

FROM SATELLITE TOWNSHIPS TO SMART TOWNSHIPS: EVOLUTION OF TOWNSHIP DEVELOPMENT IN PUNE, INDIA

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Abstract

With the onset of rapid population growth and urbanisation levels in India, significant amount of population will be living in urban areas. As existing cities are already densely populated with limited infrastructure, the emergence of townships in the vicinity of urban areas offers great potential for accommodate them. Townships have thus become an important means of sustaining urbanisation in India. This paper discusses the emergence of township development in Pune city and its neighbouring areas by performing an analysis of existing townships as cases. The salient features and major advantages of these townships are discussed in detail. The paper finds that the township development in Pune has been rather evolutionary: from 'satellite townships' that were based on the concept of 'counter magnet settlements', to 'integrated townships' that were based on the concept of 'sustainable development', and further to 'smart townships' which use the principles of 'new urbanism'. The paper therefore brings about how such evolution of township development can be replicated by other Indian cities to achieve the urbanisation and urban development.

Keywords: Townships, Integrated development, Policy, Infrastructure, Planning and Design

1. INTRODUCTION

India has been undergoing rapid levels of urbanisation (or, share of urban to total population) in last couple of decades. It has grown from 27.7% in 2001 to 31.1% in 2011, while recording an annual growth of 3.3% during 2001-11, when compared to 2.1% during 1991-2001 (Census, 2011). The urban population growth has well surpassed the rural population growth. The low population growth in rural areas is primarily due to the lack of economic opportunities and infrastructure facilities. It has been becoming evident that rural-urban migration has been on the rise due to the rural areas not able to support the population. Therefore, the cities have to accommodate much of the population rise as well as migration. However, Indian cities

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were unprepared for this task, as they have limited infrastructure facilities and have not made enough investments on infrastructure creation and expansion.

The rapid pace of population rise and urbanisation in India requires creation of good amount of social and physical infrastructure in order to cater to the growing demand for it from the people on city space. The fast growing metropolitan cities in India have been taking a major share of urban population, which is only resulting in pressure on existing city infrastructure, which was created for a not such large population. Lopsided pattern of urbanisation and inadequate infrastructure investments has led to serious deficiencies in urban infrastructure and services like housing, transport, water supply, sanitation and social infrastructure especially in all cities (Zope, 2013). Therefore, the development of 'new towns' is considered as an alternate to promoting the growth of existing cities. In fact, the UK had exercised this option as means to revive its economic growth in the post-World War reconstruction period.

India is known for having the potential for higher economic growth as one of the growing economies because of its status of 'demographic dividend' associated with the country i.e., young people who are well educated and have a lot of potential to contribute to the growth of the country form a majority of the population. However, an important constraint faced by growth is the shortfall of housing and physical infrastructure that creates habitable conditions. Indian cities lack sufficient habitable infrastructure facilities, and also fall short of a self-reliant and self-sufficient housing model which has the amenities required by the citizens will be an excellent concept to meet the current needs of the country. Unlike the UK's experiment with the creation of several new towns, India only created few new towns in the post-independence era. Chandigarh, Gandhi Nagar and Bhubaneswar are the only new towns created after independence, which have had a limited impact in terms of accommodating the population in them together with creation of infrastructure facilities¹.

Townships are, therefore, emerging as a means of overcoming some of the infrastructural constraints in the existing cities and becoming a new format for the future growth when it comes to urban development in India. With urban areas getting more crowded and due to lack of planned settlements, townships are a potential solution. Although the concept of townships is not very new², it is moving away from the conventional role of those that serve as a satellite space for living to in-coming population. Modern townships are not mere standalone settlements like those in 'satellite townships', but those with integrated infrastructure development built into them based on the economic concepts of technological efficiencies and scale economies associated with the service provision in such development. Most recently, these

¹In fact, the creation of the new towns is linked to the formation of capital cities to newly formed Indian states.

²The original idea behind townships came from Ebenezer Howard's Garden city model of development in England during the 16th Century.

townships are going further to incorporate the principles of new urbanism which emphasize on smart and sustainable development i.e., they integrate energy and environmental resource conservation.

1.1. Township Development in India

Township development has, however, been taking place over a period of time in India (for about more than 20 years) under various development models. Initially, these were isolated settlements far away from the existing city with organised settlements development. However, over the time, the township development in India has become rather evolutionary. The initial township development was in the city outskirts in somewhat less organised but certainly linked to the central city through transportation trunk line. Then came the integrated townships, which are self-sustained to accommodate the population through plotted developments with housing units along commercial and recreational facilities.

Township development took the turn towards efficiency and environmental conservation subsequently with the modern townships exhibiting the adoption of energy and resource conserving building construction and infrastructure development as well as maintenance. The whole township development in Indian cities has been going beyond the conventional models of 'development sites and services' to 'organised settlements and infrastructure services' to 'efficiently managed services and built spaces' to finally 'smart management of services and use of technological innovations'. This evolution of townships is shown in the Figure 1.

