Journal of Civil Engineering and Environmental Technology
Print ISSN: 2349-8404; Online ISSN: 2349-879X; Volume 2, Number 4; April-June, 2015 pp. 322-328

http://www.krishisanskriti.org/jceet.html

Planning Strategies to Promote Urban Sustainable Traffic and Transportation System in Central Business District (CBD) in Heritage Cities Case Study: Mysore and Isfahan city

Setareh Oruji[1], Ehsan Amini[2] and T.M. Mahesh[3]

[1]MUD (MYSORE). PhD Student in Development Study (Urban Design) Institute of Development Studies, University of Mysore Mysore, Karnataka, India
2MURP (MYSORE), Ph.D Student in Urban and Regional Planning Institute of Development Studies, University of Mysore Mysore, Karnataka, India
3MURP (HONG KONG) Professor of Urban and Regional Planning, Institute of Development Studies, University of Mysore Mysore, Karnataka, India
E-mail: [1]setarehoruji@yahoo.com, [2]amini.urbanplanner@gmail.com, [3]maheshprourp@rediffmail.com

Abstract—*By considering high grate rate of spreading historical cities in developing countries and its population which cause to increase demand for different types of transportation, there is no scape to planning strategies to decongest some of highly choked areas. Pedestrian traffic is found to be very heavy in the CBD areas of the heritage cities due to high commercial activities and tourist movement. Due to the mixing up of different types of vehicles, severe congestion has been found to be occurring frequently in the CBD area. In this paper author tried to identifying existing issues in traffic and transportation system in famous historical and most visited Mysore and Isfahan city that have located in India and Iran respectively which are developing countries. This procedures has to be done to in order to encourage growing travel demand to use public transportation and propose appropriate strategies to achieve integrated sustainable transportation system that prevent air and noise pollution, urban congestion and incident accidents and also provide secure and pleasant environment for people.*

1. INTRODUCTION

Transportation is an essential part of today's life. It has been an essential and an integral part of the functioning of any city. In the heritage urban areas in historical tourist town, the well – organized transportation provides the connecting linkage with heritage landmark zone to avail the working opportunities and the movement of people in most efficient manner possible. The main factors which influence the choice of different modes of transport are cost of services, speed of transport, regularity and flexibility of services, traffic volume, and management. The spatial expansion of both cities are radially which is started form the heritage cores which has surrounded CBD area. Central Business District (CBD) is focal point of a city. It is the commercial, office, retail, and cultural center of the city and usually is the center point for transportation networks. One of the most issues which is evident in CBD area is traffic congestion. Traffic congestion is a condition on road networks that occurs as use increases, and is characterized by slower speeds, longer trip times, and increased vehicular queuing. However, using a Triple Bottom Line framework (economic s, environmental protection, community and individual human well-being) to guide planning and implementation can provide steps toward developing a sustainable outcome. According to these issues providing pedestrian zones in this area which has adequate opportunity would provide appropriate benefits. It would cause to decongest these areas and decrease traffic volume and provide transcendent privacy protection of historical land marks. Today, pedestrian zones have been achieved to increase rapidly disappearing open space and to provide comfortable and safe circulation for pedestrians..

2. OBJECTIVES

1. Analysis the growth of population and vehicles between Mysore and Isfahan.
2. To study the existing roads hierarchy linkages in the both cities.
3. To identify the existing traffic problems in the CBD area in both cities.
4. To propose strategies to achieve integrated sustainable traffic and transportation system in CBD area in both cities.

