Accessibility Analysis of BRTS Public Transport Stops along Route Zundal Circle to L.D. Engineering College through West Zone of Ahmedabad

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Abstract: Accessibility refers to people's ability to reach goods, services and activities, which is the ultimate goal of most transport activity. It is important to measure public transport accessibility to improve the sustainability of public transport system in metropolitan areas. Improving public transport accessibility can be considered an effective way of reducing the external costs and negative side effects of motorized commuting. Ahmedabad has two type of public transport systems namely Bus Rapid Transit System (BRTS) and Ahmedabad Municipal Transport Service (AMTS). Rail transit for public transport Metro-Link Express for Gandhinagar and Ahmedabad (MEGA) is under construction. The BRTS route from Commerce six road to Zundal circle has 33 stops with a total length of 20.8 km. The Public Transport Accessibility Level (PTAL) methodology in this study, which was originally developed by the London Borough of Hammersmith and Fulham and later implemented by Transport for London (TfL) has been adopted for the city of Ahmedabad, Gujarat. PTAL is derived by considering average walk speed, average walk time, distances to public transport stops and peak-hour route frequencies. Data collection will be carried out by approaching public transport facility users. TransCAD software is used to generate a visual representation of PTAL. The Accessibility Indices obtained are allocated to eight bands of PTAL from very poor to excellent which can be used to suggest recommendation for future public transport system improvement.

IndexTerms: **Accessibility, BRTS, PTAL, Public Transport, TransCAD**

I. INTRODUCTION

Public transport is a key part of national and regional transportation infrastructure, and aims to provide accessibility to jobs, health care, and other activities. Heavy traffic congestion is one of the biggest problems that is faced by everyone in each city. Public transportation, while maybe not as pleasant as travelling in private vehicle, does ease congestion, reduce emissions. The imperishable cities associate five conventions of viability for communal transport system: accessibility; affordability; connectivity; land use planning; and planning with the environment in mind.

Accessibility generally refers to physical access to goods, services and destinations, which is what people usually mean by transportation. Accessibility is widely used to evaluate the level of service of urban transportation systems. It is important to measure public transport accessibility to help improve the sustainability of transport systems in metropolitan areas. Since accessibility is the ultimate goal of most transportation activity (excepting the small amount of travel that has no desired destination), transport planning should be based on accessibility. Unfortunately, in analyzing transit travel demand and level of transit use, most existing studies have focused on only a few aspects of transit systems and overlooked basic accessibility and transportation equity. Significant attention is being placed on accessibility analysis of public transportation networks in order to make them more desirable and to increase their utilization.

Ahmedabad has a high percentage of population living in slums. According to the Ahmedabad Urban Development Plan 2011 (AUDA 2002), in 1998, 32% of the city's population lived in slums, with 60% of these households falling below the poverty line. According to the Global Report on Understanding Slums (2003), the percentage of Ahmedabad housing categorized as slums increased from 17% in 1961 to 23% in 1971 to 26% in 2011. One study suggested that 40% of Ahmedabad's population lives in slums (informal settlements) and chawls (tenements) (Somani 2011). The modal share in Ahmedabad is 17% public transport (all buses) and 54% non-motorized transport (NMT) (walking and cycling) (LGBC 2001). This suggests that a very high percentage of the urban poor population cannot afford public transport for commuting. Mapping public transport accessibility levels can be a useful tool in achieving the goal of improving the level and quality of service of public transport system.

II. ACCESSIBILITY INDEX

Accessibility Index is Used in measuring the ease of residents going from one place to another. By analysing the accessibility indices, one can review a network system of transportation in the regions under study. The accessibility to public transport can be find out on spatial or temporal basis. Temporal coverage is more important factor than spatial coverage to find accessibility. Primary data such as average walk speed, average walking distance, waiting time, transfer time can be obtained by questionnaire survey and peak-hour route frequencies from secondary data. Mostly preferred method to find public transport accessibility is PTAL. PTAL include both spatial coverage and temporal coverage. PTAL can be obtained by considering average walk speed, average walk time, average walk distances to public transportation stops and peak hour route regularities.