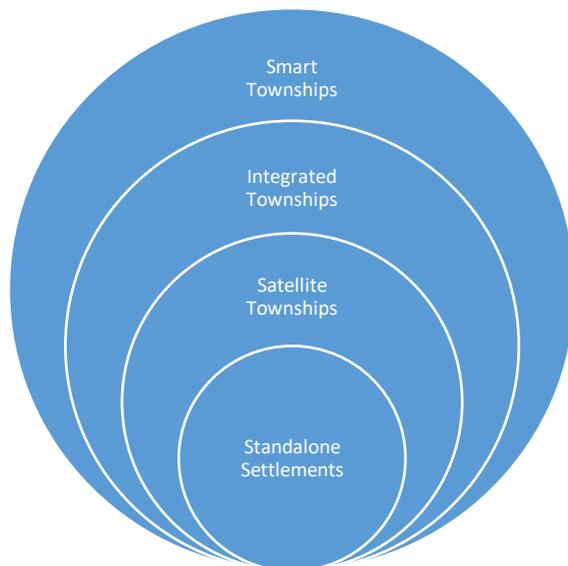


FIGURE 1 - EVOLUTION OF TOWNSHIP MODEL IN INDIAN CITIES

Township development began with the emergence of industrial towns in the early years of independence which were developed with the concept of accommodating labour force around the work place. These townships had the cooperation from their respective governments. Townships which were self- sustained

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came into being and provided the residents with basic needs and infrastructure on education, healthcare, recreation and shopping. Today these townships have further moved on to smart cities wherein the digitalization of townships is taking place. Undoubtedly, integrated townships are shaping the urban development scenario. With urban areas getting more crowded and due to lack of planned settlements, townships are a potential solution. They serve as counter magnets where investments can flow.

New policies for Integrated Townships have been formulated which is a good sign for a planned and well administrated development of this model. The policy will act as a guideline because the development is different from the usual residential complexes as they have a varied product mix of row houses, villas, apartments as well as ancillary activities such as commercial spaces, healthcare, retail etc. Today, integrated townships are shaping the urban development scenario. But unfortunately, not all the states in the country have well defined township development policies and regulations in place. Only four states – Gujarat, Maharashtra, Karnataka and Rajasthan – have announced integrated township policies for promoting this model of urban development in their states (Tak Rai, 2012).

1.2. Township Development Policy of Maharashtra

Among the few states that have a well-defined policy with regards to township development, Maharashtra was the first state to draft and announce a policy in 2004. In this context, the Government of Maharashtra's policy on integrated township development is an enabling policy that kick-started township development in the State. According to Maharashtra's Township Policy, for a project to fall under the category, it needs to fulfill the following characteristics (GoM, 2004):

- A minimum area of 100 acres (contiguous land)
- Abundant and clean water supply available on 24x7 basis
- A reliable power infrastructure
- A well-knit road structure of widths varying between 30 and 80 ft
- Availability of schools, college, hospital, fire station on the premises
- 60% of the area to be dedicated purely to residences and a minimum of 20% area to be dedicated to open spaces
- Should have EIA clearance and other clearances from various government bodies

The Government of Maharashtra has been revisiting its policy from time to time in response to the township development on ground. It was revised three times since after the first policy promulgation. It has been updating the policy so as to overcome some of the constraints faced by the developers as well as offering more incentives in order to make it an attractive option for the flow of funds into township development. The latest policy update is aimed at the offering maximum development potential in order to attract foreign

direct investment (FDI) into the development of smart townships with the government confining to the regulator for the approval of such proposals from private sector (Times, 2016).

The new township policy retained the provisions of earlier policy proposals, including the reservation of 20% of the residential built-up space to be reserved for social housing comprising smaller units for low income and economically weaker sections (ibid). Importantly, it seeks the township developers to reserve 15% of the development area for public amenities like markets, town hall, schools, healthcare facilities and economic activities likes shopping and theatres. Further, a five per cent of master plan area has to be reserved for gardens and another 7.5% for play grounds (which is besides reserving space for public utilities like fire brigade station, police station, sewerage treatment plant etc.(Times, 2016).

2. TOWNSHIP DEVELOPMENT IN PUNE

Pune is the eighth largest metropolitan city in India in terms of the urban population. It is the second largest city in the state of Maharashtra, next to Mumbai, in terms of city population. Pune is also one of the oldest cities of India, dating to 17th century, when it was founded by the Maratha rulers. Besides the past heritage, Pune is known for the presence of research and higher educational facilities in it. It has a growing industrial hinterland, with information technology and automotive companies setting up factories in the district. The presence of industrial (especially, automobile and automotive industries) sector and the development of services sector (especially, information technology and recreation services) have pulled a large amount of hinterland people to the city due to its ability to provide employment to them. Table 1 shows the key facts about the city.

TABLE 1 - FACTS ABOUT PUNE CITY

Area (square kilometres):	331
Population (Census, 2011)	50,57,709
Population growth rate	30.34% compared to population as per 2001
Density (per square kilometres):	603
Sex ratio (females per 1000 males)	910
Literacy rate	87.19%
Per capita income	Rs 1.27 lakh (2010-11)

(Thornton, 2013)

Pune is a thriving industrial centre sheltering manufacturing units of some of the most prestigious industrial houses of the world (Magar, 2014). In the recent past, it has been emerging as the hub of service sector activities like the Information Technology and Recreational Tourism. The dynamic culture and job opportunities attract people from all over India. The growth in the city is peripheral and the driving forces for this growth are mainly(Thornton, 2013):

- Information technology hub
- Presence of leading education institutes

- Auto and auto components
- Manufacturing units
- Cosmopolitan city culture
- Fast developing infrastructure
- Proximity to Mumbai

Pune is known for the township development and it is the pioneer of taking the township concept to various types of development – be it industrial, agro-processing, information technology, integrated development, residential development and so on. The development of township has evolved considerably in the city as well with a move towards efficient and smarter townships that have been designed over a period of time. Pune is among the first few cities that have promoted township development for a long period of time. The township development in Pune has also been evolving over time, from the ‘satellite townships’ during the initial phase of development to ‘integrated townships’ in the next phase to ‘smart townships’ in the recent times. Figure 2 graphically shows the evolution of such township development over time in Pune.