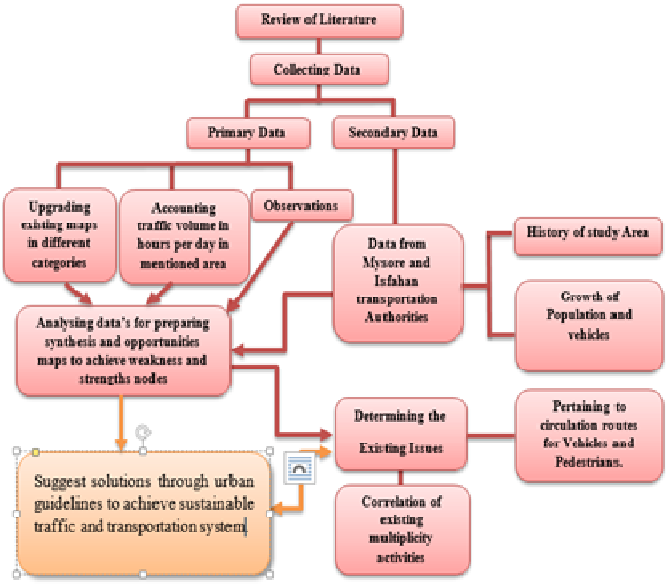
3. LOCATION OF STUDY AREAS

Mysore, a majestic and mysterious city is cultural capital and second most important city of Karnataka state of India. Mysore has a number of historical and heritage buildings. It is an Indian city of palaces. Referred to as the cultural capital of Karnataka, Mysore is well known for the festivities that take place during the period of Dasara, the state festival of Karnataka. Mysore city is geographically located at 770 m above sea level between 12° 18" 26 North Latitude and 76° 38' 59" East Longitude. Isfahan is located in 32°38' 30" N latitude and 51°38' 40" E longitude (Fig. 2). The minimum height is 1550 meters around Zayandeh Rood and maximum is 2232 meters in Sofeh Mountains. Isfahan is the capital city of Isfahan province and the third biggest city in population in Iran and one of Iran metropolises. In recent decades, it has been the centre of attention and population because of economic, industrial, tourism and cultural development. This city is famous as half of the world because of multiplicity heritage monuments in city (Fig. 1).

Fig. 1: Mysore city location

Fig. 2: Isfahan city location

4. MYTHOLOGY



5. SPATIAL EXPANSION AND GROWTH OF POPULATION IN MYSORE AND ISFAHAN CITY

It is observed that the rate at which a particular area grows is not uniform both in time and space. There are several factor, which govern the growth rate and also responsible for the growth to be continue in a particular direction. The traffic nodes are assumed to be one of the most important factors. Hence transportation in general is the most important factors in governing the type and rate of growth of the urban areas. At 2001 Mysore city has 106.27 Km2 areas under Municipal Corporation and 128.42 Km2 of area Urban Agglomeration .Mysore city's urban area has marginally increased from 1901 to 2011 due to natural increase of population as well as migration towards the city.

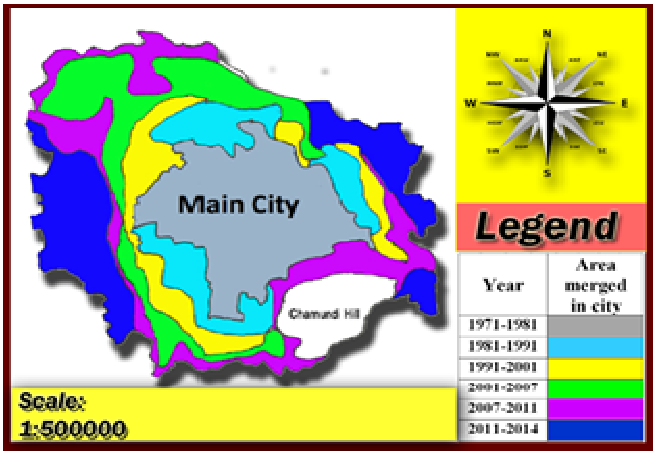


Fig. 3: Spatial Expansion of Mysore city

Table 2: Area and population of Isfahan in different years

Year	Density	Populatin	Area(hectars)
1956	129.08	254708	1973
1967	116.6	424045	3637
1975	89.04	661510	7429
1990	81.3	127030	13856
2014	77.3	1994521	25802

