

**2.1 Existing Road Network**

The existing transport network in National Capital Region is ‘radial’ in nature. It comprises of expressways, national highways, state highways, major district and other district roads. The road network is being developed and maintained by NHAI, PWD, MCD, NDMC, Delhi Cantonment Board and DDA. Five National Highways (NH-1, 2, 8, 10 & 24) converge on Ring Road of Delhi and one National Highway (NH-58) meets NH-24 at Ghaziabad. In addition, NH-71, 71-A, 71-B, NH-91 and NH-119 also pass through the region. Apart from these national highways, some state highways also serve in strengthening the regional road network. Other than these highways, MDRs and ODRs also act as important linkages among these highways.

Existing road transport network of the National Capital Region was examined for the existing connectivity, mobility and accessibility in the study.

Mobility-based measurement and accessibility-based measurement are two significant approaches of measuring the transportation system performances. Mobility refers to the movement of people or goods while accessibility refers to the ability to reach “opportunities” like desired goods, services, activities and destinations. Accordingly, Road Network Analysis has been carried out and elaborated in subsequent paras.

**2.2 Network form and spread**

Network form and spread has been analysed in four parts in the Study as stated below:

- a. Road Density
- b. Accessibility
- c. Mobility
- d. Connectivity (Graph Theory)

**a. Road Density**

The region and sub-region wise road density<sup>1</sup> in the NCR is presented in **Table 2.1**.

**Table 2.1: Sub-Region Wise Road Density in NCR**

Sub-region NCR	Area (Sq. Kms)	Total Length (Km)	Km per 100 sq. km of area	Length of NH (Km)	Km per 100 sq. km of area	Length of SH (Km)	Km per 100 sq. km of area	Length of MDR (Km)	Km Per 100 sq. km of area
Haryana*	13413	7954	59.30	528	3.93	1448.2	10.79	580	4.32
UP*	10853	5504	50.71	321.4	2.96	805.6	7.42	432.66	3.98
Rajasthan*	7829	3976	50.79	35.3	0.45	1010.1	12.90	326.76	4.04
Total	32095	17434	54.32	884.70	2.76	3263.90	10.17	1339.42	4.14

Note: 1) Excludes NCTD

2) Does not includes ODRs & VRs.

Source: \* Study on Integrated Transportation Plan for NCR, CES primary survey 2007

Road densities of NCR when compared with the national level shows that density of National Highways (2.84) and State Highways (9.72) in NCR is higher than the density of National Highways (1.99) and State Highways (4.19) in India. But in case of MDR, road density of NCR (3.95) is much

<sup>1</sup> Road Density is given as length of roads per unit area of land. A high road density indicates that major share of the population has some access to the road network.



less as compared to that in India (14.23). **Table 2.2** presents a comparative picture of the road densities by category.

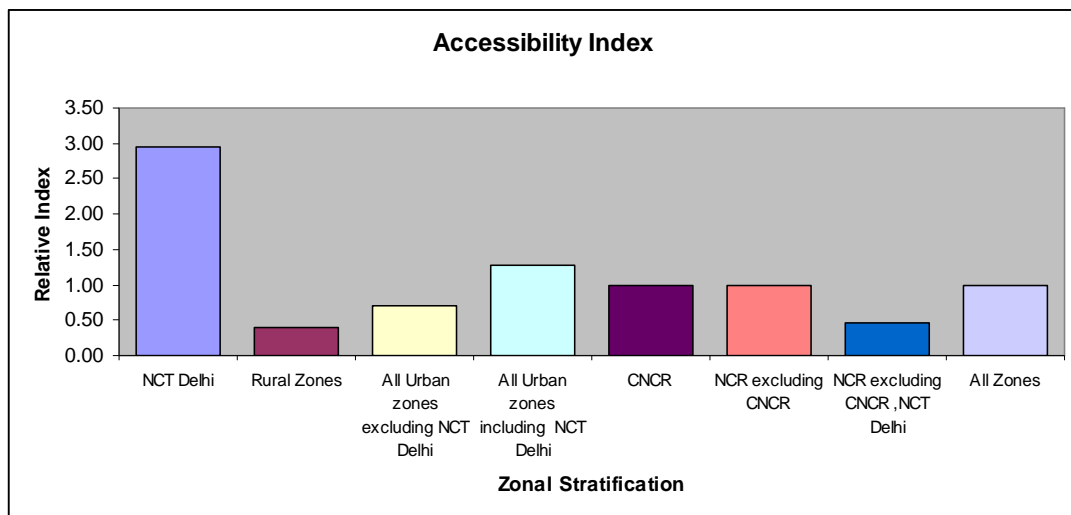
**Table 2.2: Comparison of Road Density by NH, SH and MDRs**

