressway will also connect all important Sikh religious sites.

## 1.3 The Consultancy Services

The NHAI has hired M/s. FEEDBACK INFRA to provide the required Consultancy services for the preparation of the DPR of the Delhi-Ludhiana-Amritsar-Katra Expressway excluding spurs on a BOT and EPC basis.

# CHAPTER 2

# BACKGROUND

## 2.1 Corridor Background and Alignment

The Delhi-Amritsar-Katra Expressway is one of six Greenfield Expressways identified under Bharatmala Pariyojna Phase I it is one of 22 Greenfield Corridors identified in Budget Announcements for FY21.In the meeting taken by secretary on 03.01.2019, it was decided that Delhi -Amritsar -Katra expressway will be implemented in 2 phases viz **Delhi -Gurdaspur** and **Gurdaspur katra** Greenfield alignment for the phase -l Delhi Gurdaspur section approved in the aforesaid meeting.

**Table 2.1 Length of Corridor in Different States**

| State/UT | Corridor | Length (km) | Length to be developed (Km) |
|---|---|---|---|
| Haryana | Main Expressway | 135.70 | 135.70 |
| Punjab | Main Expressway | 300.30 | 300.30 |
| | Greenfield connectivity to Amritsar airport | 99.00 | 99.00 |
| Jammu | Main Expressway | 132.50 | 108.50(excluding Sidhra Jammu Domel section of NH - 44) |
| | Spur connectivity to Jammu | 7.385 | 7.385 |
| **TOTAL** | | 674.885 | 650.885 |

## 2.2 Delhi Katra Expressway Route Map

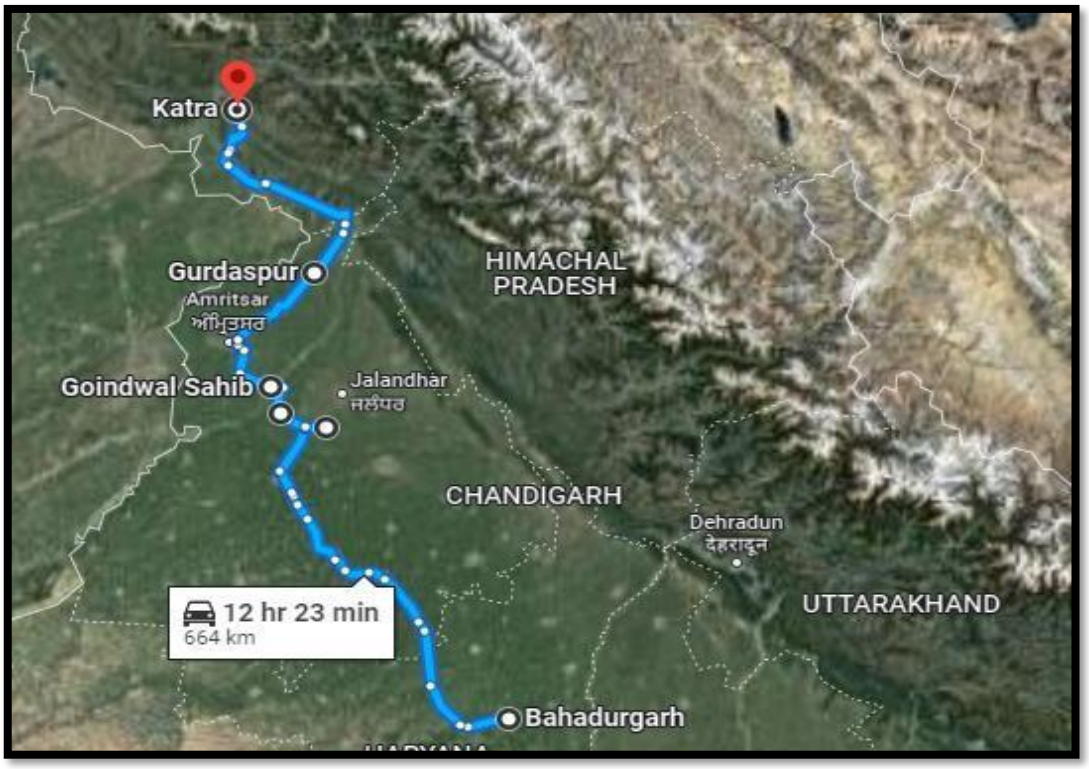


**Fig.2.1 Route Map**

## 2.3 Project Details

The final alignment of Delhi – Amritsar - Katra is proposed to be developed in two Phases:

Phase-1: Delhi (0+000) to Gurdaspur Bypass

Alignment of the proposed Expressway starts at KMP Expressway (28.79556 °N, 76.88096 °E) near village JasaurKheri (Jhajjar, Haryana). Take-offs point of the proposed expressway alignment is about 10 km from the existing interchanges on NH-10 near Bahadurgarh and on Sonipat-Auchandi-Bawana road near Kharkhoda

The proposed Greenfield alignment would be intersecting National and State Highways in the state of Haryana/NCR before entering Punjab. The detail of interchanges in the state of Haryana/NCR are as follows:

- KMP(Kundli-Palwal) at Village JassaurKheri.
- NH-334B (Jhajjar-Sonipat National Highway) at Village Hassangarh,
- SH-18 (Rohtak-Kharkhoda State Highway) at village Humayunpur.
- NH-709 (Rohtak-Panipat National Highway) at Village Rukhipana.
- NH-352A (Jind-Gohana National Highway) at Village Butana
- Trans Haryana link at Dada Khera village.
- SH-12 (Jind-Naguran-Assandh-Karnal State Highway) at Villlage Alewa Village.

- NH-152 (Narwana-Kaithal-Ambala National Highway) at Village Kharak Pandwa

And thereafter enter the state of Punjab near village Barta. In the State of Punjab, the alignment would be intersecting:

- NH-152A (Punjab-Haryana border Moonak-Kaithal) at Village GulzarpuraTharwa.
- SH-10 (Patran-Samana State Highway) at Village Lalwa.
- SH-12A (Sunam to Bhawanigarh State Highway) at Village Roshanwala.
- SH-11 (Malerkotla- Nabha State Highway) at Village Ahmdabad.
- SH-11 (Malerkotla- Ludhiana State Highway) at Village Bhogiwal.
- NH-5 (Ludhiana-Moga National Highway) at Village Dhaka.
- SH-48 (Nakodar-Nurmahal State Highway) at Village Uppal Khalsa.
- NH-703 (Jalandhar-Nakodar National Highway) at Village Kang Sahbu.
- NH-703A (Jalandhar-Kapurthala National Highway) at Village Firoz.
- NH-3 (Kartarpur-Amritsar National Highway) at Village Dialpur,
- NH-503A (Sri Hargobindpur-Amritsar National Highway) at Village KishanKot
- Spur Connecting Expressway with Dera Baba Nanak (Kartarpur Corridor)
- NH-54 (Pathankot-Amritsar National Highway) at Gurdaspur bypass

Phase-2: Gurdaspur (397+700) to near Katra (End point)

Alignment of the proposed Phase 2 Expressway starts at Gurdaspur Bypass. The proposed expressway alignment would be intersecting National and State Highways in the state of Punjab / J&K before ending at Katra. The detail of interchanges are as follows:

- NH-44 (Pathankot – Jammu National Highway) at Village Rajbagh.
- Hiranagar road near Village Maila.
- NH-44 (Pathankot – Jammu National Highway) at Village Samba.
- Jammu Kunjwani bypass near Barian village.
- NH-44 (Jammu - Udhanpur National Highway) at Village Rotore Dhok.
- NH-44 (Jammu - Udhanpur National Highway) at Village Domel.

.

The Project corridor has been divided into homogeneous sections based on the interchanges provided on National Highways as well as state highway crossings. The homogeneous sections are indicated in table and shown in **Figure**

**Table 2.2 Homogeneous Section**

| Homogeneous Section | From (Km) | To (Km) | Length (Km) | Phase |
|---|---|---|---|---|
| 1 | 0+000 | 5+534 | 5.534 | PHASE I |
| 2 | 5+534 | 14+072 | 8.538 | |
| 3 | 14+072 | 36+281 | 22.209 | |
| 4 | 36+281 | 55+670 | 19.389 | |
| 5 | 55+670 | 79+102 | 23.432 | |
| 6 | 79+102 | 87+126 | 8.024 | |
| 7 | 87+126 | 117+211 | 30.085 | |
| 8 | 117+211 | 137+452 | 20.241 | |
| 9 | 137+452 | 157+063 | 19.611 | |
| 10 | 157+063 | 185+332 | 28.269 | |
| 11 | 185+332 | 216+755 | 31.423 | |
| 12 | 216+755 | 227+742 | 10.987 | |
| 13 | 227+742 | 261+800 | 34.058 | |
| 14 | 261+800 | 292+526 | 30.726 | |
| 15 | 292+526 | 306+054 | 13.528 | |
| 16 | 306+054 | 321+194 | 15.140 | |
| 17 | 321+194 | 333+184 | 11.990 | |
| 18 | 333+184 | 359+663 | 26.479 | |
| 19 | 359+663 | 377+353 | 17.690 | |
| 20 | 377+353 | 397+700 | 20.347 | |

| Homogeneous Section | From (Km) | To (Km) | Length (Km) | Phase |
|---|---|---|---|---|
| 21 | 397+700 | 424+557 | 26.857 | |
| **22** | **424+557** | **428+000** | **3.443** | |
| **23** | **428+000** | **438+780** | **10.780** | |
| 24 | 438+780 | 452+671 | 13.891 | |
| 25 | 452+671 | 465+798 | 13.127 | |
| 26 | 465+798 | 481+150 | 15.352 | **PHASEII** |
| 27 | 481+150 | 486+993 | 5.843 | |
| 28 | 486+993 | 502+000* | 15.007 | |
| 29 | 515+000 | 531+000 | 16.000 | |
| 30 | 531+000 | 552+000 | 21.000 | |
| 31 | 552+000 | 564+700 | 12.700 | |
| **TOTAL** | | | 551.700 | |

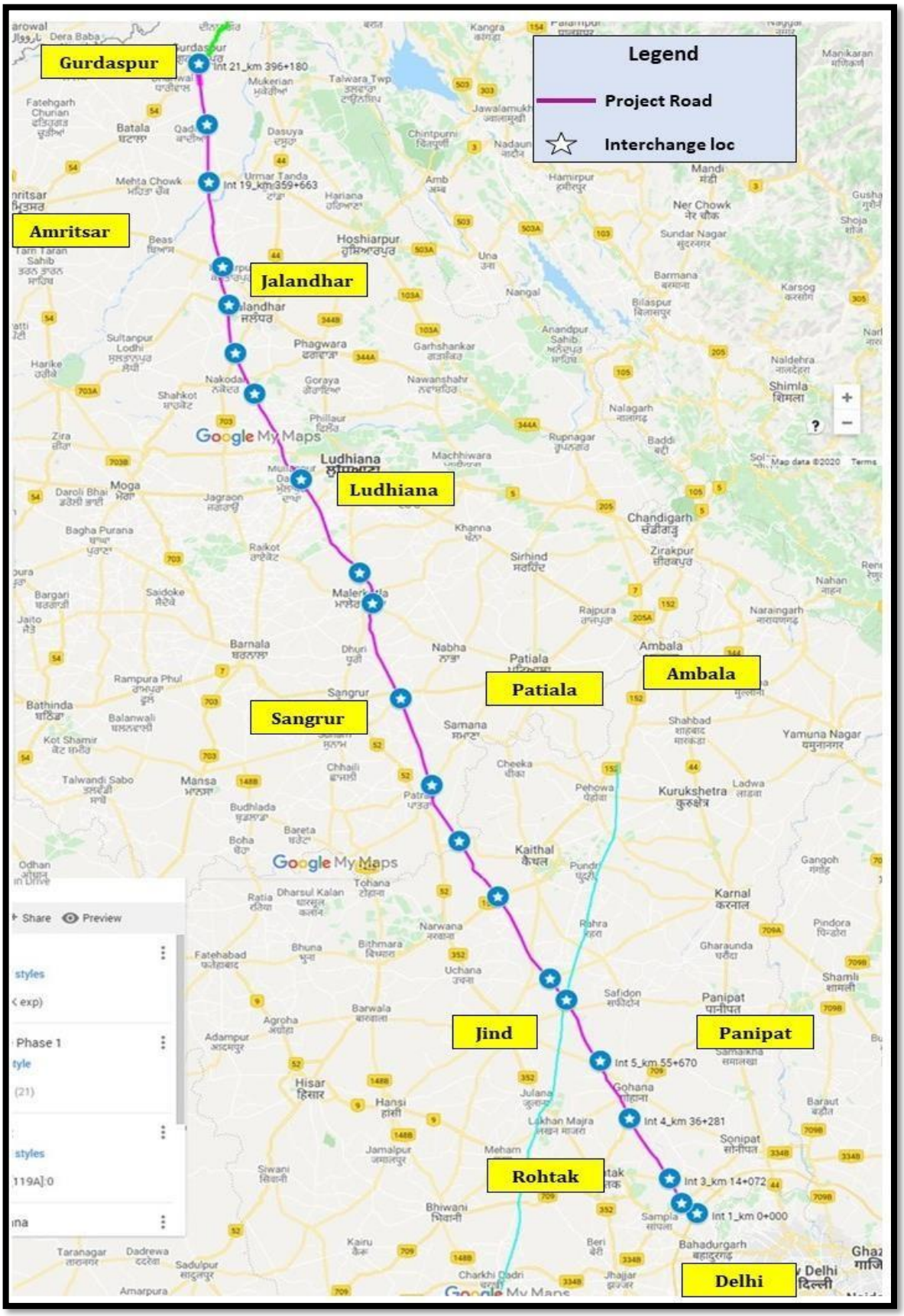
Legend
Project Road
Interchange loc
Gurdaspur
Amritsar
Jalandhar
Ludhiana
Patiala
Ambala
Sangrur
Jind
Panipat
Rohtak
Delhi
Int 21_km 396+180
Int 19_km 359+663
Int 5_km 55+670
Int 4_km 36+281
Int 3_km 14+072
Int 1_km 0+000
Google My Maps


**Fig 2.2 Project Road Sections & Interchange Locations**

## 2.4 Benefits

1. Reduction in travel time from Delhi to Amritsar within 4-4$^{1/2}$ hours and from Delhi to katra within 6-6$^{1/2}$ hours.

2. Punjab and Haryana are both agrarian states. The expressway will improve farm produce access to further markets.

3. Improved connectivity to raw materials and end-user centres in other areas, as well as easy access to markets

4. Tourism especially in the state of HP and UT of J&K will benefit.

5. Connectivity to religious places of north will improve. Thereby, boosting the religious tourism.

# CHAPTER 3

# GEOMETRIC DESIGN

**3.1 Objective:** To provide an overview of the geometric design , grade separators and project facilities provided in Delhi Katra expressway as per IRC specifications.

### 3.2 General

This chapter is intended to give brief introduction regarding the various design proposals for the Delhi katra expressway. These design proposals are based on the findings from various engineering studies carried out on the project road. The proposed expressway includes the provisions for the following major items:

- Geometric design
- Typical cross section

### 3.3 Geometric Design Proposals

The project highway is a greenfield highway passing through the states of Haryana and Punjab. It mostly passes through the open and agriculture land. The design speed for this expressway is **120 kmph** which is consider as per clause 2.2 of IRC :SP 99-2013.

**Table 3.1 Design Speed**

| Nature of Terrain | X Slope of the Ground | Design Speed(kmph) |
|---|---|---|
| Plain | < 10 % | **120** |
| Rolling | Between 10 & 25 % | 100 |

The proposals for the geometric elements of any highway generally includes

- Typical cross-sectional elements
- Horizontal alignment
- Vertical alignment
- Super elevation

### 3.4 ROW details

The minimum ROW throughout the stretch is **90 m.** This value is taken as per consideration given in clause 2.3.1of IRC SP : 99 2013

### 3.5 Cross sectional elements:

The Project Corridor's standard lane width is 3.750 m. This value is as per clause 2.4 of IRC: SP 99 - 2013

### 3.6 Horizontal Alignment

The horizontal alignment of the corridor has been designed for a speed of **120 kmph**. The corridor is fixed based on straight alignment, minimum disturbance to habitation and avoiding forest ranges and Wild Life Sanctuaries.

#### 3.6.1 Super Elevation

If the radius of the curve is less than the minimum allowable radius, the super elevation is restricted to 7%. It shall be restricted to 5% if the radius is greater than or equal to the minimum allowable radius.. At no location super elevation provided is less than the minimum specified crossfall. These values of superelevation are taken from clause 2.9.2.2 of IRC SP 99:2013

#### 3.6.2 Radii of horizontal curve:

The desirable minimum radii of horizontal curves is mentioned in table below. These values are considered as per clause 2.9.2.3.of IRC: SP 99- 2013

**Table 3.2 Minimum Radii of Horizontal Curves**

| Design Parameters | Radii (m) |
|---|---|
| Design Speed (Km/h) | 120 |
| Absolute Minimum Radius (m) | 670 |
| Desirable Minimum Radius (m) | 1000 |

#### 3.6.3 Transition curves:

The minimum length of transition curves is designed for 120 KMPH as per clause 2.9.2.4 IRC: SP 99 - 2013

**Table 3.3 Minimum Length of Transition Curves**

| Design Speed | Min length of transition Curve |
|---|---|
| **120** | **100** |
| 100 | 85 |
| 80 | 70 |

### 3.7 Vertical Alignment

#### 3.7.1 Sight Distance

The table below shows the desirable minimum sight distance for an 8-lane divided main road at 120 Kmph speed limit. As per Section 2 clause 2.9.3 of IRC: SP 99, an intermediate sight distance has been provided throughout.

**Table 3.4 Safe Sight Distance**

| Design Speed (Kmph) | Safe Stopping Sight Distance (m) | Desirable Minimum Sight Distance (m) (Intermediate Sight distance) |
|---|---|---|
| **120** | **250** | **500** |
| 100 | 180 | 360 |
| 80 | 120 | 240 |

The vertical alignment is provided for a smooth longitudinal profile. The vertical design, particularly at grade change locations such as VUP, ROB, as well as bridge locations, is implemented in accordance with IRC SP 23 clause 4.4.

#### 3.7.2 Gradients

As per section 2, clause 2.9.4.2 of IRC: SP 99, the ruling gradients for plain terrain are used throughout the project highway**.**

**Table 3.5 Ruling Gradient**

| Terrain | Ruling Gradient |
|---|---|
| Plain | 2.5% |

The minimum slope for drainage considerations in cut-sections is 0.5 percent (1 in 200) if the side drains are lined, and 1.0 percent (1 in 100) if they are unlined. Vertical alignment is designed using a ruling gradient.

#### 3.7.3 Vertical Curves

According to clause 2.9.4.3 of IRC SP 99: 2013, the minimum grade change requiring a vertical curve and the minimum length of the vertical curve are as follows:

**Table 3.6 Minimum Length of Vertical Curves**

| Design Speed(Km/h) | Minimum Grade Change Requiring Vertical Curve(%) | Minimum Length of Vertical Curve (m) |
|---|---|---|
| **120** | **0.5** | **100** |
| 100 | 0.5 | 85 |
| 80 | 0.6 | 70 |

### 3.7.4 Cross fall and Superelevation

The crossfall on straight sections of project road carriageway shall be as given as per clause 2.8.1of IRC SP 99: 2013

**Table 3.7 Crossfall on different Surfaces**

| Cross – sectional Element | Annual Rainfall | |
|---|---|---|
| | 1000 mm or more | Less than 1000 mm |
| Carriageway, paved shoulders, Edge Strip , Flush Median | 2.5 | 2 |

## 3.8 Grade separator

### 3.8.1 Interchanges

Project Road crosses 332 roads of different category apart from cart tracks.

### 3.8.2 Vehicular Under Pass(VUP)

Vehicular under pass are presented at crossing between the Project Highway and MDRs. The crossroad's lane width extends from 7.0m to 10.0m as specified in clause 2.10.1 of SP 99 : 2013

### 3.8.3 Small Vehicular Under pass ( SVUP)

For mud roads with widths just under 5.50m, a smaller dimension VUP (SVUP) is made to make sure complete access control and cost-effective grade separation.as specified in clause 2.10.2 IRC SP 99: 2013

### 3.8.4 Flyover

Based on the lane configuration and significance of the road, flyovers are provided at crossings between the project road and the NH or SH.

## 3.9 Project Facilities

### 3.9.1 Proposed Connecting/ Service Road / Slip Road

At some locations connecting road has been provided to connect nearby tracks so as to optimise the number of SVUP along the project road. Generally, access has been provided to all cross road, in case 2 or more earthen roads cross the proposed expressway in close interval, access has been provided to one road and rest are joined to underpass by connecting road outside the PROW.

### 3.9.2 Toll Plaza

Toll booths have been installed in accordance with IRC: SP-99. Toll booths are designed for peak hour traffic and are expected to last at least 25 years.

### 3.9.3 Crash Barrier

Metal beam crash barrier is provided all along the project on shoulder as specified on SP 99 :2013 clause 10.7 on both the sides excluding structure location where concrete crash barrier is provided.

### 3.9.4 Retaining wall

Retaining wall shall be provided as per Typical cross section.

### 3.9.5 Road Signal

Road signage are provided at all junction location, start of project and end of project. Cautionary signs, mandatory sign, one way hazard marker, two-way hard markers, informatory signs of different sizes are provided in the project highway.

### 3.9.6 Lighting

Lighting must be as per specified in IRC:SP:99-2013 clause 12.4.17.

# CHAPTER 4

## DESIGN OF FLEXIBLE PAVEMENT

**4.1 Objective:** To find out the total thickness and crust composition of the flexible pavement for homogeneous section 22.

### 4.2 Fundamental Consideration for Flexible Pavement Design

1. Wheel loads

2. Contact area and pressure

3..Intial Traffic (CVPD)

4..Future Traffic Prediction for design year

5.Design Life of the pavement

6.Vehicle Damage Factor

7.Directional Distribution Factor

8.Lane Distribution Factor

9.Design Traffic

10.Design CBR

#### 4.2.1 Wheel loads

As per IRC standard axle load is 8160 kgs

#### 4.2.2 Contact area and pressure

The tyre imprint assumes to be circular for analytical purpose and tyre pressure of commercial traffic is taken as 0.56 MPa

#### 4.2.3 Initial Traffic

The initial traffic after pavement construction is calculated in terms of CVPD .Only CV weighing three tonnes or more are considered for design purposes.