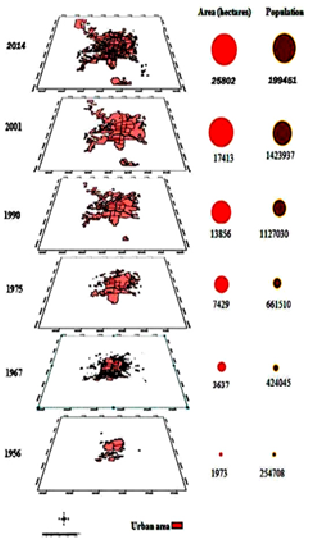


Fig. 4: Change trend of Isfahan population and urban area during 1956-2014

As it can be seen in Fig. 4, physical area of Isfahan is 25802 hectares in 2014 which have expanded about 9 times than1956. Also, studying population growth rate showed that population is 7.8 times bigger in the last 5 decades.Immigration from suburban areas and countries to cities, regional industrialization and rural areas which get thick to the city. As it is observed in fig no . Isfahan had horizontal growth during 1956- 1990 and since 1991 it has vertical growth. Therefore horizontal expansion and destruction of suburb lands have been less. The highest population density in the city of Isfahan has occurred over the period of 1956–1975, whereas during the years of 1975 to 2001, the lowest density is observed.

6. GROWTH OF POPULATION IN MYSORE CITY

Study Growth of population have been estimated based on the census data from 1971-2011 for the Mysore city. The following table gives the growth of population during five recently decades.

Table 3: Growth of Population of Mysore city (1971-2011)

Growth of population in Mysore city (1971-2011)			
Census year	**Population**	**Area of the city (sq.km)**	**Decadal Growth rate (%)**
1971	359,449	40.0	
1981	479,081	68.8	33.28%
1991	653,345	91.7	36.37%
2001	799,228	128.4	22.33%
2011	887,446	128.4	11.03%

7. TRAFFIC AND TRANSPORTATION SCENARIO IN MYSORE AND ISFAHAN CITY

Mysore City road network system is a mixture of fast and slower traffic system such as animal drawn vehicles. Motor traffic consists of mainly cars, light vans, light commercial vehicles, jeeps, different kinds of mopeds, scooters and motor cycles, different kinds of commercial vehicles, buses, auto rickshaws etc. In addition to these, there are a considerable percentage of cycles plying on the city roads. Pedestrian traffic is found to be very heavy in the CBD areas of the city due to high commercial activities and tourist movement. Due to the mixing up of different types of vehicles, the journey speed is considerably reduced and the capacity of the roads is adversely affected and severe congestion has been found to be occurring frequently in the CBD area.

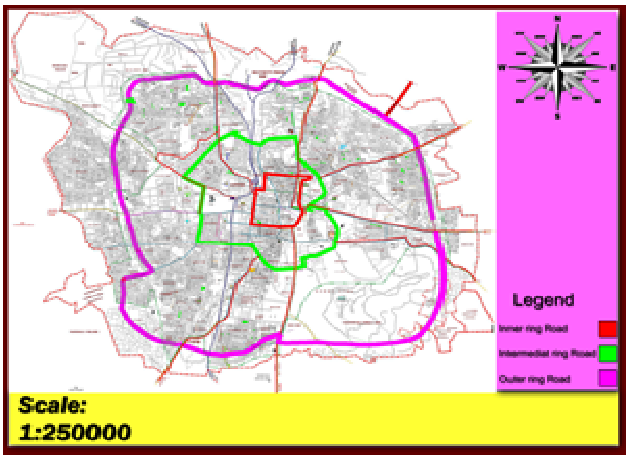


Fig. 6: Mysore Ring Road 2011

Mysore City road network comprised of three ring roads - Intermediate Ring Road, Inner Ring Road and Outer Ring Road. In addition to these ring roads, there are number of Arterial Roads, Sub-Arterial Roads, Collector Roads and other Roads. The ring roads not only collect traffic from other roads but also act as by-pass reducing congestion especially at the core of the city.

