

# Alternative Strategies for Sustainable Urban Mobility in Central Business District of Sabzevar City, Iran

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**ABSTRACT-** Rapid urbanisation is a main feature of developing countries and this population needs to be spaced for mobility. In such circumstances, urban mobility is one of the main concerns among urban planners. But there's a reality which is of no symmetry between growth of population and vehicles and the growth of mobility infrastructure in numerous cities. Sabzevar city as the developing city and one of the largest cities in the territory in north-east of Iran, is one of those cities in which there is no mobility infrastructure especially in central business district. Instead, it has faced with a significant increase in vehicles. As a result there is vehicle and pedestrian traffic congestion in central business district. The paper discusses the problems of urban mobility and proposes strategies for improving mobility pattern in central business district of Sabzevar city.

**KEYWORDS:** Urban Mobility, Developing Cities, Urban Infrastructure, Traffic Congestion

## INTRODUCTION

Mobility and Accessibility are the two main components of the Transportation system. The urban mobility may be defined as the ability of individuals to travel in order to overcome the spatial distribution of activities within the urban area under optimal circumstances of time duration and price. The aspects of awareness of the urban mobility are various. They are related on one hand, to the transportation system in terms of infrastructure, modes of transport, travel behaviour, travel time, etc., and on the other hand, to the human activities of different types, locations, accessibility, and so on. The need for more sustainable and integrative planning processes as a way of dealing with the complexity of urban mobility has been widely recognised. New approaches to urban mobility planning are emerging as local authorities seek to break out of past silo approaches and develop strategies that can stimulate a shift towards cleaner and more sustainable transport modes.

The mobility experience is accountable for reshaping not only to show people move physically from one place to another in a given environment, but also, in doing so, the manners in which the environment including nature perspective and other societies are built, used and appreciated aesthetically.

## CHARACTERISTICS OF URBAN MOBILITY

In the last century with the arrival of vehicles to urban spaces and then increasing trips, both physical and social structure has changed. The car has significant role in this revolution. Streets are significant public open spaces and most available component in cities which they are occupied by vehicles. Even streets in residential areas are dominated by vehicles which are the cause of the cohesion in the neighbourhood making it unsafe and unhealthy.

Historically, mobility has been viewed largely as a product, which includes the vehicles, physical infrastructure and fuels required to move people around. Increasingly, however, mobility is approached as a service: the method by which we procure food, engage in economic activity, access entertainment or meet with friends and family, all through seamless movements from place to place. Already, the ways in which we fulfil these tasks are changing radically as we use mobile phones, web and video to manage our lives on the go.

Significant supplement in the number of vehicles in Sabzevar city and existence of narrow streets especially in Central part of city are causes of concern for mobility. According to statistics on 2013, there are 52000 four wheelers, 10000 heavy vehicles and around 92000 motorcycles in Sabzevar city. While streets in central business district of Sabzevar city have designed for 50 years ago in which there were wooden cart and stagecoach and a few vehicles. In fact today there is no appropriate urban mobility infrastructure in Sabzevar city.

#### • BACKGROUND OF SABZEVAR CITY

Sabzevar is a city in Northeast Iran, situated in Razavi Khorasan province with geographical coordinates of 36° 12' 52" North and 57° 40' 47" East. Sabzevar city area has an extent of about 2676 sq.km and it is located approximately 220 kms at west of Mashhad, the provincial capital and also 670 kms at east of Tehran, capital of the country. The history of Sabzevar goes back to the 1st millennium BC. Ancient remains include fire-temple 'Azarbarzin' which is still visible. Until the early decades of this century the social structures and physical morphology of Sabzevar and its neighbouring cities was similar in many respects to those of other Islamic cities in the Middle East, although their evolution under a predominantly Persian culture has given them a distinctive character of their own. By considering to Antiquity and historical background of Sabzevar city, this city, particularly in central parts of city has a Traditional tissue. With respect to increase population and thus increase vehicles and travels there is Inadequate street capacity problem. During the 2011 census, its population was 232,000.