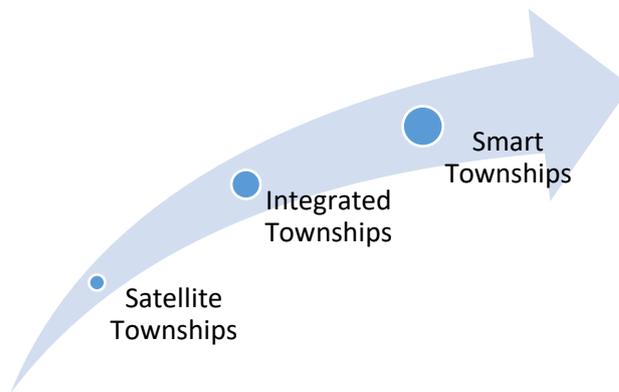


FIGURE 2 - EVOLUTION OF TOWNSHIP DEVELOPMENT IN PUNE

3. CASE STUDIES OF TOWNSHIP DEVELOPMENT IN PUNE

In this section, we discuss the ‘evolved-ness’ of township development through three case studies of township development in Pune. It is important to understand the structure and the function of the townships and how there has been a change in the design of living. This has mainly taken place due to the change in the mindset of the people, type of work done by the population, technological advances, etc. Having given the background and the introduction, the subsequent parts of the paper consist of the following cases of township development in Pune in an evolved manner:

- Case Study 1: Magarpatta City
- Case Study 2: Amanora Park Town
- Case Study 3: Lavasa City

3.1. Case Study 1: Magarpatta City

Introduction

It is a 400 acre integrated township located in Hadapsar, to the South East of Pune. It has been developed by a farmers' co-cooperative - about 120 families consisting of 800 individuals (Amit Gupta, 2012). As Pune was already famous for its automobile industry and had good educational institutions therefore Magarpatta was started to serve as alternate to the emerging industries like Information Technology (IT) and other services; therefore, it decided on developing a knowledge city with a residential complex next to the workplace. It came into existence with a vision of creating a new way of life for the networked society of the new millennium emphasising on environment control, good living standards, modern educational system and state-of-the-art working conditions with total security.

Concept

Magarpatta City attempts to create a new life in the over-stressed cities – encouraging a networked community, with emphasis on proper environment control, good living standards, modern educational system and state-of-the-art working conditions with total security. Good quality environs, walkable city and designing an inclusive city for all makes this development a success. Being one of its first kinds in the city, it was typically designed as a walk to work concept integrated township the following features were beautifully incorporated in its design. Some key concepts that went into township design include (Anonymus, 1999):

(i) Walk-to-Work / Walk-to-School – Designed as an integrated township development, all city level amenities and features are integrated into the area; all these facilities are easily accessible, easily walkable. This forms a crucial planning parameter to Magarpatta City's success. As more than 90% of the daily trips made from home are for work and school / college, by placing these units in the vicinity a greater amount of valuable travel time can be saved resulting in a better social and a family life. Magarpatta City has been planned in such a way. Offices are about ten minutes walking distance away from any residential sector. The City Public School is placed so that students can walk or cycle from their home in a safe and secure pedestrian priority walkway, a couple of minutes away from their residence. Great design emphasis has been laid on the design of these roadside pedestrian walkways; it also incorporates barrier free design concepts. This ensures better and more effective use of footpaths in Magarpatta City, comfortable for young, old, able and disabled.

(ii) Affordable Housing Options – a significant percentage of the total housing stock is reserved for smaller flats, priced in an affordable range, in order to ensure that blue-collared servicemen also find place for

living within the city. As a matter of fact, the housing stock is varied, with multiple choices ranging from 1 bedroom to 4 bedroom flats, to ensure a healthier mix of citizenry and socio-economic inter-reliance.

(iii) Access to Economic Facilities (Work Centres) – As an integrated township, Magarpatta City strived to move away from the traditional and outdated planning model of just making residences without developing work centres nearby; resulting in non-wastage of time, fuel and quality of family life. Magarpatta City developed around 6 Million Sq.Ft of commercial offices, banking on the IT boom of the last decade, to create a new city level business destination, for which surrounding residential development became both a sustainable proposition, and a comfortable liveability feature based on the tried-&-tested LIVE-WORK-PLAY-LEARN doctrine.

Land use

Figure 2 shows the land use pattern at Magarpatta City. About one-third of the township’s area, about 120 acres, is open area for gardens. Apart from this there are trees, plantations and green sidewalks plotted alongside the roads. The City is pollution-free and declared as an Oxygen Zone. It also adopted eco-friendly practices such as solar water heating, solar lighting and hygienic garbage disposal, which further conserves the environment. It is designed as a walled city, with fortified gates and guarded entrances; the city is also intensively patrolled day and night by security professionals. All the safety norms for fire fighting, electricity, in-city traffic are also enforced by professionals.