Road Type	India Road Length (kms)	Density (Km per 100 sq. km)	NCR Road Length (kms)	Density (Km per 100 sq. km)
NH	66590	1.99	1221.7 *	3.64
SH	131899	4.19	3263.9	9.72
MDR	467763	14.23	1339.4	3.95
Total	671064	20.41	5825.0	17.32

\* Includes the NH length in NCTD, Source: Study on Integrated Transportation Plan for NCR

**b. Accessibility**

Accessibility<sup>2</sup> measure is unit-free and has no intrinsic meaning, it provides an indication of the level of accessibility of employment / jobs for each zone; with jobs weighted more heavily the closer they are (in terms of travel time) to the zone.



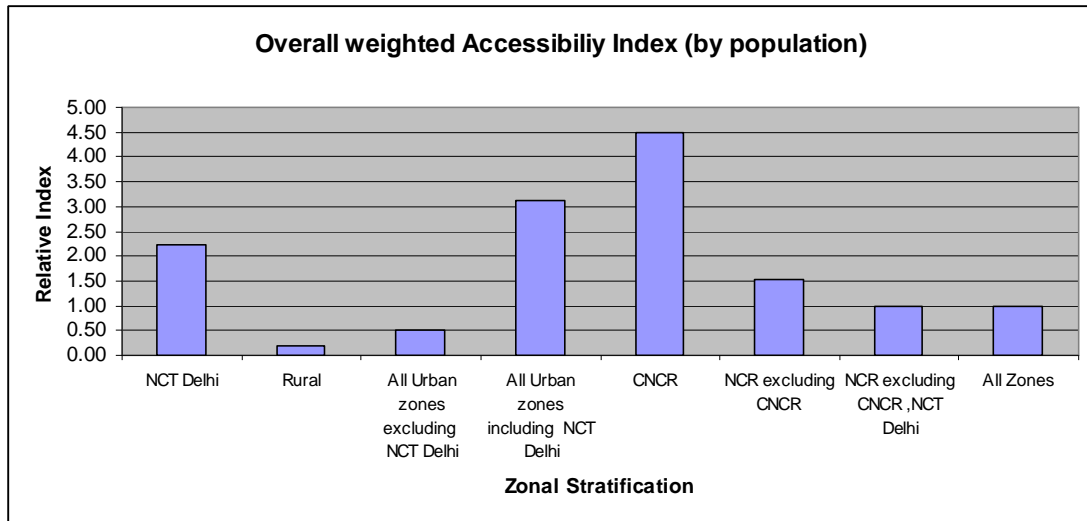
Source: Study on Integrated Transportation Plan for NCR

**Figure 2.1: Accessibility Index (by Employment)**

**Figure 2.1** presents the accessibility with respect to employment in a particular zone. It indicates that NCT Delhi has the highest accessibility of jobs in the region followed by CNCR. Rural zones indicate poor accessibility in the region.

In **Figure 2.2**, an overall weighted accessibility score for a set of zones is calculated by considering population in addition to employment facility in that zone. The accessibility index calculated for all zones is given in **Annexure 2.1**. Weighted by population, CNCR indicates the highest accessibility, followed by all urban zones and NCT Delhi. Again rural zones indicate the poor accessibility in the region.