Table 4: Classification of roads in length

6	Length of Roads(km)		% OF TOTAL	
	2001	2011		
Collector street	43.252	61.876	15.49%	17.03%
Arterial roads	37.105	45.166	13.29%	12.43%
Sub arterial road	32.021	41.397	11.47%	11.39%
Radial road	12.053	19.659	4.31%	5.41%
100ft street	27.032	35.953	9.68%	9.89%
80ft street	11.051	23.026	3.95%	6.33%

50ft street	28.064	34.247	10.26%	9.42%
40ft street	39.045	44.596	13.98%	12.27%
Major roads	49.500	57.282	17.73%	15.77%
Total	279.123	363.203	100.00%	100.00%

Table 5: Growth of population in Mysore city (1971-2011)

Growth of population in Mysore city (1971-2011)			
Census year	**Population**	**Area of the city (sq.km)**	**Decadal Growth rate (%)**
1971	359,449	40.0	
1981	479,081	68.8	33.28%
1991	653,345	91.7	36.37%
2001	799,228	128.4	22.33%
2011	887,446	128.4	11.03%

The road network to the south is more of a grid. The total road space as a percentage of land area is high at 21% (refer Table 1 below). The total length of major roads is 764 km.

Table 6: Length of Road Network in Isfahan

Type of Road	Length
Ramps at grade-separated junctions	27km
Highway	32km
Major arterial	202km
Sub-arterial	73km
Collector	240km
Access road	190km
TOTAL	764km

There are three ring roads, but only one mainly works as a ring road. The First Ring Road (1RR) by length of 12.3 km in the city centre. The Second Ring Road (2RR) predesigned to serve as major arterial dispensation traffic between city areas. It is 24.9 km at the heritage area of the city. Construction of the Third Ring Road is a 38.7 km long dual three-lane road includes an area of 78.3 sq. km. In Isfahan regarding growth and spread of urbanization, urban migration, the urban problems are more complex than ever and urban land use planning has been faced with serious challenges. Some of the existing problems in traffic and transportation of heritage areas in Isfahan city are

- The historical areas are mostly having narrow roads with many dead-end streets.
- The vehicles are parked opposite the entrance of heritage monument that has historic value and disturbing the easy movement of pedestrian.
- Poor level of service affecting safety, efficiency and economy of traffic operation.
- Traffic congestion in heritage areas especially in CBD
- Irregular movement of pedestrian in Main Street toward the historic area and taxis that carry to inner city do not have any organization in main road.

8. SOME OF THE MAJOR LANDMARK IN CBD:

After selecting Isfahan as the seat of Shah Abbas safavi2, a new core was designed between the old bazaar and the square. Creation of Nagsh-e-Jahan square played an important role in Isfahan's town planning .The important point is the best design for connecting of this new square with the old structure of the city core.

Fig. 8 & 9: Imam Square in Isfahan.

Fig. 10: Zayandeh Rood River in Isfahan

The purpose of design was linking it with the main chain of the grand bazaar, which extends from the Old Square and providing central gathering space in heritage zone. Shah Abbas redeveloped the city extensively and had a number of

new bazaars built: the buildings surrounding the Naghsh-e-Jahan square to the south east and the large bazaar to the north, where the old core was located (Walcher, 1997). The River Zayandeh lies from east-west through the southern part of the city. This road includes historical and amazing bridges which have crossed it.

9. TRANSPORTATION CHARACTERISTICS IN MYSORE AND ISFAHAN CITY

The Mysore city has connection facility to other cities such as rail, roads and airport also. Transportation system in Mysore city is depending on road network system. To have sustainable integrated transportation system in Mysore city it is required to prepare comprehensive circulation pattern for traffic and transportation system plan.

Growth of vehicles over the period 1991-2011

Table 7: Growth of vehicles over the period 1991-2011 (in thousands) in Mysore city

Vehicles (in thousands)	1991	2001	2011
4 wheeler	11.3	26.1	42.0
2 wheelers	128.3	227.5	326.8
Truck	3.7	5.1	6.8
Bus/Minibus	1.0	4.8	5.2
Auto	-	12.2	16.2
Others	-	6.9	9.2
Total	144.3	282.6	406.2

Different types of vehicles have a rapid growth around 25 times during these periods. For carrying these much of vehicles, the appropriate field has to prepare.

