

Infrastructure Development Proposals for Smart Cities in India

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ABSTRACT: Today's cities demand 21st century solutions to accommodate their growing population in ways that not only maintain the quality of life, but also need in application of technological advancements in it. That is where smart cities come in. Smart cities find ways to become more efficient, to deliver more services via mobile technology, to optimize existing infrastructure, and to leverage citizen participation to create better land-use decisions and to break down bureaucracy in order to stimulate a creative, entrepreneurial economy. A smart city is an urban region that is highly advanced in terms of overall infrastructure, sustainable real estate, communications and market viability. It is a city where information technology is the principal infrastructure and the basis for providing essential services to residents. The concept of Smart city is influenced by the idea of developing the urban hubs which would be running on technology to provide better electricity, water supply, improved sanitation and recycling of waste materials to some extent, proper traffic and transport management systems. This paper outlines the important concepts and features to be incorporated as a part of infrastructure for proposal of smart city in any urban area.

KEYWORDS: smart city, concept, features, infrastructure, services.

I. INTRODUCTION

Smart City is defined as “An urban area that provides world class sustainable infrastructure including uninterrupted clean water and power supply, well planned roads, high speed internet, automated waste disposal, sustainable public transport, affordable housing, more green space and digitised public services as whole.” In short, a Smart City is one, which comprises of all these elements for happy, healthy and smart living.



Fig.1. Smart City

Different organizations have used different definitions for Smart Cities, some of these definitions are explained as under.

- The British Standards Institute (BSI) defines the term as “the effective integration of physical, digital and human systems in the built environment to deliver sustainable, prosperous and inclusive future for its citizens”.
- IBM defines a smart city as “one that makes optimal use of all the interconnected information available today to better understand and control its operations and optimize the use of limited resources”.
- Cisco defines smart cities as those who adopt “scalable solutions that take advantage of information and communications technology (ICT) to increase efficiencies, reduce costs, and enhance quality of life”.
- UK citizens tend to consider a smart city as clean, friendly and have good transport connections.

ORIGIN OF SMART CITY:

The concept of smart cities originated at the time when the entire world was facing one of the worst economic crises. In 2008, IBM began work on a 'smarter cities' concept as part of its campaign for future urban development based on I.C.T(Information & Communication Technology).

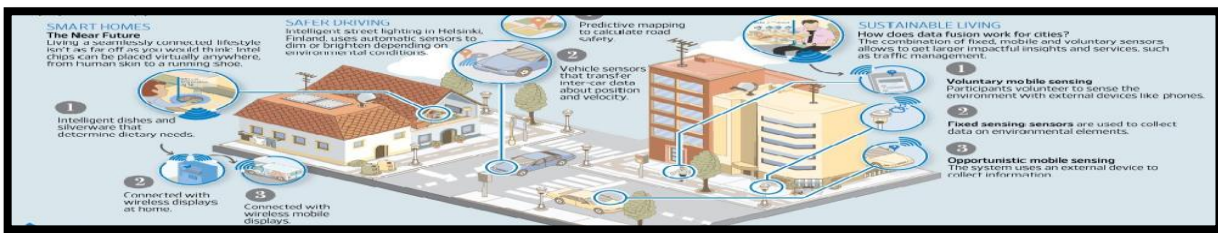


Fig.2. Components of Smart City

Abroad:Countries like U.S.A, South Korea, UAE and China began to invest heavily into their research and formation. Today, a number of excellent precedents exist that India can emulate, such as those in Vienna, Aarhus, Amsterdam, Cairo, Lyon, Málaga, Malta, the Songdo International Business District near Seoul, Verona etc.

India:Govt. of India has announced 100 cities to be developed as Smart Cities. The cities with ongoing or proposed smart cities include Kochi in Kerala, Ahmadabad and Surat in Gujarat, Pune and Solapur in Maharashtra, Manesar in Delhi NCR, Jaipur and Udaipur in Rajasthan, Vishakhapatnam in Andhra Pradesh, Chennai and Coimbatore in Tamil Nadu and Davangere in Karnataka. Many of these cities will include special investment regions or special economic zones with modified regulations and tax structures to make it attractive for foreign investment.