<sup>2</sup> Accessibility is defined for personal travel as the ability to reach desired destinations. The accessibility measure selected is a gravity-modal-based measure known as the Hansen Modal. The accessibility measures are calculated for TAZ (traffic analysis zone).

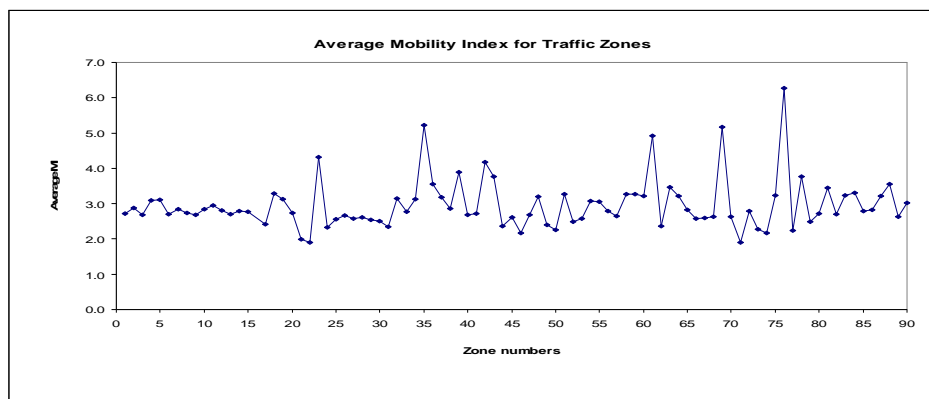


Source: Study on Integrated Transportation Plan for NCR

**Figure 2.2: Weighted Accessibility Index (by population)**

**c. Mobility**

Mobility Index<sup>3 4</sup>(MI) details presented in **Annexure 2.2** gives the percentage distribution of MI from each zone to all other zones in the base scenario. Overall results show very low level of mobility throughout the NCR.



Source: Study on Integrated Transportation Plan for NCR

**Figure 2.3: Average Mobility Index for Traffic Zones**

A mobility index below 1.5 can be considered as good inter regional connectivity. In order to assess the overall mobility of a traffic zone in NCR, the MI from each traffic zone to all other traffic zones is averaged and presented in **Figure 2.3**. In NCR, average MI is greater than or equal to 1.9 for 100 percent of the traffic zones thereby indicating requirement for better connectivity throughout the region.

<sup>3</sup> Mobility Index is a measure of the efficiency of the network. It is defined as the ratio of travel time (speed determined by the condition) by the physical route between an origin and destination and the travel time by the airline distance at desired speed. An ideal network is one which provides the most direct route between an origin and destination at the desired speed.  
<sup>4</sup> Network Analysis, Final Report, June 2003 prepared by Sheladia Associates, Inc. USA for Ethiopian Roads Authority.



**d. Connectivity**

Graph Theory approach can be used to compare and evaluate various transport network options available and to select the best option. This approach can also be used to check the connectivity and accessibility level of different transport networks. Some of the significant interpretations that were concluded from the graph theory analysis are stated below:

- Beta index of 2.86 indicates that existing network of NCR is well connected
- Alpha Index of 32.6 indicates that the network is highly connected
- Index value of 82.7 indicates good degree of connectivity
- Cyclomatic number of 883 indicates that there is redundancy in the network system.

**2.3 Road Network Inventory**

The Road Inventory Survey of the whole road network system in the NCR was carried out to assess the physical characteristics and conditions of the existing major roads in NCR and to assess the scope of potential capacity for future expansion.

The existing road network for all constituent states, i.e. NCTD, States of Haryana, Uttar Pradesh and Rajasthan as shown in **Map 2.1** was characterized by the design elements like Right of Way, Carriageway Width, Type of Road Surface, Presence of Service Roads, Pavement Condition, Road Side Drainage Facilities and Road Side Furniture like signage, road markings, etc.