#### • TRAFFIC DIMENSIONS IN CBD

As a majority of CBD has moving traffic due to the existence of old market and main commercial units, cultural and religious places, many branches of banks, institutions, schools and government departments, it needs to be in control. Most of the travels in the morning are linked to schools, administrative affairs and those people who came from towns or rural area to provide their requirements and in the evening and after working hours, most of travels are related to shopping and religious affairs.

Unfortunately, people tend to use private vehicles even for short distance which can be replaced by walking. Walking eases vehicle traffic congestion and bridges urban mobility in a healthier pace throughout the peak hours of morning and evening.

Table 1: No. of Vehicles Registered in Sabzevar city: 2011-2013

	<i>Four wheeler</i>	<i>Heavy vehicle</i>	<i>motorcycle</i>
<b>2011</b>	30000	6000	75000
<b>2012</b>	40000	7000	80000
<b>2013</b>	52000	10000	92000

Source: City Traffic Police

#### • CENTRAL BUSINESS DISTRICT OF SABZEVAR CITY

The Central Business District (CBD) has an extent of 781000 sq.mts. The residential land use accounts for 46.69% followed by 23% for traffic network and 15.21% for commercial purpose. The rest of the area is accounted for green spaces and open spaces for sports, cultural and recreational areas. The land use pattern of the CBD during 2010 is depicted in below.

Figure 1: Land Use of Central Business District



Table 2: Land Use of Central Business District -2010

Land Use		Area in Sq mts	Percentage
Residential		364649	46.69
Commercial, service, private office		118790	15.21
Public Industrial c	Educational	94501	12.1
	Healthcare		
	Military		
	Sports		
	Administrative		
	Hospitality and Tourism		
	Cultural		
	Historical cultural		
	Religious cultural		
	Warehousing and transportation		
	Urban equipment and facilities		
	Bare land		
Green space		14839	1.9
Industry		8591	1.1
Roads and Networks		179630	23
Total		781000	100

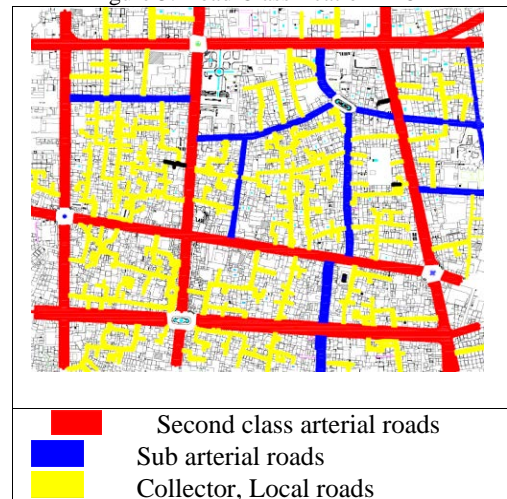
Source: Municipality Report of Subzevar City, 2010

Roads should be designed to cater for a defined function. This typically reflects the distance of travel, level of traffic flow and desired speed of travel. Road networks in Sabzevar will reflect the development of a hierarchy of roads, with motorways at the highest level and local access roads at the lowest. Grouping roads with similar functions can improve transportation planning, road infrastructure design, maintenance, traffic and road operations.

The region has chaotic structure, narrow alleys and plenty of deadlocks with high density of residential land use portion. Main streets which have been constructed from 1921 have no sufficient infrastructure. Data on accidents were collected from department of road and accident. The increase of road accidents is in link with the rapid growth

in population, economic in development, industrialization and motorization encountered by the country in 2011, reaching more than 4372 Accidents. Plenty of land use exist in this region which not only the width of existing streets couldn't be responsible but also lack of identified parking space, on street parking plays an important role to reduce roadway width.

Figure 3: Road Classification in CBD



Sabzevar is growing towards North. The radial pattern road network has 5 arterial roads, connected by two ring roads (in the south and at the Ring road which is under construction towards the east of city). Second class arterial roads connecting the Subsidiary Roads and collector roads of the neighborhoods are commonly known as main and cross roads running north to south and east to west. The CBD area of Sabzevar city is a complex and diverse zone and is bounded by second class arterial roads. Inner core of the CBD is a network of narrow and discontinuous internal roads. Its main roads are intersected by a number of internal streets and alleys of widths varying in unorganized fashion.