II. FEATURES OF SMART CITIES

The important features of smart city are:

- Environmental friendly(Use of Natural Resources)
- Transportation & ICT
- Governance
- Quality of Life (Smart Living)
- Social & Human capital
- Economy

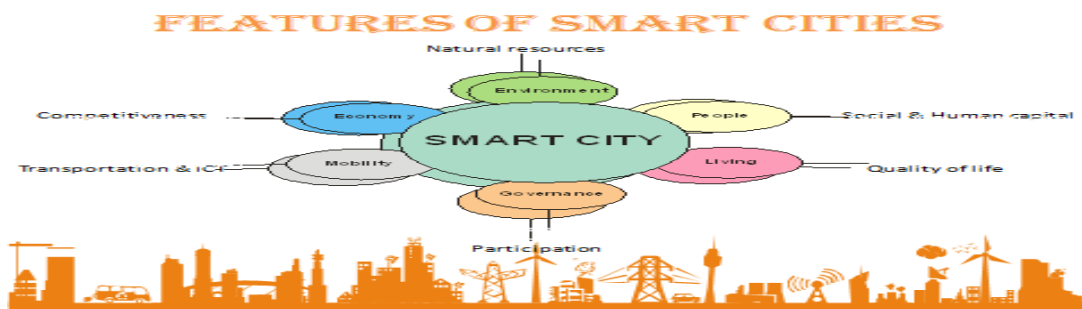


Fig.3. Features of Smart City

(a) ENVIROMENT(Natural Resources):

1. Intends to become independent fossils energy carriers on the long run.
2. Promoting mixed land use in area based developments-planning for ‘unplanned areas’ containing a range of compatible activities and land uses close to one another in order to make land use more efficient.

(b) MOBILITY(Transportationand ICT):

1. Systematically applies information and communication technology as well as technology conserving resources on its way to post-fissile society.
2. Connects new technologies for infrastructure, buildings, mobility etc. to uses resources such as energy or water as efficiently as possible.

(c) LIVING (Quality of Life):

1. Preserving and developing open spaces like parks, playgrounds and recreational spaces in order to enhance the quality of life of citizens, reduce the urban heat effects in areas and generally promote eco-balance.

(d) GOVERNANCE (Participation):

1. Making governance citizen-friendly and cost effective-increasingly rely on online services to bring about accountability and transparency, especially using mobiles to reduce cost of services and providing services without having to go to municipal offices.

(e) PEOPLE (Social And Human Capita):

1. Provides the appropriate personal and financial resources. The interaction and interconnection of these areas is the characteristic of a smart city with the aim of realising the potential for ecologic and social improvement.

III. PLANNING CONCEPTS FOR SMART CITIES

The most important concepts, which can be enumerated in the planning, designing and developing a smart city are:

- Smart Buildings (includes Green Buildings)
- Smart water (includes Rainwater Harvesting)
- Smart Mobility(includes Transportation)
- Smart Energy (includes Green energy)
- Smart public services(Drainage & waste management)
- Smart Governance (Use of Information & Communication Technology)

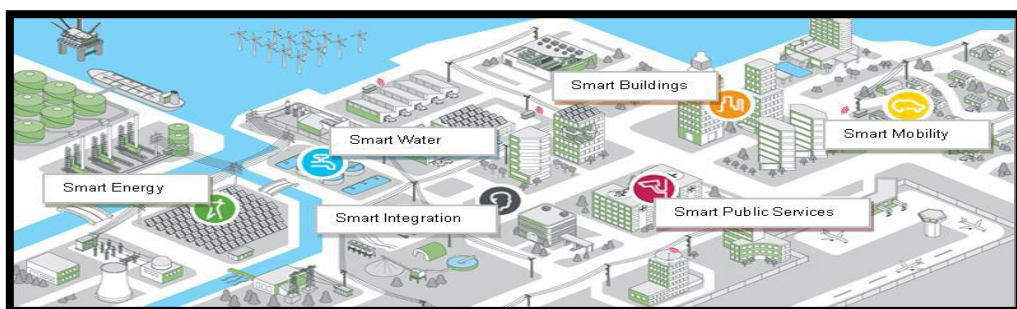


Fig.4. Concepts of Smart City

All the above concepts can be also broadly discussed as follows:

a) Traffic management system:

Traffic congestion is caused when the demand exceeds the available road capacity. Individual incidents such as accidents or sudden braking of a car in a smooth flow of heavy traffic have rippling effects and cause traffic jams.