The public transport accessibility level (PTAL) evolved in 1992 by London Borough of Hammersmith and Fulham (Cooper 2003, Gent and Symonds 2005). PTAL evolve concentration of the public transport network at a particular point (origin), using service frequency, service coverage for all accessible approaches of conveyance from that point. There are mainly seven steps involved in PTAL methodology,

STEP 1: Define points of interest (POI) and service access points (SAP)

STEP 2: Calculate walk access time (WT) from POI to SAP

STEP 3: Identify valid routes at each SAP and calculate average waiting time (AWT)

$AWT = (0.5*60)/f + K$ …… (1)

Where, f is hourly frequency and K is reliability factor.

STEP 4: Calculate minimum total access time (TAT) for each valid route at each SAP

$TAT = WT + AWT$ …… (2)

STEP 5: Convert TAT into equivalent doorstep frequency (EDF)

$EDF = 30/TAT$ …… (3)

STEP 6: Obtain the accessibility index (AI)

AI for a transport mode (m),

$AIm = EDF_{max} + 0.5 * \Sigma EDF$ …… (4)

AI for a POI,

$AI_{POI} = \Sigma AI_{m1}$ …… (5)

STEP 7: Mapping of AIs obtained for each POI into eight bands of PTAL as shown in Table 1.

Table 1 Accessibility Levels as per London PTAL Methodology

Accessibility Level	PTAL Range	Map Colour	Remark
1a (Low)	0.01-2.50		Very Poor
1b	2.51-5.00		Very Poor
2	5.01-10.00		Poor
3	10.01-15.00		Moderate
4	15.01-20.00		Good
5	20.01-25.00		Very Good
6a	25.01-40.00		Excellent
6b (High)	40.01+		Excellent

(Source: Transport for London (2010), Table 3, p. 6)

III. STUDY AREA

The city of Ahmedabad was founded in 1411 AD as a walled city on the eastern bank of the river Sabarmati, now the fifth most populous city in India and the largest in the state. Ahmedabad lies at 23.03°N 72.58°E in western India at 53 metres (174 ft) above sea level on the banks of the Sabarmati river, in north-central Gujarat. It covers an area of 464 km2. At the 2011 Census of India Ahmedabad had a population of 5,633,927, making it the fifth most populous city in India. The urban agglomeration centered upon Ahmedabad, then having a population of 6,357,693, now estimated at 7,650,000, is the seventh most populous urban agglomeration in India. Ahmedabad has two major public transport systems: the Ahmedabad Municipal Transport Service (AMTS), a bus service running in mixed traffic, and the BRTS, operated by Ahmedabad Janmarg Ltd (AJL), which runs on dedicated corridors (except junctions and a few other links). Both AMTS and BRTS are wholly-owned subsidiaries of the Ahmedabad Municipal Corporation (AMC). A metro rail system called the Metrolink Express Gandhinagar Ahmedabad (MEGA) has been under construction and is in the advanced stages of planning. The city Ahmedabad is divided into six zones; West zone, East zone, North zone, South zone, Central zone, New west zone. As of June 2018, eleven in both directions and two in circular direction; serving 149 BRTS stations and cabins at extended routes. The BRTS route from Commerce six road to Zundal circle has 33 stops with a total length of 20.8 km.