Table 8: Isfahan Motor Vehicle Fleet (2004)

Type of vehicles	No.of Reistrations	percentage
car	267,000	50.5%
Taxi(official&private)	15,000	2.8%
Motorcycle	180,000	34.1%
Minibus	700	0.1%
Bus	1,100	0.2%
Small Truck	57,000	10/8%
Large Truck	7,250	1.5%
Total	528,050	100.0%

The total number of vehicles in Isfahan in 2011 was 528,050. Of this total, 267,000 were 4 wheeler and 180,000 were 2 wheeler. There has been a rapid growth in private car and motorcycle ownership due to the lack of road-based public transport.

10. PARKING CHARACTERISTICS IN MYSORE CITY

Existing of parking space in urban area is one of the most urban criteria. Since by increasing the number of on-street parking, demand for parking space has increased sharply. Some of the areas like sayaji Rao Road, Devraj Urs Road, Ramvilas Road and Dhanvantri Road attract huge volume of vehicles especially during peak hours.The parking lots in the city (both defined/undefined) have not been able to cater to the increased demand**.** The Old Mysore Area, comprising of commercial areas such as Deveraj Urs Road, Ramvilas Road Dhanvantri Road carries a heavy traffic of pedestrians which are using their private vehicles. Non-existence of off street parking on this area result to on- street parking especially through CBD.

11. PEDESTRIANS IN ISFAHAN

Around 400 years ago the main north-South Street, the Chahar Bagh has been constructed, which has created pleasant pedestrian zone with historical symbol in heritage area. The cross-section of Chahar Bagh and other streets together with low building heights (2-3 stories) contribute to the human-scale of many city streets. Non-existence of sidewalks, continuous pedestrian network add to a pedestrian unfriendly environment. These cause to force pedestrians flow in major roads and cross in an unsafe and unsecure space which causing chaos and confliction.

Fig. 11 & 12: Char Bagh road in Isfahan in past and current

Pedestrian in Mysore city

Mysore city is witnessing considerable pedestrian traffic especially in the CBD and palace areas. With the increase in the commercial activity in some of the important areas like Devraj Urs Road, Ramvilas Road etc., there is an increased demand for better pedestrian facilities. The footpaths in many locations, especially in the commercial areas are occupied or encroached upon by vendors and hawkers resulting in spilling over of the pedestrians on to the road. The volume of pedestrian traffic is highest between10 AM and 11 AM in the morning and between 6 PM and 7 PM in the evening. Footpath facilities have been provided by MCC. However, the footpaths in many locations, especially in the commercial areas are occupied or encroached upon by vendors and hawkers on the roads. At many places the footpaths are narrow. Most of the footpaths do not have proper surface which forces pedestrians to walk on roads. Zebra crossings have generally not been provided on busy roads.

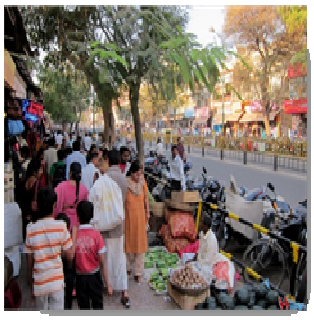



Fig. 13 & 14: Sayyaji Rao Road

12. IDENTIFYING ISSUES

Road network issues in Isfahan

- Poor road user behaviour and lack of appropriate traffic management system, design.
- Need to update guidelines and standards for roads and traffic.
- Lack of pedestrians and bicycles segregated lanes although Isfahan holds the potential to be pedestrian friendly.
- Lack of comprehensive approach to parking.

Road Network Issues in Mysore city

- Currently there is high rise in number of population and alternatively private vehicles. This situation leads to traffic congestion; thereupon strategies to decrease traffic volume and congestion have to been planned.
- There is undesirable ROW network in Major Street such as Sayajirao Road, Ashokar Road, Dhanvantri Roa Road, Kalidasa road, KRS road, NazarA Road, Bohgadi Road.
- According to high volume of commercial activities in CBD, confliction of vehicle and pedestrian movement is evident.
- Lack of footpath facility such as lighting and arboriculture.
- Existing of animals in urban streets which cause to confusion in urban movement system and traffic congested.
- Encroachment of on-street parking and pedestrians decreased carriage way lane in roads.