- **Smart Camera:** Video analysis consists of a smart camera placed which consists of sensors, a processing unit and a communication unit . The traffic is continuously monitored using a smart camera.
- **Infrared sensors:** Infrared sensors are used to detect energy emitted from vehicles, road surfaces and other objects. The energy captured by these infrared sensors is focused onto an infrared sensitive material using an optical system which then converts the energy into the electric signals.
- **RFID controller:**The RFID controller consists of RFID interrogator. This interrogator is used for the communication with the RFID tag. The RFID controller then gets the signals/data received by the interrogator. Messaging interference is used to send commands and data messages from the controller components
- **RFID tag:**RFID tags are wireless devices which make use of radio frequency electromagnetic fields to transfer data, which is used for identifying and tracking of the objects. RFID tags are of two types

b) Sustainable public transport:

To achieve this goal we will need to utilize technology such as ITS (Intelligent Transportation Systems) and other transportation systems management tools, transportation demand management, strategic major street network improvements, rapid transit, and other innovative ways to move people, goods and services,

Rapid bus transit system:Unlike the existing safely with signalized pedestrian crossings, arrangement, all BRT systems provide special foot over-bridges or underpasses, arrangements for commuters to cross the road.

Light rail transit:Light rail or light rail transit (LRT) is urban public using rolling stock similar to a tramway, but operating at a higher capacity, and often on an exclusive right-of-way.

Sensing:To handle any road application, the first thing that we need is information from the road. Sensors on roads can provide such information.

1) Static sensing:

- Loops and magnetic sensors** - Vehicle detection and counting using magnetic sensors or loops under the road surface, has been explored in research and deployed systems
- Images and videos** - Video surveillance to monitor traffic states and detect incidents and hotspots is fairly common gives a comprehensive survey of the major computer vision techniques used in traffic applications.
- Acoustic sensors** - Some recent research is being done to use acoustic sensors for traffic state estimation, especially in developing regions, where traffic being chaotic is noisy
- RF sensors** - Wireless radios placed across the road have communication signals affected by vehicular movement in between. There are commercial products and research efforts using this for traffic monitoring.

2) Mobile sensing techniques:

- GPS on public transport** or fleet vehicles - Many public transport and fleet companies have GPS installed in their vehicles for real time tracking. Several research projects have tried to exploit these as a source of road information.
- GPS on smart phones** - With the recent proliferation of smart phones, Smartphone GPS is being studied for hotspot detection and travel time estimation, after handling noise in GPS readings

- (iii) **Sensors on smart phones** - Other than GPS, smart phones also have sensors that can provide interesting information. Uses the Smartphone microphone for urban noise mapping and uses the Smartphone camera to predict the traffic signal ahead for automatic speed control of vehicle.
- (iv) **Using ordinary phones** - Some researchers have tried using ordinary cell phones, instead of smart phones, for traffic sensing. Localizing ordinary phones based on only cellular tower and Wi-Fi information and adding sensors to ordinary phone hardware are two main research focus in this area.

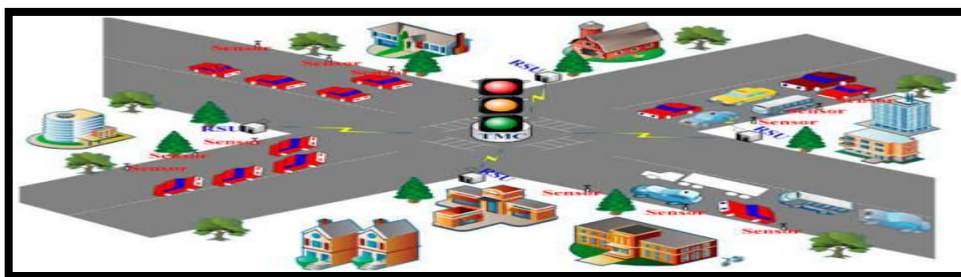


Fig.5. Sensors on smart phones

Adapting techniques for Indian roads GPS is known to have errors that affect localization of traffic information Still newer is research on trustworthiness of participatory data. In the context of participatory sensing for Indian ITS, similar work on data trustworthiness and noise reduction will be interesting.

3) Hybrid sensing techniques:

There are a set of techniques that use both static infrastructure and mobile sensors to gain traffic information.