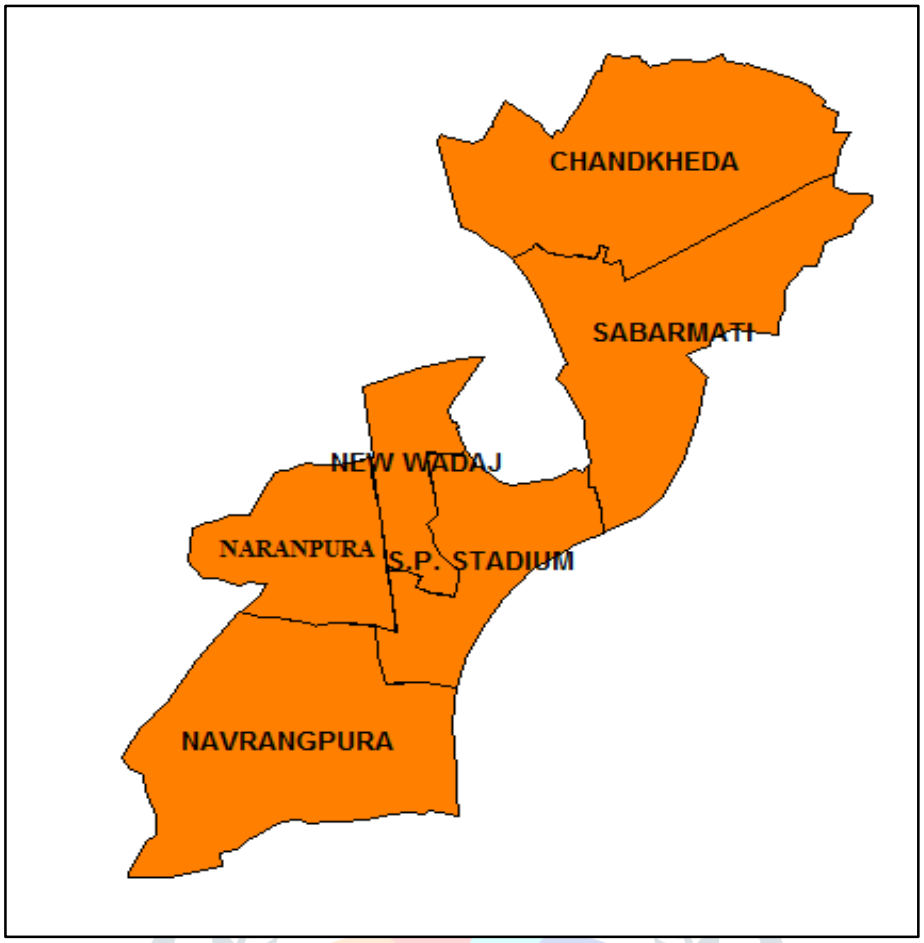

FIGURE 1 TRANSCAD DIGITIZE MAP OF WEST ZONE, AHMEDABAD

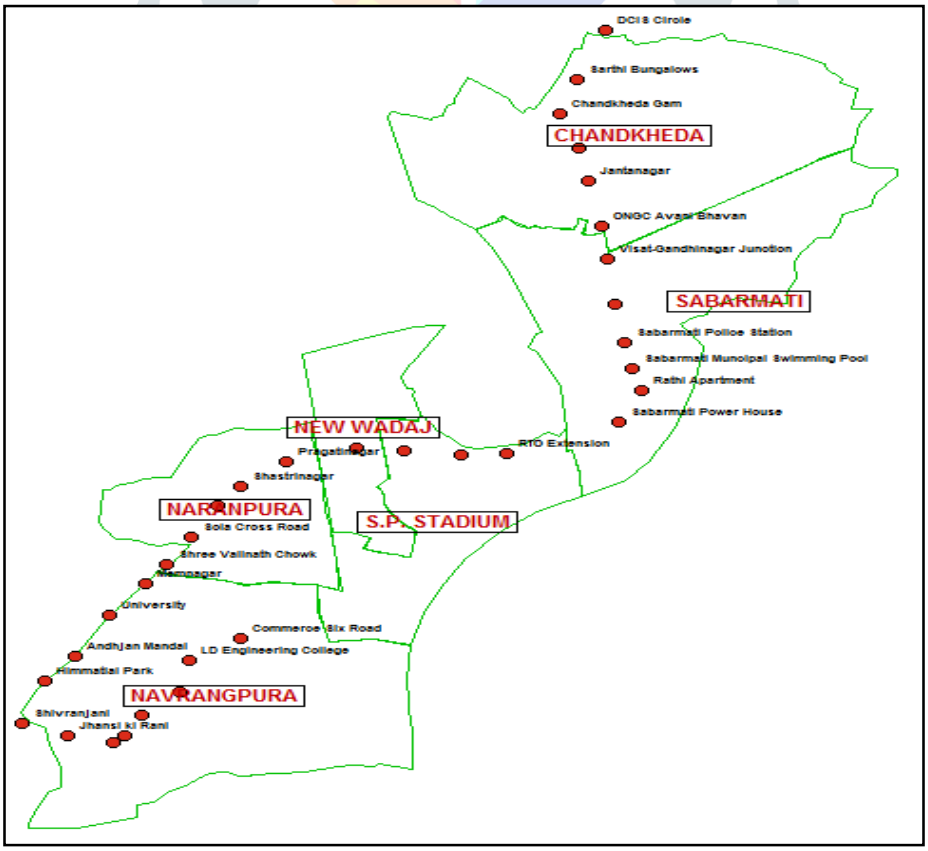

FIGURE 2 BRTS ROUTE NUMBER 4 BUS-STOPS USING TRANSCAD

IV. DATA COLLECTION

Frequency data are collected for Commerce Six Road - Zundal Circle and Zundal Circle - Commerce Six Road from BRTS Ahmedabad office as shown in Fig. 2. The data are useful for deriving reliability factor. Service frequency data is selected from the morning peak period, specifically between 08.00 to 11.00. A questionnaire is prepared containing basic and general scenario of Ahmedabad city BRTS route. The purpose is to collect and analyse the transit requirement of the community for the route. A Google survey is generated for BRTS route number 4 (Zundal Circle - Commerce Six Road) and total 2862 survey forms are filled up through questionnaire survey from all 33 BRTS stops of route Zundal Circle to Commerce Six Road. Walking time and waiting time scenarios of users of BRTS are shown in Fig. 4 and Fig. 5 respectively.