#### • ROAD WAY ANALYSIS

The central streets of the city of Sabzevar are very busy during the peak hours that's when the lack of dedicated public parking in this part of city show signs of traffic delays by two wheeler street edge parking as the narrow alleys and minor roads take in major portion of the vehicles in the context of the banks, financial and credit institutions also opposite to the Mosque which brings has vehicles stationed for longer parking requirements due to being of various ceremonies, some shopping centers and offices.

As much as 40% of inner-city traffic consists of vehicles looking for somewhere to park. Dynamic guidance systems to optimize the search for parking spaces and to relieve the pressure on city streets are to be deployed as part of a higher-level traffic management system. Old part of the CBD street systems have minimal road width as they were previously laid as early as 50 years up the system, when the vehicular accesses were lesser and considerations were given to carriages and cart-ways. And now the highest chunk of congestions happen in this system.

Sabzevar is looking into reducing parking issues that cause street congestion and wasted time for drivers searching for parking spaces. Off-street parking is not a solution: it is costly to build and takes space that could be used for other, more interesting uses. Off recent, the one way system management at the core and segregation of public vehicles like the buses and taxis through the card system has created temporary solutions. The implementation of sustainable mobility concepts and transport policies is one of the key challenges for urban areas and basis for the future development.

For a long time satisfying the parking demand has been the major strategy for dealing with that part of inner city mobility. Until the 1980s planning policies considered the principle of "each car user expects three parking places: at home, at the working place and on any other trip necessary" as its maxim. Parking was only a matter for the building code, meaning: providing more parking spaces in the commercial spaces in the city core.

At Sabzevar, most of banks and financial branches are located in streets No. 1 i.e Beyhagh Street and street no 4 which is Asrar Street. Most important religious places (Great Mosque, Pantheon and etc.) heritage zones and oldest

markets are located in Beyhagh Street. Municipality, education department and main city police station are located in Asrar Street. Hospitals, most of Clinics, Training centres and Treatment centres are located in streets Kashefi Street which is street no 2 and Asadaabadi Street which is street no 5. The road carriage ways are mentioned below for reference in Table no 3.

Table3: Carriage roadway width in CBD

Street	St No.1	St No.2	St No.3	St No.4	St No.5
Carriage roadway width (meter)	13.7	12.4	13.7	13	14.5

According to above statistics, it is clear that there is mismatch between the width of the streets, the core magnets or the attractive places of trip and people who have trips to this area.

- *Vehicle Parking Scenario:*

In the core of Sabzevar city, on-street parking is very predominant and vehicles are parked in state of perpendicular or parallel relating to low width of carriage way and limited space. Existing on-street parking has occupied significant part of roads which results in effective width of carriageway being reduced. The volume has increased in the major roads and this conventional on-street parking system method is typically unsafe, unattractive and is inefficient.

The on-street parking is causing greater problem for road users due to reduction of effective width of carriageway viz. Reduced width of carriage way, uneasy manoeuvres and reduction in speed of vehicles.

There are two official off-street parking areas, one at the northern side and it is situated very close to the municipality. The other site parking area is situated at south-eastern part of the Grand Mosque. Apart from two official off-street parking, there are 6 institutions which provide the parking facilities in their premises though there are about 90 governmental departments, banks, institutions which are located in the central area of city, and only four of them have parking facilities for their employees.

According to the above mentioned parking weakness and Average Occupancy rate in one hour through all the roads of CBD, below table shows major troubled roads in terms of on-street parking in order of preference. The availability of parking is critical for CBD accessibility and thus an important determinant of modal choice in Sabzevar. Control over available spaces, the length of availability and the costs of parking can thus prove effective in restricting private motor vehicle use if incorporated in the overall city-wide transport strategy. A planned parking system offers a whole range of advantages in urban traffic which includes:

- Better operation and profitability of the taxi and private car parks,
- Reduced traffic volume and environmental pollution and
- A more attractive city and higher quality of life