- (i) **Teledensity** - Cell phone operators can give approximate vehicle densities in the neighborhood of a given cell tower, based on subscribers seen at that tower. There are commercial systems like and research efforts based on this.
- (ii) **Bluetooth** - is a system where roadside Bluetooth detectors sense Bluetooth radios in phones inside vehicles. Correlating the sensed Bluetooth addresses among different detectors, gives travel times of the vehicles between the detectors.

d) Smart Parking (Multi-level car parking system):A multi-level car parking is essentially a building with number of floors or layers for the cars to be parked. The different levels are accessed through interior or exterior ramps. An automated car parking has mechanized lifts which transport the car to the different levels. In an automated multi-level car parking, the cars are left at the entrance and are further transported inside the building by robot trolley



Fig.6. Multi-level Car parking

Moreover, the latter provides the added benefits of flexible operation without the need of an attendant and added security and least chances of vehicle damage The rotary model is specifically designed to accommodate multiple cars in the horizontal space of two.

- (f) **Waste Management:**Solid wastes comprise all the wastes arising from human and animal activities and are normally solid and are discarded as useless or unwanted. Solid waste management may be defined as the

discipline associated with the control of generation, storage, collection, transfer and transport, processing and disposal of wastes in a manner that is in accord with the best principles of public health, economics, engineering and conservation.



Fig.7.Solid waste management

- (i) **Hazardous waste:**Wastes pose a wide range of risks.. Sound management of hazardous materials includes four elements: waste reduction, segregation, safe handling, and disposal. For accomplishing solid waste management of hazardous waste following steps must be taken:
 - Providing technical assistance and training to educate decision-makers, system operators, and the public.
 - Establish incentives, disincentives, or regulations to promote waste reduction where it is not otherwise cost-effective.
- (ii) **Medical waste:**Wastes from health posts, clinics, hospitals, and other medical facilities. Suggested measures for managing medical waste are as follows:
 - Burn infectious waste in a single-chamber incinerator, if possible. This kills >99 percent of the organisms and is the best option for minimal facilities.

Disposal methods for different waste categories

CATEGORY	DISPOSAL METHODS	COMMENTS
Solids	Landfill	No more than 1% of the daily municipal waste should be disposed of daily in an untreated form (non- immobilized) to a landfill.
Semi-solids	Waste encapsulation	
Powders	Waste inertization Medium and high temperature incineration (cement kiln incinerator)	
Liquids	Sewer High temperature incineration (cement kiln incinerator)	Antineoplastics not to sewer.
Ampoules	Crush ampoules and flush diluted fluid to sewer	Antineoplastics not to sewer.
Anti-infective drugs	Waste encapsulation Waste inertization Medium and high temperature incineration (cement kiln incinerator)	Liquid antibiotics may be diluted with water, left to stand for several weeks and discharged to a sewer.
Antineoplastics	Return to donor or manufacturer Waste encapsulation Waste inertization	Not to landfill unless encapsulated. Not to sewer. No medium temperature incineration.

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Controlled drugs	Waste encapsulation Waste inertization Medium and high temperature incineration	Not to landfill unless encapsulated
Disinfectants	Use To sewer or fast-flowing watercourse: small quantities of diluted disinfectants (max. 50 liters per day under supervision)	No undiluted disinfectants to sewers or water courses. Maximum 50 liters per day diluted to sewer or fast-flowing watercourse.
PVC plastic, glass	Landfill	Not for burning in open containers
Paper, cardboard	Recycle, burn, landfill	

(i) **Smart Governance (E-Governance):**The purpose to include e-governance to government is to make means more efficient in various aspects. E-government brings many advantages into play such as facilitating information delivery, application process/renewal between both business and private citizen, and participation with constituency. The major areas are:

- ICT(Information and Communication Technology)
- G2C(Government-To-Customer)
- G2B(Government-To-Business)
- G2G(Government-To-Government)

(j) **Green building:**A green building is one which uses less water, optimises energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building. It operates on

- operates energy efficiently
- conserves less water
- is comfortable, safe and healthy in waste minimization
- is durable and maintainable with use of locally available materials

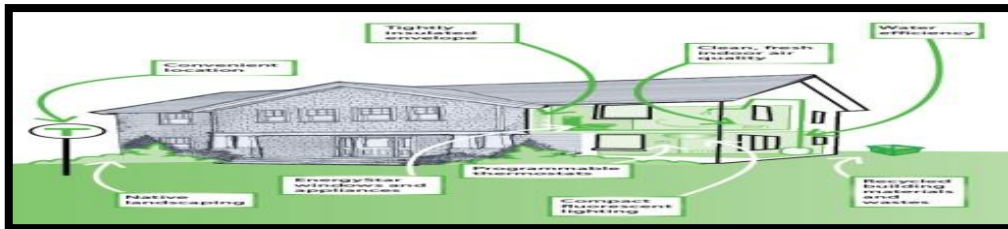


Fig.8. Green building

Certification agencies for Green Building:

- a) (LEED) Leadership in energy and environmental design
- b) (IGBC) The Indian Green Building Council
- c) (TERI) The Energy and Resources Institute
- d) Water Conservation:

The efficient and optimum utilization of water is most important in Smart Building concepts. Because of less rainfall and reducing ground water table, Rainwater Harvesting is very important concept and widely accepted and to be used in urban and rural areas as a whole.

(i) Rain water harvesting:

Rainwater harvesting, in its broadest sense, is a technology used for collecting and storing rainwater for human use from rooftops, land surfaces or rock catchments using simple techniques such as jars and pots as well as engineered techniques. It is also a good option in areas where good quality fresh surface water or groundwater is lacking. Some of the systems are described below.

- Roof catchment
- Gutters
- Down pipe and first flush pipe
- Filter unit
- Storage tank
- Collection pit

(a) **Simple roof water collection systems:** The main components in a simple roof water collection system are the cistern itself, the piping that leads to the cistern and the appurtenances within the cistern. The materials and the degree of sophistication of the whole system largely depend on the initial capital investment. Some cost effective systems involve cisterns made with fibrocement, etc. In some cases, the harvested rainwater may be filtered

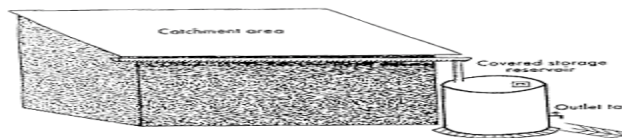


Fig.9. Roof water collection system

(b) **Land surface catchments:** Rainwater harvesting using ground or land surface catchment areas can be a simple way of collecting rainwater. Compared to rooftop catchment techniques, ground catchment techniques provide more opportunity for collecting water from a larger surface area. By retaining the flows (including flood flows) of small creeks and streams in small storage reservoirs (on surface or underground) created by low cost (e.g., earthen) dams, this technology can meet water demands during dry periods.

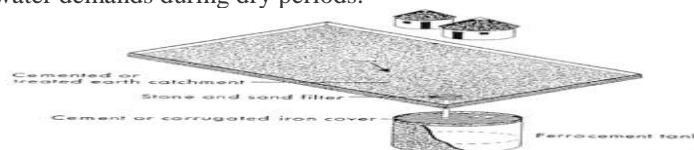


Fig.10. Ground catchment system

(c) Collection of storm water in urbanized catchments. The surface runoff collected in storm water ponds/reservoirs from urban areas is subject to a wide variety of contaminants. Keeping these catchments clean is of primary importance, and hence the cost of water pollution control can be considerable.

IV. GOVT. OF INDIA INITIATIVES FOR SMART CITIES

The Central government has prepared a blueprint to define the key elements of the 100 smart cities in its plan to establish across the nation. The 100 smart cities have been selected among the States and Union Territories (UTs) on the basis of equitable criteria, and each aspirant competed for selection as a smart city in a “city challenge” process. As on today, 20 smart cities started getting the financial aid among the 100 smart cities announced by the Government of India. Here are the five main elements of the proposed smart cities identified by the Urban Development Ministry:

1. In terms of infrastructure, the smart cities should have 24x7 availability of high quality utility services like water and power.
2. A robust transport system that emphasises on public transport is also a key element.
3. In social infrastructure, the cities should provide opportunities for jobs and livelihoods for its inhabitants.
4. The smart cities should also have proper facilities for entertainment and the safety and security of the people. State-of-the-art health and education facilities are also a must.
5. The smart cities should minimize waste by increasing energy efficiency and reducing water conservation. Proper recycling of waste materials must be done in such cities.