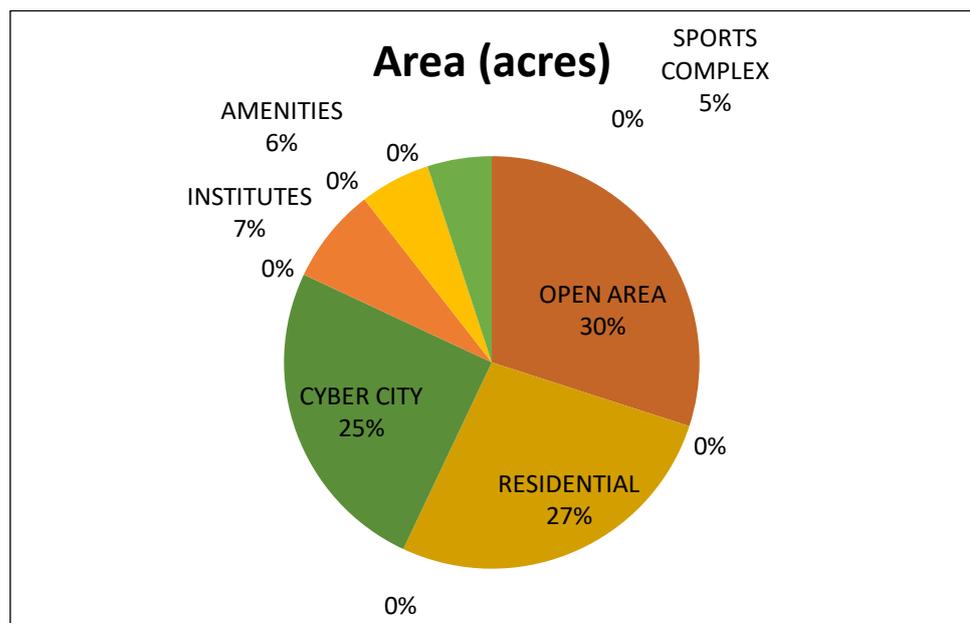


FIGURE 2 - LAND USE PATTERN AT MAGARPATTA CITY
 Source: Comparative evaluation of integrated townships (Ghule, 2011)

Magarpatta City also houses education facilities from pre-primary to graduation, enabling the walk to school concept. The recreational spaces are normally located far off in any city, but at Magarpatta City they are right around the home. Amphitheatres, Cultural Centres, Aqua Sports Complexes, Shopping and Entertainment centres, Golf Clubs and more offer the maximum delight. The healthcare needs are met by a 200-bed multi-specialty hospital in Magarpatta City. The ultra-modern hospital provides the best in healthcare by eminent medical professionals. A consistently top quality of construction procedures is maintained at Magarpatta City. Broad wide roads, traffic islands, block parks are designed in accordance with international procedures.

Infrastructure

Infrastructure facilities are planned and designed to provide comfortable and simple living to the citizens of township. Infrastructure provision also follows some planning concepts (Anonymus, 1999):

(i) Green Hierarchy – At the city level, there are distinct hierarchies of usage patterns of green spaces. They vary from more passive roadside plantations that give green cover to pedestrians and enhance the beauty of the road, to cosy tot-lots which have sheltered children play areas, to sector level play areas for older children and young adults, to open areas for social assembly and merriment for sector citizens, to a larger city level urban park for all the citizens to access, enjoy and rejuvenate themselves. Magarpatta maintains and respects this hierarchy so every citizen has easy access to surrounding greenery, and responsive landscaping that is actually used and appreciated. Every residential sector has buildings at the periphery overlooking a centralised open space, in an obvious abstraction of the traditional courtyard planning. Bringing back the trees and lush landscaping in our progressively urban lives, enhance health and well-being. All parks are open for public use.

(ii) Road Hierarchy for Reducing Vehicle-Pedestrian Conflict – Magarpatta City has a large network of roads that facilitate vehicular movement in a planned hierarchical manner, and segregated pedestrian movement corridors alongside the carriageways. Special design emphasis is laid on the design and detailing of the pedestrian corridors and footpaths. Shaded and beautiful landscaping is meant to entice citizens into rediscovering the joys of walking to nearby places. Well-designed urban signage facilitates wayfinding at the city level. At stipulated activity areas, there are seating zones near pedestrian corridors, for resting and pausing to enjoy the surrounding city life. Junctions are well treated with traffic calming systems to ensure intracity vehicular traffic is wary of the pedestrian priority aspect of Magarpatta City's planning. Visual corridors are pre-planned to ensure high visibility during turning, thus ensuring better predictability on incoming pedestrian / vehicular traffic, and thus reducing conflict possibility.

(iii) Places for Social Interaction – Contemporary cities have too often lost the spark of humanity, where neighbour greeted neighbour, where citizens reached out to help one another, where a chance encounter with an acquaintance in the local market led to extended sessions of story-telling and revelry. Modern cities have socially deteriorated to isolated ghettos where people have lost touch of being a social citizen. Most of this problem has ensued with holes in the city planning process, which focussed on building and roads, and forgot to provide public space for interaction, and in effect, forgot about its people and how society is built. This lacuna is effectively countered in Magarpatta where great efforts are made to create pride, mutual affection, social bonhomie and a responsive citizenship. This is done by two means – a) by providing various spaces and activities, at differing scales, for people to meet people, and participate in travelling through life together; and b) by promoting various activities at a township level that inspires participation and collective enjoyment, like planting saplings alongside roads and in parks, or lighting thousands of diyas on the roads during Diwali, up to enjoying a night of music filled merriment on Foundation Day.

(iv) Integrated Amenities – All necessary social and physical infrastructures are integrated in planning to ensure that the township is self-sufficient. These include (Anonymus, 1999):

- School
- Multi-Speciality Hospital
- Workplaces (IT Offices, Professional Offices, others)
- Shopping Centre
- Restaurants
- Banks / ATMs
- Gymkhana / Sports Facility
- Cultural Assembly Space
- Security Checkpoints
- City-level Public Parks
- Auto Stands / Bus Stands / Transit Interchange Points

Sustainability Practices

Rainwater harvesting to canalize water from terraces is planned for over 8 natural wells, 515 recharging bores, over 1.25 acres of an artificial lake body and to recharge ground water levels. Inter-locking paving blocks and cutout grass concrete pavers assist in raising groundwater levels. Pune's largest mist fountain enhances the microclimatology here. Waste water is recycled with three sewage treatment plants planned with a capacity of 2 million litres a day and the recycled water is used for gardening purpose via the

conserving drip irrigation and sprinkler distribution system. This keeps the garden lush green and lowers temperatures in the surroundings.(Anonymus, 1999)