#### 4.2.4 Future Traffic

The future traffic on project corridor is calculated based on regular traffic, diverted traffic, developmental traffic and generated traffic. Once the expressway is completed, additional traffic will be generated from developments around the project road and diverted traffic from nearby roads to the project road.

For Delhi -Katra expressway , the final recommended growth rate is mentioned in table

These values are taken from the clause 4.2.6 " **traffic studies and forecast final** ".

**Table 4.1 Estimated and Recommended Traffic Growth Rate**

| Year / Mode | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | >44 |
|---|---|---|---|---|---|---|
| Car | 6.9 | 5.6 | 4.5 | 3.6 | 3.0 | 2.4 |
| Bus | 5.5 | 4.5 | 3.6 | 2.9 | 2.4 | 1.9 |
| LCV | 5.8 | 5.5 | 5.3 | 4.9 | 4.5 | 4.0 |
| 2 Axle Truck | 3.0 | 2.8 | 2.5 | 2.2 | 1.5 | 1.5 |
| 3 Axle Truck | 3.3 | 3.0 | 2.8 | 2.3 | 1.7 | 1.7 |
| MAVs | 5.7 | 5.5 | 5.2 | 4.9 | 4.6 | 4.2 |

### 4.2.5 Design Life of the pavement

As per clause 4.3.1 of IRC: 37-2018, For the expressway, a minimum design life of 30 years has been considered. The base year of traffic estimation considered is 2018 and the proposed expressway shall be opened to traffic in the year of 2024.

### 4.2.6 Vehicle damage factor (VDF)

The VDF is a multiplier that is used to convert the number of commercial vehicles with various axle loads and axle configurations to the number of standard axle load repetitions. The relationships recommended in IRC: 37-2012 to determine ESAL.

Axle load survey has been carried out at **3 locations** on parallel roads along the proposed alignment. The Homogeneous section 22 comes under axle load location number **2** (Lakhanpur check post).

**Table 4.2 Actual VDF Summary**

| Type of vehicle | Axle load location No | Homogeneous section | Direction | Bus | LCV-4 | LCV-6 | 2-Axle | 3-Axle | MAV |
|---|---|---|---|---|---|---|---|---|---|
| Actual VDF | 2 | 22 | Both | 0.85 | 0.18 | 0.66 | 2.05 | 3.37 | 6.9 |

### 4.2.7 Directional Distribution Factor (DDF)

The table illustrates the directional split at survey locations. As can be seen in table below , the directional split for upward and downward traffic is nearly equal along the survey locations. DDF value of 50 percent is taken for the expressway design.

**Table 4.3 Directional Split**

| Location | Up direction(%) | Down direction(%) |
|---|---|---|
| Mubarak Chowk– Panipat section (NH-44 near Baghan) | 49.4 | 50.6 |
| Rajpura – Patiala (NH-07 near Daun Kalan) | 50.1 | 49.9 |
| Ambala -Kurukshetra section (NH-44 near Sarifgarh) | 50.2 | 49.8 |
| Churu – Hisar (Laseri Toll Plaza_NH-52) | 50.0 | 50.0 |
| Jalandhar – Amritsar_NH-3 | 50.5 | 49.5 |
| Domel – Katra | 50.6 | 49.4 |

### 4.2.8 Lane Distribution Factor (LDF)

Lane distribution factors have been considered as per clause 4.5.1 (iv) of IRC: 37-2012 and the same are given in table

**Table 4.4 Adopted Lane Distribution Factor**

| SI. No | Description | Design Period | | LDF (%) |
|---|---|---|---|---|
| | | From(years) | To(years) | |
| 1 | 4 Lane Divided Main Carriageway | 2024 | 2053 | 75 |

### 4.2.9 Design Traffic

The design traffic loading for the Main carriageway in terms of million standard axles (msa) has been predicted for a design life of 30 years (post construction). The design traffic is measured in terms of the total number of standard axles to be carried during the proposed highway's design period. It is calculated using equation 4.5 mentioned in clause 4.6.1 of IRC 37-2018

$$N_{Des} = 365 \times \frac{[(1+r)^n - 1]}{r} \times A \times D \times F$$

Where

$N_{Des}$ = cumulative number of standard axles to be catered for during the design period of n years

A = initial traffic ( commercial vehicle per day) in the year of completion of construction.

D = lateral distribution factor

F = vehicle damage factor (VDF)

n = design period , in years

r = annual growth rate of commercial vehicles in decimal

### 4.2.10 Design CBR

Effective design CBR adopted is 12 % as per Clause 2.2.8 of Detailed Project Report ( Highway and Pavement design)

### 4.3 Traffic Surveys and Analysis

#### 4.3.1Objective :

1. Establish base year traffic demand

2. Determination of the project stretch's travel pattern and influence area

3. Determination of Commodity Movement Patterns

### 4.4 Traffic Homogeneous Section

The details of traffic homogeneous section is given in table below

**Table 4.5 Traffic Homogeneous Section**

| Homogeneous section | From (Km) | To (Km) | Length (Km) |
|---|---|---|---|
| 22 | 424.557 | 428 | 3.443 |

### 4.5 Traffic Intensity and Composition

The Vehicle Classification as Generally Used in The Traffic Survey in Central or State Government Studies Along with Their PCU Values Are Presented in Table Below .These equivalency factors are extracted from **IRC 64 – 1990**

**Table 4.6 Passenger Car Equivalency Factors**

| S.No | Vehicle Types | PCU Factors |
|---|---|---|
| 1 | Two-Wheeler | 0.5 |
| 2 | Auto–rickshaw | 1 |
| 3 | Car / Jeep / Van | 1 |
| 4 | Minibus | 1.5 |
| 5 | Standard Bus | 3 |
| 6 | LCV, Agricultural Tractor | 1.5 |
| 7 | Two Axle Truck | 3 |
| 8 | Three Axle Truck | 3 |
| 9 | Truck Trailer/Multi Axle Vehicle | 4.5 |
| 10 | Agriculture Tractor-trailer | 4.5 |
| 11 | Animal Drawn | 8 |
| 12 | Cycle | 0.5 |
| 13 | Hand Cart | 3 |
| 14 | Cycle Rickshaw | 2 |

#### 4.5.1 Average Daily Traffic ( ADT)

Traffic volume count data for seven days at each of the eleven count locations were averaged to determine Average Daily Traffic (ADT).Average daily traffic and average annual daily traffic data is taken from the report **"Traffic Studies &Forecast Final"** Clause 4.1.10 Table 4-6

**Table 4.7 Average Daily Traffic**

| Vehicle Type | Gurdaspur – Pathankot section of NH- 54 |
|---|---|
| Tollable Traffic No | |
| Car / Jeep / Van | 6935 |
| Car / Jeep (Taxi) | |
| Shared Jeep | |
| Minibus | 0 |
| School. Bus | 0 |
| Govt. Bus | 0 |
| Pvt. Bus | 0 |
| Maxx/Pick-Up | 677 |
| LCV (4 tyre) | 592 |
| LCV (6 tyre) | 0 |
| 2 Axle | 1315 |
| 3 Axle | 1597 |
| MAV (4 to 6 Axles) | 1061 |
| MAV (> 6 Axles) | 0 |
| Others | 5 |
| Total vehicles | 12182 |
| Total PCUs | 22032 |

| Vehicle Type | Gurdaspur – Pathankot section of NH- 54 |
|---|---|
| Non Tollable Traffic No | |
| 3-Wheeler | 557 |
| 2-Wheeler | 8978 |
| Agriculture Tractor | 23 |
| Agriculture Tractor/ Trailer | 275 |
| Cycle | 157 |
| Cycle Rickshaw | 15 |
| Animal Drawn Cart | 0 |
| Toll Exempted Car | 0 |
| Toll Exempted Bus | 0 |
| Toll Exempted LCV | 0 |
| Toll Exempted Truck | 0 |
| Total Non-Tollable (Nos.) | 10006 |
| Total Non-Tollable (PCUs) | 6426 |
| Grand Total (Nos.) | 22188 |
| Grand Total (PCUs) | 28458 |

### 4.5.2 Annual Average Daily Traffic (AADT)

Seasonal variation factors by vehicle type are essential to account for variations in traffic volume trends on project road sections throughout the year. These factors are calculated using **month-by-month fuel** sales data collected along the roads where the survey was conducted**.**

**Table 4.8 Seasonal Correction Factors**

| Month | SCF | |
|---|---|---|
| | Petrol | Diesel |
| April | 1.03 | 0.99 |
| May | **1.01** | **0.94** |
| June | 0.96 | 0.96 |
| July | 1.00 | 1.10 |
| August | 0.90 | 1.11 |
| September | 1.05 | 1.06 |
| October | 0.97 | 0.98 |
| November | 0.94 | 0.90 |
| December | 1.02 | 0.90 |
| January | 1.09 | 1.07 |
| February | 1.06 | 1.01 |
| March | 1.01 | 1.06 |
| **Average** | **1.00** | **1.01** |

**Table 4.9 Average Annual Daily Traffic at Survey location**

| Vehicle Type | Gurdaspur – Pathankot section of NH- 54 |
|---|---|
| Car / Jeep / Van | 7004 |
| Taxi | |
| Shared Jeep | |
| Minibus | 0 |
| School. Bus | |
| Govt. Bus | |
| Pvt. Bus | |
| Maxx/Pick-Up | 671 |
| LCV (4 tyre) | 586 |
| LCV (6 tyre) | 0 |
| 2 Axle | 1302 |
| 3 Axle | 1581 |
| MAV (4 to 6 Axles) | 1050 |
| MAV (> 6 Axles) | 0 |
| Others | 5 |
| Total vehicles | 12199 |
| **Total PCUs** | **21951** |
| **Non Tollable Traffic** | |
| 3-Wheeler | 557 |
| 2-Wheeler | 8978 |
| Agriculture Tractor | 23 |
| Agriculture Tractor/ Trailer | 275 |
| Cycle | 157 |
| Cycle Rickshaw | 15 |
| Animal Drawn Cart | 0 |
| Toll Exempted Car | 0 |
| Toll Exempted Bus | 0 |
| Toll Exempted LCV | 0 |
| Toll Exempted Truck | 0 |
| Total Non-Tollable (Nos.) | 10005 |
| Total Non-Tollable (PCUs) | 6427 |
| Grand Total (Nos.) | 22204 |
| **Grand Total (PCUs)** | **28377** |

**Table 4.10 Traffic Projection of Homogeneous section 22 ( 2018-2038)**

**PCU 1 1 1.50 1 3 1 1.5 3 3 4.50**

| Year | Car | Taxi | Mini bus | Govt Bus | Pvt Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18-19 | 5639 | 0 | 109 | 0 | 569 | 394 | 490 | 882 | 920 | 643 | 9646 | **16938** |
| 19-20 | 6026 | 0 | 115 | 0 | 600 | 416 | 517 | 926 | 966 | 680 | 10246 | **17926** |
| 20-21 | 6439 | 0 | 121 | 0 | 633 | 439 | 546 | 972 | 1014 | 719 | 10884 | **18973** |
| 21-22 | 6881 | 0 | 128 | 0 | 668 | 464 | 577 | 1021 | 1065 | 760 | 11563 | **20082** |
| 22-23 | 7353 | 0 | 135 | 0 | 705 | 489 | 609 | 1072 | 1118 | 803 | 12284 | **21257** |
| 23-24 | 7857 | 0 | 142 | 0 | 744 | 517 | 643 | 1126 | 1174 | 849 | 13051 | **22501** |
| 24-25 | 8294 | 0 | 150 | 0 | 781 | 545 | 678 | 1182 | 1233 | 895 | 13758 | **23696** |
| 25-26 | 8755 | 0 | 157 | 0 | 820 | 575 | 716 | 1241 | 1295 | 944 | 14503 | **24954** |
| 26-27 | 9242 | 0 | 165 | 0 | 861 | 607 | 755 | 1303 | 1359 | 996 | 15288 | **26279** |
| 27-28 | 9756 | 0 | 173 | 0 | 904 | 641 | 797 | 1368 | 1427 | 1050 | 16116 | **27675** |
| 28-29 | 10298 | 0 | 182 | 0 | 949 | 676 | 841 | 1437 | 1499 | 1107 | 16989 | **29144** |
| 29-30 | 10762 | 0 | 191 | 0 | 997 | 712 | 885 | 1509 | 1574 | 1165 | 17794 | **30568** |
| 30-31 | 11246 | 0 | 200 | 0 | 1046 | 749 | 932 | 1584 | 1652 | 1227 | 18637 | **32062** |
| 31-32 | 11752 | 0 | 210 | 0 | 1099 | 789 | 981 | 1663 | 1735 | 1291 | 19520 | **33628** |
| 32-33 | 12281 | 0 | 221 | 0 | 1154 | 830 | 1032 | 1746 | 1822 | 1359 | 20445 | **35272** |
| 33-34 | 12834 | 0 | 232 | 0 | 1211 | 874 | 1087 | 1834 | 1913 | 1431 | 21414 | **36996** |
| 34-35 | 13301 | 0 | 244 | 0 | 1272 | 917 | 1141 | 1925 | 2008 | 1502 | 22310 | **38672** |
| 35-36 | 13785 | 0 | 256 | 0 | 1336 | 963 | 1198 | 2022 | 2109 | 1577 | 23245 | **40424** |
| 36-37 | 14287 | 0 | 269 | 0 | 1402 | 1011 | 1258 | 2123 | 2214 | 1656 | 24220 | **42258** |
| 37-38 | 14807 | 0 | 282 | 0 | 1472 | 1062 | 1321 | 2229 | 2325 | 1739 | 25237 | **44176** |

**Traffic Projection of Homogeneous section 22 ( 2038-2060)**

| Year | Car | Taxi | Mini bus | Govt Bus | Pvt Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38-39 | 15346 | 0 | 296 | 0 | 1546 | 1115 | 1387 | 2340 | 2441 | 1826 | 26297 | **46184** |
| 39-40 | 15798 | 0 | 311 | 0 | 1623 | 1171 | 1456 | 2457 | 2563 | 1917 | 27297 | **48179** |
| 40-41 | 16264 | 0 | 327 | 0 | 1704 | 1229 | 1529 | 2580 | 2691 | 2013 | 28338 | **50264** |
| 41-42 | 16744 | 0 | 343 | 0 | 1790 | 1291 | 1605 | 2709 | 2826 | 2114 | 29422 | **52443** |
| 42-43 | 17238 | 0 | 360 | 0 | 1879 | 1355 | 1686 | 2845 | 2967 | 2219 | 30550 | **54722** |
| 43-44 | 17747 | 0 | 378 | 0 | 1973 | 1423 | 1770 | 2987 | 3115 | 2330 | 31724 | **57105** |
| 44-45 | 18171 | 0 | 397 | 0 | 2072 | 1494 | 1859 | 3136 | 3271 | 2447 | 32847 | **59497** |
| 45-46 | 18605 | 0 | 417 | 0 | 2175 | 1569 | 1951 | 3293 | 3435 | 2569 | 34015 | **61998** |
| 46-47 | 19050 | 0 | 438 | 0 | 2284 | 1648 | 2049 | 3458 | 3607 | 2698 | 35230 | **64612** |
| 47-48 | 19505 | 0 | 459 | 0 | 2398 | 1730 | 2152 | 3630 | 3787 | 2833 | 36494 | **67345** |
| 48-49 | 19971 | 0 | 482 | 0 | 2518 | 1816 | 2259 | 3812 | 3976 | 2974 | 37810 | **70204** |
| 49-50 | 20449 | 0 | 507 | 0 | 2644 | 1907 | 2372 | 4003 | 4175 | 3123 | 39179 | **73193** |
| 50-51 | 20937 | 0 | 532 | 0 | 2776 | 2003 | 2491 | 4203 | 4384 | 3279 | 40604 | **76319** |
| 51-52 | 21438 | 0 | 558 | 0 | 2915 | 2103 | 2615 | 4413 | 4603 | 3443 | 42088 | **79588** |
| 52-53 | 21950 | 0 | 586 | 0 | 3061 | 2208 | 2746 | 4633 | 4833 | 3615 | 43633 | **83008** |
| 53-54 | 22475 | 0 | 616 | 0 | 3214 | 2318 | 2883 | 4865 | 5075 | 3796 | 45242 | **86585** |
| 54-55 | 23012 | 0 | 646 | 0 | 3375 | 2434 | 3027 | 5108 | 5328 | 3986 | 46917 | **90328** |
| 55-56 | 23562 | 0 | 679 | 0 | 3543 | 2556 | 3179 | 5364 | 5595 | 4185 | 48663 | **94244** |
| 56-57 | 24125 | 0 | 713 | 0 | 3721 | 2684 | 3338 | 5632 | 5875 | 4394 | 50481 | **98341** |
| 57-58 | 24701 | 0 | 748 | 0 | 3907 | 2818 | 3505 | 5914 | 6168 | 4614 | 52375 | **102628** |
| 58-59 | 25292 | 0 | 786 | 0 | 4102 | 2959 | 3680 | 6209 | 6477 | 4845 | 54349 | **107115** |
| 2059-60 | 25896 | 0 | 825 | 0 | 4307 | 3107 | 3864 | 6520 | 6801 | 5087 | 56407 | **111811** |

### 4.6 Travel Pattern

The percentage of trips from major areas along the project road is shown in the table below.

**Table 4.11 Distribution of Trip in the Project Influence Area**

| State /vehicle type | Passenger Vehicles (%) | | | Freight Vehicles (%) | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Car** | **Minibus** | **Bus** | **Mini LCV** | **LCV** | **2-Axle Trucks** | **3- Axle Trucks** | **MAV (4 to 6 Axle)** |
| Punjab | 46 | 44 | 43 | 49 | 31 | 42 | 41 | 33 |
| Haryana | 29 | 23 | 21 | 31 | 36 | 20 | 24 | 29 |
| Delhi | 14 | 16 | 18 | 9 | 15 | 12 | 10 | 11 |
| J & K | 5 | 7 | 8 | 5 | 6 | 16 | 13 | 10 |
| Rest of India | 7 | 10 | 10 | 6 | 12 | 10 | 12 | 16 |
| Total | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

### 4.7 Lead Distribution

The data of Origin & destination was studied to determine lead ranges for various vehicle categories.

**Table 4.12 Lead Distribution of Passenger Vehicles**

| Vehicle Type | Trip Length Range ( Km) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0-20 | 20-50 | 50-100 | 100-200 | 200-500 | 500-1000 | >1000 | Total |
| **Gurdaspur - Pathankot section (NH-54 near Ladpalwan)** | | | | | | | | |
| Car | 0.3 | 49.1 | 3.8 | 27.7 | 17.5 | 1.5 | 0.1 | 100 |
| Mini Bus | 0.0 | 13.2 | 0.0 | 56.6 | 30.2 | 0.0 | 0.0 | 100 |
| Std. Bus | 0.0 | 5.5 | 0.0 | 64.7 | 27.6 | 2.2 | 0.0 | 100 |

**Table 4.13 Lead Distribution of Goods Vehicles**

| Vehicle Type | Trip Length Range ( Km) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0-20 | 20-100 | 100-200 | 200-500 | 500-1000 | >10000 | Total |
| **Gurdaspur - Pathankot section (NH-54 near Ladpalwan)** | | | | | | | |
| **Mini LCV** | 49.3 | 11.2 | 22.1 | 14.8 | 2.2 | 0.4 | **100.0** |
| **LCV** | 15.4 | 5.4 | 49.2 | 24.8 | 3.8 | 1.5 | **100.0** |
| **2A** | 15.3 | 8.0 | 32.6 | 36.8 | 5.7 | 1.5 | **100.0** |
| **3A** | 17.7 | 7.6 | 35.2 | 28.9 | 6.9 | 3.7 | **100.0** |
| **MAV** | 10.1 | 3.6 | 31.2 | 35.3 | 9.7 | 10.0 | **100.0** |

### 4.8 Commodity Group

The various commodities registered during the O-D survey have been listed into seventeen categories and are shown in the table below. All possible commodities have been taken into account, and they have been classified into homogeneous groups

**Table 4.14 Commodities Classification**

| Code | Commodity Type |
|---|---|
| 1 | Grain crops and other farm commodities |
| 2 | Fruits, vegetables – perishables |
| 3 | Wood and Forest Products |
| 4 | Petroleum, oil, Gas and lubricants product |
| 5 | Minerals, chemicals, fertilizer |
| 6 | Iron, Metal and steel |
| 7 | Finished and manufactured products |
| 8 | Parcel Service & Containers |
| 9 | Medicines |
| 10 | Building materials (Brick, Tiles, Mud and Blocks) |
| 11 | Mining (Sand, Bajri and Coarse Aggregate) |
| 12 | Cement |
| 13 | Marble stone |
| 14 | Textiles & Fibre |
| 15 | Coal |
| 16 | Miscellaneous goods (Livestock, Waste, paper etc.) |
| 17 | Empty vehicles |