V. BASIC FACILITIES PROVIDED

- 1) Adequate water supply, Assured electricity supply, Sanitation, including solid waste management.
- 2) Efficient urban mobility and public transport, Robust IT connectivity and digitalization.
- 3) Good governance, especially e-Governance and citizen participation.
- 4) Sustainable environment, Storm water drains to reduce flooding.
- 5) Pedestrians, non-motorized and public transport facilities, parking spaces, multi-storeyed and rotary car parking, bus rapid transit system.
- 6) Traffic management system, Health and education.
- 7) Detection control devices, Personnel safety equipment, Screening and scanning equipment, Security systems, Tracking systems under vehicle inspection ,CCTV / video surveillance devices, Access control.
- 8) Distribution automation and substation automation, Energy efficiency, Electricity distributors, Electronic power, conditioning equipment, Fault detectors, Smart meters, Smart appliances, Telecommunications, Transformer monitoring systems, Voltage sensors.
- 9) Power meters, Combined heat and power(CHP), Energy saving devices, Energy storage Led lights, Rooftop solar systems, Smart grid, Smart meters, Solar heaters, Street lighting.
- 10) Big data, Data security and management, Firewalls and protection, Geographic information system (GIS), Mobile marketing, Sensors, Smart cards, Smart devices (Routers /modems, etc.), Wireless technologies / products, Information management services, Cyber security solutions.
- 11) Smart heating & cooling, Building automation systems and products, Smart home devices, Smart appliances & living solutions, Elevators/escalators/auto walks.
- 12) Air pollution control management & systems, Environmental protection systems, Equipment & tools recycling, Renewable energy
- 13) Airport surveillance and safety equipment, High speed rail, Infrastructure developers, Landscaping and park furnishings, Nano rail.

VI. LITERATURE SURVEY AND ANALYSIS

Smart cities in India:

1) Gujarat International Finance Tech-city (GIFT):

Gujarat International Finance Tec-City (GIFT) is an under construction central business district between Ahmadabad and Gandhi Nagar in the Indian state of Gujarat. It will be built on 359 hectares (886 acres) of land. Its main purpose is to provide high quality physical infrastructure (electricity, water, gas, district cooling, roads, telecoms and broadband network).

2) Kochi (Kerala):

Smart City Kochi is an IT Special Economic Zone (SEZ) under construction in Kochi, Kerala in India. Smart City (Kochi) Infrastructure Pvt. Ltd. is a joint venture company formed to develop the Kochi Smart City project. Smart City Kochi is one of the first two projects of Smart City's vision to build a large network of knowledge-based industry townships across the world

Smart cities abroad:

The smart cities abroad are New York, London, Chicago, Tokyo, Boston, San Francisco, Barcelona

ANALYSIS OF LITERATURE SURVEY

Smart Cities In India:

Sr. No	Name of smart city	Important features
1	Gujarat International Finance Tech-city(GIFT)	<ul style="list-style-type: none"> • High speed fibre network • Green building • Integrated utility trenches • Solid waste management • Water supply: zero discharge city • District cooling system • Intelligent transport system • Multi-level car parking hubs
2	Smart city Kochi	<ul style="list-style-type: none"> • Solar power lighting • Rain water harvesting • Covered walkways • green building.

Smart Cities Abroad:

Sr. No.	Name of smart city	Important features
1	New York	<ul style="list-style-type: none"> • Electric vehicles • Open data • Non-motorized transport
2	London	<ul style="list-style-type: none"> • Robust transit system • Largest free Wi-Fi network

3	Chicago	<ul style="list-style-type: none"> • Solar power bike stations • Open data • Green building
4	Tokyo	<ul style="list-style-type: none"> • Energy efficient: solar panels, storage batteries
5	Boston	<ul style="list-style-type: none"> • Online transactions • Digital security
6	San Francisco	<ul style="list-style-type: none"> • Sustainable urban development • Green building
7	Barcelona	<ul style="list-style-type: none"> • Low carbon solution • Solar powered bikes

VII. CASE STUDY - GIFT City, Ahmadabad (Gujarat)

GIFTCL proposes to implement GIFT with an eventual built-on area of 7,900,000 m² (85,000,000 sq ft). The company plans to develop, finance, implement all infrastructures in and around GIFT on a turnkey basis to ensure that all conceivable services in relation to connectivity, communication, technology, security, services for quality of life etc. are established and sustained. It will be built on 359 hectares (886 acres) of land. GIFT aims at providing a transportation network that ensures accessibility, easy and fast mobility and few accidental road deaths. GIFT City will also have its own metro stations. Using a multimodal mix of transport systems (MRTS/LRTS/BRTS, etc.) for both intercity transport to Ahmadabad, Airport, and Gandhinagar) and intra-city transport. All waste will be automatically sucked through underground pipes at a high speed of 90 km/h (56 mph), and will be treated through plasma gasification.