Eco-friendly practice of segregation of over 400 tonnes of household and commercial garbage, trash and waste per month is done at source of which 280 tonnes of biodegradable waste is used for vermi-culture and bio-compost. Over 120 tonnes of non-biodegradable waste is recycled in a way not hazardous to nature, disposed-off safely and the re-usable scrap is sold.(Anonymus, 1999).³ Over 7,000 solar water heating panels installed on the terraces reduce the heat effects on the top floors and are designed to save over 1.75 crore electrical units which potentially translates to more than 13,000 tonnes of carbon emissions saved every year. An electrical vehicle is used for security. Low power consumption lights are fitted in streets and common areas.(Anonymus, 1999)

The nursery has vermi-culture and bio-compost pits, which generate manure from garbage segregated at source at Magarpatta City. The manure composted here provides for nourishing these saplings and shrubs. Not only are plants, saplings and organic vegetables sold here, a unique facility of a Plant Library is offered whereby just like a book/ video library one can enjoy the different plants here at a nominal charge for a limited period providing a refreshing and dynamic feel to ones dwelling.(Anonymus, 1999)

Fly ash which is an environmental hazardous waste produced by thermal power plants is used as a part replacement of cement and fine aggregates, is an inert material & saves energy required for production of cement. Usage of fly ash bricks helps in reduction of greenhouse gases, which are depleting the ozone layer. These bricks are better than traditional bricks because of various reasons, like controlling of pollution, cost, breakage, wastages, evenness, finish while manufacturing and more compressive strength. As fly ash bricks are produced mechanically they are economical, good for any type of masonry and absorb very less water. For every tone of fly ash used in construction, approximately 1 tone of CO₂ emission in environment is reduced. Magarpatta City is set to consume 1, 30,000 tone of fly ash by the time construction is completed, translating into a huge saving of over the same, i.e. 1,30,000 tone of carbon emission.(Anonymus, 1999)

Magarpatta City has become home to one of the largest residential Solar Water- Heating systems in the country. The solar panels have been put in all the residential apartments comprising of about 3500 flats in the Phase-I & II. On completion, the total capacity will be in the region of 7 lakh liters per day which will

³ A two tonne capacity Biogas plant is installed here wherein biodegradable waste goes through a process and the non-polluting biogas which is generated is used to generate power to operate a major percentage of the garden pumps. This saves excessive power requirements equivalent to 118 commercial gas cylinders of 19 kilograms capacity per month, which translates to a power generation of over 270 electrical units per day.

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save power to the tune of 37 KWH per day and in monetary terms Rs.3.9 crore a year. This is one of the many environment-friendly practices carried out in Magarpatta City. (Anonymus, 1999)

3.2. Case Study 2: Amanora Park Town

Introduction

Amanora Park Township, launched in 2007, is a unique, exclusive and the first-of-its-kind township project in Maharashtra. It is a 400 acre township project with 70 acres of well designed clean and open space located in Hadapsar, adjacent to Pune-Solapur highway. This project was developed by City Corporation Limited, which is a real estate firm. Amanora is the first township project that qualified all norms laid down by the Government of Maharashtra Township policy viz. (Amanora, 2014). Amanora Park Town is located on the Eastern Corridor of Pune in Hadapsar on Kharadi By-pass near Magarpatta, which is the buzzing IT Centre of Pune. Hospital and School are part of the township and located at walkable distances within the township. Figure 3 shows the location of the township on map.

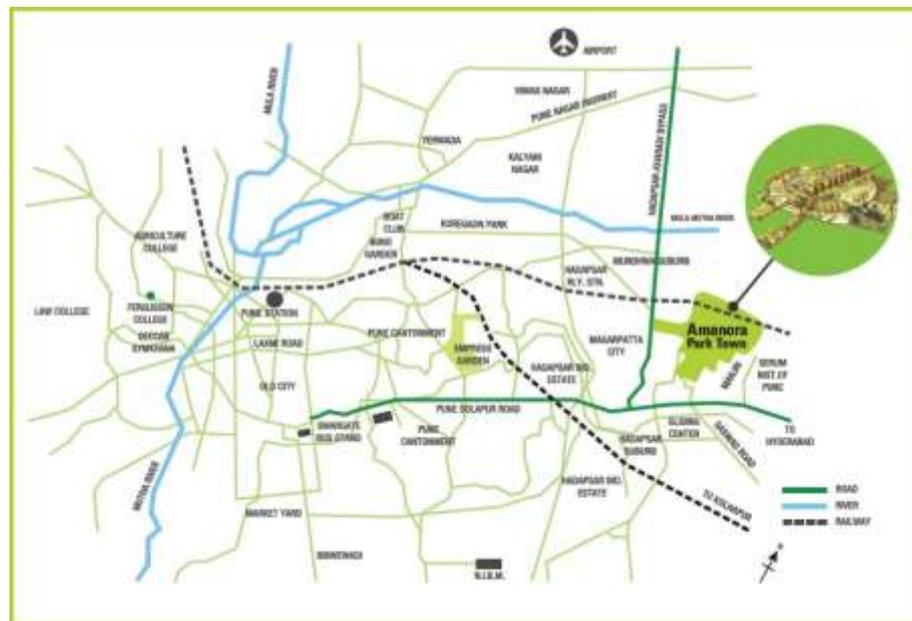


FIGURE 3 - LOCATION OF AMANORA PARK TOWN
Source: Amanora Website, Location (Amanora, Location, 2014)

Concept

Amanora Park Town is designed with an idea of providing its citizens with an environment free of congestion and pollution. It drew inspiration from 'Garden City Model' of Ebenezer Howard. The township holds out the hope of a 'Future India Easy India' with a well-planned and secure neighborhood. Amanora

Park Town, has worked towards creating this environment with following concepts (Group, Concept Brochure, 2014):

- Stress-free living with walk to destination concept, as the township encompasses residences, work areas and entertainment facilities;
- Comforts of living life, as the township is designed to provide public convenience and security along with infrastructure and public utilities.
- Devoid of maintenance burden, as the township promoters maintain it for the lifetime with private management team for maintenance of the township.
- Modern infrastructure facilities like power and water distribution, planned roads and service corridors, school and health facilities.