Table 4. Reduced Functional Capacity of Roads from On-street Parking

Name of the street	Occupancy Average	Roadway width (m) (carriage way + parking)	Reduced functional Capacity due to on-street parking (%)
West side of road No.4	1.96	9 (6.5+2.5)	27.77
South side of road No.1	1.86	9.5 (7+2.5)	26.31
South side of road No.6	1.76	7.28 (4.78+2.5)	34.34

East side of road No.2	1.41	8.6 (6.1+2.5)	29.06
North side of road No.3	1.32	6.5 (4+2.5)	38.46
North side of road No.5	1.23	12.6 (10.1+2.5)	19.84
2 sides of road No.10	1.13	13.6 (8.6+5)	36.76

Source: Sabzevar Municipality Report, 2013

#### • TRAFFIC VOLUME CONDITION

Except heavy vehicles like bus, trucks, trailer and etc (Excluding public urban bus), all kinds of vehicles are allowed to commute in CBD. There are more number of vehicles and pedestrian traffic due to existing prominent tourist spots, and presence of heritage and religious structures. People do not prefer living in the central core due to its urban imageability being sober and less interesting due to exhaustion and obsolescence of the city's older texture.

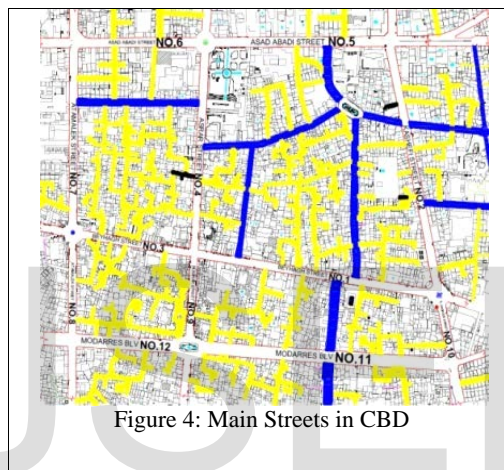


Figure 4: Main Streets in CBD

Appropriate infrastructure and facilities are required for the willingness to live in that area. So with the status quo residential population of units has reduced and families prefer living in surrounding neighborhoods. Conversely, the number of enterprises and businessmen has increased. So there is sharp increase of population in commercial points at the day and relatively quiet at nights. This region has a special substance in the evenings due to existence of commercial centers.

- *Public Transportation:*
- **Bus:** There are eleven city bus lanes that are active in city, of which eight bus lanes are accessible in the CBD area. Kashefi Streets (No.2 & 10) are busiest streets and 22 Bahman Square that connects Beyhagh and Kashefi streets (the most important commercial, remedial, cultural and etc. units are located in these two streets) are the busiest point.

According to observation and information relative to urban bus lanes, peak hours are as follows:

- Peak hours in morning: 9 to 10, 12.2 percentages of passengers,
- Peak hours in noon: 11 to 12, 15.1 percentages of passengers,
- Peak hours in evening: 17 to 18, 14.2 percentages of passengers.

Five of the most important bus stops are located in CBD area, the bus stop located at the west of north side of hakim square, has appropriate space for parking. But others have constructed in the passages without sufficient space which causes vehicle congestions. In CBD area major bus stop and main destination bus stop has been noticed to turn into a gathering space which also acts as a transitory space for urban bus lanes.

As mentioned, according to surveys conducted, passenger waiting time for public bus system increases to 20 minutes due to vehicle traffic congestion and insufficient number of public buses in different lanes.



- **Taxi:** There are three kinds of taxis:
  - Organized taxi (yellow color),
  - Unorganized taxi (yellow color),
  - Taxi equipped with wireless communication 133 (green color).

All kinds of above taxis are allowed to commute in CBD. In addition to what was said, there are informal transport vehicles, there are private cars operating as a taxi services which are not registered and illegal. Taxis provide better public service to citizens, reduce traffic congestions. According to existence of taxi stop boards, the taxi drivers pick up or drop off passengers along main roads.