**Table 4.15 Design Traffic Loading(MSA)**

| year | Traffic | | | | | | LDF | DDF | Traffic | ESAL(MSA) | | Design Life (years) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bus | LCV-4 | LCV-6 | 2-Axle | 3-Axle | MAV | | | | Yearly | cumulative | |
| **2018** | **678** | **394** | **490** | **882** | **920** | **643** | **0.75** | **0.5** | **4007** | **1.41** | | **Base year** |
| 2019 | 715 | 416 | 517 | 926 | 966 | 680 | 0.75 | 0.5 | 4220 | 1.49 | | |
| 2020 | 755 | 439 | 546 | 972 | 1014 | 719 | 0.75 | 0.5 | 4445 | 1.57 | | |
| 2021 | 796 | 464 | 577 | 1021 | 1065 | 760 | 0.75 | 0.5 | 4682 | 1.65 | | |
| 2022 | 840 | 489 | 609 | 1072 | 1118 | 803 | 0.75 | 0.5 | 4931 | 1.74 | **Construction Period** | |
| 2023 | 886 | 517 | 643 | 1126 | 1174 | 849 | 0.75 | 0.5 | 5194 | 1.83 | | |
| **2024** | **930** | **545** | **678** | **1182** | **1233** | **895** | **0.75** | **0.5** | **5464** | **1.93** | **1.93** | **1** |
| 2025 | 977 | 575 | 716 | 1241 | 1295 | 944 | 0.75 | 0.5 | 5747 | 2.03 | 3.96 | 2 |
| 2026 | 1026 | 607 | 755 | 1303 | 1359 | 996 | 0.75 | 0.5 | 6046 | 2.14 | 6.09 | 3 |
| 2027 | 1077 | 641 | 797 | 1368 | 1427 | 1050 | 0.75 | 0.5 | 6360 | 2.25 | 8.34 | 4 |
| 2028 | 1131 | 676 | 841 | 1437 | 1499 | 1107 | 0.75 | 0.5 | 6691 | 2.36 | 10.70 | 5 |
| 2029 | 1187 | 712 | 885 | 1509 | 1574 | 1165 | 0.75 | 0.5 | 7032 | 2.49 | 13.19 | 6 |
| 2030 | 1247 | 749 | 932 | 1584 | 1652 | 1227 | 0.75 | 0.5 | 7391 | 2.61 | 15.80 | 7 |
| 2031 | 1309 | 789 | 981 | 1663 | 1735 | 1291 | 0.75 | 0.5 | 7768 | 2.75 | 18.55 | 8 |
| 2032 | 1375 | 830 | 1032 | 1746 | 1822 | 1359 | 0.75 | 0.5 | 8164 | 2.89 | 21.44 | 9 |
| 2033 | 1443 | 874 | 1087 | 1834 | 1913 | 1431 | 0.75 | 0.5 | 8581 | 3.04 | 24.47 | 10 |
| 2034 | 1516 | 917 | 1141 | 1925 | 2008 | 1502 | 0.75 | 0.5 | 9010 | 3.19 | 27.66 | 11 |
| 2035 | 1591 | 963 | 1198 | 2022 | 2109 | 1577 | 0.75 | 0.5 | 9460 | 3.35 | 31.01 | 12 |

| year | Traffic | | | | | | LDF | DDF | Traffic | ESAL(MSA) | | Design Life(years) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Bus | LCV-4 | LCV-6 | 2-Axle | 3-Axle | MAV | | | | Yearly | Cumulative | |
| 2036 | 1671 | 1011 | 1258 | 2123 | 2214 | 1656 | 0.75 | 0.5 | 9933 | 3.51 | 34.52 | 13 |
| 2037 | 1754 | 1062 | 1321 | 2229 | 2325 | 1739 | 0.75 | 0.5 | 10430 | 3.69 | 38.21 | 14 |
| 2038 | 1842 | 1115 | 1387 | 2340 | 2441 | 1826 | 0.75 | 0.5 | 10951 | 3.87 | 42.08 | 15 |
| 2039 | 1934 | 1171 | 1456 | 2457 | 2563 | 1917 | 0.75 | 0.5 | 11499 | 4.07 | 46.15 | 16 |
| 2040 | 2031 | 1229 | 1529 | 2580 | 2691 | 2013 | 0.75 | 0.5 | 12074 | 4.27 | 50.42 | 17 |
| 2041 | 2133 | 1291 | 1605 | 2709 | 2826 | 2114 | 0.75 | 0.5 | 12678 | 4.48 | 54.91 | 18 |
| 2042 | 2239 | 1355 | 1686 | 2845 | 2967 | 2219 | 0.75 | 0.5 | 13312 | 4.71 | 59.62 | 19 |
| 2043 | 2351 | 1423 | 1770 | 2987 | 3115 | 2330 | 0.75 | 0.5 | 13977 | 4.94 | 64.56 | 20 |
| 2044 | 2469 | 1494 | 1859 | 3136 | 3271 | 2447 | 0.75 | 0.5 | 14676 | 5.19 | 69.75 | 21 |
| 2045 | 2592 | 1569 | 1951 | 3293 | 3435 | 2569 | 0.75 | 0.5 | 15410 | 5.45 | 75.21 | 22 |
| 2046 | 2722 | 1648 | 2049 | 3458 | 3607 | 2698 | 0.75 | 0.5 | 16180 | 5.72 | 80.93 | 23 |
| 2047 | 2858 | 1730 | 2152 | 3630 | 3787 | 2833 | 0.75 | 0.5 | 16989 | 6.01 | 86.94 | 24 |
| 2048 | 3001 | 1816 | 2259 | 3812 | 3976 | 2974 | 0.75 | 0.5 | 17839 | 6.31 | 93.25 | 25 |
| 2049 | 3151 | 1907 | 2372 | 4003 | 4175 | 3123 | 0.75 | 0.5 | 18731 | 6.63 | 99.88 | 26 |
| 2050 | 3308 | 2003 | 2491 | 4203 | 4384 | 3279 | 0.75 | 0.5 | 19667 | 6.96 | 106.83 | 27 |
| 2051 | 3474 | 2103 | 2615 | 4413 | 4603 | 3443 | 0.75 | 0.5 | 20651 | 7.31 | 114.14 | 28 |
| 2052 | 3647 | 2208 | 2746 | 4633 | 4833 | 3615 | 0.75 | 0.5 | 21683 | 7.67 | 121.81 | 29 |
| **2053** | **3830** | **2318** | **2883** | **4865** | **5075** | **3796** | **0.75** | **0.5** | **22767** | **8.05** | **129.86** | **30** |
| 2054 | 4021 | 2434 | 3027 | 5108 | 5328 | 3986 | 0.75 | 0.5 | 23906 | 8.46 | 138.32 | 31 |
| Vehicle type | | | | Bus | LCV-4 | LCV-6 | 2-Axle | 3-Axle | MAV | | | |
| Actual VDF | | | | 0.85 | 0.18 | 0.66 | 2.05 | 3.37 | 6.90 | | | |

### 4.9 Design Calculations of flexible pavement

#### 4.9.1 Effective resilient modulus of subgrade

Resilient modulus of subgrade is calculated from the empirical relation given in IRC37 -2018 ( clause 6.3)

$M_{RS} = 10 \times CBR$ for CBR $\leq 5\%$

$M_{RS} = 17.6 \times (CBR)^{0.64}$ for CBR > 5%

Where $M_{RS}$ = resilient modulus of subgrade soil ( in MPa)

CBR = California bearing ratio of subgrade soil (%)

$M_{RS} = 17.6 \times (12)^{0.64}$

= 86.335 MPa ( less than 100 MPa , upper limit)

#### 4.9.2 Selection of trial thickness

The trial thickness is assumed from the table mentioned in **IRC 37 -2018 clause 12.3**. . Provide a surface layer of 50mm thick BC, a base course of 150mm DBM, a granular base (WMM) of 250mm thickness, and a granular sub base of 250mm thickness (GSB). The granular layer's total thickness is 500 mm.

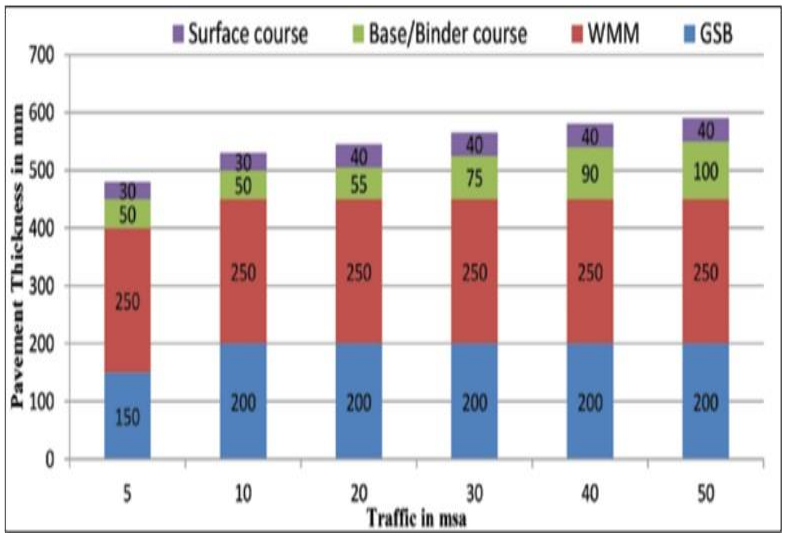


**Fig 4.1 Catalogue for pavement with bituminous surface course with granular base and sub base**

**Effective CBR 12%**

### 4.9.3 Resilient modulus of the granular layer

Equation 7.1 of IRC 37-2018 ( clause 7.2.3) is used to calculate resilient modulus of the granular layer.

$M_{RGRAN} = 0.2(h)^{0.45} \times M_{RSUPPORT}$

where h= thickness of granular layer in mm

$M_{RGRAN}$ = resilient modulus of the granular layer (MPa)

$M_{RSUPPORT}$ =( effective) resilient modulus of the supporting layer(MPa)

$M_{RGRAN} = 0.2 \times (500)^{0.45} \times 86.335$

= **283MPa**

### 4.9.4 Allowable vertical compressive strain

The permissible vertical compressive strain for a design traffic of 130 msa is calculated from IRC 37-2018 ( clause 3.6.1)

$N_R = 4.1656 \times 10^{-8} \left[\frac{1}{\epsilon_v}\right]^{4.5337}$ ( for 80% reliability )

$N_R = 1.4100 \times 10^{-8} \left[\frac{1}{\epsilon_v}\right]^{4.5337}$ ( for 90 % reliability)

Where

$N_R$ = subgrade rutting life

$\epsilon_v$ = vertical compressive strain at the top of the subgrade

Use above equation for 90 % reliability

$\epsilon_v = \mathbf{3.01 \times (10)^{-4}}$

### 4.9.5 Allowable horizontal tensile strain

The allowable horizontal tensile strain for design traffic of 130 msa is calculated from IRC 37 – 2018 ( clause 3.6.2)

$N_F = 0.5161 \times C \times (10)^{-4} \times \left(\frac{1}{\epsilon t}\right)^{3.89} \times \left(\frac{1}{M}\right)^{0.854}$ for 90 % reliability

$C = 10^M$

Where $M = 4.84 \times (v_{be}) \div (v_a + v_{be}) - 0.69$

$M = 4.84(11.5 \mid (3.5+11.5) - 0.69$

M= 0.371

$C = 10^{M} = 10^{0.371} = 2.35$

Putting all the values in above equation

$$\epsilon_t = 1.39 \times (10)^{-4}$$

**Pavement Analysis using IIT PAVE**

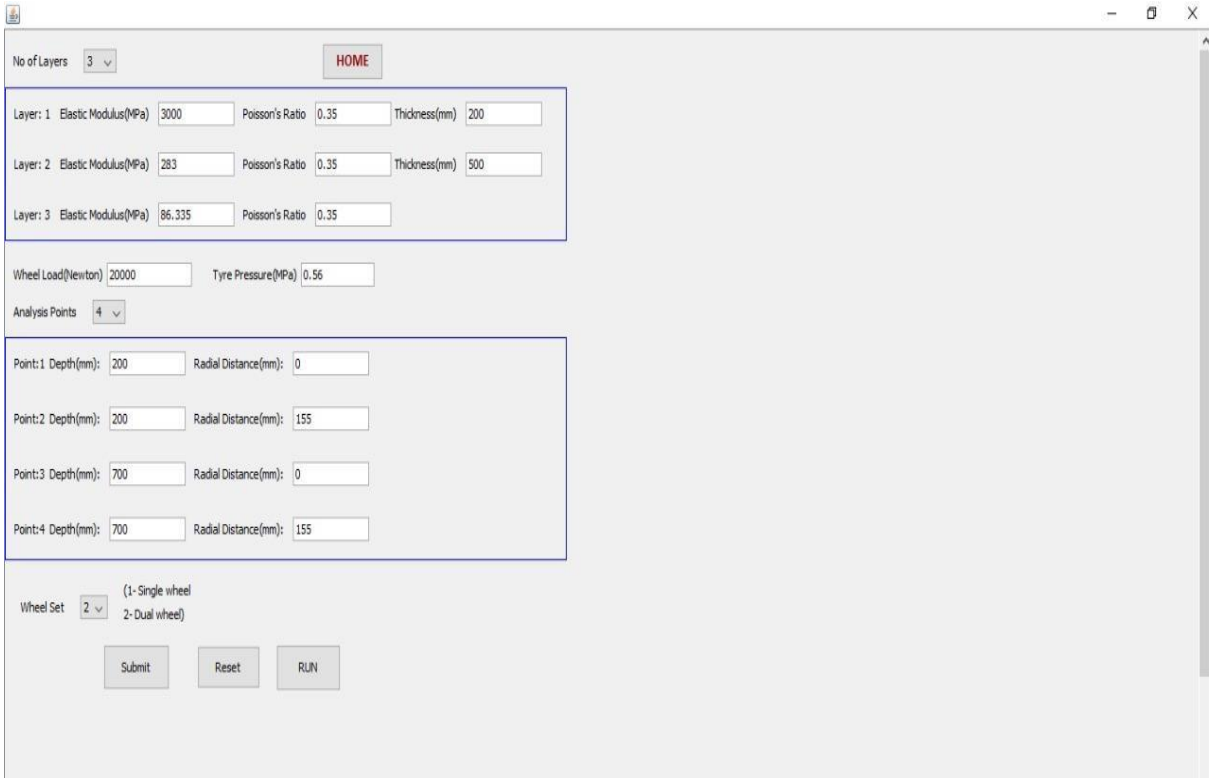


**Fig 4.2 Screenshot of IIT Pave Input**

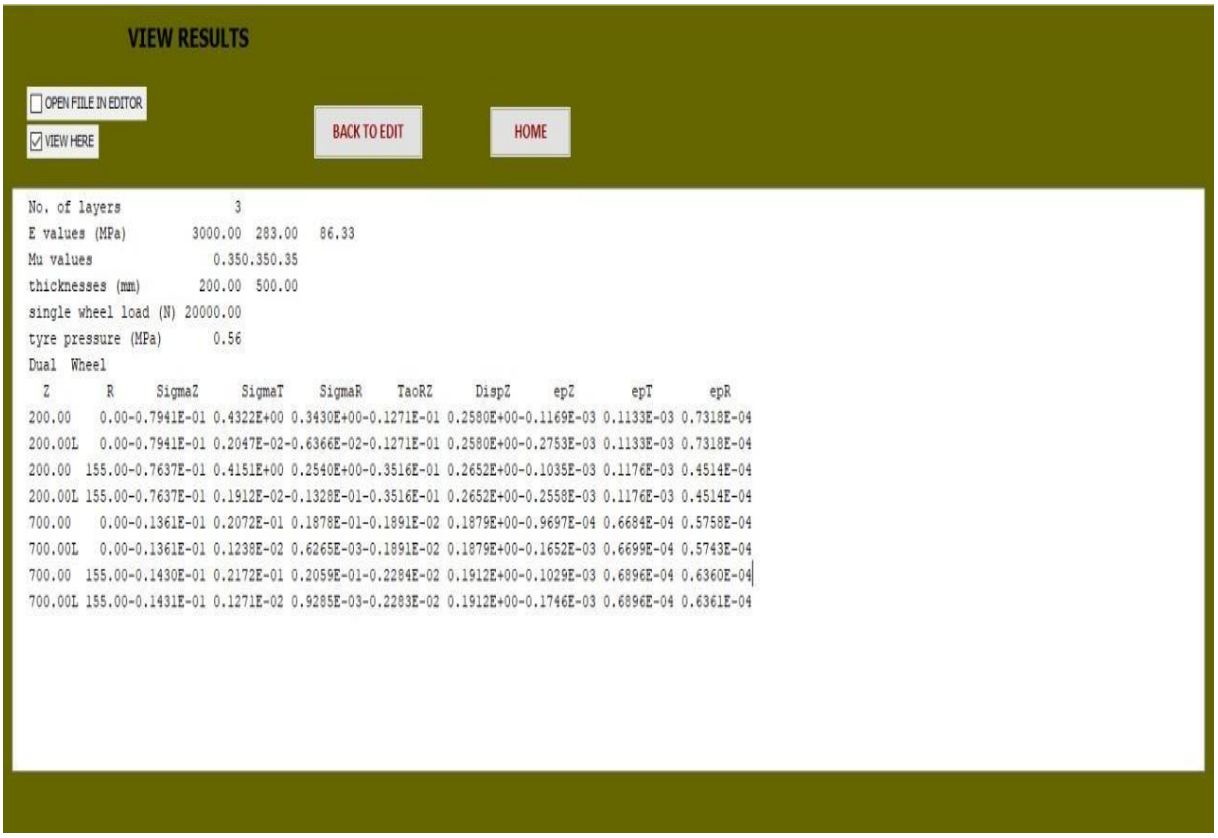


**Fig 4.3 Screenshot of IIT Pave output**

**Table 4.16 Flexible Pavement Crust Composition with granular base & subbase for Main Carriageway**

| **Homogeneous Section** | | **22** |
|---|---|---|
| Section (KM) | From | 424.557 |
| | To | 428 |
| Lane Configuration | | 4 Lane |
| msa | | 130 |
| Effective Design CBR (%) | | 12 |
| Grade Of Bitumen | | VG 40 |
| Proposed Crust Composition(mm) | BC | 50 |
| | DBM | 150 |
| | WMM | 250 |
| | GSB | 250 |
| Allowable Horizontal Tensile Strain ($\epsilon_t$) | | $1.39 \times (10)^{-4}$ |
| Allowable Vertical Compressive Strain ( $\epsilon_v$) | | $3.01 \times (10)^{-4}$ |
| Actual Horizontal Tensile Strain ($\epsilon_t$) | | $1.17 \times (10)^{-4}$ |
| Actual Vertical Compressive Strain ( $\epsilon_v$) | | $1.74 \times (10)^{-4}$ |

## Homogeneous section 23

### 4.10 Fundamental Consideration for Flexible Pavement Design

#### 4.10.1 Design Life

According to IRC: 37-2018 clause 4.3.1, a design life of 30 years has been taken into account for flexible pavement design of main carriageway. The base year of traffic estimation considered is 2018 and the proposed Highway shall be opened to traffic in the year of 2024

#### 4.10.2 Lane Distribution Factor (LDF)

Lane distribution factors have been considered as per clause 4.5.1 (iv) of IRC: 37-2012 and the same are given in table below:

**Table 4.17 Adopted Lane Distribution Factor**

| SI. No | Description | Design Period | | LDF (%) |
|---|---|---|---|---|
| | | From(years) | To(years) | |
| 1 | 4 Lane Divided Main Carriageway | 2024 | 2053 | 75 |

#### 4.10.3 Directional Distribution Factor (DDF)

The table shows the directional split at survey locations.

**Table 4.18 Directional Split**

| Location | Up direction(%) | Down direction(%) |
|---|---|---|
| Mubarak Chowk– Panipat section (NH-44 near Baghan) | 49.4 | 50.6 |
| Rajpura – Patiala (NH-07 near Daun Kalan) | 50.1 | 49.9 |
| Ambala -Kurukshetra section (NH-44 near Sarifgarh) | 50.2 | 49.8 |
| Churu – Hisar (Laseri Toll Plaza_NH-52) | 50.0 | 50.0 |
| Jalandhar – Amritsar_NH-3 | 50.5 | 49.5 |
| Domel – Katra | 50.6 | 49.4 |

### 4.10.4 Vehicle Damage Factor (VDF)

Homogeneous section 23 comes under axle load location number 2 (Lakhanpur check post)

**Table 4.19 Actual VDF Summary**

| Type of vehicle | Axle load location No | Homogeneous section | Direction | Bus | LCV-4 | LCV-6 | 2-Axle | 3-Axle | MAV |
|---|---|---|---|---|---|---|---|---|---|
| Actual VDF | 2 | 23 | Both | 0.85 | 0.18 | 0.66 | 2.05 | 3.37 | 6.9 |

### 4.10.5 Projected Traffic Growth Rate

The final recommended growth rate is given in table below. The values of growth rate mentioned in table below are taken from the clause 4.2.6 of " **traffic studies and forecast final**".

**Table 4.20 Traffic Growth Rate**

| Year / Mode | 20-24 | 25-29 | 30-34 | 35-39 | 40-44 | >44 |
|---|---|---|---|---|---|---|
| Car | 6.9 | 5.6 | 4.5 | 3.6 | 3.0 | 2.4 |
| Bus | 5.5 | 4.5 | 3.6 | 2.9 | 2.4 | 1.9 |
| LCV | 5.8 | 5.5 | 5.3 | 4.9 | 4.5 | 4.0 |
| 2 Axle Truck | 3.0 | 2.8 | 2.5 | 2.2 | 1.5 | 1.5 |
| 3 Axle Truck | 3.3 | 3.0 | 2.8 | 2.3 | 1.7 | 1.7 |
| MAVs | 5.7 | 5.5 | 5.2 | 4.9 | 4.6 | 4.2 |

### 4.10.6 Design CBR

Effective design CBR adopted is 12 % as per Clause 2.2.8 of Detailed Project Report

### 4.10.7 Resilient Modulus of Bituminous Mix

The value of resilient modulus of bituminous mix is taken as per table 9.2 of IRC 37-2018

**Table 4.21 Indicative values of resilient modulus (MPa) of bitumen mixes**

| Mix Type | Average Annual Pavement Temperature ℃ | | | | |
|---|---|---|---|---|---|
| BC and DBM for VG 40 bitumen | 20 | 25 | 30 | 35 | 40 |
| | 6000 | 5000 | 4000 | 3000 | 2000 |

The resilient modulus calculated at 35 °C temperature as specified in ASTM 4123 shall be used for design purposes.

### 4.11 Traffic Survey Data

#### 4.11.1 Traffic Homogeneous Section

The details of traffic homogeneous section is given in table below

**Table 4.22 Traffic Homogeneous Section**

| Homogeneous section | From (Km) | To (Km) | Length (Km) |
|---|---|---|---|
| 23 | 428.000 | 438.780 | 10.780 |

### 4.11.2 Traffic Projection

Vehicle forecasting for homogeneous section 23 is shown in tabular form.