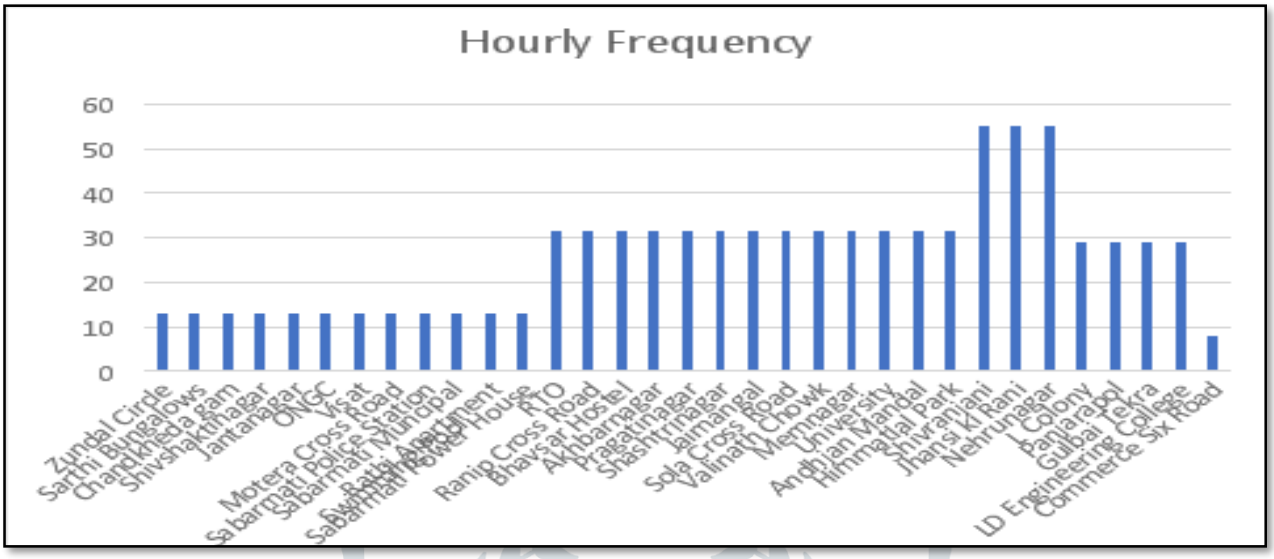

FIGURE 3 HOURLY FREQUENCY OF SAPS

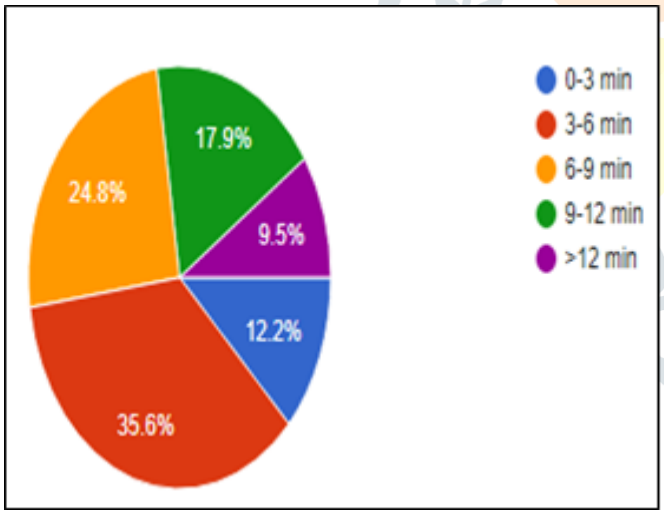

FIGURE 4 Walk Time from Origin to SAP

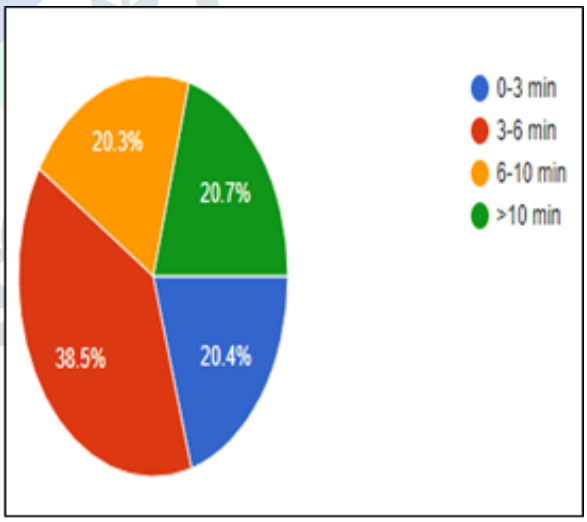

FIGURE 5 Waiting Time for Bus

V. PTAL CALCULATIONS

Point of Interest (POI)

The BRTS route Zundal Circle to Commerce Six Road is passes through 6 wards of west zone, Ahmedabad. These 6 wards (Chandkheda, Sabarmati, New Wadaj, S.P.Stadium, Naranpura, Navrangpura) are considered as POI.

Service Access Point (SAP)

All the 33 BRTS stops of BRTS route number 4 are considered as SAP.

The Walk Access Time

Walk access times are measured from the origin to the SAPs using the questionnaire survey. For buses the maximum walk time is defined as 8 minutes. For rail, underground and light rail services the maximum walking time is defined as being 12 minutes.

Scheduled Waiting Time (SWT)

For selected route the scheduled waiting time (SWT) is calculated. This is estimated as half the headway (i.e. the interval between services,) so SWT = 0.5 * (60/Frequency). Thus a 10-minute service frequency (6 buses per hour) would give an SWT of 5 - on average a passenger would have to wait 5 minutes for a bus/train to appear.

Reliability Factor

The reliability factor reflects the fact that actual wait times can be longer because services do not arrive in an entirely regular manner. The regularity of buses, underground and rail services are affected by a variety of factors, with bus services the worst affected. The reliability factor is the difference between average headway of survey waiting time and average headway of schedule frequency which is derived as 1 for Ahmedabad BRTS.