Pedestrian issues in Mysore and Isfahan city

1. The majority of pedestrian footpath in CBD or most populated commercial area is encroached by vendors and hawkers, so lead to flow pedestrian on the road that creates unsafe space.
2. Lack of appropriate width for footpath along many of roads.
3. In majority of intersections the non-existence of adequate zebra crossing for pedestrian is evident and signal for stopping vehicles are not provided in Mysore city.
4. Non-existence of appropriate trees beside footpath to providing essential shadow for pedestrian in Mysore city.
5. Due to inadequate lighting along footpaths, security of footpaths is low at night.
6. Non-existence of drainage facilities through pedestrians in rainy season in Mysore city.
7. Non-existence of special shelter for supporting pedestrians through rainy seasons.

Public transport issues in Mysore and Isfahan city

1. Majority part of the city has limited ROW to allow bus transition in CBD in Isfahan and in all part of Mysore approximately.
2. All the bus terminals including city bus stand-suburban bus stand and private bus terminal have located in city center. It cause to congestion and high mass of traffic volume especially in heritage zone.
3. The condition of buses is poor and most of them are amortized in Mysore city. This would create air and noise pollution in Mysore city. Currently condition of buses in Isfahan is fair.
4. Adequate shelters for buses are not observed in Mysore city.
5. Non-existence of BRT system and their facilities such as routs in Mysore city which it has provided in Isfahan city.
6. Non-existence of special bus lines in Mysore city creates congestion and confliction within urban area.

13. PROPOSAL AND CONCLUSION

Principal Strategies

The following strategies have to propose to solve existing issues to achieve sustainable urban traffic and transportation system and pleasant & secure city for dwell.

1. Land use and Transport Strategy
2. Improvement of accessibility and mobility for all the residents through corridors in as safe and environment friendly modes of transport.
3. Improve public transit service and encourage road users to use public transportation
4. Promote Non - motorized transport
5. Travel Demand Management Strategy
6. Improve roads infrastructure
7. Pedestranization of connecting road to heritage land mark in CBD.
8. Considering F.A.R for city development to prevent mismatching between height of building and width of roads.
9. Removing hawkers and vendors form pedestrian footpath
10. Road lighting along the footpath to make it usable at night in a touristic area.

11. Put continuous cycle route along the footpath.
12. Removing on-street parking.
13. Locating off-street parking near to this road
14. Put continuous cycle lane along road.
15. Broaden the road to decrease traffic volume.
16. Posing green fence between footpath and on-street parking.

REFERENCES

[1] Dipti Srinivasana, Ruey Long Cheub, Young Peng Poha, Albert Kim Chwee Ngc, Development of an intelligent technique for trace network incident detection, 2000.
[2] Lei Jia, Licai Yang, Qingjie Kong, Shu Lin, Study of Artificial Immune Clustering Algorithm and Its Applications to Urban Traffic Control, 2006.
[3] Traffic management and public transport in Isfahan, 2005.
[4] Assari, a., Mahesh, T. M., Emtehani, M. R., & Assari, E. COMPARATIVE SUSTAINABILITY OF BAZAAR IN IRANIAN TRADITIONAL CITIES: CASE STUDIES IN ISFAHAN AND TABRIZ. International Journal on Technical and Physical Problems of Engineering (IJTPE), 3 (9), 18-24. (2011)
[5] Babaie, S. Isfahan and its Palaces: Statecraft, Shi'ism and the Architecture of Conviviality in Early Modern Iran. Edinburgh: Edinburgh University Press. (2008)
[6] Cantacuzino, S. Can Isfahan Survive? Architectural Review, 159 (951), 292-300. . (1976)
[7] CHARTER, W. CHARTER FOR THE CONSERVATION OF HISTORIC TOWNS AND URBAN AREAS. Washington, DC: Adopted by ICOMOS General Assembly. (October 1987)
[8] Cuthbert, A. R. Conservation and Capital Accumulation in Hong Kong. Third World Planning Review, 95-115. (1984)
[9] Foltz, R. c., & Ferederic, M. Islam and Ecology:a Bestowed Trust . Cambidge: Harward University Press. (2003)
[10] Hejazi, M. The Risks to Cultural Heritage in Western and Central Asia. Journal of Asian Architecture and Building Engineering, 239-245. (2008).