**Table 4.23 Traffic Projection-Most likely Scenario (2018-2038)**

| Year | Car | Taxi | Mini bus | Govt Bus | Pvt Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18-19 | 5430 | 0 | 113 | 0 | 660 | 419 | 562 | 973 | 1002 | 677 | 9836 | **17813** |
| 19-20 | 5803 | 0 | 119 | 0 | 696 | 442 | 593 | 1022 | 1052 | 716 | 10443 | **18845** |
| 20-21 | 6201 | 0 | 126 | 0 | 735 | 467 | 626 | 1073 | 1105 | 757 | 11089 | **19937** |
| 21-22 | 6626 | 0 | 133 | 0 | 775 | 493 | 661 | 1126 | 1160 | 800 | 11774 | **21093** |
| 22-23 | 7081 | 0 | 140 | 0 | 818 | 520 | 698 | 1183 | 1218 | 845 | 12503 | **22317** |
| 23-24 | 7567 | 0 | 148 | 0 | 863 | 549 | 737 | 1242 | 1279 | 894 | 13278 | **23614** |
| 24-25 | 7988 | 0 | 155 | 0 | 906 | 580 | 778 | 1304 | 1343 | 942 | 13995 | **24865** |
| 25-26 | 8432 | 0 | 163 | 0 | 951 | 612 | 821 | 1369 | 1410 | 994 | 14751 | **26181** |
| 26-27 | 8900 | 0 | 171 | 0 | 999 | 646 | 866 | 1438 | 1480 | 1048 | 15548 | **27568** |
| 27-28 | 9395 | 0 | 180 | 0 | 1048 | 681 | 914 | 1509 | 1554 | 1105 | 16388 | **29028** |
| 28-29 | 9918 | 0 | 188 | 0 | 1101 | 719 | 965 | 1585 | 1632 | 1166 | 17274 | **30566** |
| 29-30 | 10364 | 0 | 198 | 0 | 1156 | 757 | 1015 | 1664 | 1714 | 1227 | 18095 | **32064** |
| 30-31 | 10830 | 0 | 208 | 0 | 1214 | 797 | 1069 | 1747 | 1799 | 1292 | 18956 | **33636** |
| 31-32 | 11318 | 0 | 218 | 0 | 1274 | 839 | 1125 | 1835 | 1889 | 1360 | 19858 | **35285** |
| 32-33 | 11827 | 0 | 229 | 0 | 1338 | 883 | 1184 | 1926 | 1984 | 1431 | 20803 | **37015** |
| 33-34 | 12359 | 0 | 241 | 0 | 1405 | 929 | 1246 | 2023 | 2083 | 1506 | 21793 | **38830** |
| 34-35 | 12809 | 0 | 253 | 0 | 1475 | 976 | 1309 | 2124 | 2187 | 1582 | 22714 | **40604** |
| 35-36 | 13276 | 0 | 265 | 0 | 1549 | 1024 | 1374 | 2230 | 2297 | 1661 | 23676 | **42460** |
| 36-37 | 13759 | 0 | 278 | 0 | 1627 | 1076 | 1443 | 2342 | 2411 | 1744 | 24679 | **44402** |
| 37-38 | 14260 | 0 | 292 | 0 | 1708 | 1129 | 1515 | 2459 | 2532 | 1831 | 25726 | **46435** |

# Traffic Projection (2038-2060)

| Year | Car | Taxi | Mini bus | Govt Bus | Pvt Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 38-39 | 14779 | 0 | 307 | 0 | 1793 | 1186 | 1591 | 2582 | 2659 | 1923 | **26818** | **48563** |
| 39-40 | 15215 | 0 | 322 | 0 | 1883 | 1245 | 1670 | 2711 | 2792 | 2019 | **27856** | **50688** |
| 40-41 | 15663 | 0 | 339 | 0 | 1977 | 1307 | 1754 | 2846 | 2931 | 2120 | **28937** | **52911** |
| 41-42 | 16125 | 0 | 355 | 0 | 2076 | 1373 | 1841 | 2989 | 3078 | 2226 | **30063** | **55235** |
| 42-43 | 16601 | 0 | 373 | 0 | 2180 | 1442 | 1933 | 3138 | 3232 | 2337 | **31235** | **57666** |
| 43-44 | 17091 | 0 | 392 | 0 | 2289 | 1514 | 2030 | 3295 | 3393 | 2454 | **32457** | **60209** |
| 44-45 | 17499 | 0 | 411 | 0 | 2403 | 1589 | 2132 | 3460 | 3563 | 2576 | **33634** | **62774** |
| 45-46 | 17918 | 0 | 432 | 0 | 2523 | 1669 | 2238 | 3633 | 3741 | 2705 | **34859** | **65456** |
| 46-47 | 18346 | 0 | 454 | 0 | 2649 | 1752 | 2350 | 3814 | 3928 | 2840 | **36134** | **68261** |
| 47-48 | 18784 | 0 | 476 | 0 | 2782 | 1840 | 2468 | 4005 | 4124 | 2982 | **37462** | **71195** |
| 48-49 | 19233 | 0 | 500 | 0 | 2921 | 1932 | 2591 | 4205 | 4331 | 3132 | **38844** | **74264** |
| 49-50 | 19693 | 0 | 525 | 0 | 3067 | 2028 | 2721 | 4416 | 4547 | 3288 | **40285** | **77476** |
| 50-51 | 20164 | 0 | 551 | 0 | 3220 | 2130 | 2857 | 4636 | 4774 | 3453 | **41785** | **80835** |
| 51-52 | 20645 | 0 | 579 | 0 | 3381 | 2236 | 2999 | 4868 | 5013 | 3625 | **43348** | **84351** |
| 52-53 | 21139 | 0 | 608 | 0 | 3551 | 2348 | 3149 | 5112 | 5264 | 3806 | **44977** | **88030** |
| 53-54 | 21644 | 0 | 638 | 0 | 3728 | 2465 | 3307 | 5367 | 5527 | 3997 | **46674** | **91879** |
| 54-55 | 22161 | 0 | 670 | 0 | 3914 | 2589 | 3472 | 5635 | 5803 | 4197 | **48442** | **95908** |
| 55-56 | 22691 | 0 | 704 | 0 | 4110 | 2718 | 3646 | 5917 | 6094 | 4406 | **50286** | **100126** |
| 56-57 | 23233 | 0 | 739 | 0 | 4316 | 2854 | 3828 | 6213 | 6398 | 4627 | **52208** | **104540** |
| 57-58 | 23789 | 0 | 776 | 0 | 4532 | 2997 | 4020 | 6524 | 6718 | 4858 | **54212** | **109160** |
| 58-59 | 24357 | 0 | 815 | 0 | 4758 | 3147 | 4221 | 6850 | 7054 | 5101 | **56302** | **113997** |
| 2059-60 | 24939 | 0 | 855 | 0 | 4996 | 3304 | 4432 | 7192 | 7407 | 5356 | | |

### 4.12 Design Calculations:

#### 4.12.1 Effective Resilient Modulus of Subgrade

Resilient modulus of subgrade is calculated from the empirical relation as per clause 6.3 given in IRC 37 -2018

$M_{RS} = 10 \times CBR$ for $CBR \leq 5\%$

$M_{RS} = 17.6 \times (CBR)^{0.64}$ for $CBR > 5\%$

$M_{RS} = 17.6 \times (12)^{0.64}$

= 86.335 MPa ( less than 100 MPa , upper limit)

#### 4.12.2 Selection of trial thickness

The trial thickness is assumed from the table mentioned in **IRC 37 -2018 clause 12.3** . Provide a surface layer of 50mm thick BC, a base course of 150mm DBM, a granular base (WMM) of 250mm thickness, and a granular sub base of 250mm thickness (GSB). The granular layer's total thickness is 500 mm.

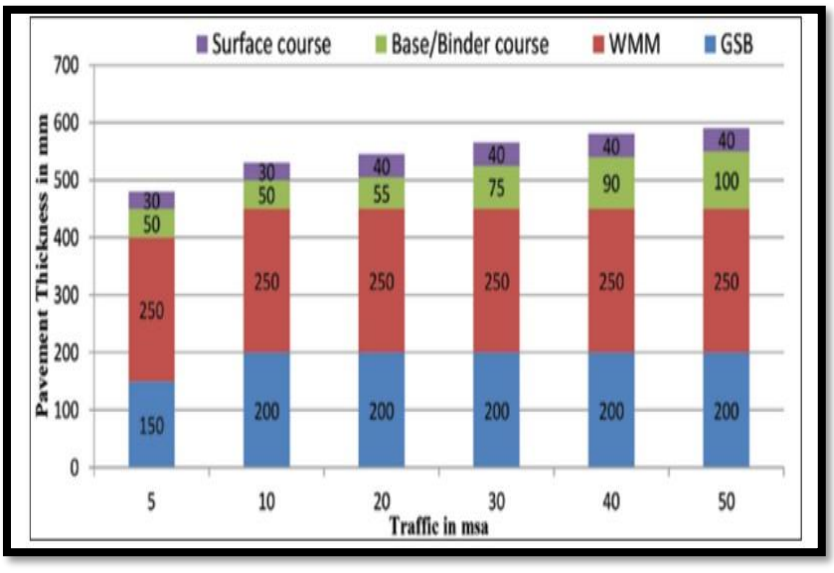


**Fig 4.4 Catalogue for pavement with bituminous surface course with granular base and sub base -base with Effective CBR 12%**

### 4.12.3 Resilient Modulus of The Granular Layer

Equation 7.1 of IRC 37-2018 ( clause 7.2.3) is used to calculate resilient modulus of the granular layer.

$M_{RGRAN} = 0.2(h)^{0.45} \times M_{RSUPPORT}$

$M_{RGRAN} = 0.2 \times (500)^{0.45} \times 86.335$

= **283MPa**

### 4.12.4 Allowable vertical compressive strain

The permissible vertical compressive strain for design traffic of 140 msa is calculated from IRC 37-2018( clause 3.6.1)

$N_R = 4.1656 \times 10^{-8} [\frac{1}{\epsilon_v}]^{4.5337}$ ( for 80% reliability )

$N_R = 1.4100 \times 10^{-8} [\frac{1}{\epsilon_v}]^{4.5337}$ ( for 90 % reliability)

$\epsilon_v = 2.96 \times (10)^{-4}$

### 4.12.5 Allowable horizontal tensile strain

The allowable horizontal tensile strain for design traffic of 140 msa is calculated from IRC 37 – 2018 **( clause 3.6.2)**

$N_F = 0.5161 \times C \times (10)^{-4} \times (\frac{1}{\epsilon t})^{3.89} \times (\frac{1}{M})^{0.854}$ for 90 % reliability

$C = 10^M$

Where $M = 4.84 \times (v_{be}) \div (v_a + v_{be}) - 0.69$

$M = 4.84(11.5|(3.5 + 11.5) - 0.69$

M= 0.371

$C = 10^M = 10^{0.371} = 2.35$

Putting all the values in above equation

$$\epsilon_t = 1.37 \times (10)^{-4}$$

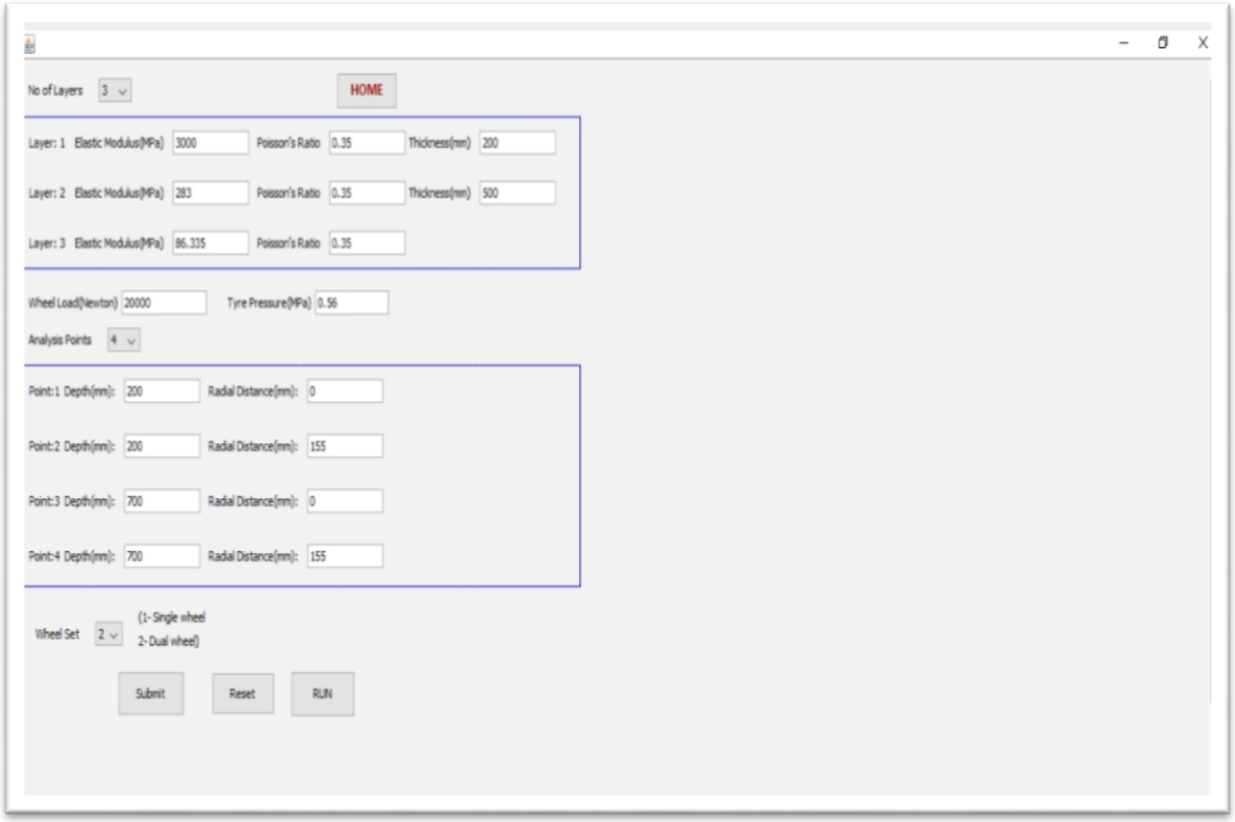


**Fig 4. 5 Screenshot of IIT Pave Input**


**Fig 4.6 Screenshot of IIT Pave Output**

**Table 4.24 Flexible Pavement Crust Composition with granular base & subbase for Main Carriageway**

| **Homogeneous Section** | | **23** |
|---|---|---|
| Section (KM) | From | 428.000 |
| | To | 438.780 |
| Lane Configuration | | 4 Lane |
| msa | | 140 |
| Effective Design CBR (%) | | 12 |
| Grade Of Bitumen | | VG 40 |
| Proposed Crust Composition(mm) | BC | 50 |
| | DBM | 150 |
| | WMM | 250 |
| | GSB | 250 |
| Allowable Tensile Strain ($\epsilon_t$) | | $1.37 \times (10)^{-4}$ |
| Allowable Vertical Strain ( $\epsilon_v$) | | $2.96 \times (10)^{-4}$ |
| Actual Tensile Strain ($\epsilon_t$) | | $1.17\times (10)^{-4}$ |
| Actual Vertical Strain ( $\epsilon_v$) | | $1.74 \times (10)^{-4}$ |

# CHAPTER 5

# CAPACITY ANALYSIS

## 5.1 Capacity Analysis

### 5.1.1 General

Capacity analysis is fundamental to the preparing, design, & operation of National Highways since it serves as the foundation for determining the carriageway width to be provided at any point in time in relation to traffic volume and composition. It serves as a critical tool for determining the amount of investment required for upcoming road construction and developments, as well as determining road project priorities**.**

## 5.2 Level of Service of The Expressway

According to clause 4.2.6 of the MORTH specification, level of service is a grading system for the amount of congestion, with the letter A representing the lowest amount of congestion and the letter F representing the most amount of congestion . Level B is recommended for expressways, while Level C is acceptable.

**Table 5.1 Level of Service Characteristics**

| Level of Service | Description |
|---|---|
| A | Free Flow with low volumes and high speed |
| B | Reasonably free flow ,but speeds beginning to be restricted by traffic conditions |
| C | In stable flow zone, but most drivers are restricted in the freedom to select their own speeds. |
| D | Approaching unstable flow, drivers have little freedom to select their own speeds. |
| E | Unstable flow, may be short stoppages |

## 5.3 Capacity Augmentation Proposal ( lane requirement )

As per SP 099 -2013, the design service volume for LOS - B for plain or rolling terrain shall be 1300 PCU per hour per lane for the purposes of design and future expansion of the Project Expressway. The MORTH Standards for Expressways can be used to calculate the design service volume. The design service volume per day will be calculated by PHF and will be as shown in the table .

**Table 5.2 Design service volume in PCUs per day for LOS B**

| **Design service volume in PCUs per day for LOS B** | | |
|---|---|---|
| Four Lane | Six Lane | Eight Lane |
| 86,000 for PHF (6%)<br>65,000 for PHF (8%) | 1,30,000 for PHF(6%)<br>98,000 for PHF(8%) | 1,73,000 for PHF(6%)<br>1 30,000 for PHF(8%) |

### 5.4 Projected Traffic Growth Rate

The final recommended growth rate is given in table below. The values of growth rate mentioned in table below are taken from the clause 4.2.6 of " **traffic studies and forecast final**".

**Table 5.3 Traffic Growth Rate**

| **Year / Mode** | **20-24** | **25-29** | **30-34** | **35-39** | **40-44** | **>44** |
|---|---|---|---|---|---|---|
| Car | 6.9 | 5.6 | 4.5 | 3.6 | 3.0 | 2.4 |
| Bus | 5.5 | 4.5 | 3.6 | 2.9 | 2.4 | 1.9 |
| LCV | 5.8 | 5.5 | 5.3 | 4.9 | 4.5 | 4.0 |
| 2 Axle Truck | 3.0 | 2.8 | 2.5 | 2.2 | 1.5 | 1.5 |
| 3 Axle Truck | 3.3 | 3.0 | 2.8 | 2.3 | 1.7 | 1.7 |
| MAVs | 5.7 | 5.5 | 5.2 | 4.9 | 4.6 | 4.2 |

| FY | Section 21 | Section 22 | Section23 | Section24 | Section25 | Section26 | Section27 | Section28 | Section29 | Section30 | Section31 | Average PCUs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 18-19 | 18894 | 16945 | 18900 | 18829 | 18439 | 18439 | 18318 | 18447 | 21250 | 21250 | 7893 | **17964** |
| 19-20 | 19898 | 17837 | 19901 | 19821 | 19413 | 19413 | 19286 | 19421 | 22422 | 22422 | 8372 | **18928** |
| 20-21 | 20961 | 18780 | 20959 | 20871 | 20443 | 20443 | 20309 | 20451 | 23666 | 23666 | 8881 | **19948** |
| 21-22 | 22084 | 19777 | 22077 | 21981 | 21533 | 21533 | 21392 | 21540 | 24983 | 24983 | 9423 | **21028** |
| 22-23 | 23272 | 20832 | 23260 | 23154 | 22685 | 22685 | 22536 | 22691 | 26379 | 26379 | 9999 | **22170** |
| 23-24 | 24530 | 21946 | 24511 | 24395 | 23904 | 23904 | 23748 | 23910 | 27859 | 27859 | 10611 | **23380** |
| 24-25 | 26958 | 24116 | 26937 | 26808 | 26270 | 26270 | 26099 | 26278 | 30647 | 30647 | 11707 | **25703** |
| 25-26 | 28219 | 25241 | 28197 | 28060 | 27500 | 27500 | 27321 | 27508 | 32112 | 32112 | 12302 | **26916** |
| 26-27 | 29543 | 26422 | 29519 | 29375 | 28791 | 28791 | 28604 | 28799 | 33650 | 33650 | 12928 | **28188** |
| 27-28 | 30932 | 27662 | 30907 | 30755 | 30146 | 30146 | 29950 | 30155 | 35267 | 35267 | 13588 | **29525** |
| 28-29 | 32391 | 28963 | 32365 | 32204 | 31569 | 31569 | 31364 | 31578 | 36966 | 36966 | 14281 | **30929** |
| 29-30 | 33711 | 30149 | 33689 | 33524 | 32866 | 32866 | 32652 | 32876 | 38476 | 38476 | 14886 | **32197** |
| 30-31 | 35088 | 31385 | 35071 | 34901 | 34218 | 34218 | 33997 | 34230 | 40051 | 40051 | 15516 | **33521** |
| 31-32 | 36524 | 32675 | 36512 | 36337 | 35629 | 35629 | 35399 | 35644 | 41693 | 41693 | 16174 | **34901** |
| 32-33 | 38021 | 34022 | 38016 | 37836 | 37102 | 37102 | 36863 | 37119 | 43406 | 43406 | 16861 | **36341** |
| 33-34 | 39584 | 35427 | 39585 | 39401 | 38639 | 38639 | 38390 | 38658 | 45192 | 45192 | 17577 | **37844** |
| 34-35 | 40977 | 36689 | 40991 | 40806 | 40020 | 40020 | 39763 | 40042 | 46759 | 46759 | 18194 | **39184** |
| 35-36 | 42423 | 38000 | 42451 | 42266 | 41454 | 41454 | 41188 | 41479 | 48383 | 48383 | 18833 | **40574** |
| 36-37 | 43924 | 39362 | 43967 | 43781 | 42943 | 42943 | 42668 | 42971 | 50067 | 50067 | 19496 | **42017** |
| 37-38 | 45482 | 40775 | 45542 | 45356 | 44490 | 44490 | 44206 | 44522 | 51812 | 51812 | 20182 | **43515** |
| 38-39 | 47099 | 42243 | 47176 | 46991 | 46096 | 46096 | 45802 | 46133 | 53623 | 53623 | 20894 | **45071** |

| FY | Section 21 | Section 22 | Section23 | Section24 | Section25 | Section26 | Section27 | Section28 | Section29 | Section30 | Section31 | Average PCUs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39-40 | 48498 | 43522 | 48598 | 48416 | 47496 | 47496 | 47194 | 47537 | 55167 | 55167 | 21499 | **46417** |
| 40-41 | 49944 | 44846 | 50068 | 49889 | 48944 | 48944 | 48633 | 48990 | 56761 | 56761 | 22121 | **47809** |
| 41-42 | 51439 | 46214 | 51589 | 51413 | 50442 | 50442 | 50122 | 50493 | 58404 | 58404 | 22763 | **49248** |
| 42-43 | 52983 | 47629 | 53161 | 52989 | 51990 | 51990 | 51662 | 52048 | 60100 | 60100 | 23424 | **50734** |
| 43-44 | 54580 | 49093 | 54786 | 54619 | 53593 | 53593 | 53255 | 53656 | 61850 | 61850 | 24106 | **52271** |
| 44-45 | 56019 | 50423 | 56258 | 56099 | 55047 | 55047 | 54702 | 55118 | 63394 | 63394 | 24691 | **53654** |
| 45-46 | 57501 | 51794 | 57776 | 57624 | 56547 | 56547 | 56193 | 56624 | 64980 | 64980 | 25290 | **55078** |
| 46-47 | 59028 | 53207 | 59339 | 59197 | 58092 | 58092 | 57729 | 58177 | 66611 | 66611 | 25906 | **56544** |
| 47-48 | 60600 | 54663 | 60951 | 60819 | 59685 | 59685 | 59314 | 59777 | 68286 | 68286 | 26538 | **58055** |
| 48-49 | 62220 | 56166 | 62613 | 62490 | 61328 | 61328 | 60948 | 61429 | 70009 | 70009 | 27186 | **59611** |
| 49-50 | 63888 | 57714 | 64326 | 64213 | 63022 | 63022 | 62632 | 63132 | 71779 | 71779 | 27851 | **61214** |
| 50-51 | 65607 | 59311 | 66092 | 65990 | 64769 | 64769 | 64369 | 64887 | 73599 | 73599 | 28533 | **62866** |
| 51-52 | 67378 | 60958 | 67913 | 67823 | 66571 | 66571 | 66161 | 66699 | 75470 | 75470 | 29233 | **64568** |
| 52-53 | 69204 | 62657 | 69790 | 69714 | 68429 | 68429 | 68009 | 68567 | 77394 | 77394 | 29951 | **66322** |
| 53-54 | 71085 | 64410 | 71726 | 71664 | 70346 | 70346 | 69914 | 70494 | 79372 | 79372 | 30689 | **68129** |
| 54-55 | 73023 | 66218 | 73723 | 73676 | 72324 | 72324 | 71881 | 72483 | 81406 | 81406 | 31445 | **69992** |
| 55-56 | 75021 | 68084 | 75783 | 75751 | 74365 | 74365 | 73910 | 74535 | 83498 | 83498 | 32222 | **71912** |
| 56-57 | 77081 | 70008 | 77907 | 77893 | 76471 | 76471 | 76004 | 76653 | 85650 | 85650 | 33019 | **73892** |
| 57-58 | 79205 | 71995 | 80099 | 80104 | 78644 | 78644 | 78165 | 78838 | 87863 | 87863 | 33837 | **75932** |
| 58-59 | 81395 | 74045 | 82361 | 82385 | 80886 | 80886 | 80396 | 81094 | 90139 | 90139 | 34677 | **78037** |
| 59-60 | 83653 | 76161 | 84694 | 84740 | 83201 | 83201 | 82698 | 83422 | 92480 | 92480 | 35539 | **80206** |