Fi.11.GIFT city, Gujarat

Unique facilities in GIFT City:

- 1) **District cooling system:** District Cooling System is introduced for the first time in India for any commercial use. The chilled water will be supplied till building level and it will reduce energy & maintenance cost, reduce noise & vibrations, improves air quality.
- 1) **Electricity:** GIFT Project ensures 99.999% power reliability, which means outage of 5.3 minutes per annum.
- 2) **Piped Gas:** Piped and natural gas will be distributed to every house and building via pipes, which is cheaper and safer than cylinders. Gas supply to the city will be made from the existing gas network of GSPL, the state-owned company for gas transmission pipelines. Piped natural gas is already in distribution in the nearby cities of Ahmadabad and Gandhinagar.
- 3) **Air Conditioning:** GIFT will have a centralized air conditioning system called “District Cooling” which is cheaper to run and uses less electricity.
- 4) **Solid Waste Management:** All waste will be automatically sucked through underground pipes at a high speed of 90 km/h (56 mph), and will be treated through plasma. Automated Waste Collection System (AWCS) and Segregation Plant is one of the unique next class infrastructure planned in GIFT Project.
- 5) **Water supply:** GIFT Project is zero discharge city; water will be drinkable from any tap. Storage of surface run-off & rain water will be done and the water infrastructure will consist of next class Water Treatment Plants (WTP) and Sewage Treatment Plants (STP).
- 6) **Transportation:** GIFT aims at providing a transportation network that ensures accessibility, easy and fast mobility and few accidental road deaths. This would be achieved by using a multimodal mix of transport systems ([MRTS/LRTS/BRTS](#), etc.) for both intercity and intra-city transport. Multi Level Car Parking (MLP) have been planned for systematic and efficient parking in GIFT City. There are 14 MLPs planned for facilitating 60000 Car Parks.
- 7) **Commercial Buildings:** Construction of 4 Towers as WTC (World Trade Center) is a big achievement in the proposed GIFT City with a total 1.35 Million Sq.Ft.



Fig.12. World Trade Center at GIFT City

Important features from GIFT City:

1. It is the India's only large financial service potential offering global firm with world class infrastructure and facilities.
2. The GIFT City is located on the banks of river Sabarmati to provide river front and is around 12 km from Ahmedabad international airport. It is accessible from all directions through 4-6 lane state and national highways.
3. The district cooling system is unique feature of this project to improve the air quality and also maintain temperature control throughout the city.
4. The common utility trench networks are provided throughout the project to transmit facilities like electricity, gas pipe lines and various pipelines to achieve ease in maintenance and space optimisation.
5. Automated waste collection system is provided to suck the waste through underground pipes and waste treatment through Plasma technology.
6. The concept of zero discharge city is proposed by 24x7 water supply, recycling and reuse of waste water; rain water harvesting.

7. It is a perfect example of zoning in which the residential zone is completely separated from industrial zone and also having green area along the river front of Sabarmati river.
 8. Transportation by Metro corridor and road networks is provided to achieve efficient and sustainable transport system. There are also travellers and multi-level car parking hubs provided for crowd management.
 9. The iconic buildings in this project are the Diamond tower, The Gateway tower and the crystal towers.
- Integrated township with the best of social and physical infrastructure is implemented

VIII. TECHNICAL ASPECTS FOR INFRASTRUCTURE DEVELOPMENT OF SMART CITIES

a) ENVIRONMENT (GREEN SPACE):

- There must be provision of balconies in flats that should be 20% covered with trees and plants, to control air pollution.
- The distance between compound of building and building should be covered with green belt.
- Landscape treated as an extension of vegetation on site

b) CLEAN ENERGY:

- Energy efficiency building.
- Energy and climate change.
- Passive solar building design is often implemented in low-energy homes
- Onsite generation of renewable energy through solar power, wind power, biomass can significantly reduce the environment impact of the building

c) E-GOVERNANCE:

- Digital governance
- Use of I.T.
- Reducing paper clutter, staffing cost, or communication with private citizen or public governance.

d) CLEAN WATER SUPPLY:

- Modernization of water supply
- Providing sewage treatment plant so that treated water can be use for various purposes.
- Making artificial pond, reservoir, etc. so that rain water or natural water can be save and provided.

e) QUALITY OF LIFE (GREEN BUILDING):

- Specify high performance window and extra insulation in walls, ceiling and floors.
- Providing gardens between two buildings for fresh air and less pollution.
- Giving maximum distance between two houses so that proper air and sun light can be provided.

f) RAIN WATER HARVESTING:

- Collection and storing rain water for human use from roof tops, land surface or rock catchment using simple techniques.
- It provides a water supply buffer for use in times of emergency or break down of public water system.
- It is also reduce the storm drainage load and flooding in City Street.

g) AUTOMATED SOLID WASTE MANAGEMENT:

- Reduce, recycle and reuse of waste.
- Disposal of hazardous waste like air pollutants, green house gases.