Land Use

Amanora is fully developed on mixed land use pattern, with a good amount of land allocated to residential and open spaces as well as infrastructure facilities. Table 2 illustrates the same.

TABLE 2 - LAND USE PATTERN IN AMANORA PARK TOWN

Land use category	Area (acres)	Percentage (%)
Residential use	255	63.75
Open Spaces	70	17.50
Educational Infrastructure	30	7.50
Medical Facility	5	1.25
Amanora Town Centre	30	7.50
Miscellaneous Amenities	10	2.50
Total	400	100.00

Design

Amanora reflects the planned development of a new township with positive urban attributes taking care not to disturb key features of the existing landscape such as - the natural drains (nalla), tree clusters, slopes and natural drainage patterns. The objective is comfort and convenience for citizens without upsetting the ecosystem of the region. The major residential development projects in the township include:

- Future Towers: Designed by architect Jacob Van Rijs, Future Towers is a project that comprises 1-5 BHK apartments.
- Gateway Towers: Marvelled by Swarovski, Gateway Towers is a 45 storey residential project that comprises 1- 4 BHK apartments.
- Neo Towers: Neo Towers is a residential project that comprises 1-4BHK apartments

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- Aspire Towers: Aspire Towers 1-10, consists of 18 to 22 storeys and comprise of 4 BHK apartments. Aspire Towers 11-12, an extension of Aspire Towers 1-10, consists of twin towers of 24-28 storeys and comprises 2-3BHK apartments
- Amanora Town Centre (ATC): it is a shopping mall in the precincts of Amanora Park Town, which was designed by the Walker Group Architects Ltd, NZ. The mall comprises low rise formats, entertainment, hypermarket and home anchor, spa, fitness and wellness centre. ATC is an ecologically designed structure with waste management, rainwater harvesting and recycling of solid waste management.

Infrastructure

Amanora Park Town is an independent model of developed urban life that incorporates modern values with conventional community living that give comfort, security and reliability. Table 3 shows various infrastructure facilities in this township.

TABLE 3 - INFRASTRUCTURE AT AMANORA PARK TOWN

S. No.	Infrastructure	Description
1	Road Infrastructure	Crescent Road, the main road to drive around the township, is 26.6 m wide with two lanes to accommodate hassle free traffic movement. Internally there is provision of bituminous roads, cycle tracks and pavements.
2	Uninterrupted Power	20 MVA electrical sub-station with underground cable system through electrical ducts avoids overhead lines. Efficient electrical devices and energy saving devices have been used along with renewable energy resources for street lights and landscaped areas to reduce energy consumption
3	24*7 Water Supply	All day water supply is ensured by sourcing water from 15 th Sholapur Highway canal using a 4.5km pipeline. Water treatment plant of 2.5MLD capacity and water filtration plant with 1.25 lakh litres per hour capacity are also present
4	Sewage Treatment Plant (STP)	STP of 1.75MLD capacity is present. Treated water is used for sectoral and external gardening. Post tertiary treatment, the water will also be used for flushing.
5	Piped Gas	Amanora is first township that offers PNG. PNG is mainly methane (CH ₄) with small percentages of hydrocarbons which burns completely making it clean and eco-friendly.
6	Health Care	A 150 beds multi-speciality hospital with provision to expand up to 200 beds with medical history stored on smart cards directly linked to hospital database
7	Education	Comprises sports and education facility in about 30 acres of land parcel. Plan to accommodate classes from pre-primary to post graduate level courses with specialization courses
8	Digital Living	Data centre which makes digital living possible at Amanora aided by smart cards, smart home systems, web portal to shop in neighbourhood, etc.
9	Living Amidst Nature	26 acre garden with fountains and additional 2.5 acre lake. Comprises 'Temple of Environment' with an enshrined golden tree to convey the message 'tree is as precious as gold'

Source: Amanora Website, Infrastructure (Amanora, Amanora at a Glance - Infrastructure, 2014)

Apart from the above mentioned infrastructure facilities, following amenities are also available at the Township(Group, Concept Brochure, 2014):

- Commercial complex to fulfil daily shopping needs
- Amanora Club
- 24-hour fire station
- Internal eco-friendly bus transportation
- Post Office
- Police Station
- Library

Sustainability Features

There are several features present in the Amanora township that render it with sustainable living to the residents of township. Some major such features include (Amanora, Amanora at a Glance - Infrastructure, 2014):

- Rain Water Harvesting
- Water Treatment and Water Filtration Plant
- Sewage Treatment Plant
- Use of Renewable Resources for Lighting Common Area
- Installation of Smart Devices like Motion Sensing Light Features which help in reducing load on electricity
- Balance of green and open spaces to built spaces
- PNG use in cities makes LPG available for rural areas, thereby reduces deforestation.
- Walk to Destination concept reduces pollution and fuel consumption by private vehicles with further reduction achieved using eco-friendly bus services.
- Digitalization in the form of smart cards and e-governance induces a paper free environment.