**Table 5.4 Section Wise Total Traffic Projection (PCUs)**

**Table 5.5 Capacity Augmentation as per IRC: SP: 99-2013**

| FY | Section21 | Section22 | Section23 | Section24 | Section25 | Section26 | Section27 | Section28 | Section29 | Section30 | Section31 | Average PCUs |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year when Expressway will be functional 2024-25 | 26958 | 24116 | 26937 | 26808 | 26270 | 26270 | 26099 | 26278 | 30647 | 30647 | 11707 | **25703** |
| Threshold for Upgradation of Expressway From 4 To 6 Lanes (2052-53) | 69204 | 62657 | 69790 | 69714 | 68429 | 68429 | 68009 | 68567 | 77394 | 77394 | 29951 | **66322** |

As per IRC: SP: 99-2013, the capacity of 4-lane is 65000 PCUs for peak hour flow (8%) which gets exhausted in 2052 -53. Hence, considering the IRC: SP: 099-2013, the entire expressway is to be made 4-lane

# CONCLUSIONS

Design of flexible pavement of homogeneous section 22 & 23 and capacity analysis of phase 2 is done. Following are the conclusions regarding this design :

1. The total thickness of each section comes out to be same that is 700 mm.

2. The value of allowable vertical and tensile strain for both the section is roughly same

3. Threshold for Upgradation of Expressway From 4 To 6 Lanes is required in the year 2052-53.

4. The actual msa for HS 22 & 23 is 130 and 140 msa respectively.

# REFERENCES

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5.Saxena S.C., “A Text Book of Highway and Traffic Engineering”, Published by C.B.S. Publishers, Delhi 2014
6. IRC: 106-1990, “Guidelines for Capacity of Urban Roads in Plain Areas”, Indian Road Congress, New Delhi.
7. Highway Capacity Manual 2000,Highway Research Board, U.S.A.
8. IRC:37-2012, “ Tentative Guidelines for the design of Flexible Pavements, “Indian Roads congress ,New Delhi

# ANNEXURE

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 6859 | 0 | 123 | 0 | 680 | 503 | 563 | 957 | 1012 | 568 | **11265** | **18894** |
| 2019-20 | 7330 | 0 | 130 | 0 | 717 | 532 | 596 | 986 | 1046 | 600 | **11936** | **19898** |
| 2020-21 | 7832 | 0 | 137 | 0 | 757 | 563 | 630 | 1016 | 1080 | 635 | **12650** | **20961** |
| 2021-22 | 8370 | 0 | 144 | 0 | 799 | 595 | 666 | 1047 | 1116 | 671 | **13408** | **22084** |
| 2022-23 | 8944 | 0 | 152 | 0 | 842 | 630 | 705 | 1078 | 1153 | 709 | **14214** | **23272** |
| 2023-24 | 9557 | 0 | 161 | 0 | 889 | 666 | 745 | 1111 | 1192 | 750 | **15070** | **24530** |
| 2024-25 | 10593 | 0 | 176 | 0 | 975 | 738 | 826 | 1199 | 1289 | 830 | **16626** | **26958** |
| 2025-26 | 11182 | 0 | 184 | 0 | 1018 | 779 | 872 | 1233 | 1327 | 876 | **17470** | **28219** |
| 2026-27 | 11804 | 0 | 192 | 0 | 1064 | 822 | 920 | 1267 | 1367 | 923 | **18359** | **29543** |
| 2027-28 | 12460 | 0 | 201 | 0 | 1111 | 867 | 971 | 1303 | 1408 | 974 | **19294** | **30932** |
| 2028-29 | 13153 | 0 | 210 | 0 | 1161 | 915 | 1024 | 1339 | 1450 | 1027 | **20279** | **32391** |
| 2029-30 | 13745 | 0 | 218 | 0 | 1203 | 963 | 1078 | 1373 | 1490 | 1080 | **21150** | **33711** |
| 2030-31 | 14363 | 0 | 226 | 0 | 1246 | 1014 | 1135 | 1408 | 1531 | 1137 | **22059** | **35088** |
| 2031-32 | 15010 | 0 | 234 | 0 | 1291 | 1067 | 1195 | 1444 | 1574 | 1196 | **23009** | **36524** |
| 2032-33 | 15685 | 0 | 242 | 0 | 1338 | 1123 | 1257 | 1480 | 1617 | 1258 | **24000** | **38021** |
| 2033-34 | 16391 | 0 | 251 | 0 | 1386 | 1182 | 1324 | 1518 | 1662 | 1323 | **25035** | **39584** |
| 2034-35 | 16987 | 0 | 258 | 0 | 1426 | 1240 | 1389 | 1550 | 1700 | 1389 | **25940** | **40977** |
| 2035-36 | 17606 | 0 | 266 | 0 | 1468 | 1301 | 1457 | 1584 | 1740 | 1457 | **26878** | **42423** |
| 2036-37 | 18247 | 0 | 273 | 0 | 1511 | 1365 | 1529 | 1618 | 1781 | 1529 | **27852** | **43924** |
| 2037-38 | 18911 | 0 | 281 | 0 | 1555 | 1433 | 1604 | 1653 | 1822 | 1605 | **28863** | **45482** |
| 2038-39 | 19599 | 0 | 290 | 0 | 1600 | 1503 | 1683 | 1689 | 1865 | 1684 | **29912** | **47099** |
| 2039-40 | 20177 | 0 | 296 | 0 | 1638 | 1570 | 1758 | 1714 | 1896 | 1761 | **30811** | **48498** |
| 2040-41 | 20772 | 0 | 303 | 0 | 1677 | 1640 | 1836 | 1740 | 1929 | 1841 | **31739** | **49944** |
| 2041-42 | 21385 | 0 | 311 | 0 | 1717 | 1713 | 1918 | 1766 | 1962 | 1925 | **32697** | **51439** |
| 2042-43 | 22016 | 0 | 318 | 0 | 1757 | 1790 | 2004 | 1793 | 1995 | 2013 | **33686** | **52983** |
| 2043-44 | 22666 | 0 | 326 | 0 | 1799 | 1869 | 2093 | 1820 | 2029 | 2105 | **34707** | **54580** |
| 2044-45 | 23207 | 0 | 332 | 0 | 1834 | 1944 | 2177 | 1848 | 2064 | 2193 | **35598** | **56019** |
| 2045-46 | 23762 | 0 | 338 | 0 | 1869 | 2022 | 2264 | 1876 | 2099 | 2285 | **36515** | **57501** |
| 2046-47 | 24330 | 0 | 345 | 0 | 1905 | 2103 | 2354 | 1904 | 2135 | 2381 | **37457** | **59028** |
| 2047-48 | 24911 | 0 | 351 | 0 | 1941 | 2187 | 2448 | 1933 | 2172 | 2481 | **38425** | **60600** |
| 2048-49 | 25507 | 0 | 358 | 0 | 1979 | 2275 | 2546 | 1962 | 2209 | 2585 | **39420** | **62220** |
| 2049-50 | 26116 | 0 | 365 | 0 | 2017 | 2366 | 2648 | 1991 | 2247 | 2694 | **40444** | **63888** |
| 2050-51 | 26741 | 0 | 372 | 0 | 2055 | 2460 | 2754 | 2021 | 2285 | 2807 | **41496** | **65607** |
| 2051-52 | 27380 | 0 | 379 | 0 | 2095 | 2559 | 2864 | 2052 | 2324 | 2925 | **42577** | **67378** |
| 2052-53 | 28034 | 0 | 386 | 0 | 2135 | 2661 | 2979 | 2083 | 2364 | 3048 | **43690** | **69204** |
| 2053-54 | 28704 | 0 | 394 | 0 | 2176 | 2767 | 3098 | 2114 | 2404 | 3176 | **44834** | **71085** |
| 2054-55 | 29390 | 0 | 401 | 0 | 2218 | 2878 | 3222 | 2146 | 2445 | 3309 | **46010** | **73023** |
| 2055-56 | 30093 | 0 | 409 | 0 | 2260 | 2993 | 3351 | 2179 | 2487 | 3448 | **47220** | **75021** |
| 2056-57 | 30812 | 0 | 417 | 0 | 2304 | 3113 | 3485 | 2212 | 2530 | 3593 | **48464** | **77081** |
| 2057-58 | 31548 | 0 | 425 | 0 | 2348 | 3237 | 3624 | 2245 | 2573 | 3744 | **49744** | **79205** |
| 2058-59 | 32302 | 0 | 433 | 0 | 2393 | 3367 | 3769 | 2279 | 2617 | 3901 | **51061** | **81395** |
| 2059-60 | 33074 | 0 | 441 | 0 | 2439 | 3501 | 3920 | 2313 | 2662 | 4065 | **52416** | **83653** |

**Traffic Projection Phase 2 Section21**

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 5646 | 0 | 109 | 0 | 569 | 394 | 490 | 882 | 920 | 643 | **9653** | **16945** |
| 2019-20 | 6033 | 0 | 115 | 0 | 600 | 417 | 518 | 909 | 951 | 680 | **10223** | **17837** |
| 2020-21 | 6447 | 0 | 121 | 0 | 633 | 441 | 548 | 936 | 982 | 719 | **10828** | **18780** |
| 2021-22 | 6890 | 0 | 128 | 0 | 668 | 466 | 580 | 965 | 1015 | 760 | **11470** | **19777** |
| 2022-23 | 7362 | 0 | 135 | 0 | 705 | 493 | 613 | 994 | 1048 | 803 | **12153** | **20832** |
| 2023-24 | 7867 | 0 | 142 | 0 | 744 | 521 | 649 | 1024 | 1083 | 849 | **12879** | **21946** |
| 2024-25 | 8720 | 0 | 156 | 0 | 816 | 578 | 719 | 1105 | 1171 | 940 | **14205** | **24116** |
| 2025-26 | 9205 | 0 | 163 | 0 | 852 | 610 | 759 | 1136 | 1207 | 991 | **14922** | **25241** |
| 2026-27 | 9716 | 0 | 171 | 0 | 890 | 643 | 801 | 1168 | 1243 | 1045 | **15677** | **26422** |
| 2027-28 | 10257 | 0 | 178 | 0 | 930 | 679 | 845 | 1201 | 1280 | 1102 | **16471** | **27662** |
| 2028-29 | 10827 | 0 | 186 | 0 | 971 | 717 | 892 | 1234 | 1319 | 1163 | **17307** | **28963** |
| 2029-30 | 11314 | 0 | 193 | 0 | 1006 | 754 | 939 | 1266 | 1355 | 1223 | **18049** | **30149** |
| 2030-31 | 11823 | 0 | 200 | 0 | 1043 | 794 | 988 | 1298 | 1392 | 1287 | **18824** | **31385** |
| 2031-32 | 12355 | 0 | 207 | 0 | 1080 | 836 | 1040 | 1330 | 1431 | 1354 | **19632** | **32675** |
| 2032-33 | 12911 | 0 | 214 | 0 | 1119 | 880 | 1095 | 1364 | 1470 | 1424 | **20477** | **34022** |
| 2033-34 | 13492 | 0 | 222 | 0 | 1160 | 926 | 1152 | 1399 | 1511 | 1498 | **21359** | **35427** |
| 2034-35 | 13983 | 0 | 229 | 0 | 1194 | 972 | 1209 | 1429 | 1546 | 1572 | **22132** | **36689** |
| 2035-36 | 14492 | 0 | 235 | 0 | 1228 | 1019 | 1268 | 1460 | 1582 | 1650 | **22935** | **38000** |
| 2036-37 | 15020 | 0 | 242 | 0 | 1264 | 1070 | 1331 | 1491 | 1619 | 1731 | **23768** | **39362** |
| 2037-38 | 15566 | 0 | 249 | 0 | 1301 | 1122 | 1396 | 1523 | 1657 | 1817 | **24632** | **40775** |
| 2038-39 | 16133 | 0 | 257 | 0 | 1339 | 1177 | 1465 | 1556 | 1695 | 1906 | **25529** | **42243** |
| 2039-40 | 16609 | 0 | 263 | 0 | 1371 | 1230 | 1530 | 1580 | 1724 | 1993 | **26300** | **43522** |
| 2040-41 | 17099 | 0 | 269 | 0 | 1403 | 1285 | 1599 | 1604 | 1754 | 2084 | **27096** | **44846** |
| 2041-42 | 17603 | 0 | 275 | 0 | 1437 | 1342 | 1670 | 1628 | 1784 | 2179 | **27918** | **46214** |
| 2042-43 | 18123 | 0 | 282 | 0 | 1471 | 1402 | 1744 | 1652 | 1814 | 2279 | **28767** | **47629** |
| 2043-44 | 18657 | 0 | 289 | 0 | 1506 | 1465 | 1822 | 1677 | 1845 | 2382 | **29643** | **49093** |
| 2044-45 | 19103 | 0 | 294 | 0 | 1535 | 1523 | 1895 | 1703 | 1877 | 2483 | **30412** | **50423** |
| 2045-46 | 19560 | 0 | 300 | 0 | 1564 | 1584 | 1971 | 1728 | 1909 | 2587 | **31202** | **51794** |
| 2046-47 | 20027 | 0 | 305 | 0 | 1594 | 1647 | 2050 | 1755 | 1942 | 2695 | **32015** | **53207** |
| 2047-48 | 20506 | 0 | 311 | 0 | 1625 | 1713 | 2132 | 1781 | 1975 | 2809 | **32851** | **54663** |
| 2048-49 | 20996 | 0 | 317 | 0 | 1656 | 1782 | 2217 | 1808 | 2009 | 2927 | **33711** | **56166** |
| 2049-50 | 21498 | 0 | 323 | 0 | 1688 | 1853 | 2306 | 1835 | 2043 | 3050 | **34595** | **57714** |
| 2050-51 | 22012 | 0 | 330 | 0 | 1720 | 1927 | 2398 | 1863 | 2078 | 3178 | **35505** | **59311** |
| 2051-52 | 22538 | 0 | 336 | 0 | 1753 | 2004 | 2494 | 1891 | 2113 | 3311 | **36440** | **60958** |
| 2052-53 | 23076 | 0 | 342 | 0 | 1787 | 2085 | 2594 | 1920 | 2149 | 3450 | **37403** | **62657** |
| 2053-54 | 23628 | 0 | 349 | 0 | 1821 | 2168 | 2697 | 1949 | 2186 | 3595 | **38393** | **64410** |
| 2054-55 | 24193 | 0 | 356 | 0 | 1856 | 2255 | 2805 | 1978 | 2224 | 3746 | **39412** | **66218** |
| 2055-56 | 24771 | 0 | 362 | 0 | 1892 | 2345 | 2917 | 2008 | 2262 | 3903 | **40460** | **68084** |
| 2056-57 | 25363 | 0 | 369 | 0 | 1928 | 2439 | 3034 | 2038 | 2300 | 4067 | **41539** | **70008** |
| 2057-58 | 25969 | 0 | 377 | 0 | 1965 | 2536 | 3156 | 2069 | 2340 | 4238 | **42649** | **71995** |
| 2058-59 | 26590 | 0 | 384 | 0 | 2003 | 2638 | 3282 | 2100 | 2380 | 4416 | **43791** | **74045** |
| 2059-60 | 27225 | 0 | 391 | 0 | 2041 | 2743 | 3413 | 2132 | 2420 | 4602 | **44967** | **76161** |

## Section22

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 6517 | 0 | 113 | 0 | 660 | 419 | 562 | 973 | 1002 | 677 | **10923** | **18900** |
| 2019-20 | 6964 | 0 | 119 | 0 | 696 | 443 | 594 | 1003 | 1035 | 716 | **11571** | **19901** |
| 2020-21 | 7442 | 0 | 126 | 0 | 735 | 469 | 629 | 1033 | 1070 | 757 | **12259** | **20959** |
| 2021-22 | 7952 | 0 | 133 | 0 | 775 | 496 | 665 | 1064 | 1105 | 800 | **12990** | **22077** |
| 2022-23 | 8498 | 0 | 140 | 0 | 818 | 524 | 703 | 1096 | 1142 | 846 | **13767** | **23260** |
| 2023-24 | 9081 | 0 | 148 | 0 | 863 | 555 | 744 | 1130 | 1180 | 894 | **14593** | **24511** |
| 2024-25 | 10065 | 0 | 162 | 0 | 946 | 615 | 824 | 1219 | 1276 | 990 | **16097** | **26937** |
| 2025-26 | 10625 | 0 | 169 | 0 | 988 | 649 | 870 | 1253 | 1314 | 1044 | **16912** | **28197** |
| 2026-27 | 11215 | 0 | 177 | 0 | 1033 | 685 | 918 | 1289 | 1354 | 1101 | **17770** | **29519** |
| 2027-28 | 11839 | 0 | 185 | 0 | 1079 | 723 | 969 | 1325 | 1394 | 1161 | **18673** | **30907** |
| 2028-29 | 12497 | 0 | 193 | 0 | 1127 | 763 | 1022 | 1362 | 1436 | 1224 | **19623** | **32365** |
| 2029-30 | 13059 | 0 | 200 | 0 | 1167 | 803 | 1076 | 1396 | 1476 | 1288 | **20465** | **33689** |
| 2030-31 | 13647 | 0 | 207 | 0 | 1209 | 845 | 1133 | 1432 | 1516 | 1355 | **21344** | **35071** |
| 2031-32 | 14261 | 0 | 215 | 0 | 1253 | 889 | 1192 | 1468 | 1558 | 1426 | **22262** | **36512** |
| 2032-33 | 14903 | 0 | 222 | 0 | 1298 | 936 | 1255 | 1505 | 1601 | 1500 | **23220** | **38016** |
| 2033-34 | 15574 | 0 | 230 | 0 | 1345 | 985 | 1321 | 1543 | 1645 | 1578 | **24221** | **39585** |
| 2034-35 | 16141 | 0 | 237 | 0 | 1385 | 1034 | 1386 | 1576 | 1684 | 1656 | **25097** | **40991** |
| 2035-36 | 16728 | 0 | 244 | 0 | 1425 | 1085 | 1454 | 1610 | 1723 | 1737 | **26006** | **42451** |
| 2036-37 | 17337 | 0 | 251 | 0 | 1467 | 1138 | 1526 | 1645 | 1763 | 1823 | **26949** | **43967** |
| 2037-38 | 17968 | 0 | 258 | 0 | 1509 | 1194 | 1601 | 1681 | 1804 | 1913 | **27928** | **45542** |
| 2038-39 | 18622 | 0 | 266 | 0 | 1553 | 1253 | 1680 | 1717 | 1846 | 2008 | **28944** | **47176** |
| 2039-40 | 19171 | 0 | 272 | 0 | 1590 | 1309 | 1755 | 1743 | 1878 | 2099 | **29816** | **48598** |
| 2040-41 | 19737 | 0 | 278 | 0 | 1628 | 1367 | 1833 | 1769 | 1910 | 2195 | **30717** | **50068** |
| 2041-42 | 20319 | 0 | 285 | 0 | 1667 | 1428 | 1915 | 1796 | 1942 | 2295 | **31647** | **51589** |
| 2042-43 | 20919 | 0 | 292 | 0 | 1706 | 1492 | 2000 | 1823 | 1976 | 2400 | **32606** | **53161** |
| 2043-44 | 21536 | 0 | 299 | 0 | 1746 | 1558 | 2089 | 1850 | 2009 | 2509 | **33597** | **54786** |
| 2044-45 | 22050 | 0 | 304 | 0 | 1780 | 1621 | 2173 | 1878 | 2044 | 2615 | **34465** | **56258** |
| 2045-46 | 22577 | 0 | 310 | 0 | 1814 | 1685 | 2260 | 1907 | 2079 | 2724 | **35357** | **57776** |
| 2046-47 | 23117 | 0 | 316 | 0 | 1849 | 1753 | 2350 | 1935 | 2114 | 2839 | **36273** | **59339** |
| 2047-48 | 23669 | 0 | 322 | 0 | 1884 | 1823 | 2444 | 1965 | 2150 | 2958 | **37216** | **60951** |
| 2048-49 | 24235 | 0 | 329 | 0 | 1921 | 1896 | 2542 | 1994 | 2187 | 3082 | **38186** | **62613** |
| 2049-50 | 24814 | 0 | 335 | 0 | 1958 | 1972 | 2644 | 2024 | 2225 | 3212 | **39183** | **64326** |
| 2050-51 | 25407 | 0 | 341 | 0 | 1995 | 2050 | 2750 | 2055 | 2263 | 3347 | **40208** | **66092** |
| 2051-52 | 26015 | 0 | 348 | 0 | 2033 | 2132 | 2860 | 2086 | 2301 | 3487 | **41262** | **67913** |
| 2052-53 | 26636 | 0 | 355 | 0 | 2072 | 2218 | 2974 | 2118 | 2341 | 3634 | **42347** | **69790** |
| 2053-54 | 27273 | 0 | 361 | 0 | 2112 | 2306 | 3093 | 2150 | 2381 | 3786 | **43462** | **71726** |
| 2054-55 | 27925 | 0 | 368 | 0 | 2153 | 2399 | 3217 | 2182 | 2421 | 3945 | **44610** | **73723** |
| 2055-56 | 28592 | 0 | 375 | 0 | 2194 | 2495 | 3345 | 2215 | 2463 | 4111 | **45790** | **75783** |
| 2056-57 | 29276 | 0 | 383 | 0 | 2236 | 2594 | 3479 | 2248 | 2505 | 4284 | **47005** | **77907** |
| 2057-58 | 29975 | 0 | 390 | 0 | 2279 | 2698 | 3618 | 2282 | 2548 | 4464 | **48254** | **80099** |
| 2058-59 | 30692 | 0 | 397 | 0 | 2323 | 2806 | 3763 | 2317 | 2591 | 4651 | **49540** | **82361** |
| 2059-60 | 31425 | 0 | 405 | 0 | 2368 | 2918 | 3914 | 2352 | 2636 | 4846 | **50863** | **84694** |