- **MODES OF MOTORIZED AND NON-MOTORIZED TRANSPORT**

Car dependency is also served by a cultural and commercial system, which promotes the car as a symbol of status and personal freedom. Therefore, many developing countries perceive motorisation as a condition for development. The private car has become a status symbol, depicting affluence and success in life. A number of influential converging factors, such as economic policies that maintain fuel subsidies and planning practices that incentivise suburban residential developments, large malls and retail centres with extensive parking—all play a role in increasing motorisation (UN-Habitat). For very short trips, walking is the main mode of transport in most societies, rich or poor. Indeed, most trips in all countries involve some walking as access and egress to the main mode. The modal share of walking can be very high.

Non-motorized transportation is often the dominant mode of urban mobility when public transport services are poor and incomes are low. The two major modes of Non-Motorized Transport, also called “Active Transport” are walking and various forms of cycling, which can be personal or public transport. Clearly, walking dominates for shorter trips, but even in terms of distances travelled, walking accounts for over 50 percent of all trips.

While encouraging a shift to non-motorized transport modes, such modes are best suited for local travel and that motorized transport (in particular public transport) has an important role while travelling longer distances. Due to existence of smart land use, The CBD at Sabzevar attracts different type of people for different purpose from distant places.

- **VEHICULAR MOVEMENT PATTERN IN CBD:**

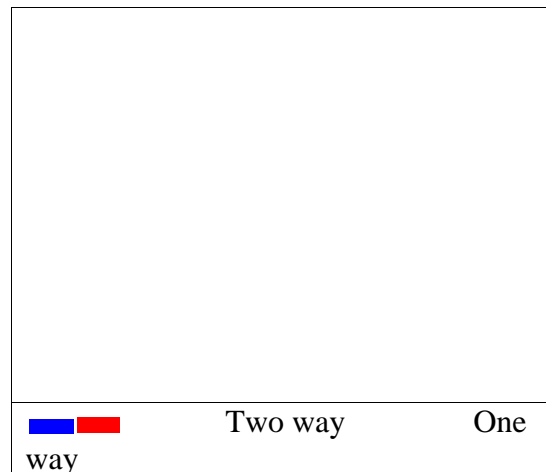
By considering the narrow street widths and existence of traffic congestion in major roads of CBD, the movement of vehicles faced many problems. Beyhagh Street No.1 was accounted for 16931 Passenger Car Unit(PCU) followed by Asadaabadi Street-5 with 14217 PCU, Kashefi Street-2 for around 13295 PCU and Asraar Street-4 for 11216 PCU in 2005. These roads were catering for two-way traffics when the survey was made.

Figure 4: No. of vehicle on Major Roads of CBD, 2014

**Source:** Primary Survey in 2014

While most of the innovations introduced in urban transport will come from local and regional actors, higher levels of government also have a crucial role to play. The city government then decided to adapt all busy roads to one-way since 2009 to reduce vehicular traffic congestions in CBD. The one-way cycle lane includes the Beyhagh Street (St.No.1), the Kashefi Street (St.No.2), Asadaabadi Street (St.No.5) and Asrar Street (St.No.4) as seen in Figure 5. For better service to the citizens, there has been special one lane carriage space for emergency public transportation.

Figure 5: Vehicle Movement Pattern in CBD Since 2009



- **PEDESTRIAN MOVEMENT PATTERN IN CBD:**

The CBD is enticed with grand and elegant shopping precincts owing to which there is more pedestrian volume when compared to the rest of the city. A pedestrian traffic volume count was undertaken by the researcher for Five of the major roads on both sides of sidewalks in CBD in 2014, as can be seen in the below figure. Taking consideration of the walking patterns, at different periods during a day (morning/afternoon) analysis of pedestrian volume traffic volume shows that pedestrian flow is neither uniform nor homogenous and is greatly affected due to the land-use patterns.

Figure 6: Pedestrian Traffic Volume on Major Roads of CBD, 2014

Source: Primary Survey Conducted by the Author in 2014

- **LEVEL OF SERVICES IN CBD:**

Level of Service, is a qualitative assessment categorizing traffic flow and assigning quality levels of traffic based on performance measure like speed, travel time, freedom of manoeuvre and road safety analyzed by the user virtually unaffected by the presence of others in the traffic stream. It is later rolled to evaluate and determine the density of the infrastructure.

The levels of service can be classified into six categories from A to F where level A represents the best conditions and level of service F represents worst traffic conditions.