3.3. Case Study 3: Lavasa City

Introduction

Lavasa is an upcoming modern mega township, which is situated amidst the Shayadri mountain range along the Warsagaon Lake near the Mumbai-Pune Economic Corridor. It is located between Mumbai and Pune, in the midst of the lush greenery of Mose valley of Sahyadri hills at an elevation of 2100 feet. It is spread across 12,500 acres consisting of five self-sustaining towns -Dasve, Mugaon, Dhamanohol,

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Sakhari-Wadavali- and Central Business District. As it is located between two key cities, Mumbai and Pune, it is appropriate for industries like hospitality, tourism, healthcare and education(Lavasa, 2014).

Concept

Lavasa is the first planned hill city after independence and the city layout has been derived from the traditional patterns of Indian town planning. The master plan has been worked with the concept of Bio-mimicry, where models are created and design strategies are used to create the spaces by mimicking the environment. Use of practises like reforestation, bio-swales, rainwater harvesting are part of the plan. The landscape and architectural design follows the transect model where the development is denser near the town centre and gradually reduces uphill. The Lavasa development is based on the new principles of urbanisation as in Box 1.

Box 1: The Principles of New Urbanism

- **Commuting and Connectivity:** The city plan is in such a way that all the spaces lie in a ten kilometre radius and people can easily travel from home to work and vice versa as they are connected by a network of streets.
- **Mixed Use and Diversity:** A healthy mix of residential, commercial and recreational spaces for the people from all walks of life.
- **Mixed Housing:** A wide range of housing to cater to the needs of people.
- **Architecture and Urban Design:** Detailed attention to aesthetics and human comfort
- **Neighbourhood Structuring:** The city is planned in such a way that there are public spaces which can be used for interaction and be made use of by the people.
- **Planned Increased Density:** Transect Planning
- **Smarter Transportation:** Cost effective and technologically advanced travel network
- **Sustainability:** Minimal impact on the environment

Source:A City in Making(Srivastava, 2013)

Lavasa township is a comprehensive project has been planned to house around 3 lakh citizens with city infrastructure supported by GIS mapping, miniature hydro dams and e-governance. The city's concept revolves around New Urbanism which focuses on planning the residential and commercial spaces such that they are in walking distance of each other according to Scot Wrigton, City Manager of Lavasa. It has been planned in such a way that the land has been divided into sustainable and manageable regions.

Lavasa belongs in the smart city category as it implements lifestyle technology solutions on a large scale. It provides City Management services, e-governance, ICT infrastructure and value added services. It has also proposed detailed infrastructure for telecom based services that will facilitate smart homes and buildings. Geographic Information System has been used to find out the pattern of population and work

place resultant of land use. It was overlaid on the slope map, natural ravine pattern and proposed parks. The streets and roads were decided and designed according to the population pattern. GIS also assists in carrying operations and maintenance of the spaces. (Srivastava, 2013)

Design

Lavasa is designed as cluster of five towns in the valleys and slopes of the seven surrounding hills. A sustainable environment has been created to make use of the latest technology as well as efficient use of time, material, space and other resources. The structures have design recommendations which try to act like the natural environment like, the pavements allow the water to permeate back into the ground, the roof vaporises the water falling in it, etc. The roads were inspired by the local anthills which are stable even during heavy rain falls. This is done by channelizing the water and slows them. The spaces are connected well with walkways which are formal and informal. Lavasa City offers a wide array of with exclusive amenities residential apartments namely (Lavasa, 2014):

- Brook View Apartments (Dasve): These apartments offer studio and 2 bedroom homes and are located at Dasve city. Educational institutions, hospitals, shopping, entertainment are provided in its close proximity.
- Delfino (Dasve): It is a premium residential apartment block and provides 4.5 BHK configuration with an area of 2900 sqft. It has been provided with world-class amenities.
- Valley View Apartments (Dasve): These apartments are elegantly designed Portfino styled apartments in East Dasve. They provide the configurations Studio, 1 and 2 BHK with area ranging from 421 sq ft to 1100 sq ft.
- Hillshore and Belshore Apartments (Mugaon): The proposed location is near the exit-route tunnel that directly opens into the town from the Mumbai-Pune Express Highway, via Lonavala and Tamhini. The apartments provide Studio, 1.5- 4 BHK configurations and it has access to the entertainment, leisure, hospitality spaces in its near vicinity.

The project strives towards utilising the township building components such as windows, doors have been standardized and making the required materials such as bricks, crusher and RMC plant on the site itself. It is trying to bring in new technology and scrap conventional construction and depend less on labour. The Mugaon town uses locally available materials like stone, bamboo and sustainable technologies like hollow fly ash-concrete blocks, solar panels, green roofs, micro wind turbines and solar heaters.

The site is hilly and very steep at some places. Multiple roofed houses at different levels with integrating courts have been proposed rather than large structures with bulky roofs as they would blend into the natural environment. The privacy of the houses have also been maintained by locating them at different

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angles. The houses look out to green spaces and not to other structure (Srivastava, 2013). The team identified the ecosystem services provided by the environment and they were used as design guiding principles. The trees would maintain the soil quality, store water throughout the dry season and also provide a canopy to control evaporation. The foundation system was also designed by Buro Happold, an engineering consultancy, which stores water like how the trees which once existed in the site did (Srivastava, 2013).