## Section23

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 6308 | 0 | 100 | 0 | 639 | 510 | 590 | 978 | 1011 | 687 | **10823** | **18829** |
| 2019-20 | 6741 | 0 | 106 | 0 | 674 | 539 | 624 | 1008 | 1045 | 726 | **11462** | **19821** |
| 2020-21 | 7203 | 0 | 111 | 0 | 711 | 571 | 660 | 1038 | 1079 | 768 | **12141** | **20871** |
| 2021-22 | 7697 | 0 | 117 | 0 | 750 | 603 | 698 | 1070 | 1115 | 812 | **12863** | **21981** |
| 2022-23 | 8225 | 0 | 124 | 0 | 792 | 638 | 738 | 1102 | 1152 | 858 | **13629** | **23154** |
| 2023-24 | 8789 | 0 | 131 | 0 | 835 | 675 | 781 | 1135 | 1190 | 907 | **14444** | **24395** |
| 2024-25 | 9742 | 0 | 143 | 0 | 916 | 748 | 865 | 1226 | 1287 | 1004 | **15932** | **26808** |
| 2025-26 | 10284 | 0 | 150 | 0 | 957 | 789 | 913 | 1260 | 1326 | 1059 | **16738** | **28060** |
| 2026-27 | 10856 | 0 | 156 | 0 | 1000 | 833 | 964 | 1295 | 1366 | 1117 | **17586** | **29375** |
| 2027-28 | 11459 | 0 | 163 | 0 | 1044 | 879 | 1017 | 1332 | 1407 | 1178 | **18479** | **30755** |
| 2028-29 | 12096 | 0 | 171 | 0 | 1091 | 928 | 1073 | 1369 | 1449 | 1242 | **19418** | **32204** |
| 2029-30 | 12641 | 0 | 177 | 0 | 1130 | 976 | 1130 | 1403 | 1489 | 1307 | **20253** | **33524** |
| 2030-31 | 13209 | 0 | 183 | 0 | 1171 | 1028 | 1189 | 1439 | 1530 | 1375 | **21124** | **34901** |
| 2031-32 | 13804 | 0 | 190 | 0 | 1213 | 1082 | 1252 | 1475 | 1572 | 1446 | **22034** | **36337** |
| 2032-33 | 14425 | 0 | 197 | 0 | 1257 | 1139 | 1318 | 1513 | 1616 | 1521 | **22985** | **37836** |
| 2033-34 | 15074 | 0 | 204 | 0 | 1302 | 1199 | 1387 | 1551 | 1660 | 1600 | **23977** | **39401** |
| 2034-35 | 15623 | 0 | 210 | 0 | 1340 | 1258 | 1455 | 1584 | 1699 | 1679 | **24849** | **40806** |
| 2035-36 | 16191 | 0 | 216 | 0 | 1380 | 1320 | 1527 | 1619 | 1739 | 1762 | **25753** | **42266** |
| 2036-37 | 16781 | 0 | 222 | 0 | 1420 | 1385 | 1602 | 1654 | 1779 | 1850 | **26691** | **43781** |
| 2037-38 | 17392 | 0 | 229 | 0 | 1461 | 1453 | 1681 | 1689 | 1821 | 1941 | **27666** | **45356** |
| 2038-39 | 18025 | 0 | 236 | 0 | 1504 | 1524 | 1763 | 1726 | 1863 | 2037 | **28677** | **46991** |
| 2039-40 | 18556 | 0 | 241 | 0 | 1540 | 1592 | 1842 | 1752 | 1895 | 2130 | **29548** | **48416** |
| 2040-41 | 19104 | 0 | 247 | 0 | 1576 | 1663 | 1924 | 1778 | 1927 | 2227 | **30446** | **49889** |
| 2041-42 | 19667 | 0 | 253 | 0 | 1614 | 1737 | 2010 | 1805 | 1960 | 2328 | **31374** | **51413** |
| 2042-43 | 20248 | 0 | 259 | 0 | 1652 | 1815 | 2099 | 1833 | 1994 | 2435 | **32333** | **52989** |
| 2043-44 | 20845 | 0 | 265 | 0 | 1691 | 1896 | 2193 | 1860 | 2028 | 2546 | **33323** | **54619** |
| 2044-45 | 21343 | 0 | 270 | 0 | 1723 | 1972 | 2281 | 1888 | 2063 | 2652 | **34192** | **56099** |
| 2045-46 | 21853 | 0 | 275 | 0 | 1756 | 2050 | 2372 | 1917 | 2098 | 2764 | **35085** | **57624** |
| 2046-47 | 22376 | 0 | 280 | 0 | 1790 | 2132 | 2467 | 1946 | 2134 | 2880 | **36005** | **59197** |
| 2047-48 | 22910 | 0 | 286 | 0 | 1825 | 2218 | 2566 | 1975 | 2170 | 3001 | **36950** | **60819** |
| 2048-49 | 23458 | 0 | 291 | 0 | 1860 | 2306 | 2668 | 2005 | 2207 | 3127 | **37922** | **62490** |
| 2049-50 | 24019 | 0 | 297 | 0 | 1895 | 2399 | 2775 | 2035 | 2245 | 3258 | **38923** | **64213** |
| 2050-51 | 24593 | 0 | 303 | 0 | 1932 | 2495 | 2886 | 2066 | 2283 | 3395 | **39951** | **65990** |
| 2051-52 | 25180 | 0 | 308 | 0 | 1969 | 2594 | 3001 | 2097 | 2322 | 3538 | **41010** | **67823** |
| 2052-53 | 25782 | 0 | 314 | 0 | 2007 | 2698 | 3121 | 2129 | 2362 | 3686 | **42099** | **69714** |
| 2053-54 | 26398 | 0 | 320 | 0 | 2045 | 2806 | 3246 | 2161 | 2403 | 3841 | **43220** | **71664** |
| 2054-55 | 27029 | 0 | 326 | 0 | 2084 | 2918 | 3376 | 2194 | 2444 | 4002 | **44373** | **73676** |
| 2055-56 | 27675 | 0 | 333 | 0 | 2124 | 3035 | 3511 | 2227 | 2485 | 4170 | **45560** | **75751** |
| 2056-57 | 28337 | 0 | 339 | 0 | 2165 | 3156 | 3651 | 2260 | 2528 | 4346 | **46782** | **77893** |
| 2057-58 | 29014 | 0 | 346 | 0 | 2207 | 3283 | 3797 | 2294 | 2571 | 4528 | **48040** | **80104** |
| 2058-59 | 29707 | 0 | 352 | 0 | 2249 | 3414 | 3949 | 2329 | 2615 | 4718 | **49334** | **82385** |
| 2059-60 | 30417 | 0 | 359 | 0 | 2292 | 3551 | 4107 | 2364 | 2660 | 4917 | **50667** | **84740** |

## Section24

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 6295 | 0 | 104 | 0 | 584 | 514 | 570 | 934 | 1009 | 675 | **10685** | **18439** |
| 2019-20 | 6727 | 0 | 110 | 0 | 616 | 544 | 603 | 962 | 1043 | 714 | **11318** | **19413** |
| 2020-21 | 7188 | 0 | 116 | 0 | 650 | 575 | 638 | 992 | 1077 | 754 | **11990** | **20443** |
| 2021-22 | 7681 | 0 | 122 | 0 | 686 | 608 | 675 | 1022 | 1113 | 797 | **12704** | **21533** |
| 2022-23 | 8208 | 0 | 129 | 0 | 724 | 643 | 713 | 1053 | 1150 | 843 | **13463** | **22685** |
| 2023-24 | 8771 | 0 | 136 | 0 | 763 | 681 | 755 | 1084 | 1188 | 891 | **14269** | **23904** |
| 2024-25 | 9722 | 0 | 149 | 0 | 837 | 754 | 836 | 1171 | 1285 | 986 | **15740** | **26270** |
| 2025-26 | 10263 | 0 | 156 | 0 | 875 | 796 | 882 | 1203 | 1323 | 1040 | **16538** | **27500** |
| 2026-27 | 10833 | 0 | 163 | 0 | 914 | 840 | 931 | 1237 | 1363 | 1097 | **17377** | **28791** |
| 2027-28 | 11436 | 0 | 170 | 0 | 954 | 886 | 983 | 1272 | 1404 | 1157 | **18261** | **30146** |
| 2028-29 | 12071 | 0 | 178 | 0 | 997 | 935 | 1037 | 1307 | 1446 | 1220 | **19191** | **31569** |
| 2029-30 | 12615 | 0 | 184 | 0 | 1033 | 984 | 1092 | 1340 | 1486 | 1284 | **20017** | **32866** |
| 2030-31 | 13182 | 0 | 191 | 0 | 1070 | 1036 | 1149 | 1374 | 1527 | 1351 | **20879** | **34218** |
| 2031-32 | 13775 | 0 | 197 | 0 | 1109 | 1091 | 1209 | 1409 | 1569 | 1421 | **21780** | **35629** |
| 2032-33 | 14395 | 0 | 205 | 0 | 1149 | 1148 | 1273 | 1445 | 1612 | 1495 | **22721** | **37102** |
| 2033-34 | 15043 | 0 | 212 | 0 | 1190 | 1208 | 1340 | 1481 | 1657 | 1572 | **23704** | **38639** |
| 2034-35 | 15591 | 0 | 218 | 0 | 1225 | 1268 | 1406 | 1513 | 1695 | 1650 | **24566** | **40020** |
| 2035-36 | 16158 | 0 | 225 | 0 | 1261 | 1330 | 1475 | 1546 | 1735 | 1732 | **25461** | **41454** |
| 2036-37 | 16746 | 0 | 231 | 0 | 1298 | 1396 | 1548 | 1579 | 1775 | 1817 | **26390** | **42943** |
| 2037-38 | 17356 | 0 | 238 | 0 | 1336 | 1465 | 1624 | 1613 | 1817 | 1907 | **27354** | **44490** |
| 2038-39 | 17988 | 0 | 245 | 0 | 1375 | 1537 | 1704 | 1648 | 1859 | 2001 | **28355** | **46096** |
| 2039-40 | 18518 | 0 | 251 | 0 | 1407 | 1605 | 1780 | 1673 | 1891 | 2092 | **29217** | **47496** |
| 2040-41 | 19065 | 0 | 256 | 0 | 1440 | 1677 | 1859 | 1698 | 1923 | 2188 | **30106** | **48944** |
| 2041-42 | 19627 | 0 | 263 | 0 | 1475 | 1752 | 1942 | 1724 | 1956 | 2287 | **31025** | **50442** |
| 2042-43 | 20206 | 0 | 269 | 0 | 1509 | 1830 | 2029 | 1750 | 1989 | 2392 | **31973** | **51990** |
| 2043-44 | 20802 | 0 | 275 | 0 | 1545 | 1911 | 2119 | 1776 | 2023 | 2501 | **32953** | **53593** |
| 2044-45 | 21299 | 0 | 280 | 0 | 1575 | 1988 | 2204 | 1803 | 2058 | 2606 | **33813** | **55047** |
| 2045-46 | 21809 | 0 | 286 | 0 | 1605 | 2067 | 2292 | 1830 | 2093 | 2715 | **34697** | **56547** |
| 2046-47 | 22330 | 0 | 291 | 0 | 1636 | 2150 | 2384 | 1858 | 2129 | 2829 | **35607** | **58092** |
| 2047-48 | 22863 | 0 | 297 | 0 | 1667 | 2236 | 2479 | 1886 | 2165 | 2948 | **36542** | **59685** |
| 2048-49 | 23410 | 0 | 303 | 0 | 1699 | 2325 | 2578 | 1915 | 2202 | 3072 | **37504** | **61328** |
| 2049-50 | 23969 | 0 | 308 | 0 | 1732 | 2418 | 2681 | 1943 | 2240 | 3201 | **38493** | **63022** |
| 2050-51 | 24542 | 0 | 314 | 0 | 1765 | 2515 | 2789 | 1973 | 2278 | 3335 | **39512** | **64769** |
| 2051-52 | 25129 | 0 | 320 | 0 | 1799 | 2616 | 2900 | 2003 | 2317 | 3475 | **40559** | **66571** |
| 2052-53 | 25729 | 0 | 326 | 0 | 1834 | 2720 | 3016 | 2033 | 2357 | 3621 | **41637** | **68429** |
| 2053-54 | 26344 | 0 | 333 | 0 | 1869 | 2829 | 3137 | 2063 | 2397 | 3773 | **42746** | **70346** |
| 2054-55 | 26974 | 0 | 339 | 0 | 1905 | 2942 | 3262 | 2095 | 2438 | 3932 | **43887** | **72324** |
| 2055-56 | 27619 | 0 | 346 | 0 | 1941 | 3060 | 3393 | 2126 | 2480 | 4097 | **45061** | **74365** |
| 2056-57 | 28279 | 0 | 352 | 0 | 1979 | 3182 | 3528 | 2158 | 2522 | 4269 | **46270** | **76471** |
| 2057-58 | 28955 | 0 | 359 | 0 | 2017 | 3310 | 3670 | 2191 | 2566 | 4448 | **47514** | **78644** |
| 2058-59 | 29647 | 0 | 366 | 0 | 2055 | 3442 | 3816 | 2224 | 2609 | 4635 | **48795** | **80886** |
| 2059-60 | 30355 | 0 | 373 | 0 | 2095 | 3580 | 3969 | 2258 | 2654 | 4830 | **50113** | **83201** |

## Section25

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 6295 | 0 | 104 | 0 | 584 | 514 | 570 | 934 | 1009 | 675 | **10685** | **18439** |
| 2019-20 | 6727 | 0 | 110 | 0 | 616 | 544 | 603 | 962 | 1043 | 714 | **11318** | **19413** |
| 2020-21 | 7188 | 0 | 116 | 0 | 650 | 575 | 638 | 992 | 1077 | 754 | **11990** | **20443** |
| 2021-22 | 7681 | 0 | 122 | 0 | 686 | 608 | 675 | 1022 | 1113 | 797 | **12704** | **21533** |
| 2022-23 | 8208 | 0 | 129 | 0 | 724 | 643 | 713 | 1053 | 1150 | 843 | **13463** | **22685** |
| 2023-24 | 8771 | 0 | 136 | 0 | 763 | 681 | 755 | 1084 | 1188 | 891 | **14269** | **23904** |
| 2024-25 | 9722 | 0 | 149 | 0 | 837 | 754 | 836 | 1171 | 1285 | 986 | **15740** | **26270** |
| 2025-26 | 10263 | 0 | 156 | 0 | 875 | 796 | 882 | 1203 | 1323 | 1040 | **16538** | **27500** |
| 2026-27 | 10833 | 0 | 163 | 0 | 914 | 840 | 931 | 1237 | 1363 | 1097 | **17377** | **28791** |
| 2027-28 | 11436 | 0 | 170 | 0 | 954 | 886 | 983 | 1272 | 1404 | 1157 | **18261** | **30146** |
| 2028-29 | 12071 | 0 | 178 | 0 | 997 | 935 | 1037 | 1307 | 1446 | 1220 | **19191** | **31569** |
| 2029-30 | 12615 | 0 | 184 | 0 | 1033 | 984 | 1092 | 1340 | 1486 | 1284 | **20017** | **32866** |
| 2030-31 | 13182 | 0 | 191 | 0 | 1070 | 1036 | 1149 | 1374 | 1527 | 1351 | **20879** | **34218** |
| 2031-32 | 13775 | 0 | 197 | 0 | 1109 | 1091 | 1209 | 1409 | 1569 | 1421 | **21780** | **35629** |
| 2032-33 | 14395 | 0 | 205 | 0 | 1149 | 1148 | 1273 | 1445 | 1612 | 1495 | **22721** | **37102** |
| 2033-34 | 15043 | 0 | 212 | 0 | 1190 | 1208 | 1340 | 1481 | 1657 | 1572 | **23704** | **38639** |
| 2034-35 | 15591 | 0 | 218 | 0 | 1225 | 1268 | 1406 | 1513 | 1695 | 1650 | **24566** | **40020** |
| 2035-36 | 16158 | 0 | 225 | 0 | 1261 | 1330 | 1475 | 1546 | 1735 | 1732 | **25461** | **41454** |
| 2036-37 | 16746 | 0 | 231 | 0 | 1298 | 1396 | 1548 | 1579 | 1775 | 1817 | **26390** | **42943** |
| 2037-38 | 17356 | 0 | 238 | 0 | 1336 | 1465 | 1624 | 1613 | 1817 | 1907 | **27354** | **44490** |
| 2038-39 | 17988 | 0 | 245 | 0 | 1375 | 1537 | 1704 | 1648 | 1859 | 2001 | **28355** | **46096** |
| 2039-40 | 18518 | 0 | 251 | 0 | 1407 | 1605 | 1780 | 1673 | 1891 | 2092 | **29217** | **47496** |
| 2040-41 | 19065 | 0 | 256 | 0 | 1440 | 1677 | 1859 | 1698 | 1923 | 2188 | **30106** | **48944** |
| 2041-42 | 19627 | 0 | 263 | 0 | 1475 | 1752 | 1942 | 1724 | 1956 | 2287 | **31025** | **50442** |
| 2042-43 | 20206 | 0 | 269 | 0 | 1509 | 1830 | 2029 | 1750 | 1989 | 2392 | **31973** | **51990** |
| 2043-44 | 20802 | 0 | 275 | 0 | 1545 | 1911 | 2119 | 1776 | 2023 | 2501 | **32953** | **53593** |
| 2044-45 | 21299 | 0 | 280 | 0 | 1575 | 1988 | 2204 | 1803 | 2058 | 2606 | **33813** | **55047** |
| 2045-46 | 21809 | 0 | 286 | 0 | 1605 | 2067 | 2292 | 1830 | 2093 | 2715 | **34697** | **56547** |
| 2046-47 | 22330 | 0 | 291 | 0 | 1636 | 2150 | 2384 | 1858 | 2129 | 2829 | **35607** | **58092** |
| 2047-48 | 22863 | 0 | 297 | 0 | 1667 | 2236 | 2479 | 1886 | 2165 | 2948 | **36542** | **59685** |
| 2048-49 | 23410 | 0 | 303 | 0 | 1699 | 2325 | 2578 | 1915 | 2202 | 3072 | **37504** | **61328** |
| 2049-50 | 23969 | 0 | 308 | 0 | 1732 | 2418 | 2681 | 1943 | 2240 | 3201 | **38493** | **63022** |
| 2050-51 | 24542 | 0 | 314 | 0 | 1765 | 2515 | 2789 | 1973 | 2278 | 3335 | **39512** | **64769** |
| 2051-52 | 25129 | 0 | 320 | 0 | 1799 | 2616 | 2900 | 2003 | 2317 | 3475 | **40559** | **66571** |
| 2052-53 | 25729 | 0 | 326 | 0 | 1834 | 2720 | 3016 | 2033 | 2357 | 3621 | **41637** | **68429** |
| 2053-54 | 26344 | 0 | 333 | 0 | 1869 | 2829 | 3137 | 2063 | 2397 | 3773 | **42746** | **70346** |
| 2054-55 | 26974 | 0 | 339 | 0 | 1905 | 2942 | 3262 | 2095 | 2438 | 3932 | **43887** | **72324** |
| 2055-56 | 27619 | 0 | 346 | 0 | 1941 | 3060 | 3393 | 2126 | 2480 | 4097 | **45061** | **74365** |
| 2056-57 | 28279 | 0 | 352 | 0 | 1979 | 3182 | 3528 | 2158 | 2522 | 4269 | **46270** | **76471** |
| 2057-58 | 28955 | 0 | 359 | 0 | 2017 | 3310 | 3670 | 2191 | 2566 | 4448 | **47514** | **78644** |
| 2058-59 | 29647 | 0 | 366 | 0 | 2055 | 3442 | 3816 | 2224 | 2609 | 4635 | **48795** | **80886** |
| 2059-60 | 30355 | 0 | 373 | 0 | 2095 | 3580 | 3969 | 2258 | 2654 | 4830 | **50113** | **83201** |