- Use of pneumatic waste management system which is environmentally beneficial.

h) INTELLIGENT TRANSPORT SYSTEM:

- Movement of trains ,route diversion in automated way, parking space etc
- A transportation system is dynamically integrated with land use which creates an efficient, sustainable and vibrant city.
- Provide access to mobility and high quality of life for all citizens and maintain walking, cycling and other forms of active transportation facilities.
- Provide well-maintained transportation system for economic vitality and positive city image.

i) WELL PLANNED ROAD NETWORK:

- Provide four- five lane road.
- Provide alternative routes for traffic which will facilitate the movement of people allowing for social interaction.
- Increase road capacity and reduce road congestion, traffic accidents, light, and noise and air pollution.
- Provide subways and skywalks for public crossing to avoid road accidents.

j) ON- STREET AND OFF -STREET PARKING:

- Provide multi storied car parking system.
- Provide bicycles parking stands near the bus stop.
- Provide underground & multi-storied parking where parking space is limited
- Provide parking facilities via mobile app ,website or SMS which includes smart parking meters and garages.

k) HIGH SPEED INTERNET:

- Provide uninterrupted internet throughout the city for better connectivity.
- Provide wireless internet access points i.e.Wifi in public places like airport halls, libraries, in some cases just for brief use while standing.

l) UNDERGROUND CABLES:

- It reduces the area of maintenance manholes and also less execution and repair.
- There is a significant purpose of making the power lines less susceptible to outages during high wind, thunder storm or tree collapse.
- Underground cables can transmit power across densely populated areas where land is costly or environmentally sensitive.
- Underground cables pose no hazards to low flying aircraft or to wildlife.

m) SEWAGE TREATMENT PLANT:

- The sewage treatment plant must be constructed outside the residential area so as to avoid the harmful pollutants to affect the environment of the city.
- There can be provisions of for Soil Bio-Technology plants where the sewage water is treated and can be used for gardening, bathing use etc except for drinking. This technology also enhances the green environment of the city.
- The treated water from the sewage treatment plant can be reused by watering plants roadside, providing supply connections to buildings of treated water for car washing etc.

n) CLOSED CIRCUIT TELEVISION ON AND OFF ROADS:

On roads:

- The on road provision of CCTV on every fixed interval will help in redressal from accident, causes of accidents and speed detection.
- CCTV'S must be provided on every junction of roads.
- This provision can also help in crime reduction.
- There can be application's connected through GPS and main centers of CCTV's for the people to analyze the current situation an divert their routes.

Off roads:

- The provision of CCTV's on every entrance of the society or industry for the automatic registration of the people visiting.
- For a residential building CCTV must be provided on every floor at such an angle to analyze every situation.

o) INTELLIGENT SIGNAL SYSTEM:

- The signals at every junction of roads must be provided with sensors and CCTV's to detect the traffic congestion.
- These must be interconnected through an application and GPS to avoid further traffic congestion by diverting the cars coming on that particular route.

p) ZONING:

- The city must be planned keeping the industrial and residential zones separate according to the zoning laws.
- The residential and industrial zones must be connected by proper public transport facilities.
- There can be provisions of gardens, parks, joggers parks etc. To increase the green zone of the city.

IX. CONCLUSION

1. Smart cities are considered to be better than the normal cities developed so far.
2. The detail features of the proposed smart cities have beused for the planning of smart cities in INDIA.
3. All the benefits and facilities provided in the existing smart cities in INDIA and ABROD have been studied in detail, which could be incorporated in the proposed smart cities in India.
4. Each and every minute detail regarding the planning and designing of a smart city should be based on the prevailing bye-laws exciting in that particular sate and country.
5. All the detailed technical aspects related with the infrastructure development off smart cities should be included for the future smart cities, whenever there being conceptualized in a developing country like INDIA

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