Figure7: Study Area of the Levels of Service

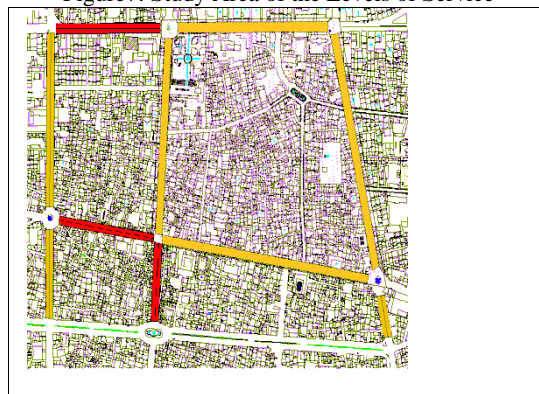
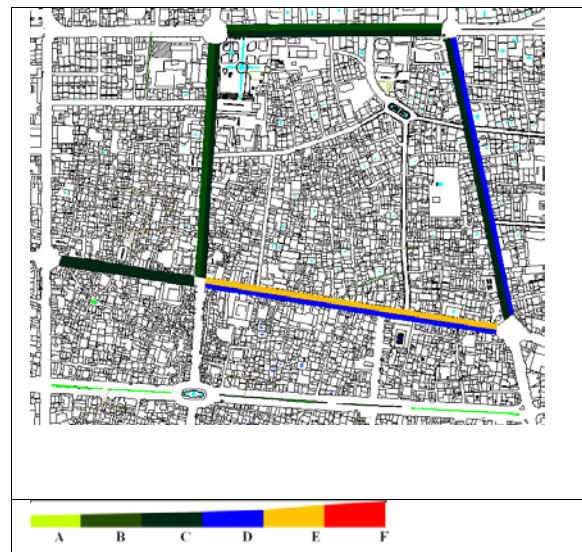


Figure8: Classified Level of Service





### • SUSTAINABLE URBAN MOBILITY

World Business Council for Sustainable Development defines sustainable mobility as “ the ability to meet society’s need to move freely, gain access, communicate, trade, and establish relationships without sacrificing other essential human or ecological values, today or in future”

Mobility is our capacity to travel, our potential for movement. Mobility alone is not enough, since without reaching a chosen destination, travel is (usually seen as) pointless. On the other hand, mobility is not always a necessary condition for accessibility. “Mobility is only the means; activities are the end, accessibility is the key” (Handy 1994).

Sustainable urban mobility planning involves the consideration of a three-step approach: reduce or avoid travel or the need to travel; shift to more environmentally friendly modes of transport; improve the energy efficiency of transport modes and vehicle technology.

Since the Brundtland Report of 1987, sustainable urban mobility has moved beyond environmental concerns to include social, economic and institutional considerations. Urban planning is no longer preoccupied with traffic flows and the movement of people and is instead searching for the enhancement of spatial proximity. “A holistic and integrated approach to urban land-use and transport planning and investment is needed if urban areas are to become socially, environmentally and economically sustainable” (UN-Habitat 2013).

Sustainable mobility is not only about reducing one’s own travel footprint but also to reduce the same of the society. Alternative fuels are a further part in the jigsaw puzzle of sustainable urban mobility; which goes beyond the concept of consuming lesser fuels but by improving energy security and lowering carbon emissions as well as a refuelling and recharging infrastructure Literature widely recognises that a mixture of policies is necessary in order to create a relevant impact in the field of sustainable mobility.

The broader concept of sustainable urban mobility should incorporate land use planning and several allocation of land for different activities thus reducing travel demand through reduced trip frequency and trip distance by bridging the amount of gap between the need of transport services and infrastructure between both the sides of the social ladder.