## Section26

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 6256 | 0 | 104 | 0 | 578 | 510 | 566 | 928 | 1000 | 673 | **10615** | **18318** |
| 2019-20 | 6685 | 0 | 110 | 0 | 610 | 539 | 599 | 956 | 1033 | 711 | **11244** | **19286** |
| 2020-21 | 7144 | 0 | 116 | 0 | 643 | 571 | 633 | 985 | 1068 | 752 | **11911** | **20309** |
| 2021-22 | 7634 | 0 | 122 | 0 | 679 | 603 | 670 | 1015 | 1103 | 795 | **12621** | **21392** |
| 2022-23 | 8158 | 0 | 129 | 0 | 716 | 638 | 708 | 1046 | 1140 | 840 | **13374** | **22536** |
| 2023-24 | 8717 | 0 | 136 | 0 | 755 | 675 | 749 | 1077 | 1177 | 888 | **14176** | **23748** |
| 2024-25 | 9662 | 0 | 149 | 0 | 829 | 748 | 830 | 1163 | 1273 | 984 | **15638** | **26099** |
| 2025-26 | 10199 | 0 | 156 | 0 | 866 | 789 | 876 | 1196 | 1311 | 1037 | **16430** | **27321** |
| 2026-27 | 10766 | 0 | 163 | 0 | 904 | 833 | 924 | 1229 | 1351 | 1094 | **17264** | **28604** |
| 2027-28 | 11365 | 0 | 170 | 0 | 944 | 879 | 976 | 1263 | 1391 | 1154 | **18142** | **29950** |
| 2028-29 | 11997 | 0 | 178 | 0 | 987 | 928 | 1029 | 1299 | 1433 | 1217 | **19066** | **31364** |
| 2029-30 | 12537 | 0 | 184 | 0 | 1022 | 976 | 1084 | 1332 | 1472 | 1280 | **19887** | **32652** |
| 2030-31 | 13101 | 0 | 191 | 0 | 1059 | 1028 | 1141 | 1365 | 1513 | 1347 | **20744** | **33997** |
| 2031-32 | 13690 | 0 | 197 | 0 | 1097 | 1082 | 1201 | 1400 | 1555 | 1417 | **21639** | **35399** |
| 2032-33 | 14307 | 0 | 205 | 0 | 1137 | 1139 | 1264 | 1435 | 1598 | 1490 | **22573** | **36863** |
| 2033-34 | 14950 | 0 | 212 | 0 | 1178 | 1199 | 1330 | 1472 | 1642 | 1568 | **23550** | **38390** |
| 2034-35 | 15495 | 0 | 218 | 0 | 1212 | 1258 | 1396 | 1503 | 1680 | 1645 | **24407** | **39763** |
| 2035-36 | 16059 | 0 | 225 | 0 | 1248 | 1320 | 1464 | 1536 | 1719 | 1726 | **25296** | **41188** |
| 2036-37 | 16643 | 0 | 231 | 0 | 1284 | 1385 | 1536 | 1569 | 1759 | 1812 | **26219** | **42668** |
| 2037-38 | 17249 | 0 | 238 | 0 | 1322 | 1453 | 1612 | 1603 | 1800 | 1901 | **27177** | **44206** |
| 2038-39 | 17877 | 0 | 245 | 0 | 1360 | 1524 | 1691 | 1638 | 1842 | 1995 | **28172** | **45802** |
| 2039-40 | 18404 | 0 | 251 | 0 | 1392 | 1592 | 1767 | 1662 | 1874 | 2086 | **29028** | **47194** |
| 2040-41 | 18947 | 0 | 256 | 0 | 1425 | 1663 | 1845 | 1687 | 1906 | 2181 | **29911** | **48633** |
| 2041-42 | 19506 | 0 | 263 | 0 | 1459 | 1737 | 1928 | 1713 | 1938 | 2281 | **30824** | **50122** |
| 2042-43 | 20081 | 0 | 269 | 0 | 1494 | 1815 | 2014 | 1739 | 1971 | 2385 | **31767** | **51662** |
| 2043-44 | 20674 | 0 | 275 | 0 | 1529 | 1896 | 2103 | 1765 | 2005 | 2493 | **32741** | **53255** |
| 2044-45 | 21168 | 0 | 280 | 0 | 1559 | 1972 | 2188 | 1792 | 2039 | 2598 | **33595** | **54702** |
| 2045-46 | 21674 | 0 | 286 | 0 | 1588 | 2050 | 2275 | 1819 | 2074 | 2707 | **34474** | **56193** |
| 2046-47 | 22192 | 0 | 291 | 0 | 1619 | 2132 | 2366 | 1846 | 2110 | 2821 | **35377** | **57729** |
| 2047-48 | 22722 | 0 | 297 | 0 | 1650 | 2218 | 2461 | 1874 | 2146 | 2939 | **36307** | **59314** |
| 2048-49 | 23265 | 0 | 303 | 0 | 1682 | 2306 | 2559 | 1903 | 2183 | 3063 | **37263** | **60948** |
| 2049-50 | 23821 | 0 | 308 | 0 | 1714 | 2399 | 2661 | 1931 | 2220 | 3192 | **38246** | **62632** |
| 2050-51 | 24391 | 0 | 314 | 0 | 1747 | 2495 | 2768 | 1961 | 2258 | 3326 | **39258** | **64369** |
| 2051-52 | 24973 | 0 | 320 | 0 | 1780 | 2594 | 2879 | 1990 | 2297 | 3465 | **40299** | **66161** |
| 2052-53 | 25570 | 0 | 326 | 0 | 1815 | 2698 | 2994 | 2020 | 2336 | 3611 | **41370** | **68009** |
| 2053-54 | 26181 | 0 | 333 | 0 | 1849 | 2806 | 3113 | 2051 | 2376 | 3762 | **42472** | **69914** |
| 2054-55 | 26807 | 0 | 339 | 0 | 1885 | 2918 | 3238 | 2082 | 2416 | 3920 | **43606** | **71881** |
| 2055-56 | 27448 | 0 | 346 | 0 | 1921 | 3035 | 3367 | 2113 | 2458 | 4085 | **44773** | **73910** |
| 2056-57 | 28104 | 0 | 352 | 0 | 1958 | 3156 | 3502 | 2145 | 2500 | 4257 | **45974** | **76004** |
| 2057-58 | 28776 | 0 | 359 | 0 | 1996 | 3283 | 3642 | 2177 | 2542 | 4435 | **47210** | **78165** |
| 2058-59 | 29463 | 0 | 366 | 0 | 2034 | 3414 | 3788 | 2210 | 2586 | 4622 | **48483** | **80396** |
| 2059-60 | 30167 | 0 | 373 | 0 | 2073 | 3551 | 3939 | 2244 | 2630 | 4816 | **49793** | **82698** |

## Section27

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 6253 | 0 | 104 | 0 | 572 | 528 | 583 | 940 | 1007 | 684 | **10671** | **18447** |
| 2019-20 | 6682 | 0 | 110 | 0 | 604 | 559 | 617 | 969 | 1040 | 723 | **11302** | **19421** |
| 2020-21 | 7140 | 0 | 116 | 0 | 637 | 591 | 652 | 998 | 1075 | 764 | **11973** | **20451** |
| 2021-22 | 7630 | 0 | 122 | 0 | 672 | 625 | 690 | 1028 | 1111 | 808 | **12685** | **21540** |
| 2022-23 | 8154 | 0 | 129 | 0 | 709 | 661 | 730 | 1059 | 1148 | 854 | **13442** | **22691** |
| 2023-24 | 8713 | 0 | 136 | 0 | 748 | 699 | 772 | 1091 | 1186 | 903 | **14247** | **23910** |
| 2024-25 | 9657 | 0 | 149 | 0 | 820 | 775 | 855 | 1178 | 1282 | 1000 | **15716** | **26278** |
| 2025-26 | 10194 | 0 | 156 | 0 | 857 | 817 | 902 | 1211 | 1321 | 1054 | **16512** | **27508** |
| 2026-27 | 10761 | 0 | 163 | 0 | 895 | 863 | 952 | 1245 | 1360 | 1112 | **17350** | **28799** |
| 2027-28 | 11359 | 0 | 170 | 0 | 935 | 910 | 1005 | 1280 | 1401 | 1173 | **18233** | **30155** |
| 2028-29 | 11991 | 0 | 178 | 0 | 976 | 961 | 1061 | 1316 | 1443 | 1237 | **19161** | **31578** |
| 2029-30 | 12530 | 0 | 184 | 0 | 1012 | 1011 | 1116 | 1349 | 1483 | 1301 | **19986** | **32876** |
| 2030-31 | 13094 | 0 | 191 | 0 | 1048 | 1064 | 1175 | 1383 | 1524 | 1369 | **20848** | **34230** |
| 2031-32 | 13684 | 0 | 197 | 0 | 1086 | 1120 | 1237 | 1418 | 1566 | 1440 | **21748** | **35644** |
| 2032-33 | 14299 | 0 | 205 | 0 | 1125 | 1179 | 1302 | 1454 | 1609 | 1515 | **22688** | **37119** |
| 2033-34 | 14943 | 0 | 212 | 0 | 1166 | 1241 | 1371 | 1491 | 1654 | 1594 | **23670** | **38658** |
| 2034-35 | 15487 | 0 | 218 | 0 | 1200 | 1302 | 1438 | 1523 | 1692 | 1672 | **24532** | **40042** |
| 2035-36 | 16050 | 0 | 225 | 0 | 1235 | 1366 | 1509 | 1556 | 1731 | 1755 | **25427** | **41479** |
| 2036-37 | 16635 | 0 | 231 | 0 | 1271 | 1434 | 1583 | 1589 | 1772 | 1842 | **26355** | **42971** |
| 2037-38 | 17240 | 0 | 238 | 0 | 1308 | 1504 | 1661 | 1624 | 1813 | 1933 | **27320** | **44522** |
| 2038-39 | 17868 | 0 | 245 | 0 | 1346 | 1578 | 1742 | 1659 | 1855 | 2028 | **28321** | **46133** |
| 2039-40 | 18395 | 0 | 251 | 0 | 1378 | 1649 | 1820 | 1684 | 1887 | 2121 | **29183** | **47537** |
| 2040-41 | 18937 | 0 | 256 | 0 | 1411 | 1722 | 1901 | 1709 | 1919 | 2217 | **30073** | **48990** |
| 2041-42 | 19496 | 0 | 263 | 0 | 1444 | 1799 | 1986 | 1735 | 1952 | 2318 | **30993** | **50493** |
| 2042-43 | 20071 | 0 | 269 | 0 | 1478 | 1879 | 2075 | 1761 | 1985 | 2424 | **31942** | **52048** |
| 2043-44 | 20663 | 0 | 275 | 0 | 1513 | 1963 | 2167 | 1788 | 2019 | 2535 | **32923** | **53656** |
| 2044-45 | 21157 | 0 | 280 | 0 | 1542 | 2041 | 2254 | 1815 | 2054 | 2641 | **33785** | **55118** |
| 2045-46 | 21663 | 0 | 286 | 0 | 1572 | 2123 | 2344 | 1842 | 2089 | 2752 | **34671** | **56624** |
| 2046-47 | 22181 | 0 | 291 | 0 | 1602 | 2208 | 2438 | 1870 | 2125 | 2868 | **35582** | **58177** |
| 2047-48 | 22711 | 0 | 297 | 0 | 1633 | 2296 | 2535 | 1898 | 2161 | 2988 | **36519** | **59777** |
| 2048-49 | 23253 | 0 | 303 | 0 | 1664 | 2388 | 2637 | 1927 | 2198 | 3114 | **37483** | **61429** |
| 2049-50 | 23809 | 0 | 308 | 0 | 1696 | 2484 | 2742 | 1956 | 2236 | 3244 | **38476** | **63132** |
| 2050-51 | 24378 | 0 | 314 | 0 | 1729 | 2583 | 2852 | 1985 | 2274 | 3381 | **39496** | **64887** |
| 2051-52 | 24961 | 0 | 320 | 0 | 1762 | 2686 | 2966 | 2015 | 2313 | 3523 | **40546** | **66699** |
| 2052-53 | 25557 | 0 | 326 | 0 | 1796 | 2794 | 3085 | 2046 | 2352 | 3671 | **41626** | **68567** |
| 2053-54 | 26168 | 0 | 333 | 0 | 1830 | 2905 | 3208 | 2077 | 2392 | 3825 | **42738** | **70494** |
| 2054-55 | 26794 | 0 | 339 | 0 | 1866 | 3021 | 3336 | 2108 | 2433 | 3985 | **43883** | **72483** |
| 2055-56 | 27434 | 0 | 346 | 0 | 1901 | 3142 | 3470 | 2140 | 2475 | 4153 | **45061** | **74535** |
| 2056-57 | 28090 | 0 | 352 | 0 | 1938 | 3268 | 3609 | 2172 | 2517 | 4327 | **46273** | **76653** |
| 2057-58 | 28761 | 0 | 359 | 0 | 1975 | 3399 | 3753 | 2205 | 2560 | 4509 | **47521** | **78838** |
| 2058-59 | 29448 | 0 | 366 | 0 | 2013 | 3535 | 3903 | 2238 | 2604 | 4698 | **48805** | **81094** |
| 2059-60 | 30152 | 0 | 373 | 0 | 2052 | 3676 | 4059 | 2272 | 2649 | 4896 | **50128** | **83422** |

## Section28

| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 9834 | 0 | 160 | 0 | 813 | 866 | 728 | 1511 | 384 | 243 | **14539** | **21250** |
| 2019-20 | 10509 | 0 | 169 | 0 | 858 | 916 | 770 | 1557 | 397 | 257 | **15432** | **22422** |
| 2020-21 | 11230 | 0 | 178 | 0 | 905 | 969 | 814 | 1604 | 410 | 272 | **16381** | **23666** |
| 2021-22 | 12000 | 0 | 188 | 0 | 955 | 1025 | 861 | 1653 | 424 | 287 | **17392** | **24983** |
| 2022-23 | 12823 | 0 | 198 | 0 | 1007 | 1084 | 911 | 1703 | 438 | 304 | **18467** | **26379** |
| 2023-24 | 13703 | 0 | 209 | 0 | 1063 | 1146 | 964 | 1754 | 452 | 321 | **19612** | **27859** |
| 2024-25 | 15188 | 0 | 229 | 0 | 1166 | 1270 | 1068 | 1894 | 489 | 355 | **21659** | **30647** |
| 2025-26 | 16032 | 0 | 240 | 0 | 1218 | 1341 | 1127 | 1947 | 504 | 375 | **22782** | **32112** |
| 2026-27 | 16924 | 0 | 250 | 0 | 1272 | 1415 | 1189 | 2001 | 519 | 395 | **23965** | **33650** |
| 2027-28 | 17865 | 0 | 261 | 0 | 1329 | 1493 | 1255 | 2057 | 534 | 417 | **25211** | **35267** |
| 2028-29 | 18858 | 0 | 273 | 0 | 1388 | 1575 | 1324 | 2115 | 550 | 440 | **26523** | **36966** |
| 2029-30 | 19707 | 0 | 283 | 0 | 1438 | 1658 | 1394 | 2168 | 566 | 462 | **27676** | **38476** |
| 2030-31 | 20593 | 0 | 293 | 0 | 1490 | 1746 | 1467 | 2223 | 581 | 486 | **28880** | **40051** |
| 2031-32 | 21520 | 0 | 304 | 0 | 1544 | 1837 | 1545 | 2279 | 597 | 512 | **30138** | **41693** |
| 2032-33 | 22489 | 0 | 315 | 0 | 1599 | 1934 | 1626 | 2337 | 614 | 538 | **31451** | **43406** |
| 2033-34 | 23501 | 0 | 326 | 0 | 1657 | 2036 | 1711 | 2396 | 631 | 566 | **32824** | **45192** |
| 2034-35 | 24356 | 0 | 336 | 0 | 1705 | 2136 | 1796 | 2448 | 645 | 594 | **34016** | **46759** |
| 2035-36 | 25243 | 0 | 346 | 0 | 1755 | 2241 | 1884 | 2501 | 660 | 624 | **35253** | **48383** |
| 2036-37 | 26161 | 0 | 356 | 0 | 1807 | 2351 | 1977 | 2555 | 676 | 655 | **36536** | **50067** |
| 2037-38 | 27114 | 0 | 366 | 0 | 1859 | 2467 | 2074 | 2610 | 691 | 687 | **37868** | **51812** |
| 2038-39 | 28101 | 0 | 377 | 0 | 1914 | 2588 | 2176 | 2666 | 708 | 721 | **39249** | **53623** |
| 2039-40 | 28930 | 0 | 386 | 0 | 1959 | 2704 | 2273 | 2707 | 720 | 754 | **40430** | **55167** |
| 2040-41 | 29783 | 0 | 395 | 0 | 2005 | 2824 | 2374 | 2748 | 732 | 788 | **41649** | **56761** |
| 2041-42 | 30662 | 0 | 404 | 0 | 2053 | 2950 | 2480 | 2789 | 744 | 824 | **42906** | **58404** |
| 2042-43 | 31566 | 0 | 414 | 0 | 2101 | 3082 | 2591 | 2831 | 757 | 862 | **44203** | **60100** |
| 2043-44 | 32497 | 0 | 424 | 0 | 2151 | 3219 | 2706 | 2874 | 770 | 901 | **45542** | **61850** |
| 2044-45 | 33274 | 0 | 432 | 0 | 2192 | 3348 | 2814 | 2917 | 783 | 939 | **46700** | **63394** |
| 2045-46 | 34069 | 0 | 440 | 0 | 2235 | 3482 | 2927 | 2962 | 797 | 978 | **47889** | **64980** |
| 2046-47 | 34883 | 0 | 448 | 0 | 2277 | 3621 | 3044 | 3006 | 810 | 1019 | **49110** | **66611** |
| 2047-48 | 35717 | 0 | 457 | 0 | 2321 | 3766 | 3166 | 3052 | 824 | 1062 | **50365** | **68286** |
| 2048-49 | 36571 | 0 | 466 | 0 | 2366 | 3917 | 3292 | 3098 | 838 | 1107 | **51654** | **70009** |
| 2049-50 | 37445 | 0 | 475 | 0 | 2411 | 4074 | 3424 | 3145 | 853 | 1153 | **52978** | **71779** |
| 2050-51 | 38340 | 0 | 484 | 0 | 2457 | 4237 | 3561 | 3192 | 867 | 1201 | **54339** | **73599** |
| 2051-52 | 39256 | 0 | 493 | 0 | 2505 | 4406 | 3704 | 3240 | 882 | 1252 | **55737** | **75470** |
| 2052-53 | 40194 | 0 | 503 | 0 | 2553 | 4582 | 3852 | 3289 | 897 | 1305 | **57174** | **77394** |
| 2053-54 | 41155 | 0 | 512 | 0 | 2602 | 4766 | 4006 | 3339 | 912 | 1359 | **58650** | **79372** |
| 2054-55 | 42138 | 0 | 522 | 0 | 2652 | 4956 | 4166 | 3389 | 928 | 1416 | **60168** | **81406** |
| 2055-56 | 43145 | 0 | 532 | 0 | 2703 | 5154 | 4333 | 3440 | 944 | 1476 | **61727** | **83498** |
| 2056-57 | 44177 | 0 | 542 | 0 | 2755 | 5361 | 4506 | 3492 | 960 | 1538 | **63330** | **85650** |
| 2057-58 | 45232 | 0 | 553 | 0 | 2807 | 5575 | 4686 | 3545 | 976 | 1603 | **64977** | **87863** |
| 2058-59 | 46314 | 0 | 563 | 0 | 2861 | 5798 | 4873 | 3599 | 993 | 1670 | **66671** | **90139** |
| 2059-60 | 47420 | 0 | 574 | 0 | 2916 | 6030 | 5068 | 3653 | 1010 | 1740 | **68412** | **92480** |