Schedule Waiting Time (SWT) = 1.5 minutes

Survey Average Waiting Time = 2.5 minutes

Reliability Factor = 2.5 – 1.5 = 1.0 minute

Accessibility of SAPs for The Wards of West Zone

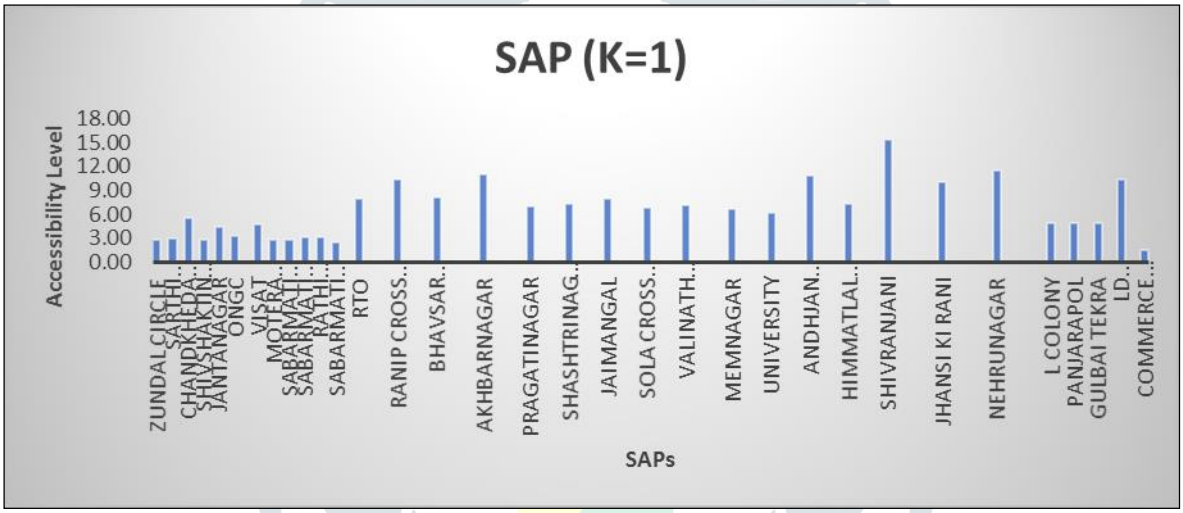

FIGURE 6 ACCESSIBILITY OF SAPS FOR THE WARDS OF WEST ZONE

Accessibility of BRTS Route Number 4

For Reliability Factor K= 1.0, the accessibility of BRTS route number 4 is 31.31 that lies in band 6a of PTAL which is Excellent.

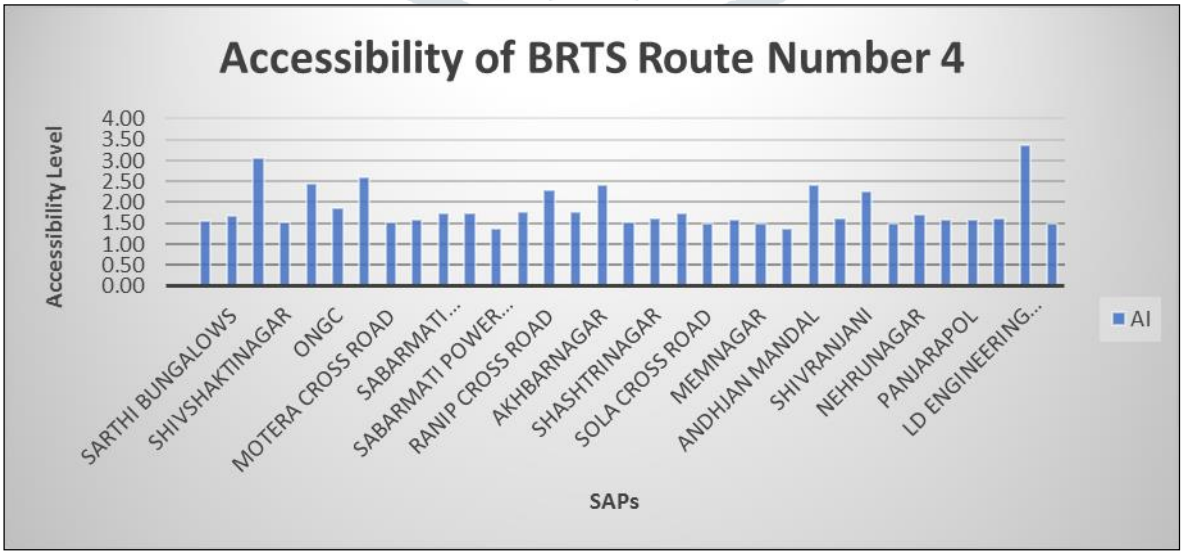

FIGURE 8 ACCESSIBILITY OF BRTS ROUTE NUMBER 4

VI. Mapping of Accessibility Levels

Fig 9 shows the map created in TransCAD software. PTAL is given as one attribute and map showing the accessibility index of different wards is created.