Sustainable Practises

The city has an Environment Management Plan which addresses ecology concerns such as topsoil management, tree transplantation and mass plantation to processes of hydro seeding, soil, water, and air pollution control and monitoring system. Artificial water holes, wildlife corridors and releasing fish in dam water to maintain a healthy biodiversity are also practised. There are several other eco-friendly developments and practices prevalent (Lavasa, 2014):

- Hydro-seeding: It is a planting process that uses slurry of seed and mulch. It helps in mass plantation, prevents soil erosion and facilitates quick vegetation.
- Soil Bioengineering: To protect the slope during monsoon and to preserve the green cover, living plant materials were used to prevent it from getting washed away.
- Water Conservation: Trenches are dug on the sides of roads for the rain water to percolate into the soil. Mass plantations are done on the site in order to raise the water table of the region.
- Water Treatment: UV and Ozonisation is used for sewage water treatment.
- Air Treatment: Water is sprinkled while carrying out construction to settle the dust particles and dust masks are used.

Infrastructure

The first phase is at its final stages where the city Dasve has completed 85% of the residential segment, the hotels ITC Fortune and Mercure and the educational buildings are under construction. It has also launched its second town Mugaon which is spread over 2200 acres of land. (Lavasa, 2014). Lavasa is a self-sufficient city with a town hall in the centre, a club, convention centre, water sports complex, hotels, a hospitality college, hospital, post office, a school and a retirement home. The facilities that are provided in Dasve are (Lavasa, 2014):

- 2 km long promenade
- Cafes, Boutiques, Al Fresco Dining
- Water sports at Dasvelake

- Scenic walkway across the Warasgaon Lake
- Apollo Hospital & Apollo Pharmacy operational

Lavasa provides education for Hospitality Management, Finance and Marketing Management and education for children with special needs. There are hotels, serviced apartments, villas and other kinds of services that are available in Lavasa. They cater to the tourists and business guests for their stay (Lavasa, 2014). At present Lavasa offers its visitors and citizens, the following amenities (Lavasa, 2014):

- Town hall & Public Safety Centre
- Police Posts
- Public transport through Bus Services
- Post Office
- Fuel Station
- 24 X 7 Power & Water
- 24 Hour ATM
- Optical Fibre all across the city for all your telecom / data needs
- Hospital & Pharmacy

City Management is a very important function that has been established by Lavasa. This governs and monitors the whole city's function as a whole to improve the quality of living. Few of the responsibilities of the city manager is public safety and security, uninterrupted power supply, integrated housekeeping, waste water management etc. (Srivastava, 2013). A joint venture formed by Cisco and Wipro have been responsible for lifestyle technology solutions by providing city management services, e-governance, ICT infrastructure and other value added services. Information and Communication Technology (ICT) is used for planning, maintaining and executing the technological services for administration, residential, hospitality services and utility services. With the help of all these services, Lavasa is shaped into a smart and sustainable city. The final goal is to achieve a world class city and to take standards of living to a whole new level.

4. CONCLUSIONS

Magarpatta, Amanora and Lavasa, are all splendid examples of integrated township development each came into being due to an urge, one of the reasons being rapid urbanization of the Pune city. Magarpatta and Amanora are spread across the same spatial area and locality, yet they are unique in their own way. In malice of the time period in which the developments occurred, they have similar physical and social infrastructure and differ in modernization aspects. The differentiator lies in the fact that while Magarpatta is a conventional township with "walk to destination concept", Amanora Township went a pace ahead of

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conventional integrated township and made it efficient with digitization of some of the amenities and even a proposal for the township's own railway station. Moving on to the Lavasa Township, which is also an integrated township development, is being developed on a much larger scale with physical and social infrastructure similar to the other two townships.

TABLE 2 - A COMPARISON OF FEATURES OF ALTERNATE MODELS OF TOWNSHIP DEVELOPMENT:

Parameter	Magarpatta City	Amanora Park Town	Lavasa City
Area	400 Acres	400 Acres	12500 Acres
Location	Hadapsar, Pune	Hadapsar, Pune	Mumbai Pune Economic Corridor - Shahyadri Range
Land Use	Mixed Use	Mixed Use	Mixed Use
Physical Infrastructure	IT Park, Roads with Traffic Islands, Water and Power Infra, Rain Water Harvesting and Solar Systems	Office Area, Water and Power Infra, Rain Water Harvesting and Solar Systems, Railway Station, Digitalization like Amanora Aadhar Card	GIS Mapping, Telecom Based Services, Miniature Hydro Dams
Social Infrastructure	Multi-Speciality Hospital, School, Recreational Spaces, Parks and Open Spaces	Multi-Speciality Hospital, School, Recreational Spaces, Parks and Open Spaces	E-Governance, Hospital, School, Recreational Spaces, Parks and Open Spaces
Development Form	Sustainable	Sustainable and Self Reliant	Sustainable and Self Reliant
Construction System	In situ, conventional	High rise	Precast-Insitu Locally available materials
Design	Cluster design	Cluster and different types of apartment blocks	Use of GIS and Building Envelope Model
Mix of Housing	Walk to work	All inclusive with high end housing	Sustainable and Inclusive
Category	<i>Conventional Township</i>	<i>Efficient/ Integrated Township</i>	<i>Smart Township</i>

Source: (Based on the case study)

Unlike other two townships, Lavasa is a mega-township with an amalgamation of five self-sustaining towns. The way for smarter cities paved by Amanora was taken further ahead with not only digitalization of amenities and services in Lavasa, but by introduction of services like City Management and Environment Management with GIS mapping, e-governance etc. Lifestyle smart solutions are being implemented on a very large scale in Lavasa pushing the township in to 'Smart City/Township' category. Table 2 shows a comparison of township development models in an evolutionary manner based on the case study. The three township developments namely, Magarpatta, Amanora and Lavasa clearly demonstrate the evolution of townships according to the changing needs and to increase the performance and efficiency of development from conventional to efficient to smart developments.

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