## Section29

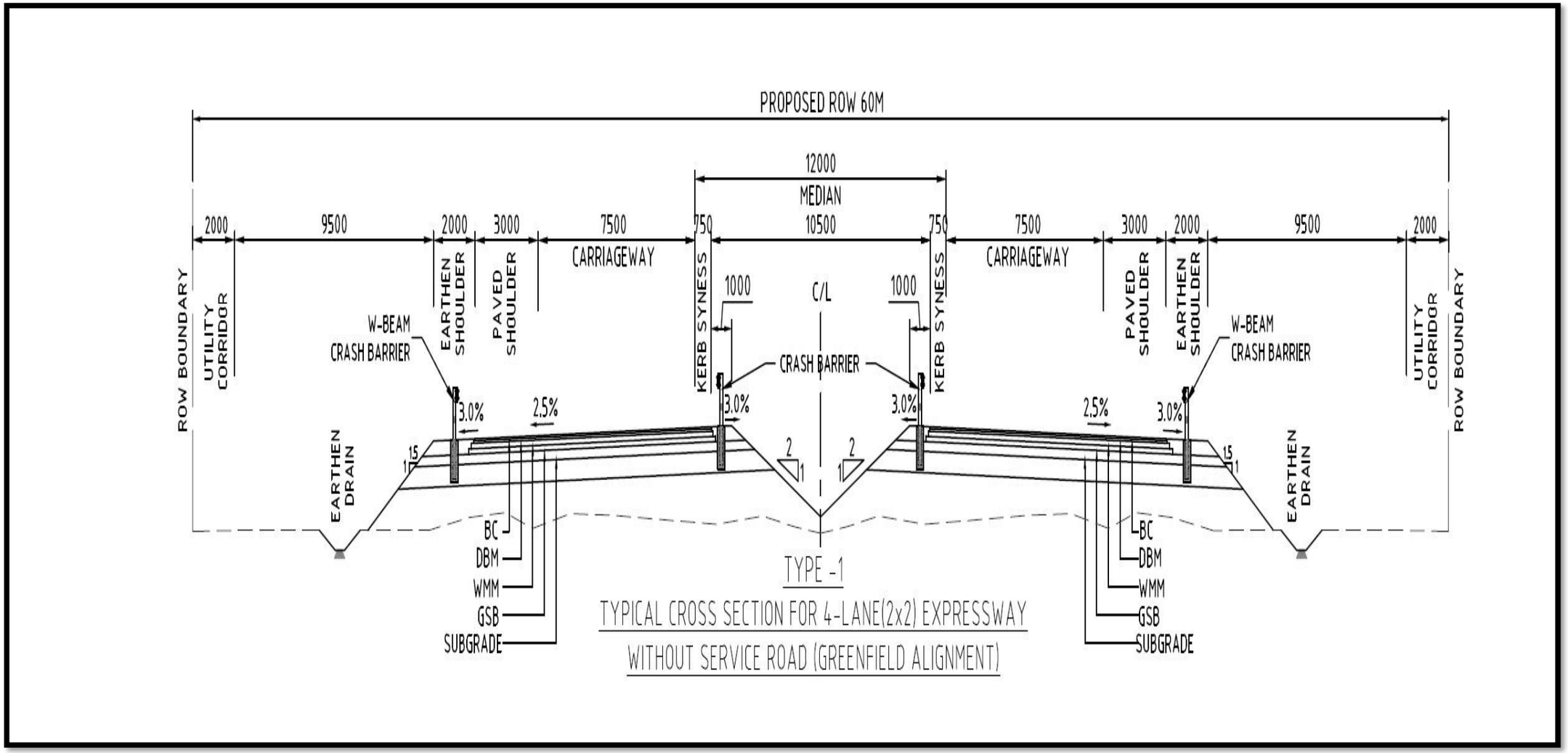
| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 9834 | 0 | 160 | 0 | 813 | 866 | 728 | 1511 | 384 | 243 | **14539** | **21250** |
| 2019-20 | 10509 | 0 | 169 | 0 | 858 | 916 | 770 | 1557 | 397 | 257 | **15432** | **22422** |
| 2020-21 | 11230 | 0 | 178 | 0 | 905 | 969 | 814 | 1604 | 410 | 272 | **16381** | **23666** |
| 2021-22 | 12000 | 0 | 188 | 0 | 955 | 1025 | 861 | 1653 | 424 | 287 | **17392** | **24983** |
| 2022-23 | 12823 | 0 | 198 | 0 | 1007 | 1084 | 911 | 1703 | 438 | 304 | **18467** | **26379** |
| 2023-24 | 13703 | 0 | 209 | 0 | 1063 | 1146 | 964 | 1754 | 452 | 321 | **19612** | **27859** |
| 2024-25 | 15188 | 0 | 229 | 0 | 1166 | 1270 | 1068 | 1894 | 489 | 355 | **21659** | **30647** |
| 2025-26 | 16032 | 0 | 240 | 0 | 1218 | 1341 | 1127 | 1947 | 504 | 375 | **22782** | **32112** |
| 2026-27 | 16924 | 0 | 250 | 0 | 1272 | 1415 | 1189 | 2001 | 519 | 395 | **23965** | **33650** |
| 2027-28 | 17865 | 0 | 261 | 0 | 1329 | 1493 | 1255 | 2057 | 534 | 417 | **25211** | **35267** |
| 2028-29 | 18858 | 0 | 273 | 0 | 1388 | 1575 | 1324 | 2115 | 550 | 440 | **26523** | **36966** |
| 2029-30 | 19707 | 0 | 283 | 0 | 1438 | 1658 | 1394 | 2168 | 566 | 462 | **27676** | **38476** |
| 2030-31 | 20593 | 0 | 293 | 0 | 1490 | 1746 | 1467 | 2223 | 581 | 486 | **28880** | **40051** |
| 2031-32 | 21520 | 0 | 304 | 0 | 1544 | 1837 | 1545 | 2279 | 597 | 512 | **30138** | **41693** |
| 2032-33 | 22489 | 0 | 315 | 0 | 1599 | 1934 | 1626 | 2337 | 614 | 538 | **31451** | **43406** |
| 2033-34 | 23501 | 0 | 326 | 0 | 1657 | 2036 | 1711 | 2396 | 631 | 566 | **32824** | **45192** |
| 2034-35 | 24356 | 0 | 336 | 0 | 1705 | 2136 | 1796 | 2448 | 645 | 594 | **34016** | **46759** |
| 2035-36 | 25243 | 0 | 346 | 0 | 1755 | 2241 | 1884 | 2501 | 660 | 624 | **35253** | **48383** |
| 2036-37 | 26161 | 0 | 356 | 0 | 1807 | 2351 | 1977 | 2555 | 676 | 655 | **36536** | **50067** |
| 2037-38 | 27114 | 0 | 366 | 0 | 1859 | 2467 | 2074 | 2610 | 691 | 687 | **37868** | **51812** |
| 2038-39 | 28101 | 0 | 377 | 0 | 1914 | 2588 | 2176 | 2666 | 708 | 721 | **39249** | **53623** |
| 2039-40 | 28930 | 0 | 386 | 0 | 1959 | 2704 | 2273 | 2707 | 720 | 754 | **40430** | **55167** |
| 2040-41 | 29783 | 0 | 395 | 0 | 2005 | 2824 | 2374 | 2748 | 732 | 788 | **41649** | **56761** |
| 2041-42 | 30662 | 0 | 404 | 0 | 2053 | 2950 | 2480 | 2789 | 744 | 824 | **42906** | **58404** |
| 2042-43 | 31566 | 0 | 414 | 0 | 2101 | 3082 | 2591 | 2831 | 757 | 862 | **44203** | **60100** |
| 2043-44 | 32497 | 0 | 424 | 0 | 2151 | 3219 | 2706 | 2874 | 770 | 901 | **45542** | **61850** |
| 2044-45 | 33274 | 0 | 432 | 0 | 2192 | 3348 | 2814 | 2917 | 783 | 939 | **46700** | **63394** |
| 2045-46 | 34069 | 0 | 440 | 0 | 2235 | 3482 | 2927 | 2962 | 797 | 978 | **47889** | **64980** |
| 2046-47 | 34883 | 0 | 448 | 0 | 2277 | 3621 | 3044 | 3006 | 810 | 1019 | **49110** | **66611** |
| 2047-48 | 35717 | 0 | 457 | 0 | 2321 | 3766 | 3166 | 3052 | 824 | 1062 | **50365** | **68286** |
| 2048-49 | 36571 | 0 | 466 | 0 | 2366 | 3917 | 3292 | 3098 | 838 | 1107 | **51654** | **70009** |
| 2049-50 | 37445 | 0 | 475 | 0 | 2411 | 4074 | 3424 | 3145 | 853 | 1153 | **52978** | **71779** |
| 2050-51 | 38340 | 0 | 484 | 0 | 2457 | 4237 | 3561 | 3192 | 867 | 1201 | **54339** | **73599** |
| 2051-52 | 39256 | 0 | 493 | 0 | 2505 | 4406 | 3704 | 3240 | 882 | 1252 | **55737** | **75470** |
| 2052-53 | 40194 | 0 | 503 | 0 | 2553 | 4582 | 3852 | 3289 | 897 | 1305 | **57174** | **77394** |
| 2053-54 | 41155 | 0 | 512 | 0 | 2602 | 4766 | 4006 | 3339 | 912 | 1359 | **58650** | **79372** |
| 2054-55 | 42138 | 0 | 522 | 0 | 2652 | 4956 | 4166 | 3389 | 928 | 1416 | **60168** | **81406** |
| 2055-56 | 43145 | 0 | 532 | 0 | 2703 | 5154 | 4333 | 3440 | 944 | 1476 | **61727** | **83498** |
| 2056-57 | 44177 | 0 | 542 | 0 | 2755 | 5361 | 4506 | 3492 | 960 | 1538 | **63330** | **85650** |
| 2057-58 | 45232 | 0 | 553 | 0 | 2807 | 5575 | 4686 | 3545 | 976 | 1603 | **64977** | **87863** |
| 2058-59 | 46314 | 0 | 563 | 0 | 2861 | 5798 | 4873 | 3599 | 993 | 1670 | **66671** | **90139** |
| 2059-60 | 47420 | 0 | 574 | 0 | 2916 | 6030 | 5068 | 3653 | 1010 | 1740 | **68412** | **92480** |

## Section30

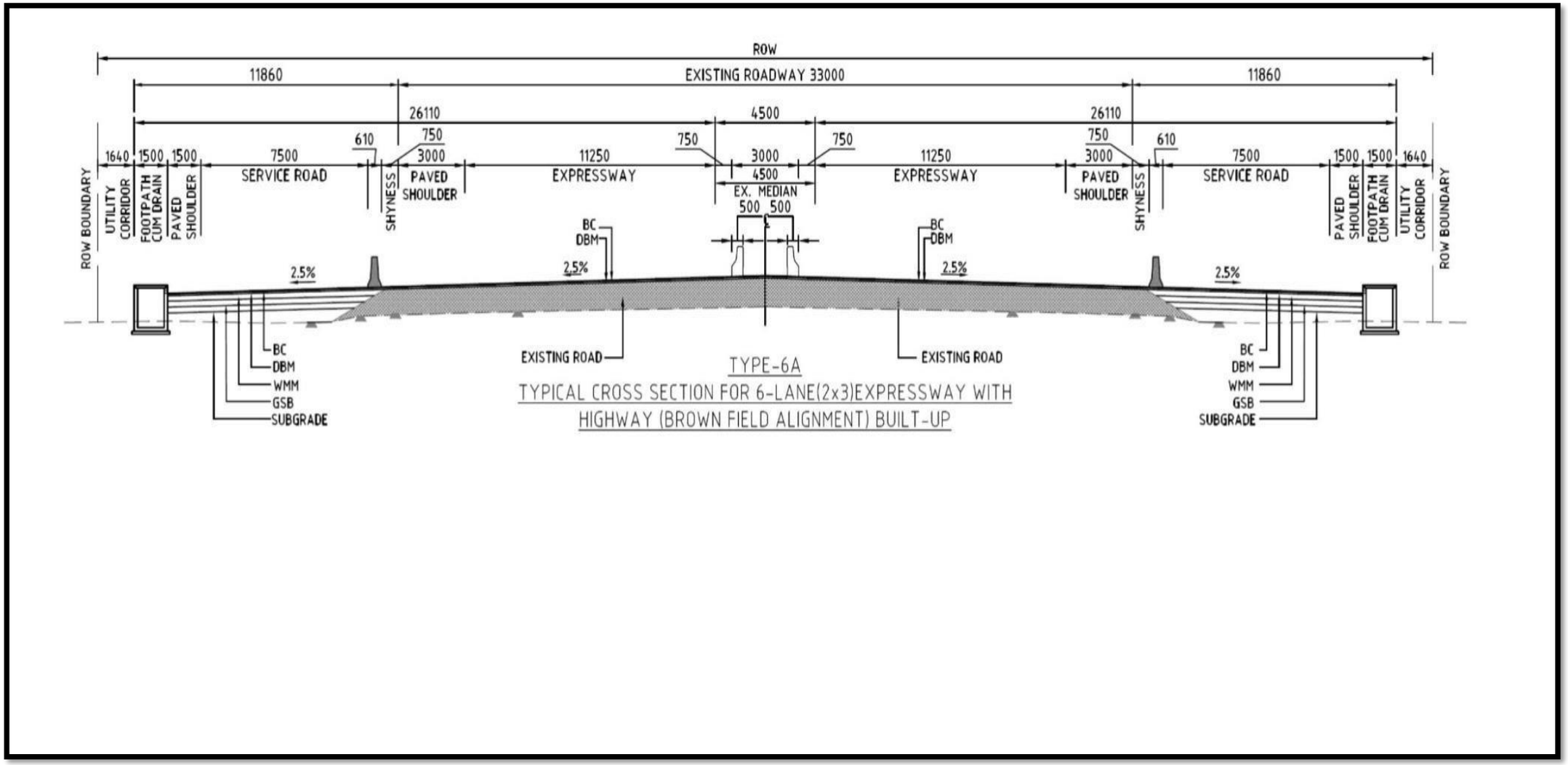
| Year | Car | Shared Jeep | Mini bus | School Bus | Std. Bus | LMV | LCV | 2 Axle | 3 Axle | MAV (4 - 6 A) | Total Vehicles | Total PCU |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2018-19 | 4713 | 0 | 64 | 0 | 505 | 273 | 169 | 202 | 90 | 37 | **6053** | **7893** |
| 2019-20 | 5036 | 0 | 68 | 0 | 533 | 289 | 179 | 208 | 93 | 39 | **6444** | **8372** |
| 2020-21 | 5382 | 0 | 71 | 0 | 562 | 306 | 189 | 214 | 96 | 41 | **6862** | **8881** |
| 2021-22 | 5751 | 0 | 75 | 0 | 593 | 323 | 200 | 221 | 99 | 44 | **7306** | **9423** |
| 2022-23 | 6146 | 0 | 79 | 0 | 626 | 342 | 212 | 228 | 103 | 46 | **7780** | **9999** |
| 2023-24 | 6567 | 0 | 84 | 0 | 660 | 361 | 224 | 235 | 106 | 49 | **8285** | **10611** |
| 2024-25 | 7279 | 0 | 92 | 0 | 724 | 400 | 248 | 253 | 115 | 54 | **9165** | **11707** |
| 2025-26 | 7684 | 0 | 96 | 0 | 756 | 423 | 262 | 260 | 118 | 57 | **9655** | **12302** |
| 2026-27 | 8111 | 0 | 100 | 0 | 790 | 446 | 276 | 268 | 122 | 60 | **10172** | **12928** |
| 2027-28 | 8562 | 0 | 105 | 0 | 825 | 471 | 291 | 275 | 125 | 63 | **10717** | **13588** |
| 2028-29 | 9038 | 0 | 109 | 0 | 862 | 497 | 308 | 283 | 129 | 67 | **11292** | **14281** |
| 2029-30 | 9444 | 0 | 113 | 0 | 893 | 523 | 324 | 290 | 133 | 70 | **11790** | **14886** |
| 2030-31 | 9869 | 0 | 117 | 0 | 925 | 550 | 341 | 297 | 136 | 74 | **12311** | **15516** |
| 2031-32 | 10314 | 0 | 122 | 0 | 959 | 579 | 359 | 305 | 140 | 78 | **12854** | **16174** |
| 2032-33 | 10778 | 0 | 126 | 0 | 993 | 610 | 378 | 312 | 144 | 82 | **13422** | **16861** |
| 2033-34 | 11263 | 0 | 130 | 0 | 1029 | 642 | 397 | 320 | 148 | 86 | **14016** | **17577** |
| 2034-35 | 11673 | 0 | 134 | 0 | 1059 | 673 | 417 | 327 | 151 | 91 | **14526** | **18194** |
| 2035-36 | 12098 | 0 | 138 | 0 | 1090 | 707 | 438 | 334 | 155 | 95 | **15054** | **18833** |
| 2036-37 | 12538 | 0 | 142 | 0 | 1122 | 741 | 459 | 342 | 159 | 100 | **15602** | **19496** |
| 2037-38 | 12994 | 0 | 146 | 0 | 1155 | 778 | 482 | 349 | 162 | 105 | **16170** | **20182** |
| 2038-39 | 13467 | 0 | 151 | 0 | 1188 | 816 | 505 | 356 | 166 | 110 | **16760** | **20894** |
| 2039-40 | 13865 | 0 | 154 | 0 | 1217 | 853 | 528 | 362 | 169 | 115 | **17261** | **21499** |
| 2040-41 | 14274 | 0 | 158 | 0 | 1245 | 891 | 551 | 367 | 172 | 120 | **17778** | **22121** |
| 2041-42 | 14695 | 0 | 162 | 0 | 1275 | 930 | 576 | 373 | 175 | 126 | **18310** | **22763** |
| 2042-43 | 15128 | 0 | 165 | 0 | 1305 | 972 | 602 | 378 | 178 | 131 | **18859** | **23424** |
| 2043-44 | 15574 | 0 | 169 | 0 | 1336 | 1015 | 628 | 384 | 181 | 137 | **19425** | **24106** |
| 2044-45 | 15947 | 0 | 172 | 0 | 1362 | 1056 | 654 | 390 | 184 | 143 | **19906** | **24691** |
| 2045-46 | 16328 | 0 | 176 | 0 | 1388 | 1098 | 680 | 396 | 187 | 149 | **20400** | **25290** |
| 2046-47 | 16718 | 0 | 179 | 0 | 1414 | 1142 | 707 | 402 | 190 | 156 | **20907** | **25906** |
| 2047-48 | 17118 | 0 | 183 | 0 | 1441 | 1187 | 735 | 408 | 193 | 162 | **21427** | **26538** |
| 2048-49 | 17527 | 0 | 186 | 0 | 1469 | 1235 | 765 | 414 | 197 | 169 | **21961** | **27186** |
| 2049-50 | 17946 | 0 | 190 | 0 | 1497 | 1284 | 795 | 420 | 200 | 176 | **22508** | **27851** |
| 2050-51 | 18374 | 0 | 193 | 0 | 1526 | 1336 | 827 | 427 | 203 | 183 | **23070** | **28533** |
| 2051-52 | 18814 | 0 | 197 | 0 | 1555 | 1389 | 860 | 433 | 207 | 191 | **23646** | **29233** |
| 2052-53 | 19263 | 0 | 201 | 0 | 1585 | 1445 | 894 | 440 | 210 | 199 | **24237** | **29951** |
| 2053-54 | 19724 | 0 | 205 | 0 | 1616 | 1503 | 930 | 446 | 214 | 207 | **24844** | **30689** |
| 2054-55 | 20195 | 0 | 209 | 0 | 1647 | 1563 | 967 | 453 | 218 | 216 | **25467** | **31445** |
| 2055-56 | 20678 | 0 | 213 | 0 | 1678 | 1625 | 1006 | 460 | 221 | 225 | **26106** | **32222** |
| 2056-57 | 21172 | 0 | 217 | 0 | 1710 | 1690 | 1046 | 467 | 225 | 235 | **26762** | **33019** |
| 2057-58 | 21678 | 0 | 221 | 0 | 1743 | 1758 | 1088 | 474 | 229 | 245 | **27435** | **33837** |
| 2058-59 | 22196 | 0 | 225 | 0 | 1777 | 1828 | 1132 | 481 | 233 | 255 | **28126** | **34677** |
| 2059-60 | 22726 | 0 | 229 | 0 | 1811 | 1901 | 1177 | 488 | 237 | 266 | **28835** | **35539** |

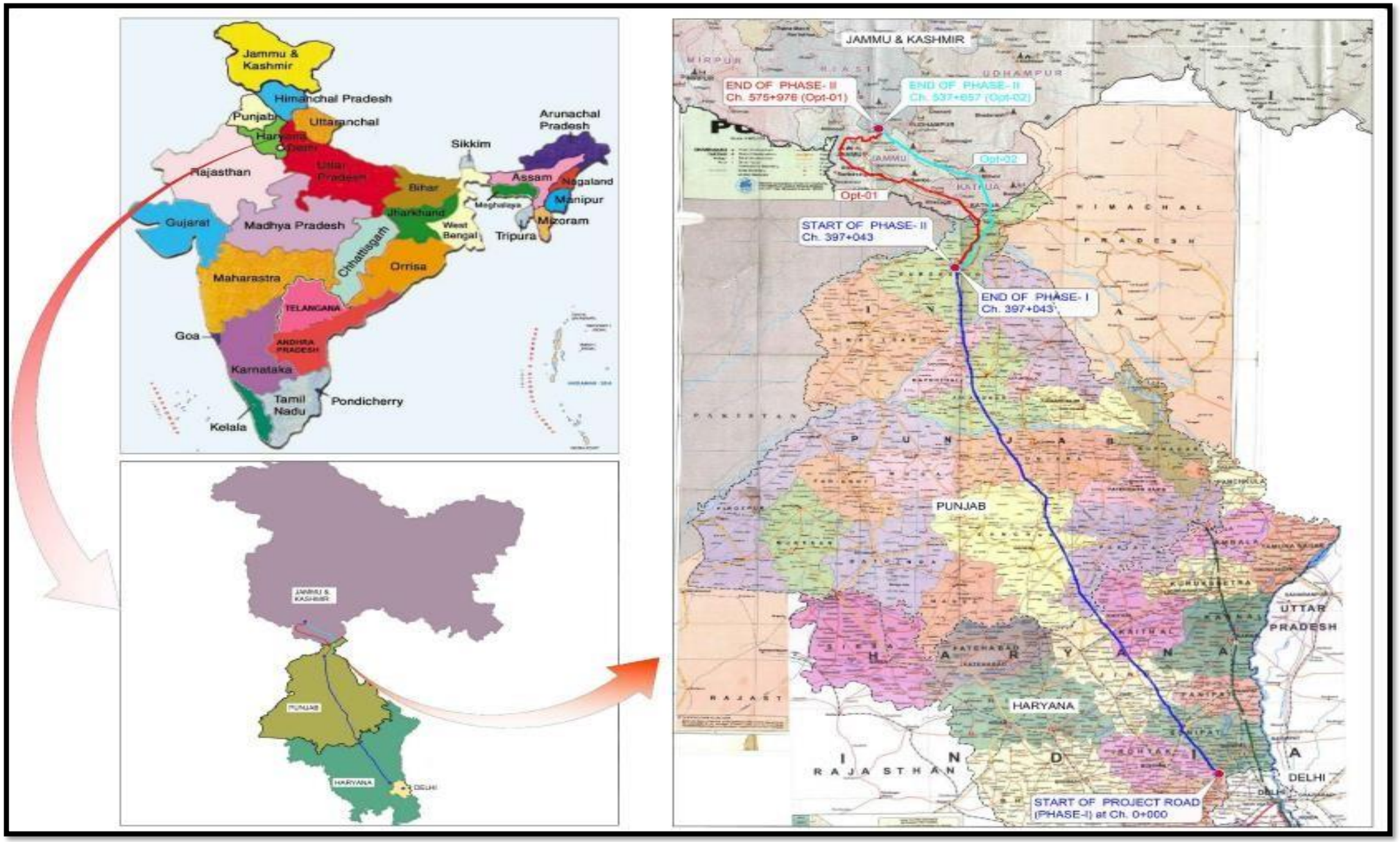
## Section31

## TYPICAL CROSS SECTION FOR GREENFIELD



## TYPICAL CROSS SECTION FOR BROWNFIELD




Jammu & Kashmir
Himanchal Pradesh
Punjab
Uttaranchal
Haryana
Delhi
Rajasthan
Uttar Pradesh
Bihar
Sikkim
Arunachal Pradesh
Assam
Nagaland
Manipur
Meghalaya
Jharkhand
West Bengal
Tripura
Mizoram
Gujarat
Madhya Pradesh
Chhattisgarh
Orrisa
Maharastra
TELANGANA
ANDHRA PRADESH
Goa
Karnataka
Tamil Nadu
Pondicherry
Kelala
JAMMU & KASHMIR
END OF PHASE- II
Ch. 575+976 (Opt-01)
END OF PHASE- II
Ch. 537+657 (Opt-02)
JAMMU
KATHUA
Opt-02
Opt-01
START OF PHASE- II
Ch. 397+043
END OF PHASE- I
Ch. 397+043
HIMACHAL PRADESH
PUNJAB
HARYANA
UTTAR PRADESH
RAJASTHAN
DELHI
START OF PROJECT ROAD
(PHASE-I) at Ch. 0+000