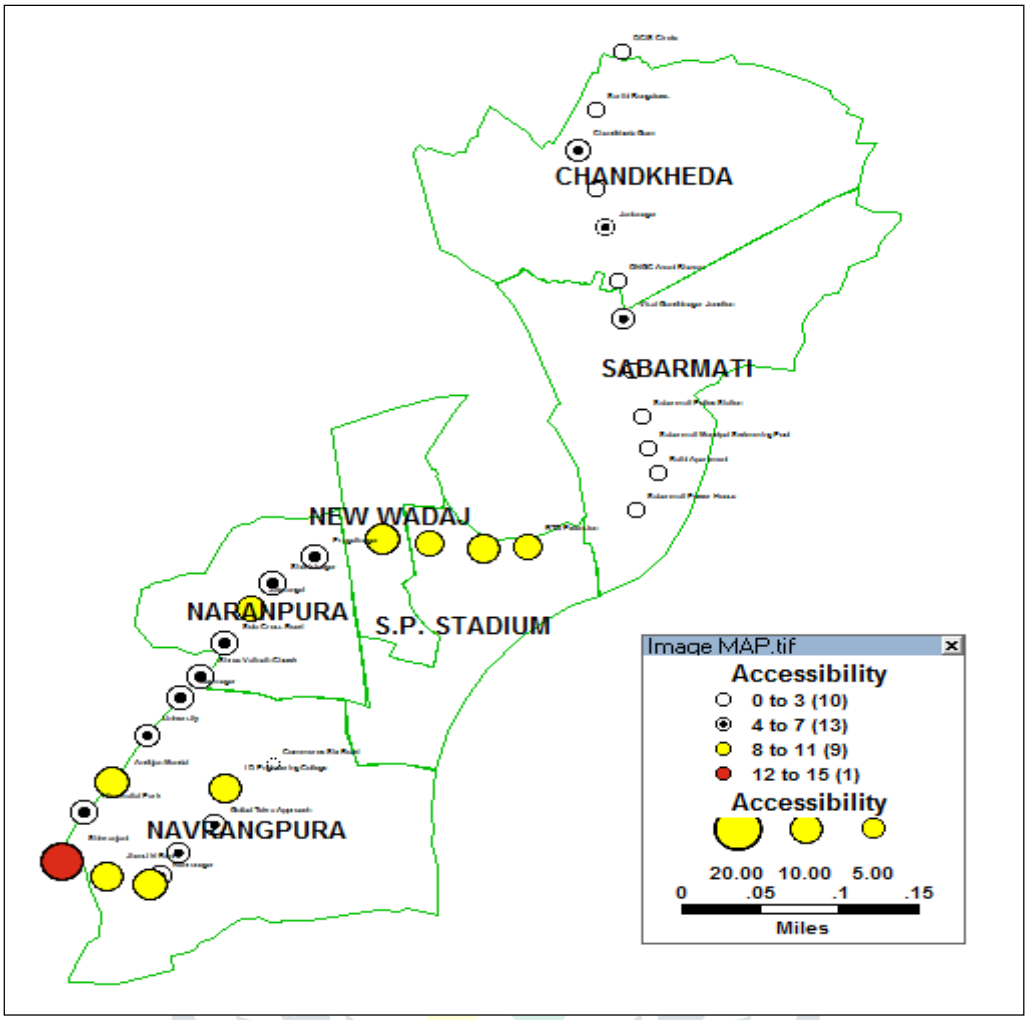

Figure 9 Map showing different PTALs of SAPs of BRTS Route Number 4

VII. Conclusion

- The reliability factor of BRTS is calculated as 1 min using SWT and average waiting time parameters.
- The surveyed route is maximum used by persons who are generally involved in the activities like work & education.
- As per the data collected the average waiting time is 2.5 min and average walking time is 5 min for the route.
- Navrangpura ward have excellent accessibility due to having a greater number of BRTS stops and having lower waiting time which is an important parameter to find public transport accessibility.
- Accessibility of BRTS route number 4 is analysed as excellent accessibility as per PTAL methodology.
- As per the calculation results, it is overall observed that Navrangpura, S.P. Stadium and Navrangpura having more accessibility than Chandkheda, Sabarmati and New Wadaj Area along BRTS route Commerce Six Road to Zundal Circle.
- The PTAL scenario of SAPs of west zone, Ahmedabad is maximum at Shivranjani BRTS stop and minimum at Commerce Six Road BRTS stop.
- The PTAL scenario of SAPs of BRTS route number 4 (Commerce Six Road to Zundal Circle) is maximum at L.D. Engineering College and minimum at University.

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