### • ISSUES

The various issues from economic, social and environment perspectives are generated by the movement of goods and people as seen in the Table

Table 5. Issues of Urban Mobility System

Economics	Social	Environmental
Traffic congestion	Mobility for vulnerable groups	Air pollution

Infrastructure costs Consumer costs	Human health impacts Community chosen and street life loss	Habitat loss Hydrologic impacts
Mobility barriers	Community livability	Depletion of non-renewable resources
Accident damages Time loss due to sprawl	Aesthetics	Noise Photo chemical smog, lead and benzene

Source: Litman and Burwell, 2006

The other issues which after analyzing the current situation could be brought under as:

- Inadequate street, junction and intersection`s capacity

CBD of Sabzevar city is the center of all main commercial, social, cultural activities. Most of administrations are located in this area which effectively increases the traffic congestion through most of the streets and most of intersections in CBD, which were planned like around 50 years ago. For the current size of city`s population and vehicles it is clear, intersections and streets capacities are inadequate. The central streets of the city of Sabzevar now a day are quite busy and traffic volume flow is low and there is a strong conflict among vehicles during peak hours.

Figure 9: Vehicle Traffic Congestion in CBD



- Lack of appropriate public transportation service.
- On street parking in all CBD streets, collector roads and even alleys which are unofficial and also cranks up most of the carriage way capacity thus bringing a huge shortage for vehicles to be parked during peak hours as seen in Figure 10 and Figure 11.

Figure10: On Street Parking in Main Streets, Collector Roads and Double on-Street Parking in CBD



**Figure11.** Unofficial Off street parking in CBD



- Construction in narrow streets and alleys in CBD regardless of the street capacity,

Figure12: Construction of a Commercial complex



- Lack of appropriate bus and taxi stands or layover spaces over the streets to pick up and drop off passengers. The Special one-way lane is blocked for this facility too, which in turn creates traffic congestions when users alight or get down the vehicle at their convenience

Figure13: Inappropriate Bus Stand



- Short of general traffic culture among the locals,
- Pedestrian and Vehicle conflict in the crossings
- Lack of intelligent traffic system
- Deficient Planning organization for public transportation,
- Lack of Institutional capacity for a strong city level action,
- Existence of varied land attractiveness which brings in the traffic volume,
- Ineffective sustainable urban transport systems

#### • STRATEGIES

Certain potential strategies are pivotal in strengthening the transit oriented development and urban form linkage by bringing in improved urban sustainability approach through:

- Multi-level car parking,

Multi-level car parking system is meant to maximize car parking capacity by utilizing vertical rather than horizontal space. Because street width in CBD is inappropriate and multi-level car parking itself is effective to increase vehicles traffic jamming, it is suggested to create multi-level car parking at busiest entries of CBD.

- Create recreational-Commercial area based on pedestrian and Transfer of offices to out of CBD,
- Improve and integrated public transportation system in CBD,

In form of improve public transportation and provide good facilities and suggestions which have listed, people will be encouraged to use public transportation. It is too important to reduce vehicle traffic congestion, delay in time and improve vehicle mobility in CBD.

- Shift to more environmentally friendly modes of transport,
- Reduce or avoid travel or the need to travel,
- Encouraging sustainable forms of mobility.

## • CONCLUSION

Cities need to be more consciously planned to address sustainable urban transport appropriately. A strategic plan for urban mobility is required to achieve better quality of life that builds on existing planning practices with due consideration to urban mobility. However, for the process to be successful there is a need for proper policy framework, adequate manpower with requisite planning skills and facilities, sufficient financial resources and a well-structured citizen participation framework; In addition, adequate time should be allocated for proper stakeholder engagement

According to most of the world's population growth in next thirty years will occur in cities and towns of developing countries, more attention on developing cities is required. Today, Sabzevar as a developing city in Iran doesn't have mobility infrastructure and is facing vehicle mobility problem in CBD. The cities planned with transport modes as an integrated system are more likely to evolve and prosper as centers of trade, commerce, industry, education, tourism and services

This paper highlights the existing mobility in central business district of Sabzevar city, mode of motorized and non-motorized transport, vehicle and pedestrian movement pattern in CBD, level of service (LOS) for roads and sidewalks in CBD and an automobile growth rate in city through perspectives and strategies for sustainable urban mobility were reviewed. For which the proposals to solve mobility problems in CBD of Sabzevar city using integrated package were suggested. The most obvious working model for the context would be the integrated transportation system and create recreational-commercial area based on pedestrian within CBD.

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