The above design characteristics for road side links in NCR were analyzed for assessing the Volume/ Capacity Ratio and for pavement condition so as to assess the need for capacity augmentation and up-gradation of existing roads to meet the traffic intensity and travel demand of traffic on the basis of analysis of inventory data, salient characteristics of major roads is presented in **Annexure 2.3**.

**2.4 Volume / Capacity Ratio**

The Volume / Capacity Ratio assessed by road links and length is presented in **Table 2.3** below:

**Table 2.3: Distribution of Road Length by V/C Ratio**

V/C	Road Links	%Age	Road Length	%Age
0.001 - 0.3	72.00	25.26	779.30	26.42
0.3 - 0.6	122.00	42.81	1253.40	42.49
0.6 - 0.99	63.00	22.11	697.60	23.65
> 1	28.00	9.82	219.70	7.45
<b>Total</b>	<b>285.00</b>	<b>100.00</b>	<b>2950.00</b>	<b>100.00</b>

*Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007*

**2.5 Pavement Condition**

Further, the condition of the pavement was analyzed by sufficiency rating using Paser Condition Rating Criteria which is described below:

Pavement Condition	Paser Rating
No deficiencies such as rutting, corrugation, raveling, potholes, transverse cracks, alligator cracks, longitudinal cracks, etc.	: 10
Total failure	: 0
Good	: 8,9 or 10



<b>Pavement Condition</b>	<b>Paser Rating</b>
Fair	: 5,6 or 7
Poor	: 1,2,3,4

Based on this Paser Rating, all links are classified for maintenance needs. If Paser Rating is good, then it means routine maintenance would suffice, if the rating is fair, then the road needs preventive maintenance and if the road rating is poor, then the road would need rehabilitation of existing pavement. The distribution of road length by pavement condition for NCR sub-regions is presented in **Table 2.4** below:

**Table 2.4: Distribution of Road Length by Type of Pavement Condition**

Pavement Condition	Road Length (Km)				%Age Road Length			
	Rajasthan	U.P.	Haryana	Total	Rajasthan	U.P.	Haryana	Total
Good	179.5	619.7	1061.54	1860.74	41.93	92.33	57.36	63.08
Fair	180.6	31.8	640.06	852.46	42.19	4.74	34.58	28.90
Poor	68	19.7	149.1	236.8	15.88	2.94	8.06	8.03
<b>Total</b>	<b>428.1</b>	<b>671.2</b>	<b>1850.7</b>	<b>2950</b>	<b>100</b>	<b>100</b>	<b>100.00</b>	<b>100.00</b>

*Source: Study on Integrated Transportation Plan for NCR, CES primary survey 2007*

## 2.6 Road Network Analysis - Inferences and Recommendations

It was observed in the Study that the safety provisions on the highways do not match with the international standards. The road network is inadequate both in quantity and quality and therefore appropriate measures should be taken to improve the riding quality and the capacity of existing roads to meet the travel demand of goods and passenger traffic. The study proposed following improvements of road network in NCR:

- a. All the road-side encroachments must be cleared to enhance the capacity of the existing corridors
- b. The riding quality of the existing pavements must be improved to effect fuel savings and riding comfort
- c. Dedicated facilities must be provided for pedestrians, cyclists, and other non-motorized vehicles
- d. Exclusive bus lanes should be provided and other mass transport modes such as RRT System, LRT System, Metro and Mono-rails should be encouraged throughout NCR to meet inter-regional and intra-regional transport demand.
- e. The alternative parallel routes must be explored to divert the traffic from the congested corridors
- f. The construction of missing links, bridges, flyovers, underpasses, bypasses must be taken up on priority to improve the safety and efficiency of traffic to an acceptable level of service.



Functional Plan on Transport for National Capital Region-2032

